

**INVESTIGATION OF SETTLING BEHAVIOUR OF
SPHALERITE AT THE ZINC CONCENTRATE THICKENER**

**SFALERİTİN ÇİNKO KONSANTRE TİKNERİNDE
ÇÖKELME DAVRANIMININ İNCELENMESİ**

AYŞE NİHAN ŞAHİN

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Head: Prof.Dr. Üner ÇOLAK : _____

Member: Prof.Dr. Zafir EKMEKÇİ: _____

Advisor: Dr. N. Metin CAN : _____

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Science and Engineering

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Ayşe Nihan Şahin

ABSTRACT

The gravity thickener is one of the most important equipments in the mineral processing. It is used for separating suspended solid particles from the associated liquid, producing a clear stream of liquid and a densified slurry.

This thesis started out to find the probable reasons of froth accumulation at the top of the zinc thickener surface. During the first step, operation parameters of Zn thickener at the Çayeli Bakır İşletmeleri was reviewed with the objective of evaluation of Zn thickener operation and capacity. Some field applications, such as sludge solid determination was applied by taking samples from different locations and depths of the thickener, or thickener feed was diluted with water to see the settling behaviour of concentrates, or recirculated the thickener underflow discharge to feed for 11 hours while feed continued to enter the thickener.

Afterwards, the second step was focused on investigation the settling behaviour of sphalerite. Laboratory settling tests were carried out by using different types of anionic and nonionic polymers with different dosages. The most effective polymer in flocculating the zinc concentrate was found to be Hydrafloc 9130, an anionic type flocculant at a dosage of 18 g/ton. And additionaly flocculation tests with mixture of anionic and nonionic type flocculants 50/50 were conducted with optimum dosage as 18 g/ton, but the results didn't increase.

The present practises of Zn thickener capacity verified the based on the effective flocculant type and dosage in the existing application and thickener area calculations and approved that the froth accumulation can be removed with an effective water spray application.

Keywords: Zn concentrate, settling, flocculation, anionic and nonionic polymers, thickeners.

Advisor: Dr.N.Metin CAN, Hacettepe University, Department of Mining Engineering, Mining Engineering Section.

SFALERİTİN ÇİNKO KONSANTRE TİKNERİNDE ÇÖKELME DAVRANIMININ İNCELENMESİ

Ayşe Nihan Şahin

ÖZ

Gravite tiknerleri cevher hazırlamadaki en önemli ekipmanlardan birisidir. Süspansiyon halinde su ile birlikte bulunan katının konsantrasyonun çökeltme ile artırılmasını ve aynı zamanda üst kısımda berrak bir sıvının elde edilmesinde kullanılır.

İlgili çalışma çinko tikner yüzeyindeki köpük birikintisinin muhtemel sebeplerini bulma amacıyla başlamıştır. Çalışmanın ilk safhasında, Çayeli Bakır İşletmeleri'nde bulunan Zn tiknerinin operasyon ve kapasite değerlendirmesini yapmak amacıyla operasyon parametreleri yeniden incelenmiştir. Bazı saha çalışmaları test edilmiş; Zn tiknerin farklı yer ve yüksekliklerinden örnek alınarak pülpün katı oranı belirlenmiş, tikner beslemesi seyreltilerek konsantrenin çökme davranımı incelenmiş, tikner alt akış yoğunluğu besleme devam ederken 11 saat boyunca beslemeye tekrar döndürülerek devri daim çalıştırılmıştır.

Daha sonra, ikinci safhada sfaleritin çökme davranımının incelenmesi üzerine odaklanılmıştır. Farklı tip flokülantlarla; anyonik ve iyonik olmayan, ve farklı dozajlarda laboratuvar çöktürme testleri uygulanmıştır. Zn konsantre flokülasyonunda en etkili polimerin 18 g/ton kullanım ile anyonik tip flokülantlardan Hydrafloc 9130 olduğu tesbit edilmiştir. İlave olarak anyonik ve iyonik olmayan flokülantlar yarı yarıya karıştırılarak, optimum dozaj olan 18 g/ton için çöktürme testleri yapılmıştır. Ancak sonuçta çökme hızında artış elde edilmemiştir.

Flokülant tipi ve dozajı temel alınarak yapılan çalışmalar ve tikner alan hesaplamaları mevcut Zn tiknerin kapasite durumunu doğrulamıştır ve tikner yüzeyindeki köpük oluşumunun etkili bir spreyci uygulaması ile giderilebileceği görülmüştür.

Anahtar sözcükler: Zn konsantre, çökme, flokülasyon, anyonik ve iyonik olmayan polimerler, tiknerler.

Danışman: Dr.N. Metin CAN, Hacettepe Üniversitesi, Maden Mühendisliği Bölümü.

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1. INTRODUCTION

A variety of separation processes have been developed that take advantage of either physical or chemical differences between the desired mineral and the gangue. These processes generally use aqueous slurries and hence the need for solid/liquid separation (Richardson et al, 1988).

Most mineral-separation processes involve the use of substantial quantities of water and the final concentrate has to be separated from a pulp in which the water/solids ratio may be high.

Dewatering, or solid-liquid separation, produces a relatively dry concentrate for shipment. In mineral processing, a combination of three methods; sedimentation, filtration and thermal drying are applied according to required solid content of this separation product (Wills, 1985)

Thickening produces a thickened pulp of 55-65 % solids by weight and separates the suspended solid particles from a liquid by gravity sedimentation. It is the most widely applied dewatering technique in mineral processing for many reasons. Thickeners are cheap for their capacity and involve low shear forces, thus generally providing good conditions for flocculation of fine particles. The ideally operated thickener gives two products: an underflow of target % solids and a clear overflow (Vergouw, 1998).

The settling rate and quality of the supernatant are important in thickening operations. In a continuous thickener, the settling rate must be fast enough so that the solids can be removed at approximately the same rate that they enter the settler. By this way, coagulants and flocculants are chemicals used to achieve the desired settling rate, acceptable clarity, and acceptable underflow density in clarification processes (Richardson et al, 1988).

Coagulation is basically electrostatic in that it is brought about by a reduction of the repulsive potential of the electrical double layer. The term flocculation is derived from the Latin, "flocculus", literally a small tuft of wool, or a loosely fibrous

structure. Flocculation is brought about by the action of high molecular weight materials such as starch or polyelectrolytes, where the material physically forms a bridge between two or more particles, uniting the solid particles into a random, three-dimensional structure which is loose and porous (Gric et al, 1978).

Both naturally occurring and synthetic polymers find use as flocculants in the mining industry. Synthetic flocculants as non-ionic and anionic flocculants are widely used. Because they can be manufactured with very high molecular weights, and thus are capable of forming large, rapid-settling, good-compaction flocs. Cationic polyacrilamides are rarely used in the mining area. They are usually much less cost-effective than their non-ionic and anionic counterparts, because of higher cost and lower molecular weight.

It is impossible to predict from theoretical knowledge which synthetic flocculant is most suited to a particular suspension. Flocculation selection is generally done on an empirical basis, with some pre-selection based on experience. Tests should be carried out in the laboratory. One of the major aim of such testing is to screen the range of flocculants in order to determine which individual product is most cost-effective for that particular substrate. However, the tests can also yield additional information as to the approximate dosage rates required to achieve the desired plant performance, approximate supernatant clarities and mud solids contents which can be attained, and will enable estimation of required thickener areas to be made (Day, 2002).

The aim of this research was investigate the settling behaviour of zinc concentrate considering the froth accumulation at the top of the thickener surface. This accumulation probable reasons were examined because of suspicion of problem at the settling behaviour of zinc concentrate. Thereby operational paramaters were evaluated like U/F solid contents, O/F missing and flocculation performance.

2. LITERATURE REVIEW

2.1. Introduction to Solid/Liquid Separation

Separation technology now has a dominant role in the chemical process industries. Since the mid-1990s, approximately half the capital investment and over half of the operating costs were associated with separation processes. This of course includes both the separation of chemical species and that of phases, with solid-liquid separation being part of the latter but often closely associated with the former.

That the importance of separation is to grow even further is certain. There are three main reasons for this:

1. the ever-increasing demands on product purity, particularly in the pharmaceutical, biotechnology and food industries,
2. the gradual reduction in the quality of raw materials, this being a particularly serious problem in mineral processing,
3. the growing demands for environmental acceptability of waste materials (Ruthven, 1997).

Most of the process industries in which particulate slurries are handled use some form of solid-liquid separation within their flowsheets. It is used in many processes with the aim of:

1. recovering and dewatering the valuable solids (this may be followed by washing),
2. recovering and cleaning the liquid,
3. separating the two phases from each other before recycling/reusing both,
4. separating the two phases, for environmental reasons, for example, before disposing of either or of both (Svarovsky, 2000).

2.2. Principles and Equipments

There are several processes in and aspects of solid-liquid separation which, due to their special role, require special attention. One such process closely married to solid-liquid separation is solid-solid separation by particle size, particle shape, solids density or affinity to water. The purpose here is to use the solid-liquid separation processes to remove only one fraction of the solids or only one mineral from a mixture.

Taking first the separation by particle size, this is clearly based on the size dependent nature of some solid-liquid separation principles and equipment such as hydrocyclones or sedimenting centrifuges. Solids are 'classified' by the separation process and the feed is either split into coarse and fine fractions (with the fine fraction usually remaining in suspension) or only a tail removed from either end of the size distribution (de-gritting or de-sliming). Even in cases when solids classification is not required it may still be desirable before the solid-liquid separation stage in order that the material in each size range may be treated by the type of equipment best suited to it. The grade efficiency concept is used extensively here, the major concern being the steepness of the curve because it determines the amount of misplaced material (fines in the coarse product and coarse particles in the fine product).

General classification of equipment and principles of solid-liquid separation can be seen in Figure 2.1. There are two separate main groups of equipment which differ in the way the particles are collected (Svarovsky, 2000).

In the first group of sedimentation and flotation, the liquid is constrained in a stationary or rotating vessel and the particles move freely within the liquid. The separation is due to mass forces acting on the particles because of an external or internal field of acceleration that might be the gravity field, centrifugal field or magnetic field. The separation doesn't end by the arrival of the particles onto a collecting surface. If the process is to be continuous, the collected particles have to be transported and discharged from the separator vessel. If gravity or

centrifugal fields are used (except in the case of flotation), a density difference must exist between the solids and the suspending liquid for the separation to take place. On the whole, the principles in this group can result in continuously operating equipment which often turns out to be cheaper than filtration. Gravity sedimentation or flotation should be looked at possible alternatives in the early stages of equipment selection.

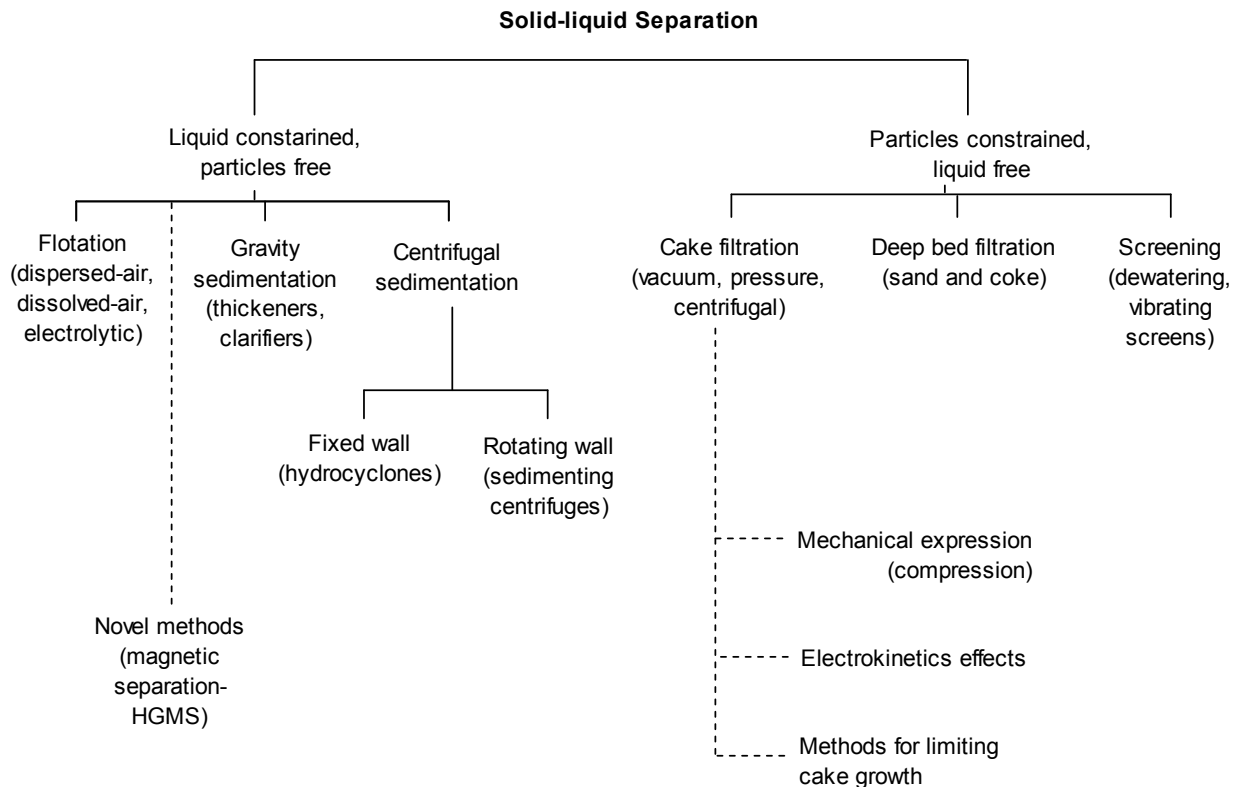


Figure 2.1. Classification of solid-liquid separation processes.

The second group, loosely called filtration, constrains the particles by a medium and the liquid is allowed to flow freely through the medium. Density difference is not necessary in this group but a truly continuous operation is either not easy or impossible to achieve and the costs might be high (Svarovsky, 2000).

2.2.1. Flotation

Basically flotation utilises the differences in physico-chemical surface properties of particles of various minerals. After treatment with reagents, such differences in

surface properties between minerals within the flotation pulp become apparent and, for flotation to take place, an air bubble must be able to attach itself to a particle, and lift it to the water surface.

On the other hand flotation is a gravity separation process based on the attachment of air or gas bubbles to solid (or liquid) particles, which are then carried to the liquid surface, where they accumulate as a 'float' and can be skimmed off. The process consists of two stages: the production of suitably small bubbles and their attachment to the particles. Depending on the method of bubble production, flotation is classified as dispersed air, dissolved air or electrolytic. The particles to be floated have to be hydrophobic.

Dispersed air flotation generates the bubbles by injection of air combined with agitation (froth flotation) or by bubbling air through porous media (foam flotation). The size of bubbles is rather large (typically 1 mm), capable of floating large and heavy particles. Dispersed air flotation has been used for many years in mineral processing to concentrate base metals, as a solid-solid separation process where one mineral is hydrophobic (i.e. floats) while the other is hydrophilic (i.e. sinks).

Dissolved air (and electrolytic) flotation has made considerable inroads into solid-liquid separation because it can be applied to fine suspensions. It offers a viable alternative to gravity sedimentation because it can operate at much higher overflow rates and use smaller, more compact equipment of lower capital cost (but higher operating cost). Dissolved air flotation is based on the higher solubility of air in water as the pressure increases. Part or all of the feed is recycled through a saturator vessel where the water is saturated with air at high pressure. The air-saturated water is then mixed with the incoming feed where the pressure is reduced so that fine air bubbles appear and become available for flotation. The bubbles produced are typically less than 100 or even 60 microns in size and can therefore float fine solids. The typical overflow rates (sometimes called 'hydraulic loading') per unit plan area of the flotation cell are from 1.5 to 17 metres per hour. Most industrial applications of dissolved air flotation are in waste water treatment where the particles might often be hydrophobic (oily) by nature.

In electrolytic flotation (electroflotation), hydrogen and oxygen gas bubbles are generated by electrolysis. The bubbles produced can be smaller than 30 microns. Instead of the saturator, an expensive rectifier system is required. The flotation unit is very similar to the dissolved air unit, and in fact the same unit can be used for either, having electrodes in one case and an external recycle saturation system in the other. As with the dissolved air units, a flocculation stage normally precedes the flotation stage (Svarovsky, 2000).

2.2.2. Magnetic Separation

The use of a magnetic field is an obvious means of removing ferromagnetic particles from a suspension. In mineral processing, permanent magnets have been used for removing tramp iron and for concentrating magnetic ores. Ceramic magnets, metal-alloy magnets or magnetized steel balls are useful when placed into the flow for separation of small ferromagnetic particles from hydraulic fluids. These 'filters' are generally cleaned manually by withdrawing the entire assembly.

Continuous magnetic separators such as the wet drum separators are widely used for beneficiation of ores and for recycling of magnetite or ferrosilicon from the heavy media pulps used for coal washing (Oberteuffer, 1974), or in the Sirofloc process (Walton, 1980; CSIRO, 1980) in water treatment.

Wet drum separators can be operated with concurrent rotation or counterrotation. Concurrent rotation is better for separation of magnetics from nonmagnetics whilst counter-rotation is more efficient for high recoveries

Magnetic ion exchangers can also be recovered from slurries (Swinton, 1987) after appropriate reactions by wet drum separators. Ion exchange resins and other adsorbents have been made in the form of magnetic beads by incorporation of suitable oxides into the monomer mixes before polymerization.

Much stronger magnetic fields and gradients can be produced by the High Gradient Magnetic Separators (HGMS) which have enjoyed considerable attention recently. They can be used for separation of very fine and weakly paramagnetic

particles on a large scale. The main advantage of HGMS is their high efficiency of separation even at relatively high flow rates and minimum pressure drops across the filter. The capital cost is very high, however, and only large installations are attractive economically (Svarovsky, 2000).

2.2.3. Gravity Separation

The available gravity sedimentation equipment can be divided into batch operated settling tanks and continuously operated thickeners or clarifiers. The batch settling tanks are still used where relatively small quantities of liquids are to be treated such as, for example, in spent lubrication oil reclamation and cleaning. The bulk of the processing by gravity sedimentation is, however, in continuously operated thickeners and clarifiers.

Gravity sedimentation equipment, hydrocyclones, sedimenting centrifuges or flotation cells have also been extensively used in mineral processing for separation of minerals according to density or affinity to water.

2.2.3.1. Hydrocyclones

The separation action of hydrocyclones is based on the effect of centrifugal forces. In contrast to sedimenting centrifuges, however, hydrocyclones do not have any rotating parts and the necessary vortex action is produced by pumping the fluid tangentially into a mono-cylindrical body. The cylindrical part is closed on top by a cover, through which the liquid overflow pipe (often called 'vortex finder') protrudes some distance into the cyclone body. The underflow, which carries most of the solids, leaves through the opening in the apex of the cone. There have been many different designs in use in some specialized fields but for separation of granular solids, the above described, conventional design is still the best.

The diameters of individual cyclones range from 10 mm to 2.5 m, cut sizes for most solids range from 2 to 250 microns, flow rates (capacities) of single units range from 0.1 to 7200 cubic meters per hour. The operating pressure drops vary from 0.34 to 6 bar, with smaller units usually operated at higher pressures than the large ones.

If hydrocyclones are to be used to produce thick underflows, the total mass recovery of the feed solids has to be sacrificed because throttling the underflow orifice inevitably leads to some loss of the solids to the overflow. A hydrocyclone as a single unit cannot therefore be used for both clarification and thickening at the same time. Typically the underflow concentrations that can be achieved with hydrocyclones are up to 50% by volume or more. In this they compare favourably with gravity thickeners and hydrocyclone systems are often used to replace the much larger and more expensive gravity thickeners.

Another application of hydro cyclones is for solid-solid separation by particle size. As the grade efficiency of a cyclone increases with particle size, it can be used to split the feed solids into fine and coarse fractions. This may be a process requirement, by which coarse and fine solids are separated to follow different routes in the plant, such as, for example, in closed circuit wet grinding where the oversize particles are returned to the mill for further grinding. Most frequently in this category, hydrocyclones are used either to remove coarse particles from the product (in a de-gritting or 'refining' operation) or to remove fine particles from the product (in a de-sliming or 'washing' operation). Hydrocyclones are also used as classifiers simply to improve the performance of other filtration or separation equipment.

In heavy media separation, the use of hydrocyclones is for solid-solid separation by solid density as required in mining and mineral processing. The density of the suspending medium is chosen to be between the densities of the two minerals to be separated and the cyclone is then used as a 'sink-and-float' separator.

Another important use of hydrocyclones in heavy media separation plants is for densification (= thickening) of the recovered and cleaned medium. Very fine solid suspensions of magnetite or ferrosilicon are used to obtain a heavy medium because there are no liquids of such high densities that are necessary.

Hydrocyclones can also be used for washing of solids by arranging several stages in a counter-current arrangement similar to that used with gravity thickeners. Such

systems are found in the production of potato or corn starch, or in the chemical industry (Svarovsky, 2000).

2.2.3.2. Sedimenting Centrifuges

A sedimenting centrifuge is an imperforate bowl into which a suspension is fed and which is rotated at high speed. The liquid is removed through a skimming tube or over a weir while the solids either remain in the bowl or are intermittently (or continuously) discharged from the bowl. There are different types of industrial sedimenting centrifuges, classified according to the design of the bowl and of the solids discharge mechanism: tabular, multi-chamber, imperforate basket, scroll type and disc centrifuges. The disc centrifuges are further divided into solids retaining, solids ejecting and nozzle types. The tubular, multi-chamber and solids retaining disc centrifuges are only suitable as liquid clarifiers because the bowls have to be cleaned manually. The imperforate basket type and the solids ejecting disc type are suitable for moderate feed concentrations and have intermittent solids discharge during which the feed may have to be briefly interrupted. Only the nozzle disc type and the scroll type centrifuges are truly continuous in both the operation and solids discharge, the latter being suitable for particularly high feed solids concentrations of up to 50% volume.

Most of the centrifuge types are capable of giving cut sizes well into the sub-micron region. The scroll type gives a cut size in the region of about 2 microns with materials such as clay, silica or similar. It is widely used in the chemical industry, in coal preparation and other mineral processing applications. It is also often used for dewatering of coarse solids like PVC particles of size in excess of 100 microns. The most usual design of the scroll centrifuge is one in which the solids and the liquid move in a counter-current fashion in the bowl. A relatively recent, co-current design offers certain advantages, mostly because it requires lower speeds for the same separation duty.

Sedimentation centrifuges, due to the lack of shear in the flow, are suitable for flocculation and suitable agents are often added to the feed upstream of the centrifuge. In solid-liquid separation, centrifuges are often compared with the

Rolls-Royces in the car industry: they perform well but the capital and running costs are high (Svarovsky, 2000).

2.3. Thickening

Thickening is defined as removing a portion of the liquid from a slurry or suspension, thereby concentrating the solid particles into the remainder. In gravitational thickening, it is achieved by allowing the solids to settle under the influence of gravity in a sedimentation basin. That part of the original suspending liquid which is essentially depleted of solids flows to an overflow point or launder system. The settled and thickened solids are scraped to a discharge point where they are taken off as an underflow. The amount of liquid remaining with the underflow must be at least sufficient to yield a flowable or pumpable slurry (Dahlstrom et al, 1985).

2.3.1. History of Thickener Development

Modern Sedimentation technology was developed in the mining industry. Prior to development of the continuous thickener, batch gravitational settling was employed. In such batch operations, dilute feed was pumped into a tank continuously until a clear overflow was no longer obtained. The feed was then discontinued and the tank left undisturbed until the solids had settled. After a suitable retention time, clear supernatant liquor was decanted and the thickened sludge removed.

Following batch settling operations, cone settlers were developed. These could be operated continuously by delivering a continuous feed stream to the settling cone; removing the settled solids underflow continuously from the bottom of the cone; and the overflow continuously over weirs into launders at the surface and on the periphery of the cone. To maintain a uniform underflow from the cone, and to insure proper removal of the solids, the slope of the cone often had to be fairly steep. A steep cone slope limited the size of the cone settler.

Since the effectiveness of gravitational settling is largely a function of area, it soon was recognized that the basic cone design had serious limitations. As the

technology developed it became obvious that continuous movement of the solids deposited over a large area toward a common withdrawal point was necessary (King, 1980, Mular et al, 1980).

While clarification deals with very dilute suspensions, thickening is performed to produce pulps that are more concentrated. Maybe this is the reason clarification was the first of these operations amenable to mathematical description. The work of Hazen in 1904 was the first analysis of factors affecting the settling of solid particles from dilute suspensions in water. Hazen's analysis shows that detention time is not a factor in the design of settling tanks, but rather that the portion of solid removed is directly proportional to the surface area of the tank, is directly proportional to the settling properties of the solid matter and is inversely proportional to the flow rate through the tank.

The invention of the Dorr thickener in 1905 can be mentioned as the starting point of the modern thickening era. It made the continuous dewatering of dilute pulp possible, whereby a regular discharge of a thick pulp of uniform density took place concurrently with overflow of clarified solution. Scraper blades or rakes, driven by a suitable mechanism, rotating slowly over the bottom of the tank, which usually slopes gently toward the center, move the material as fast as it settles without enough agitation to interfere with the settling (Figure 2.2) (Dorr, 1915, Concha Et al, 2003).



Figure 2.2 Original Dorr thickener (Dorr, 1936).

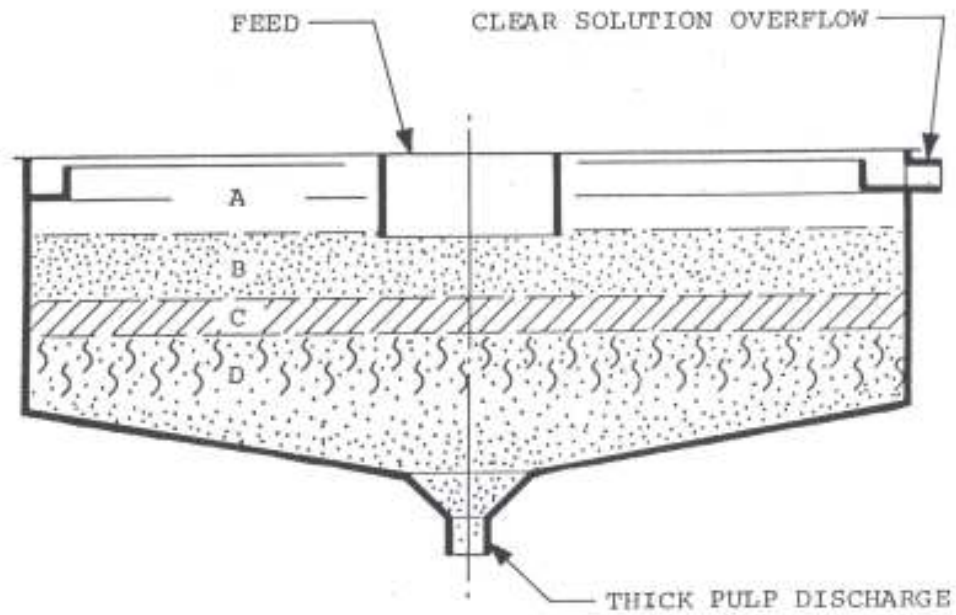
2.3.2. The Details for Thickener Functions

As a feed stream enters the thickener, the solids settle to the bottom. Clarified liquor overflows the top and the settled solids underflow is removed from the bottom.

Figure 2.3 shows a cross-section, schematically illustrating the operation of a continuous thickener. Zone A, which is the clear overflow liquor, is essentially free of solids in most applications. Zone B consists of a pulp of fairly uniform consistency which is nearly the same solids concentration as the feed stream. Zone C is an intermediate state in which the pulp is in a condition of transition between free unhindered settling and compression. Zone D shows the pulp in compression, where dewatering occurs by compression of the solids forcing the liquids out of the interstices.

In actual practice, special characteristics which distinguish zones B, C, and D are not readily discernible, except for an increasing solids concentration, and the description is more academic than realistic.

Figure 2.4 presents an illustration of that which actually occurs in a continuous thickener. Feed slurry becomes very diluted on entering the feedwell (unless the feedwell is submerged in a moderately concentrated pulp zone as illustrated in Figure 2.3), and leaves the feedwell as a dilute suspension from which particulate settling, rather than "zone" or "line" settling must occur. Considerable lateral movement occurs in the floc bed zone as liquid into the feedwell to sustain this dilution action. The floc particles agglomerate and settle to the surface of the thickening pulp, and continue to concentrate in this zone until underflow density is reached (King, 1980, Mular et al, 1980).



SECTION THROUGH A CONTINUOUS THICKENER ILLUSTRATING
POSITION OF FOUR ZONES OF SETTLING PULP

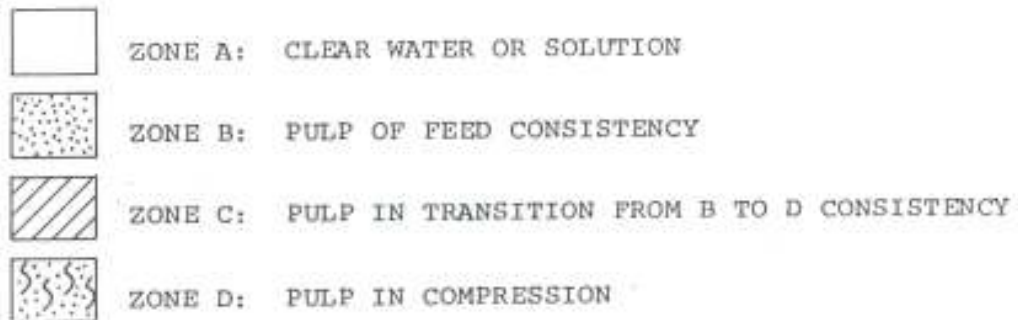


Figure 2.3. Four zones of settling pulp, illustrating continuous thickening

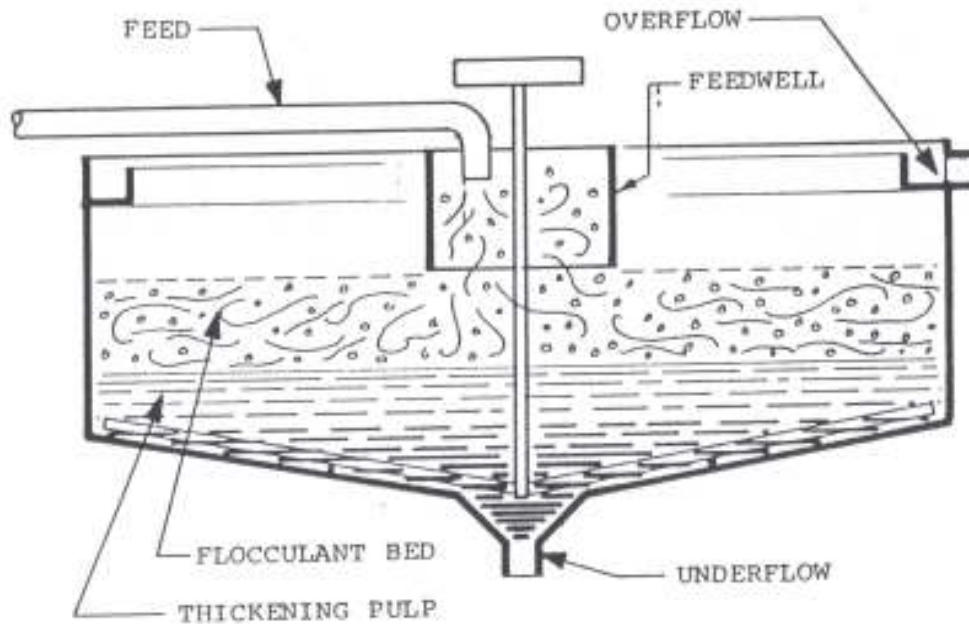


Figure 2.4. Section through a continuous thickener, illustrating thickener action.

2.3.3 Elements of a Continuous Thickener and its Functions

Refer to Figure 2.5 and Figure 2.6 for schematic representations of two basic thickener configurations as bridge, or beam support type and column support type.

The feedwell function is to dissipate energy of movement in the the feed stream so as to cause the feed to enter the tank in a relatively quiescent condition and to provide a means of introducing the slurry at an appropriate depth in the thickener.

The tank provides holding time to produce settled solids and clarified liquor. The sloped bottom assists movement of the concentrated solids toward the discharge point (King, 1980, Mular et al, 1980).

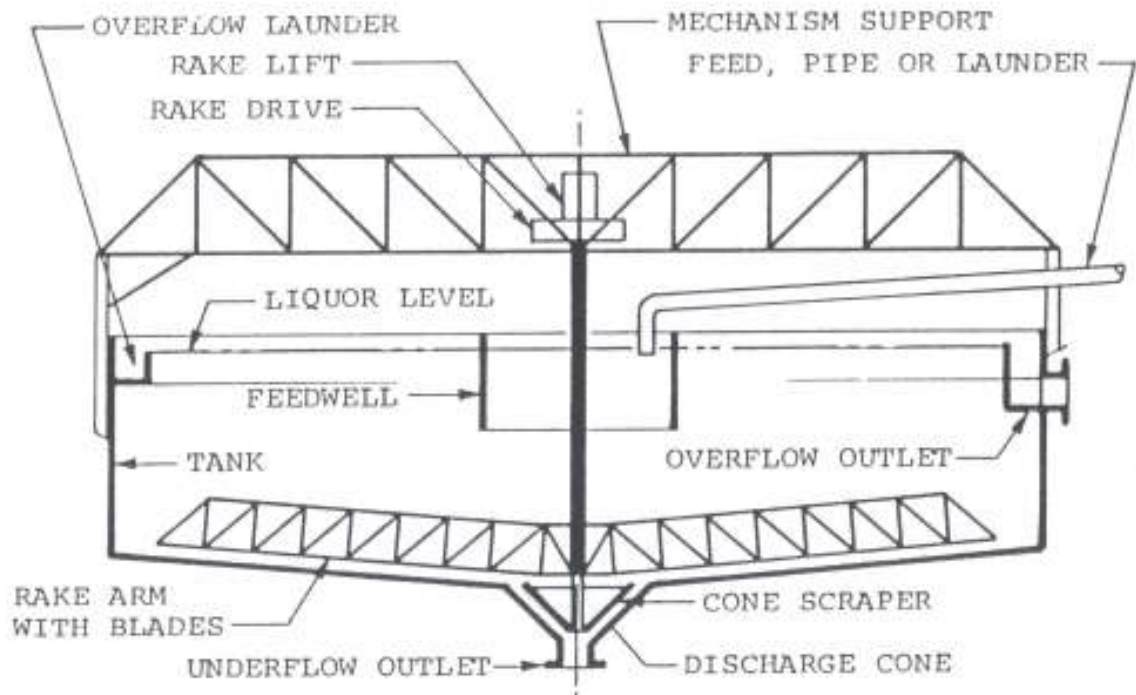


Figure 2.5. Elements of a continuous thickener as bridge, or beam support type

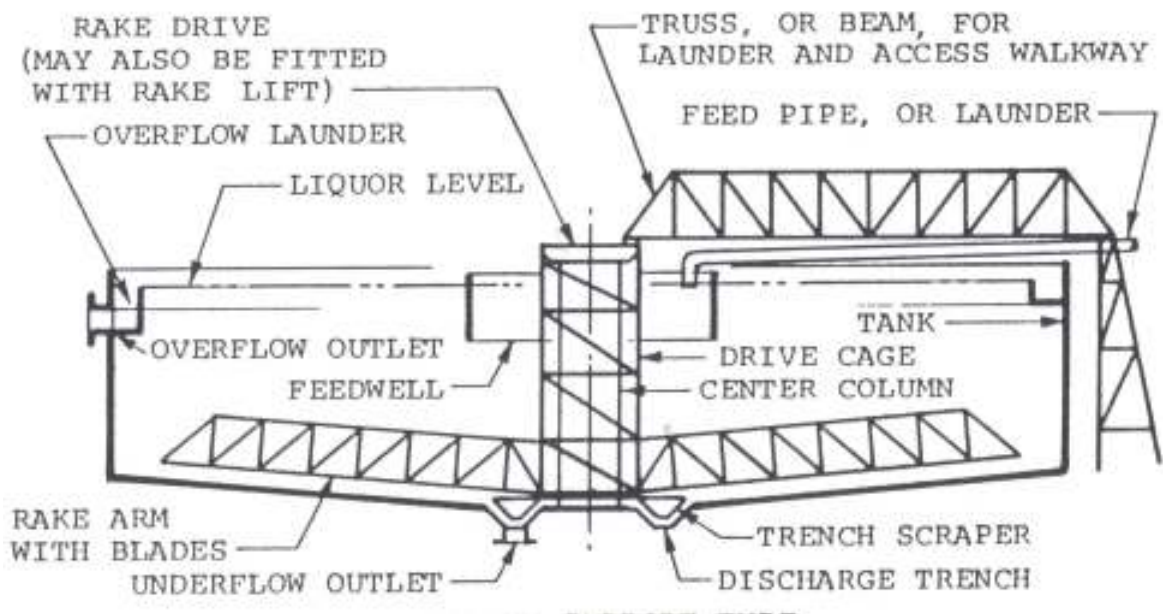


Figure 2.6. Elements of a continuous thickener as column support type.

The rake arms serve three functions:

1. Move the settled solids toward the discharge point;
2. Maintain a degree of fluidity in the thickener to ensure hydraulic removal, and
3. Increase underflow solids concentration by providing for channels for water to escape from the thickening solids in the compression zone.

Cone, or trench, scrapers perform an action similar to the rake arms so that underflow solids can be discharged.

The overflow launder collects clarified liquor for transport to an outlet. Best design practice is for a uniform rate of overflow around the tank periphery.

The rake provides driving force (torque) to move the rake arms and blades against resistance of the thickened solids.

The rake lift provides a means of lifting the rake arms out of contact with the more concentrated solids so as to reduce the driving force demand from the rake drive. The lift will operate while the rake arms are rotating (King, 1980, Mular et al, 1980).

2.3.4. Some Factors That Size Continuous Thickener Basins

In an ideal thickener operation the solids in the feed to be withdrawn in the underflow must move continuously toward the withdrawn point at the same rate as they enter the compression zone. The solids do not merely settle on the bottom and then are pushed by the rakes toward the discharge point. The pulp is retained in the compression zone, which must provide adequate time for thickening to final density, but too long a retention time can result in overload to the thickener mechanism. The underflow rate must be controlled so that pulp density, as withdrawn, will be the maximum practical at a given feed rate with the minimum pulp level in the thickener.

2.3.4.1. Overflow Rate

The overflow, or upflow rate, of the unit must be low enough so that excessive turbulence does not prevent separation of the solids from the liquid and not greater than the settling rate of the slowest settling particle or flocculi. Thus, in thickeners which are essentially clarifiers (that is, are used to remove very finely divided material from a dilute suspension) the overflow rate expressed as volume per day per unit area (meter cubed/day/meter squared) becomes a critical design factor. For materials which apparently settle very fast in laboratory tests, it is good practice to design the area and volume of the unit so that the overflow rate does not exceed values established by experience.

2.3.4.2. Detention Time

In addition to providing sufficient detention time to allow separation of the slow settling particles from the overflow, special consideration must be given to the compression zone. The volume of the compression zone, or for practical purposes the entire volume beneath the pulp level will have a direct bearing on the final underflow solids concentration as long as the particles within this zone are in a state of subsidence, that is, not at rest.

2.3.4.3. Area

The area of a thickener must provide sufficient detention time to allow the slowest settling particle to reach the bottom of the unit. Thickener size is often expressed in area per unit weight of dry solids per day (Meter squared/ton of dry solids/ day) (King, 1980, Mular et al, 1980).

There are several empirical methods for determining thickener area requirements from settling tests which are conducted in graduated cylinders of at least 1 liter capacity.

The oldest method is that of Coe and Clevinger, now little used partly because it was devised before the advent of synthetic flocculants, and partly because a series of batch settling tests are required. It is best suited to unflocculated pulps.

The test is based on obtaining settling rate data for a series of dilutions of pulp between that of the feed and a concentration well within the compression zone. This leads to determination of the “critical flux” of the thickener. Thickener area is calculated from:

$$A = (1/C - 1/C_u) / U$$

where:

A= thickener unit area ($\text{m}^2/\text{d}/\text{mt}$)

C= initial test concentration (mt/m^3)

C_u = required underflow concentration (mt/m^3)

U= initial settling rate (m/d)

Talmadge and Fitch, with its modification of the Oltmann construction, is the procedure favored by Dorr-Oliver. It is the method most generally accepted as giving reliable results under conditions met with in practice. A single batch-settling test provides sufficient data. Mudline height versus time is plotted as before and then the compression point identified. This is the point on the curve where the settling rate of the sludge begins to slow down due to the physical compression forces within the pulp. It is usually indicated by a change in slope of the settling curve.

A tangent (the Talmadge and Fitch construction line) is then drawn to the curve at the compression point together with a horizontal line representing the underflow concentration desired. The height H_u of the settled pulp corresponding to that required pulp density is calculated from (Suttill, 1991) :

$$H_o C_o = H_u C_u$$

where:

H_0 = initial pulp height in cylinder (cm)

C_0 = initial pulp concentration (g/l)

H_u = mudline height (cm) corresponding to underflow concentration C_u

C_u = underflow concentration (g/l)

$$A = t_u / (H_0 C_0)$$

where:

A = thickener unit area ($\text{m}^2 / \text{mt} / \text{d}$)

t_u = underflow time (days)

H_0 = initial pulp height (N.B. meters not cm)

C_0 = initial pulp concentration (N.B. mt/m^3 not g/l)

If there is a doubt about the position of the compression point, a common occurrence, a series of tangents can be constructed and areas calculated for each position and the lowest flux rate taken for design purposes. Alternative procedures are to change the plotting method (plotting the same data as lo-log plot sometimes aids in identification of the compression point), or diluting the feed slurry and re-running the tests (Figure 2.7).

The Talmadge and Fitch method generally underestimates thickener capacity and therefore provides an in-built element of oversize.

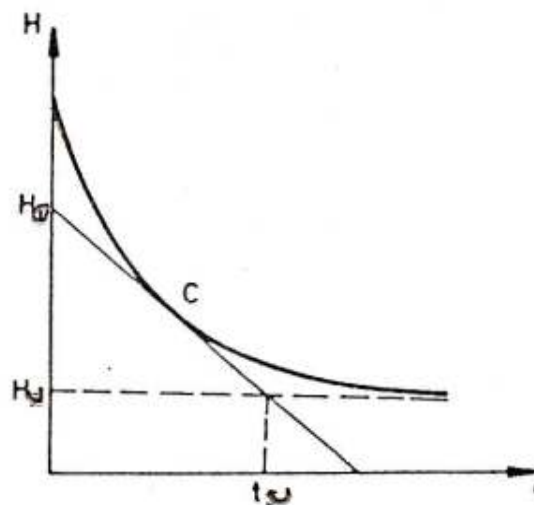


Figure 2.7. Settling curve showing Talmadge and Fitch method

Oltmann construction is a modification of Talmadge and Fitch developed empirically by Oltmann of Dorr-Oliver. It gives results closer to the Coe and Clevenger method but depends on identifying thickener capacity.

Using the single settling-test data a line is drawn from the origin of the curve H_o , provided no induction time is indicated, through the compression point, CP, to intersect the required pulp density line H_u . From there a vertical line is dropped to intersect the time axis at t_y . This is less than the Talmadge and Fitch construction which gives t_u and is called the Oltmann underflow time (Suttill, 1991).

Once the area and the retention time required to obtain the final density or maximum density desired are known, the total amount of material that must be contained in the compression zone can be calculated. From the average dilution of material in the compression zone it is then possible to calculate the depth of material required in compression. To this must be added allowances for the transition and free settling zones, and feed disturbance to obtain a total depth of tank. About 60 cm each is normally allowed for the transition zone and feed disturbance. Some 30-180 cm may be allowed for free settling depending on the nature of the solids being thickened (Suttill, 1991).

2.3.5. Thickener Types

There are eight basic types of continuous thickeners equipped with solids raking mechanisms which are primarily designated by tank shape.

2.3.5.1. Bridge-Support Thickener

The basic concept is illustrated in Figure 2.8 bridge across the diameter of the tank supports the drive mechanism and rake arms. Generally, economics dictate the maximum diameter of this type as 100 ft (30.5 m), although there are exceptions, because above this the required bridge structure becomes too costly. Underflow piping arrangement is the simplest with this design.

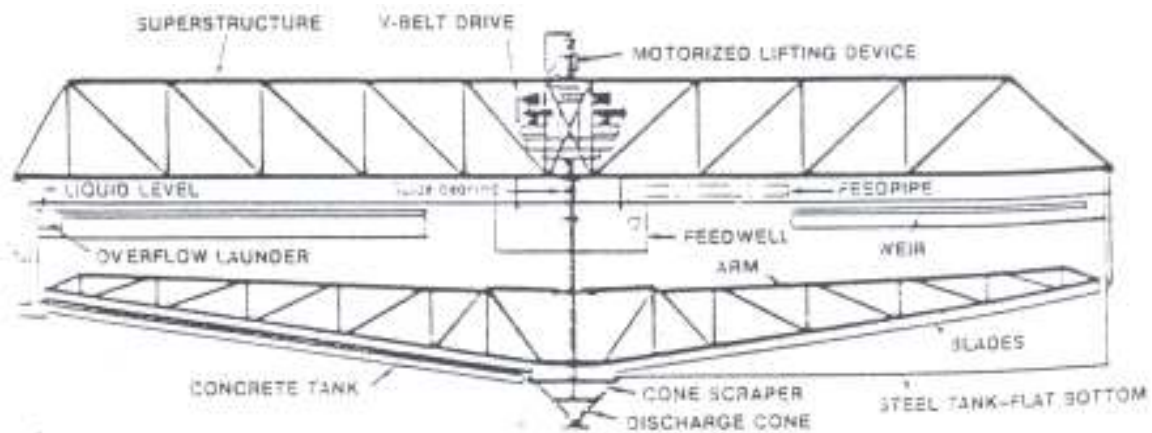


Figure 2.8. Typical bridge-support type thickener.

2.3.5.2. Center Pier Thickener

Figure 2.9 illustrates the basic concept. A center pier carries the weight of the drive mechanism and rake arms as well as the walkway when employed. The center pier is generally steel-reinforced concrete, or suitable corrosion-resistant metal. A circular collection trough around the base of the pier is employed for underflow withdrawal. This type is primarily employed above 100 ft in diam (30.5 m). They are feasible in size up to 180 m because of the unique properties of the hydrostatic bearing. The rake arms connected to a large-diameter slewing ring supported on hydrostatic pads. Pressurized oil entering the center of the pads floats the slewing ring permitting very high load-bearing capacity with very low friction. The slewing ring is rotated by one or, in the larger thickeners, three reduction units.

Caisson thickeners are a variant of the center –pier design where the center pier is cylindrical and accommodates the underflow pumps. Underflow is pumped up and out of the central caisson obviating the need to construct expensive access tunnels. Thickeners of this design have been made with caissons up to 8 m diameter (Dahlstrom et al, 1985; Weiss, 1985).

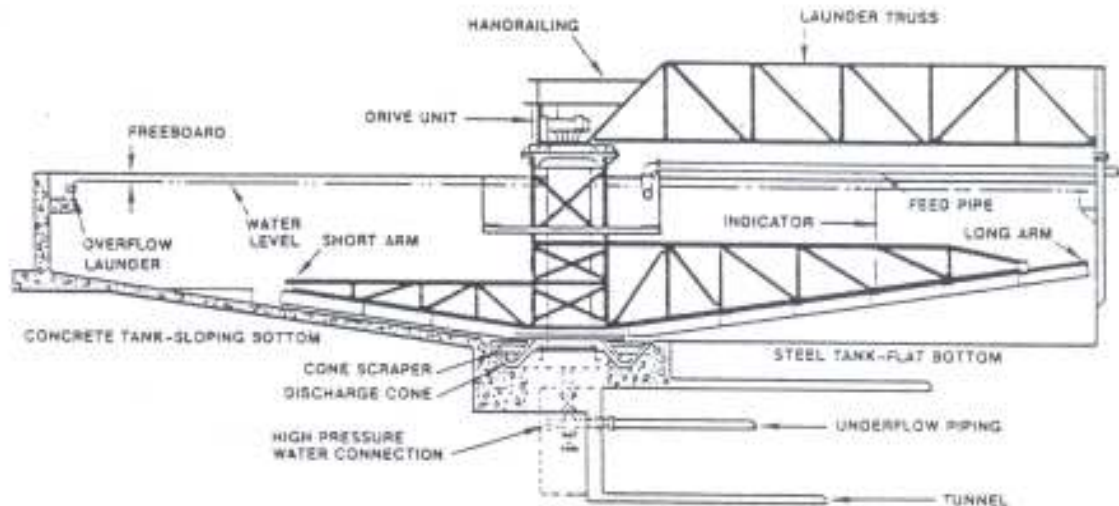


Figure 2.9. Basic concept of center pier thickener.

2.3.5.3. Traction Thickener

Figure 2.10 indicates the basic concept, which is a center pier carrying the weight of the raking mechanism. However, the drive is at the tank wall riding on a track. While it has been employed in many diameters up to 450 ft (137.2 m), it has not been widely used for several reasons. Generally, it is more costly than the bridge or center pier, cannot employ a lifting device for rake protection, and is difficult to use where icing conditions occur. Raking capacity is limited by the arm configuration, and in most designs power input, and therefore torque, is limited by the dead load on the drive wheels and friction between the wheels and rail. A further disadvantage is that it is difficult to fit rake-lifting mechanisms to overcome temporary high loads. It is less flexible in application and cannot be as easily covered. It does have special applications, particularly when more exotic materials of construction are required and major truss work can be kept above the liquid level (Dahlstrom et al, 1985; Weiss, 1985).

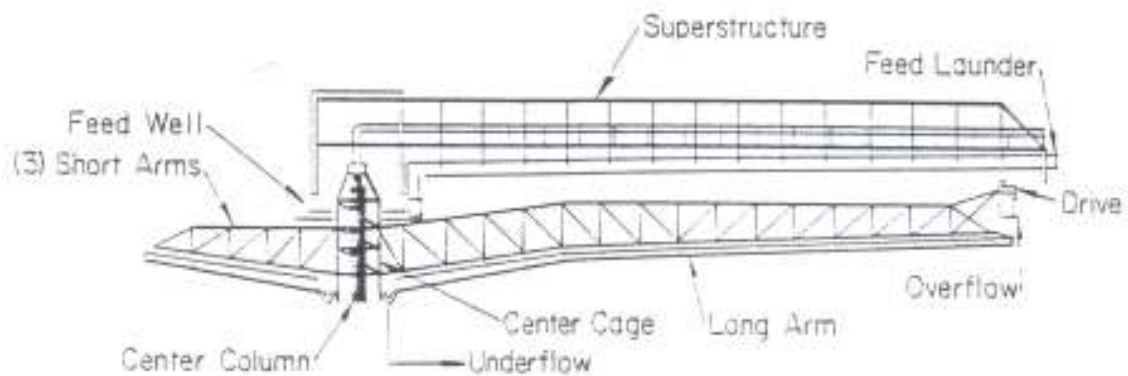


Figure 2.10. Typical traction-type thickener.

2.3.5.4. Tray Thickener

This type of unit consists of one thickener mounted on top of another, as illustrated in Figure 2.11. Tray thickeners with as many as six compartments have been employed, with each raking mechanism on a common shaft. They have been employed with all compartments in parallel with a common underflow and also in countercurrent decantation in series. The obvious advantage is the savings in materials, ground area, and heat when elevated temperatures are involved. A major user in the past has been the alumina industry. However, its usage has seriously decreased as unit area requirements are as much as two times greater than the unit thickeners, operating control is more difficult, and underflow solids concentrations are usually lower. In addition, with the growing increase in plant capacities, several units still must be employed (Dahlstrom et al, 1985; Weiss 1985).

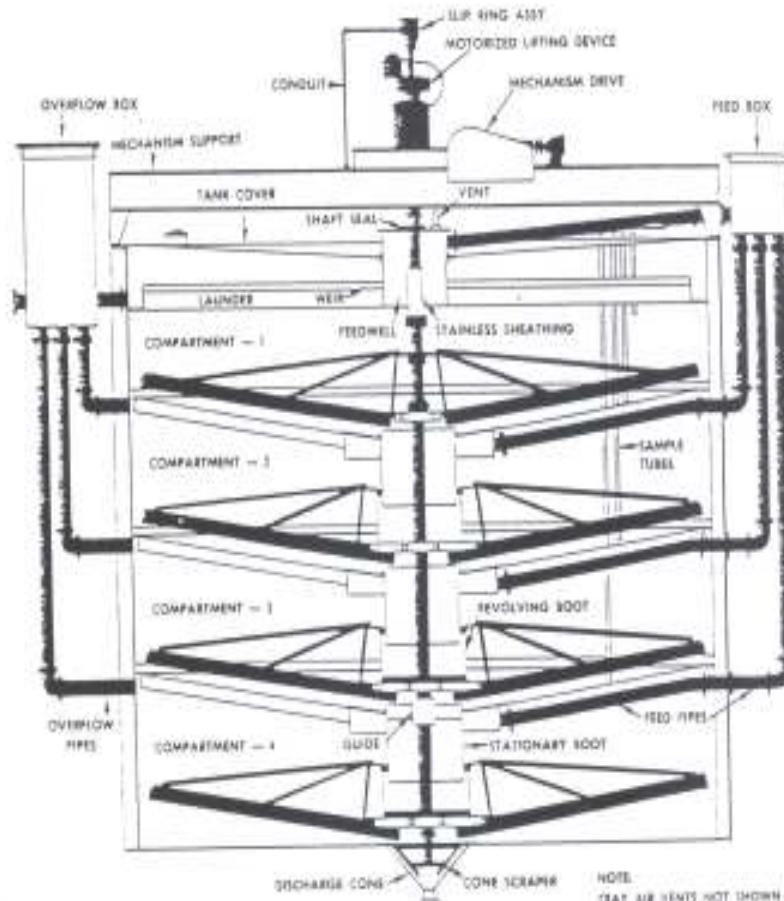


Figure 2.11. Typical tray-type thickener.

2.3.5.5. Hi-Capacity Thickener

This unit also employs a circular tank with a raking mechanism in the bottom. However, the feed well contains a special flocculation chamber (Figure 2.12). With the growth in flocculant capability, particularly the high molecular weight polyelectrolytes, appreciably lower unit areas can be achieved with optimum flocculation procedures. Generally this means adjusting the mixing intensity to that required by the colloidal solids, insuring good and rapid contact between the small volume of flocculant solution to the large volume of feed, and minimizing handling after flocculation. A series of mixing impellers of required shear and pumping capacity are placed on a vertical shaft driven by a variable speed drive. Flocculant solution is added at each impeller to improve homogenous mixing. The flocculated slurry exits directly into the thickened pulp. Because of the floc structure, the

thickened solids act as a filter bed to further improve overflow clarity. To increase stability of the compression zone, sometimes inclined lamella plates are employed at about 50° to 60° to dampen action which would tend to cause the bed to erupt. Either a bridge type or center pier machine can be employed with this principle and a lift may also be employed. Because of the optimum flocculation and machine design, much lower unit areas result, from one-fourth to one-tenth those obtained in conventional units where this concept is employed. However, it must be instrumented to control the sludge level and at the same time control the flocculant to feed solids ratio. Unquestionably, because of capital and other savings, this principle will find wide application in the future(Dahlstrom et al, 1985).

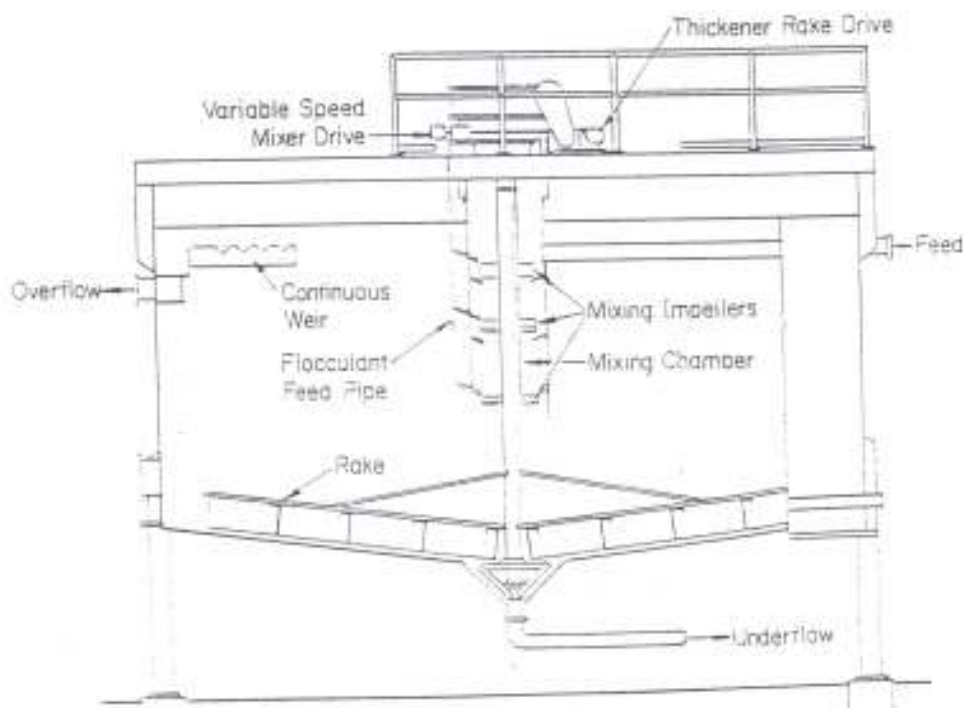


Figure 2.12. Typical high capacity thickener.

2.3.5.6. Rectangular Thickeners

These are generally referred to as drag tanks and are typified by Figure 2.13. Feed generally enters at one end under a vertical baffle and a double chain mechanism with cross flights which carries the settled solids to the opposite end where they are either raked up the beach or pumped out from the bottom. Overflow can be removed at one end or from peripheral launders. Its advantage is a lower capital cost, but maintenance costs are higher. Underflow concentrations

are always lower and overflow clarity poorer. Rectangular thickeners have been primarily employed in coal processing for desliming purposes.

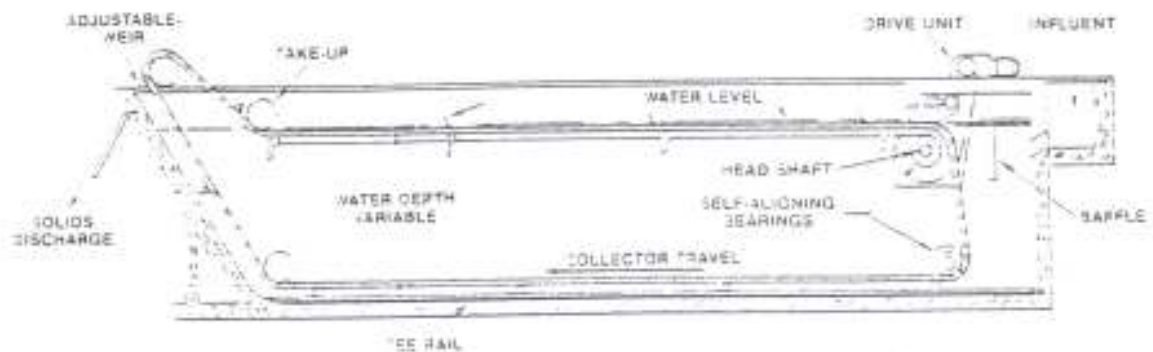


Figure 2.13. Typical rectangular clarifier.

2.3.5.7. Lamella or Tilted Plate Separators

This device normally does not employ thickener rakes. Although the phenomenon has been known for many years, its application as a processing device has only recently occurred. The idea is based on permitting solids to settle only a short distance until they reach an inclined plane. The concept is illustrated in Figure 2.14 (Wills, 1985). The projected area per unit volume, A_s , is obviously increased as the angle of inclination and the perpendicular distance between plates is decreased as per the following equation (Dahlstrom et al, 1985; Weiss 1985):

$$A_s = \cos \alpha / N$$

However, α must be larger than the angle of repose of the sludge so it will slide down the inclined plate. Values of α range from 45° to 50°, with most being 55° to 60°. The plate separation N is usually 50 to 75 mm to prevent plugging and interference between the up flowing liquid on the top and the downward moving solids on the bottom of the lamella. The major advantage of this type of unit is the increased settling area per unit area of floor space. No raking mechanism is employed for the thickened solids, which reduces the underflow solids concentration. There are a large number of designs available which vary primarily

in their feeding methods. They are used primarily for clarification applications and for smaller flow rates up to about 200 m³/h (880 US gpm) per unit.

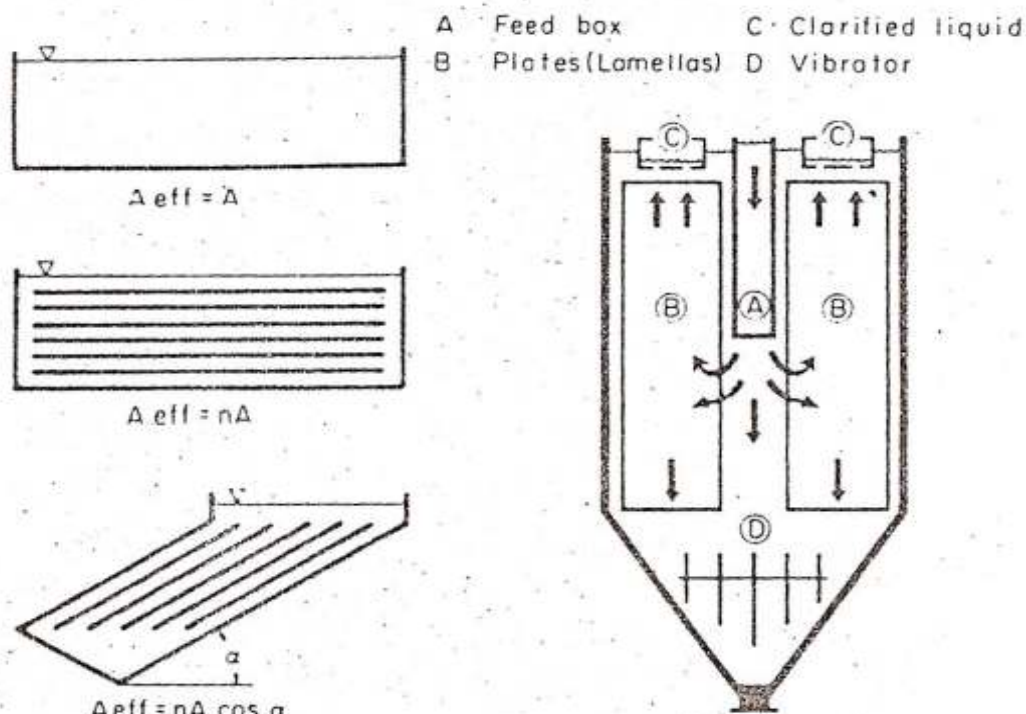


Figure 2.14. Lamella type thickener

2.3.5.8. Miscellaneous Types

There are miscellaneous type thickeners which are either continuous or batch in nature. The most common is a cylindrical tank with a conical bottom usually of a 90° inclined angle or larger. Feed usually enters centrally submerged near the top and the overflow is collected by either a peripheral launder or an outlet pipe. The underflow may be by a spigot type discharge or an automatic valve. They are normally employed for fast settling solids. low feed rates. or where a desliming type operation is required. Because of heights required by the conical section and the fact that no raking mechanism is employed, they are generally limited to a maximum of 20 ft (6.1 m) in diameter. The liquid cyclone has replaced most of them in desliming applications. Their widest application is in thickening and storage of crystalline solids (Dahlstrom et al, 1985, Weiss, 1985).

2.3.6. Magra Ultrasep High Performance Thickener/Clarifier

A suspension of solid particles in the carrier liquid at low density enters the mixing chamber and mixes with the flocculant. The mixing chamber extends down to the free settling zone. The downward velocity of the suspension suddenly decreases passing from the mixing chamber (small diameter) to the thickener tank (larger diameter).

The sudden decrease in the downward velocity allows the large particles to settle out and the small particles are carried upward and accelerate through the annular throat creating turbulence and collisions. The settling velocity of the fines particles increases as the particles grow larger. The upward flow velocity above the throat decreases until the top of the conical baffle is reached. When the settling velocity of the particles exceeds the upward velocity, the particles start to drop downwards and on its downward path collisions occur with upward moving particles. This causes agglomeration and the particles finally become large and heavy enough to drop back through the annular throat into the free settling zone. The fine particles form a floc bed which act as a filter and a clarified zone is formed above the floc bed. Clarified liquid overflows into the overflow launder.

The fines particles dropping down from the floc bed mixes with the feed exiting from the mixing chamber diverted by the conical collector. Coagulation of fines now takes place and fewer fines are carried upward through the throat. This increases the capacity of the Ultrasep 2000 Thickener far beyond any other known unit. Flow diagram is illustrated in Figure 2.15 (Magra Process, 2003).

The passage of solids particles exiting the mixing chamber and annular throat are intercepted by the inclined surfaces of the consolidation cone. Consolidation takes place and the particles slide or roll down the inclined surfaces. Liquid separating the solids is displaced and collects below the collector cone. Some liquid returns to the free settling zone resulting in continuous dilution of the free settling zone leading to faster settling of solids particles.

Liquid collected under the collector cone move up the dewatering pipe. Upward movement of the liquid in the dewatering pipe is caused by the difference in

pressure at position 1 (liquid pressure) and position 2 (pressure due to liquid zone above floc bed plus floc bed density and feed density). The liquid in the dewatering pipe contains unspent flocculant which overflows into the mixing chamber and thereby acts to dilute and flocculate the feed. A continuous internal dilution cycle is created. Dilution further reduces flocculant consumption (grammes/tonne) and settling rate is increased.

Density increases with consolidation and compaction due to the intergranular contact pressure between the particles. The depth of the compaction zone can be used to control the underflow density. With an increase in height, the residence time increases and together with the additional pressure being exerted on the compaction zone allows for liquid to escape from the compaction zone thereby increasing the density.

A suspension of solid particles in the carrier liquid at high density enters the mixing chamber and mixes with the flocculant. Because of the high density of the suspension there will be a level displacement in the mixing chamber. The top edge of the mixing chamber is modified to include V-notches similar in shape to the overflow launder V-notches and is also lowered to the level of the overflow launder. A second internal dilution cycle is now created. This causes an increase in the upward flow velocity which is now much lower with less dewatering required at high feed density compared with low feed density to obtain the same underflow density. Increasing the upflow velocity to the previous low density condition will not affect the operation. The thickener again operates like a low feed density unit. Flocculant consumption are at the same level as a low feed density unit. (Magra Process, 2003).

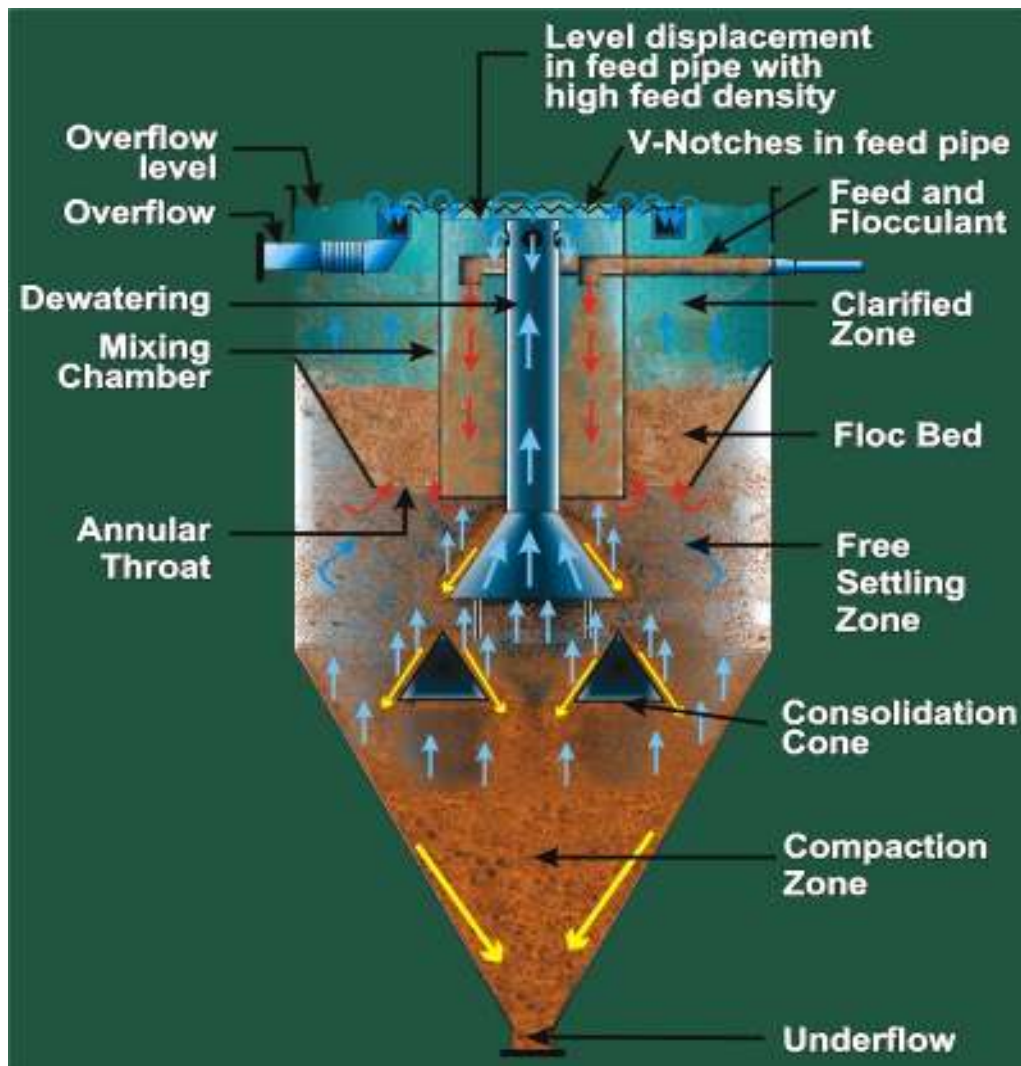


Figure 2.15. Flow diagram of Magra Ultrasep High Performance Thickener/Clarifier.

2.3.7. Eimco E-Cat Clarifier and Thickener

Clarification within the E-CAT is accomplished in the "Clarifying Cylinders". The clarifying cylinders are arranged in one or more rings around the feedwell. These cylinders are of constant cross section along their operating length and are open top and bottom. This rakeless design uses novel technology to accomplish both clarification and thickening in a single unit with minimal area.

The feed suspension enters the feedwell through the influent pipe. In the feedwell feed velocity is reduced. The feed then passes downward into the body of the Clarifier/Thickener where the solids are thickened (removed from suspension). The supernatant flows upward through the clarifying cylinders where final solids

are removed from suspension. When the effluent initially enters the bottom of the clarifying cylinders, the solids in suspension are in the form of discrete particles or small flocs. Since these have low settling velocities, they will mostly be carried up by the flow of the suspension entering the cylinders. Repeated collisions between particles and flocs cause the flocs to increase in size and, under the correct conditions, in density. These large flocs will have higher settling velocities, which means that they slow down in the upflow conditions within the cylinders. Eventually, they become large and dense enough to drop down against the flow, and out the lower end of the clarifying cylinders. Clarified effluent flows out through the top of the cylinders, overflows the weir assembly into the launder and is discharged through the dropout box and effluent pipe. The solids settle into the tank bottom cone for thickening and sludge dewatering, and discharge of the thickened solids through the slurry discharge pipe at the bottom of the cone.

The design advantages include low capital and maintenance cost, much smaller required area and operating cost compared to conventional thickener (Figure 2.16) (FLDSmith Dorr Oliver, 2008).

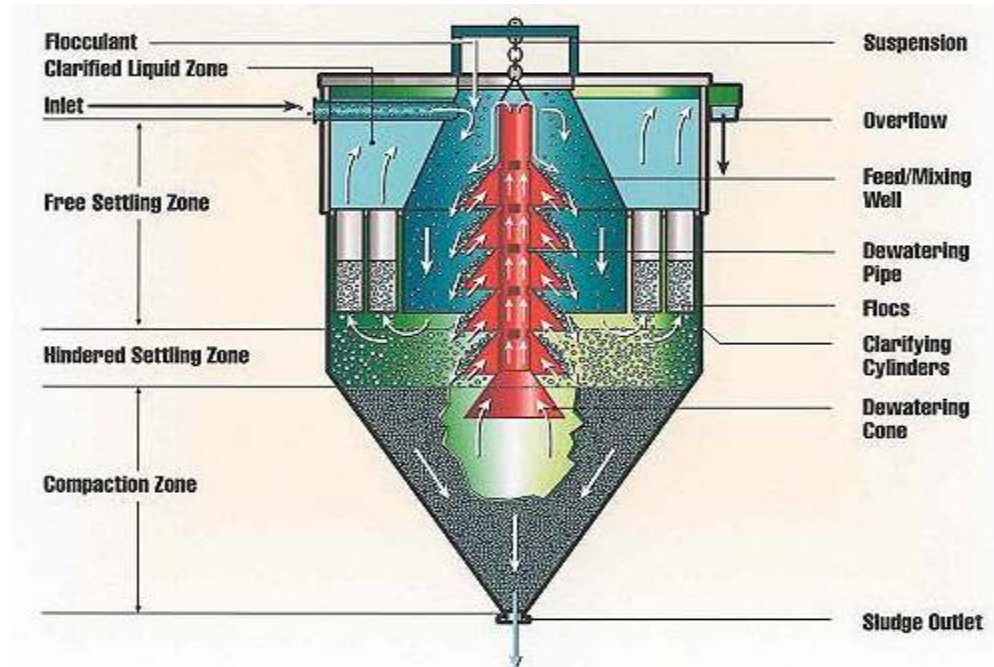


Figure 2.16. Eimco E-Cat Clarifier and Thickener

2.4. The Nature of the Particle Surface

Related to both the chemical composition data and the physical/chemical data is a knowledge of the type and magnitude of electrical charge existing on the surfaces of particles in any given particle system. The concept of an electrical double layer is widely used to explain and quantify the electrical nature of particle surfaces. The electrical double layer develops when a particle is immersed in the continuous fluid phase. Once immersion has taken place, charged species will begin to migrate across the solid/liquid interface until an equilibrium is established. At equilibrium, the particle surface will have acquired a charge with respect to the liquid phase so that a region of electrical inhomogeneity exists at the particle/fluid interface. The excess charge at the particle surface (whether positive or negative) must then be balanced by a region of equal but opposite charges on the fluid side. The surface charge and the diffuse region in the fluid near the particle surface make up the electrical double layer.

The electrical charge on a particle surface can be generated by a number of mechanisms such as chemisorption of charged species from the fluid phase, preferential dissolution of surface ions into the fluid phase, lattice structure substitution at the particle surface of one molecular species for another, and the selective adsorption of ions onto the particle surface from the liquid phase. These charged species, or ions, play a dominant role in establishing the nature of the electrical double layer. Ions that give rise directly to the charge on the particle surfaces are called potential determining ions; they are unique to each type of particle system. Ions that serve only to maintain electrical neutrality are called counterions.

While the potential determining ions are specific in nature for each specific particle system, the counterions can be quite variable. With many types of solid particles, especially those that are oxides, the potential determining ions are H^+ and OH^- . Thus, simply changing the pH of the liquid phase can cause a change in the particle surface charge. Experience has shown that as pH is increased, the OH^- concentration increases and the particle surface charge will go from positive to

negative. This is all important observation and one that is key to understanding the use of chemicals in particle systems. The point of zero charge (PZC) is that value of pH for which the surface charge is neutral.

Figure 2.17 shows schematically the concept of surface charge and counterions. The fact that there is an alignment of ions leads directly to a potential energy difference, ψ_ζ , analogous to a parallel plate condenser in elementary physics. The first layer of counterions lies in the Stern plane, or shear plane, at a distance δ from the surface. This distance is determined by the ionic radius (in some cases, in aqueous fluids, the hydrated ionic radius) (Rajagopalan et al, 1997).

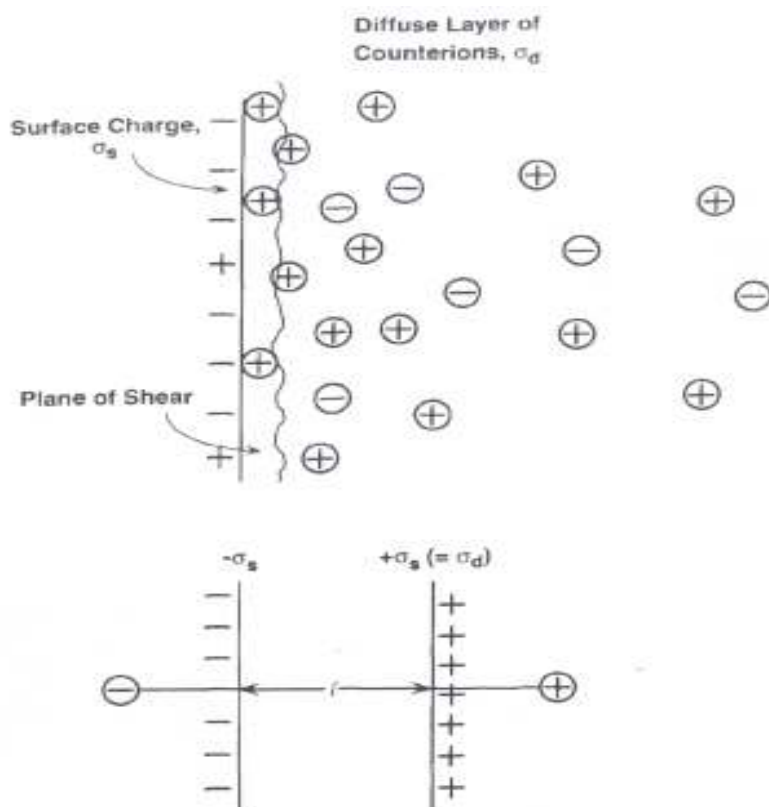


Figure.2.17. The concept of electrical potential of a particle surface.

Figure 2.18 shows the decay of potential energy as a function of distance from the particle surface.. Experimentally, one measures the potential at the plane of shear and the measured potential is denoted as ψ_ζ . The value of ψ_ζ called zeta potential, is the single most important parameter for describing a particle's surface condition

in a particle system. Zeta potential ψ_ζ is usually less than ψ_0 but still is a good approximation of the particle surface condition.

Obviously, as the distance from the particle surface increases, the electrical neutrality of the fluid phase reestablishes itself, resulting in a zero potential. The sign of zeta potential ψ_ζ and its magnitude will be used in both explaining and selecting appropriate chemicals for use in particle systems. When ions present in the fluid phase adsorb on the particle surface so as to maintain electrical neutrality, and such ions adsorb only by electrostatic attraction (e.g., positive ions neutralizing negative surface charges), they are called indifferent ions. Some chemicals, however will exhibit surface activity in addition to electrostatic attraction or will associate with (adsorb on) particle surfaces independent of the condition of the surface charge. Thus, the use of appropriate chemicals in particle systems offers a much greater flexibility to utilize and control particle surface conditions for a desired end result (Rajagopalan et al, 1997).

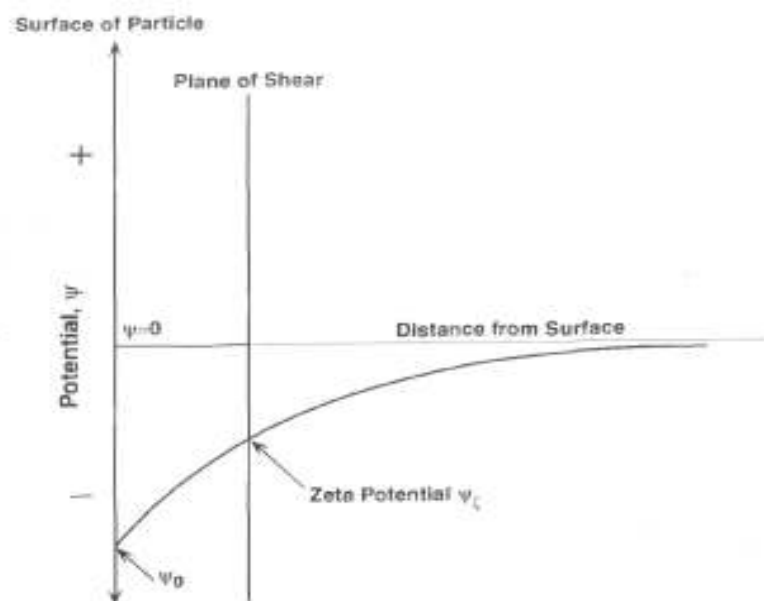


Figure 2.18. Schematic representation of the decay of electrical potential with distance from the surface of the particle.

2.5. The Need for Coagulation and Flocculation

Coagulants and flocculants are generally used to promote the separation of particles from the liquid continuous phase, an engineering process which falls in

the category of solid/liquid separation. In this module the emphasis is on the chemicals themselves that are used in such processes. Why are chemicals necessary to separate particles, which are usually fine solids, from liquids, which are usually aqueous? This need is demonstrated by the well-known Stokes law for describing the settling velocity of spherical particles in a fluid. Stokes law can be represented by:

$$V = \frac{2gr^2(p_1 - p_2)}{9\eta}$$

where V is the final settling velocity of the sphere of radius r , g is the gravitational constant, p_1 is the specific gravity of the sphere, p_2 is the specific gravity of the liquid, and η is the viscosity of the fluid. One of the key implications of the Stokes law is that the larger the particle size, the faster the settling velocity; that is, $V \propto r^2$. To illustrate this relationship, we will analyze the settling behavior of spherical particles of four different diameters: 1000 microns (1 mm), 100 microns, 10 microns, and 1 micron. If the assumptions are made that the specific gravity of the particles is 2.5 and that the settling of the spheres is occurring in water at room temperature (i.e., a viscosity of 0.01 centipoise), the settling velocity for the various sized spheres can be directly calculated using the Stokes law.

Using only gravity as a settling force, what such a calculation shows is startling: a 1 mm diameter sphere takes roughly one second to settle one meter, a 0.1 mm (100 micron) diameter sphere takes roughly 80 seconds, a 0.01 mm (10 micron) sphere takes approximately three hours and twenty minutes, and a 0.001 mm (1 micron) sphere takes 15 days. It is evident that if time is important, and if an acceptable separation of a finely divided solid is desired, even in a low viscosity fluid like water, the effective particle size of the system must be greatly increased. Quite simply stated, the role of chemical coagulants and flocculants is to speed up the settling process by promoting the development of larger bunches of particles; these in turn act like larger single particles from a settling viewpoint (Rajagopalan et al, 1997).

2.6. Flocculation Mechanisms

Polymers provide enhanced formation of larger aggregates, or flocs, of particles by two general mechanisms called charge patching and bridging. Figure 2.19 illustrates the charge patch mechanism for the very common situation of having a particle with fixed surface sites of negative charge. A cationic polymer, a positively charged polymer, can adsorb on a patch on the surface. This localized adsorption of the polymer neutralizes the negative charges in the immediate area of adsorption giving rise to a net positive charge in that specific portion of the particle. As long as the dosage of the cationic polymer is not excessive, so that it covers all of the particle surfaces, the net effect of this patch adsorption is that the particle surface will contain patches of both negative and positive sites. This then allows the particles to come together by electrostatic attraction of a positive patch on one particle to a negative patch on another. This situation is illustrated in Figure 2.20 and 2.21 (Day, 2002).

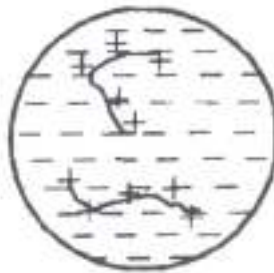


Figure 2.19. Charge patches

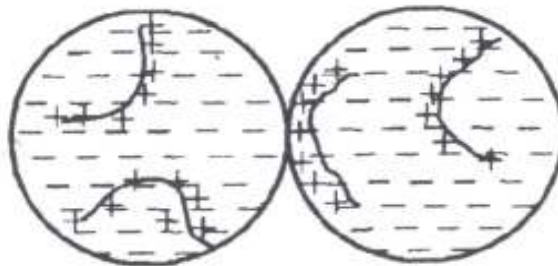


Figure 2.20. Charge patch attraction

The most common types of polymer to operate by this mechanism are the polyamines. These are condensation polymers, and are relatively low in molecular weight, with the result that flocs formed in this way are fairly small and slow-settling (Rajagopalan et al, 1997).

Figure 2.22 and Figure 2.23 shows the bridging model, where the polymer chain adsorbs on the particle surface at only a few places of attachment leaving ends and loops of the polymer extending into the solution to contact other particles. The implication of bridging is that the longer the chain (or the higher the molecular weight if the polymer is more or less linear in shape), the more effective the polymer in promoting the development of flocs.

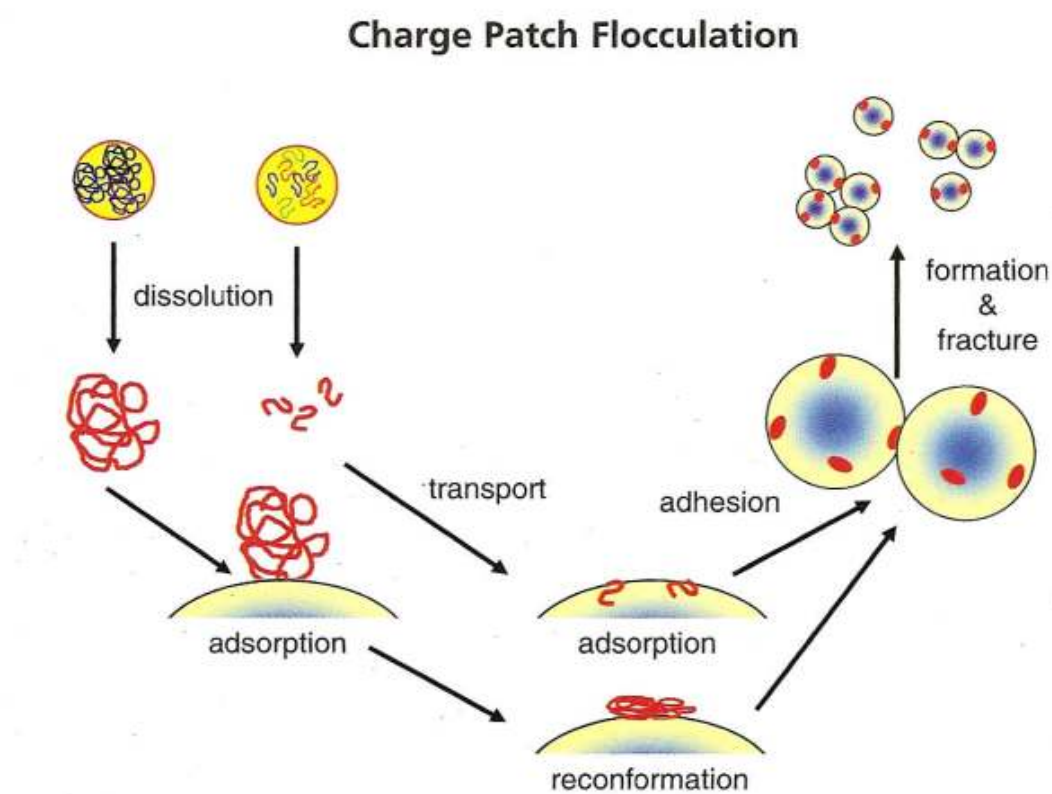


Figure 2.21. Charge patch mechanism

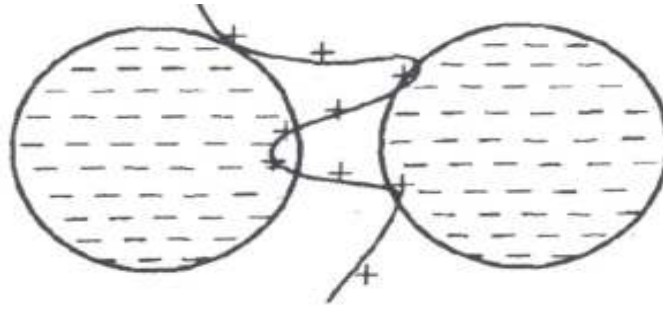


Figure 2.22. Bridging mechanism

Clearly, bridging can only take place with polymers of very high molecular weight, which need not carry a charge opposite in sign to that of the suspended particles. The majority of synthetic polymers of this type are based on acrylamide and its derivatives as the monomers (Day, 2002).

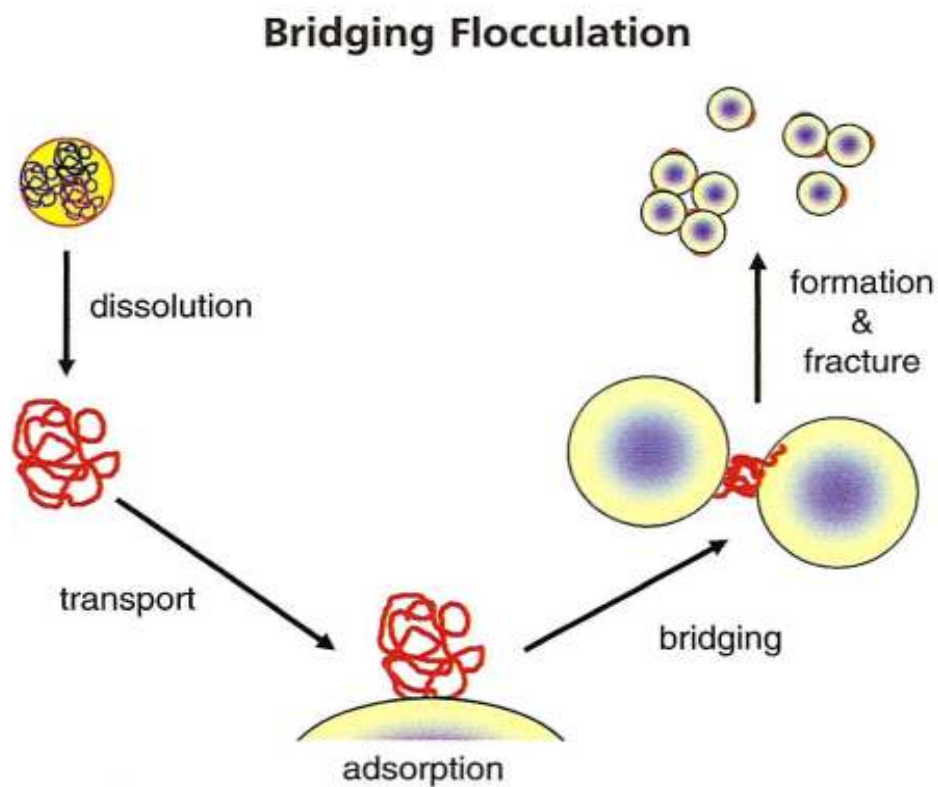


Figure 2.23. Bridging mechanisms overall view

Bonding may be due to either chemical forces (which operate over very short distances), or to physical forces (which extend over longer distances) (Fowkes, 1965), or to a combination of both.

The important physical forces can be briefly summarized as follows:

- a) Electrostatic (coulombic) forces: These result in the adsorption of polyelectrolytes onto any surface of opposite charge, irrespective of their chemical nature.
- b) Dipole attraction forces: These were suggested (Kitchener, 1969; Slater et al, 1969) to explain the flocculation of ionic-type crystal (e.g., fluorite) by nonionic polyacrylamide.
- c) London -van der Waals attraction forces: In these, neutral molecules or atoms constitute systems of oscillating charges producing synchronized dipoles that attract each other (Stumm et al, 1970).
- d) Hydrophobic association: This is characterized by the tendency of nonpolar molecular groups (or substances) to escape from an aqueous environment.

The important chemical forces that result in a covalent-type bond can be classified as follows:

- a) Chemical bonding: This is exemplified by reactions of the polymer groups with metallic sites on the solid surface that may result in the formation of insoluble compounds by covalent or ionic bonding.
- b) Coordination bonding: This includes chelation or complex formation resulting in polymer attachment to a surface.
- c) Hydrogen bonding: In organic compounds where the hydrogen atom is combined with a strongly electronegative atom (such as O, S, N), the hydrogen atom is able to accept electrons from atoms on the solid surface (Kuzkin et al, 1966), such as from the —OH groups of the hydrated surface of an oxide mineral (Kitchener, 1972), resulting in formation of a hydrogen bond.

Figure 2.24 gives an illustration of some typical polymer attachment configurations in aqueous particle systems. Conditions 2.24.a and 2.24.b are examples of electrostatic bonding, condition 2.24.c hydrophobic bonding, condition 2.24.d

hydrogen bonding, and condition 2.24.e chelation bonding with a metal atom M on the particle surface.

2.7. Types of Polymeric Flocculants

A polymer may be defined as a large molecule comprised of repeating structural units joined by covalent bonds. (Greek: poly = many, meros = part.) In this context, a large molecule is arbitrarily regarded either as one having a molecular weight of at least 1000 or as one containing 100 structural units or more. A structural unit consists of a relatively simple group of atoms joined by covalent bonds in a specific spatial arrangement .

Polymeric flocculants are generally those macromolecular organic substances that cause finely divided particles to aggregate and form discrete flocs. The process describing this action is known as flocculation. Typically polymeric flocculants consist of long-chain molecules with molecular weights of 10^6 or greater. They may be either natural, synthetic, or derivatized hybrid organic products. Due to their great molecular chain lengths, they are capable of adsorbing on several particles simultaneously. The resulting molecular bridging action is believed to be the chief mechanism for binding the adjoining particles within the floc (Krishnan et al, 1988) .

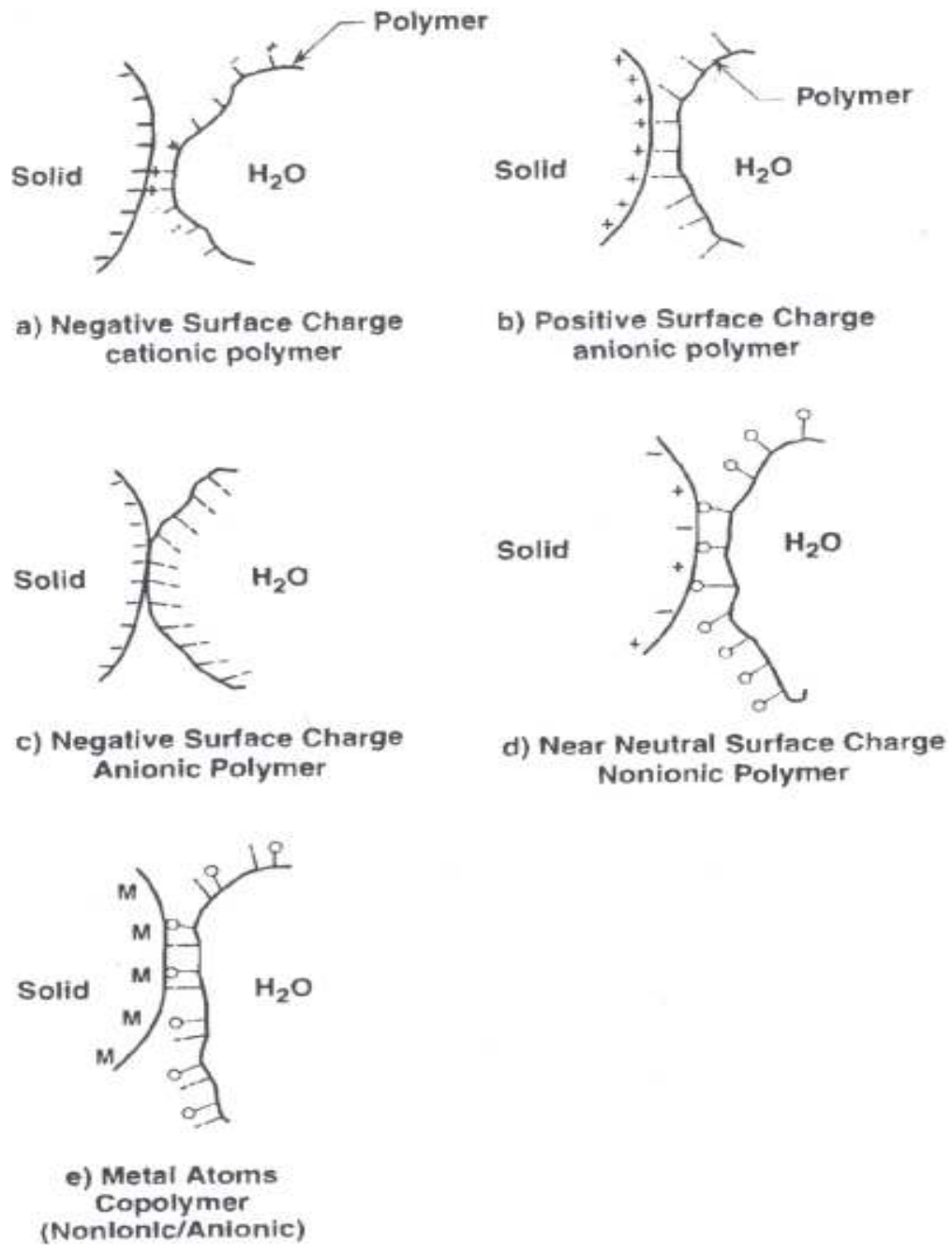


Figure 2.24. Common types of polymer attachment configurations on particle surfaces in aqueous particle systems.

2.7.1. Natural Flocculants

Polymeric flocculants derived from natural sources have been used since very early times. The natural polymers and their derivatives used as flocculants include starches, galactomannans, cellulose derivatives, alginates, and chitin. These are

water-soluble polymers and vary in structure, molecular weight, biodegradability, ease of dissolution, and temperature of preparation.

Starches belong to the class of carbohydrates and are composed of carbon, hydrogen, and oxygen in the ratio of $C_6H_{10}O_5$. Molecular weights of starches range from 50,000 up to several million. The structure of starch molecules in aqueous solutions is complicated by their association through hydrogen bonding. The infrared spectra of starch indicate that the hydroxyl groups are strongly hydrogen bonded (Samec, 1957).

Galactomannans are branched polysaccharides composed of D-galactose and D-mannose commonly found in endosperms of Leguminosae where they serve as reserve foods (Levine, 1981). Guar is the most important species of galactomannans. Guar gum or guar gum is used as a flocculant in industrial processes. Derivatives of guar include hydroxy propyl, hydroxy ethyl, carboxy methyl, carboxy methyl hydroxy propyl, and cationic guar.

Cellulose is the chief structural element of the cell walls of trees and other higher plants. Cellulose derivatives include cellulose nitrate, cellulose acetate, methyl cellulose, carboxymethyl cellulose, hydroxyethyl cellulose, cellulose xanthate, and hydroxypropyl cellulose (Levine, 1981). Of these, the derivatives most widely used is carboxymethyl cellulose (CMC).

Commercially available alginates are sodium, potassium, ammonium, ammonium-calcium, and mixed sodium-calcium salts of alginic acid and propylene glycol alginate. In the mineral industry, the chief uses of alginates are for thickening and stabilizing mineral suspensions (Cotrell et al, 1980).

Chitin is a polymer found in the organic skeletal substance of marine organisms and fungi. It consists of a homopolymer of N-acetylglucosamine that is structurally related to cellulose. A well-known derivative of chitin, chitosan, is a water-soluble cationic polysaccharide, prepared by partial deacetylation with alkali. Flocculating properties of chitosan have been reported (Muzzarelli, 1977).

2.7.2. Synthetic Flocculants

Synthetic or man-made polymers dominate as the chief type of polymeric flocculants used in the mineral industry. These polymers are almost invariably based on polyacrylamides, though a significant number of other chemical types also exist. Commercial polymeric flocculants can be anionic, cationic, or nonionic.

2.7.2.1. Anionic Polymers

Anionic polymers containing carboxyl groups are by far the most important class of anionics, both in the high and low molecular weight ranges. The most common of these anionic polymers are based on polyacrylic acid, salts of polyacrylic acid, or on acrylamides. The latter type is generally prepared by either polymerization/hydrolysis of acrylamide or by copolymerization of acrylamide with acrylic acid or acrylate salts. Polyacrylamides contain a rather random distribution of a relatively few carboxylate groups along the predominantly polyacrylamide chain. Since only a fraction of the carboxylate groups are present and make a contribution to the molecular charge, these types of polymers are relatively weakly ionized. However, salts of polyacrylic acids are highly ionized in alkaline medium. An example of a type of anionic polymer that is highly ionized is the sulfur-containing polymer, polystyrene sulfonate. Those anionic polymers containing phosphonic groups form polymers that have acid strengths intermediate between the weak and strong anionics (Luttinger, 1981; Vorchheimer, 1981).

2.7.2.2. Cationic Polymers

Cationic polymeric flocculants positively charged groups, such as amino (—NH_3^+), imino ($\text{—CH}_2\text{—NH}_2^+\text{—CH}_2$), or quaternary amino ($\text{—}^+\text{NR}_4$). Most of the high-molecular-weight cationic polymers available today are made by free-radical copolymerization of acrylamide with minor amounts (10 mol % or less) of the cationic monomer (Luttinger, 1981).

Other cationic polymers, in very limited applications, include those that are sulfonium-based or phosphonium-based. A recent development in the area of cationic polymeric flocculants has been the hydrophobic polymers. These polymers include regularly alternating copolymers of styrene and imidazolines, cationic aminomethylated acrylamide-styrene copolymers or acrylamide-styrene-

quaternized aminoacrylate terpolymers, and aminomethylated acrylamide copolymers with other hydrophobic monomers, such as methyl methacrylate (Vorchheimer, 1981).

A unique feature of cationic polymeric flocculant is that both low-molecular-weight polymers and high-molecular-weight polymers function as flocculants. This is primarily because the majority of particles found in nature bears negative charges. These cationic polymers usually function by a combination of charge neutralization and bridging mechanisms (Luttinger, 1981).

2.7.2.3. Nonionic Polymers

Nonionic polymeric flocculants are fewer in number than anionic or cationic polymers. Nonionic polymers consist chiefly of polyols and anhydrolyzed polyethers and polyamides.

Polyvinyl alcohol is the prime example of a polyol used as a flocculant. It is produced by first polymerizing vinyl acetate monomer followed with alcoholysis of the polyvinyl acetate, by dissolving in a solvent, usually methanol, and alcoholizing by use of either an acid or alkaline catalyst.

Two of the most common non ionic polymeric flocculants used in the mineral industry are polyacrylamide and polyethylene oxide. A truly non ionic polyacrylamide flocculant does not exist, because the polymerization of acrylamide intended to produce high molecular weight polymers is conducted under adiabatic conditions in aqueous solutions, conditions that also favor hydrolysis. Most commercial "nonionic" polyacrylamides contain about 1% or 2% hydrolyzed amide groups, making them slightly anionic (Vorchheimer, 1981).

The other nonionic polymer that has been of significant use in the mineral industry as a flocculant is polyethylene oxide (PEO). These polymers range in molecular weight from 20, 000 to about 5 million.

2.7.3. Factors Affecting Flocculation

The factors below are described individually, it is a combination of many factors that ultimately determines a polymer's activity as a flocculant.

2.7.3.1 Polymer Charge

The driving force (heat of adsorption) for adsorption is controlled by the mineralogical characteristics of the suspended solids, as well as the aqueous environment. Although amide and carboxylate groups have the capacity to adsorb onto mineral surfaces, evidence collected in a large number of applications strongly suggests that the primary function of acrylamide groups in copolymers is adsorption (builds strong floc) by hydrogen bonding, while the primary function of the carboxylate groups is to extend the polymer chain in solution by electrostatic repulsion, enabling bridging to take place more easily.

Copolymers of acrylamide and acrylate are often more active than homopolymer acrylamide in spite of the fact that most particles carry a negative surface charge. The enhanced activity of anionic acrylamides can be ascribed to uncoiling of the polymers brought about by electrostatic repulsion between the anionic groups. Uncoiling of the polymer is expected to increase with increasing anionic charge. One way of measuring polymer uncoiling is by monitoring the effect that added polymer has on solution viscosity. As the polymer uncoils the viscosity increases (Richardson et al, 1988).

2.7.3.2. Ionic Strength

Based on a model of flocculant activity related to polymer uncoiling, it is easy to understand why ionic strength can have such a large effect on flocculation. At very high ionic strength, the charged centers on the polymer are shielded and the polymer will coil up. The coiling of the polymer manifests itself as a reduction in intrinsic viscosity as a function of salt concentration.

Although high levels of electrolyte generally have deleterious effects on the activity of anionic flocculants, the presence of low levels of cations, especially calcium, (Michael, 1954, O'Goormon et al, 1974) to be necessary for optimum activity.

2.7.3.3. pH

The solution pH can cause changes in both flocculant chemistry and rheology as well as affect the surface chemistry of the mineral particle. At high pH, acrylamide will hydrolyze to acrylate; while at low pH, acrylate is in chemical equilibrium with the acid form.

A consideration of the acid-base behavior of acrylate illustrates the effect that lowering the pH can have on the polymers. The pK value of acrylic acid, which is 4.25, allows the relative amounts of acrylate and acrylic acid in solution to be estimated. At pH 7, the acrylate /acrylic acid ratio is approximately 560:1. At pH 5, this ratio becomes 5.6:1, while at pH 3, essentially all the acrylate is in the acid form. This will affect the molecular rheology. At pH 7, polyacrylate would be extended in solution, while at pH 3, the polymer will be much more coiled. Hence, as the pH is lowered, the performance of conventional anionic polymers will decrease. One would expect, however, that pH should have a minimal effect on nonionic polyacrylamide.

Recently, acrylamide flocculants have been prepared containing acrylamide substituted with salts of sulfonic acid. Because sulfonic acid is a much stronger acid than acrylic acid, these new flocculants should show improved activity at low pH. And also nonionic and acidic sulfonic acid polymers show minimal pH dependence, while the conventional anionic acrylamide exhibits a large pH dependence (Richardson et al, 1988).

2.7.3.4. Slurry Solids

The pulp solids content should affect the optimum dosage since it determines the number of interparticle collisions. However, although the optimum dosage decreases at very low pulp densities, the changes in optimum dosage over the range 4% to 50% have been shown to be negligible (using silica).

The rate at which aggregates form is proportional to the square of the concentration of the particles, and the "time of coagulation" (ie the time for the

number of particles to be halved) is inversely proportional to the initial concentration.

Stability of flocs to agitation increases with increasing pulp density. After the flocs become torn apart by agitation, the probability of recombination of flocs depends on the time before collision with another particle. With low pulp densities, this time is relatively large and the polymer molecules will tend to adsorb on the same particle, reducing the amount of bridging in the system. With higher pulp densities there is a greater chance of collision with another particle before this happens (Gric et al, 1978).

2.7.3.5. Flocculant Dilution

Performance of the polymer can be affected by polymer concentration. Faster settling rates, which indicate improved activity, are obtained using more dilute polymer solutions. This improved activity can be attributed to the better distribution obtained by dilution of the flocculant.

2.7.3.6. Shear

All flocs, whether formed by natural coagulation or bridging flocculation, are subject to breaking up with excessive agitation, and do not readily reform when the cause of agitation is removed. If flocs formed in the presence of excess polymer are agitated, they degrade faster than those formed with the optimum polymer ratio. The excess polymer is then adsorbed from solution, since as the flocs break apart, fresh adsorption sites are exposed. The flocs cannot then reform efficiently as the excess adsorbed polymer causes repulsion. Hence optimum dosages for a polymer only hold for a particular degree of agitation.

2.7.3.7. Molecular Weight

Considering that the polymer's ability to bridge between particles is an important flocculation mechanism, it is not surprising that molecular weight has an effect on activity as a flocculant. While higher molecular weight results in better activity in most thickener applications, there have been a number of instances in which increasing molecular weight results in loss of activity. A number of factors can account for this loss in performance, higher-molecular-weight polymers are not as

easily distributed throughout a slurry because of increased viscosity. Since adsorption is fast and usually irreversible, this could cause a loss in activity. Also, for the same weight of added polymer, the number of molecules decreases with increasing molecular weight. In high-solids slurries there may not be enough polymer molecules to floc all the solids (Richardson et al, 1988).

Overall molecular weight is not the only criterion for effective flocculation, since two products with the same apparent molecular weight may have different molecular weight distributions, as shown in Figure 2.25.

Polymers A and B have the same average molecular weight and aqueous viscosity, but can give considerably different performance. Polymer A has a wide molecular weight spread, containing considerable amounts of both high and low fractions, and polymer B has a narrower spread with more of the intermediate fractions than polymer A. The actual difference in performance in a given situation may depend on the nature of the slurry being treated as well as the properties of the polymer (Gric et al, 1978).

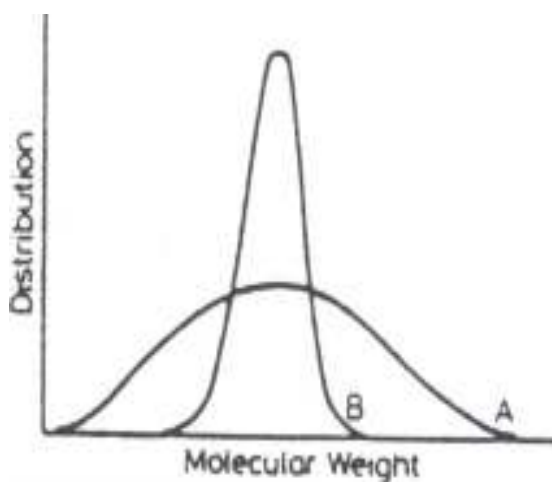


Figure 2.25. Two products with the same apparent molecular weight.

2.7.3.8. Temperature

It is generally thought that increase in temperature improves flocculation, although this is not always the case, since a change in temperature will exert different effects in different systems. The rate of diffusion of flocculant and the rate of collision of particles must increase with rise in temperature but the adsorption step, which is exothermic, must be unfavourably affected by higher temperature. The

linear extension of the polymer molecules may vary with changing temperature, depending on the nature of the solvent-solute interactions. Thus it is difficult to accurately predict the effect of temperature in a given system.

2.7.3.9. Polymer Dosage

Flocculation in a given system can not be increased beyond a certain optimum dosage of polyelectrolyte, and further additions result in decreased efficiency.

The optimum dosage is the maximum amount of polymer that the solid can utilise for flocculation under the conditions of the experiment and is directly related to the amount of multiparticle adsorption. The point beyond which the polymer is not completely adsorbed corresponds to the optimum dosage determined from settling rates. However, the total amount adsorbed continues to increase with increasing concentration.

Optimum dosages (ie the dosage required for maximum settling rate) cannot be easily predicted since they are known to vary not only with ionic character and degree, but also with molecular weight. Optimum dosages increase with increasing molecular weight, but on the other hand the settling rates achieved will be higher.

2.7.3.9. Particle Size

On fine silica particles, the optimum polymer/solid ratio has been found to be directly proportional to the surface area of the solid, therefore, a decrease in particle size means an increase in flocculant demand (Gric et al, 1978)..

2.7.3.10. Process Conditions

Getting the optimum performance from any chemical program depends to a great extent on how the polymer is applied. Factors such as dilution and slurry solids have already been discussed. Control of these parameters is important in maintaining flocculant activity. In addition, the feed point of the polymer can have a large effect on its activity. The proper feed point ensures sufficient mixing without too much shear. One must also keep in mind that the optimum feed points can change as production rates are changed.

As already noted, variables such as ionic strength and pH affect the choice of flocculant. These variables can be dramatically different at various points in the beneficiation process. An example of a process where these changes can occur rapidly is in countercurrent decantation (CCD). This process is used when the mineral is dissolved in order to separate it from the gangue. The key here is that the solids, which are moving out of the circuit, are being washed with increasingly fresh water coming in to the circuit. Generally this is broken down into several washing stages, with each stage receiving flocculant. At each step, the water chemistry can change dramatically, and the same flocculant is not necessarily best for each stage. Improved performance can be achieved at times by using more than one polymer type for flocculation. Generally a compromise must be made between the complexities of handling a number of flocculants and the desire for the most cost effective program (Richardson et al, 1988).

3. MATERIAL AND METHODS

3.1. Material

Samples used in experiments were taken from Çayeli Bakır İşletmeleri A.Ş. ÇBI is processing complex massive sulphide ores and producing copper and zinc concentrates. It is the major copper and zinc concentrate producer in Turkey. The Çayeli concentrator was commissioned in 1994, with a design capacity of 600,000 tonnes/year and its upgraded capacity has been 1,250,000 tonnes/year since 2002 (Aksarı 2007).

The Çayeli ore is primarily clastic in texture. The orebody is made up of massive sulphide conglomerates, breccias and sandstones consisting of more than 90% sulphide minerals with minor dolomite and barite gangue. Major sulphides are pyrite (FeS_2), chalcopyrite (CuFeS_2) as well as accessory bornite (Cu_5FeS_4) and secondary copper minerals and sphalerite with lesser amounts of galena; PbS and the sulphosalt tetrahedrite. Major gangue minerals include barite; BaSO_4 , dolomite; $\text{CaMg}(\text{CO}_3)_2$, quartz; SiO_2 , sericite; $\text{NaAl}_2(\text{Si}_3\text{Al})\text{O}_{10}(\text{OH})_2$ and kaolinite; $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$.

The ore is separated into four different types where it is blended from surface storage bins in order to achieve optimal metallurgical results. Black ore and Yellow ore are referred to as “Spec” ore types and are separated based on the zinc content. Black ore has $>4.5\% \text{Zn}$ and a Cu/Zn ratio of <1 . The third ore type is called Clastic and generally occurs as a relatively narrow zone over the top of the deposit. The distinctive feature of these massive sulphides is that it contains fragments of sphalerite typically ranging from 1 cm to 40 cm in size. These sphalerite fragments contain a significant amount of chalcopyrite intergrowths, which have negative effects on the metallurgical recoveries. And low grade yellow ore contains lower than 2.5 % Cu differ from yellow ore.

The flowsheet including dewatering circuit is illustrated in Figure 3.1. The copper and zinc concentrate slurries are thickened in two identical circuits. Each circuit includes a steel 16 meter diameter conventional thickener. A steel bridge with an open type steel-grating floor provides access from the filter floor level to the thickener mechanisms. Both thickener underflows are transferred to two 5,000 mm diameters x 6,400 mm high surge tanks.

Pressure filters are used for filtration of the thickened copper and zinc concentrates. Recently two Lasta filters were installed in order to improve filtering capacity of copper and zinc concentrates. There are four pressure filters in the circuit. Two of them are used for copper, one for zinc and a standby filter for both copper and zinc filtration. The filters are equipped with hydraulic open/close capability and semi-automatic, automatic cake discharge and cloth washing. Copper and zinc concentrates drop directly down to reinforced concrete base square storage area of having nominally 1,000 tons of capacity. Stand-by filter has equipped with two ways conveyor to carry both copper and zinc concentrates and drop to load out area. Copper and zinc concentrates are removed from the storage area by front-end loader and loaded into trucks provided by a contractor. Each truck is weighed at the plant gate prior to transporting the concentrate to the Rize port located approximately 28 kilometers from the concentrate site.

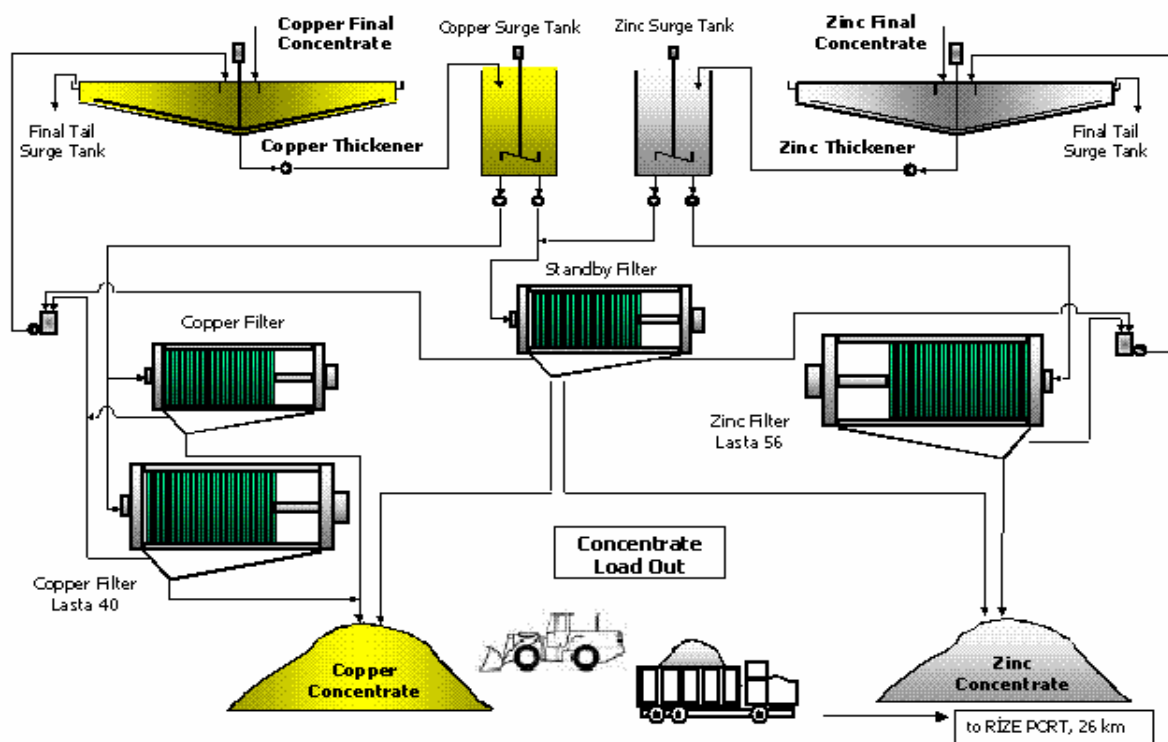


Figure 3.1. The flowsheet of CBI dewatering circuit.

Non-spec campaign material and the blend with 50 % black ore and 50 % clastic ore were decided to test during this study. Preliminary examination of testwork conducted by CBI staff as well as by equipment suppliers indicated that the problems being experienced with the thickeners, particularly zinc thickener during non-spec campaigns, were due to flocculation difficulties rather than mechanical considerations. Attention was, therefore, concentrated primarily on these aspects of the operation.

Chemical analysis of the samples are determined by AAS method and the particle size distribution data obtained from cyclosizer. During this non-spec campaign chemical analyses results can be seen in Table 3.1.

Table 3.1. Chemical analysis results during non-spec campaign.

Sample Description	Copper Cu %	Zinc Zn %	Lead Pb %	Iron Fe %	Sulphur S %	Silver Ag g/ton	Gold Au g/ton	Silica SiO ₂ %
Feed	3,80	11,68	0,62	27,03	35,79	118,00	2,09	5,68
Cu Concentrate	19,72	8,80	2,22	28,39	37,28	152,21	2,29	0,57
Zn Concentrate	3,10	49,82	0,51	8,65	34,53	171,63	1,68	0,57
Tail	0,71	1,37	0,15	35,17	39,74	38,21	0,96	9,50

Particle size distribution results are illustrated in Figure 3.2, as the details in Appendix A. Cu concentrate is finer than the other samples, flotation feed and zinc concentrate have similar particle sizes. The relationship between particle size and Cu, Zn and Fe distribution contents for flotation feed is showed in Figure 3.3.

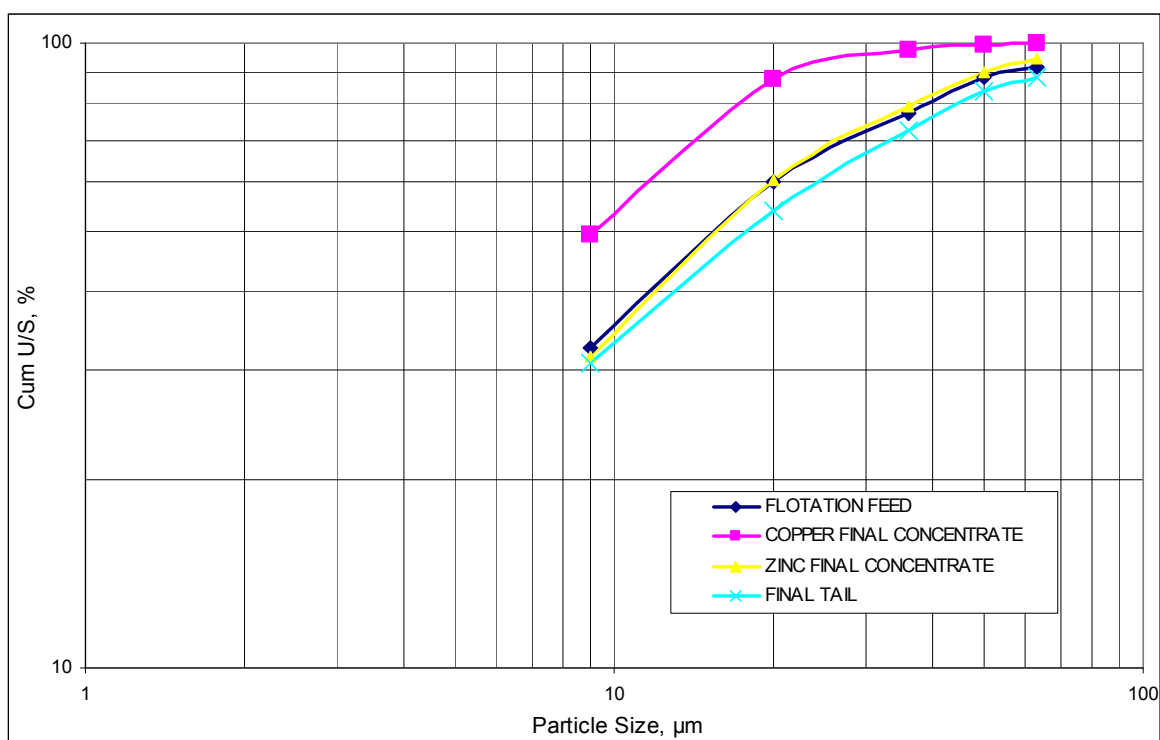


Figure 3.2. Particle size results versus cumulative undersize %

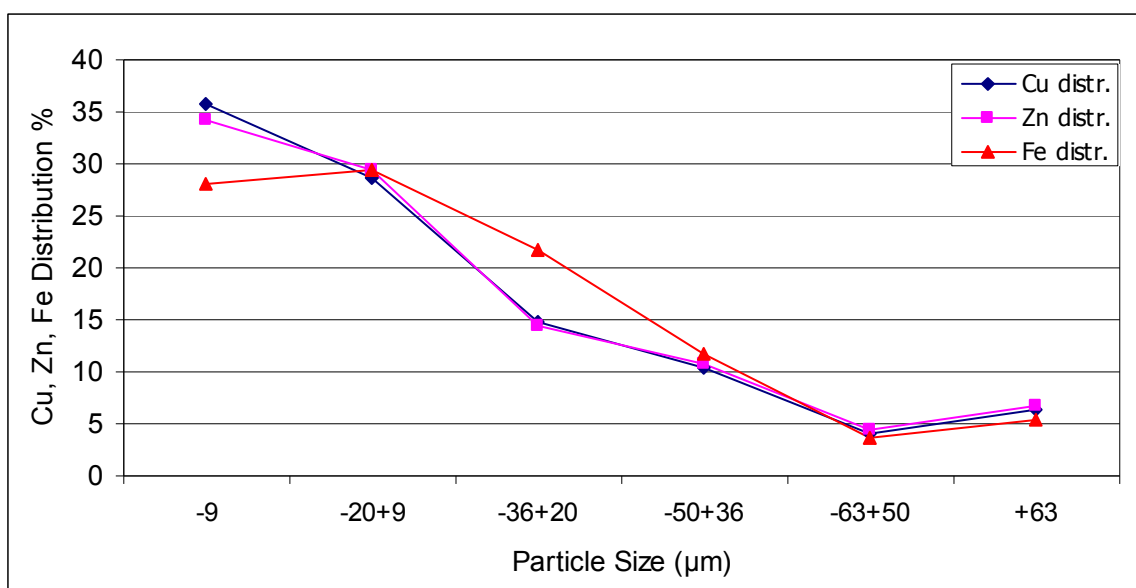


Figure 3.3. The graph of particle size vs Cu, Zn, Fe distribution for flotation feed.

The following figures 3.4, 3.5 and 3.6 show the relationship between particle size and metal distributions at copper concentrate, zinc concentrate and final tail, while non-spec campaign feeds to mill. Furthermore, detail analysis data can be seen in Appendix A, Table A2, A3 and A4. Examination of particle size distribution of samples reveals that particle sizes are very fine which indicates the presence of high specific surface area.

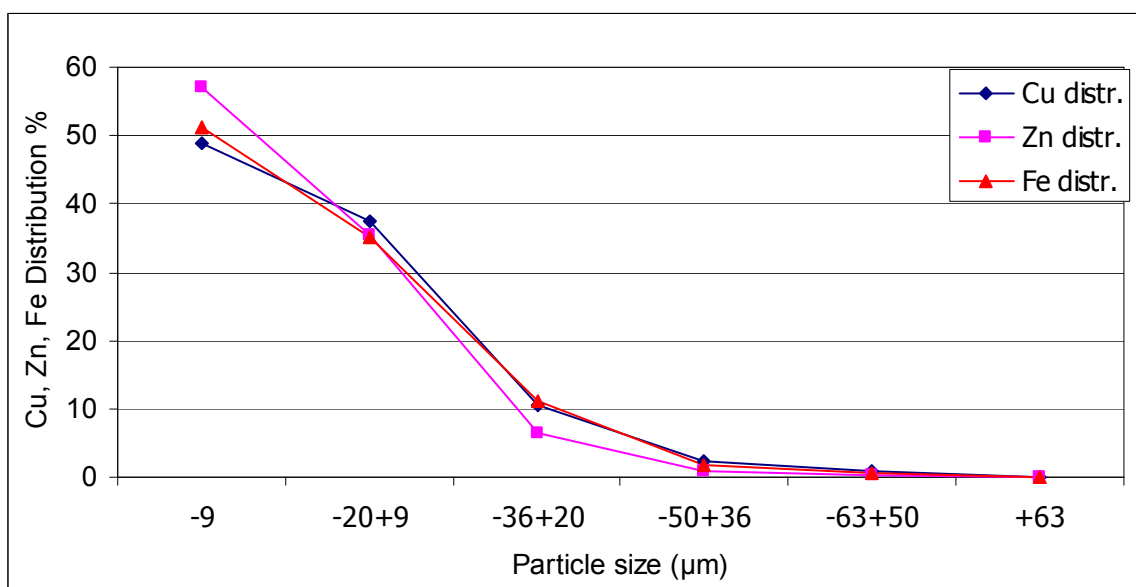


Figure 3.4. The graph of particle size vs Cu, Zn, Fe distribution for Cu concentrate.

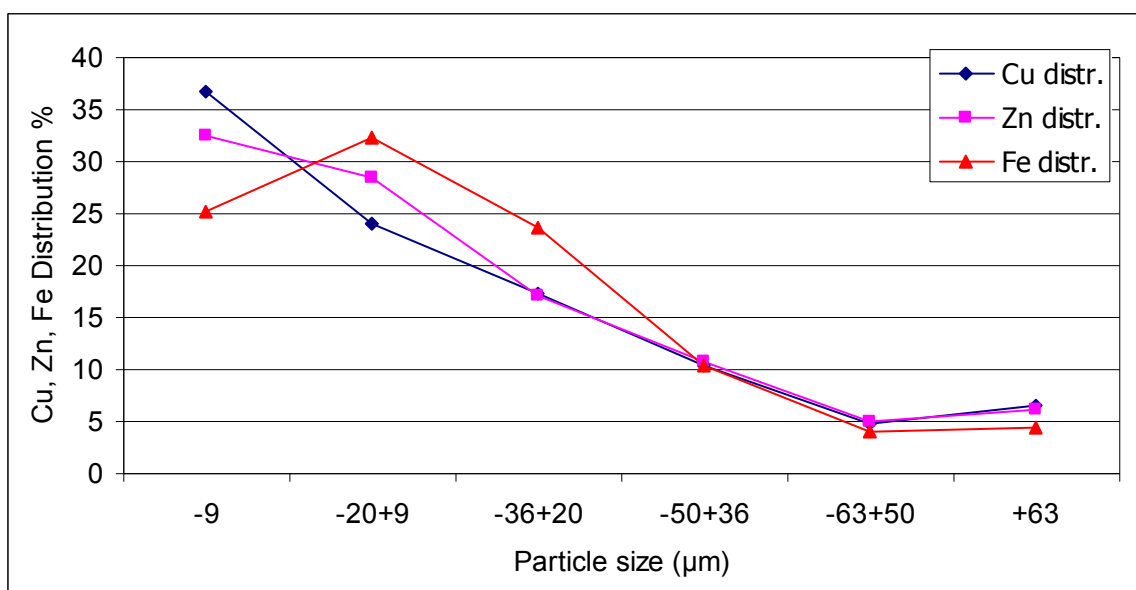


Figure 3.5. The graph of particle size vs Cu, Zn, Fe distribution for Zn concentrate.

Table 3.2 shows the results of pH and temperature for Cu and Zn concentrates. Averagely, Cu concentrate has 9.85 pH and 25.2 °C and Zn concentrate has 9.08 pH and 20.1 °C. In winter time, temperature can be decreased to lower values.

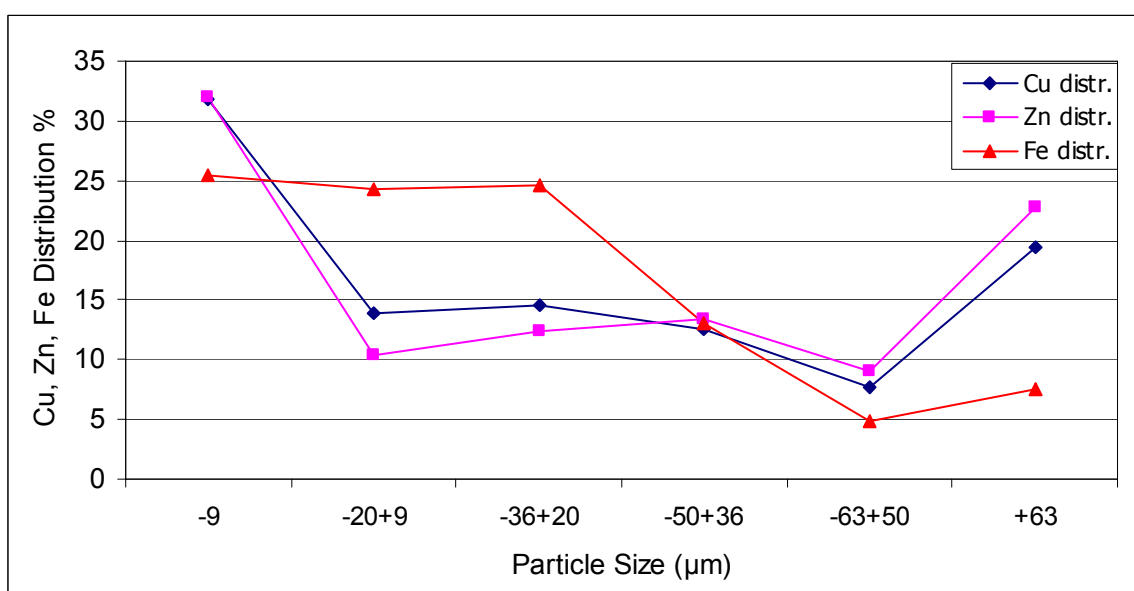


Figure 3.6. The graph of particle size vs Cu, Zn, Fe distribution for final tail.

Table 3.2. The data for pH and temperature of Cu and Zn concentrates.

	Cu Conc		Zn Conc	
	pH	Temp (°C)	pH	Temp (°C)
	9.70	24.5	8.94	20.5
	9.85	25.0	9.16	20.3
	9.86	25.0	9.20	20.0
	9.88	25.1	8.97	19.5
	9.89	26.0	9.12	20.0
	9.92	25.5	9.07	20.5
Average	9.85	25.2	9.08	20.1

As the Table 3.3 illustrates that Zn thickener feed surface charge was detected as -14.2 at pH 6.5 with 5.5/300 specific conductance voltage applied, on the one hand "0" zero charge with little movement to "+" pole was detected with 1505/100 V at NaCl addition. Underflow sample was in possession of neutral charge at both voltage application. Besides froth sample surface charge was determined as -13.8 with 23.6/300 voltage applied at pH 8. pH values at the surface charge measurements were determined according to the availability reading of zeta potentials of samples.

Table 3.3. The results for surface charges at samples from Zn thickener.

Samples from Zn thickener	pH	Specific Conductance Voltage (Applied) (V)	Zeta Potential STD
Froth	8.00	23.6 / 300 (No NaCl)	-13.8 / ± 1.43
U/F	6.45	2.8 / 300 (No NaCl)	"0"
		1364 / 100 (10^{-2} M NaCl)	"0"
Feed	6.50	5.5 / 300 (No NaCl)	-14.2 / ± 1.2
		1505 / 100 (10^{-2} M NaCl)	"0" very little movement to "+" pole

3.2. Methods

3.2.1. Laboratory Settling Tests

Flocculants used in the experiments were prepared as 0.1 % solutions freshly. Powdered flocculant at pre-determined dosage is poured to beaker as slow as possible to ensure uniform mixing without lump formation and stirred with a magnetic stirrer for 2 hours until complete dissolution.

The samples used for laboratory flocculant dosage tests with different flocculant types were obtained from the plant as late as possible prior to running the tests to avoid ageing effects on the test substrate, In order to reduce sample to sample variation, main sample was determined as non-spec campaign and mill feed as 50 % clastic and 50 % black ore. Sub-samples for individual tests taken from main sample are representative of the substrate as a whole and are in the form that are to be treated as same solid content, pH etc. Efficient mixing during sampling was applied to prevent solids segregation for each test samples are identical the next.

Settling tests in the laboratory were carried to reached the simulation the action of flocculants in a thickener. These tests were performed in 1000 mL graduated cylinders with sizes of 30 cm in length and 3.2 cm in internal radius (Figure 3.7). Before the starting the settling tests, the slurry was mixed by raising and lowering a loosely fitting plunger inside the cylinder. The plunger was designed as cylinder area with solid and perforated surface. Once the slurry is homogeneous, flocculants are added via a syringe, and immediately agitated the sample with plunger in 3 plunger strokes (down and up) slowly. When mixing is completed, the change of interface height as a function of setting time is recorded at certain periods.



Figure 3.7. Graduated cylinder and plunger used in the laboratory tests.

3.2.1.1. Preliminary Settling Tests

The beginning step in the preliminary laboratory tests for final Zn concentrate was to evaluate the sample settling behaviour whether or not its surface property change. Firstly, settling tests were performed as the sample was obtained from the plant, and then these tests were repeated both 7 and 21 days later as the same solid pulp content as the previous test, 20 % solid. Repeated test samples were filtered, dried and stored in the refrigerator in a bag. And the other step in the preliminary laboratory tests was carried the settling test procedure for all three product as Cu and Zn concentrates and also tail as soon as possible after obtain the samples from the plant.

Laboratory preliminary settling tests were conducted on samples of the three thickeners with Hydrifloc 9130 with settling test procedure as previous section mentioned.

3.2.1.2. Settling Tests for Zn Concentrate

At the first step of these tests, samples were conducted without flocculant addition. And second step Zn concentrate was filtered from 20 % solid pulp as the solid weight was 235 g for 1175 g/L pulp, dried and then conditioned in a 1 % H_2O_2

solution for 15 minutes. H_2O_2 solution was prepared from 35 % H_2O_2 solution in 1 L beaker. After conditioning, pulp was filtered and added water to dilute 20 % solid, agitated with plunger and settling tests were performed as recorded settling times at certain periods.

At the other step Zn concentrate was tested with different types of flocculants and dosages. The dosages were identified according to average Zn concentrate weight % and flocculant consumption at Zn thickener (Appendix Table A5 and A6) and as histogram curve in Figure 3.8. By this way, test plan was formed as usage of flocculant dosage as; 6, 18, 28 and 38 g/ton as seen in Table A7.

Flocculant used in plant is supplied by domestic Abacı Chemical Company as free flowing and granular powder formation with the commercial name as Hydrofloc 9130. Chemical description of this flocculant is anionic high molecular weight polyacrylamide copolymer with 14×10^6 g/mol and anionic charge density is lower than 10 %.

Along with Hydrafloc 9130 plant flocculant type, the other flocculant type settling tests were conducted using the same degree anionic flocculant (Cytec A-100), strong anionic flocculant with 21×10^6 g/mol and anionic charge density is 25 % (Magnafloc 1011 from Ciba) and non-ionic flocculant as Superfloc N-300 from Cytec with the same settling test procedure in section 3.2.1.

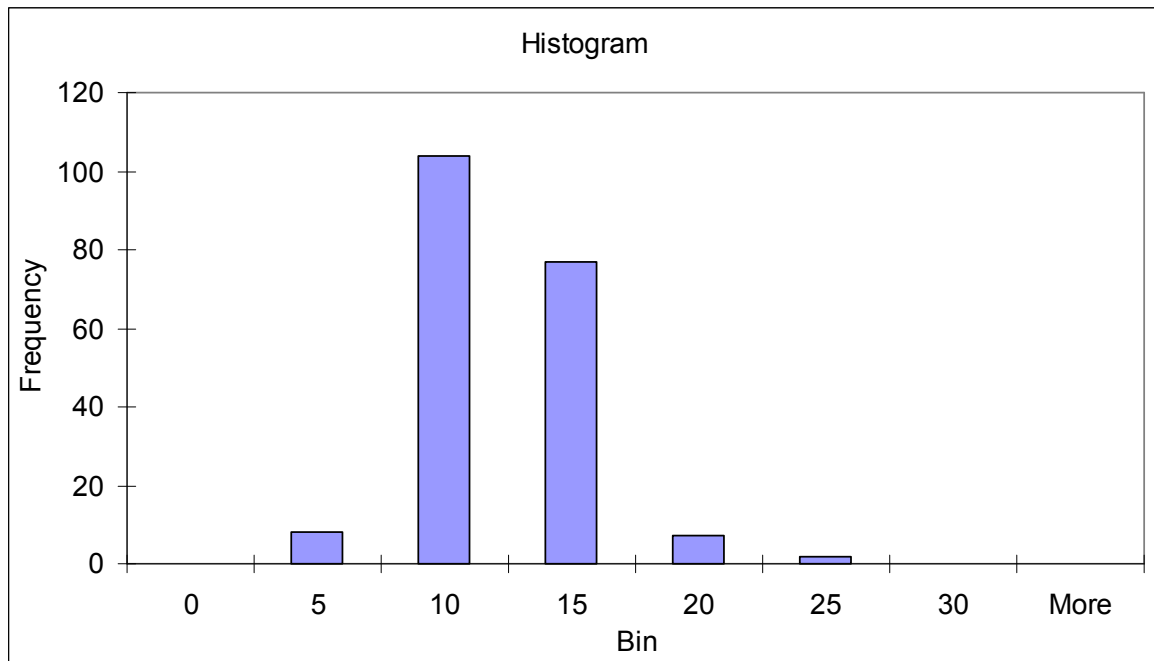


Figure 3.8. Histogram for Zn concentrate weight %.

3.2.2. Sludge Solid Determination Tests at Thickeners

The copper and zinc concentrate thickeners are concentration Dorr-Oliver units; tail thickener is of similar design, but it is also equipped with the Dorr-Oliver high rate Dynafloc feedwell. Samples were taken from different places and elevations of the three thickeners by sampler designed by Hacettepe University Mining Engineering Department as seen in Figure 3.9. It is a kind of a plexiglass vessel which is lowered into the thickeners until the end of the pre-determined level position reached and opened the cover for 1-2 seconds to fill the pulp inside. Horizontal sampling points were fixed from next of thickener's launders to feed well center location as 190 cm gap distances, and vertical sampling points were fixed according to the rake position as shown in Figure 3.10 and 3.11.

Correspondingly of these manual measurements, bed level detection probe was mounted as Outokumpu supplier to determinate the solid content as an automation (Figure 3.12). The probe position is at midpoint between the launder and the feed well outer lip, and submerged the depth as 2.3 meter below surface as seen from Figure 3.13. A drerakain fibreglass cone shaped float, containing

magnets on an inner sleeve, is placed on the probe, this activates the reed switches as it floats on the bed and slides up and down the stainless tube. The probe has a stop, both in the lower and upper positions to prevent the unit from falling out of range. By filling the cone float with water it is weighted so it sinks very slowly in a bucket of process water, therefore it will float on any solids, giving an indication of the bed level.

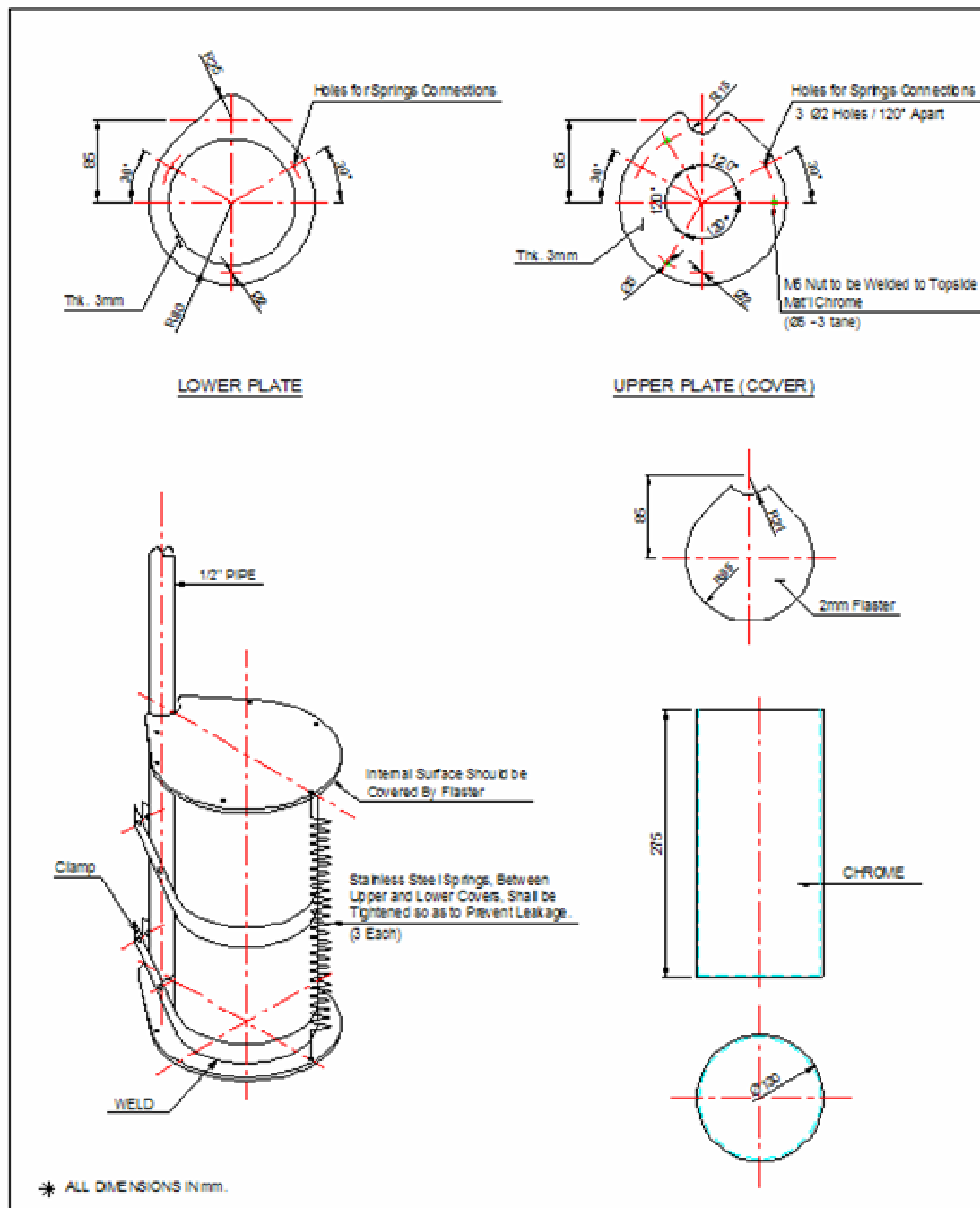


Figure 3.9. Sampler used at sludge level determination tests.

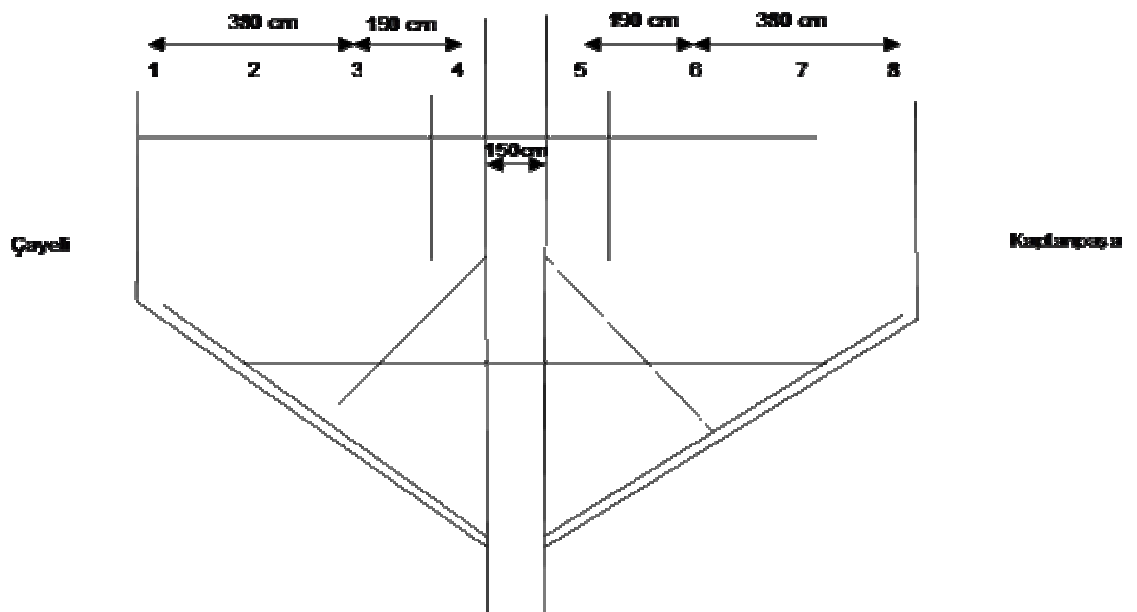


Figure 3.10. Sampling points for sludge level determination tests

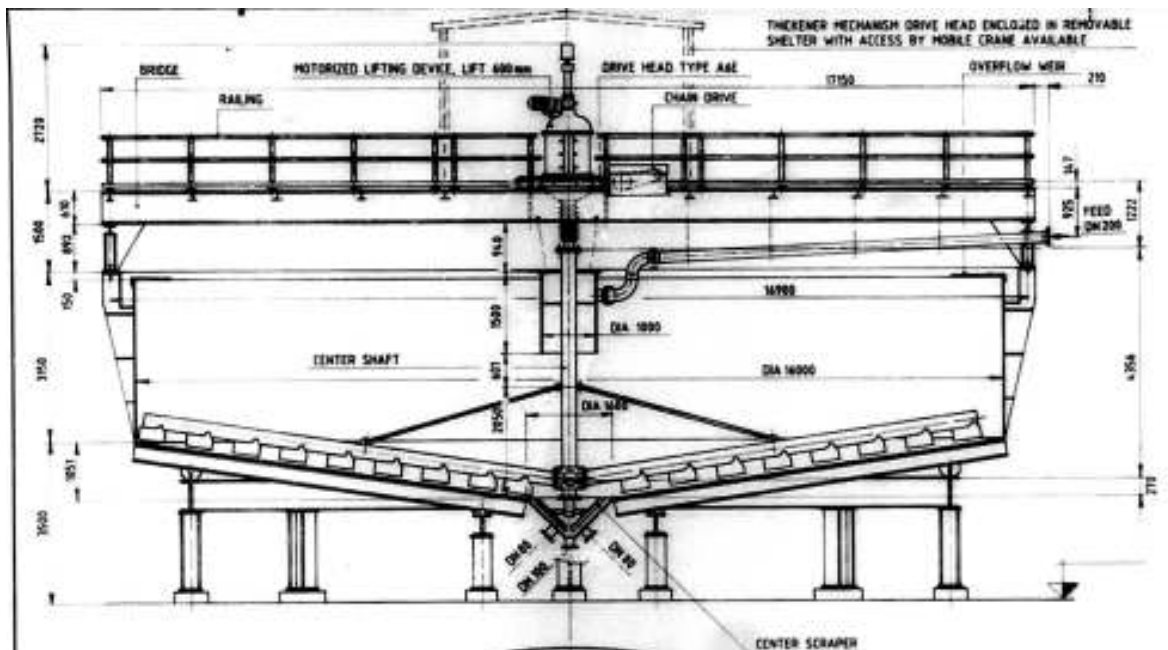


Figure 3.11. Cu and Zn thickener drawings as general assembly.

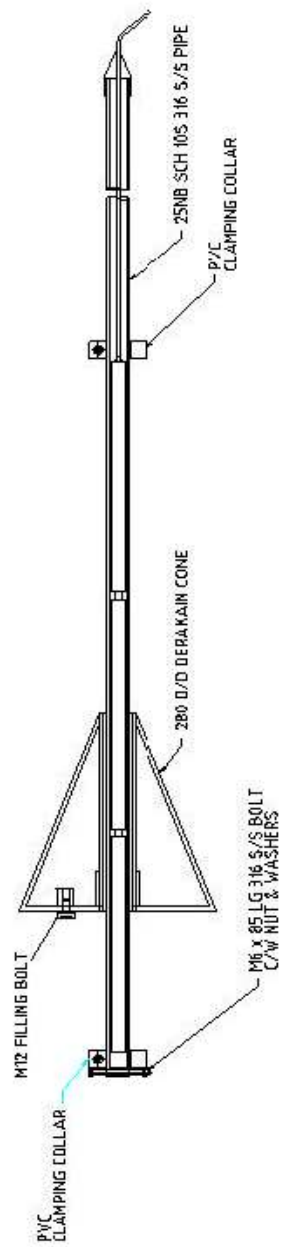


Figure 3.12. Outokumpu bed level detection probe



Figure 3.13. Bed level location as midpoint between the launder and the feed well outer lip.

3.2.3. Dilution Tests at Different Thickeners

Three of the thickener feeds were diluted with addition of water by the use of a pump which get the water from top of the thickener surface. The pump is a kind of 3.1 kw flygt pump and capability to feed water as 30 m³/h. The capability for water delivery was calculated according to filling time of a cylinder drum ($\varnothing = 53$ cm, L = 100 cm). In reversed to performance curve for pump, pump capacity is different as need maintenance to reach its real capability (Figure 3.14). Water addition point was feed well for Cu and Zn thickener, but for tail thickener water added also before flocculant addition point.

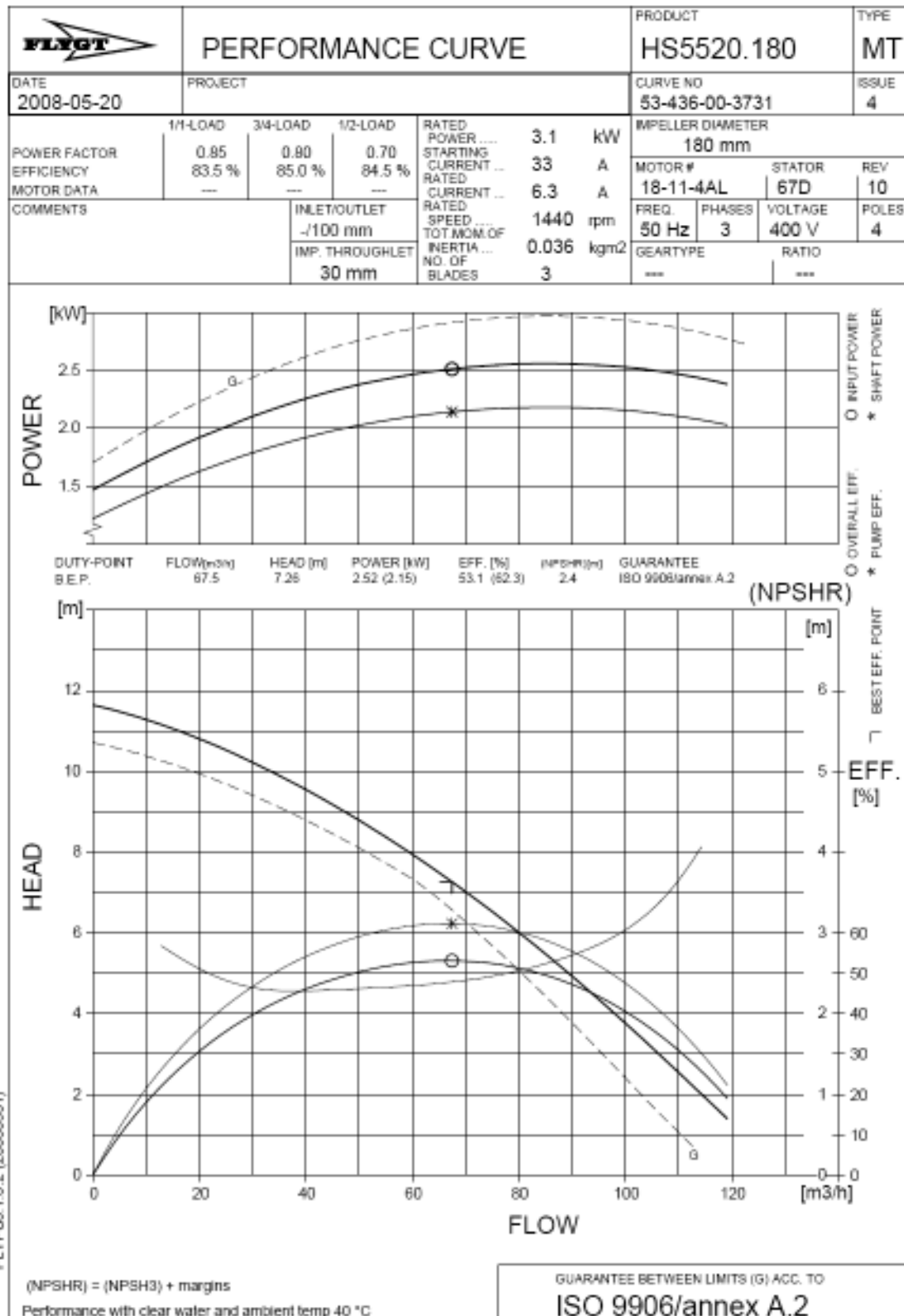


Figure 3.14. Performance curve of pump used for dilution tests at the thickeners.

3.2.4. Zn Thickener Capacity Test

To evaluate the Zn thickener capacity, thickener underflow transfer to Zn surge tank was stopped for 11 hours both with and without flocculant addition. Thickener underflow was recirculated to thickener feed well and then taken samples from overflow in determined period to see solid content. Also obtained samples with Hacettepe sampler from opposite location of bed level detection probe to see the solid content at different horizontal and vertical points of the thickener every hour during this application.

4.RESULTS & DISCUSSION

4.1. Laboratory Preliminary Tests with Plant Flocculant Type at Different Flocculant Dosages

4.1.1 Zn Concentrate

Flocculant dosages are determined according to plant dosage at the running test period. Final Zn concentrate as to feed Zn thickener was taken to test their settling behaviours as seen in Figure 4.1. The tests were performed firstly without flocculant usage, and then with 6 g/ton flocculant as plant dosage and 12 g/ton as double of plant dosage. Dosage increase has not illustrate significant difference, results with both two dosages showed similar settling rate, but also faster than without flocculant test result. Appendix B1 contains data of these tests.

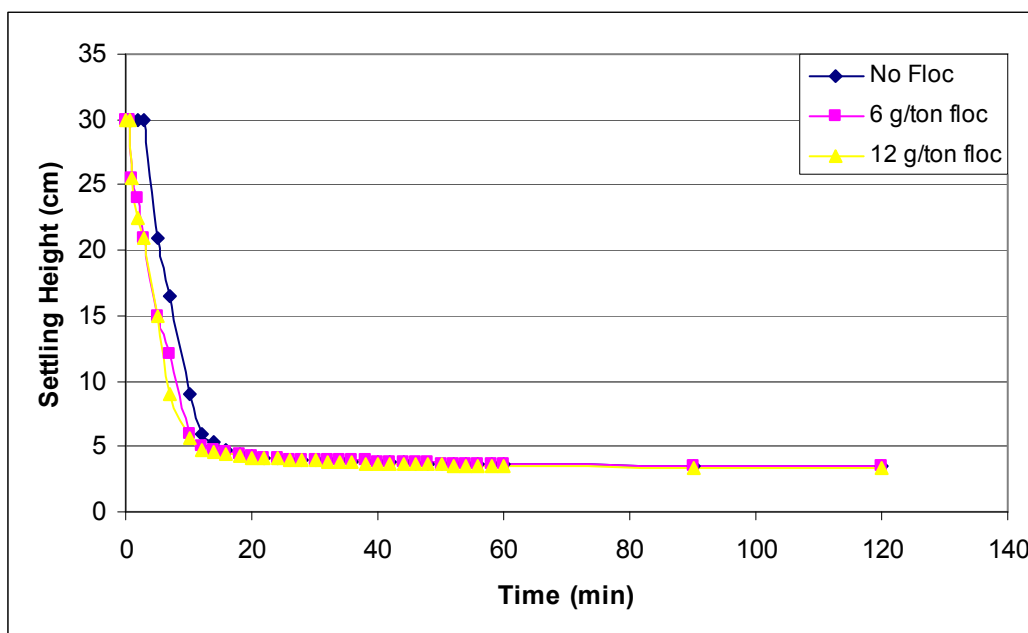


Figure 4.1. Settling test result for freshly taken Zn concentrate sample.

Then settling tests were carried out for Zn concentrate at three stage; one of them was fresh sample and the others were carried 7 and 21 days later, as the fresh sample stored. Figure 4.2 shows the results of flocculation tests with these three kinds of samples. Settling rates increased from fresh sample to stored samples at both with and without flocculant additions. And the results showed that surface property of sample was changed after storage in spite of applied same conditions. The detailed data can be reached from Appendix B, Table B2.

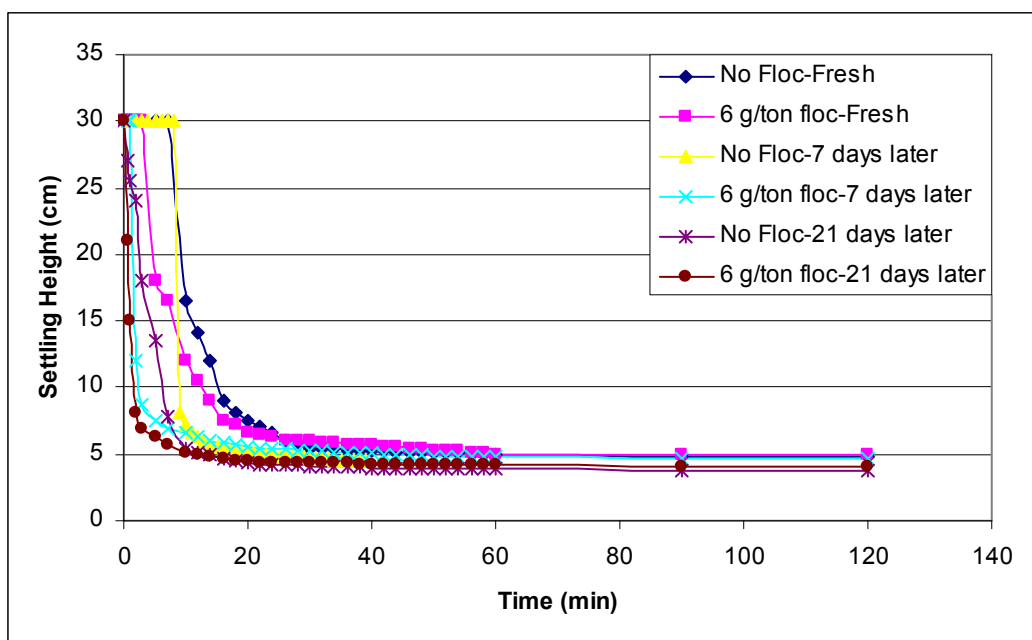


Figure 4.2. Flocculation test results for Zn concentrate at 3 stages.

4.1.2 Cu Concentrate

To see the dilution effect on settling of Cu concentrate, firstly the test was applied at taken solid content as 27 %, and then diluted the pulp solid as 15 %. Figure 4.3 shows that diluted concentrate settled faster than more solid concentrate sample. The detail data is attached in Table B3 as Appendix B.

4.1.3 Tail Thickener

Final tail sample was tested as flocculant addition as plant used dosage as 28 g/ton and with plant solid content as 21 % and also performed the settling test after diluted to 15 % as seen in Figure 4.4 and the detail data in Table B4 as Appendix B. The result after dilution the pulp with flocculant addition has the highest settling rate and the test dilution without flocculant addition showed similar settling behaviour as denser pulp test with flocculant addition. Also, the general results showed that sedimentation have not completed for 2 hours as the horizontal line has not reached in the figure.

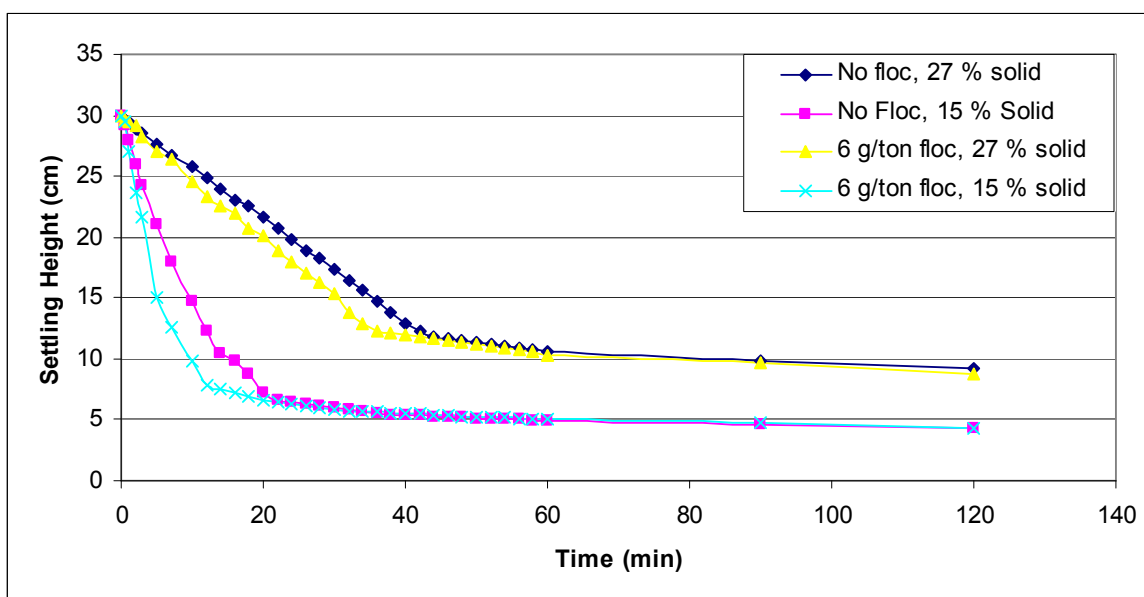


Figure 4.3. Preliminary settling test at Cu concentrate with and without dilution.

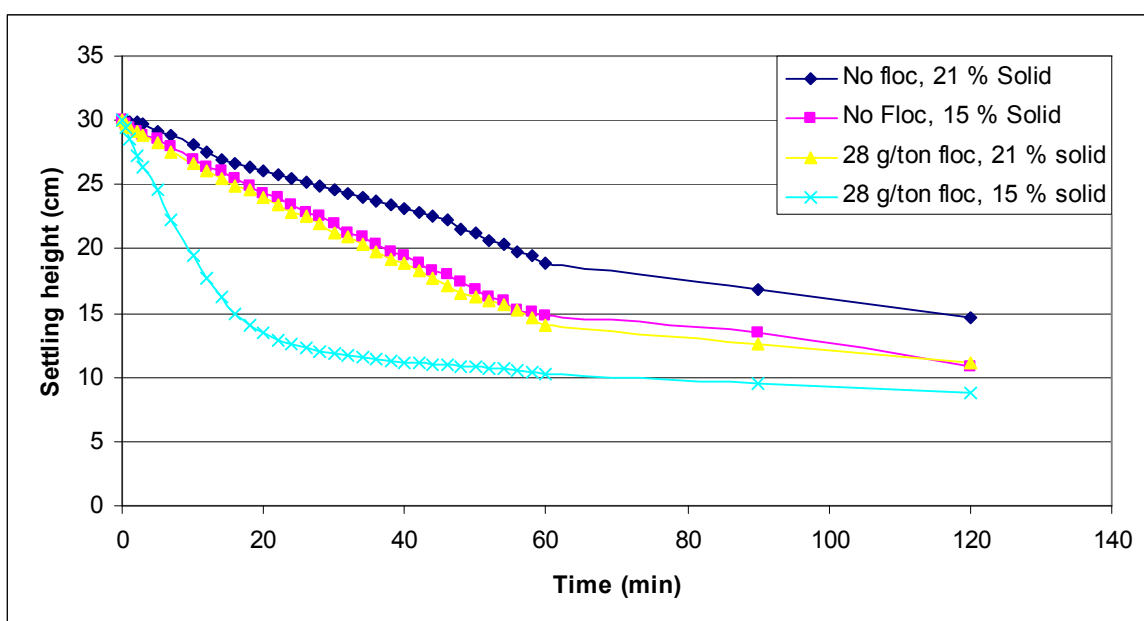


Figure 4.4. Preliminary settling test at final tail with and without dilution.

Figure 4.5 contains the result of different flocculant dosage at final tail. When the flocculant dosage increased, faster sedimentation has reached, but not in a significant difference (Table B5 in Appendix B).

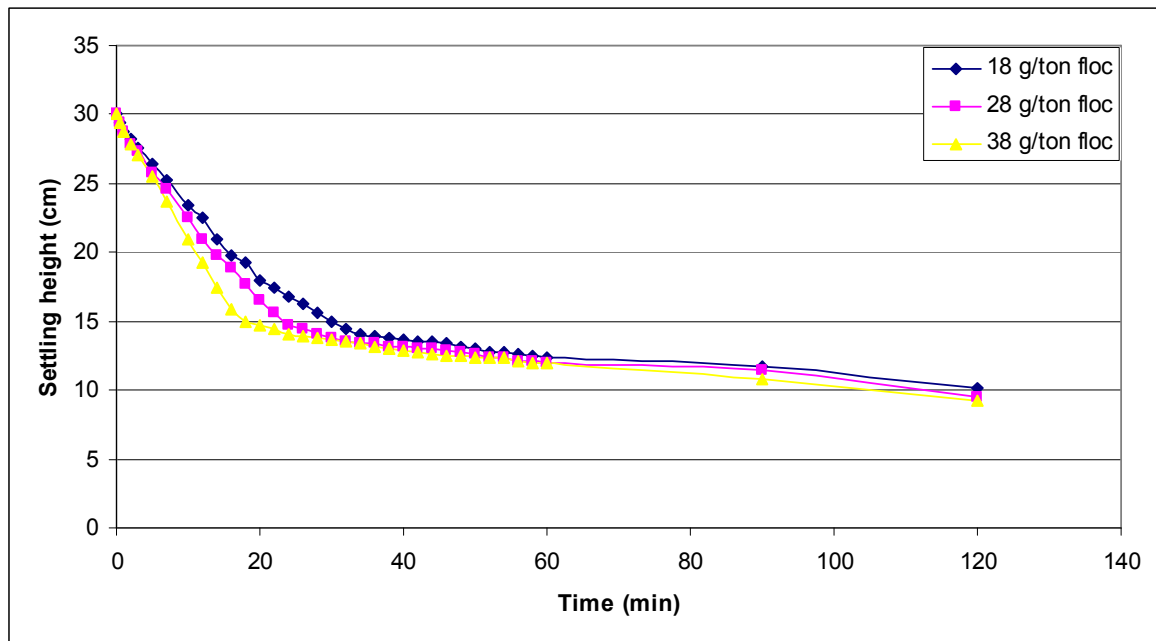


Figure 4.5. Preliminary settling test at final tail with different flocculant dosages

4.2. Sludge Solid Determination Tests

4.2.1 Zn Concentrate

Manual bed height measurements to get the solid contents of different elevations and places were taken over a period in 5 set at Zn thickener. Figure 4.6 shows the results of solid % for 1 meter depth of the Zn thickener. Totally solid contents are lower than 1.6 %, at 2nd and 7th sampling points as middle point of launder and feed well have little higher solid contents than the other sampling points.

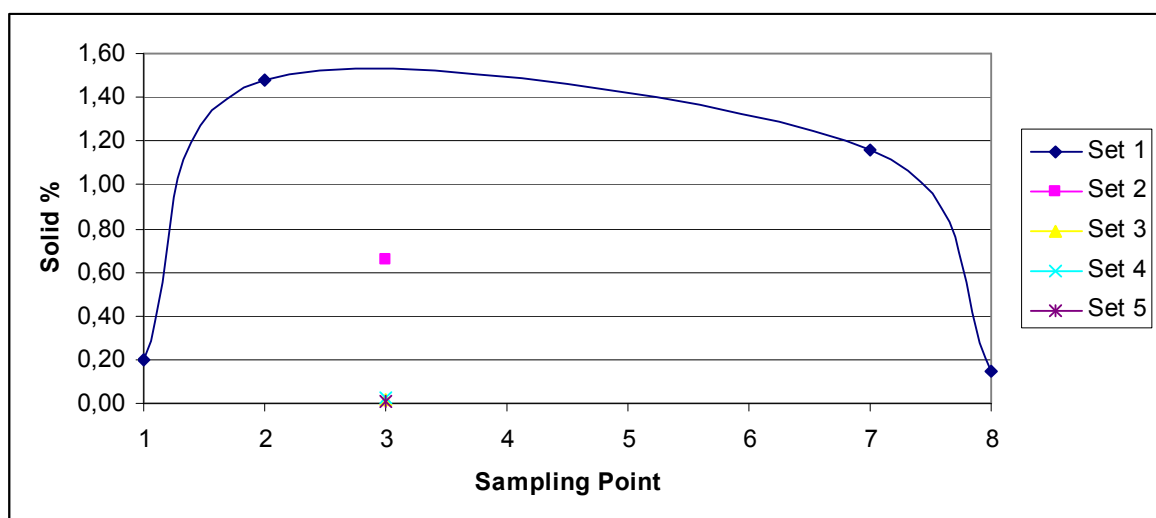


Figure 4.6. Sludge Level Determination Test for Zn thickener at 1 m.

The other depth results as 2 and 3 meters are also showed similar results as low solid content and no bed level formation (Figure 4.7 and Figure 4.8). The data details are summarized in Table C1, Appendix C.

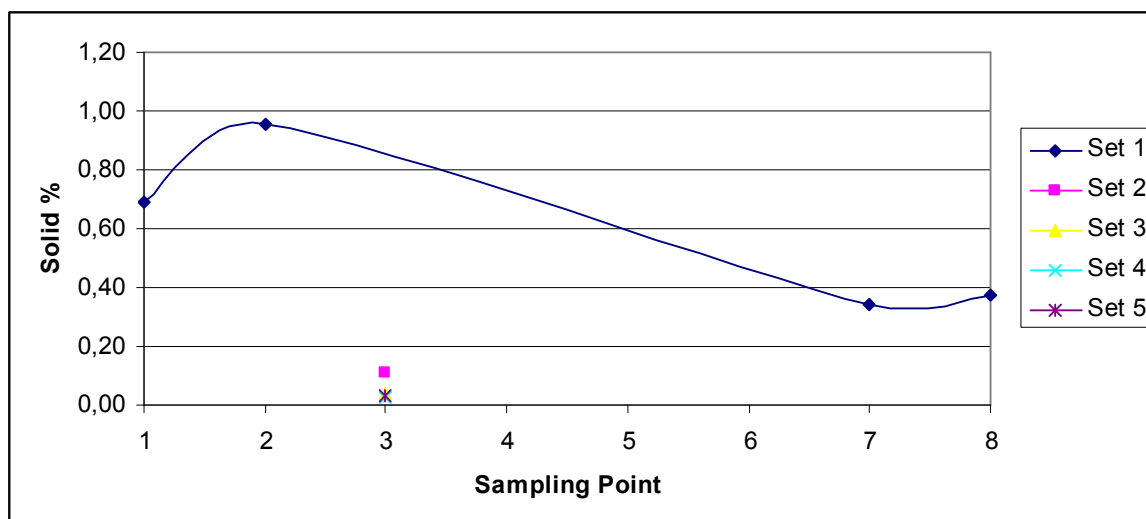


Figure 4.7. Sludge Level Determination Test for Zn thickener at 2 m.

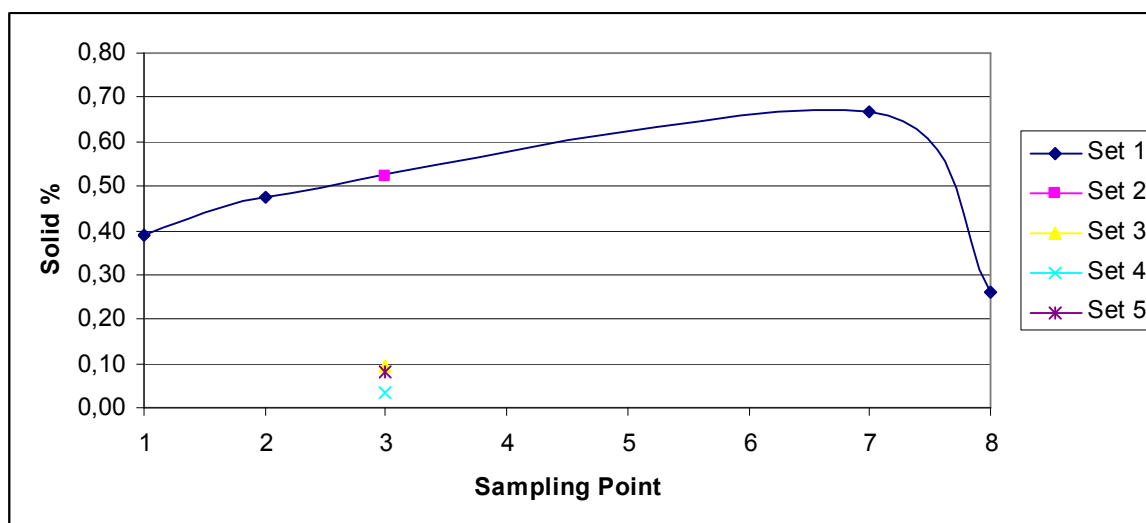


Figure 4.8. Sludge Level Determination Test for Zn thickener at 3 m.

4.2.2 Cu Concentrate

Same sampling methods were also carried at Cu thickener. The solid contents for Cu thickener are same as Zn thickener as low (Figure 4.9 and Figure 4.10). Sampling points near to feed well as 4th and 5th points gave lower solid contents, also parallel points as 1 to 8 or 2 to 7 have similar solid %.

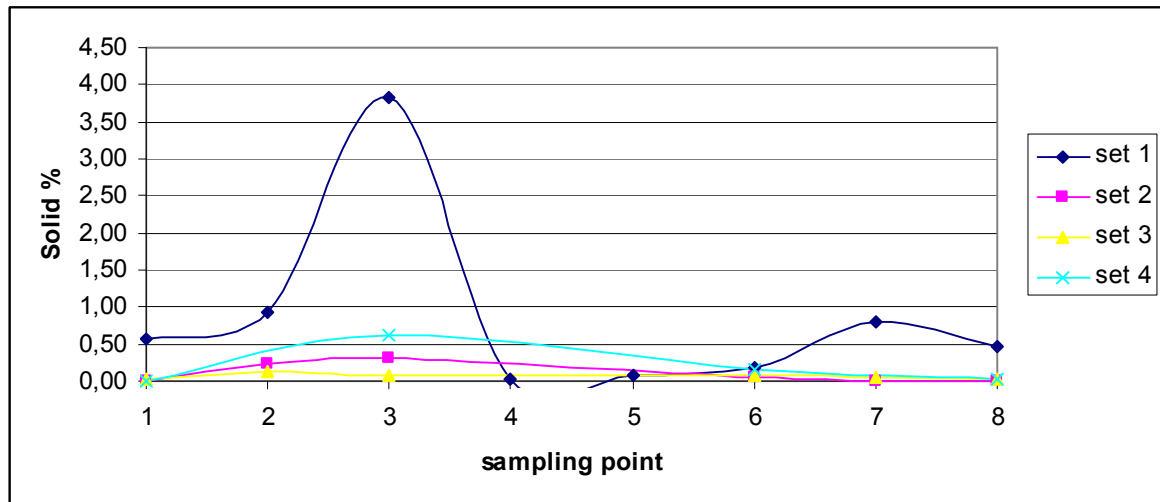


Figure 4.9. Sludge Level Determination Test for Cu thickener at 1 m.

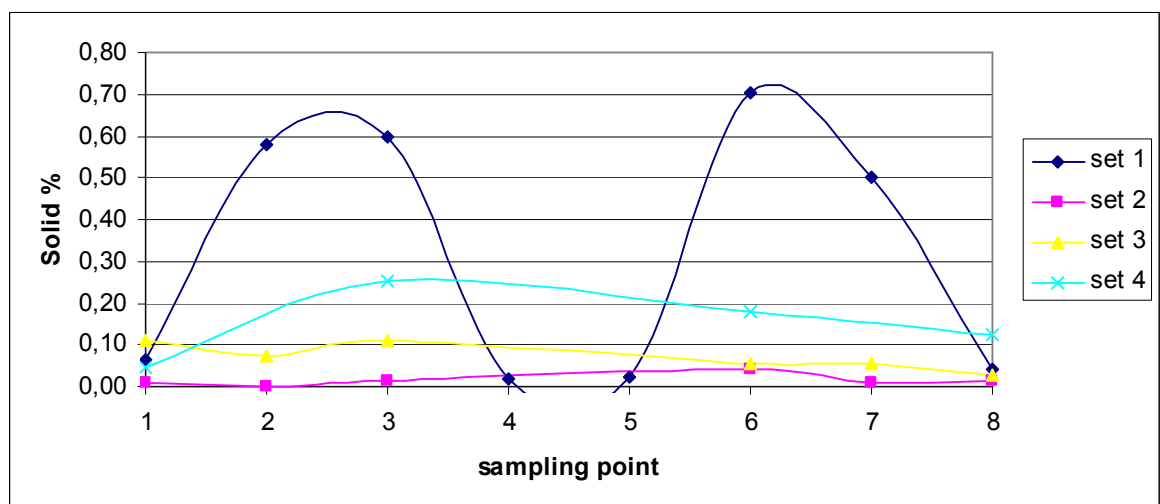


Figure 4.10. Sludge Level Determination Test for Cu thickener at 2 m.

4.2.3 Tail Thickener

On the other hand tail thickener showed a bed level formation as higher solid content than the other thickeners. But, it has not an exact increase trend at depth to depth and showed similar high solid content as averagely 55 % as seen in Figures 4.11, 4.12 and 4.13 with details in Table C3, Appendix C. These low solid contents can be attributed to possible surface charge changes and effected the flocculation adsorption to the particles, and so settling behaviours.

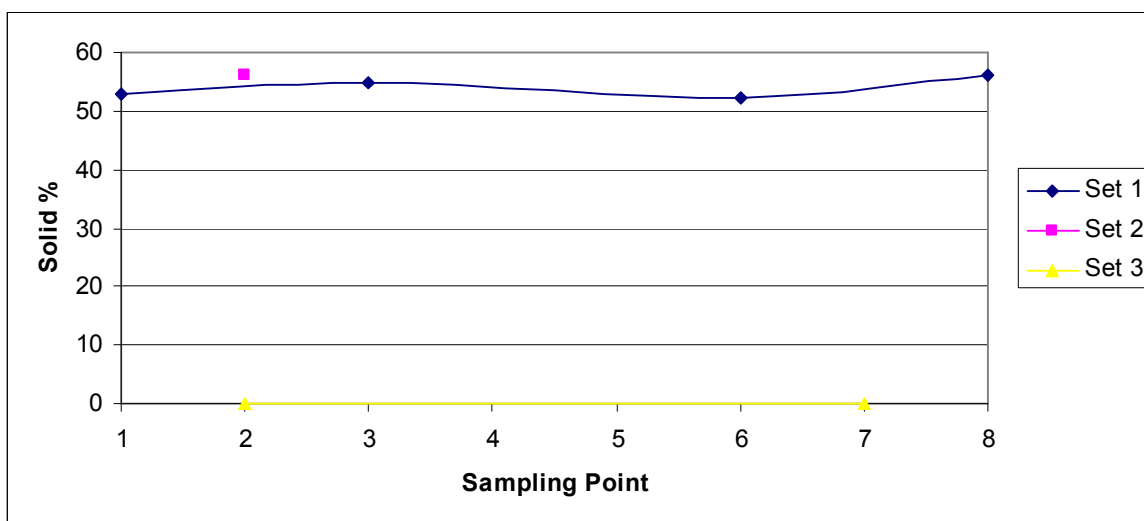


Figure 4.11. Sludge Level Determination Test for tail thickener at 1 m.

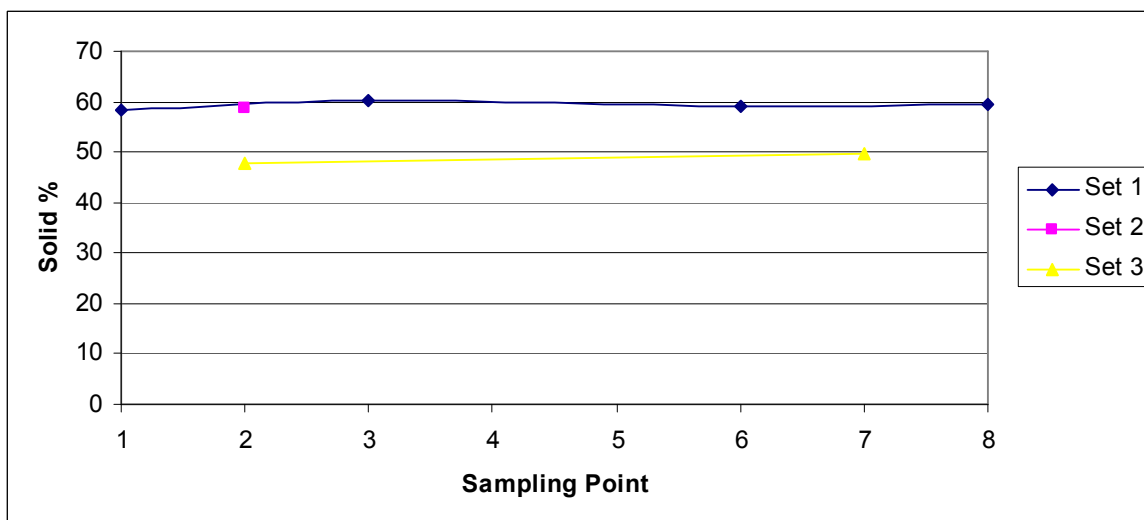


Figure 4.12. Sludge Level Determination Test for tail thickener at 2 m.

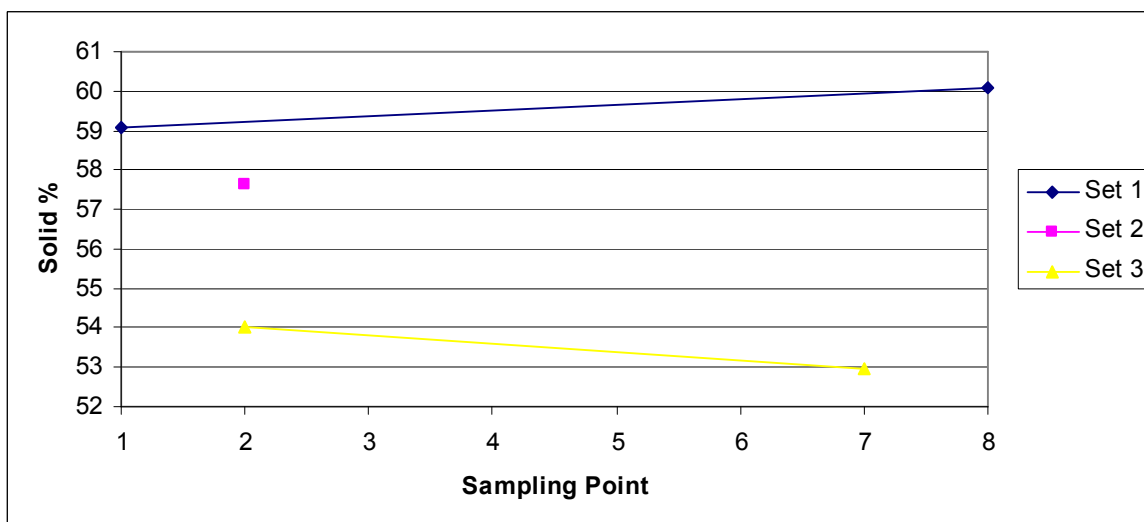


Figure 4.13. Sludge Level Determination Test for tail thickener at 3 m.

4.3. Dilution Tests

4.3.1 Zn Concentrate

Zn thickener feed diluted with water addition to feed well from 19.6 % to 12.5 %. This application didn't cause a significant difference at the operation as averagely U/F solid % increased from 63.1 % to 64.7 % and torque decreased from 1.33 to 1.16 as seen in Figure 4.14 and 4.15. Appendix D, Table D1 gives the data for dilution test period, Table D2 gives the data for calculation results for dilution amount as test times are also underlined as green lines and Table D3 gives the details of Zn concentrate data.

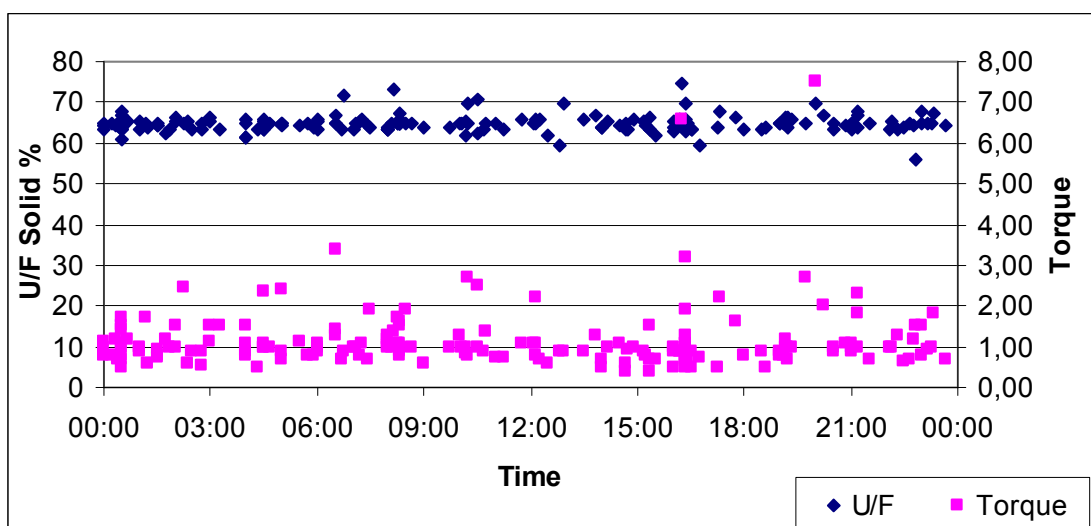


Figure 4.14. U/F Solid % and Torque as a function of time after diution for Zn thickener

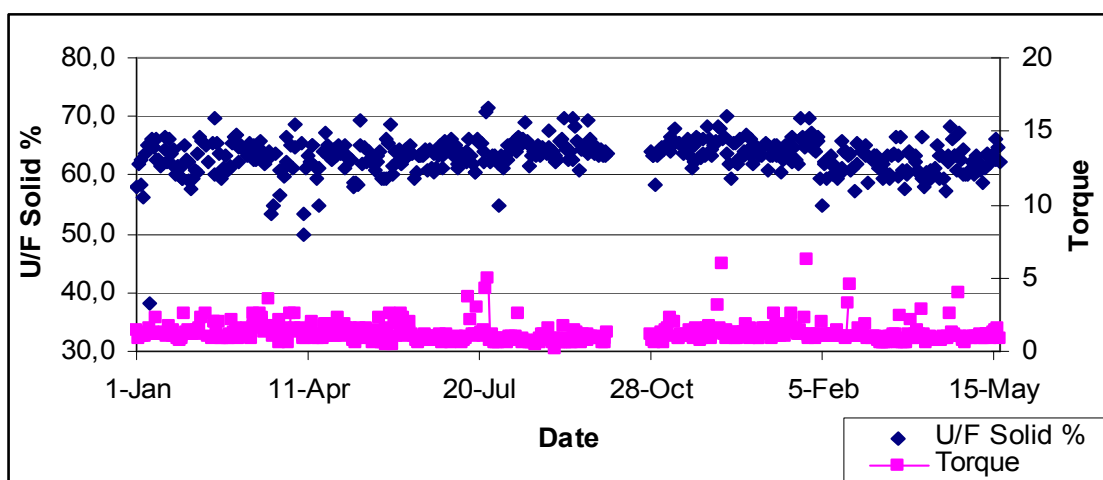


Figure 4.15. U/F Solid % and Torque as a function of time without dilution for Zn thickener

4.3.2 Cu Concentrate

Cu thickener feed was diluted from 37.3 % solid to 20.8 % to see the effect of dilution about particles' settling behaviour. Without dilution average U/F solid % was 65.4 % and torque was 5,11. After dilution, U/F solid content increased to 65.1 % and torque decreased to 4.2. Like Zn concentrate also at Cu concentrate, dilution has not resulted a significant difference. The details can be seen in Table D4, D5 nad D6 as Appendix D.

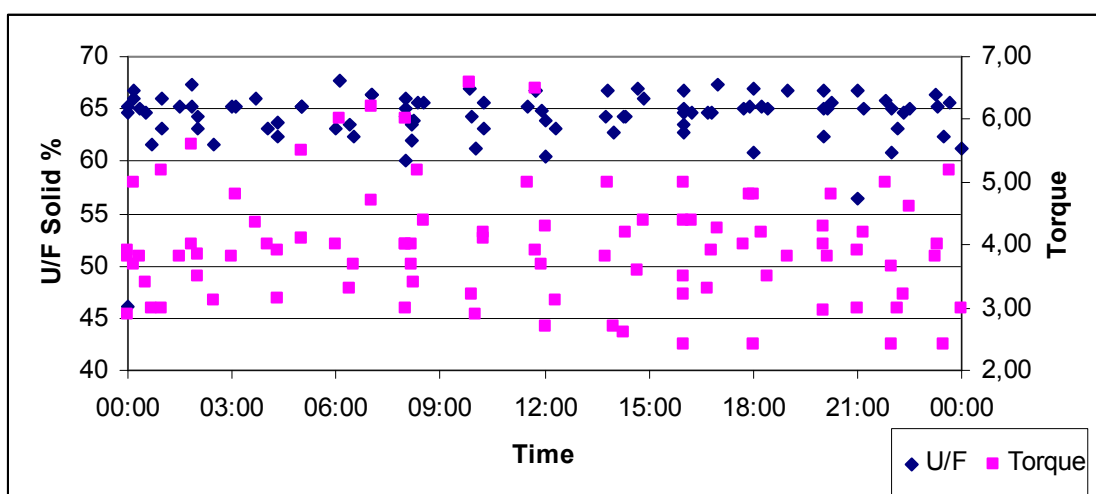


Figure 4.16. U/F Solid % and Torque as a function of time after diution for Cu thickener.

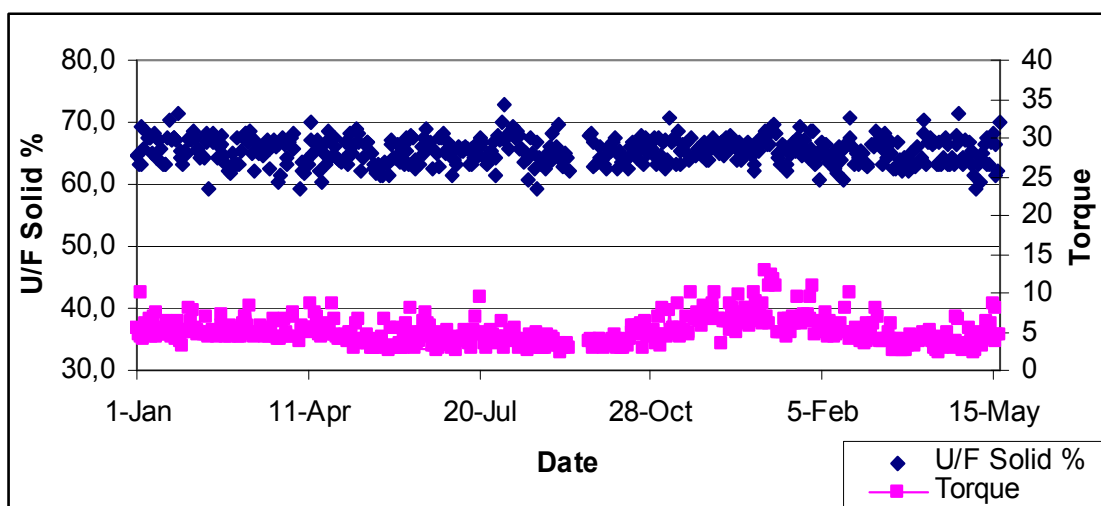


Figure 4.17. U/F Solid % and Torque as a function of time without diution for Cu thickener.

4.3.3 Tail Thickener

Averagely tail thickener U/F solid content is 65 % and torque is 7 as summarized in Appendix D with Table D7 and D8. To see the dilution effect on tail, tail thickener feed was diluted at two stages. One of them was performed as dilution before flocculant addition as seen in Figure 4.18 and U/F solid has not changed as 64 % and torque has increased such a little as 9. On the other hand, when the dilution tested after flocculant addition, this application increased the torque to 13 and as the same as U/F solid content to 64 % (Figure 4.19 and Figure 4.20).

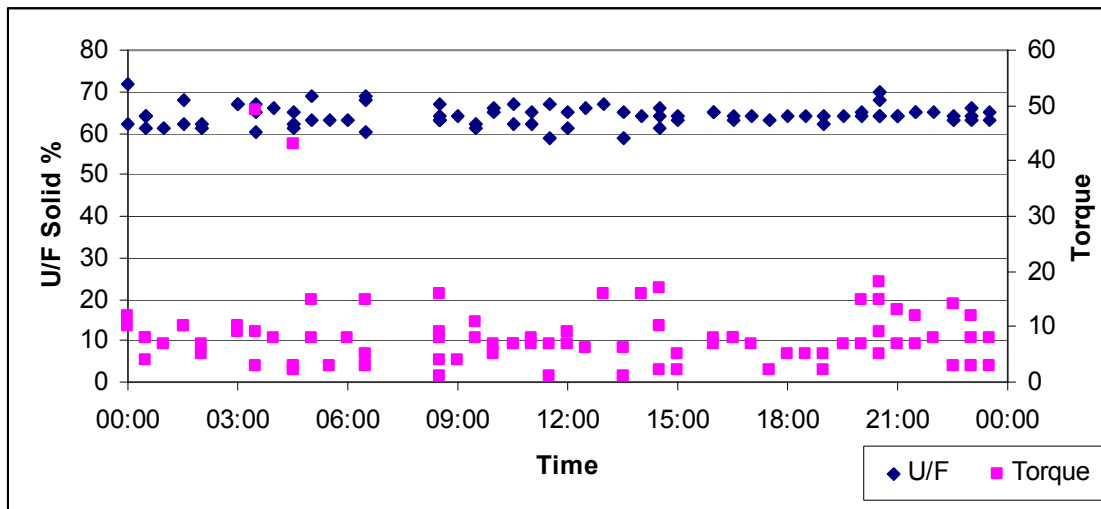


Figure 4.18.U/F Solid % and Torque as a function of time dilution before flocculant addition for tail thickener.

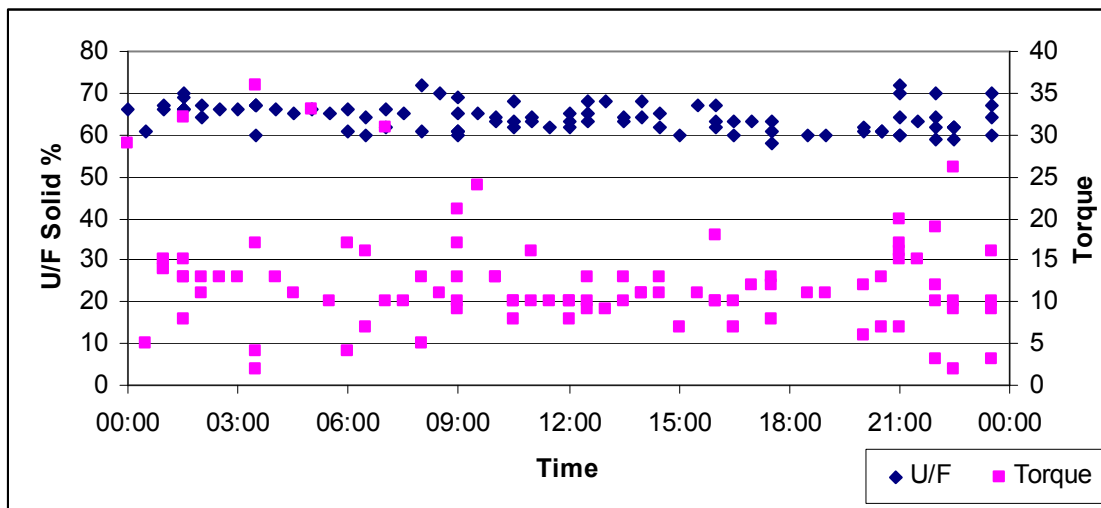


Figure 4.19.U/F Solid % and Torque as a function of time dilution after flocculant addition for tail thickener.

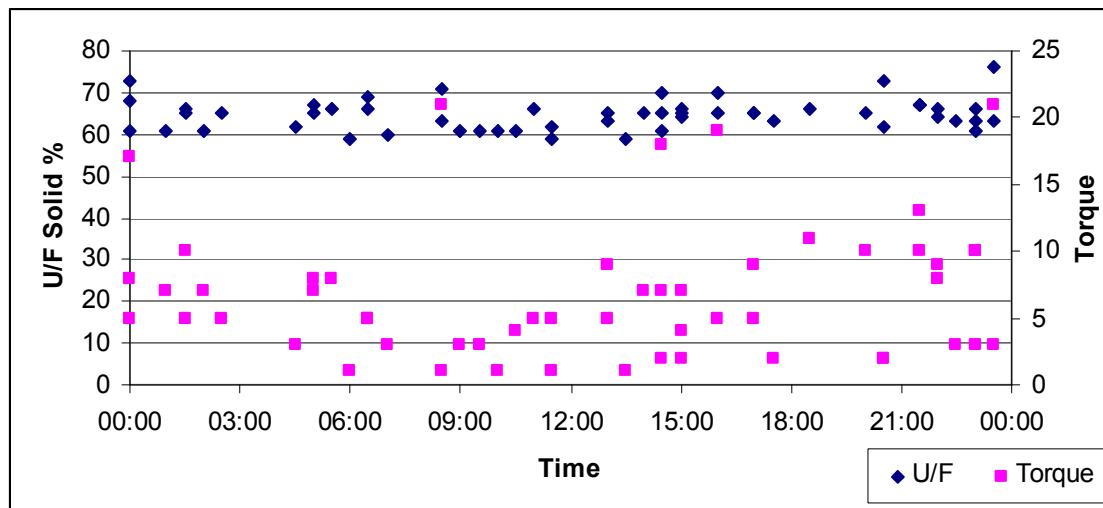


Figure 4.20.U/F Solid % and Torque as a function of time without dilution for tail thickener.

When the thickener feed was diluted with addition of water, particle surface are more positive. That is to say that due to the decrease in zeta potential, the effectiveness of anionic polymer increases and better flocs can be obtained (Sabah et al., 2000).

Stability of flocs to agitation increases with increasing pulp density. After the flocs become torn apart by agitation, the probability of recombination of flocs depends on the time before collision with another particle. With low pulp densities, this time is relatively large and the polymer molecules will tend to adsorb on the same particle, reducing the amount of bridging in the system. With higher pulp densities there is a greater chance of collision with another particle before this happens (Gric et al, 1978). However, these dilutions have not delivered better sedimentation rate at three of the thickeners.

4.4. Zn Thickener Capacity Test

4.4.1. With Flocculant Addition

To evaluate the Zn thickener capacity, under flow was recirculated to feed for 11 hours also continued to flocculant addition as 14 g/ton. During this application as 8 times, samples were taken from opposite to bed level probe as the location middle

point of launder and feed well, with 3 depth points. Solid contents were low than 0.2 % at both 1 m and 2 m elevations (Figure 4.21). At 3 m depth, solid content increased to as maximum as 43.5 % at 14:30 as seen in Figure 4.22. At the end of the work, U/F solid reached to 2224 g/l and torque 16.3. Also O/F was controlled and reached to maximum 170 ppm as seen in Table 4.1. And bed level measurements were verified this situations as reading 0,012 % (Table E3). The detail data are summarized in Table E1, Appendix E.

Table 4.1. The results of O/F at Zn thickener capacity test for two conditions

With Flocculant		Without Flocculant	
Time	O/F (ppm)	Time	O/F (ppm)
07:00	152	07:00	158
08:00	155	08:00	165
09:00	156	09:00	170
10:00	158	10:00	173
11:00	160	11:00	175
12:00	160	12:00	176
13:00	165	13:00	179
14:00	168	14:00	180
15:00	166	15:00	183
16:00	170	16:00	185

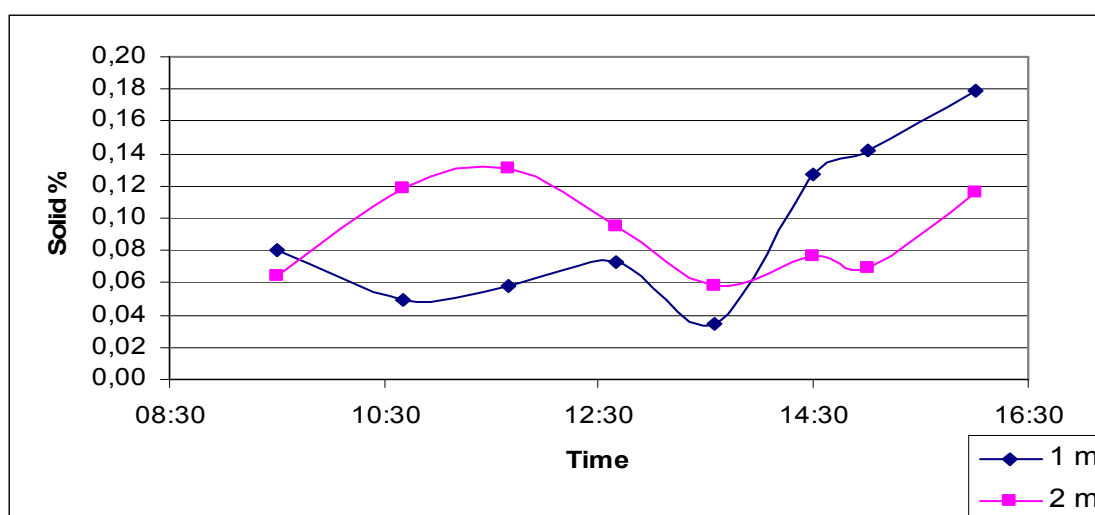


Figure 4.21 Solid % vs time curve at 1 m and 2 m depth of Zn thickener with flocculant addition test

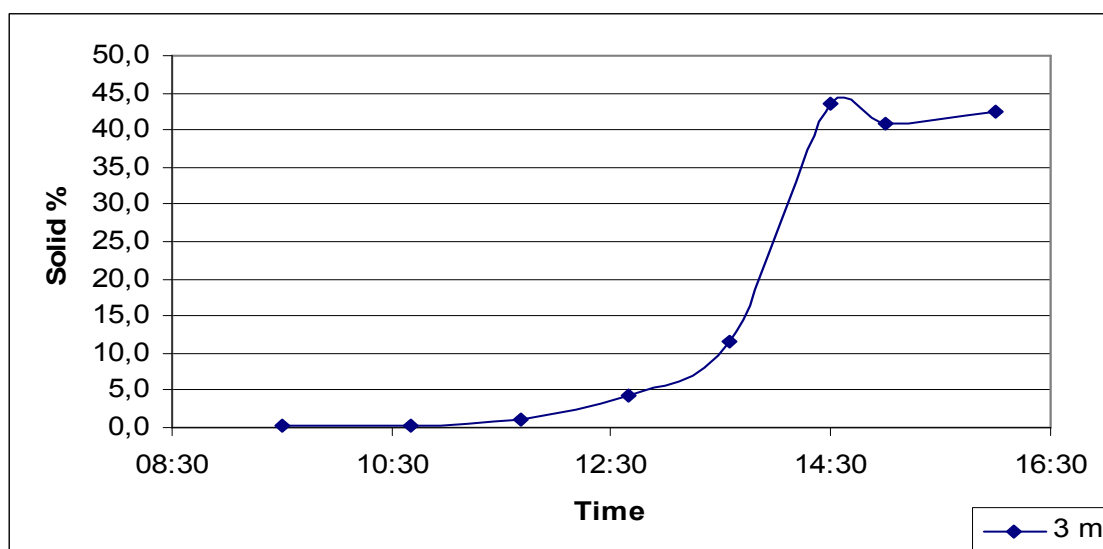


Figure 4.22. Solid % vs time curve at 3 m depth of Zn thickener with flocculant addition test.

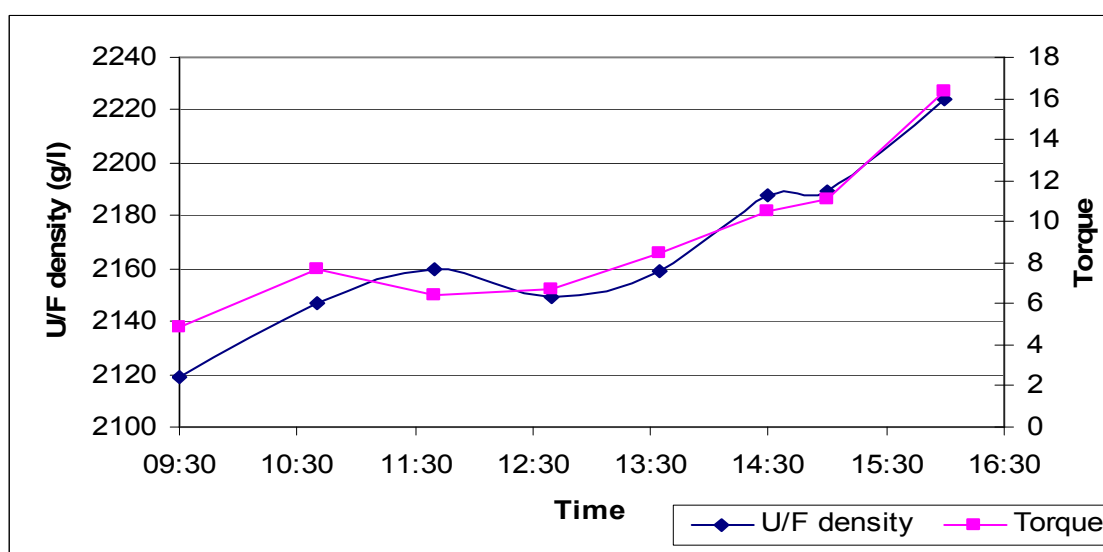


Figure 4.23. U/F Solid % and Torque as a function of time at Zn thickener capacity tests with flocculant addition.

4.4.2. Without Flocculant Addition

At the other step, under flow transfer to surge tank was stopped for 11 hours without flocculant addition. Manual measurements were taken from different elevations as the previous test as with flocculant addition. Higher solid contents and U/F densities were reached; 63.8 % and 2329 g/dm³, but lower torque as final value was 5.06. First two levels as 1 and 2 m, solid contents were low than 3 %,

even they started a positive bias towards to end of the tests (Figure 4.24). Otherwise, the results for 3 m elevation were directed to step-up trend against time (Figure 4.25). As well torque and underflow solid contents were exhibited increasing path during the test as seen in Figure 4.26. As the detail data can be read from Table E2, Appendix E. In the way that, bed level probe readings were 0.010 % and so verified the manual measurement results, the detail data can be seen in Table E3, Appendix E. And moreover overflow was on the control as the reached as maximum 185 ppm (Table 4.1).

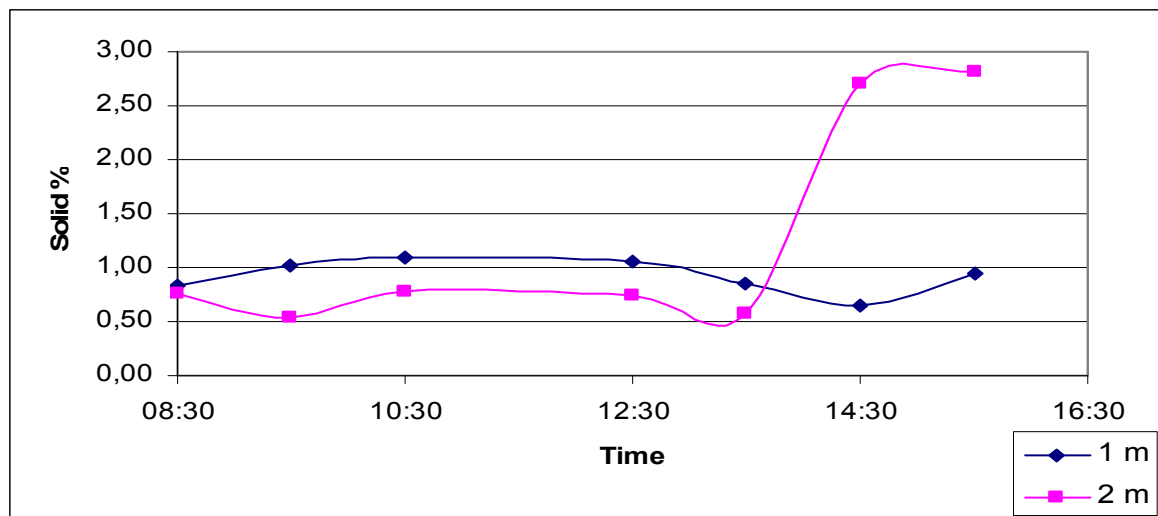


Figure 4.24 Solid % vs time curve at 1 m and 2 m depth of Zn thickener without flocculant addition test

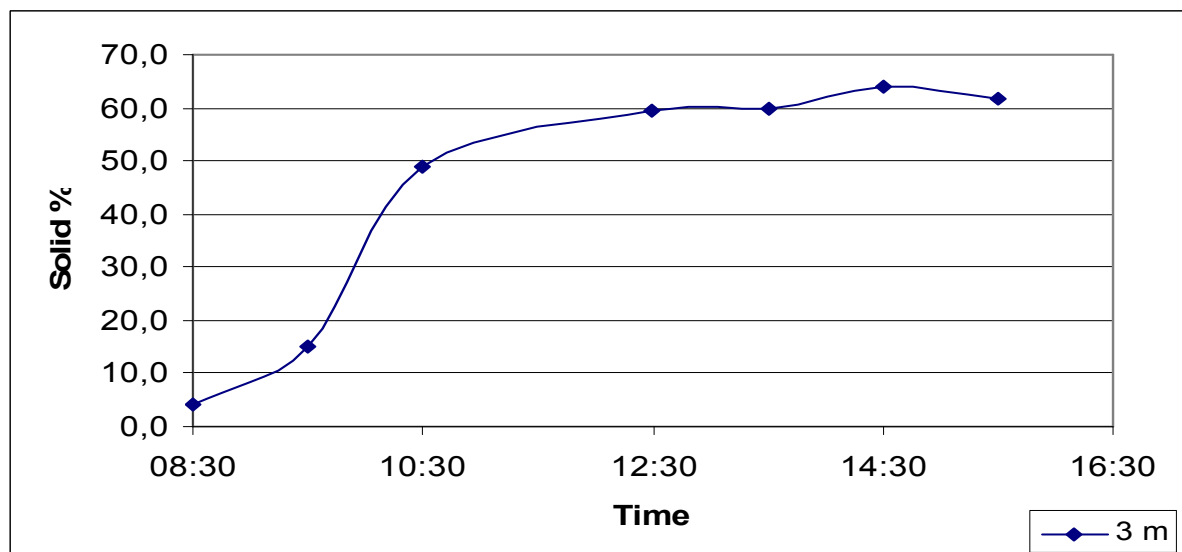


Figure 4.25. Solid % vs time curve at 3 m depth of Zn thickener without flocculant addition test.

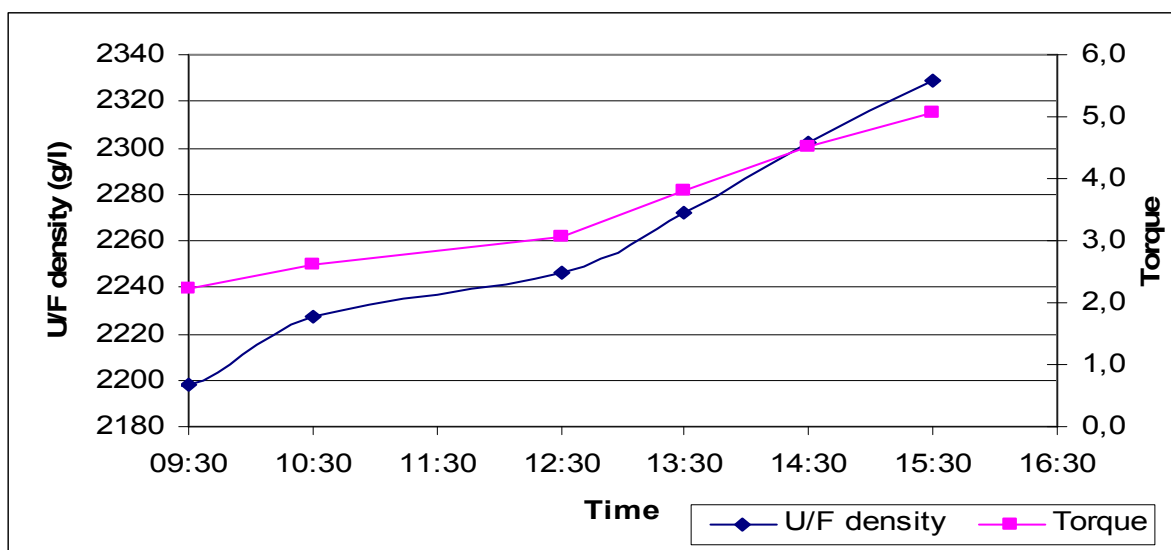


Figure 4.26. U/F Solid % and Torque as a function of time at Zn thickener capacity tests without flocculant addition.

4.5. Laboratory Flocculant Dosages Tests for Zn Concentrate

4.5.1. Without Flocculant Usage and with H_2O_2 Addition

To investigate the settling behaviour of Zn concentrate, firstly settling laboratory tests were conducted without flocculant usage. Afterward the tests were carried out after H_2O_2 solution conditioning as the purpose of destroy the coated collector remaining from flotation stage and creating excess oxidation at the surface of the particles (Figure 4.27). Tests after H_2O_2 conditioning were performed faster sedimentation than without flocculant addition tests. The data are summarized in Table F1, Appendix F.

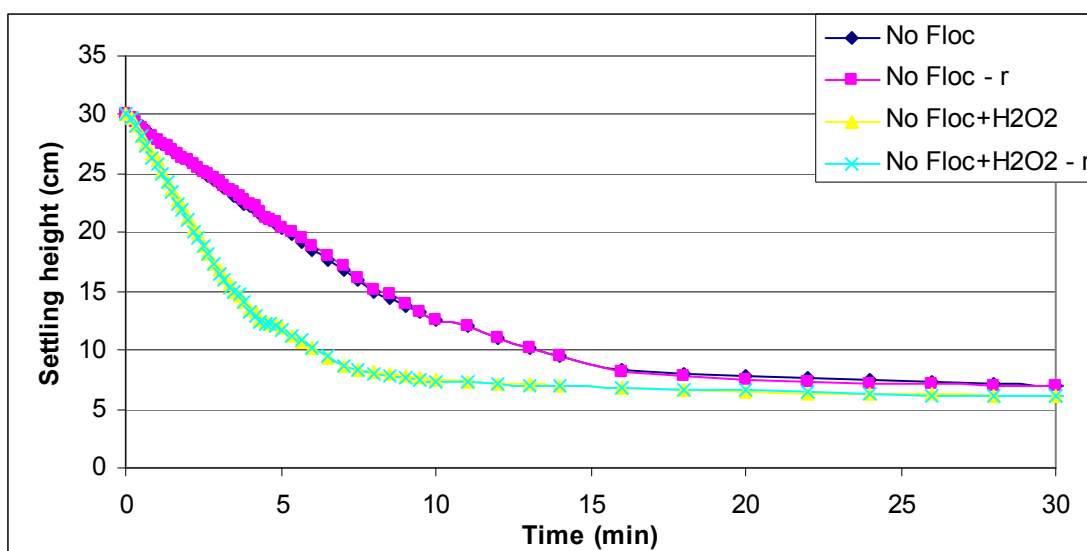


Figure 4.27. The results of settling tests without flocculant usage and H₂O₂ addition

4.5.2. With Anionic Type Flocculants

To establish the most appropriate polymer type and dosage for the efficiency of sedimentation of Zn concentrate, settling tests were conducted with different molecular weight anionic polymers and nonionic polymer.

Settling test results with Hydrafloc 9130 as seen in Figure 4.28 illustrated that similar sedimentation effect at 18, 28 and 38 g/ton dosages, but faster settling than 6 g/ton dosage. First 30 minutes were considered to see the differences in an accurate position. The detail data is summarized in Table F2 as Appendix F.

Cytec A-100 as an anionic type flocculant as the same molecular weight classification as high molecular weight was tested like Hydrafloc 9130 with different dosages. Individual results were reflected resembling match as higher flocculant dosages as same settling behaviour and faster than lowest dosage (Figure 4.29). Table F3 contains the details data in Appendix F.

According to the comparison of two flocculant type results, Hydrafloc 9130 performed more effective sedimentation than Cytec A-100. At the same dosages, Hydrafloc 9130 has higher settling rate.

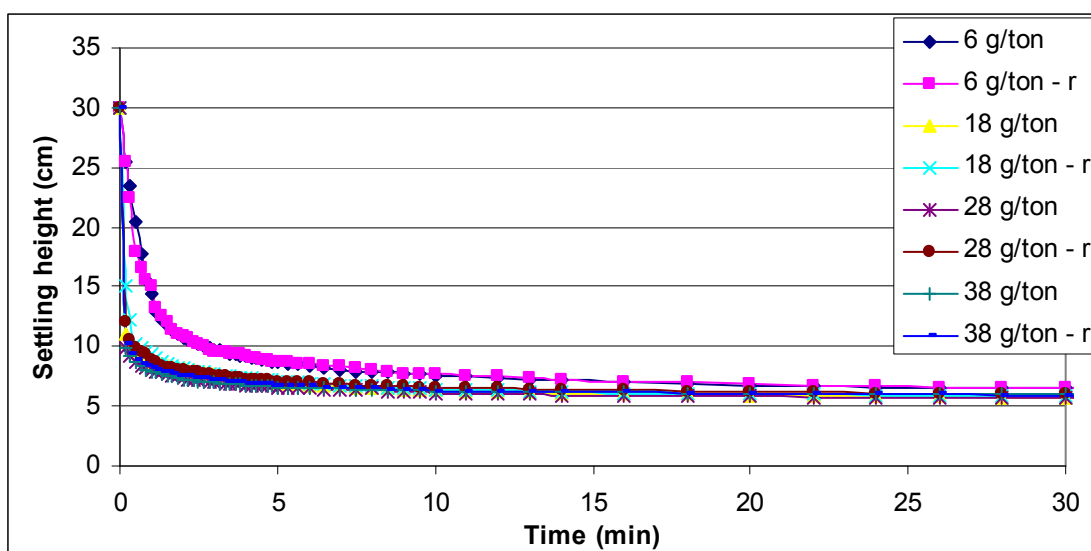


Figure 4.28. The results of settling test for Hydrafloc 9130 with different dosages.

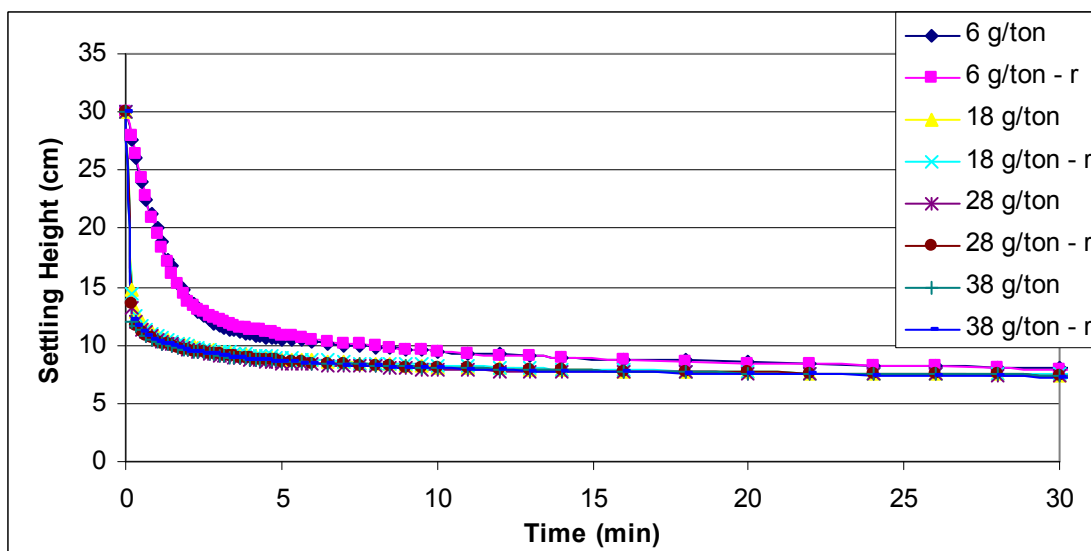


Figure 4.29. The results of settling test for Cytec A-100 with different dosages.

On the other hand, even Magnafloc 1011 has very high molecular weight, settling test results with different dosages was not fast as Hydrafloc 9130 (Figure 4.30). Higher molecular weight has not concluded with more advantage than others. 6 g/ton flocculant dosage usage differed from the other dosages by means of being slower. The detailed data can be seen in Table F4, Appendix F.

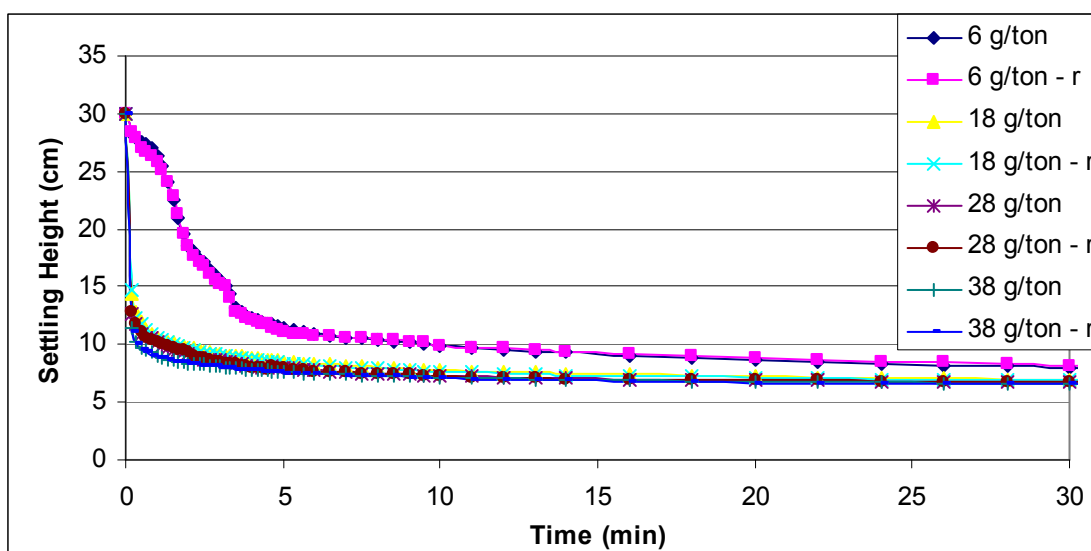


Figure 4.30. The results of settling test for Magnafloc 1011 with different dosages.

4.5.3. With Nonionic Type Flocculant

Nonionic type flocculant as Superfloc N-300 was tested at different dosages as seen from Figure 4.31. Settling times increased correspondingly dosage increase. Nevertheless this difference was slow down between the last three dosages as similar results as especially towards to end of the tests. Table F5 is summarized the detail data in Appendix F.

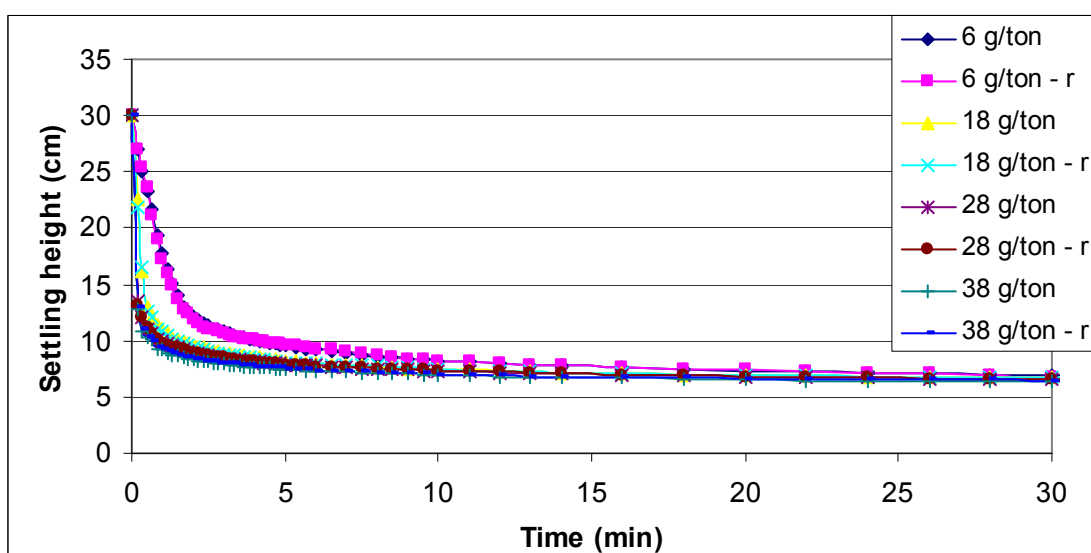


Figure 4.31. The results of settling test for Superfloc N-300 with different dosages.

4.5.4. Mixture of Anionic and Nonionic Flocculant Types

Each anionic type flocculants were mixed with nonionic type flocculant by 50 % and 50 % with 18 g/ton dosage usage as the purpose of bringing a synergy between anionic and nonionic type flocculants. Similar results were observed as similar settling behaviours as individual flocculant usages. Mixture with Hydrafloc 9130 showed the highest settling rate, but not a significant difference according to the others (Figure 4.32).

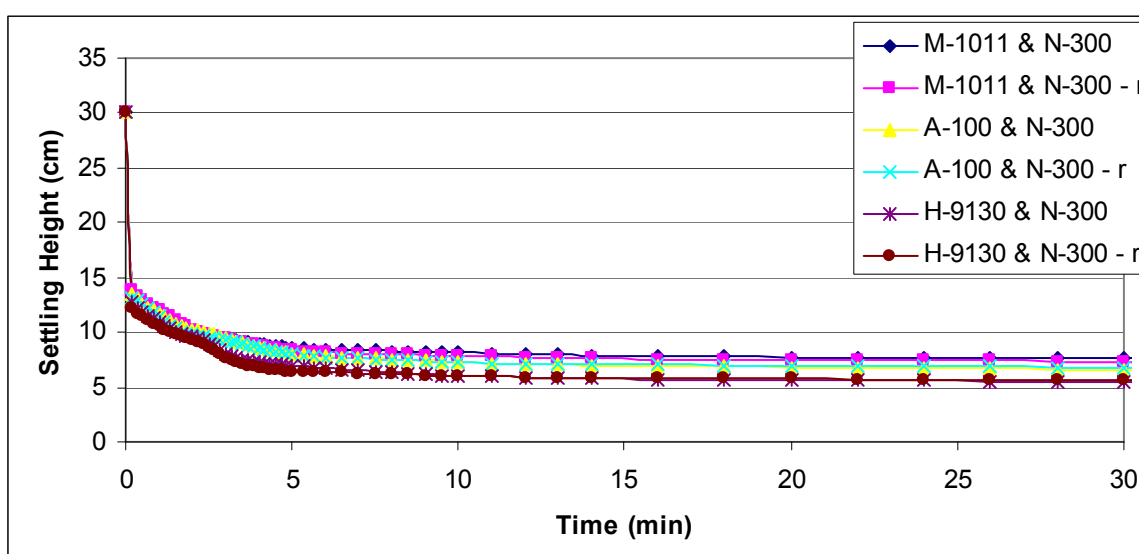


Figure 4.32. The results of settling test as mixture of anionic and nonionic type flocculants

4.6. Change at Water Spray System of Zn Thickener

To decrease the froth accumulation of the surface of Zn thickener, some changes were applied to water spray system. One of them was deal with increasing the water pressure by increasing the water spray's pipe line's diameter as seen from Figure 4.33 and 4.34. Red colour numbers are represents the changes of lines. The other innovation was the addition of water sprays to the existing ones from different places.

At the end of these applications, froth view of the surface was changed as seen in Figure 4.35. Most parts of froth were removed from the surface by the help of more efficient application of water sprays.

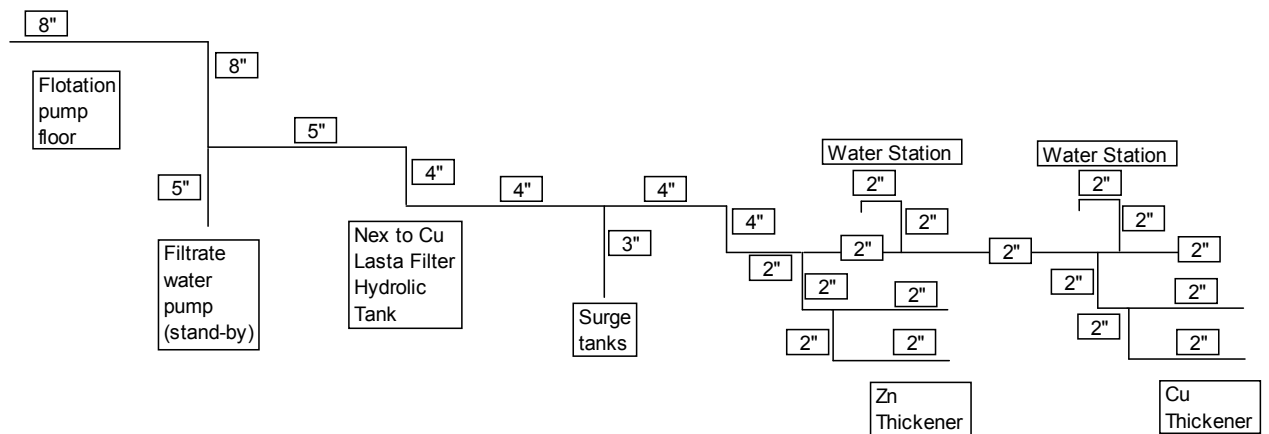


Figure 4.33. The rough drawing about the old water spray pipe line.

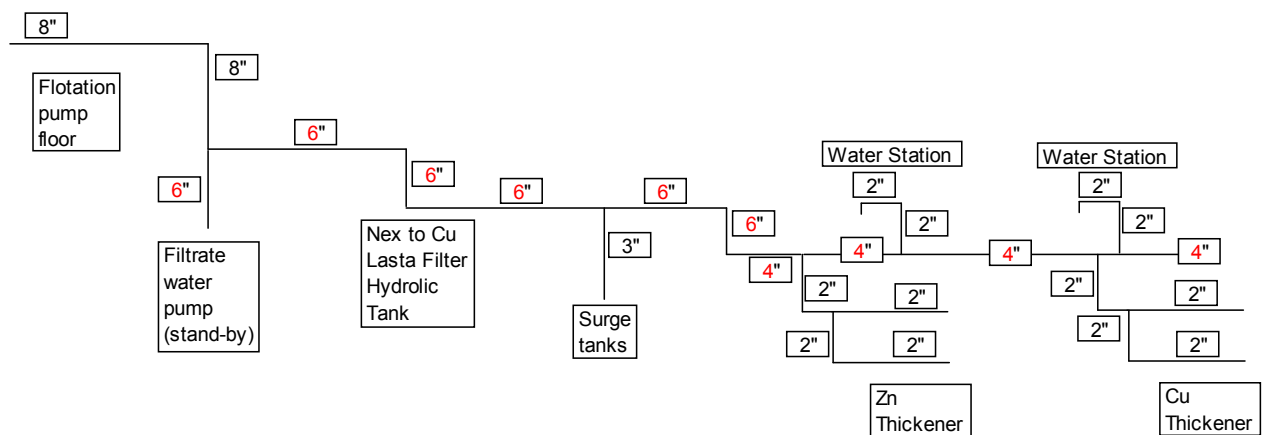


Figure 4.34. The rough drawing about the new water spray pipe line.



Figure 4.35. The view of Zn thickener before and after water spray application

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

For the solid liquid separation of zinc concentrate, a series of systematic flocculation tests with anionic and nonionic polymers are performed. The most effective polymer type is high molecular weight Hydrafloc 9130 and the optimum dosage is 18 g/ton. Overall settling curves of these tests at were showed in Figure 5.1. Highest molecular weight flocculant, Magnafloc 1011, has not exhibited a different performance, it means similar sedimentation rate. This situation may depend on the nature of the slurry being treated as well as the properties of the polymer.

Calculation results of thickener area for settling tests of Zn concentrate are illustrated in Table 5.1. At these calculations, average 375 t/day Zn concentrate production was considered for non-spec campaign and Talmadge and Fitch method was used. General radius results are lower than the design thickener radius as 8 m even with safety factor increases. The lowest radius was derived from Hydrafloc 9130 and highest radius without flocculant addition.

Table 5.1. Thickener area calculations for settling tests of Zn concentrate

Name of floc	Dosage (g/ton)	Hu (cm)	Cu (g/L)	% Solid	tu (min)	Area (m ² /t/d)	r (m)	r (m) with 1.2 safety factor
Hydrofloc 9130	6	6.18	1142	62.72	1.38	0.014	1.27	1.53
	18	5.70	1238	65.41	0.47	0.005	0.74	0.89
	28	5.82	1213	64.71	1.06	0.010	1.12	1.34
	38	5.73	1232	65.23	1.14	0.011	1.16	1.39
Cytec A-100	6	7.38	956	56.87	2.56	0.025	1.73	2.08
	18	7.20	980	57.67	1.03	0.010	1.10	1.32
	28	7.23	976	57.54	1.21	0.012	1.19	1.43
	38	7.11	993	58.09	1.14	0.011	1.16	1.39
Magnafloc 1011	6	7.01	1007	58.55	3.44	0.034	2.01	2.41
	18	6.68	1057	60.14	1.20	0.012	1.19	1.42
	28	6.53	1081	60.89	1.13	0.011	1.15	1.38
	38	6.51	1084	60.99	1.14	0.011	1.16	1.39
Superfloc N300	6	6.62	1066	60.44	2.25	0.022	1.63	1.95
	18	6.57	1074	60.69	1.17	0.012	1.17	1.41
	28	6.47	1091	61.19	1.14	0.011	1.16	1.39
	38	6.30	1120	62.08	1.18	0.012	1.18	1.41
H9130+N300	18	5.33	1324	67.64	3.03	0.030	1.89	2.26
A100+N300	18	6.48	1089	61.14	2.30	0.023	1.64	1.97
M1011+N300	18	7.43	950	56.65	3.33	0.033	1.98	2.37
No Floc	-	6.39	1105	61.61	15.5	0.153	4.27	5.12
No Floc+H2O2	-	5.72	1234	65.29	8.24	0.081	3.11	3.73

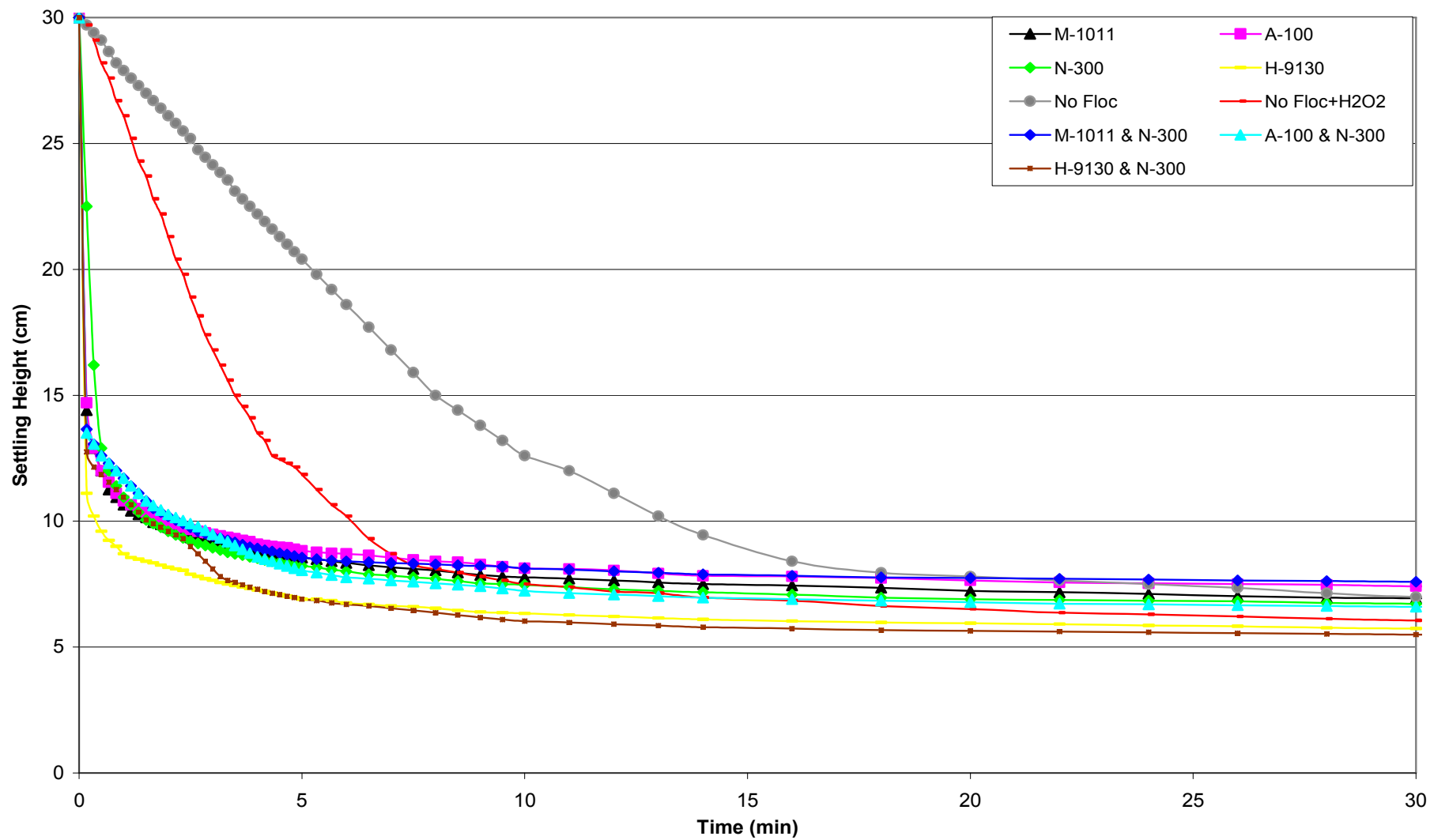


Figure 5.1. Zn concentrate laboratory settling tests with determined optimum dosage.

5.2. RECOMENDATIONS

Anionic type flocculant as Hydrafloc 9130 is currently being used in the plant is considered to be a satisfactory choice. Automatic polymer dissolving system can be used for both faster and better mixing.

Overflow clarity also can be determined by a turbidimeter as an automation control of overflow thickener. Spray applications can consolidate by froth skimmer to remove froth accumulation at top of thickener surface.

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APPENDICES

APPENDIX A

Table A1. The results for particle size and chemical analyses of flotation feed.

Particle size (µm)	% weight	Cum U/S %	% Cu	% Zn	% Fe	Cu distr.	Zn distr.	Fe distr.
+63	8,35	100,00	2,89	5,44	18,55	6,29	6,80	5,45
-63+50	3,70	91,65	4,18	7,85	27,75	4,03	4,33	3,63
-50+36	10,65	87,95	3,76	6,71	31,10	10,44	10,71	11,66
-36+20	17,15	77,30	3,33	5,64	35,85	14,86	14,50	21,66
-20+9	27,65	60,15	3,98	7,06	30,30	28,65	29,37	29,50
-9	32,50	32,50	4,22	7,00	24,55	35,73	34,29	28,10
	100,00		3,83	6,65	28,38	100,00	100,00	100,00

Table A2. The results for particle size and chemical analyses of Cu concentrate.

Particle size (µm)	% weight	Cum U/S %	% Cu	% Zn	% Fe	Cu distr.	Zn distr.	Fe distr.
+63	0,00	100,00	0,00	0,00	0,00	0,00	0,00	0,00
-63+50	0,65	100,00	28,95	2,73	28,95	0,86	0,27	0,68
-50+36	1,75	99,35	28,05	3,02	28,65	2,22	0,83	1,81
-36+20	10,05	97,60	23,25	4,21	30,50	10,66	6,52	11,03
-20+9	38,35	87,55	21,45	5,98	25,70	37,46	35,39	35,15
-9	49,20	49,20	21,80	7,54	28,95	48,80	56,98	51,32
	100,00		21,96	6,50	27,81	100,00	100,00	100,00

Table A3. The results for particle size and chemical analyses of Zn concentrate.

Particle size (µm)	% weight	Cum U/S %	% Cu	% Zn	% Fe	Cu distr.	Zn distr.	Fe distr.
+63	5,75	100,05	3,16	52,35	7,46	6,62	6,12	4,44
-63+50	4,70	94,30	2,90	51,85	8,27	4,83	4,96	4,04
-50+36	10,65	89,60	2,72	49,85	9,50	10,43	10,81	10,40
-36+20	18,50	78,95	2,62	45,70	12,35	17,38	17,20	23,64
-20+9	28,90	60,45	2,33	48,45	10,85	24,08	28,49	32,39
-9	31,55	31,55	3,24	50,60	7,72	36,72	32,48	25,14
	100,05		2,78	49,16	9,67	100,05	100,05	100,05

Table A4. The results for particle size and chemical analyses of final tail.

Particle size (µm)	% weight	Cum U/S %	% Cu	% Zn	% Fe	Cu distr.	Zn distr.	Fe distr.
+63	11,70	99,90	1,04	2,27	19,85	19,37	22,81	7,52
-63+50	4,65	88,20	1,04	2,27	32,90	7,70	9,03	4,89
-50+36	11,15	83,55	0,71	1,42	36,60	12,61	13,39	13,00
-36+20	18,40	72,40	0,50	0,79	42,15	14,50	12,40	24,66
-20+9	23,30	54,00	0,37	0,52	32,80	13,92	10,31	24,32
-9	30,70	30,70	0,65	1,23	26,10	31,80	31,95	25,52
	99,90		0,63	1,18	31,40	99,90	99,90	99,90

Table A5. Data for Zn concentrate weight % in CBI.

	Zn Conc weight %		Zn Conc weight %		Zn Conc weight %		Zn Conc weight %		Zn Conc weight %		Zn Conc weight %
1-Jul	6,67	1-Aug	10,3	1-Sep	4,28	1-Oct	6,17	1-Nov	10,1	1-Dec	12,5
2-Jul	8,12	2-Aug	11,8	2-Sep	4,17	2-Oct	9,36	2-Nov	14,0	2-Dec	12,1
3-Jul	10,1	3-Aug	11,1	3-Sep	4,90	3-Oct	12,2	3-Nov	14,7	3-Dec	12,4
4-Jul	11,7	4-Aug	11,2	4-Sep	4,00	4-Oct	10,9	4-Nov	13,5	4-Dec	13,6
5-Jul	11,0	5-Aug	12,3	5-Sep	6,36	5-Oct	11,0	5-Nov	15,0	5-Dec	13,4
6-Jul	8,59	6-Aug	11,6	6-Sep	9,68	6-Oct	7,63	6-Nov	13,8	6-Dec	9,1
7-Jul	7,03	7-Aug	13,8	7-Sep	11,5	7-Oct	6,30	7-Nov	15,5	7-Dec	13,2
8-Jul	4,37	8-Aug	12,9	8-Sep	9,60	8-Oct	5,72	8-Nov	12,0	8-Dec	13,5
9-Jul	4,23	9-Aug	4,79	9-Sep	7,38	9-Oct	8,13	9-Nov	14,9	9-Dec	15,5
10-Jul	5,85	10-Aug	6,14	10-Sep	5,91	10-Oct	10,5	10-Nov	10,9	10-Dec	12,0
11-Jul	9,81	11-Aug	8,52	11-Sep	4,88	11-Oct	10,4	11-Nov	13,8	11-Dec	16,2
12-Jul	11,0	12-Aug	6,78	12-Sep	7,09	12-Oct	9,97	12-Nov	6,04	12-Dec	7,6
13-Jul	11,0	13-Aug	7,09	13-Sep	13,3	13-Oct	7,63	13-Nov	8,68	13-Dec	7,1
14-Jul	15,0	14-Aug	5,69	14-Sep	14,3	14-Oct	5,80	14-Nov	5,29	14-Dec	8,1
15-Jul	12,5	15-Aug	11,1	15-Sep	10,7	15-Oct	8,32	15-Nov	6,32	15-Dec	8,5
16-Jul	9,67	16-Aug	13,6	16-Sep	7,23	16-Oct	8,39	16-Nov	7,65	16-Dec	9,0
17-Jul	7,54	17-Aug	11,4	17-Sep	7,71	17-Oct	10,3	17-Nov	7,52	17-Dec	10,9
18-Jul	6,06	18-Aug	8,16	18-Sep	9,79	18-Oct	9,93	18-Nov	7,22	18-Dec	13,8
19-Jul	5,93	19-Aug	6,15	19-Sep	7,89	19-Oct	10,5	19-Nov	10,1	19-Dec	12,8
20-Jul	6,53	20-Aug	6,52	20-Sep	10,4	20-Oct	13,4	20-Nov	11,87	20-Dec	15,6
21-Jul	8,37	21-Aug	7,73	21-Sep	13,5	21-Oct	12,9	21-Nov	7,07	21-Dec	15,6
22-Jul	13,2	22-Aug	6,97	22-Sep	11,7	22-Oct	12,6	22-Nov	10,6	22-Dec	11,6
23-Jul	18,5	23-Aug	6,97	23-Sep	11,1	23-Oct	11,3	23-Nov	9,15	23-Dec	13,1
24-Jul	20,7	24-Aug	7,26	24-Sep	9,55	24-Oct	10,7	24-Nov	7,51	24-Dec	7,4
25-Jul	20,6	25-Aug	7,61	25-Sep	11,3	25-Oct	8,35	25-Nov	6,64	25-Dec	5,6
26-Jul	9,79	26-Aug	9,43	26-Sep	12,2	26-Oct	5,85	26-Nov	8,11	26-Dec	6,9
27-Jul	9,20	27-Aug	8,41	27-Sep	12,1	27-Oct	5,57	27-Nov	7,26	27-Dec	6,5
28-Jul	8,33	28-Aug	8,09	28-Sep	13,2	28-Oct	6,37	28-Nov	10,1	28-Dec	8,7
29-Jul	7,09	29-Aug	9,11	29-Sep	11,8	29-Oct	5,33	29-Nov	13,1	29-Dec	8,0
30-Jul	7,25	30-Aug	8,53	30-Sep	6,96	30-Oct	6,64	30-Nov	12,7	30-Dec	5,5
31-Jul	6,48	31-Aug	8,42			31-Oct	5,57			31-Dec	9,3

Table A6. The results for bin vs frequency as the related with Zn concentrate weight %.

	Bin	Frequency
	0	0
0-5	5	8
5-10	10	104
10-15	15	77
15-20	20	7
20-25	25	2
25-30	30	0
More	More	0

Table A7. Test plan for Zn concentrate laboratory flocculant tests

Test No	Type of floc	Molecular Weight	Name of floc	Dosage (g/ton)	Dosage (mL)	% Solid	Pulp Density (g/L)	Weight (g)
1	No Floc	-	-	-		20	1175	235
2	No Floc	-	-	-		20	1175	235
3	Anionic	High	Hydrofloc 9130	6	1,4	20	1175	235
4	Anionic	High	Hydrofloc 9130	6	1,4	20	1175	235
5	Anionic	High	Hydrofloc 9130	18	4,2	20	1175	235
6	Anionic	High	Hydrofloc 9130	18	4,2	20	1175	235
7	Anionic	High	Hydrofloc 9130	28	6,6	20	1175	235
8	Anionic	High	Hydrofloc 9130	28	6,6	20	1175	235
9	Anionic	High	Hydrofloc 9130	38	8,9	20	1175	235
10	Anionic	High	Hydrofloc 9130	38	8,9	20	1175	235
11	Anionic	High	Cytec A-100	6	1,4	20	1175	235
12	Anionic	High	Cytec A-100	6	1,4	20	1175	235
13	Anionic	High	Cytec A-100	18	4,2	20	1175	235
14	Anionic	High	Cytec A-100	18	4,2	20	1175	235
15	Anionic	High	Cytec A-100	28	6,6	20	1175	235
16	Anionic	High	Cytec A-100	28	6,6	20	1175	235
17	Anionic	High	Cytec A-100	38	8,9	20	1175	235
18	Anionic	High	Cytec A-100	38	8,9	20	1175	235
19	Anionic	Very High	Magnafloc 1011	6	1,4	20	1175	235
20	Anionic	Very High	Magnafloc 1011	6	1,4	20	1175	235
21	Anionic	Very High	Magnafloc 1011	18	4,2	20	1175	235
22	Anionic	Very High	Magnafloc 1011	18	4,2	20	1175	235
23	Anionic	Very High	Magnafloc 1011	28	6,6	20	1175	235
24	Anionic	Very High	Magnafloc 1011	28	6,6	20	1175	235
25	Anionic	Very High	Magnafloc 1011	38	8,9	20	1175	235
26	Anionic	Very High	Magnafloc 1011	38	8,9	20	1175	235
27	Non-ionic	High	Superfloc N300	6	1,4	20	1175	235
28	Non-ionic	High	Superfloc N300	6	1,4	20	1175	235
29	Non-ionic	High	Superfloc N300	18	4,2	20	1175	235
30	Non-ionic	High	Superfloc N300	18	4,2	20	1175	235
31	Non-ionic	High	Superfloc N300	28	6,6	20	1175	235
32	Non-ionic	High	Superfloc N300	28	6,6	20	1175	235
33	Non-ionic	High	Superfloc N300	38	8,9	20	1175	235
34	Non-ionic	High	Superfloc N300	38	8,9	20	1175	235
35	No Floc+H2O2	-	-	-		20	1175	235
36	No Floc+H2O2	-	-	-		20	1175	235

APPENDIX B

Table B1. Data for preliminary settling test results for freshly taken Zn concentrate sample.

No Floc		
Settling height (cm)	Pulp volume (mL)	Time (min)
30,0	1000	0
30,0	1000	0,5
30,0	1000	1
30,0	1000	2
30,0	1000	3
21,0	700	5
16,5	550	7
9,0	300	10
6,0	200	12
5,4	180	14
4,8	160	16
4,5	150	18
4,4	145	20
4,2	140	22
4,2	140	24
4,1	135	26
4,1	135	28
3,9	130	30
3,9	130	32
3,9	130	34
3,8	125	36
3,8	125	38
3,8	125	40
3,8	125	42
3,8	125	44
3,6	120	46
3,6	120	48
3,6	120	50
3,6	120	52
3,6	120	54
3,6	120	56
3,6	120	58
3,6	120	60
3,5	115	90
3,5	115	120
3,5	115	240
3,5	115	300
3,5	115	720
3,5	115	1440

Hydrofloc-9130, 6 g/t		
Settling height (cm)	Pulp volume (mL)	Time (min)
30,0	1000	0
30,0	1000	0,5
25,5	850	1
24,0	800	2
21,0	700	3
15,0	500	5
12,0	400	7
6,0	200	10
5,1	170	12
4,8	160	14
4,7	155	16
4,5	150	18
4,4	145	20
4,2	140	22
4,2	140	24
4,1	135	26
4,1	135	28
3,9	130	30
3,9	130	32
3,9	130	34
3,9	130	36
3,9	130	38
3,8	125	40
3,8	125	42
3,8	125	44
3,8	125	46
3,8	125	48
3,6	120	50
3,6	120	52
3,6	120	54
3,6	120	56
3,6	120	58
3,6	120	60
3,5	115	90
3,5	115	120
3,5	115	240
3,5	115	300
3,5	115	720
3,5	115	1440

Hydrofloc-9130, 12 g/t		
Settling height (cm)	Pulp volume (mL)	Time (min)
30,0	1000	0
30,0	1000	0,5
25,5	850	1
22,5	750	2
21,0	700	3
15,0	500	5
9,0	300	7
5,7	190	10
4,8	160	12
4,7	155	14
4,5	150	16
4,4	145	18
4,2	140	20
4,2	140	22
4,2	140	24
3,9	130	26
3,9	130	28
3,9	130	30
3,8	125	32
3,8	125	34
3,8	125	36
3,6	120	38
3,6	120	40
3,6	120	42
3,6	120	44
3,6	120	46
3,6	120	48
3,6	120	50
3,5	115	52
3,5	115	54
3,5	115	56
3,5	115	58
3,5	115	60
3,3	110	90
3,3	110	120
3,3	110	240
3,3	110	300
3,3	110	720
3,3	110	1440

Table B2. Data for preliminary flocculation test results for Zn concentrate at 3 stages.

Fresh Zn Concentrate						Zn Concentrate 7 days later						Zn Concentrate 21 days later					
No Floc			Hydrofloc-9130, 6 g/t			No Floc			Hydrofloc-9130, 6 g/t			No Floc			Hydrofloc-9130, 6 g/t		
Settling height (cm)	Pulp volume (mL)	Time (min)	Settling height (cm)	Pulp volume (mL)	Time (min)	Settling height (cm)	Pulp volume (mL)	Time (min)	Settling height (cm)	Pulp volume (mL)	Time (min)	Settling height (cm)	Pulp volume (mL)	Time (min)	Settling height (cm)	Pulp volume (mL)	Time (min)
30,0	1000	0	30,0	1000	0	30,0	1000	0	30,0	1000	0	30,0	1000	0	30,0	1000	0
30,0	1000	0,5	30,0	1000	0,5	30,0	1000	0,5	30,0	1000	0,5	27,0	900	0,5	21,0	700	0,5
30,0	1000	1	30,0	1000	1	30,0	1000	1	30,0	1000	1	25,5	850	1	15,0	500	1
30,0	1000	2	30,0	1000	2	30,0	1000	2	12,0	400	2	24,0	800	2	8,1	270	2
30,0	1000	3	30,0	1000	3	30,0	1000	3	8,7	290	3	18,0	600	3	6,9	230	3
30,0	1000	5	18,0	600	5	30,0	1000	5	7,5	250	5	13,5	450	5	6,3	210	5
30,0	1000	7	16,5	550	7	30,0	1000	7	6,9	230	7	7,8	260	7	5,7	190	7
16,5	550	10	12,0	400	10	30,0	1000	10	6,6	220	10	5,4	180	10	5,1	170	10
14,1	470	12	10,5	350	12	8,1	270	12	6,3	210	12	5,1	170	12	5,0	165	12
12,0	400	14	9,0	300	14	7,2	240	14	6,0	200	14	5,0	165	14	4,8	160	14
9,0	300	16	7,5	250	16	6,6	220	16	5,9	195	16	4,7	155	16	4,7	155	16
8,1	270	18	7,2	240	18	6,3	210	18	5,7	190	18	4,5	150	18	4,5	150	18
7,5	250	20	6,6	220	20	6,0	200	20	5,6	185	20	4,4	145	20	4,5	150	20
7,1	235	22	6,5	215	22	5,7	190	22	5,4	180	22	4,2	140	22	4,4	145	22
6,6	220	24	6,3	210	24	5,6	185	24	5,4	180	24	4,2	140	24	4,4	145	24
6,0	200	26	6,0	200	26	5,4	180	26	5,4	180	26	4,2	140	26	4,4	145	26
5,7	190	28	6,0	200	28	5,3	175	28	5,3	175	28	4,2	140	28	4,4	145	28
5,4	180	30	6,0	200	30	5,1	170	30	5,3	175	30	4,1	135	30	4,4	145	30
5,4	180	32	5,9	195	32	5,1	170	32	5,3	175	32	4,1	135	32	4,4	145	32
5,4	180	34	5,9	195	34	5,1	170	34	5,1	170	34	4,1	135	34	4,4	145	34
5,3	175	36	5,7	190	36	5,1	170	36	5,1	170	36	4,1	135	36	4,4	145	36
5,3	175	38	5,7	190	38	5,0	165	38	5,1	170	38	4,1	135	38	4,2	140	38
5,3	175	40	5,7	190	40	5,0	165	40	5,1	170	40	3,9	130	40	4,2	140	40
5,3	175	42	5,6	185	42	5,0	165	42	5,0	165	42	3,9	130	42	4,2	140	42
5,1	170	44	5,6	185	44	4,8	160	44	5,0	165	44	3,9	130	44	4,2	140	44
5,1	170	46	5,4	180	46	4,8	160	46	5,0	165	46	3,9	130	46	4,2	140	46
5,1	170	48	5,4	180	48	4,8	160	48	5,0	165	48	3,9	130	48	4,2	140	48
5,1	170	50	5,3	175	50	4,8	160	50	4,8	160	50	3,9	130	50	4,2	140	50
5,1	170	52	5,3	175	52	4,8	160	52	4,8	160	52	3,9	130	52	4,2	140	52
5,1	170	54	5,3	175	54	4,7	155	54	4,8	160	54	3,9	130	54	4,2	140	54
5,0	165	56	5,1	170	56	4,7	155	56	4,8	160	56	3,9	130	56	4,2	140	56
5,0	165	58	5,1	170	58	4,7	155	58	4,8	160	58	3,9	130	58	4,2	140	58
5,0	165	60	5,0	165	60	4,7	155	60	4,8	160	60	3,9	130	60	4,2	140	60
4,8	160	90	5,0	165	90	4,5	150	90	4,7	155	90	3,8	125	90	4,1	135	90
4,8	160	120	5,0	165	120	4,5	150	120	4,7	155	120	3,8	125	120	4,1	135	120
4,8	160	240	5,0	165	240	4,5	150	240	4,7	155	240	3,8	125	240	4,1	135	240
4,8	160	300	5,0	165	300	4,5	150	300	4,7	155	300	3,8	125	300	4,1	135	300
4,8	160	720	4,8	160	720	4,5	150	720	4,7	155	720	3,8	125	720	4,1	135	720
4,8	160	1440	4,8	160	1440	4,5	150	1440	4,7	155	1440	3,8	125	1440	4,1	135	1440

Table B3. Data for preliminary settling tests at Cu concentrate with and without dilution.

Cu Concentrate, 27 % Solid						Cu Concentrate, 15 % Solid					
No Floc			Hydrofloc-9130, 6 g/t			No Floc			Hydrofloc-9130, 6 g/t		
Settling height (cm)	Pulp volume (mL)	Time (min)	Settling height (cm)	Pulp volume (mL)	Time (min)	Settling height (cm)	Pulp volume (mL)	Time (min)	Settling height (cm)	Pulp volume (mL)	Time (min)
30,0	1000	0	30,0	1000	0	30,0	1000	0	30,0	1000	0
29,7	990	0,5	29,7	990	0,5	29,1	970	0,5	29,4	980	0,5
29,4	980	1	29,4	980	1	27,9	930	1	27,0	900	1
28,8	960	2	29,1	970	2	26,0	865	2	23,7	790	2
28,5	950	3	28,2	940	3	24,3	810	3	21,6	720	3
27,6	920	5	27,0	900	5	21,0	700	5	15,0	500	5
26,7	890	7	26,4	880	7	18,0	600	7	12,6	420	7
25,8	860	10	24,6	820	10	14,7	490	10	9,9	330	10
24,9	830	12	23,4	780	12	12,3	410	12	7,8	260	12
24,0	800	14	22,5	750	14	10,5	350	14	7,5	250	14
23,1	770	16	21,9	730	16	9,9	330	16	7,2	240	16
22,5	750	18	20,7	690	18	8,7	290	18	6,9	230	18
21,6	720	20	20,1	670	20	7,2	240	20	6,6	220	20
20,7	690	22	18,9	630	22	6,6	220	22	6,5	215	22
19,8	660	24	18,0	600	24	6,5	215	24	6,3	210	24
18,9	630	26	17,1	570	26	6,3	210	26	6,2	205	26
18,3	610	28	16,2	540	28	6,2	205	28	6,0	200	28
17,4	580	30	15,3	510	30	6,0	200	30	5,9	195	30
16,5	550	32	13,8	460	32	5,9	195	32	5,7	190	32
15,6	520	34	12,9	430	34	5,7	190	34	5,7	190	34
14,7	490	36	12,3	410	36	5,6	185	36	5,7	190	36
13,8	460	38	12,2	405	38	5,4	180	38	5,6	185	38
12,9	430	40	12,0	400	40	5,4	180	40	5,6	185	40
12,3	410	42	11,9	395	42	5,4	180	42	5,6	185	42
11,9	395	44	11,7	390	44	5,3	175	44	5,4	180	44
11,7	390	46	11,6	385	46	5,3	175	46	5,4	180	46
11,6	385	48	11,4	380	48	5,3	175	48	5,3	175	48
11,4	380	50	11,3	375	50	5,1	170	50	5,3	175	50
11,3	375	52	11,1	370	52	5,1	170	52	5,3	175	52
11,1	370	54	11,0	365	54	5,1	170	54	5,3	175	54
11,0	365	56	10,8	360	56	5,1	170	56	5,1	170	56
10,8	360	58	10,7	355	58	5,0	165	58	5,1	170	58
10,7	355	60	10,4	345	60	5,0	165	60	5,1	170	60
9,8	325	90	9,6	320	90	4,7	155	90	4,8	160	90
9,2	305	120	8,7	290	120	4,4	145	120	4,4	145	120
7,5	250	240	7,5	250	240	4,2	140	240	4,4	145	240
7,5	250	300	7,5	250	300	4,2	140	300	4,4	145	300
7,5	250	720	7,5	250	720	4,2	140	720	4,4	145	720
7,5	250	1440	7,5	250	1440	4,2	140	1440	4,4	145	1440

Table B4. Data for preliminary settling tests at final tail with and without dilution.

Final Tail, 21 % Solid						Final Tail, 15 % Solid					
No Floc			Hydrofloc-9130, 28 g/t			No Floc			Hydrofloc-9130, 28 g/t		
Settling height (cm)	Pulp volume (mL)	Time (min)	Settling height (cm)	Pulp volume (mL)	Time (min)	Settling height (cm)	Pulp volume (mL)	Time (min)	Settling height (cm)	Pulp volume (mL)	Time (min)
30,0	1000	0	30,0	1000	0	30,0	1000	0	30,0	1000	0
30,0	1000	0,5	29,7	990	0,5	29,7	990	0,5	29,4	980	0,5
29,9	995	1	29,4	980	1	29,4	980	1	28,5	950	1
29,9	995	2	29,1	970	2	29,1	970	2	27,3	910	2
29,7	990	3	28,8	960	3	28,8	960	3	26,4	880	3
29,1	970	5	28,2	940	5	28,5	950	5	24,6	820	5
28,8	960	7	27,6	920	7	27,9	930	7	22,2	740	7
28,1	935	10	26,7	890	10	27,0	900	10	19,5	650	10
27,6	920	12	26,1	870	12	26,4	880	12	17,7	590	12
27,0	900	14	25,5	850	14	26,1	870	14	16,2	540	14
26,7	890	16	24,9	830	16	25,5	850	16	15,0	500	16
26,4	880	18	24,6	820	18	24,9	830	18	14,1	470	18
26,1	870	20	24,0	800	20	24,3	810	20	13,5	450	20
25,8	860	22	23,4	780	22	24,0	800	22	12,9	430	22
25,5	850	24	22,8	760	24	23,4	780	24	12,6	420	24
25,2	840	26	22,5	750	26	22,8	760	26	12,3	410	26
24,9	830	28	21,9	730	28	22,5	750	28	12,0	400	28
24,6	820	30	21,3	710	30	21,9	730	30	11,9	395	30
24,3	810	32	21,0	700	32	21,3	710	32	11,7	390	32
24,0	800	34	20,4	680	34	21,0	700	34	11,6	385	34
23,7	790	36	19,8	660	36	20,4	680	36	11,4	380	36
23,4	780	38	19,2	640	38	19,8	660	38	11,3	375	38
23,1	770	40	18,9	630	40	19,5	650	40	11,1	370	40
22,8	760	42	18,3	610	42	18,9	630	42	11,1	370	42
22,5	750	44	17,7	590	44	18,3	610	44	11,0	365	44
22,2	740	46	17,1	570	46	18,0	600	46	11,0	365	46
21,6	720	48	16,5	550	48	17,4	580	48	10,8	360	48
21,3	710	50	16,2	540	50	16,8	560	50	10,8	360	50
20,7	690	52	15,9	530	52	16,2	540	52	10,7	355	52
20,4	680	54	15,6	520	54	15,9	530	54	10,7	355	54
19,8	660	56	15,3	510	56	15,3	510	56	10,5	350	56
19,5	650	58	14,7	490	58	15,2	505	58	10,4	345	58
18,9	630	60	14,1	470	60	14,9	495	60	10,2	340	60
16,8	560	90	12,6	420	90	13,5	450	90	9,5	315	90
14,7	490	120	11,1	370	120	10,8	360	120	8,9	295	120
11,1	370	240	10,8	360	240	9,3	310	240	7,8	260	240
10,8	360	300	10,7	355	300	7,7	255	300	7,5	250	300
9,9	330	720	9,2	305	720	7,5	250	720	7,4	248	720
9,8	325	1440	9,1	303	1440	7,4	245	1440	7,4	245	1440

Table B5. Data for preliminary settling test at final tail with different flocculant dosages.

Hydrofloc-9130, 18 g/t			Hydrofloc-9130, 28 g/t			Hydrofloc-9130, 38 g/t		
Settling height (cm)	Pulp volume (mL)	Time (min)	Settling height (cm)	Pulp volume (mL)	Time (min)	Settling height (cm)	Pulp volume (mL)	Time (min)
30,0	1000	0	30,0	1000	0	30,0	1000	0
29,4	980	0,5	29,4	980	0,5	29,4	980	0,5
28,8	960	1	28,8	960	1	28,8	960	1
28,2	940	2	27,9	930	2	27,9	930	2
27,6	920	3	27,3	910	3	27,0	900	3
26,4	880	5	25,8	860	5	25,5	850	5
25,2	840	7	24,6	820	7	23,7	790	7
23,4	780	10	22,5	750	10	21,0	700	10
22,5	750	12	21,0	700	12	19,2	640	12
21,0	700	14	19,8	660	14	17,4	580	14
19,8	660	16	18,9	630	16	15,9	530	16
19,2	640	18	17,7	590	18	15,0	500	18
18,0	600	20	16,5	550	20	14,7	490	20
17,4	580	22	15,6	520	22	14,4	480	22
16,8	560	24	14,7	490	24	14,1	470	24
16,2	540	26	14,4	480	26	14,0	465	26
15,6	520	28	14,1	470	28	13,8	460	28
15,0	500	30	13,8	460	30	13,7	455	30
14,4	480	32	13,5	450	32	13,5	450	32
14,1	470	34	13,4	445	34	13,4	445	34
14,0	465	36	13,4	445	36	13,2	440	36
13,8	460	38	13,2	440	38	13,1	435	38
13,7	455	40	13,2	440	40	12,9	430	40
13,5	450	42	13,1	435	42	12,8	425	42
13,5	450	44	13,1	435	44	12,6	420	44
13,4	445	46	12,9	430	46	12,5	415	46
13,2	440	48	12,8	425	48	12,5	415	48
13,1	435	50	12,6	420	50	12,3	410	50
12,8	425	52	12,3	410	52	12,3	410	52
12,8	425	54	12,3	410	54	12,3	410	54
12,6	420	56	12,2	405	56	12,2	405	56
12,5	415	58	12,2	405	58	12,0	400	58
12,3	410	60	12,0	400	60	12,0	400	60
11,7	390	90	11,4	380	90	10,8	360	90
10,2	340	120	9,5	315	120	9,3	310	120
9,2	305	240	9,2	305	240	9,2	308	240
9,2	305	300	9,2	305	300	9,2	308	300
9,2	305	720	9,2	305	720	9,2	308	720
9,2	305	1440	9,2	305	1440	9,2	308	1440

APPENDIX C

Table C1. Data for sludge level determination at Zn thickener

Set 1				
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
1 m	1	2155	4,32	0,20
	2	1222	18,1	1,48
	7	1152	13,4	1,16
	8	1491	2,13	0,14
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
2 m	1	1251	8,65	0,69
	2	1372	13,09	0,95
	7	1566	5,4	0,34
	8	1632	6,09	0,37
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
3 m	1	1684	6,59	0,39
	2	1253	5,97	0,48
	7	1669	11,2	0,67
	8	1828	4,78	0,26
Set 2				
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
1 m	3	1255	8,27	0,66
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
2 m	3	1468	1,6	0,11
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
3 m	3	1455	7,61	0,52
Set 3				
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
1 m	3	1647	0,29	0,02
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
2 m	3	1647	0,59	0,04
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
3 m	3	1339	1,25	0,09
Set 4				
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
1 m	3	1458	0,4	0,03
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
2 m	3	1453	0,4	0,03
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
3 m	3	1426	0,5	0,04

Set 5				
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
1 m	3	1795	0,2	0,01

Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
2 m	3	1848	0,6	0,03

Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
3 m	3	1389	1,1	0,08

Table C2. Data for sludge level determination at Cu thickener

Set 1				
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
1 m	1	1323	7,45	0,5631
	2	1244	11,66	0,9373
	3	1277	48,84	3,8246
	4	1096	0,42	0,0383
	5	1092	0,82	0,0751
	6	1329	2,38	0,1791
	7	1287	10,34	0,8034
	8	1250	5,73	0,4584

Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
2 m	1	2255	1,43	0,0634
	2	1752	10,15	0,5793
	3	1431	8,55	0,5975
	4	1536	0,3	0,0195
	5	1453	0,34	0,0234
	6	1480	10,41	0,7034
	7	1884	9,45	0,5016
	8	1425	0,59	0,0414

Set 2				
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
1 m	1	2143	0,07	0,0033
	2	1454	3,49	0,2400
	3	1538	4,88	0,3176
	6	1622	0,84	0,0518
	7	1732	0,05	0,0029
	8	1496	0,06	0,0040

Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
2 m	1	1032	0,08	0,0078
	2	1375	0,03	0,0022
	3	1319	0,16	0,0121
	6	1346	0,53	0,0394
	7	1132	0,11	0,0097
	8	1446	0,18	0,0124

Set 3				
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
1 m	1	2258	0,53	0,0235
	2	2331	2,92	0,1253
	3	2278	1,66	0,0729
	6	2188	1,61	0,0736
	7	2200	1,09	0,0495
	8	2212	0,37	0,0167

Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
2 m	1	2347	2,61	0,1112
	2	2227	1,67	0,0750
	3	2212	2,44	0,1103
	6	2194	1,21	0,0552
	7	2264	1,22	0,0539
	8	2230	0,65	0,0291

Set 4				
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
1 m	1	2565	0,03	0,0012
	3	2681	16,7	0,6229
	6	2577	4,05	0,1572
	8	2639	0,63	0,0239

Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
2 m	1	2583	1,23	0,0476
	3	2652	6,66	0,2511
	6	2610	4,67	0,1789
	8	2651	3,26	0,1230

Table C3. Data for sludge level determination at tail thickener

Set 1				
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
1 m	1	3751	1985	52,9
	3	3844	2106	54,8
	6	3915	2095	52,1
	8	3918	2205	56,3

Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
2 m	1	4153	2425	58,4
	3	4117	2484	60,3
	6	4193	2476	59,1
	8	4200	2502	59,6

Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
3 m	1	4021	2376	59,1
	8	4150	2494	60,1

Set 2				
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
1 m	2	4212	2361	56,1

Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
2 m	2	4316	2533	58,7

Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
3 m	2	4228	2437	57,6

Set 3				
Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
1 m	2	2287	0,51	0,02
	7	2315	0,71	0,03

Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
2 m	2	3801	1816	47,77
	7	3970	1978	49,82

Sludge level (m)	Sampling points	Pulp Weight (g)	Solid weight(g)	% Solid
3 m	2	3966	2143	54,03
	7	4044	2143	52,98

APPENDIX D

Table D1. Data for dilution test at Zn Thickener

Time	Density		Torque	Level	Density	U/F Solid %
	Auto	Manuel			Surge Tank	
00:00	1940	1940	1,15	75	1820	64,60
08:00	1900	1960	1,05	67	1830	63,16
16:00	1890	1910	0,50	70	1840	62,79
00:00	1910	1900	0,80	91	1850	63,53
08:00	1910	1960	1,00	44	1840	63,53
16:00	1960	1980	1,00	86	1860	65,31
00:00	1930	1970	1,00	81	1780	64,25
08:00	1920	1930	1,20	50	1790	63,89
16:00	1920	1940	0,90	90	1800	63,89
8:00	1910	1940	1,30	86	1780	63,53
10:45	1940	1930	1,37	60	1750	64,60
14:45	1910	1910	0,95	64	1780	63,53
16:20	1940	2000	1,30	71	1800	64,60
19:05	1950	2000	0,80	90	1780	64,96
22:05	1910	1960	0,99	63	1800	63,53
0:30	1920	1960	1,40	74	1800	63,89
3:15	1900	1950	1,50	87	1760	63,16
5:55	1920	1910	0,80	74	1640	63,89
5:00	1930	1950	2,40	72	1720	64,25
7:00	1900	1920	1,00	70	1700	63,16
8:30	1940	1920	1,90	81	1800	64,60
10:30	1880	1910	1,00	84	1740	62,41
11:45	1970	1960	1,10	80	1730	65,65
14:40	1950	1940	0,60	56	1760	64,96
16:25	1950	1930	0,75	75	1820	64,96
19:00	1940	1940	0,80	90	1800	64,60
0:00	1955	1970	1,30	66	1830	65,13
1:30	1940	2000	0,80	83	1860	64,60
5:45	1940	1960	0,80	54	1840	64,60
7:25	1925	1970	0,70	55	1860	64,07
8:20	1960	1970	1,10	69	1830	65,31
10:00	1950	1960	1,30	88	1820	64,96
12:10	1960	1975	1,10	78	1780	65,31
14:30	1930	1940	1,10	84	1800	64,25
16:10	1950	1950	0,87	84	1800	64,96
19:15	1990	1980	0,70	63	1820	66,33
20:50	1930	1890	1,10	59	1780	64,25
23:00	1940	1950	0,80	82	1780	64,60
0:30	1935	1920	0,80	93	1830	64,43
1:30	1934	1910	0,75	77	1830	64,39
4:30	1975	1950	2,36	55	1810	65,82
6:30	1950	1950	1,40	52	1720	64,96
8:40	1950	1970	1,00	76	1800	64,96
10:10	1960	1980	1,00	83	1780	65,31
12:05	1940	1950	1,10	77	1780	64,60
14:10	1960	1970	1,00	66	1800	65,31
16:20	1940	1960	0,75	83	1780	64,60
19:10	1940	2020	1,20	75	1850	64,60
21:00	1940	1980	1,10	58	1800	64,60
22:45	1930	1950	1,20	50	1800	64,25
0:20	1930	1950	1,20	50	1800	64,25
1:45	1880	1890	1,20	62	1750	62,41
4:30	1900	2030	1,00	62	1810	63,16
6:30	1940	1910	1,30	60	1730	64,60
8:20	1940	1920	0,86	60	1730	64,60
9:45	1920	1930	1,00	69	1750	63,89
12:10	1980	2000	2,20	86	1750	65,99
13:50	2000	2020	1,30	93	1770	66,67
15:20	1990	2000	1,50	95	1750	66,33
17:20	2040	2140	2,20	94	1700	67,97
20:15	2000	2000	2,00	81	1740	66,67
22:40	1940	1970	0,70	47	1680	64,60
00:30	1840	1890	0,50	58	1700	60,87
02:45	1906	2030	0,55	70	1720	63,38
04:20	1900	1940	0,50	76	1760	63,16
06:40	1900	1930	0,68	56	1810	63,16
09:00	1920	1900	0,60	64	1800	63,89
11:00	1940	1900	0,75	80	1790	64,60
13:30	1970	1950	0,90	91	1700	65,65
15:30	1870	1850	0,70	66	1680	62,03
17:15	1920	1900	0,50	76	1780	63,89

21:10	1920	1930	1,00	83	1670	63,89
23:40	1930	1950	0,67	58	1680	64,25
00:25	1930	1930	0,70	48	1700	64,25
01:30	1930	1860	0,95	55	1720	64,25
05:30	1930	1930	1,15	67	1680	64,25
10:40	1900	1870	0,90	95	1650	63,16
12:10	1940	1900	0,80	73	1650	64,60
14:00	1920	1900	0,70	44	1660	63,89
16:20	1950	1960	0,70	61	1700	64,96
21:30	1950	2000	0,70	63	1710	64,96
00:30	1910	1920	1,00	42	1720	63,53
01:50	1900	1900	1,00	42	1630	63,16
04:00	1850	1820	0,90	69	1700	61,26
06:30	2000	2030	3,40	81	1710	66,67
10:15	2100	2170	2,70	92	1750	69,84
12:55	2090	2070	0,90	68	1780	69,54
14:55	1980	1990	1,00	50	1680	65,99
16:45	1800	1780	0,75	64	1610	59,26
21:10	2000	2050	1,80	88	1680	66,67
23:20	2010	2050	1,80	88	1680	67,00
00:30	2000	2000	1,10	46	1670	66,67
02:00	1990	2000	1,00	30	1680	66,33
06:00	1980	2000	0,90	65	1700	65,99
08:15	1950	1940	1,70	82	1750	64,96
10:30	2120	2220	2,50	74	1790	70,44
12:50	1800	1780	0,90	70	1730	59,26
16:20	2100	2180	3,20	70	1730	69,84
19:10	1990	1950	1,00	93	1770	66,33
23:15	1950	1960	1,00	93	1770	64,96
01:00	1960	1970	0,96	42	1610	65,31
03:00	1960	1950	1,15	70	1700	65,31
04:30	1960	1940	1,00	81	1660	65,31
06:45	2170	2100	0,90	38	1640	71,89
08:10	2210	2100	1,35	26	1700	73,00
16:15	2270	2360	6,60	55	1740	74,60
20:00	2090	2110	7,50	95	1940	69,54
22:50	1720	1750	1,50	81	1880	55,81
00:30	2040	2000	1,50	64	1800	67,97
03:00	1986	1960	1,50	58	1750	66,20
04:00	1970	1970	1,50	55	1710	65,65
07:15	1970	1970	1,10	75	1700	65,65
08:20	1970	1980	1,00	83	1700	65,65
10:15	1950	1950	0,80	78	1780	64,96
16:10	1980	2020	0,90	56	1730	65,99
19:20	1970	1960	1,00	42	1720	65,65
00:40	1960	1950	1,20	75	1690	65,31
02:00	1960	1930	1,50	57	1650	65,31
04:00	1950	1930	1,10	70	1700	64,96
06:00	1960	1920	1,00	87	1700	65,31
08:05	1950	1930	1,00	65	1740	64,96
10:05	1950	2050	1,00	50	1710	64,96
16:20	1975	1970	1,90	86	1730	65,82
17:45	1990	1980	1,60	82	1750	66,33
21:10	2040	2030	2,30	81	1780	67,97
00:30	1980	1980	1,70	60	1780	65,99
02:15	1950	1950	2,46	48	1750	64,96
04:00	1850	1850	0,80	49	1700	61,26
07:30	1920	1910	1,90	76	1710	63,89
08:20	1950	1930	1,60	91	1720	64,96
10:10	1860	1920	0,85	78	1740	61,65
12:30	1860	1950	0,61	66	1780	61,65
14:40	1900	1940	0,40	49	1710	63,16
16:30	1900	1890	0,50	65	1710	63,16
18:35	1921	1960	0,50	86	1720	63,93
21:00	1900	1950	1,00	75	1780	63,16
01:00	1900	1960	0,90	52	1740	63,16
02:30	1900	1900	0,90	70	1750	63,16
04:30	1900	1900	1,10	90	1740	63,16
06:00	1910	1920	1,10	95	1700	63,53
08:20	2010	2100	1,50	80	1820	67,00
14:00	1920	1950	0,50	62	1810	63,89
15:20	1910	1940	0,40	65	1770	63,53
16:20	1890	1890	0,50	60	1750	62,79
19:45	1950	1920	2,70	67	1760	64,96

22:30	1916	1900	0,62	56	1740	63,74
01:15	1920	1880	0,60	54	1740	63,89
08:20	1950	2020	1,00	72	1740	64,96
11:15	1900	1970	0,75	56	1730	63,16
15:20	1910	1970	0,70	78	1820	63,53
16:20	1920	1970	0,66	75	1700	63,89
18:00	1900	1975	0,80	60	1710	63,16
00:30	1900	1920	0,70	61	1710	63,16
02:45	1950	1980	0,90	88	1730	64,96
05:00	1950	1980	0,90	88	1720	64,96
07:10	1955	1920	0,80	50	1760	65,13
08:20	1950	1980	0,80	63	1720	64,96
12:15	1980	1990	0,70	91	1750	65,99
15:15	1930	1980	0,80	63	1730	64,25
16:20	1930	1940	1,00	55	1710	64,25
20:30	1940	1920	0,87	58	1690	64,60
23:10	1950	1940	0,95	67	1670	64,96
00:15	1950	1970	0,80	59	1690	64,96
02:20	1960	1980	0,60	60	1700	65,31
05:00	1940	2000	0,70	90	1700	64,60
07:05	1950	1930	1,00	66	1700	64,96
08:15	1940	2000	1,10	57	1720	64,60
15:10	1960	2010	0,90	78	1760	65,31
16:20	1940	1920	1,10	67	1700	64,60
19:15	1920	1900	1,00	56	1700	63,89
21:00	1950	1900	0,90	71	1710	64,96
23:00	2040	2020	1,50	81	1720	67,97
01:10	1940	2000	1,70	86	1800	64,60
04:40	1940	1940	1,00	54	1790	64,60
16:30	1900	1900	0,90	55	1710	63,16
18:30	1900	1900	0,90	54	1700	63,16
20:30	1910	1910	1,00	59	1710	63,53
22:20	1900	1900	1,30	68	1720	63,16
16:20	1920	1900	1,00	58	1680	63,89
19:00	1950	1950	0,90	76	1700	64,96
22:10	1960	1970	1,00	85	1710	65,31

Table D2. Data for Zn concentrate solid % with dilution calculations

	Daily Average	DMT			After dilution
	Conc Solid %	Tonnages	Water tonnage	Pulp tonnage	Conc Solid %
27-Feb	20,4	214,8	838,1	1052,8	12,1
28-Feb	18,4	173,8	771,7	945,6	10,4
1-Mar	18,9	148,6	636,0	784,6	9,9
2-Mar	18,2	174,5	782,4	956,9	10,4
3-Mar	17,5	290,5	1365,7	1656,2	12,2
4-Mar	20,4	257,6	1004,7	1262,3	13,0
5-Mar	19,5	288,9	1188,9	1477,8	13,1
6-Mar	19,5	270,3	1118,3	1388,6	12,8
7-Mar	19,4	133,3	554,1	687,4	9,5
8-Mar	19,0	147,0	627,2	774,2	9,8
9-Mar	19,3	410,9	1721,2	2132,1	14,4
10-Mar	20,6	462,4	1783,3	2245,7	15,6
11-Mar	20,2	391,3	1547,5	1938,8	14,7
12-Mar	19,7	354,8	1447,1	1801,9	14,1
13-Mar	19,6	401,6	1651,1	2052,7	14,5
14-Mar	20,1	479,2	1903,3	2382,5	15,4
15-Mar	21,4	470,6	1726,1	2196,7	16,1
16-Mar	20,9	440,0	1666,9	2106,9	15,6
17-Mar	20,8	545,8	2076,8	2622,6	16,3
18-Mar	21,9	472,3	1685,3	2157,5	16,4
19-Mar	21,5	383,4	1401,4	1784,8	15,3
20-Mar	19,0	211,7	901,5	1113,2	11,5
21-Mar	16,3	189,1	971,4	1160,6	10,1
22-Mar	14,7	184,6	1072,2	1256,8	9,3
23-Mar	13,8	69,5	434,0	503,6	5,7
26-Mar	20,8	355,6	1356,6	1712,2	14,6
27-Mar	19,9	292,9	1180,6	1473,5	13,4
28-Mar	19,2	188,3	790,1	978,5	11,1
29-Mar	19,7	325,4	1328,3	1653,7	13,7
30-Mar	20,9	368,5	1391,8	1760,3	14,9
2-Apr	19,9	337,8	1357,2	1695,0	14,0
3-Apr	19,1	126,3	533,7	660,1	9,2
6-Apr	19,1	396,3	1681,7	2078,0	14,2
7-Apr	19,5	352,8	1460,1	1812,9	13,9
8-Apr	17,3	313,4	1501,4	1814,9	12,4
9-Apr	16,1	127,9	666,9	794,8	8,4
10-Apr	12,1	145,5	1058,6	1204,0	7,6
11-Apr	12,4	52,3	368,1	420,4	4,6
12-Apr	12,7	142,6	977,0	1119,6	7,8
13-Apr	18,2	240,2	1079,9	1320,0	11,8
14-Apr	18,6	302,1	1325,6	1627,8	12,9
15-Apr	19,2	332,9	1399,5	1732,4	13,6
16-Apr	18,6	230,8	1007,1	1238,0	11,8
17-Apr	17,2	304,7	1466,7	1771,4	12,2
21-Apr	15,7	189,0	1011,4	1200,3	9,8
22-Apr	19,5	194,1	799,9	994,0	11,3

23-Apr	18,4	198,8	882,7	1081,5	11,0
24-Apr	19,2	179,1	753,3	932,4	10,8
25-Apr	17,7	223,0	1040,0	1262,9	11,2
26-Apr	19,3	309,6	1290,5	1600,1	13,3
27-Apr	19,8	294,0	1189,1	1483,0	13,3
28-Apr	20,3	281,8	1108,3	1390,1	13,4
29-Apr	17,8	136,8	631,2	768,1	9,2
30-Apr	19,7	134,0	546,8	680,8	9,6
1-May	15,9	43,1	228,1	271,2	4,3
4-May	16,5	123,4	624,5	747,9	8,4
5-May	15,7	73,7	395,4	469,1	6,2
6-May	14,6	63,8	373,8	437,6	5,5
7-May	12,3	67,6	479,8	547,4	5,3
8-May	12,8	186,0	1263,1	1449,1	8,6
9-May	14,9	182,9	1042,8	1225,7	9,4
10-May	18,7	234,4	1018,8	1253,2	11,9
11-May	18,4	291,5	1289,0	1580,5	12,7
12-May	20,3	244,7	962,2	1206,9	12,7
13-May	19,9	298,8	1203,8	1502,6	13,4
14-May	18,6	125,9	551,8	677,8	9,0
15-May	16,4	138,8	706,8	845,6	8,9
16-May	17,3	223,9	1072,2	1296,1	11,1
19-May	17,5	133,1	626,3	759,4	9,0
20-May	15,0	164,5	931,6	1096,1	9,1
21-May	17,6	205,4	958,7	1164,0	10,9
22-May	19,1	159,3	673,0	832,4	10,3
23-May	17,6	62,2	292,3	354,5	5,8
24-May	12,2	97,0	697,1	794,1	6,4
25-May	14,5	61,2	361,6	422,8	5,4
26-May	15,6	211,6	1142,6	1354,2	10,2
27-May	18,4	311,9	1380,3	1692,2	12,9
28-May	19,6	150,5	616,8	767,3	10,1
29-May	17,8	90,9	419,0	510,0	7,4
30-May	15,9	161,5	854,0	1015,5	9,3
31-May	18,5	377,8	1658,8	2036,5	13,7
1-Jun	20,2	310,1	1226,6	1536,7	13,7
2-Jun	22,1	232,2	818,5	1050,7	13,1
3-Jun	19,8	227,2	921,0	1148,1	12,2
4-Jun	19,0	188,8	804,9	993,6	11,0
5-Jun	18,6	201,7	879,9	1081,6	11,2
6-Jun	19,8	141,8	574,8	716,6	9,9
7-Jun	18,7	133,4	580,9	714,3	9,3
8-Jun	18,8	238,3	1031,6	1269,9	12,0
9-Jun	19,5	237,0	980,9	1217,9	12,2
10-Jun	19,9	201,1	808,8	1009,9	11,6
11-Jun	19,5	191,1	790,1	981,2	11,2
12-Jun	18,1	161,9	731,8	893,7	10,0
13-Jun	18,8	209,6	908,1	1117,7	11,4
14-Jun	19,0	121,5	517,1	638,6	8,9
15-Jun	17,3	146,7	699,8	846,5	9,4
16-Jun	16,8	162,8	804,0	966,7	9,6
17-Jun	19,2	243,3	1025,6	1268,9	12,2
18-Jun	17,5	190,7	898,6	1089,3	10,5
19-Jun	17,5	229,2	1080,2	1309,4	11,3
20-Jun	20,7	248,3	950,9	1199,2	12,9

21-Jun	18,4	218,9	968,3	1187,2	11,5
22-Jun	18,5	262,3	1152,2	1414,5	12,3
23-Jun	17,2	173,5	832,3	1005,7	10,1
24-Jun	19,2	206,3	870,3	1076,6	11,5
25-Jun	20,8	133,4	509,3	642,7	9,8
26-Jun	18,8	33,4	144,2	177,6	3,7
27-Jun	18,4	64,9	286,8	351,7	6,1
28-Jun	13,6	176,5	1124,7	1301,2	8,7
29-Jun	18,5	166,5	735,4	901,8	10,3
30-Jun	18,0	149,3	679,4	828,7	9,6
1-Jul	18,4	206,2	913,4	1119,5	11,2
2-Jul	17,8	262,7	1213,2	1475,9	12,0
3-Jul	18,7	264,1	1149,4	1413,5	12,4
4-Jul	19,5	315,2	1301,8	1617,0	13,5
5-Jul	19,6	111,5	457,3	568,7	8,7
6-Jul	20,1	160,3	639,3	799,6	10,6
7-Jul	19,6	226,0	928,7	1154,7	12,1
8-Jul	20,3	135,7	531,2	666,9	9,8
9-Jul	18,0	133,7	610,6	744,3	9,1
10-Jul	17,1	179,7	870,0	1049,7	10,2
11-Jul	17,9	303,9	1391,6	1695,6	12,6
12-Jul	19,5	323,2	1334,0	1657,3	13,6
13-Jul	20,5	319,7	1242,6	1562,3	14,0
14-Jul	19,9	373,5	1506,1	1879,6	14,4
15-Jul	20,0	367,1	1466,4	1833,5	14,4
16-Jul	19,3	287,2	1201,0	1488,2	13,0
17-Jul	20,3	200,5	786,5	987,0	11,7
18-Jul	18,4	172,1	763,3	935,4	10,4
19-Jul	19,5	179,6	739,0	918,6	11,0
20-Jul	20,2	190,2	750,1	940,4	11,5
21-Jul	19,1	248,2	1049,5	1297,7	12,3
22-Jul	21,4	398,4	1464,6	1863,0	15,4
23-Jul	19,8	527,6	2132,8	2660,4	15,6
24-Jul	20,2	553,2	2180,8	2734,0	16,0
25-Jul	21,1	141,6	529,4	671,0	10,2
26-Jul	20,6	191,9	740,0	931,9	11,6
27-Jul	21,0	280,6	1054,6	1335,2	13,7
28-Jul	20,9	267,8	1013,5	1281,3	13,4
29-Jul	21,3	218,9	806,7	1025,6	12,5
30-Jul	21,3	223,9	829,3	1053,2	12,6
31-Jul	20,5	183,4	709,7	893,1	11,4
1-Aug	21,1	290,1	1085,9	1376,0	13,8
2-Aug	20,2	305,6	1209,1	1514,7	13,7
3-Aug	20,8	204,0	779,1	983,1	12,0
4-Aug	23,8	337,2	1082,0	1419,2	15,8
5-Aug	22,9	369,7	1244,2	1613,8	15,8
6-Aug	21,4	321,5	1182,3	1503,8	14,5
7-Aug	20,6	435,9	1676,7	2112,6	15,4
8-Aug	20,8	376,1	1431,9	1808,0	14,9
9-Aug	21,2	105,6	392,7	498,3	8,7
10-Aug	21,7	206,2	744,7	950,9	12,3
11-Aug	23,4	305,5	998,9	1304,4	15,1
12-Aug	23,3	239,6	786,5	1026,0	13,7
13-Aug	23,6	254,7	822,9	1077,6	14,2
14-Aug	22,5	55,3	190,4	245,7	5,7

15-Aug	22,5	259,3	893,6	1153,0	13,8
16-Aug	21,2	440,9	1637,6	2078,5	15,8
17-Aug	22,1	348,1	1226,0	1574,1	15,2
18-Aug	21,4	190,1	698,0	888,1	11,8
19-Aug	20,8	216,1	823,4	1039,5	12,3
20-Aug	20,9	230,3	869,9	1100,1	12,7
21-Aug	20,6	267,9	1031,8	1299,7	13,3
22-Aug	21,2	248,7	923,4	1172,1	13,1
23-Aug	21,2	250,2	931,8	1182,0	13,2
24-Aug	19,9	258,7	1043,1	1301,9	12,8
25-Aug	20,1	268,8	1068,8	1337,6	13,1
26-Aug	21,1	331,6	1240,4	1572,0	14,5
27-Aug	20,4	301,4	1176,9	1478,3	13,7
28-Aug	20,1	261,5	1036,6	1298,2	13,0
29-Aug	20,1	293,3	1169,0	1462,3	13,4
30-Aug	20,6	184,4	712,6	897,0	11,4
31-Aug	23,6	283,8	920,4	1204,2	14,7
1-Sep	22,1	150,3	530,4	680,7	10,7
2-Sep	21,8	148,4	531,5	679,9	10,6
3-Sep	19,7	176,7	719,1	895,8	10,9
4-Sep	20,3	144,2	564,6	708,8	10,1
5-Sep	19,8	221,9	898,4	1120,3	12,1
6-Sep	21,7	106,5	385,2	491,7	8,8
7-Sep	23,3	220,5	724,7	945,2	13,2
8-Sep	20,1	281,2	1115,7	1396,9	13,3
9-Sep	20,4	206,4	807,8	1014,2	11,9
10-Sep	19,3	174,3	731,2	905,5	10,7
11-Sep	19,4	153,3	639,0	792,4	10,1
12-Sep	18,9	215,6	923,8	1139,4	11,6
13-Sep	18,6	417,1	1820,9	2238,0	14,1
14-Sep	21,9	429,3	1528,0	1957,3	16,0
15-Sep	22,1	332,6	1170,1	1502,7	15,0
16-Sep	21,9	219,0	778,8	997,9	12,7
17-Sep	21,8	242,1	867,5	1109,6	13,2
18-Sep	22,6	107,5	368,1	475,6	9,0
19-Sep	22,6	153,2	525,8	679,0	11,0
20-Sep	22,7	325,5	1109,7	1435,2	15,1
21-Sep	21,7	424,7	1532,8	1957,5	15,9
22-Sep	23,9	368,6	1175,9	1544,5	16,3
23-Sep	22,4	336,9	1167,5	1504,4	15,1
24-Sep	21,9	279,2	997,6	1276,7	14,0
25-Sep	21,7	327,3	1182,6	1509,9	14,7
26-Sep	23,3	118,1	388,8	507,0	9,6
27-Sep	22,5	111,6	383,7	495,2	9,2
28-Sep	23,1	383,5	1274,5	1658,0	16,1
29-Sep	23,5	334,2	1086,6	1420,8	15,6
30-Sep	23,9	200,1	637,8	838,0	12,8
1-Oct	22,4	179,3	622,1	801,4	11,8
2-Oct	20,5	265,3	1026,2	1291,5	13,2
3-Oct	20,5	334,7	1299,8	1634,5	14,2
4-Oct	18,8	291,7	1255,9	1547,6	12,9
5-Oct	19,7	117,7	480,9	598,6	8,9
6-Oct	19,8	114,6	462,7	577,3	8,8
7-Oct	19,2	175,9	742,2	918,0	10,7
8-Oct	18,9	159,7	687,5	847,2	10,2

9-Oct	19,8	213,7	863,4	1077,1	11,9
10-Oct	20,7	294,7	1126,1	1420,9	13,8
11-Oct	22,9	307,8	1037,2	1345,0	14,9
12-Oct	21,7	297,7	1074,9	1372,6	14,2
13-Oct	20,8	234,9	896,1	1131,0	12,7
14-Oct	20,7	175,0	669,6	844,6	11,2
15-Oct	22,0	270,6	962,0	1232,7	13,9
16-Oct	22,5	266,9	917,7	1184,7	14,0
17-Oct	21,4	319,0	1174,5	1493,5	14,4
18-Oct	22,4	323,8	1120,8	1444,5	15,0
19-Oct	23,0	338,3	1131,4	1469,7	15,4
20-Oct	19,9	414,4	1663,5	2077,9	14,8
21-Oct	19,3	418,7	1749,5	2168,2	14,5
22-Oct	19,1	410,1	1733,1	2143,2	14,3
23-Oct	19,1	367,5	1556,3	1923,8	13,9
24-Oct	17,1	347,3	1685,0	2032,3	12,6
25-Oct	14,3	259,2	1555,8	1815,0	10,2
26-Oct	13,3	187,6	1224,3	1411,9	8,8
27-Oct	13,3	178,3	1162,5	1340,8	8,7
28-Oct	14,1	210,0	1284,6	1494,7	9,5
29-Oct	13,6	173,6	1102,4	1276,0	8,7
30-Oct	13,1	214,6	1417,1	1631,7	9,1
31-Oct	13,2	213,7	1406,1	1619,8	9,1
1-Nov	12,8	321,2	2194,3	2515,5	9,9
2-Nov	13,3	467,6	3058,2	3525,9	11,0
3-Nov	14,5	484,4	2852,4	3336,8	11,9
4-Nov	19,8	437,7	1773,7	2211,4	14,9
5-Nov	20,1	410,4	1632,9	2043,3	14,9
6-Nov	18,9	408,7	1755,0	2163,7	14,2
7-Nov	19,6	108,6	445,3	553,9	8,5
8-Nov	20,5	192,5	747,2	939,7	11,6
9-Nov	18,7	484,2	2102,2	2586,4	14,6
10-Nov	18,9	337,0	1450,4	1787,4	13,4
11-Nov	19,0	400,2	1707,7	2107,9	14,2
12-Nov	19,8	198,5	804,8	1003,3	11,5
13-Nov	19,1	302,8	1283,3	1586,1	13,1
14-Nov	20,6	183,7	706,0	889,8	11,4
15-Nov	20,2	216,8	858,6	1075,4	12,1
16-Nov	20,0	261,3	1046,4	1307,7	12,9
17-Nov	21,1	257,5	964,0	1221,5	13,3
18-Nov	20,1	247,3	983,6	1230,9	12,7
19-Nov	20,0	302,9	1211,7	1514,7	13,6
20-Nov	18,9	345,6	1482,5	1828,1	13,6
21-Nov	20,9	214,0	810,8	1024,8	12,3
22-Nov	21,0	302,2	1135,8	1438,0	14,0
23-Nov	21,2	287,1	1065,9	1353,0	13,8
24-Nov	21,4	214,6	788,3	1002,9	12,5
25-Nov	19,4	180,1	749,0	929,1	10,9
26-Nov	19,0	221,9	947,6	1169,5	11,7
27-Nov	18,8	245,1	1056,5	1301,6	12,1
28-Nov	18,8	330,9	1426,7	1757,6	13,4
29-Nov	20,1	443,6	1763,5	2207,0	15,2
30-Nov	19,2	391,4	1647,4	2038,9	14,2
1-Dec	19,2	407,0	1711,9	2118,8	14,3
2-Dec	19,7	393,7	1606,6	2000,3	14,5

3-Dec	18,9	401,6	1720,4	2121,9	14,1
4-Dec	19,5	428,7	1767,3	2195,9	14,7
5-Dec	19,4	112,2	467,2	579,4	8,6
6-Dec	19,5	135,0	558,7	693,7	9,5
7-Dec	19,2	456,7	1923,5	2380,3	14,7
8-Dec	19,1	467,9	1986,8	2454,8	14,7
9-Dec	19,2	492,8	2079,1	2571,9	15,0
10-Dec	18,9	390,5	1675,7	2066,2	14,0
11-Dec	19,6	520,2	2138,1	2658,3	15,4
12-Dec	19,6	248,0	1015,1	1263,1	12,5
13-Dec	18,8	224,3	967,4	1191,7	11,7
14-Dec	19,4	204,6	852,3	1056,9	11,5
15-Dec	19,6	303,6	1247,4	1551,0	13,4
16-Dec	20,5	323,9	1257,4	1581,3	14,1
17-Dec	19,8	364,3	1478,1	1842,4	14,2
18-Dec	20,2	427,6	1687,4	2115,1	15,1
19-Dec	21,0	244,1	915,6	1159,6	13,0
20-Dec	21,1	493,7	1848,9	2342,6	16,1
21-Dec	20,2	526,3	2079,9	2606,2	15,8
22-Dec	20,3	393,3	1542,3	1935,6	14,8
23-Dec	22,9	400,3	1349,0	1749,3	16,2
24-Dec	21,3	257,2	948,1	1205,3	13,4
25-Dec	20,1	197,8	787,9	985,7	11,6
26-Dec	19,3	165,6	692,5	858,1	10,5
27-Dec	19,0	167,9	715,5	883,4	10,5
28-Dec	18,5	292,3	1283,6	1575,9	12,7
29-Dec	19,2	264,8	1111,8	1376,7	12,6
30-Dec	18,4	183,9	814,9	998,8	10,7
31-Dec	18,8	311,5	1343,8	1655,3	13,1
1-Jan	19,4	300,6	1247,0	1547,6	13,3
2-Jan	19,9	436,5	1752,6	2189,1	15,0
3-Jan	20,1	397,5	1583,8	1981,4	14,7
4-Jan	20,1	362,7	1443,7	1806,4	14,4
5-Jan	20,6	303,8	1172,0	1475,9	13,8
6-Jan	19,8	374,1	1515,8	1889,9	14,3
7-Jan	20,1	339,7	1347,7	1687,4	14,1
8-Jan	20,4	332,6	1301,0	1633,6	14,1
9-Jan	20,2	420,1	1654,5	2074,5	15,0
10-Jan	20,9	69,0	261,0	329,9	6,6
11-Jan	18,1	181,9	824,9	1006,9	10,5
12-Jan	19,0	252,6	1074,3	1326,9	12,3
13-Jan	18,6	211,6	927,0	1138,5	11,4
14-Jan	18,9	258,8	1111,7	1370,5	12,4
15-Jan	18,9	266,2	1144,1	1410,3	12,5
16-Jan	18,4	248,4	1102,6	1351,1	12,0
17-Jan	19,8	394,1	1593,2	1987,3	14,6
18-Jan	20,4	329,5	1289,5	1619,0	14,1
19-Jan	21,6	265,5	962,8	1228,3	13,6
20-Jan	20,7	356,3	1364,8	1721,2	14,6
21-Jan	22,3	317,2	1106,7	1423,8	14,8
22-Jan	21,3	204,2	755,0	959,2	12,2
23-Jan	21,9	239,6	853,2	1092,8	13,2
24-Jan	20,3	206,9	812,3	1019,1	11,9
25-Jan	20,1	244,0	969,0	1213,0	12,6
26-Jan	19,1	168,6	715,8	884,4	10,5

27-Jan	21,4	400,6	1470,4	1870,9	15,5
28-Jan	21,2	520,4	1937,0	2457,4	16,4
29-Jan	21,4	426,7	1563,8	1990,5	15,7
30-Jan	21,7	360,8	1303,1	1663,9	15,1
31-Jan	22,0	105,0	372,3	477,4	8,8
1-Feb	20,7	246,1	943,4	1189,5	12,9
2-Feb	18,6	390,3	1702,9	2093,2	13,9
3-Feb	18,3	348,7	1553,2	1901,9	13,3
4-Feb	20,0	240,7	965,3	1206,0	12,5
5-Feb	19,8	274,0	1112,5	1386,4	13,0
6-Feb	18,8	301,8	1302,5	1604,3	13,0
7-Feb	18,1	144,6	654,6	799,3	9,5
8-Feb	16,9	218,0	1069,8	1287,8	10,9
9-Feb	17,4	166,6	789,9	956,5	9,9
10-Feb	16,8	150,4	746,1	896,5	9,3
11-Feb	16,8	197,0	972,9	1169,8	10,4
12-Feb	18,0	185,6	847,7	1033,3	10,6
13-Feb	18,7	136,6	595,2	731,8	9,4
14-Feb	17,6	81,9	384,1	466,0	6,9
15-Feb	18,3	39,8	177,5	217,3	4,2
16-Feb	15,7	166,1	894,3	1060,4	9,3
17-Feb	16,4	139,9	713,8	853,7	8,9
18-Feb	19,7	65,7	268,2	333,9	6,2
19-Feb	18,0	136,3	619,8	756,1	9,2
20-Feb	17,2	421,3	2027,2	2448,5	13,3
21-Feb	21,3	352,4	1303,9	1656,3	14,8
22-Feb	20,5	387,0	1503,6	1890,7	14,8
23-Feb	20,4	502,8	1962,0	2464,7	15,8
24-Feb	20,6	427,9	1648,3	2076,2	15,3
25-Feb	21,6	337,4	1226,4	1563,8	14,8
26-Feb	21,3	492,7	1815,3	2308,0	16,3
27-Feb	21,7	456,5	1646,1	2102,6	16,2
28-Feb	21,8	497,8	1783,9	2281,7	16,6
29-Feb	21,9	169,5	604,7	774,3	11,3
1-Mar	22,2	205,6	721,2	926,7	12,5
2-Mar	20,9	356,9	1351,1	1708,0	14,7
3-Mar	22,3	230,5	804,8	1035,3	13,1
6-Mar	21,3	393,0	1453,6	1846,6	15,3
7-Mar	22,0	364,2	1289,5	1653,8	15,3
8-Mar	20,4	419,1	1632,5	2051,6	15,1
9-Mar	20,8	261,0	992,2	1253,2	13,2
10-Mar	19,0	66,3	282,9	349,2	6,2
11-Mar	17,7	64,2	297,5	361,7	5,9
12-Mar	17,7	139,8	652,3	792,1	9,2
13-Mar	17,7	198,3	924,9	1123,2	10,8
14-Mar	19,6	350,7	1434,3	1785,0	14,0
15-Mar	19,8	317,0	1280,9	1597,8	13,7
16-Mar	19,7	434,9	1767,1	2202,0	14,9
17-Mar	19,8	406,8	1649,5	2056,3	14,7
18-Mar	19,9	583,5	2348,2	2931,7	16,0
19-Mar	19,0	418,7	1786,0	2204,7	14,3
20-Mar	17,2	159,6	767,6	927,3	9,7
21-Mar	16,1	242,7	1265,6	1508,4	10,9
22-Mar	17,0	171,6	837,8	1009,3	9,9
23-Mar	16,9	196,3	964,8	1161,1	10,4

24-Mar	16,9	236,8	1161,6	1398,4	11,2
25-Mar	18,6	76,3	334,7	411,0	6,7
26-Mar	15,3	111,2	614,1	725,3	7,7
27-Mar	18,3	323,8	1442,3	1766,1	13,0
28-Mar	18,8	338,2	1457,4	1795,6	13,4
29-Mar	19,0	275,9	1174,9	1450,8	12,7
30-Mar	18,4	516,6	2284,6	2801,2	14,7
31-Mar	19,8	466,5	1886,5	2353,0	15,2
1-Apr	20,4	194,1	757,8	951,8	11,6
2-Apr	21,1	347,4	1301,9	1649,3	14,7
3-Apr	20,6	322,2	1242,3	1564,5	14,1
4-Apr	19,6	289,3	1186,8	1476,1	13,2
5-Apr	19,8	206,0	832,9	1038,9	11,7
6-Apr	17,9	213,7	981,3	1195,1	11,2
7-Apr	18,5	279,3	1231,5	1510,7	12,5
8-Apr	19,4	172,0	714,8	886,8	10,7
9-Apr	19,1	397,4	1680,5	2077,9	14,2
10-Apr	21,8	475,4	1704,7	2180,0	16,4
11-Apr	20,8	502,1	1916,7	2418,8	16,0
12-Apr	20,5	358,4	1391,1	1749,5	14,5
13-Apr	21,3	208,5	768,3	976,9	12,3
14-Apr	18,7	149,2	649,2	798,4	9,8
15-Apr	18,0	150,7	686,3	836,9	9,7
16-Apr	20,0	67,4	269,1	336,5	6,4
17-Apr	19,8	210,1	849,6	1059,7	11,8
18-Apr	21,5	589,9	2153,4	2743,4	17,0
19-Apr	21,5	534,0	1948,1	2482,1	16,7
20-Apr	22,3	549,0	1915,2	2464,2	17,2
21-Apr	21,3	496,5	1829,2	2325,6	16,3
22-Apr	21,7	457,9	1648,2	2106,1	16,2
23-Apr	20,5	141,5	547,2	688,7	10,0
24-Apr	18,2	224,1	1004,9	1228,9	11,5
25-Apr	20,9	459,1	1740,0	2199,1	15,7
26-Apr	21,3	259,1	958,4	1217,4	13,4
27-Apr	20,7	176,7	677,0	853,7	11,2
28-Apr	19,6	224,9	925,3	1150,2	12,0
29-Apr	21,7	229,6	826,5	1056,1	12,9
30-Apr	19,2	196,6	826,4	1023,0	11,3
1-May	19,0	293,9	1253,6	1547,5	13,0
2-May	20,5	329,9	1275,7	1605,7	14,2
3-May	20,2	266,9	1054,0	1320,9	13,1
4-May	19,6	293,1	1203,8	1496,9	13,2
5-May	19,6	542,2	2224,6	2766,8	15,5
6-May	22,4	131,3	455,1	586,4	10,1
7-May	20,6	278,8	1076,6	1355,4	13,4
8-May	21,7	185,1	667,4	852,5	11,8
9-May	19,1	202,2	857,9	1060,1	11,4
10-May	20,6	311,6	1201,2	1512,7	14,0
11-May	20,6	345,4	1332,0	1677,4	14,4
12-May	20,4	288,0	1120,6	1408,7	13,5
13-May	20,2	231,9	918,0	1149,9	12,4
14-May	20,5	416,7	1614,4	2031,1	15,1
15-May	21,6	404,5	1471,3	1875,8	15,6
16-May	21,6	342,8	1243,6	1586,4	14,9
17-May	20,4	582,2	2275,7	2857,9	16,3
18-May	21,3	414,0	1529,0	1943,0	15,5
19-May	20,7	208,9	800,4	1009,4	12,1
Average	19,5	269,06	1103,48	1372,55	12,30

Table D3. Data for Zn dewatering circuit

Year 2007	Date	Thickener U/F				Surge Tank		
		Density		Solid %	Torque	Level	Density	Solid %
		Auto	Manuel					
1-Jan		1770	1760	58,0	1,40	90	1650	52,5
		1820	1780	60,1	1,10	30	1600	50,0
		1830	1820	60,5	1,00	70	1580	48,9
2-Jan		1870	1800	62,0	0,90	75	1660	53,0
		1825	1850	60,3	1,00	59	1620	51,0
		1950	2000	65,0	4,00	86	1720	55,8
3-Jan		1883	1890	62,5	1,00	46	1700	54,9
		1850	1870	61,3	1,00	31	1740	56,7
		2000	2050	66,7	4,00	90	1790	58,8
4-Jan		1780	1750	58,4	1,00	44	1700	54,9
		1850	1780	61,3	0,90	41	1700	54,9
		1840	1860	60,9	1,00	70	1670	53,5
5-Jan		1730	1680	56,3	1,00	93	1640	52,0
		1820	1790	60,1	1,00	52	1600	50,0
		2070	2000	68,9	3,00	85	1740	56,7
6-Jan		1910	1940	63,5	1,00	79	1820	60,1
		1900	1820	63,2	1,40	76	1680	54,0
		1860	1780	61,6	0,90	70	1640	52,0
7-Jan		1950	1950	65,0	1,30	78	1680	54,0
		1820	1780	60,1	1,00	56	1590	49,5
		1920	1920	63,9	1,50	68	1600	50,0
8-Jan		1400	1620	38,1	1,10	36	1680	54,0
		1840	1800	60,9	1,40	65	1750	57,1
		1870	1850	62,0	1,50	74	1680	54,0
9-Jan		1960	1960	65,3	1,50	66	1620	51,0
		1870	1900	62,0	1,20	70	1600	50,0
		1540	1550	46,8	1,00	90	1630	51,5
10-Jan		1980	1920	66,0	1,16	83	1670	53,5
		1700	1800	54,9	0,90	60	1650	52,5
11-Jan		1940	1940	64,6	1,30	72	1650	52,5
		1900	1950	63,2	1,00	71	1630	51,5
		1560	1740	47,9	1,20	90	1640	52,0
12-Jan		1985	1950	66,2	2,30	83	1640	52,0
		1840	1900	60,9	1,20	86	1620	51,0
		1810	1740	59,7	1,00	75	1620	51,0
13-Jan		1885	1840	62,6	1,20	53	1640	52,0
		1780	1840	58,4	0,90	74	1680	54,0
		1990	1950	66,3	1,00	90	1720	55,8
14-Jan		1890	1890	62,8	1,10	58	1700	54,9
		1920	1880	63,9	1,05	88	1720	55,8
		1880	1830	62,4	1,10	84	1750	57,1
15-Jan		1860	1850	61,6	1,10	89	1750	57,1
		1860	1850	61,6	1,20	90	1730	56,3
		1800	1900	59,3	0,90	35	1700	54,9
16-Jan		1870	1840	62,0	1,20	63	1720	55,8
		1720	1770	55,8	1,00	60	1700	54,9
		1830	1830	60,5	1,20	76	1620	51,0
17-Jan		2000	2020	66,7	1,20	70	1750	57,1
		1930	1900	64,2	1,35	70	1740	56,7
		1880	1860	62,4	1,30	65	1880	62,4

18-Jan	1930	1850	64,2	1,30	63	1790	58,8
	1980	1900	66,0	1,40	88	1780	58,4
	2120	2150	70,4	3,54	56	1740	56,7
19-Jan	1880	1900	62,4	1,00	87	1750	57,1
20-Jan	1980	2000	66,0	1,70	96	1800	59,3
	1945	1920	64,8	1,30	64	1670	53,5
21-Jan	1913	1850	63,6	1,30	28	1700	54,9
	1830	1810	60,5	1,80	78	1760	57,6
	1800	1500	59,3	1,25	68	1570	48,4
22-Jan	1930	1800	64,2	1,40	33	1650	52,5
	1890	1810	62,8	1,40	34	1680	54,0
	1960	1900	65,3	1,06	61	1700	54,9
23-Jan	1860	1800	61,6	1,00	45	1740	56,7
	1800	1810	59,3	1,00	35	1720	55,8
	1900	1750	63,2	1,20	90	1700	54,9
24-Jan	1820	1840	60,1	1,00	52	1650	52,5
	1800	1820	59,3	0,90	56	1600	50,0
	1830	1800	60,5	0,90	52	1500	44,4
25-Jan	1860	1740	61,6	0,90	74	1540	46,8
	1870	1890	62,0	1,00	58	1600	50,0
	1850	1860	61,3	0,90	87	1650	52,5
26-Jan	1850	1850	61,3	0,70	84	1640	52,0
	1812	1840	59,7	0,50	40	1630	51,5
	1815	1780	59,9	0,83	82	1630	51,5
27-Jan	1800	1780	59,3	1,00	81	1650	52,5
	1780	1800	58,4	0,96	46	1650	52,5
	1800	1820	59,3	0,07	75	1640	52,0
28-Jan	1800	1810	59,3	0,80	67	1650	52,5
	1950	1970	65,0	1,50	75	1670	53,5
	1960	1950	65,3	1,50	52	1700	54,9
29-Jan	1950	2000	65,0	2,60	54	1670	53,5
	1700	1800	54,9	1,20	75	1620	51,0
	1910	1900	63,5	1,50	59	1510	45,0
30-Jan	1890	1850	62,8	1,30	75	1610	50,5
31-Jan	1880	1850	62,4	1,20	76	1750	57,1
	1920	1860	63,9	1,40	81	1700	54,9
1-Feb	1795	1790	59,1	1,35	49	1630	51,5
	1855	1840	61,5	1,30	65	1700	54,9
	1990	1910	66,3	2,00	79	1800	59,3
2-Feb	1760	1790	57,6	1,15	44	1750	57,1
	1870	1840	62,0	13,00	55	1700	54,9
	1740	1700	56,7	3,80	76	1740	56,7
3-Feb	1800	1790	59,3	1,20	46	1720	55,8
	1800	1800	59,3	1,00	65	1700	54,9
	1940	1940	64,6	1,30	92	1750	57,1
4-Feb	1842	1810	60,9	1,30	66	1700	54,9
	1860	1810	61,6	1,30	63	1700	54,9
	1800	1750	59,3	1,10	82	1670	53,5
5-Feb	1918	1940	63,8	1,35	30	1720	55,8
	1840	1880	60,9	1,45	44	1700	54,9
	2100	1820	69,8	4,50	72	1750	57,1
6-Feb	1830	1800	60,5	1,20	62	1720	55,8
	1810	1750	59,7	1,20	65	1710	55,4
	1830	1810	60,5	1,20	31	1720	55,8

7-Feb	2000	1930	66,7	1,60	93	1750	57,1
	1840	1800	60,9	1,00	51	1700	54,9
8-Feb	1970	1990	65,7	2,20	84	1670	53,5
11-Feb	1950	2000	65,0	2,50	79	1570	48,4
	1970	1960	65,7	2,00	54	1600	50,0
12-Feb	1880	1800	62,4	1,00	90	1750	57,1
	1850	1920	61,3	1,30	70	1750	57,1
	1945	1920	64,8	1,05	72	1620	51,0
14-Feb	1965	1900	65,5	0,87	95	1600	50,0
15-Feb	2100	2100	69,8	2,00	71	1700	54,9
	1870	1900	62,0	1,30	80	1650	52,5
16-Feb	1818	1800	60,0	1,92	76	1650	52,5
17-Feb	1960	1950	65,3	1,30	78	1650	52,5
	1870	1800	62,0	1,20	61	1640	52,0
	1890	1750	62,8	1,50	77	1600	50,0
18-Feb	1910	1880	63,5	2,00	76	1640	52,0
	1950	1960	65,0	2,45	75	1620	51,0
	1750	1800	57,1	0,90	80	1640	52,0
19-Feb	1800	1750	59,3	1,00	83	1650	52,5
	1895	1860	63,0	1,20	56	1680	54,0
	2150	2100	71,3	3,90	90	1750	57,1
20-Feb	1830	1920	60,5	0,90	86	1800	59,3
	1870	1870	62,0	1,05	52	1750	57,1
	1920	1800	63,9	0,80	83	1730	56,3
21-Feb	1850	1830	61,3	0,80	75	1730	56,3
	1720	1740	55,8	0,80	62	1700	54,9
22-Feb	1900	1910	63,2	1,00	69	1610	50,5
	1900	1900	63,2	1,00	65	1620	51,0
	1930	1950	64,2	1,00	70	1700	54,9
23-Feb	1840	1840	60,9	0,90	78	1700	54,9
	1920	1800	63,9	0,90	68	1750	57,1
	2000	2050	66,7	2,00	90	1800	59,3
24-Feb	1850	1830	61,3	0,90	71	1770	58,0
	1870	1820	62,0	1,50	60	1730	56,3
	1910	2000	63,5	1,05	57	1700	54,9
25-Feb	1860	1860	61,6	1,20	73	1680	54,0
	1850	1830	61,3	1,30	72	1720	55,8
	2090	2100	69,5	2,30	70	1700	54,9
26-Feb	1960	1920	65,3	2,07	58	1700	54,9
	1960	1950	65,3	2,00	68	1730	56,3
	1980	1940	66,0	1,30	78	1730	56,3
27-Feb	2000	1920	66,7	1,26	80	1720	55,8
	2000	2000	66,7	1,20	48	1700	54,9
	1950	1920	65,0	0,80	68	1690	54,4
28-Feb	2010	2010	67,0	1,50	74	1690	54,4
	1980	1900	66,0	1,10	80	1700	54,9
	2050	2200	68,3	2,00	36	1660	53,0
1-Mar	1880	1840	62,4	0,90	56	1610	50,5
	1880	1930	62,4	0,80	63	1650	52,5
	1830	1840	60,5	1,00	47	1700	54,9
2-Mar	1940	1800	64,6	1,00	74	1750	57,1
	1880	1870	62,4	0,70	75	1680	54,0

3-Mar	1950	1900	65,0	1,03	92	1700	54,9
	1940	1900	64,6	1,00	55	1700	54,9
	1970	2030	65,7	1,70	57	1680	54,0
4-Mar	1930	1850	64,2	1,00	86	1700	54,9
	1945	1950	64,8	1,90	82	1730	56,3
	1930	1940	64,2	1,00	80	1720	55,8
5-Mar	1935	1890	64,4	1,09	75	1700	54,9
	1940	1950	64,6	1,00	84	1700	54,9
	1950	1950	65,0	1,00	70	1710	55,4
6-Mar	1920	1900	63,9	1,30	66	1700	54,9
	1930	1950	64,2	1,40	82	1680	54,0
	1880	1950	62,4	1,20	60	1680	54,0
7-Mar	1900	1950	63,2	1,60	90	1680	54,0
8-Mar	1960	1940	65,3	1,05	89	1800	59,3
9-Mar	1940	1950	64,6	0,90	62	1650	52,5
	1960	1950	65,3	2,40	56	1680	54,0
	1900	1920	63,2	1,80	79	1700	54,9
10-Mar	1890	1950	62,8	1,70	80	1700	54,9
	1890	1880	62,8	1,80	60	1660	53,0
	1850	1860	61,3	1,50	46	1700	54,9
11-Mar	1950	1950	65,0	2,60	90	1740	56,7
	1890	1900	62,8	1,90	42	1720	55,8
	1870	1890	62,0	1,40	65	1700	54,9
12-Mar	1885	1950	62,6	1,60	60	1650	52,5
	1820	1820	60,1	1,30	30	1700	54,9
	1920	1870	63,9	1,40	81	1690	54,4
13-Mar	1910	1850	63,5	1,60	40	1630	51,5
	1845	1850	61,1	1,25	45	1650	52,5
	1815	1790	59,9	1,30	69	1620	51,0
14-Mar	1970	2040	65,7	2,60	91	1710	55,4
	1950	1920	65,0	1,40	82	1700	54,9
	1840	1800	60,9	1,30	57	1680	54,0
15-Mar	1890	1910	62,8	2,30	63	1700	54,9
	1875	1900	62,2	1,85	42	1680	54,0
	1730	1650	56,3	1,00	86	1660	53,0
16-Mar	1920	1940	63,9	2,00	87	1750	57,1
	1820	1790	60,1	1,20	64	1580	48,9
	1920	1950	63,9	1,85	64	1700	54,9
17-Mar	1870	1910	62,0	1,30	46	1680	54,0
	1860	1900	61,6	1,40	60	1700	54,9
	1915	1900	63,7	1,60	89	1700	54,9
18-Mar	1890	1920	62,8	1,70	64	1770	58,0
	1770	1800	58,0	1,00	85	1580	48,9
	1880	1900	62,4	1,90	74	1680	54,0
19-Mar	1920	1950	63,9	3,50	65	1590	49,5
	1890	1830	62,8	1,50	57	1630	51,5
	1930	1980	64,2	2,00	70	1650	52,5
20-Mar	1900	1880	63,2	1,40	33	1650	52,5
	1860	1830	61,6	2,00	64	1670	53,5
	1730	1950	56,3	4,00	85	1650	52,5
21-Mar	1670	1680	53,5	1,36	67	1600	50,0
	1780	1750	58,4	0,90	71	1550	47,3
	1880	1980	62,4	0,75	81	1660	53,0
22-Mar	1700	1680	54,9	1,00	78	1600	50,0
	1860	1860	61,6	1,50	68	1550	47,3
	1920	1930	63,9	1,00	64	1600	50,0
23-Mar	1910	1950	63,5	1,70	66	1620	51,0
	1850	1830	61,3	2,20	75	1600	50,0
25-Mar	1740	1840	56,7	0,50	67	1570	48,4

26-Mar	1840	1880	60,9	2,10	73	1550	47,3
	1850	1950	61,3	1,40	76	1600	50,0
	1750	1790	57,1	1,20	64	1730	56,3
27-Mar	1840	1900	60,9	1,00	45	1690	54,4
	1860	1950	61,6	2,00	60	1750	57,1
	1825	1860	60,3	1,25	45	1730	56,3
28-Mar	1812	1480	59,7	1,20	55	1700	54,9
	1900	1950	63,2	1,36	58	1700	54,9
29-Mar	1875	1910	62,2	1,10	52	1720	55,8
	1820	1870	60,1	1,00	55	1760	57,6
30-Mar	2000	1940	66,7	1,60	64	1800	59,3
	1880	1940	62,4	1,40	47	1780	58,4
	1890	1880	62,8	0,90	57	1740	56,7
31-Mar	1000	1200	0,0	0,60	70	1750	57,1
1-Apr	1950	2010	65,0	2,50	78	1710	55,4
	1900	1850	63,2	1,40	33	1790	58,8
2-Apr	1850	1880	61,3	1,30	53	1650	52,5
	1800	1830	59,3	1,20	65	1700	54,9
	1865	1860	61,8	0,90	65	1740	56,7
3-Apr	1940	1950	64,6	1,50	73	1700	54,9
	1960	2060	65,3	1,90	53	1840	60,9
4-Apr	2060	2100	68,6	2,60	35	1800	59,3
	1850	1850	61,3	1,00	55	1800	59,3
7-Apr	1960	2030	65,3	1,60	44	1830	60,5
	1950	1940	65,0	1,40	39	1650	52,5
	1915	1940	63,7	1,60	51	1650	52,5
8-Apr	1600	1550	50,0	0,95	74	1750	57,1
	1850	1850	61,3	1,00	43	1750	57,1
	1830	1820	60,5	0,80	67	1780	58,4
9-Apr	1670	1750	53,5	0,90	68	1750	57,1
	1890	1820	62,8	0,80	48	1780	58,4
	1880	1920	62,4	0,80	64	1700	54,9
10-Apr	1850	1810	61,3	0,80	87	1650	52,5
	1890	1900	62,8	1,10	58	1600	50,0
11-Apr	1900	1860	63,2	1,20	88	1840	60,9
	1850	1860	61,3	1,00	58	1750	57,1
12-Apr	1880	1950	62,4	1,00	70	1600	50,0
13-Apr	1950	1920	65,0	2,00	91	1900	63,2
	1950	2000	65,0	1,10	73	1700	54,9
	1800	1870	59,3	0,80	92	1720	55,8
14-Apr	1950	1920	65,0	1,70	69	1780	58,4
	1960	1930	65,3	1,30	70	1730	56,3
	2110	2190	70,1	1,40	96	1860	61,6
15-Apr	1860	1850	61,6	0,90	35	1800	59,3
	1956	1970	65,2	1,30	77	1820	60,1
	1960	2080	65,3	1,10	64	1780	58,4
16-Apr	1800	1850	59,3	1,10	26	1760	57,6
	1830	1950	60,5	8,60	82	1750	57,1
	1900	2000	63,2	0,90	48	1770	58,0
17-Apr	1700	1780	54,9	1,10	53	1750	57,1
	1920	1950	63,9	1,80	67	1700	54,9
	1870	1970	62,0	1,30	95	1680	54,0
18-Apr	1850	1870	61,3	0,80	67	1650	52,5
	1710	1800	55,4	0,90	50	1700	54,9
20-Apr	1926	1820	64,1	0,90	58	1610	50,5
21-Apr	2017	2000	67,2	1,90	78	1700	54,9
	1900	1950	63,2	1,20	80	1760	57,6
	1850	1940	61,3	0,65	60	1750	57,1
22-Apr	1950	2000	65,0	1,90	65	1750	57,1
	1890	2020	62,8	0,95	63	1770	58,0
23-Apr	1900	2000	63,2	1,00	70	1800	59,3
	1850	1880	61,3	1,10	92	1620	51,0
	1900	2020	63,2	1,15	56	1650	52,5

24-Apr	1920	2050	63,9	1,30	63	1700	54,9
	1880	1950	62,4	1,30	72	1730	56,3
	1900	1920	63,2	1,50	67	1750	57,1
25-Apr	1890	2000	62,8	1,30	63	1700	54,9
	1940	2000	64,6	1,00	80	1780	58,4
	1930	1980	64,2	0,70	96	1750	57,1
26-Apr	1930	2000	64,2	1,00	79	1750	57,1
	1500	1540	44,4	1,00	63	1730	56,3
	1870	1900	62,0	1,50	75	1540	46,8
27-Apr	1910	2000	63,5	1,00	58	1750	57,1
	1939	2000	64,6	1,35	81	1730	56,3
	1900	1960	63,2	1,00	50	1760	57,6
28-Apr	1900	1920	63,2	1,70	62	1780	58,4
	1850	1940	61,3	2,00	51	1750	57,1
	1882	1950	62,5	0,59	30	1750	57,1
29-Apr	1950	2040	65,0	2,20	65	1850	61,3
	1910	1920	63,5	1,24	62	1800	59,3
	1890	1930	62,8	1,40	56	1750	57,1
30-Apr	1910	1950	63,5	1,30	87	1820	60,1
	1800	1950	59,3	0,90	56	1770	58,0
	1880	1980	62,4	0,90	58	1750	57,1
3-May	1850	2000	61,3	1,90	79	1890	62,8
2-May	1950	1980	65,0	1,00	87	1750	57,1
4-May	1900	2020	63,2	1,60	83	1770	58,0
	1920	1940	63,9	1,80	72	1730	56,3
	1900	2000	63,2	1,40	48	1750	57,1
5-May	1890	2000	62,8	1,15	70	1770	58,0
	1800	1880	59,3	1,90	61	1730	56,3
	1860	1880	61,6	0,70	51	1690	54,4
6-May	1890	1940	62,8	1,49	78	1720	55,8
	1900	1930	63,2	1,00	58	1780	58,4
	1620	1780	51,0	0,70	78	1750	57,1
7-May	1774	1870	58,2	0,85	80	1720	55,8
	1800	1750	59,3	0,70	50	1730	56,3
	1850	1830	61,3	1,10	59	2730	84,5
8-May	1790	1820	58,8	0,78	64	1730	56,3
	1990	2050	66,3	0,86	81	1720	55,8
9-May	1790	1810	58,8	0,61	63	1670	53,5
	1840	1850	60,9	1,40	82	1750	57,1
	1750	1850	57,1	1,60	81	1700	54,9
10-May	1780	1790	58,4	0,90	55	1680	54,0
	1810	1920	59,7	1,70	68	1700	54,9
	2380	1980	77,3	1,50	91	1700	54,9
11-May	2080	2000	69,2	1,50	95	1710	55,4
	1800	1800	59,3	0,90	78	1800	59,3
	1940	1940	64,6	1,00	55	1800	59,3
12-May	1950	1900	65,0	1,00	45	1750	57,1
	1920	1950	63,9	0,90	71	1850	61,3
	1850	1910	61,3	0,75	69	1790	58,8
13-May	1870	1750	62,0	0,80	61	1780	58,4
	1950	1900	65,0	1,13	79	1750	57,1
	1910	1920	63,5	1,20	65	1720	55,8
14-May	1940	1880	64,6	1,30	90	1750	57,1
	1880	1940	62,4	1,40	80	1730	56,3
	1970	1960	65,7	1,20	55	1750	57,1
15-May	1880	2000	62,4	1,50	52	1720	55,8
	1900	1920	63,2	1,20	73	1750	57,1
	1850	1900	61,3	1,80	88	1670	53,5

16-May	1920	1950	63,9	1,00	87	1720	55,8
	1810	1810	59,7	1,10	79	1700	54,9
	1890	1910	62,8	1,80	59	1700	54,9
18-May	1880	1940	62,4	0,90	76	1730	56,3
	1840	1890	60,9	0,60	86	1750	57,1
19-May	1880	2000	62,4	0,50	75	1780	58,4
	1800	1820	59,3	0,70	71	1750	57,1
	1900	1910	63,2	1,20	66	1740	56,7
20-May	1840	1970	60,9	1,45	61	1690	54,4
	1820	1860	60,1	0,70	55	1700	54,9
	1850	1900	61,3	0,67	64	1690	54,4
21-May	1880	1920	62,4	0,80	63	1700	54,9
	1800	1840	59,3	0,60	80	1680	54,0
	1890	1900	62,8	0,48	72	1730	56,3
22-May	1900	1970	63,2	0,70	76	1750	57,1
	1820	1800	60,1	0,53	60	1720	55,8
23-May	1920	1950	63,9	2,30	70	1750	57,1
	1710	1700	55,4	0,50	88	1700	54,9
24-May	1800	1880	59,3	0,60	57	1750	57,1
	1875	1920	62,2	0,50	59	1770	58,0
	1860	2000	61,6	0,60	61	1750	57,1
25-May	1800	1780	59,3	0,50	95	1750	57,1
	1920	1600	63,9	0,80	48	1770	58,0
	1930	1950	64,2	0,60	75	1780	58,4
26-May	1800	1880	59,3	0,40	88	1730	56,3
	1750	1790	57,1	0,55	93	1700	54,9
27-May	1980	2020	66,0	1,50	68	1840	60,9
	2060	2110	68,6	2,16	62	1880	62,4
	2000	2080	66,7	2,50	90	1850	61,3
28-May	1960	1920	65,3	1,20	60	1640	52,0
	1950	1990	65,0	50,00	1,9	1750	57,1
	1850	1860	61,3	0,70	70	1700	54,9
29-May	2058	2080	68,5	2,60	96	1640	52,0
	1900	1920	63,2	0,75	70	1750	57,1
30-May	1855	1830	61,5	0,47	53	1700	54,9
	1920	1850	63,9	2,16	78	1720	55,8
	1730	1660	56,3	0,60	65	1700	54,9
31-May	1820	1840	60,1	77,00	2140	1730	56,3
	1950	1930	65,0	1,50	85	1820	60,1
	1800	1800	59,3	1,00	42	1750	57,1
1-Jun	1923	1920	64,0	1,80	58	1400	38,1
	1920	1810	63,9	1,10	88	1180	20,3
	1970	1980	65,7	2,00	80	1780	58,4
2-Jun	1880	1860	62,4	0,94	66	1740	56,7
	1890	1870	62,8	0,90	66	1720	55,8
	1900	1900	63,2	0,40	53	1770	58,0
3-Jun	1930	1900	64,2	1,95	46	1700	54,9
	1900	1950	63,2	1,10	77	1720	55,8
	1940	1960	64,6	1,90	89	1760	57,6
4-Jun	1870	1850	62,0	1,75	88	1740	56,7
	1950	2000	65,0	2,40	87	1700	54,9
	1870	1980	62,0	2,60	95	1680	54,0
5-Jun	1880	1950	62,4	2,50	47	1780	58,4
	1900	1950	63,2	1,00	55	1750	57,1
	1850	1860	61,3	1,89	57	1700	54,9
6-Jun	1890	1900	62,8	2,20	62	1760	57,6
	1920	1980	63,9	1,90	71	1780	58,4
	1880	1800	62,4	1,25	87	1770	58,0
7-Jun	1900	1930	63,2	1,60	47	1770	58,0
	1890	1870	62,8	2,29	69	1690	54,4

8-Jun	1900	1850	63,2	1,90	72	1720	55,8
	1900	1900	63,2	1,75	62	1690	54,4
	1878	1780	62,3	1,98	71	1720	55,8
9-Jun	1910	1900	63,5	1,30	68	1350	34,6
	1900	1930	63,2	1,00	68	1750	57,1
	1970	1940	65,7	1,10	65	1750	57,1
10-Jun	1950	1950	65,0	2,00	68	1770	58,0
	1960	1990	65,3	1,50	79	1820	60,1
	1780	1780	58,4	0,60	88	1770	58,0
11-Jun	1910	1950	63,5	1,20	53	1700	54,9
	1850	1900	61,3	0,80	92	1770	58,0
	1830	1820	60,5	0,60	65	1750	57,1
12-Jun	1800	1900	59,3	1,00	70	1750	57,1
	1940	1890	64,6	1,12	62	1760	57,6
	1850	1870	61,3	0,90	52	1760	57,6
13-Jun	1830	1880	60,5	0,70	84	1720	55,8
	1920	1940	63,9	1,00	69	1750	57,1
	1900	1890	63,2	1,00	83	1740	56,7
14-Jun	1900	1930	63,2	0,80	76	1740	56,7
	1950	1910	65,0	1,60	62	1720	55,8
	1720	1780	55,8	0,50	60	1650	52,5
15-Jun	1900	1800	63,2	0,50	72	1800	59,3
	1945	2010	64,8	0,85	58	1800	59,3
	1900	1900	63,2	0,50	48	1770	58,0
16-Jun	1900	1900	63,2	0,75	51	1800	59,3
	1910	1920	63,5	0,65	77	1790	58,8
	1910	1940	63,5	0,70	78	1780	58,4
17-Jun	1900	1950	63,2	0,95	76	1790	58,8
	1910	1980	63,5	0,90	50	1800	59,3
	1910	1900	63,5	0,70	60	1800	59,3
7-Jun	1930	2000	64,2	1,00	50	1780	58,4
	1900	1900	63,2	0,54	71	1790	58,8
19-Jun	1930	2000	64,2	1,10	75	1870	62,0
	1900	1890	63,2	0,90	74	1700	54,9
	1890	1920	62,8	0,60	72	1650	52,5
20-Jun	1840	1915	60,9	1,00	45	1750	57,1
	1950	1960	65,0	1,30	90	1800	59,3
	1840	1850	60,9	0,60	84	1600	50,0
21-Jun	1930	1910	64,2	0,75	57	1750	57,1
	2000	1940	66,7	1,00	65	1780	58,4
	1882	1900	62,5	0,75	71	1610	50,5
22-Jun	1850	1840	61,3	0,70	65	1760	57,6
	1970	1950	65,7	2,90	95	1780	58,4
	1920	1920	63,9	1,30	84	1750	57,1
23-Jun	1830	1800	60,5	0,95	65	1700	54,9
	1800	1700	59,3	1,30	70	1750	57,1
	1920	1900	63,9	1,70	37	1810	59,7
24-Jun	1910	1930	63,5	1,00	76	1780	58,4
	1910	1940	63,5	1,00	70	1770	58,0
	1940	2000	64,6	1,40	87	1780	58,4
25-Jun	1850	1870	61,3	1,00	81	1750	57,1
	1930	2020	64,2	1,15	69	1760	57,6
	1350	1400	34,6	0,70	88	1750	57,1
26-Jun	1905	1890	63,3	1,00	59	1750	57,1
27-Jun	1950	2020	65,0	1,10	83	1600	50,0
28-Jun	1850	1900	61,3	0,80	85	1600	50,0
	1800	1880	59,3	0,80	92	1700	54,9
	1990	2000	66,3	0,90	90	1780	58,4
29-Jun	1900	1950	63,2	0,50	90	1720	55,8
	1900	1900	63,2	0,60	84	1730	56,3
	1900	1870	63,2	0,70	67	1750	57,1

30-Jun	1970	2010	65,7	0,70	81	1750	57,1
	1990	2040	66,3	1,00	65	1820	60,1
	1892	1900	62,9	0,91	71	1700	54,9
1-Jul	1950	1950	65,0	1,11	84	1780	58,4
	1900	1920	63,2	0,70	90	1770	58,0
	1920	1900	63,9	0,65	52	1750	57,1
2-Jul	1950	2010	65,0	0,80	75	1760	57,6
	1880	1940	62,4	0,70	70	1740	56,7
	1900	1950	63,2	0,70	48	1750	57,1
3-Jul	1990	1980	66,3	0,60	86	1750	57,1
	1970	1970	65,7	1,00	80	1760	57,6
	2100	2080	69,8	2,50	96	1780	58,4
4-Jul	1920	1910	63,9	0,70	85	1750	57,1
	1900	1840	63,2	0,80	83	1780	58,4
	1938	1900	64,5	1,00	68	1760	57,6
5-Jul	1905	1930	63,3	0,70	48	1790	58,8
	1900	1850	63,2	1,00	95	1780	58,4
6-Jul	1950	1950	65,0	0,70	92	1780	58,4
7-Jul	1870	1750	62,0	1,00	63	1720	55,8
	1950	1960	65,0	1,00	84	1830	60,5
	2200	2150	72,7	4,70	96	1820	60,1
8-Jul	1850	1900	61,3	0,90	73	1750	57,1
	1900	1920	63,2	1,30	85	1800	59,3
	1800	1810	59,3	0,80	72	1790	58,8
9-Jul	1900	1900	63,2	0,80	73	1820	60,1
	1900	1880	63,2	1,36	72	1780	58,4
	1907	1910	63,4	1,30	89	1710	55,4
10-Jul	1910	1940	63,5	0,50	85	1680	54,0
	1910	1950	63,5	1,20	63	1700	54,9
	2070	2080	68,9	2,80	96	1700	54,9
11-Jul	1900	1960	63,2	0,75	81	1670	53,5
	2010	2030	67,0	2,60	77	1640	52,0
	1904	1990	63,3	1,20	69	1610	50,5
12-Jul	1880	1890	62,4	0,96	79	1760	57,6
	1930	1880	64,2	1,20	68	1750	57,1
	1910	1940	63,5	1,00	71	1660	53,0
13-Jul	1920	1930	63,9	0,90	95	1720	55,8
	1870	1910	62,0	1,40	84	1650	52,5
	1930	1990	64,2	2,00	70	1600	50,0
14-Jul	1990	1980	66,3	3,70	66	1690	54,4
	1900	1920	63,2	1,60	60	1680	54,0
	1970	2050	65,7	5,00	80	1670	53,5
15-Jul	1900	1940	63,2	2,15	66	1670	53,5
	1930	1920	64,2	0,60	85	1690	54,4
	1840	1870	60,9	1,30	61	1630	51,5
16-Jul	1866	2000	61,9	1,20	70	1800	59,3
	1950	1950	65,0	1,66	66	1660	53,0
	2170	2230	71,9	10,30	95	1730	56,3
17-Jul	1830	1860	60,5	1,00	75	1600	50,0
	1840	1990	60,9	1,10	80	1630	51,5
	1800	1760	59,3	0,90	65	1650	52,5
18-Jul	1830	1900	60,5	1,20	55	1680	54,0
	1910	1890	63,5	1,24	71	1640	52,0
	1900	1930	63,2	2,20	87	1650	52,5
19-Jul	1980	2000	66,0	3,00	85	1640	52,0
	1850	1900	61,3	1,15	77	1700	54,9
	1900	1930	63,2	1,20	72	1750	57,1
20-Jul	1960	1950	65,3	1,20	50	1720	55,8
	1880	1910	62,4	1,20	86	1730	56,3
	1900	1990	63,2	0,90	64	1670	53,5

21-Jul	1960	1940	65,3	1,30	85	1740	56,7
	1850	1900	61,3	1,00	85	1630	51,5
	1935	1980	64,4	0,95	85	1730	56,3
22-Jul	1880	1910	62,4	1,00	84	1620	51,0
	1860	1900	61,6	0,80	82	1700	54,9
	2115	2100	70,3	3,50	95	1880	62,4
23-Jul	1920	1980	63,9	1,38	90	1730	56,3
	2030	2070	67,7	1,10	76	1840	60,9
	1870	1930	62,0	0,50	92	1700	54,9
24-Jul	2130	2190	70,7	4,30	58	1820	60,1
	1950	2020	65,0	1,20	70	1760	57,6
	2090	2100	69,5	5,00	88	1820	60,1
25-Jul	2150	2180	71,3	5,00	93	1910	63,5
27-Jul	1880	1920	62,4	0,74	63	1710	55,4
	1950	1960	65,0	1,00	51	1720	55,8
	1900	1910	63,2	1,20	92	1700	54,9
28-Jul	1900	1890	63,2	1,15	67	1690	54,4
	1925	1970	64,1	0,90	67	1700	54,9
	1900	1930	63,2	1,20	90	1700	54,9
29-Jul	1900	1930	63,2	0,60	92	1680	54,0
	1930	1950	64,2	1,00	65	1700	54,9
	1880	1900	62,4	0,60	30	1700	54,9
30-Jul	1890	1920	62,8	0,60	81	1680	54,0
	1930	1950	64,2	1,30	50	1700	54,9
	1980	1990	66,0	4,00	94	1650	52,5
31-Jul	1870	1900	62,0	0,80	71	1600	50,0
	2000	1950	66,7	1,90	47	1740	56,7
	1865	1900	61,8	0,65	90	1650	52,5
1-Aug	1700	1780	54,9	0,50	72	1590	49,5
	1950	1930	65,0	1,20	75	1710	55,4
	1910	1900	63,5	1,00	84	1650	52,5
2-Aug	1900	1930	63,2	0,80	67	1650	52,5
	1975	2040	65,8	1,20	93	1660	53,0
3-Aug	1850	1900	61,3	0,90	95	1730	56,3
	1880	1860	62,4	0,90	65	1600	50,0
4-Aug	1900	1900	63,2	0,76	72	1680	54,0
	1750	1880	57,1	0,40	70	1620	51,0
5-Aug	1890	1910	62,8	0,60	76	1670	53,5
	1890	1910	62,8	0,90	68	1610	50,5
6-Aug	1950	1930	65,0	0,70	87	1670	53,5
	1950	2010	65,0	1,20	60	1670	53,5
7-Aug	1950	1920	65,0	1,00	67	1700	54,9
	1950	2010	65,0	0,90	84	1710	55,4
8-Aug	1930	2010	64,2	1,00	60	1720	55,8
	1920	1970	63,9	0,80	76	1760	57,6
	1860	1880	61,6	0,70	67	1680	54,0
9-Aug	1950	1960	65,0	0,80	80	1700	54,9
	1950	1960	65,0	2,10	86	1600	50,0
10-Aug	1920	1890	63,9	0,70	72	1650	52,5
	1947	1930	64,9	0,93	62	1520	45,6
	1940	1970	64,6	1,30	95	1580	48,9
11-Aug	1980	1980	66,0	1,00	75	1650	52,5
	2000	2030	66,7	1,10	90	1680	54,0
	2000	2030	66,7	0,90	68	1720	55,8
12-Aug	2000	1980	66,7	2,50	68	1680	54,0
	1960	1960	65,3	0,60	90	1700	54,9
	1990	1980	66,3	0,61	67	1700	54,9
13-Aug	1980	1990	66,0	0,70	95	1700	54,9
	2000	2010	66,7	0,70	67	1720	55,8
	1995	2030	66,5	0,90	65	1750	57,1

14-Aug	1980	2000	66,0	0,80	65	1640	52,0
15-Aug	1960	2020	65,3	0,50	62	1760	57,6
	1885	1910	62,6	0,40	45	1700	54,9
16-Aug	2070	2070	68,9	0,70	93	1760	57,6
	1930	1970	64,2	0,60	57	1720	55,8
	1930	1950	64,2	0,65	51	1750	57,1
17-Aug	1970	1980	65,7	0,70	75	1780	58,4
	1970	1970	65,7	2,00	58	1720	55,8
	1920	1900	63,9	1,10	52	1640	52,0
18-Aug	1860	1900	61,6	0,54	82	1680	54,0
	1890	1880	62,8	0,30	55	1600	50,0
19-Aug	1900	1920	63,2	0,70	50	1650	52,5
	1910	1950	63,5	0,50	62	1660	53,0
	1950	1940	65,0	0,40	62	1630	51,5
20-Aug	1940	1960	64,6	0,50	52	1700	54,9
	1940	1960	64,6	0,80	83	1710	55,4
	1930	1950	64,2	0,50	78	1730	56,3
21-Aug	1920	1980	63,9	0,60	82	1750	57,1
	1950	1960	65,0	0,70	89	1750	57,1
	2030	2010	67,7	0,40	96	1750	57,1
22-Aug	1900	1960	63,2	0,40	84	1740	56,7
	1950	1950	65,0	0,50	75	1750	57,1
	1930	1950	64,2	0,60	76	1730	56,3
23-Aug	1950	1970	65,0	0,70	65	1700	54,9
	1950	1980	65,0	1,10	75	1700	54,9
	1900	1930	63,2	0,55	73	1720	55,8
24-Aug	1900	1950	63,2	0,50	71	1720	55,8
	1920	1950	63,9	0,95	70	1700	54,9
	1950	1980	65,0	1,30	60	1670	53,5
25-Aug	1930	1940	64,2	0,80	64	1730	56,3
	1885	1900	62,6	0,90	42	1850	61,3
	1870	1830	62,0	0,80	63	1680	54,0
26-Aug	1940	1900	64,6	1,20	82	1650	52,5
	1890	1900	62,8	1,20	66	1640	52,0
	1900	1980	63,2	0,90	89	1640	52,0
27-Aug	1930	1980	64,2	1,10	70	1630	51,5
	1915	1920	63,7	1,20	70	1740	56,7
	1930	1920	64,2	0,70	78	1750	57,1
28-Aug	1910	1930	63,5	0,70	88	1730	56,3
	1835	1860	60,7	1,00	90	1710	55,4
	1804	1740	59,4	0,80	80	1560	47,9
29-Aug	1940	1940	64,6	0,75	55	1720	55,8
	1890	1900	62,8	0,80	33	1750	57,1
	1920	1960	63,9	1,00	93	1800	59,3
30-Aug	2030	2050	67,7	1,60	73	1810	59,7
	1920	1930	63,9	0,70	50	1730	56,3
31-Aug	1900	1930	63,2	0,76	58	1750	57,1
	1900	1890	63,2	1,00	67	1720	55,8
	1920	1950	63,9	0,39	78	1690	54,4
1-Sep	1920	1960	63,9	0,60	59	1700	54,9
	1890	1900	62,8	0,70	69	1670	53,5
	1920	1970	63,9	0,40	59	1620	51,0
2-Sep	1900	1920	63,2	0,20	64	1650	52,5
	1907	1950	63,4	0,90	63	1680	54,0
	1920	1910	63,9	0,60	72	1720	55,8
3-Sep	1880	1900	62,4	0,90	75	1680	54,0
	1930	1950	64,2	0,80	78	1620	51,0
	1920	2050	63,9	0,70	85	1610	50,5
4-Sep	1890	1910	62,8	0,90	80	1645	52,3
	1930	200	64,2	0,70	91	1700	54,9
	1940	1860	64,6	0,70	74	1720	55,8

5-Sep	1970	1900	65,7	0,50	70	1740	56,7
	1920	1990	63,9	0,60	81	1750	57,1
	1980	1990	66,0	0,70	70	1750	57,1
6-Sep	1980	1970	66,0	0,60	85	1680	54,0
	1900	1930	63,2	0,50	81	1740	56,7
7-Sep	2100	2180	69,8	1,70	83	1780	58,4
	1860	1910	61,6	0,40	70	1740	56,7
8-Sep	1950	1960	65,0	0,80	76	1760	57,6
	1950	1980	65,0	0,70	80	1720	55,8
	1900	1900	63,2	0,60	88	1710	55,4
9-Sep	1930	1890	64,2	0,55	77	1700	54,9
	1920	1970	63,9	0,60	77	1720	55,8
	1930	1970	64,2	0,90	82	1700	54,9
10-Sep	1890	1980	62,8	0,80	80	1680	54,0
	1880	1930	62,4	0,80	82	1670	53,5
	1870	1920	62,0	0,60	65	1700	54,9
11-Sep	1920	1970	63,9	0,55	68	1700	54,9
	1880	1950	62,4	0,80	71	1710	55,4
	2080	2040	69,2	2,20	65	1750	57,1
12-Sep	1890	1930	62,8	0,80	62	1730	56,3
	1920	1940	63,9	1,00	27	1750	57,1
	1910	1930	63,5	0,60	65	1720	55,8
13-Sep	2100	2080	69,8	0,50	38	1770	58,0
	1940	1980	64,6	0,95	52	1730	56,3
	1930	1930	64,2	0,70	72	1790	58,8
14-Sep	2050	2090	68,3	1,40	92	1800	59,3
	1967	1950	65,5	1,90	65	1750	57,1
	2070	2000	68,9	3,30	53	1700	54,9
15-Sep	1970	2000	65,7	1,30	83	1780	58,4
	2040	2100	68,0	1,10	54	1800	59,3
	1900	1910	63,2	0,50	57	1820	60,1
16-Sep	1840	1880	60,9	1,00	73	1760	57,6
	1985	2010	66,2	1,30	51	1800	59,3
	2000	1770	66,7	1,60	76	1800	59,3
17-Sep	1950	1980	65,0	0,90	68	1750	57,1
	1930	1970	64,2	0,90	61	1730	56,3
	1910	1960	63,5	0,90	66	1750	57,1
18-Sep	1930	1910	64,2	0,62	65	1780	58,4
	1920	1910	63,9	0,90	58	1840	60,9
19-Sep	1930	1940	64,2	1,20	82	1800	59,3
	2030	2020	67,7	2,00	80	1800	59,3
20-Sep	1950	1960	65,0	1,00	71	1750	57,1
	1940	1930	64,6	0,60	77	1770	58,0
	1920	1990	63,9	0,60	77	1800	59,3
21-Sep	1910	1930	63,5	0,75	39	1790	58,8
	1920	1910	63,9	0,70	67	1790	58,8
	1960	1960	65,3	0,80	84	1830	60,5
22-Sep	2080	2070	69,2	1,20	75	1800	59,3
	2000	2020	66,7	1,20	54	1780	58,4
	2160	2080	71,6	3,50	93	1850	61,3
23-Sep	1985	1980	66,2	1,00	67	1800	59,3
	1980	1980	66,0	1,00	74	1820	60,1
	1960	2000	65,3	0,80	77	1780	58,4
24-Sep	1920	1940	63,9	1,00	71	1720	55,8
	1955	1980	65,1	0,90	91	1750	57,1
	1930	2000	64,2	1,50	87	1750	57,1
25-Sep	1910	1850	63,5	0,80	78	1800	59,3
	1930	1980	64,2	1,00	75	1830	60,5
	2020	2040	67,3	1,00	87	1860	61,6

26-Sep	1940	1980	64,6	1,00	86	1810	59,7
	1930	1980	64,2	0,80	61	1800	59,3
28-Sep	1900	1910	63,2	0,90	69	1790	58,8
	1990	2040	66,3	1,25	85	1810	59,7
	2000	2040	66,7	1,25	71	1860	61,6
29-Sep	1935	1940	64,4	0,90	74	1790	58,8
	2030	2050	67,7	0,90	92	1860	61,6
	1900	1910	63,2	0,75	60	1860	61,6
30-Sep	1900	1950	63,2	0,50	76	1800	59,3
	1900	1970	63,2	1,00	74	1750	57,1
	1840	1830	60,9	0,60	62	1730	56,3
1-Oct	1920	1990	63,9	0,80	67	1750	57,1
	1890	1900	62,8	0,40	74	1730	56,3
2-Oct	1900	1920	63,2	0,50	74	1750	57,1
	1920	1950	63,9	0,90	78	1760	57,6
	2030	2050	67,7	1,60	74	1780	58,4
3-Oct	1910	1920	63,5	1,30	86	1800	59,3
	1890	2000	62,8	1,00	68	1830	60,5
	2100	2180	69,8	4,00	65	1810	59,7
28-Oct	1920	2010	63,9	1,10	61	1700	54,9
	1940	1920	64,6	1,40	64	1690	54,4
	1940	1940	64,6	0,90	60	1750	57,1
29-Oct	1900	1950	63,2	0,70	48	1710	55,4
	1950	1990	65,0	0,64	61	1750	57,1
	1870	1900	62,0	0,90	95	1780	58,4
30-Oct	1900	1910	63,2	0,70	68	1710	55,4
	1970	2000	65,7	0,80	65	1750	57,1
	1950	1950	65,0	0,90	77	1750	57,1
31-Oct	1780	1750	58,4	0,60	66	1730	56,3
	2010	1960	67,0	0,80	46	1750	57,1
	2000	1980	66,7	1,20	83	1750	57,1
1-Nov	1900	1880	63,2	0,70	72	1730	56,3
	1950	1970	65,0	0,76	39	1720	55,8
2-Nov	1930	1800	64,2	0,80	83	1700	54,9
	2100	2100	69,8	2,60	83	1980	66,0
3-Nov	1940	1930	64,6	1,30	94	1840	60,9
	1900	1970	63,2	1,00	89	1800	59,3
5-Nov	1930	1910	64,2	0,55	70	1730	56,3
	1950	1940	65,0	1,18	90	1860	61,6
6-Nov	1950	1910	65,0	1,42	76	1780	58,4
	1800	1790	59,3	0,65	60	1620	51,0
7-Nov	1940	1990	64,6	1,50	56	1800	59,3
8-Nov	1920	1940	63,9	1,00	94	1780	58,4
9-Nov	2000	1970	66,7	2,20	56	1700	54,9
	2000	1910	66,7	1,10	45	1750	57,1
	2100	2270	69,8	8,20	88	1810	59,7
10-Nov	1950	1900	65,0	2,00	80	1710	55,4
	1950	1930	65,0	1,10	38	1750	57,1
	1900	1960	63,2	0,60	56	1780	58,4
11-Nov	2040	2080	68,0	2,00	21	1750	57,1
	2050	2020	68,3	1,40	67	1770	58,0
	2080	2130	69,2	3,00	94	1800	59,3
13-Nov	1960	1980	65,3	0,90	80	1750	57,1
	2000	2050	66,7	2,60	43	1770	58,0
	1980	1960	66,0	0,90	73	1810	59,7
14-Nov	1960	1980	65,3	0,90	79	1790	58,8
	1680	1610	54,0	1,20	62	1730	56,3
	2000	1980	66,7	1,00	90	1750	57,1
15-Nov	1950	2000	65,0	1,20	87	1800	59,3
	1850	1820	61,3	0,90	47	1710	55,4
	1860	1900	61,6	0,90	57	1730	56,3

16-Nov	1910	1890	63,5	1,20	91	1750	57,1
	1900	1810	63,2	4,70	70	1790	58,8
	1900	1910	63,2	0,93	70	1780	58,4
17-Nov	1960	1980	65,3	1,00	49	1780	58,4
	1800	1820	59,3	0,90	33	1720	55,8
	1840	1920	60,9	0,70	57	1820	60,1
18-Nov	1930	2020	64,2	1,00	59	1770	58,0
	1900	1830	63,2	0,90	60	1680	54,0
	1950	1950	65,0	1,00	50	1940	64,6
19-Nov	1980	1930	66,0	1,00	85	1740	56,7
	1900	1910	63,2	0,70	60	1750	57,1
	1850	1870	61,3	1,00	70	1750	57,1
20-Nov	1900	1920	63,2	1,40	80	1770	58,0
	1890	1900	62,8	0,70	74	1770	58,0
21-Nov	1850	1880	61,3	1,00	73	1780	58,4
	2050	2000	68,3	1,55	69	1770	58,0
22-Nov	1950	2000	65,0	0,90	50	1800	59,3
	1910	1960	63,5	0,90	67	1790	58,8
	1900	1920	63,2	1,30	50	1770	58,0
23-Nov	1880	1850	62,4	1,10	32	1780	58,4
	1940	1990	64,6	0,75	56	1790	58,8
	2000	1990	66,7	0,70	78	1780	58,4
24-Nov	2000	1980	66,7	1,50	72	1770	58,0
	1950	1980	65,0	1,40	59	1780	58,4
	1900	2030	63,2	0,80	48	1750	57,1
25-Nov	1990	1950	66,3	1,00	90	1710	55,4
	1900	1920	63,2	1,00	70	1710	55,4
	1960	2020	65,3	1,00	67	1750	57,1
26-Nov	1899	1900	63,1	0,70	95	1730	56,3
	1950	1970	65,0	1,00	85	1710	55,4
	1950	1990	65,0	0,80	49	1800	59,3
27-Nov	1910	1940	63,5	0,90	42	1780	58,4
	2000	2020	66,7	0,70	95	1780	58,4
	1870	1920	62,0	0,80	65	1740	56,7
28-Nov	1980	1950	66,0	1,30	42	1720	55,8
29-Nov	1900	1930	63,2	1,00	57	1740	56,7
	1910	2000	63,5	1,60	87	1810	59,7
30-Nov	2050	2059	68,3	1,53	86	1810	59,7
	1970	1950	65,7	1,00	92	1780	58,4
	2000	1950	66,7	0,80	67	1860	61,6
1-Dec	1990	1960	66,3	1,70	34	1800	59,3
	1910	1970	63,5	0,80	59	1750	57,1
	1910	1900	63,5	1,00	51	1730	56,3
2-Dec	1930	1900	64,2	1,00	54	1650	52,5
	1920	1940	63,9	0,90	65	1890	62,8
	1960	2030	65,3	1,60	57	1890	62,8
3-Dec	1900	1900	63,2	0,90	71	1720	55,8
	1920	1960	63,9	0,90	55	1850	61,3
	1900	1920	63,2	1,00	40	1830	60,5
4-Dec	1950	1950	65,0	1,30	80	1680	54,0
	1920	1940	63,9	1,00	67	1860	61,6
	1840	1800	60,9	0,70	70	1840	60,9
5-Dec	1970	1950	65,7	1,40	66	1680	54,0
6-Dec	1980	1940	66,0	1,20	80	1830	60,5
7-Dec	2050	2100	68,3	3,10	33	1700	54,9
	1960	1930	65,3	1,10	56	1750	57,1
	1960	1970	65,3	0,88	77	1830	60,5
8-Dec	2040	2100	68,0	1,50	77	1900	63,2
	1900	1970	63,2	1,30	70	1800	59,3
	2200	2180	72,7	0,95	96	1840	60,9

9-Dec	1980	2000	66,0	6,00	45	1900	63,2
	1900	1930	63,2	1,40	53	1730	56,3
	1985	1980	66,2	1,30	60	1745	56,9
10-Dec	2000	2060	66,7	1,10	36	1750	57,1
	1900	1930	63,2	0,90	67	1730	56,3
	1910	1900	63,5	0,80	41	1680	54,0
11-Dec	1910	1970	63,5	0,80	48	1750	57,1
	1940	1990	64,6	0,90	38	1810	59,7
	2020	2000	67,3	1,50	76	1750	57,1
12-Dec	2110	2120	70,1	1,40	88	1910	63,5
	1900	1910	63,2	0,90	72	1830	60,5
	1900	1910	63,2	0,80	40	1720	55,8
13-Dec	1870	2020	62,0	1,12	69	1750	57,1
	1990	1880	66,3	1,10	77	1720	55,8
	1970	1960	65,7	1,00	96	1740	56,7
14-Dec	1800	1750	59,3	1,00	68	1700	54,9
	1915	1930	63,7	0,65	70	1750	57,1
	1990	2000	66,3	1,20	35	1700	54,9
15-Dec	1960	1950	65,3	1,30	96	1760	57,6
	1975	1920	65,8	1,10	83	1750	57,1
	1970	1950	65,7	1,10	75	1700	54,9
16-Dec	1960	1970	65,3	1,30	74	1800	59,3
	2000	1970	66,7	1,40	64	1730	56,3
	1980	1950	66,0	0,80	50	1770	58,0
17-Dec	1880	1980	62,4	0,80	90	1730	56,3
	1940	1970	64,6	1,00	58	1710	55,4
	1870	1960	62,0	1,00	64	1780	58,4
18-Dec	1870	1950	62,0	0,90	85	1750	57,1
	1900	1900	63,2	0,90	91	1760	57,6
	1890	1890	62,8	1,30	75	1750	57,1
19-Dec	1980	1980	66,0	1,20	60	1720	55,8
	1920	1900	63,9	1,00	65	1650	52,5
	1800	1830	59,3	0,90	85	1790	58,8
20-Dec	1900	1920	63,2	1,20	75	1700	54,9
	1920	1950	63,9	1,20	50	1680	54,0
	1930	1940	64,2	2,86	97	1750	57,1
21-Dec	1925	190	64,1	1,30	55	1730	56,3
	2020	2050	67,3	1,45	63	1710	55,4
	1940	1970	64,6	1,70	87	1740	56,7
22-Dec	1900	1930	63,2	1,30	66	1770	58,0
	1950	1950	65,0	1,10	57	1770	58,0
	1950	1960	65,0	1,10	59	1720	55,8
23-Dec	2010	2000	67,0	1,80	58	1750	57,1
	1970	1950	65,7	2,40	64	1750	57,1
	1960	2010	65,3	1,20	61	1770	58,0
24-Dec	1935	1960	64,4	1,20	63	1720	55,8
	1950	1950	65,0	1,30	47	1800	59,3
	1910	1790	63,5	1,00	68	1770	58,0
25-Dec	1900	1900	63,2	0,90	66	1650	52,5
	1930	1900	64,2	1,10	64	1740	56,7
	1870	1890	62,0	1,10	73	1730	56,3
26-Dec	1990	1950	66,3	1,50	41	1700	54,9
	1900	1980	63,2	1,10	36	1730	56,3
	1950	1950	65,0	1,00	82	1750	57,1
27-Dec	1870	1890	62,0	1,20	32	1650	52,5
	1900	1900	63,2	0,97	48	1700	54,9
	1970	1900	65,7	0,90	83	1720	55,8
28-Dec	1940	1910	64,6	1,20	66	1700	54,9
	1950	1970	65,0	1,10	70	1710	55,4
	1920	1900	63,9	1,00	38	1720	55,8

Year 2008

29-Dec	1940	1935	64,6	1,00	51	1700	54,9
	1920	1950	63,9	1,20	76	1720	55,8
	1880	1900	62,4	1,00	37	1700	54,9
30-Dec	1920	1910	63,9	0,90	51	1680	54,0
	1880	1980	62,4	1,10	61	1690	54,4
	2000	1940	66,7	1,10	53	1700	54,9
31-Dec	1900	1920	63,2	0,90	28	1700	54,9
	1860	1850	61,6	1,20	63	1670	53,5
	1930	1920	64,2	1,16	59	1700	54,9
1-Jan	1900	1950	63,2	1,30	52	1710	55,4
	1920	1970	63,9	1,60	46	1720	55,8
	2120	2040	70,4	5,70	70	1730	56,3
2-Jan	1950	2000	65,0	1,60	59	1740	56,7
	1760	1800	57,6	1,50	32	1700	54,9
	1930	1940	64,2	2,00	66	1720	55,8
3-Jan	1960	1980	65,3	1,60	70	1700	54,9
	1950	1950	65,0	1,40	43	1730	56,3
	1970	1970	65,7	1,40	40	1700	54,9
4-Jan	1837	1960	60,8	1,10	48	1700	54,9
	1960	2000	65,3	1,10	57	1830	60,5
	1940	1950	64,6	1,30	46	1700	54,9
5-Jan	1950	1960	65,0	1,23	32	1750	57,1
	1900	1900	63,2	1,30	70	1760	57,6
	1950	1950	65,0	1,50	70	1710	55,4
6-Jan	1900	1920	63,2	1,30	24	1730	56,3
	1900	1950	63,2	1,40	32	1730	56,3
	1930	1940	64,2	1,50	32	1740	56,7
7-Jan	1900	1950	63,2	0,90	60	1800	59,3
	1890	1890	62,8	1,40	31	1790	58,8
	1850	1800	61,3	1,30	34	1750	57,1
8-Jan	1950	1980	65,0	2,60	68	1790	58,8
	1950	1930	65,0	1,20	27	1800	59,3
	1860	1990	61,6	1,00	74	1780	58,4
9-Jan	1950	1930	65,0	1,70	69	1770	58,0
	1925	1980	64,1	1,05	35	1770	58,0
	1920	1880	63,9	1,60	75	1780	58,4
10-Jan	1900	1960	63,2	1,00	30	1720	55,8
11-Jan	1920	1930	63,9	1,40	86	1750	57,1
	1950	1940	65,0	1,00	95	1700	54,9
	1880	1850	62,4	1,60	70	1670	53,5
12-Jan	1830	1830	60,5	1,00	54	1640	52,0
	1900	1920	63,2	0,90	39	1660	53,0
	1900	1890	63,2	1,20	54	1680	54,0
13-Jan	1890	1860	62,8	1,26	87	1670	53,5
	1840	1900	60,9	1,00	70	1680	54,0
	1900	2010	63,2	1,07	31	1700	54,9
14-Jan	1950	1910	65,0	1,00	79	1700	54,9
	1900	1910	63,2	1,30	68	1680	54,0
	1950	1940	65,0	1,30	65	1620	51,0
15-Jan	1940	1920	64,6	1,90	41	1610	50,5
	1950	1970	65,0	1,40	35	1650	52,5
	2000	2040	66,7	3,00	40	1700	54,9
16-Jan	1900	1860	63,2	1,50	64	1750	57,1
	1850	1870	61,3	1,20	29	1740	56,7
	1830	1890	60,5	0,80	34	1730	56,3
17-Jan	1900	1920	63,2	1,50	50	1730	56,3
	1930	2000	64,2	1,50	62	1770	58,0
	1950	1970	65,0	1,30	38	1730	56,3

18-Jan	2000	2020	66,7	2,50	44	1720	55,8
	1895	1910	63,0	1,28	48	1700	54,9
	1930	1930	64,2	1,30	67	1750	57,1
19-Jan	1880	1900	62,4	1,70	50	1700	54,9
	1840	1850	60,9	0,95	54	1650	52,5
	1910	1880	63,5	1,10	51	1630	51,5
20-Jan	1940	1930	64,6	1,30	67	1680	54,0
	1922	1910	64,0	1,27	63	1700	54,9
	1900	1890	63,2	0,90	38	1700	54,9
21-Jan	1890	190	62,8	1,50	74	1710	55,4
	1900	1920	63,2	1,40	50	1750	57,1
	1800	1750	59,3	1,00	63	1770	58,0
22-Jan	1870	1900	62,0	1,10	33	1740	56,7
	2100	2220	69,8	1,60	45	1780	58,4
	2200	2310	72,7	2,00	41	1800	59,3
23-Jan	2100	2050	69,8	1,10	46	1800	59,3
	2100	2170	69,8	1,00	70	1780	58,4
	2100	2160	69,8	0,80	65	1740	56,7
24-Jan	1980	1910	66,0	1,40	85	1820	60,1
	2040	2130	68,0	0,90	44	1740	56,7
	1980	1990	66,0	0,90	75	1730	56,3
25-Jan	1995	2010	66,5	1,10	75	1700	54,9
	2000	2080	66,7	2,60	65	1740	56,7
	1950	2020	65,0	1,40	57	1740	56,7
26-Jan	1940	2000	64,6	2,20	68	1750	57,1
	1960	2000	65,3	0,90	77	1710	55,4
	2020	2000	67,3	1,10	66	1680	54,0
27-Jan	1960	2010	65,3	6,20	31	1910	63,5
	1930	1970	64,2	1,40	34	1830	60,5
	1910	1900	63,5	1,10	41	1700	54,9
28-Jan	1950	1970	65,0	0,90	69	1720	55,8
	1920	1940	63,9	0,90	41	1710	55,4
	1990	2010	66,3	1,00	79	1720	55,8
29-Jan	2100	2100	69,8	1,00	92	1950	65,0
	1990	1980	66,3	1,60	67	1780	58,4
	2000	1940	66,7	0,95	58	1750	57,1
30-Jan	2020	1960	67,3	1,10	27	1780	58,4
	1950	1870	65,0	1,10	67	1830	60,5
	1890	1900	62,8	1,10	40	1700	54,9
31-Jan	1930	1930	64,2	1,20	30	1800	59,3
	1920	1880	63,9	0,85	30	1750	57,1
1-Feb	1920	1930	63,9	0,90	85	1730	56,3
	1890	1930	62,8	1,00	49	1700	54,9
2-Feb	1970	2000	65,7	1,20	72	1780	58,4
	2120	2150	70,4	2,60	80	1900	63,2
	2155	2100	71,5	1,70	90	1850	61,3
3-Feb	2000	1980	66,7	1,00	70	1800	59,3
	1900	1920	63,2	2,30	65	1780	58,4
	2020	1970	67,3	0,80	72	1750	57,1
4-Feb	1800	1810	59,3	1,00	78	1750	57,1
	1900	1920	63,2	1,50	35	1700	54,9
	2040	2057	68,0	3,60	35	1750	57,1
5-Feb	1700	1800	54,9	2,00	80	1710	55,4
	1900	1900	63,2	1,00	40	1750	57,1
	1820	1850	60,1	1,20	46	1780	58,4
6-Feb	1870	1900	62,0	1,00	47	1810	59,7
	1980	1890	66,0	1,40	69	1890	62,8
	1800	1820	59,3	1,50	60	1740	56,7
7-Feb	1880	1880	62,4	1,20	31	1740	56,7
	1810	1880	59,7	1,30	71	1730	56,3
	1900	1920	63,2	0,80	57	1720	55,8

8-Feb	1800	1880	59,3	1,00	65	1750	57,1
	1850	1800	61,3	1,40	46	1750	57,1
	1950	1960	65,0	1,00	72	1720	55,8
9-Feb	1880	1940	62,4	1,10	49	1680	54,0
	1850	1920	61,3	1,00	24	1700	54,9
	1820	1850	60,1	1,00	70	1680	54,0
10-Feb	1900	1920	63,2	1,10	70	1650	52,5
	1840	1920	60,9	1,00	54	1700	54,9
	1850	1870	61,3	0,70	50	1700	54,9
11-Feb	1820	1910	60,1	1,00	43	1680	54,0
	1930	1920	64,2	1,00	55	1700	54,9
	1900	1900	63,2	1,00	66	1690	54,4
12-Feb	1870	1900	62,0	1,00	54	1670	53,5
	1940	1900	64,6	1,00	45	1650	52,5
13-Feb	1850	1900	61,3	1,10	55	1640	52,0
	1930	1950	64,2	1,00	45	1700	54,9
	1800	1940	59,3	1,00	37	1700	54,9
14-Feb	1800	1840	59,3	1,35	87	1710	55,4
	1800	1800	59,3	1,00	61	1720	55,8
	1830	1800	60,5	1,50	30	1750	57,1
15-Feb	1820	1790	60,1	1,00	52	1750	57,1
	1820	1800	60,1	1,30	83	1750	57,1
	1800	1850	59,3	0,80	39	1730	56,3
16-Feb	1850	1800	61,3	1,00	65	1750	57,1
	1780	1800	58,4	1,00	81	1740	56,7
	1940	1960	64,6	0,90	50	1790	58,8
17-Feb	1970	1920	65,7	1,00	53	1800	59,3
	1840	1860	60,9	1,00	40	1780	58,4
	1820	1820	60,1	1,00	86	1750	57,1
18-Feb	1920	1830	63,9	1,00	78	1700	54,9
	1900	1910	63,2	1,00	75	1650	52,5
19-Feb	1920	1900	63,9	0,90	61	1650	52,5
20-Feb	1900	1870	63,2	3,25	45	1730	56,3
	1920	1950	63,9	1,40	66	1710	55,4
21-Feb	1910	1900	63,5	4,50	78	1760	57,6
	1880	1900	62,4	1,50	95	1840	60,9
	1860	1900	61,6	0,90	57	1720	55,8
22-Feb	1840	1850	60,9	1,00	26	1720	55,8
	1860	1870	61,6	0,80	35	1700	54,9
	1890	1920	62,8	1,00	65	1690	54,4
23-Feb	1850	1800	61,3	1,00	58	1700	54,9
	1880	1840	62,4	1,10	70	1720	55,8
	1940	1930	64,6	1,00	68	1700	54,9
24-Feb	1750	1760	57,1	1,00	70	1690	54,4
	1800	1800	59,3	0,80	45	1710	55,4
	1870	1850	62,0	1,00	49	1700	54,9
25-Feb	1870	1880	62,0	1,00	44	1680	54,0
	1890	1900	62,8	0,91	31	1650	52,5
	1880	1860	62,4	0,70	48	1670	53,5
26-Feb	1960	1970	65,3	1,00	59	1700	54,9
	1890	1900	62,8	1,00	50	1710	55,4
	1840	1830	60,9	0,70	40	1700	54,9
27-Feb	1950	1920	65,0	1,50	75	1720	55,8
	1870	1890	62,0	0,90	63	1740	56,7
	1800	1865	59,3	0,90	57	1730	56,3
28-Feb	1920	1990	63,9	1,00	87	1750	57,1
	1980	1940	66,0	1,20	75	1760	57,6
29-Feb	1920	1800	63,9	1,30	87	1780	58,4
1-Mar	1900	1850	63,2	1,00	70	1770	58,0
2-Mar	1950	2000	65,0	1,90	75	1790	58,8
	1850	1820	61,3	0,80	68	1820	60,1
	1850	1820	61,3	1,00	48	1800	59,3

3-Mar	1790	1850	58,8	0,80	44	1750	57,1
	1950	2000	65,0	1,40	48	1700	54,9
	1820	1800	60,1	0,70	69	1700	54,9
5-Mar	1890	1920	62,8	0,90	90	1720	55,8
	1800	1720	59,3	0,80	55	1700	54,9
	1730	1740	56,3	0,50	80	1700	54,9
6-Mar	1900	1900	63,2	1,00	45	1680	54,0
	1850	1840	61,3	1,00	60	1650	52,5
	1850	1840	61,3	0,60	57	1670	53,5
7-Mar	1900	1900	63,2	1,00	90	1720	55,8
	1850	1870	61,3	0,70	43	1700	54,9
	1880	1930	62,4	0,65	71	1710	55,4
8-Mar	1900	1900	63,2	1,00	58	1700	54,9
	1880	1900	62,4	0,60	49	1720	55,8
	2000	1980	66,7	5,50	60	1760	57,6
9-Mar	1850	1870	61,3	0,70	94	1760	57,6
	1800	1800	59,3	1,00	40	1720	55,8
	1830	1820	60,5	0,60	73	1650	52,5
10-Mar	1870	1820	62,0	0,50	77	1700	54,9
	1820	1840	60,1	1,00	60	1750	57,1
	1970	1980	65,7	0,65	48	1830	60,5
11-Mar	1800	1820	59,3	0,60	65	1800	59,3
	1800	1820	59,3	0,80	49	1820	60,1
	1920	1980	63,9	0,70	56	1870	62,0
12-Mar	1870	1880	62,0	0,60	81	1800	59,3
	1900	1900	63,2	1,00	64	1750	57,1
	1890	1910	62,8	1,00	67	1710	55,4
13-Mar	1830	1780	60,5	0,60	37	1700	54,9
	1800	1840	59,3	1,00	50	1700	54,9
	1880	1900	62,4	1,00	45	1700	54,9
14-Mar	1900	1830	63,2	0,50	74	1680	54,0
	1870	1860	62,0	0,80	58	1660	53,0
	1880	1900	62,4	1,00	95	1710	55,4
15-Mar	1820	1800	60,1	1,00	60	1720	55,8
	1830	1810	60,5	0,75	51	1700	54,9
	1800	1880	59,3	0,80	70	1680	54,0
16-Mar	1800	1750	59,3	0,70	45	1620	51,0
	1880	1880	62,4	0,90	68	1650	52,5
	1880	1900	62,4	1,50	58	1660	53,0
17-Mar	1900	1900	63,2	1,00	63	1700	54,9
	1850	1820	61,3	0,80	62	1680	54,0
	1820	1850	60,1	0,30	36	1700	54,9
18-Mar	1910	1920	63,5	1,20	63	1750	57,1
	2000	2050	66,7	1,40	75	1830	60,5
	2000	2070	66,7	2,40	95	1850	61,3
19-Mar	2000	2030	66,7	1,20	70	1750	57,1
	1990	2050	66,3	1,80	83	1760	57,6
	2000	1970	66,7	0,60	47	1740	56,7
20-Mar	1900	1820	63,2	0,70	60	1720	55,8
	1880	1900	62,4	1,00	67	1700	54,9
21-Mar	1810	1860	59,7	0,60	59	1710	55,4
	1850	1890	61,3	0,90	35	1700	54,9
	1920	1810	63,9	0,50	55	1720	55,8
22-Mar	2000	1970	66,7	2,40	29	1700	54,9
	1880	1880	62,4	1,50	95	1690	54,4
	1850	1830	61,3	0,50	55	1700	54,9

23-Mar	1840	1810	60,9	0,50	58	1680	54,0
	1840	1710	60,9	0,90	45	1670	53,5
	1760	1750	57,6	0,70	58	1700	54,9
24-Mar	1760	1780	57,6	0,60	34	1670	53,5
	1830	1830	60,5	1,00	65	1700	54,9
	1820	1850	60,1	1,00	79	1700	54,9
25-Mar	1840	1910	60,9	0,50	73	1710	55,4
26-Mar	1820	1840	60,1	0,80	48	1700	54,9
27-Mar	1920	1900	63,9	1,10	57	1700	54,9
	1870	1830	62,0	1,10	72	1650	52,5
	1840	1850	60,9	1,20	68	1700	54,9
28-Mar	1900	1920	63,2	2,10	55	1710	55,4
	1900	1850	63,2	1,00	64	1720	55,8
	1800	1820	59,3	0,90	64	1700	54,9
29-Mar	1900	1900	63,2	0,90	50	1680	54,0
	1820	1850	60,1	1,30	68	1700	54,9
	1820	1870	60,1	0,70	55	1700	54,9
30-Mar	1880	1900	62,4	0,90	40	1680	54,0
	1880	1850	62,4	1,20	66	1750	57,1
	1890	1890	62,8	1,20	65	1800	59,3
31-Mar	1900	1910	63,2	1,20	41	1650	52,5
	1920	1900	63,9	2,30	64	1780	58,4
	1800	1770	59,3	2,00	75	1730	56,3
1-Apr	1840	1920	60,9	1,40	59	1700	54,9
2-Apr	1820	1800	60,1	1,20	75	1700	54,9
	1980	1980	66,0	2,00	64	1690	54,4
3-Apr	2000	2010	66,7	2,90	49	1750	57,1
	1830	1830	60,5	1,00	63	1700	54,9
	1870	1820	62,0	0,50	70	1720	55,8
4-Apr	1800	1810	59,3	1,00	94	1700	54,9
	1880	1880	62,4	0,90	56	1700	54,9
5-Apr	1770	1800	58,0	1,20	70	1680	54,0
	1800	1800	59,3	0,80	35	1690	54,4
	1890	1900	62,8	1,40	95	1700	54,9
6-Apr	1830	1800	60,5	0,60	76	1670	53,5
	2100	2070	69,8	0,70	56	1640	52,0
	1880	1870	62,4	0,70	45	1680	54,0
7-Apr	1820	1840	60,1	0,80	35	1710	55,4
	1800	1800	59,3	0,60	75	1740	56,7
	1900	1900	63,2	1,40	95	1700	54,9
8-Apr	1800	1800	59,3	0,70	34	1720	55,8
	1830	1830	60,5	0,90	56	1570	48,4
	1900	1900	63,2	1,00	69	1700	54,9
9-Apr	1840	1850	60,9	1,00	50	1720	55,8
	1880	1850	62,4	0,80	70	1780	58,4
	1840	1820	60,9	1,00	51	1760	57,6
10-Apr	1830	1820	60,5	0,80	52	1740	56,7
	1830	1830	60,5	1,00	56	1740	56,7
	1900	1825	63,2	0,70	71	1750	57,1
11-Apr	1850	1820	61,3	0,70	67	1740	56,7
	1880	1880	62,4	0,90	66	1780	58,4
	2000	1980	66,7	1,50	88	1750	57,1
12-Apr	1950	1980	65,0	0,80	78	1700	54,9
	1900	1900	63,2	1,00	85	1680	54,0
	1940	1860	64,6	0,70	92	1700	54,9
13-Apr	1800	1780	59,3	0,90	42	1690	54,4
	1890	1900	62,8	1,00	85	1700	54,9
	1840	1850	60,9	0,60	73	1680	54,0
14-Apr	1900	1910	63,2	0,80	65	1670	53,5
	1890	1900	62,8	1,00	35	1650	52,5
	1850	1820	61,3	0,50	40	1620	51,0
15-Apr	1900	1900	63,2	0,70	56	1650	52,5

16-Apr	1800	1870	59,3	1,00	80	1640	52,0
	1880	1900	62,4	0,70	73	1650	52,5
17-Apr	1750	1750	57,1	0,90	52	1610	50,5
18-Apr	1900	1900	63,2	0,80	87	1680	54,0
	1920	1920	63,9	1,00	85	1750	57,1
	2100	2150	69,8	7,00	90	1800	59,3
19-Apr	1880	1900	62,4	1,00	95	1700	54,9
	2090	2100	69,5	4,40	98	1800	59,3
	2230	2210	73,5	7,50	87	1920	63,9
20-Apr	2050	2070	68,3	2,50	95	1850	61,3
	1930	1890	64,2	1,80	64	1800	59,3
	1970	1980	65,7	1,70	67	1820	60,1
21-Apr	1980	1980	66,0	1,30	57	1700	54,9
	1910	1940	63,5	1,20	55	1750	57,1
	1830	1820	60,5	0,55	70	1780	58,4
22-Apr	1900	1900	63,2	1,10	60	1680	54,0
	1800	1840	59,3	0,50	60	1720	55,8
	1850	1850	61,3	0,50	50	1750	57,1
23-Apr	1900	1900	63,2	1,00	60	1680	54,0
	1800	1800	59,3	0,80	40	1700	54,9
	1800	1840	59,3	0,43	69	1700	54,9
24-Apr	1840	1820	60,9	1,00	70	1710	55,4
	1840	1850	60,9	1,00	80	1720	55,8
	1840	1810	60,9	0,90	70	1650	52,5
25-Apr	2020	1990	67,3	4,00	70	1700	54,9
	1850	1840	61,3	0,50	40	1750	57,1
	1930	1900	64,2	1,00	45	1800	59,3
26-Apr	1890	1800	62,8	1,00	44	1750	57,1
	1800	1820	59,3	0,80	54	1700	54,9
	1800	1850	59,3	1,10	28	1700	54,9
27-Apr	1930	1840	64,2	0,80	95	1680	54,0
	1880	1800	62,4	1,00	58	1700	54,9
	1850	1800	61,3	1,00	55	1650	52,5
28-Apr	1820	1810	60,1	0,70	35	1700	54,9
	1810	1800	59,7	0,80	90	1740	56,7
	1870	1900	62,0	0,90	55	1670	53,5
29-Apr	1820	1830	60,1	0,60	68	1700	54,9
	1800	1800	59,3	0,70	75	1760	57,6
	1830	1830	60,5	1,10	71	1730	56,3
30-Apr	1820	1850	60,1	0,80	49	1700	54,9
	1900	1790	63,2	1,20	56	1680	54,0
	1900	1900	63,2	1,00	50	1650	52,5
1-May	1840	1850	60,9	1,00	56	1700	54,9
	1840	1850	60,9	0,80	59	1700	54,9
	1890	1900	62,8	0,90	65	1680	54,0
2-May	1880	1850	62,4	0,80	51	1700	54,9
	1880	1850	62,4	0,80	49	1710	55,4
	1800	1830	59,3	1,20	53	1680	54,0
3-May	1840	1850	60,9	0,80	50	1690	54,4
	1820	1820	60,1	0,97	73	1700	54,9
	1880	1800	62,4	0,90	89	1740	56,7
4-May	1820	1850	60,1	1,00	41	1750	57,1
	1890	1900	62,8	1,00	90	1720	55,8
	1900	1820	63,2	1,00	63	1740	56,7
5-May	1900	1940	63,2	1,00	82	1750	57,1
	2000	2020	66,7	1,23	70	1750	57,1
	2020	2050	67,3	1,60	68	1730	56,3

6-May	1840	1870	60,9	1,00	59	1770	58,0
7-May	1870	1840	62,0	0,90	61	1650	52,5
	1880	1900	62,4	1,00	50	1650	52,5
	1900	1880	63,2	5,00	81	1700	54,9
8-May	1840	1840	60,9	1,20	42	1750	57,1
	1780	1840	58,4	0,90	78	1730	56,3
	1860	1900	61,6	0,80	58	1750	57,1
9-May	1790	1740	58,8	0,90	39	1780	58,4
	1870	1870	62,0	1,00	65	1760	57,6
	1900	1900	63,2	1,30	65	1750	57,1
10-May	1850	1830	61,3	0,90	56	1720	55,8
	1780	1800	58,4	1,70	33	1700	54,9
	1850	1840	61,3	1,20	63	1700	54,9
11-May	1900	1900	63,2	1,20	60	1690	54,4
	1810	1800	59,7	1,20	60	1700	54,9
	1830	1800	60,5	0,80	66	1680	54,0
12-May	1910	1890	63,5	1,10	50	1650	52,5
	1850	1840	61,3	1,20	46	1700	54,9
	1850	1830	61,3	1,20	58	1700	54,9
13-May	1870	1900	62,0	1,10	65	1680	54,0
	1820	1830	60,1	0,80	28	1700	54,9
	2050	2050	68,3	1,40	56	1720	55,8
14-May	1900	1900	63,2	0,90	57	1700	54,9
	1840	1840	60,9	1,00	44	1730	56,3
	2000	2030	66,7	1,35	79	1840	60,9
15-May	1900	1900	63,2	1,30	67	1700	54,9
	1920	1880	63,9	0,90	85	1700	54,9
	1980	2000	66,0	0,80	86	1690	54,4
16-May	1890	1920	62,8	1,40	71	1680	54,0
	1900	1880	63,2	0,80	45	1700	54,9
	1890	1830	62,8	1,00	81	1750	57,1
17-May	1980	1980	66,0	1,30	60	1780	58,4
	2010	2000	67,0	1,40	62	1800	59,3
	2010	2010	67,0	0,86	48	1800	59,3
18-May	1940	1930	64,6	1,50	55	1750	57,1
	1830	1850	60,5	0,80	30	1720	55,8
	1800	1860	59,3	0,50	39	1690	54,4
19-May	1880	1840	62,4	0,80	65	1780	58,4
	1860	1850	61,6	0,60	32	1770	58,0
	1700	1830	54,9	0,60	54	1740	56,7
AVERAGE	1902	1908	63,1	1,33	68	1723	55,8

Table D4. Data for dilution test at Cu thickener

Time	Density		Torque	Level	Density	U/F Solid %
	Auto	Manuel			Surge Tank	
00:00	1960	1990	3,80	40	1800	65,31
08:00	1950	1990	4,00	33	1900	64,96
16:00	1910	1920	3,20	52	1810	63,53
00:00	1530	1530	2,90	65	1820	46,19
08:00	1820	1780	3,00	24	1780	60,07
10:00	1850	1880	2,90	32	1760	61,26
12:00	1830	1810	2,70	35	1740	60,47
14:00	1890	1850	2,70	38	1720	62,79
16:00	1890	1850	2,40	36	1710	62,79
18:00	1840	1810	2,40	41	1710	60,87
20:00	1880	1830	2,95	30	1700	62,41
21:00	1735	1710	3,00	25	1680	56,48
22:00	1840	1810	2,40	28	1710	60,87
0:00	1850	1730	3,00	20	1720	61,26
1:00	1900	1860	3,00	22	1730	63,16
2:00	1900	1860	3,50	25	1730	63,16
4:00	1900	1860	4,00	28	1740	63,16
6:00	1900	1860	4,00	34	1750	63,16
8:00	1930	1870	4,00	39	1860	64,25
16:00	2000	1980	5,00	57	1910	66,67
18:00	2010	1990	4,80	60	1900	67,00
20:00	2000	1990	4,30	58	1910	66,67
22:10	1900	1910	3,00	69	1850	63,16
23:30	1880	1900	2,40	66	1820	62,41
0:40	1860	1820	3,00	52	1830	61,65
2:30	1860	1750	3,10	75	1800	61,65
4:20	1880	1800	3,15	57	1800	62,41
6:30	1880	1870	3,70	48	1760	62,41
8:10	1870	1870	4,00	49	1730	62,03
10:15	1900	1860	4,10	35	1800	63,16
12:00	1920	1870	4,30	37	1790	63,89
14:20	1930	1890	4,20	53	1720	64,25
16:15	1940	1900	4,40	77	1810	64,60
17:55	1960	1910	4,80	85	1810	65,31
20:15	1970	1930	4,80	85	1815	65,65
21:50	1975	1940	5,00	90	1810	65,82
23:40	1970	1930	5,20	95	1800	65,65
1:00	1980	2000	5,20	90	1900	65,99
3:05	1960	1940	4,80	88	1900	65,31
5:00	1960	1950	5,50	90	1890	65,31
7:00	1990	2000	6,20	87	1950	66,33
8:00	1980	2040	6,00	84	1900	65,99
9:50	2010	2050	6,60	85	1950	67,00
11:45	2000	2040	6,50	69	1950	66,67
14:50	1980	2000	4,40	76	1930	65,99
16:00	1940	1940	4,40	60	1940	64,60
18:15	1960	1970	4,19	53	1950	65,31
20:10	1950	1950	3,80	48	1910	64,96
22:30	1950	1980	4,60	48	1920	64,96

0:00	1940	1920	3,90	66	1900	64,60
2:00	1930	1890	3,85	83	1950	64,25
11:30	1955	2000	5,00	23	1860	65,13
13:50	2000	2020	5,00	33	1900	66,67
17:00	2020	1990	4,25	75	1950	67,33
19:00	2000	2010	3,80	78	1990	66,67
21:00	2000	2020	3,90	80	2000	66,67
23:15	1990	1960	3,80	81	1960	66,33
0:10	1980	1980	3,70	81	1960	65,99
03:00	1960	2000	3,80	80	1950	65,31
05:00	1960	2000	4,10	77	1930	65,31
07:00	1990	2000	4,70	71	1920	66,33
08:30	1970	1980	4,40	67	1900	65,65
10:15	1970	1960	4,20	75	1905	65,65
11:55	1945	1920	3,70	77	1900	64,78
13:45	1930	1910	3,80	78	1890	64,25
16:50	1940	1980	3,90	75	1930	64,60
20:00	1950	2020	4,00	80	1900	64,96
22:00	1950	1950	3,67	68	1880	64,96
00:30	1940	1900	3,40	78	1900	64,60
01:50	1955	1950	4,00	75	1910	65,13
08:20	1970	1990	5,20	66	1930	65,65
11:45	2000	2080	3,90	54	1780	66,67
14:40	2010	2050	3,60	58	1840	67,00
16:00	1950	1900	3,50	55	1820	64,96
17:45	1950	1950	4,00	65	1820	64,96
21:10	1950	2000	4,20	76	1620	64,96
23:20	1960	1970	4,00	58	1700	65,31
00:10	2000	2030	5,00	54	1840	66,67
01:50	2020	2050	5,60	50	1865	67,33
04:20	1915	1920	3,90	54	1760	63,71
06:25	1910	1910	3,30	48	1790	63,53
08:15	1920	1890	3,40	34	1790	63,89
09:55	1930	1910	3,20	54	1810	64,25
12:20	1900	1880	3,10	33	1780	63,16
14:15	1930	1910	2,60	32	1790	64,25
16:40	1940	1920	3,30	34	1780	64,60
18:25	1950	1950	3,50	40	1870	64,96
22:20	1940	1940	3,20	41	1840	64,60
00:20	1950	1940	3,80	40	1880	64,96
01:30	1960	1950	3,80	41	1900	65,31
03:40	1980	1990	4,35	40	1860	65,99
06:05	2030	2100	6,00	38	1910	67,65
08:10	1910	1940	3,70	55	1910	63,53
AVERAGE	1954	1953	4,20	63	1865	65,08

Table D5. Data for Cu concentrate solid % with dilution calculations

	Daily Average	DMT			After dilution
	Conc Solid %	Tonnages	Water tonnage	Pulp tonnage	Conc Solid %
27-Feb	29,6	359,38	855,0	1214,4	18,6
28-Feb	28,6	330,29	822,8	1153,0	17,6
1-Mar	29,4	365,56	879,4	1244,9	18,6
2-Mar	30,3	343,09	790,9	1134,0	18,5
3-Mar	28,7	528,98	1314,3	1843,3	20,6
4-Mar	33,1	552,35	1117,1	1669,4	23,1
5-Mar	34,0	469,73	910,5	1380,2	22,4
6-Mar	30,4	426,36	974,8	1401,2	20,1
7-Mar	28,3	201,15	510,6	711,8	14,0
8-Mar	30,7	228,87	516,8	745,7	15,6
9-Mar	31,3	306,27	673,6	979,9	18,0
10-Mar	29,8	347,13	817,0	1164,1	18,4
11-Mar	30,9	250,21	560,4	810,7	16,3
12-Mar	28,7	369,20	917,9	1287,1	18,4
13-Mar	29,0	344,63	843,2	1187,9	18,1
14-Mar	27,4	332,31	879,5	1211,8	17,2
15-Mar	29,6	324,42	772,4	1096,9	17,9
16-Mar	28,0	419,81	1080,0	1499,8	18,9
17-Mar	32,2	411,53	868,4	1279,9	20,6
18-Mar	33,7	419,33	823,2	1242,5	21,4
19-Mar	32,6	369,24	764,5	1133,8	19,9
20-Mar	32,0	352,82	750,3	1103,1	19,4
21-Mar	30,1	427,77	994,0	1421,8	20,0
22-Mar	30,5	331,35	754,8	1086,1	18,3
23-Mar	28,8	303,06	748,4	1051,4	17,1
26-Mar	27,6	401,61	1053,2	1454,8	18,5
27-Mar	29,6	421,66	1004,5	1426,2	19,6
28-Mar	28,3	416,49	1057,4	1473,9	19,0
29-Mar	30,9	387,29	864,2	1251,5	19,6
30-Mar	30,5	382,15	869,4	1251,6	19,4
2-Apr	30,5	499,28	1137,1	1636,4	21,2
3-Apr	33,7	192,17	378,5	570,7	14,9
6-Apr	27,4	371,03	984,3	1355,3	17,9
7-Apr	29,0	472,63	1154,9	1627,5	20,1
8-Apr	29,7	383,87	908,3	1292,1	19,1
9-Apr	27,2	399,90	1071,0	1470,9	18,3
10-Apr	29,6	396,82	944,6	1341,4	19,3
11-Apr	29,6	184,13	438,1	622,2	13,7
12-Apr	33,0	316,28	641,3	957,6	18,9
13-Apr	32,1	393,39	830,5	1223,9	20,2
14-Apr	31,2	390,58	859,7	1250,3	19,8
15-Apr	31,9	481,19	1028,5	1509,7	21,6
16-Apr	33,1	519,46	1050,2	1569,7	22,7
17-Apr	32,1	442,39	936,3	1378,7	21,1
21-Apr	32,2	526,84	1109,5	1636,3	22,4
22-Apr	34,5	497,16	943,5	1440,6	23,0
23-Apr	33,8	514,18	1009,3	1523,5	22,9
24-Apr	34,3	517,29	989,0	1506,2	23,2
25-Apr	33,8	463,19	908,2	1371,4	22,1

26-Apr	34,4	537,52	1026,6	1564,1	23,5
27-Apr	34,0	471,14	913,0	1384,2	22,4
28-Apr	33,0	572,75	1163,9	1736,6	23,3
29-Apr	32,5	411,95	856,4	1268,3	20,7
30-Apr	29,6	415,80	990,3	1406,1	19,6
1-May	30,8	108,94	245,2	354,1	10,1
4-May	35,4	527,03	963,1	1490,1	23,8
5-May	36,7	545,18	939,1	1484,3	24,7
6-May	36,9	461,72	789,8	1251,6	23,4
7-May	35,6	520,28	941,8	1462,0	23,8
8-May	36,4	380,86	665,3	1046,1	21,6
9-May	35,8	459,01	822,6	1281,7	22,9
10-May	36,0	416,53	740,5	1157,0	22,2
11-May	35,9	581,96	1039,7	1621,7	24,9
12-May	36,4	358,84	627,4	986,3	21,0
13-May	35,6	413,84	748,2	1162,0	22,0
14-May	36,1	424,27	752,1	1176,4	22,4
15-May	36,4	512,58	893,8	1406,4	24,1
16-May	37,1	503,77	855,4	1359,2	24,2
19-May	36,4	242,97	424,4	667,4	17,5
20-May	34,8	370,04	693,1	1063,1	20,8
21-May	35,6	349,38	632,7	982,1	20,5
22-May	35,9	620,65	1106,9	1727,5	25,4
23-May	34,4	705,66	1344,3	2049,9	25,5
24-May	32,3	637,43	1338,8	1976,3	23,6
25-May	25,4	724,74	2123,1	2847,8	20,3
26-May	32,5	219,09	456,1	675,2	15,7
27-May	34,9	288,11	536,6	824,7	18,7
28-May	34,9	323,69	604,3	928,0	19,6
29-May	34,2	458,19	883,5	1341,7	22,2
30-May	36,0	410,98	731,4	1142,4	22,1
31-May	35,7	460,32	830,8	1291,2	22,9
1-Jun	35,4	478,07	871,9	1350,0	23,1
2-Jun	35,8	407,86	732,3	1140,1	21,9
3-Jun	36,5	317,11	551,6	868,7	20,0
4-Jun	36,4	321,47	561,7	883,2	20,1
5-Jun	35,7	339,74	612,5	952,2	20,3
6-Jun	37,2	221,71	374,6	596,3	16,8
7-Jun	36,5	289,73	503,5	793,3	19,1
8-Jun	35,7	365,95	658,7	1024,7	21,0
9-Jun	36,2	423,12	745,2	1168,3	22,4
10-Jun	36,4	426,50	745,5	1172,0	22,5
11-Jun	34,6	360,07	680,1	1040,1	20,5
12-Jun	35,3	325,96	598,6	924,6	19,8
13-Jun	36,1	370,28	654,8	1025,0	21,2
14-Jun	35,7	242,92	437,6	680,5	17,3
15-Jun	35,4	323,03	590,0	913,0	19,8
16-Jun	36,2	471,05	829,7	1300,7	23,3
17-Jun	36,8	323,72	556,3	880,1	20,2
18-Jun	35,4	381,89	696,0	1077,9	21,2
19-Jun	35,4	465,55	848,5	1314,0	22,9

20-Jun	35,8	427,83	768,2	1196,1	22,3
21-Jun	35,3	341,45	625,4	966,8	20,2
22-Jun	35,4	289,25	527,2	816,4	18,8
23-Jun	34,8	429,34	806,1	1235,4	22,0
24-Jun	34,1	397,81	770,2	1168,0	21,1
25-Jun	36,6	354,25	613,9	968,2	21,0
26-Jun	36,4	84,76	147,9	232,7	8,9
27-Jun	36,4	236,06	411,6	647,7	17,3
28-Jun	39,9	440,29	662,3	1102,6	24,2
29-Jun	42,7	398,74	534,6	933,3	24,1
30-Jun	39,0	315,29	493,8	809,0	20,6
1-Jul	37,8	384,98	633,9	1018,9	22,1
2-Jul	37,2	507,05	856,6	1363,6	24,3
3-Jul	36,3	323,13	566,7	889,8	20,1
4-Jul	35,5	332,98	606,1	939,1	20,1
5-Jul	36,0	121,98	217,1	339,0	11,5
6-Jul	36,0	164,94	292,6	457,6	14,0
7-Jul	35,8	304,65	547,3	852,0	19,4
8-Jul	36,9	334,92	573,3	908,2	20,6
9-Jul	36,2	428,17	755,8	1183,9	22,5
10-Jul	37,4	437,85	732,1	1170,0	23,2
11-Jul	33,1	287,28	581,3	868,6	18,1
12-Jul	29,6	341,50	813,1	1154,6	18,2
13-Jul	29,9	337,78	793,5	1131,3	18,2
14-Jul	29,9	227,10	532,1	759,2	15,4
15-Jul	25,3	342,08	1009,6	1351,6	16,5
16-Jul	26,1	348,08	983,4	1331,5	17,0
17-Jul	29,7	329,96	782,4	1112,3	18,0
18-Jul	28,2	486,84	1242,6	1729,4	19,9
19-Jul	35,5	585,47	1063,5	1648,9	24,7
20-Jul	37,2	495,03	836,7	1331,8	24,1
21-Jul	37,3	355,23	596,6	951,9	21,2
22-Jul	37,6	236,14	392,5	628,7	17,5
23-Jul	36,7	341,44	590,2	931,6	20,7
24-Jul	38,3	296,29	476,3	772,6	19,9
25-Jul	39,3	90,98	140,6	231,6	9,6
26-Jul	38,8	279,57	441,6	721,2	19,4
27-Jul	37,8	530,72	875,1	1405,8	25,0
28-Jul	37,5	363,56	606,9	970,4	21,5
29-Jul	37,6	276,19	457,6	733,8	19,0
30-Jul	36,5	362,94	630,8	993,8	21,2
31-Jul	37,7	418,67	692,5	1111,1	22,9
1-Aug	37,6	405,35	674,1	1079,4	22,5
2-Aug	36,1	349,20	618,8	968,0	20,7
3-Aug	37,2	236,63	399,4	636,0	17,5
5-Aug	36,8	311,73	535,2	846,9	19,9
6-Aug	37,1	400,83	680,0	1080,8	22,3
7-Aug	37,0	524,67	894,4	1419,1	24,5
8-Aug	37,3	453,09	760,5	1213,6	23,4
9-Aug	37,1	260,11	441,5	701,6	18,3
10-Aug	36,8	408,06	699,7	1107,8	22,3

11-Aug	37,6	390,28	646,5	1036,8	22,2
12-Aug	37,9	526,59	864,6	1391,2	24,9
13-Aug	38,1	481,13	780,5	1261,6	24,3
14-Aug	38,4	145,91	234,1	380,0	13,3
15-Aug	38,5	333,46	532,1	865,6	21,0
16-Aug	37,2	561,36	948,9	1510,2	25,2
17-Aug	38,6	489,76	779,7	1269,4	24,6
18-Aug	38,1	431,27	700,2	1131,5	23,3
19-Aug	37,0	522,00	887,4	1409,4	24,5
20-Aug	37,6	551,81	915,7	1467,5	25,2
21-Aug	37,5	521,99	868,2	1390,2	24,7
22-Aug	37,3	546,16	916,7	1462,9	25,0
23-Aug	37,5	513,10	856,0	1369,1	24,6
24-Aug	37,5	467,07	778,8	1245,9	23,8
25-Aug	37,7	450,48	743,3	1193,8	23,5
26-Aug	37,8	408,76	673,2	1082,0	22,7
27-Aug	37,8	519,38	853,6	1373,0	24,8
28-Aug	37,4	423,74	708,8	1132,5	22,9
29-Aug	36,9	343,40	588,4	931,8	20,8
30-Aug	37,3	223,49	375,6	599,1	16,9
31-Aug	38,3	502,98	808,9	1311,9	24,8
1-Sep	38,2	433,98	702,0	1136,0	23,4
2-Sep	38,3	546,15	879,4	1425,5	25,5
3-Sep	38,9	419,13	658,4	1077,5	23,3
4-Sep	39,0	338,14	528,4	866,6	21,3
5-Sep	37,2	332,28	560,6	892,9	20,6
6-Sep	37,8	119,59	197,2	316,8	11,5
7-Sep	37,6	200,13	331,6	531,8	16,0
8-Sep	37,0	363,89	620,0	983,9	21,4
9-Sep	37,5	278,92	465,0	743,9	19,1
10-Sep	38,1	353,47	574,4	927,9	21,5
11-Sep	37,7	389,13	642,7	1031,8	22,2
12-Sep	37,9	326,05	533,8	859,9	20,6
13-Sep	37,2	372,21	628,5	1000,8	21,6
14-Sep	37,8	399,81	659,2	1059,0	22,5
15-Sep	37,4	406,57	680,9	1087,5	22,5
16-Sep	37,0	395,95	675,4	1071,4	22,1
17-Sep	36,7	393,99	678,8	1072,8	22,0
18-Sep	36,7	157,97	272,7	430,7	13,7
19-Sep	37,5	262,26	437,1	699,4	18,5
20-Sep	36,9	324,19	553,3	877,4	20,3
21-Sep	37,0	433,07	738,9	1172,0	22,9
22-Sep	37,7	513,25	849,3	1362,6	24,6
23-Sep	37,4	612,29	1025,4	1637,7	26,0
24-Sep	37,1	369,17	625,4	994,6	21,5
25-Sep	36,8	260,99	447,3	708,2	18,3
26-Sep	36,1	91,16	161,1	252,3	9,4
27-Sep	36,2	105,42	185,8	291,2	10,4
28-Sep	36,2	293,84	518,7	812,5	19,2
29-Sep	36,8	287,64	494,3	781,9	19,2

30-Sep	36,6	300,70	520,3	821,0	19,5
1-Oct	36,0	269,59	479,9	749,5	18,3
2-Oct	36,2	315,06	554,6	869,6	19,8
3-Oct	36,6	398,07	688,7	1086,8	22,0
4-Oct	36,8	351,99	604,4	956,4	21,0
5-Oct	36,9	164,82	281,3	446,1	14,1
6-Oct	37,0	263,90	449,3	713,2	18,4
7-Oct	36,8	427,18	732,1	1159,3	22,7
8-Oct	37,0	453,44	772,1	1225,6	23,3
9-Oct	35,4	361,36	660,1	1021,4	20,8
10-Oct	34,9	424,75	793,4	1218,1	21,9
11-Oct	35,1	379,12	702,0	1081,2	21,0
12-Oct	35,5	476,16	864,3	1340,4	23,1
13-Oct	35,3	390,44	714,7	1105,2	21,4
14-Oct	34,8	444,26	832,5	1276,7	22,2
15-Oct	35,0	432,23	803,4	1235,7	22,1
16-Oct	34,7	473,27	891,9	1365,2	22,7
17-Oct	35,7	469,49	844,5	1314,0	23,1
18-Oct	35,9	471,57	841,8	1313,3	23,2
19-Oct	36,2	537,98	950,1	1488,1	24,4
20-Oct	36,5	547,71	953,5	1501,2	24,7
21-Oct	35,6	539,47	977,7	1517,2	24,1
22-Oct	35,5	566,85	1032,0	1598,8	24,4
23-Oct	35,8	441,40	791,4	1232,8	22,6
24-Oct	34,5	426,61	809,2	1235,8	21,8
25-Oct	30,7	510,44	1153,5	1664,0	21,4
26-Oct	30,2	505,34	1169,1	1674,4	21,1
27-Oct	31,1	501,97	1110,3	1612,3	21,5
28-Oct	32,2	565,47	1190,3	1755,8	22,8
29-Oct	32,8	658,54	1351,4	2010,0	24,1
30-Oct	32,6	526,68	1086,9	1613,5	22,6
31-Oct	31,2	524,62	1159,2	1683,8	21,8
1-Nov	30,9	479,58	1074,5	1554,1	21,1
2-Nov	31,4	569,18	1246,4	1815,5	22,4
3-Nov	30,7	481,36	1084,1	1565,5	21,1
4-Nov	35,4	517,02	942,1	1459,2	23,7
5-Nov	36,2	404,23	713,1	1117,3	22,0
6-Nov	32,6	457,40	944,2	1401,6	21,6
7-Nov	33,8	91,68	179,8	271,4	9,2
8-Nov	34,6	269,26	508,0	777,2	18,0
9-Nov	32,0	512,94	1089,1	1602,0	22,1
10-Nov	31,4	622,28	1358,8	1981,1	23,0
11-Nov	33,6	398,73	786,7	1185,4	20,9
12-Nov	35,1	684,38	1265,5	1949,9	25,6
13-Nov	35,6	476,75	862,4	1339,1	23,2
14-Nov	35,8	523,44	938,8	1462,3	24,0
15-Nov	35,8	572,05	1025,6	1597,7	24,7
16-Nov	35,4	531,43	970,3	1501,8	23,9
17-Nov	35,1	538,24	995,1	1533,3	23,9
18-Nov	34,7	557,05	1049,2	1606,3	23,9

19-Nov	34,0	448,93	869,8	1318,7	22,0
20-Nov	32,2	701,22	1473,4	2174,6	24,2
21-Nov	32,8	729,26	1492,4	2221,7	24,8
22-Nov	32,3	483,94	1016,3	1500,2	21,8
23-Nov	32,5	569,06	1184,1	1753,1	23,0
24-Nov	34,3	359,19	688,8	1048,0	20,3
25-Nov	29,5	355,64	848,0	1203,6	18,5
26-Nov	31,3	387,53	848,8	1236,3	19,8
27-Nov	30,7	417,64	943,9	1361,5	20,1
28-Nov	32,3	453,74	950,7	1404,5	21,4
29-Nov	33,3	572,16	1147,7	1719,9	23,5
30-Nov	33,9	600,79	1173,3	1774,1	24,1
1-Dec	31,8	593,14	1273,1	1866,3	22,9
2-Dec	30,9	466,55	1042,5	1509,1	20,9
3-Dec	31,1	528,93	1172,0	1700,9	21,8
4-Dec	30,6	476,30	1079,6	1555,9	20,9
5-Dec	30,8	115,40	259,3	374,7	10,5
6-Dec	30,3	238,59	549,5	788,1	15,8
7-Dec	32,4	421,88	881,7	1303,6	20,8
8-Dec	31,5	429,48	931,8	1361,3	20,6
9-Dec	31,4	315,98	690,3	1006,3	18,3
10-Dec	31,5	490,27	1066,5	1556,8	21,5
11-Dec	31,4	400,01	873,7	1273,7	20,1
12-Dec	31,5	523,25	1138,7	1662,0	22,0
13-Dec	31,1	483,96	1071,3	1555,3	21,3
14-Dec	32,3	332,92	696,9	1029,9	19,0
15-Dec	31,7	492,22	1061,3	1553,5	21,7
16-Dec	31,0	475,14	1057,6	1532,7	21,1
17-Dec	32,4	430,28	895,9	1326,2	21,0
18-Dec	32,6	414,48	855,6	1270,1	20,8
19-Dec	31,8	305,72	656,7	962,4	18,2
20-Dec	33,9	423,72	825,0	1248,7	21,5
21-Dec	33,5	451,70	896,8	1348,5	21,8
22-Dec	33,7	485,15	953,1	1438,2	22,5
23-Dec	33,4	407,21	812,2	1219,4	21,0
24-Dec	35,2	345,23	636,6	981,8	20,3
25-Dec	32,1	429,43	908,3	1337,7	20,9
26-Dec	32,1	265,98	563,5	829,5	17,2
27-Dec	30,6	394,81	893,5	1288,3	19,7
28-Dec	30,9	528,33	1180,7	1709,0	21,8
29-Dec	31,8	531,31	1137,1	1668,5	22,2
30-Dec	30,9	575,55	1289,4	1865,0	22,3
31-Dec	30,5	507,22	1154,1	1661,3	21,3
1-Jan	31,7	512,44	1103,1	1615,6	21,9
2-Jan	31,4	465,85	1018,7	1484,5	21,1
3-Jan	31,1	590,11	1307,8	1898,0	22,5
4-Jan	28,8	605,86	1494,4	2100,3	21,5
5-Jan	32,2	605,57	1276,9	1882,4	23,3
6-Jan	30,5	574,26	1306,6	1880,8	22,1
7-Jan	30,7	599,09	1350,1	1949,2	22,4

8-Jan	28,9	504,36	1238,3	1742,7	20,5
9-Jan	30,1	465,31	1080,3	1545,6	20,5
10-Jan	33,4	84,82	168,9	253,7	8,7
11-Jan	31,1	231,87	513,6	745,5	15,8
12-Jan	26,0	451,11	1281,8	1732,9	18,4
13-Jan	26,6	450,78	1245,4	1696,1	18,7
14-Jan	25,7	361,17	1044,8	1406,0	17,0
15-Jan	28,2	310,16	790,0	1100,2	17,0
16-Jan	31,3	287,00	629,2	916,2	17,5
17-Jan	32,0	350,63	745,5	1096,1	19,3
18-Jan	31,2	450,07	991,8	1441,9	20,8
19-Jan	33,3	318,52	639,1	957,6	19,0
20-Jan	33,4	693,65	1385,2	2078,8	24,8
21-Jan	34,9	504,10	939,5	1443,6	23,3
22-Jan	32,8	449,02	919,6	1368,6	21,5
23-Jan	31,6	349,54	758,3	1107,9	19,1
24-Jan	31,8	440,56	945,7	1386,3	20,9
25-Jan	32,1	409,97	867,1	1277,1	20,5
26-Jan	32,1	268,09	566,5	834,6	17,2
27-Jan	32,3	376,29	790,1	1166,4	19,9
28-Jan	32,5	421,36	873,7	1295,1	20,9
29-Jan	32,0	408,27	867,0	1275,3	20,5
30-Jan	31,0	602,20	1343,0	1945,2	22,6
31-Jan	30,6	128,59	291,8	420,4	11,3
1-Feb	31,9	291,49	622,3	913,8	17,8
2-Feb	30,8	486,29	1091,9	1578,2	21,2
3-Feb	30,9	456,14	1019,6	1475,8	20,8
4-Feb	30,4	636,38	1460,2	2096,6	22,6
5-Feb	31,1	414,68	918,9	1333,6	20,2
6-Feb	30,8	345,78	778,6	1124,4	18,7
7-Feb	31,4	632,56	1382,1	2014,6	23,1
8-Feb	30,9	534,48	1197,4	1731,8	21,8
9-Feb	32,1	518,10	1096,4	1614,5	22,2
10-Feb	30,4	438,04	1004,9	1442,9	20,3
11-Feb	30,2	507,81	1172,1	1679,9	21,2
12-Feb	32,1	386,22	816,5	1202,7	20,1
13-Feb	32,7	321,87	662,2	984,0	18,9
14-Feb	31,8	396,72	849,2	1246,0	20,2
15-Feb	31,5	331,78	723,1	1054,8	18,7
16-Feb	31,7	414,65	895,0	1309,6	20,4
17-Feb	33,3	477,16	954,9	1432,1	22,2
18-Feb	36,5	396,81	690,4	1087,2	22,0
19-Feb	33,8	348,75	682,5	1031,2	19,9
20-Feb	32,2	589,10	1241,1	1830,2	23,1
21-Feb	36,5	450,13	784,1	1234,2	23,0
22-Feb	35,7	450,00	809,2	1259,2	22,7
23-Feb	35,2	379,79	700,1	1079,9	21,1
24-Feb	36,0	506,38	901,3	1407,7	23,8
25-Feb	37,0	440,81	749,4	1190,2	23,1
26-Feb	36,3	428,64	751,2	1179,8	22,6
27-Feb	36,7	358,23	618,0	976,3	21,1

28-Feb	36,7	465,35	803,6	1268,9	23,4
29-Feb	38,0	139,63	227,4	367,1	12,8
1-Mar	36,9	131,10	223,8	354,9	12,2
2-Mar	34,5	389,21	738,0	1127,2	21,1
3-Mar	36,5	327,34	569,1	896,4	20,3
6-Mar	35,4	548,77	1000,1	1548,9	24,2
7-Mar	36,5	570,02	991,6	1561,6	25,0
8-Mar	27,2	609,17	1630,7	2239,9	20,6
9-Mar	30,0	393,44	918,4	1311,9	19,4
10-Mar	33,5	408,36	808,9	1217,3	21,1
11-Mar	32,5	517,04	1073,0	1590,0	22,4
12-Mar	29,8	492,45	1157,7	1650,1	20,8
13-Mar	29,8	518,97	1220,0	1739,0	21,1
14-Mar	31,0	469,53	1043,8	1513,3	21,0
15-Mar	33,8	478,52	938,1	1416,6	22,4
16-Mar	33,0	341,97	694,6	1036,6	19,5
17-Mar	33,4	366,24	730,0	1096,2	20,2
18-Mar	32,9	312,80	638,4	951,2	18,7
19-Mar	31,6	324,07	700,3	1024,3	18,6
20-Mar	27,6	249,44	652,9	902,4	15,4
21-Mar	30,2	467,92	1082,5	1550,5	20,6
22-Mar	30,5	453,08	1033,1	1486,2	20,5
23-Mar	32,0	337,80	719,2	1057,0	19,0
24-Mar	31,3	401,22	880,7	1281,9	20,0
25-Mar	30,4	169,41	387,5	556,9	13,3
26-Mar	28,3	252,81	641,6	894,4	15,7
27-Mar	30,6	452,75	1027,9	1480,7	20,6
28-Mar	31,5	449,41	976,8	1426,2	20,9
29-Mar	33,1	327,91	661,5	989,4	19,2
30-Mar	34,2	372,28	717,2	1089,5	20,6
31-Mar	34,3	373,51	715,9	1089,4	20,6
1-Apr	34,6	216,71	410,2	626,9	16,1
2-Apr	34,7	408,09	767,7	1175,8	21,5
3-Apr	35,4	426,04	776,1	1202,1	22,2
4-Apr	35,9	566,99	1012,8	1579,8	24,7
5-Apr	35,9	548,72	979,6	1528,3	24,4
6-Apr	36,2	494,63	871,2	1365,8	23,7
7-Apr	35,7	524,59	946,1	1470,7	23,9
8-Apr	35,1	530,33	980,8	1511,1	23,8
9-Apr	34,3	520,09	997,3	1517,4	23,2
10-Apr	36,2	347,08	611,1	958,2	20,7
11-Apr	36,4	318,82	557,0	875,8	20,0
12-Apr	36,3	396,56	696,0	1092,6	21,9
13-Apr	36,0	403,22	716,9	1120,1	21,9
14-Apr	35,7	350,11	630,1	980,2	20,6
15-Apr	35,7	339,42	612,0	951,4	20,3
16-Apr	35,5	192,15	349,1	541,2	15,2
17-Apr	34,9	253,91	473,7	727,6	17,5
18-Apr	36,3	299,95	526,9	826,9	19,4
19-Apr	36,1	279,04	495,0	774,0	18,7

20-Apr	36,9	377,22	645,3	1022,5	21,6
21-Apr	37,5	298,51	497,9	796,4	19,7
22-Apr	37,0	222,23	377,6	599,8	16,8
23-Apr	34,9	595,27	1110,3	1705,6	24,5
24-Apr	33,6	621,52	1227,7	1849,2	24,2
25-Apr	36,2	370,42	653,3	1023,7	21,2
26-Apr	36,5	576,56	1003,2	1579,8	25,1
27-Apr	36,8	373,35	642,4	1015,7	21,5
28-Apr	36,8	391,23	672,2	1063,4	21,9
29-Apr	36,4	368,86	643,5	1012,4	21,3
30-Apr	36,5	432,71	752,8	1185,5	22,7
1-May	35,8	449,72	805,6	1255,3	22,8
2-May	37,6	327,43	542,3	869,8	20,6
3-May	37,6	407,11	676,1	1083,2	22,6
4-May	37,4	330,08	552,1	882,2	20,6
5-May	37,4	204,64	341,9	546,6	16,2
6-May	36,8	180,18	310,0	490,1	14,9
7-May	37,2	385,02	650,5	1035,5	21,9
8-May	37,4	384,99	643,9	1028,9	22,0
9-May	35,7	366,73	661,8	1028,6	21,0
10-May	36,9	435,00	742,8	1177,8	22,9
11-May	36,6	478,14	827,2	1305,3	23,6
12-May	36,9	421,30	720,0	1141,3	22,6
13-May	36,5	547,54	953,3	1500,9	24,7
14-May	35,0	458,06	850,8	1308,9	22,6
15-May	35,7	555,68	1000,7	1556,4	24,4
16-May	36,3	419,18	736,3	1155,5	22,4
17-May	36,2	379,84	668,7	1048,5	21,5
18-May	34,6	318,70	602,3	921,0	19,4
19-May	34,1	394,46	762,4	1156,8	21,0
Average	34,1	407,93	802,75	1210,68	20,7

Table D6. Data for Cu dewatering circuit

	Shift	Date	Thickener U/F				Surge Tank		
			Density		Solid %	Torque	Level	Density	Solid %
			Auto	Manuel					
Year 2007	N/S	1-Jan	1940	1870	64,6	5,50	70	1800	59,3
	D/S		1860	1830	61,6	5,00	42	1750	57,1
	A/S		1930	1900	64,2	4,90	40	1720	55,8
	N/S	2-Jan	1900	1850	63,2	4,50	60	1700	54,9
	D/S		1830	1750	60,5	5,00	45	1680	54,0
	A/S		1860	1800	61,6	4,60	26	1750	57,1
	N/S	3-Jan	2085	2190	69,4	10,00	89	1950	65,0
	D/S		2130	2250	70,7	12,00	90	2020	67,3
	A/S		2000	2000	66,7	4,00	90	1850	61,3
	N/S	4-Jan	1900	1830	63,2	4,30	77	1680	54,0
	D/S		1936	1930	64,5	4,00	53	1680	54,0
	A/S		1930	1940	64,2	3,80	47	1820	60,1
	N/S	5-Jan	1970	1980	65,7	4,00	53	1750	57,1
	D/S		1880	1840	62,4	4,30	61	1680	54,0
	A/S		2080	2040	69,2	7,00	60	1850	61,3
	N/S	6-Jan	2060	2120	68,6	5,90	81	2000	66,7
	D/S		1950	1910	65,0	4,50	70	1680	54,0
	A/S		1940	1890	64,6	4,50	45	1750	57,1
	N/S	7-Jan	2020	2050	67,3	4,90	32	1800	59,3
	D/S		1920	1840	63,9	5,00	86	1710	55,4
	A/S		1840	1800	60,9	5,50	55	1700	54,9
	N/S	8-Jan	2020	2050	67,3	5,10	42	1750	57,1
	D/S		1900	1800	63,2	4,80	80	1700	54,9
	A/S		2000	1930	66,7	4,50	75	1750	57,1
	N/S	9-Jan	2020	2080	67,3	6,65	86	1850	61,3
	D/S		2000	1950	66,7	5,00	50	1800	59,3
	A/S		1950	1900	65,0	4,50	75	1780	58,4
	N/S	10-Jan	1950	1950	65,0	4,42	54	1850	61,3
	D/S		1970	1950	65,7	4,50	80	1800	59,3
	N/S	11-Jan	2050	2080	68,3	7,00	74	1950	65,0
	D/S		2000	2040	66,7	6,60	86	1960	65,3
	A/S		1900	1920	63,2	4,00	65	1840	60,9
	N/S	12-Jan	2030	2100	67,7	7,40	91	1840	60,9
	D/S		1980	1950	66,0	5,50	37	1850	61,3
	A/S		1930	1950	64,2	3,90	40	1840	60,9
	N/S	13-Jan	1930	1900	64,2	4,30	67	1600	50,0
	D/S		1970	1920	65,7	4,00	51	1840	60,9
	A/S		2050	2120	68,3	7,00	83	1900	63,2
	N/S	14-Jan	2010	2020	67,0	4,90	80	1880	62,4
	D/S		1970	2000	65,7	5,00	45	1850	61,3
	A/S		1910	1970	63,5	4,30	45	1800	59,3
	N/S	15-Jan	1970	2000	65,7	5,50	75	1740	56,7
	D/S		1930	1930	64,2	4,80	67	1750	57,1
	A/S		1980	2000	66,0	3,90	37	1760	57,6
	N/S	16-Jan	1900	1900	63,2	4,50	68	1700	54,9
	D/S		1880	1920	62,4	5,20	83	1700	54,9
	A/S		1860	1820	61,6	4,40	30	1680	54,0
	N/S	17-Jan	1900	1900	63,2	4,50	65	1720	55,8
	D/S		1850	1810	61,3	4,70	36	1700	54,9
	A/S		1900	1880	63,2	4,50	60	1800	59,3
	N/S	18-Jan	1900	1900	63,2	4,70	85	1720	55,8
	D/S		1940	1850	64,6	4,90	54	1770	58,0
	A/S		2025	2030	67,5	5,40	78	1830	60,5

D/S	19-Jan	2030	2120	67,7	6,40	82	1920	63,9
D/S	20-Jan	2120	2280	70,4	6,00	70	1870	62,0
A/S		1965	1900	65,5	4,70	86	1850	61,3
N/S	21-Jan	2013	1950	67,1	4,20	51	1800	59,3
D/S		1850	1790	61,3	4,30	68	1820	60,1
A/S		1950	1880	65,0	4,30	48	1750	57,1
N/S	22-Jan	2030	1910	67,7	5,30	63	1770	58,0
D/S		2090	2220	69,5	6,70	77	1780	58,4
A/S		2030	1990	67,7	3,55	90	1900	63,2
N/S	23-Jan	2020	2090	67,3	4,60	90	1950	65,0
D/S		2060	2120	68,6	5,30	83	1900	63,2
A/S		2130	2150	70,7	10,00	93	1950	65,0
N/S	24-Jan	2010	1900	67,0	4,10	74	1940	64,6
D/S		2080	2180	69,2	4,20	93	1900	63,2
A/S		2070	2060	68,9	4,15	94	1900	63,2
N/S	25-Jan	2150	2200	71,3	6,20	87	2060	68,6
D/S		1990	1950	66,3	5,00	50	1900	63,2
A/S		2000	1950	66,7	3,60	44	1900	63,2
N/S	26-Jan	1930	1950	64,2	5,20	51	1850	61,3
D/S		2010	2000	67,0	3,95	65	1750	57,1
A/S		1940	1980	64,6	3,80	72	1700	54,9
N/S	27-Jan	1960	2010	65,3	3,70	71	1920	63,9
D/S		1920	1900	63,9	3,35	28	1760	57,6
A/S		1700	1680	54,9	3,01	25	1760	57,6
N/S	28-Jan	1900	1920	63,2	3,10	54	1710	55,4
D/S		1934	1950	64,4	3,50	35	1720	55,8
A/S		1910	1880	63,5	3,50	35	1710	55,4
N/S	29-Jan	1960	1920	65,3	5,00	47	1750	57,1
D/S		2010	2000	67,0	5,40	76	1810	59,7
A/S		1950	2000	65,0	4,90	39	1810	59,7
N/S	30-Jan	1950	1880	65,0	5,00	50	1800	59,3
D/S		1910	1930	63,5	5,10	78	1750	57,1
A/S		2040	2080	68,0	6,30	97	1660	53,0
N/S	31-Jan	2010	2080	67,0	8,00	95	1900	63,2
A/S		1980	1960	66,0	5,20	77	1810	59,7
N/S	1-Feb	2020	2040	67,3	5,15	61	1900	63,2
D/S		2040	2100	68,0	6,45	30	1750	57,1
A/S		1890	1850	62,8	4,30	68	1850	61,3
N/S	2-Feb	2010	2010	67,0	6,40	67	1910	63,5
D/S		2030	2000	67,7	6,00	90	1860	61,6
A/S		2020	1900	67,3	4,80	88	1900	63,2
N/S	3-Feb	2058	2100	68,5	7,80	94	1970	65,7
D/S		2040	2000	68,0	7,90	90	1910	63,5
A/S		2130	2240	70,7	10,00	86	2030	67,7
N/S	4-Feb	2020	2010	67,3	5,45	91	1940	64,6
D/S		1970	1910	65,7	5,50	57	1840	60,9
A/S		1960	1990	65,3	6,50	84	1900	63,2
N/S	5-Feb	1975	1960	65,8	4,50	84	1870	62,0
D/S		1960	1910	65,3	4,90	24	1800	59,3
A/S		1950	1890	65,0	4,40	48	1800	59,3
N/S	6-Feb	1965	1920	65,5	5,10	72	1750	57,1
D/S		1990	1850	66,3	5,30	64	1850	61,3
A/S		1970	1950	65,7	4,80	40	1920	63,9
N/S	7-Feb	1930	1900	64,2	5,00	30	1700	54,9
A/S		1880	1890	62,4	4,90	25	1830	60,5
N/S	8-Feb	1940	1950	64,6	5,00	29	1710	55,4
D/S		2150	2200	71,3	13,10	19	1850	61,3
A/S		1880	1820	62,4	3,60	56	1730	56,3
N/S	9-Feb	1930	1900	64,2	4,70	61	1720	55,8
D/S		2000	1900	66,7	5,70	62	1740	56,7
A/S		2070	2120	68,9	10,20	22	1720	55,8

N/S	10-Feb	2050	2000	68,3	7,00	76	1730	56,3
D/S		1960	1900	65,3	4,70	64	1850	61,3
A/S		2000	2020	66,7	4,20	52	1830	60,5
N/S	11-Feb	2000	1980	66,7	4,50	78	1850	61,3
D/S		1980	2100	66,0	6,50	75	1900	63,2
A/S		1960	1940	65,3	3,50	89	1850	61,3
N/S	12-Feb	1800	1850	59,3	4,30	56	1800	59,3
D/S		2000	2050	66,7	4,60	67	1850	61,3
A/S		2000	2010	66,7	5,20	51	1870	62,0
A/S	14-Feb	2050	2100	68,3	5,13	27	1860	61,6
N/S	15-Feb	2000	1950	66,7	4,50	82	1850	61,3
A/S		1910	1870	63,5	4,00	54	1830	60,5
N/S	16-Feb	2020	2050	67,3	4,80	69	1810	59,7
A/S		1985	1900	66,2	4,70	65	1810	59,7
N/S	17-Feb	1930	1950	64,2	4,30	71	1900	63,2
D/S		1930	1890	64,2	4,70	80	1850	61,3
A/S		1930	1840	64,2	4,00	88	1800	59,3
N/S	18-Feb	1980	2050	66,0	4,60	45	1840	60,9
D/S		1950	1970	65,0	4,70	67	1720	55,8
A/S		1920	1800	63,9	4,50	60	1700	54,9
N/S	19-Feb	1990	2000	66,3	5,70	61	1860	61,6
D/S		2025	2060	67,5	6,25	85	1940	64,6
A/S		1950	1950	65,0	4,20	49	1800	59,3
N/S	20-Feb	2040	2060	68,0	7,20	80	1800	59,3
D/S		2110	2120	70,1	6,75	87	1940	64,6
A/S		2050	2000	68,3	6,50	95	1900	63,2
N/S	21-Feb	1940	1950	64,6	4,80	65	1870	62,0
D/S		2120	2150	70,4	7,40	95	1850	61,3
N/S	22-Feb	1900	1920	63,2	4,40	52	1780	58,4
D/S		1840	1840	60,9	4,70	46	1790	58,8
A/S		1875	1850	62,2	4,95	91	1850	61,3
N/S	23-Feb	1870	1940	62,0	5,00	82	1840	60,9
D/S		1970	1900	65,7	4,70	32	1750	57,1
A/S		1880	1900	62,4	3,60	82	1800	59,3
N/S	24-Feb	1890	1880	62,8	4,30	62	1780	58,4
D/S		1900	1890	63,2	5,00	55	1800	59,3
A/S		1930	2000	64,2	5,20	53	1850	61,3
N/S	25-Feb	1860	1810	61,6	5,70	43	1650	52,5
D/S		1950	1890	65,0	5,75	30	1630	51,5
A/S		1890	1800	62,8	4,70	62	1870	62,0
N/S	26-Feb	1950	2100	65,0	5,30	45	1850	61,3
D/S		1950	2050	65,0	7,20	62	1840	60,9
A/S		1880	1840	62,4	4,70	58	1830	60,5
N/S	27-Feb	1900	1860	63,2	5,00	48	1870	62,0
D/S		2020	2000	67,3	4,80	60	1850	61,3
A/S		1920	1900	63,9	3,50	62	1890	62,8
N/S	28-Feb	1900	1830	63,2	5,00	63	1790	58,8
D/S		2080	2100	69,2	7,50	46	1850	61,3
A/S		1930	1890	64,2	3,60	46	1880	62,4
N/S	1-Mar	2030	2010	67,7	4,70	41	1890	62,8
D/S		2000	2000	66,7	4,70	20	1900	63,2
A/S		1940	1940	64,6	4,50	73	1900	63,2
N/S	2-Mar	1900	1890	63,2	4,40	71	1750	57,1
D/S		1945	2000	64,8	5,40	51	1900	63,2
A/S		2020	2090	67,3	4,00	74	1950	65,0
N/S	3-Mar	1960	1980	65,3	4,40	69	1720	55,8
D/S		2030	2000	67,7	5,70	81	1900	63,2
A/S		2140	2310	71,0	8,10	93	2050	68,3
N/S	4-Mar	2020	2100	67,3	6,00	91	2000	66,7
D/S		2040	2050	68,0	6,47	76	2000	66,7
A/S		1990	1990	66,3	4,40	82	1940	64,6

N/S	5-Mar	2050	2000	68,3	6,94	73	1900	63,2
D/S		2100	2200	69,8	7,00	72	2000	66,7
A/S		2070	2100	68,9	8,00	67	1830	60,5
N/S	6-Mar	2050	2070	68,3	7,00	77	1810	59,7
D/S		1920	1900	63,9	4,80	54	1810	59,7
A/S		1970	1980	65,7	5,00	32	1790	58,8
N/S	7-Mar	2000	2050	66,7	5,80	48	1950	65,0
A/S	8-Mar	2060	2100	68,6	8,40	81	1900	63,2
N/S	9-Mar	1950	2000	65,0	4,50	67	1950	65,0
D/S		2060	2130	68,6	6,30	37	1920	63,9
A/S		2030	2040	67,7	5,00	16	1880	62,4
N/S	10-Mar	1870	1900	62,0	4,30	47	1850	61,3
D/S		1880	1870	62,4	1,90	35	1830	60,5
A/S		2030	2000	67,7	4,20	41	1700	54,9
N/S	11-Mar	2010	2050	67,0	4,50	61	1970	65,7
D/S		1920	1930	63,9	4,70	35	1850	61,3
A/S		1930	1910	64,2	4,00	40	1830	60,5
N/S	12-Mar	1960	2050	65,3	5,00	55	1850	61,3
D/S		1890	1870	62,8	4,70	30	1830	60,5
A/S		1970	1900	65,7	4,30	53	1810	59,7
N/S	13-Mar	1950	1940	65,0	4,60	54	1800	59,3
D/S		1900	1910	63,2	4,80	55	1780	58,4
A/S		1980	1900	66,0	5,00	38	1710	55,4
N/S	14-Mar	1985	2040	66,2	5,70	78	1910	63,5
D/S		1890	1850	62,8	4,60	93	1870	62,0
A/S		1940	1890	64,6	4,10	39	1850	61,3
N/S	15-Mar	1940	2000	64,6	4,50	48	1870	62,0
D/S		1920	1910	63,9	4,20	30	1800	59,3
A/S		1890	1930	62,8	4,00	31	1800	59,3
N/S	16-Mar	1970	1990	65,7	5,00	71	1890	62,8
D/S		1950	1950	65,0	5,00	82	1860	61,6
A/S		1920	1950	63,9	4,70	85	1900	63,2
N/S	17-Mar	1980	1990	66,0	4,40	77	1870	62,0
D/S		1970	1990	65,7	4,80	72	1840	60,9
A/S		1980	2050	66,0	5,00	72	1850	61,3
N/S	18-Mar	2010	2060	67,0	5,30	81	1890	62,8
D/S		1920	1840	63,9	4,20	88	1780	58,4
A/S		2030	2000	67,7	5,70	86	1850	61,3
N/S	19-Mar	1970	1920	65,7	5,10	76	1880	62,4
D/S		1950	1930	65,0	5,10	40	1780	58,4
A/S		1960	1950	65,3	3,50	23	1900	63,2
N/S	20-Mar	1880	1840	62,4	4,20	22	1820	60,1
D/S		2000	1980	66,7	5,30	38	1850	61,3
A/S		1930	2000	64,2	4,20	35	1750	57,1
N/S	21-Mar	1980	1990	66,0	5,30	60	1850	61,3
D/S		2015	1940	67,2	6,18	72	1900	63,2
A/S		1950	2010	65,0	3,30	88	1930	64,2
N/S	22-Mar	2010	2100	67,0	6,45	87	1920	63,9
D/S		2040	2000	68,0	5,90	81	1850	61,3
A/S		1990	1990	66,3	5,60	81	1930	64,2
N/S	23-Mar	1980	2000	66,0	4,20	67	1900	63,2
D/S		2020	2000	67,3	7,40	65	1940	64,6
A/S		1950	2010	65,0	3,70	48	1900	63,2
N/S	24-Mar	1990	1970	66,3	4,00	67	1690	54,4
D/S		1820	1700	60,1	3,20	70	1750	57,1
A/S		1860	1790	61,6	3,80	66	1670	53,5
N/S	25-Mar	1830	1690	60,5	4,30	84	1560	47,9
A/S		1880	1820	62,4	3,30	48	1740	56,7
N/S	26-Mar	1850	1900	61,3	4,00	50	1710	55,4
D/S		2010	2000	67,0	6,00	22	1750	57,1
A/S		1800	1720	59,3	5,00	69	1740	56,7

N/S	27-Mar	2030	2040	67,7	6,30	71	1750	57,1
D/S		2040	2050	68,0	6,00	80	1950	65,0
A/S		1970	1970	65,7	4,90	74	1850	61,3
N/S	28-Mar	1990	1950	66,3	6,50	25	1880	62,4
A/S		1930	1910	64,2	5,00	74	1890	62,8
N/S	29-Mar	1930	1900	64,2	5,00	60	1880	62,4
D/S		1920	1900	63,9	5,00	71	1870	62,0
N/S	30-Mar	1900	1850	63,2	4,50	87	1860	61,6
D/S		2050	2100	68,3	5,80	89	1820	60,1
A/S		2000	2030	66,7	3,70	77	1880	62,4
N/S	31-Mar	2000	2000	66,7	4,40	48	1900	63,2
D/S		2080	2090	69,2	5,50	21	1850	61,3
A/S		1990	2050	66,3	4,20	30	1950	65,0
N/S	1-Apr	2030	2050	67,7	4,20	29	1900	63,2
D/S		2000	2020	66,7	6,00	29	1820	60,1
A/S		1985	2030	66,2	4,15	92	1900	63,2
N/S	2-Apr	2050	2100	68,3	7,40	84	2000	66,7
D/S		2010	2020	67,0	5,30	80	1880	62,4
A/S		2000	1980	66,7	6,20	40	1920	63,9
N/S	3-Apr	1975	2000	65,8	7,00	85	1950	65,0
D/S		2020	2090	67,3	8,60	94	1930	64,2
N/S	6-Apr	1800	1800	59,3	3,70	77	1750	57,1
D/S		1930	1870	64,2	5,50	62	1700	54,9
N/S	7-Apr	1910	1860	63,5	5,70	96	1830	60,5
D/S		1960	1960	65,3	8,00	80	1800	59,3
A/S		1860	1850	61,6	4,20	51	1780	58,4
N/S	8-Apr	1870	180	62,0	5,20	72	1700	54,9
D/S		1920	1870	63,9	7,00	53	1750	57,1
A/S		1850	1750	61,3	3,20	45	1730	56,3
N/S	9-Apr	1860	1830	61,6	5,10	40	1750	57,1
D/S		1950	2000	65,0	8,20	90	1900	63,2
A/S		1900	1910	63,2	4,70	76	1810	59,7
N/S	10-Apr	1920	1900	63,9	5,50	50	1770	58,0
A/S		1960	1950	65,3	6,20	74	1850	61,3
N/S	11-Apr	1900	1920	63,2	5,00	57	1800	59,3
D/S		1980	1950	66,0	6,50	65	1900	63,2
A/S	12-Apr	2100	2100	69,8	8,70	85	1650	52,5
N/S	13-Apr	2010	1940	67,0	5,40	83	1920	63,9
D/S		2020	1960	67,3	6,50	32	1850	61,3
A/S		1950	1980	65,0	3,60	39	1910	63,5
N/S	14-Apr	1955	1950	65,1	5,40	58	1800	59,3
D/S		1900	1940	63,2	5,50	60	1850	61,3
A/S		1890	1850	62,8	3,70	65	1740	56,7
N/S	15-Apr	2000	2000	66,7	7,40	92	1920	63,9
D/S		1960	1940	65,3	7,00	64	1900	63,2
A/S		1950	1970	65,0	6,30	88	1880	62,4
N/S	16-Apr	1990	1950	66,3	5,60	90	1910	63,5
D/S		2000	2000	66,7	7,00	60	1900	63,2
A/S		2000	2060	66,7	6,10	87	1890	62,8
N/S	17-Apr	2010	2040	67,0	7,00	69	1880	62,4
D/S		2045	2100	68,1	8,40	88	1850	61,3
A/S		1910	1900	63,5	4,40	44	1650	52,5
N/S	18-Apr	1870	1800	62,0	4,70	35	1700	54,9
D/S		1890	1850	62,8	4,80	54	1700	54,9
A/S		1800	1700	59,3	4,20	29	1740	56,7
N/S	19-Apr	1830	1750	60,5	4,30	41	1650	52,5
A/S		1920	1850	63,9	4,75	45	1670	53,5
N/S	20-Apr	1950	1850	65,0	5,30	50	1800	59,3
A/S		1885	1890	62,6	4,80	51	1720	55,8

N/S	21-Apr	2000	1980	66,7	6,00	52	1880	62,4
D/S		1950	2000	65,0	5,00	83	1920	63,9
A/S		2000	2100	66,7	3,00	80	1890	62,8
D/S	22-Apr	1900	1880	63,2	4,50	48	1820	60,1
A/S		1970	2100	65,7	5,35	40	1700	54,9
N/S	23-Apr	2060	1850	68,6	4,70	91	1850	61,3
D/S		2090	2150	69,5	7,00	72	2010	67,0
A/S		2010	1550	67,0	4,30	74	1600	50,0
N/S	24-Apr	1930	1900	64,2	5,20	70	1850	61,3
D/S		2020	2050	67,3	8,00	54	1930	64,2
A/S		1980	2060	66,0	7,50	87	1910	63,5
N/S	25-Apr	2030	2100	67,7	8,60	60	1950	65,0
D/S		1960	2020	65,3	6,20	58	1930	64,2
A/S		1750	1820	57,1	3,20	71	1900	63,2
N/S	26-Apr	1980	2050	66,0	4,60	65	2000	66,7
D/S		2080	2220	69,2	6,80	93	2020	67,3
A/S		2100	2160	69,8	5,00	60	1960	65,3
N/S	27-Apr	2020	2050	67,3	6,50	82	2000	66,7
D/S		2000	2030	66,7	5,70	90	1870	62,0
A/S		1930	1950	64,2	4,50	69	1900	63,2
N/S	28-Apr	1930	1950	64,2	4,40	67	1910	63,5
D/S		2040	2040	68,0	6,50	49	1930	64,2
A/S		2040	2050	68,0	9,00	89	1900	63,2
N/S	29-Apr	1920	1910	63,9	4,10	56	1970	65,7
D/S		1880	1870	62,4	4,28	63	1830	60,5
A/S		1920	1900	63,9	3,40	53	1850	61,3
N/S	30-Apr	1910	1880	63,5	4,10	68	1830	60,5
D/S		2000	2010	66,7	4,80	57	1800	59,3
A/S		2030	2040	67,7	5,50	79	1850	61,3
N/S	1-May	1925	2000	64,1	4,30	81	1900	63,2
A/S	3-May	2000	2010	66,7	4,50	85	1900	63,2
N/S	4-May	1900	1860	63,2	3,85	88	1870	62,0
D/S		2040	2030	68,0	6,75	85	1900	63,2
A/S		2100	2200	69,8	8,40	85	1850	61,3
N/S	5-May	1950	1970	65,0	4,30	74	1820	60,1
D/S		2060	2050	68,6	6,50	100	1900	63,2
A/S		1950	1920	65,0	3,05	74	1850	61,3
N/S	6-May	2050	1950	68,3	4,83	73	1950	65,0
D/S		2100	2030	69,8	13,00	40	1980	66,0
A/S		2000	2100	66,7	4,70	70	1990	66,3
N/S	7-May	1955	1960	65,1	4,90	54	1900	63,2
D/S		2200	2210	72,7	18,00	95	1920	63,9
A/S		2150	2270	71,3	15,00	86	1900	63,2
N/S	8-May	1990	1600	66,3	3,00	55	1850	61,3
D/S		2020	2000	67,3	2,50	20	1800	59,3
N/S	9-May	2065	2070	68,8	6,00	71	1920	63,9
D/S		2050	2050	68,3	5,70	77	1950	65,0
A/S		2080	2170	69,2	6,80	96	1950	65,0
N/S	10-May	2050	2060	68,3	6,50	90	1920	63,9
D/S		2000	1950	66,7	4,60	80	1880	62,4
A/S		2050	2140	68,3	5,40	77	1930	64,2
N/S	11-May	2000	1980	66,7	3,50	88	1890	62,8
D/S		2100	2150	69,8	7,00	92	2050	68,3
A/S		2020	2120	67,3	4,60	82	2000	66,7
N/S	12-May	1870	1850	62,0	3,70	83	1800	59,3
D/S		1980	2050	66,0	4,80	56	1750	57,1
A/S		1950	1990	65,0	4,50	60	1900	63,2
N/S	13-May	1930	1880	64,2	3,90	34	1800	59,3
D/S		1860	1850	61,6	3,90	26	1700	54,9
A/S		1980	2020	66,0	3,30	48	1930	64,2

N/S	14-May	1995	1890	66,5	3,90	90	1840	60,9
D/S		2000	2100	66,7	5,30	13	1850	61,3
A/S		1950	1950	65,0	3,80	38	1800	59,3
N/S	15-May	2000	2050	66,7	4,70	47	1950	65,0
D/S		1960	1980	65,3	4,30	77	1960	65,3
A/S		1950	1960	65,0	2,80	79	1900	63,2
N/S	16-May	2000	1800	66,7	3,50	60	1920	63,9
D/S		1950	2000	65,0	4,00	59	1850	61,3
A/S		2020	2050	67,3	5,10	50	1990	66,3
D/S	18-May	1950	2000	65,0	3,00	36	1830	60,5
A/S		2030	2010	67,7	5,20	49	1900	63,2
N/S	19-May	1900	1900	63,2	3,00	78	1950	65,0
D/S		2000	2080	66,7	4,70	36	1920	63,9
A/S		1890	1920	62,8	3,00	31	1900	63,2
N/S	20-May	1880	1820	62,4	2,80	68	1840	60,9
D/S		1900	1900	63,2	52,00	4	1840	60,9
A/S		2070	2050	68,9	6,18	61	1850	61,3
N/S	21-May	1860	1870	61,6	3,00	60	1930	64,2
D/S		1880	1890	62,4	3,20	34	1900	63,2
A/S		2130	2150	70,7	13,80	42	2050	68,3
N/S	22-May	1900	1880	63,2	3,90	16	1860	61,6
A/S		1980	1950	66,0	4,00	68	1750	57,1
N/S	23-May	1850	1860	61,3	3,70	85	1640	52,0
D/S		1900	1910	63,2	3,50	1730	1700	54,9
A/S		1860	1850	61,6	72,00	1730	1720	55,8
N/S	24-May	1850	1750	61,3	4,30	98	1740	56,7
D/S		1950	1980	65,0	5,60	72	1800	59,3
A/S		1970	2050	65,7	6,40	58	1900	63,2
N/S	25-May	1900	1840	63,2	3,50	86	1730	56,3
D/S		1900	1850	63,2	3,00	57	1600	50,0
A/S		1950	1950	65,0	6,40	87	1810	59,7
N/S	26-May	1910	1960	63,5	6,50	95	1850	61,3
D/S		2090	2050	69,5	8,00	88	1900	63,2
N/S	27-May	1900	1990	63,2	3,00	28	1700	54,9
D/S		1890	1970	62,8	2,65	63	1840	60,9
A/S		2000	2100	66,7	3,20	70	1800	59,3
N/S	28-May	1850	1870	61,3	2,70	41	1760	57,6
D/S		1909	1940	63,5	3,00	31	1810	59,7
A/S		1900	1980	63,2	2,60	46	1760	57,6
N/S	29-May	2011	2040	67,0	5,33	69	1860	61,6
D/S		2080	2070	69,2	8,50	70	2000	66,7
A/S		2030	2110	67,7	5,90	95	2000	66,7
N/S	30-May	1990	1980	66,3	3,00	68	1800	59,3
D/S		1900	1850	63,2	3,10	52	1850	61,3
A/S		1910	1980	63,5	2,60	50	2040	68,0
N/S	31-May	1930	1920	64,2	3,26	38	1840	60,9
D/S		1970	1950	65,7	4,60	70	1960	65,3
A/S		2050	2140	68,3	5,70	70	2000	66,7
N/S	1-Jun	1930	1750	64,2	2,80	30	1720	55,8
D/S		1940	1980	64,6	4,40	49	1840	60,9
A/S		1960	2000	65,3	4,50	55	1860	61,6
N/S	2-Jun	1990	2000	66,3	5,30	83	1850	61,3
D/S		1940	1900	64,6	5,20	77	1900	63,2
A/S		1950	1980	65,0	3,90	74	1880	62,4
N/S	3-Jun	1950	1970	65,0	3,30	57	1850	61,3
D/S		1880	1900	62,4	3,20	33	1350	34,6
A/S		2090	2200	69,5	7,00	66	1900	63,2
N/S	4-Jun	1910	1900	63,5	3,15	49	1830	60,5
D/S		1910	1950	63,5	3,70	42	1800	59,3
A/S		1950	1960	65,0	3,50	39	1820	60,1
N/S	5-Jun	1920	1910	63,9	3,00	51	1820	60,1
D/S		1900	1850	63,2	3,00	47	1800	59,3
A/S		1910	1970	63,5	2,95	33	1800	59,3

N/S	6-Jun	1990	2000	66,3	5,00	53	1900	63,2
D/S		1900	1920	63,2	3,20	70	1780	58,4
A/S		1908	1930	63,5	2,50	47	1800	59,3
D/S	7-Jun	1960	2010	65,3	4,00	34	1710	55,4
A/S		1940	2000	64,6	3,80	53	1950	65,0
N/S	8-Jun	2020	2100	67,3	5,90	38	1950	65,0
D/S		1940	1960	64,6	2,90	73	1860	61,6
A/S		1912	1950	63,6	3,00	62	1870	62,0
N/S	9-Jun	1900	1950	63,2	3,30	37	1870	62,0
D/S		1900	1920	63,2	3,00	38	1810	59,7
A/S		1900	1900	63,2	3,00	73	1870	62,0
N/S	10-Jun	2040	2150	68,0	8,00	35	1950	65,0
D/S		1980	2050	66,0	3,60	80	1930	64,2
A/S		2030	2050	67,7	4,50	85	1900	63,2
N/S	11-Jun	2020	2100	67,3	5,00	80	1900	63,2
D/S		1900	1950	63,2	3,30	40	1800	59,3
A/S		1850	1870	61,3	3,50	30	1480	43,2
N/S	12-Jun	1880	1950	62,4	3,00	37	1800	59,3
D/S		1890	1920	62,8	3,10	62	1830	60,5
A/S		1990	1950	66,3	3,50	48	1800	59,3
N/S	13-Jun	1920	1940	63,9	3,50	74	1620	51,0
D/S		1870	1840	62,0	3,20	41	1730	56,3
A/S		1900	1900	63,2	3,20	56	1790	58,8
N/S	14-Jun	1900	1950	63,2	3,30	44	1850	61,3
D/S		1860	1820	61,6	3,00	36	1820	60,1
A/S		1880	1890	62,4	3,70	39	1890	62,8
N/S	15-Jun	1900	1980	63,2	3,60	43	1800	59,3
D/S		1900	1960	63,2	3,15	36	1760	57,6
A/S		1900	1910	63,2	2,80	50	1750	57,1
N/S	16-Jun	1980	2050	66,0	4,80	41	1890	62,8
D/S		1920	1920	63,9	3,78	45	1850	61,3
A/S		2020	2050	67,3	5,70	72	1850	61,3
N/S	17-Jun	2020	1940	67,3	6,30	12	1830	60,5
D/S		1980	2050	66,0	4,80	76	1860	61,6
A/S		1890	1860	62,8	2,50	47	1840	60,9
N/S	18-Jun	1950	1990	65,0	4,40	53	1780	58,4
D/S		2160	2200	71,6	6,00	80	1900	63,2
N/S	19-Jun	2070	2100	68,9	7,40	91	1980	66,0
D/S		1930	1920	64,2	3,40	74	1920	63,9
A/S		2020	2150	67,3	5,00	84	1950	65,0
N/S	20-Jun	1985	2050	66,2	5,90	75	1900	63,2
D/S		2010	2000	67,0	6,00	80	1890	62,8
A/S		2030	2100	67,7	6,50	86	1950	65,0
N/S	21-Jun	2000	2020	66,7	5,84	93	1910	63,5
D/S		1980	2100	66,0	4,10	93	1700	54,9
A/S		1975	2000	65,8	5,00	88	1790	58,8
N/S	22-Jun	1980	1980	66,0	4,60	86	1860	61,6
D/S		1930	1930	64,2	3,30	94	1830	60,5
A/S		1900	1940	63,2	2,40	47	1800	59,3
N/S	23-Jun	1880	1830	62,4	3,05	26	1750	57,1
D/S		2070	2100	68,9	6,10	42	2000	66,7
A/S		1970	2000	65,7	3,20	92	1900	63,2
N/S	24-Jun	1960	1980	65,3	3,10	85	1860	61,6
D/S		2040	2030	68,0	3,40	62	1900	63,2
A/S		1880	1850	62,4	2,80	83	1850	61,3
N/S	25-Jun	1950	1960	65,0	2,70	68	1850	61,3
D/S		1960	1900	65,3	3,00	51	1810	59,7
A/S		1890	1850	62,8	2,70	34	1750	57,1
N/S	26-Jun	1890	1900	62,8	2,90	40	1790	58,8
A/S	27-Jun	2020	2050	67,3	5,00	41	1700	54,9

N/S	28-Jun	2020	2030	67,3	3,50	44	1800	59,3
D/S		2020	2040	67,3	4,00	63	1920	63,9
A/S		1980	1980	66,0	2,90	82	1910	63,5
N/S	29-Jun	2050	2040	68,3	4,60	90	1930	64,2
D/S		2060	2150	68,6	6,10	81	2010	67,0
A/S		1900	1970	63,2	2,70	88	1910	63,5
N/S	30-Jun	1953	2040	65,1	3,80	78	1850	61,3
D/S		1950	1970	65,0	4,00	86	1880	62,4
A/S		1946	1900	64,8	3,39	60	1850	61,3
N/S	1-Jul	1999	2060	66,6	3,93	45	1820	60,1
D/S		1910	1930	63,5	3,00	64	1860	61,6
A/S		1900	1870	63,2	2,50	48	1830	60,5
N/S	2-Jul	1970	1990	65,7	5,20	31	1860	61,6
D/S		1980	2070	66,0	3,70	42	1900	63,2
A/S		1945	2000	64,8	3,60	85	1870	62,0
N/S	3-Jul	1950	1920	65,0	3,70	52	1860	61,6
D/S		1950	1920	65,0	5,00	75	1850	61,3
A/S		1990	1980	66,3	5,50	78	1890	62,8
N/S	4-Jul	1850	1850	61,3	2,90	69	1880	62,4
D/S		2010	2060	67,0	4,80	78	1820	60,1
A/S		1970	1980	65,7	3,80	78	1800	59,3
N/S	5-Jul	1925	1900	64,1	3,70	42	1800	59,3
D/S		1950	2010	65,0	4,10	63	1880	62,4
A/S	6-Jun	1900	1870	63,2	2,80	57	1770	58,0
N/S	7-Jul	1900	1900	63,2	2,70	26	1810	59,7
D/S		1950	1980	65,0	3,00	19	1770	58,0
A/S		1900	1880	63,2	3,00	58	1780	58,4
N/S	8-Jul	1980	2050	66,0	4,40	23	1870	62,0
D/S		1850	1860	61,3	3,20	38	1700	54,9
A/S		1910	1930	63,5	2,90	53	1720	55,8
N/S	9-Jul	1960	2010	65,3	3,70	69	1850	61,3
D/S		1920	200	63,9	3,60	78	1810	59,7
A/S		2000	2130	66,7	4,40	80	1910	63,5
N/S	10-Jul	1960	1980	65,3	3,80	85	1900	63,2
D/S		1920	1950	63,9	4,00	50	1850	61,3
A/S		2090	2190	69,5	5,60	92	1870	62,0
N/S	11-Jul	1970	2000	65,7	4,40	90	1900	63,2
D/S		1940	1890	64,6	3,70	79	1800	59,3
A/S		1919	1950	63,9	2,96	40	1740	56,7
N/S	12-Jul	1980	1950	66,0	5,10	80	1840	60,9
D/S		1970	1940	65,7	4,40	93	1850	61,3
A/S		1950	2000	65,0	4,60	84	1860	61,6
N/S	13-Jul	1970	1980	65,7	4,30	89	1830	60,5
D/S		1910	1970	63,5	3,80	67	1870	62,0
A/S		1940	1910	64,6	3,40	80	1800	59,3
N/S	14-Jul	1900	1910	63,2	3,50	46	1780	58,4
D/S		1900	1900	63,2	3,00	73	1760	57,6
A/S		1920	1900	63,9	3,10	59	1870	62,0
N/S	15-Jul	1900	1870	63,2	3,00	55	1840	60,9
D/S		1890	1870	62,8	3,00	80	1790	58,8
A/S		1900	1780	63,2	3,20	91	1810	59,7
N/S	16-Jul	1970	2050	65,7	4,30	54	1890	62,8
D/S		2050	2120	68,3	5,00	25	1870	62,0
A/S		1940	1930	64,6	3,40	47	1890	62,8
N/S	17-Jul	1930	1880	64,2	5,20	64	1840	60,9
D/S		1910	1900	63,5	5,00	88	1810	59,7
A/S		1980	2010	66,0	6,10	90	1790	58,8
N/S	18-Jul	1990	1970	66,3	7,00	77	1850	61,3
D/S		1950	1970	65,0	3,67	65	1890	62,8
A/S		1970	1960	65,7	10,50	20	1840	60,9

N/S	19-Jul	1940	1960	64,6	4,60	73	1860	61,6
D/S		2000	2050	66,7	5,40	93	1850	61,3
A/S		2160	2430	71,6	10,50	99,5	1980	66,0
N/S	20-Jul	2020	2000	67,3	9,50	90	1960	65,3
D/S		2100	2200	69,8	10,60	90	1940	64,6
A/S		2000	2020	66,7	4,90	67	1950	65,0
N/S	21-Jul	1980	1990	66,0	4,50	40	1920	63,9
D/S		1955	1990	65,1	3,90	31	1850	61,3
A/S		1965	2020	65,5	4,20	25	1840	60,9
N/S	22-Jul	2000	2050	66,7	5,00	50	1880	62,4
D/S		2040	2130	68,0	4,10	62	1970	65,7
A/S		1945	1950	64,8	2,50	71	1780	58,4
N/S	23-Jul	1930	1870	64,2	3,45	38	1750	57,1
D/S		1900	1810	63,2	2,60	28	1780	58,4
A/S		1990	1990	66,3	4,00	63	1870	62,0
N/S	24-Jul	1920	1910	63,9	3,40	45	1800	59,3
D/S		1960	1930	65,3	3,40	69	1890	62,8
A/S		1990	1950	66,3	2,80	75	1830	60,5
N/S	25-Jul	1900	1870	63,2	3,00	29	1750	57,1
N/S	27-Jul	1960	2020	65,3	5,20	89	1870	62,0
D/S		2000	2050	66,7	4,30	48	1850	61,3
A/S		2000	2020	66,7	6,00	50	1910	63,5
N/S	28-Jul	2000	2050	66,7	4,50	77	1890	62,8
D/S		2040	2100	68,0	6,30	83	1870	62,0
A/S		1940	1960	64,6	6,00	85	1900	63,2
N/S	29-Jul	1850	1800	61,3	3,35	49	1850	61,3
D/S		1890	1920	62,8	3,00	27	1850	61,3
A/S		1940	1960	64,6	4,00	35	1860	61,6
N/S	30-Jul	1930	1940	64,2	3,60	63	1820	60,1
D/S		1900	1910	63,2	3,20	21	1750	57,1
A/S		1940	1945	64,6	2,00	35	1910	63,5
N/S	31-Jul	2040	2000	68,0	4,20	87	1950	65,0
D/S		2010	1930	67,0	4,00	86	1820	60,1
A/S		2035	2000	67,8	2,80	93	1900	63,2
N/S	1-Aug	2010	1980	67,0	3,70	90	1880	62,4
D/S		2130	2060	70,7	4,40	93	1850	61,3
A/S		2100	2090	69,8	4,80	63	1930	64,2
N/S	2-Aug	2100	2100	69,8	6,30	22	1880	62,4
A/S		2170	2180	71,9	7,50	47	1960	65,3
N/S	3-Aug	2200	2230	72,7	4,20	95	1970	65,7
A/S		2020	1920	67,3	3,80	85	1860	61,6
N/S	4-Aug	2010	1910	67,0	3,00	87	1850	61,3
A/S		2000	1870	66,7	3,20	67	1790	58,8
N/S	5-Aug	2040	1950	68,0	4,20	42	1780	58,4
A/S		2060	2040	68,6	4,40	69	1940	64,6
N/S	6-Aug	1970	1950	65,7	3,80	75	1830	60,5
A/S		2020	1960	67,3	3,80	51	1850	61,3
N/S	7-Aug	2055	2000	68,5	5,20	58	1850	61,3
A/S		2050	2000	68,3	4,60	67	1930	64,2
N/S	8-Aug	2075	2020	69,1	4,60	64	1910	63,5
D/S		2088	2030	69,5	5,20	43	1930	64,2
A/S		2080	2040	69,2	4,60	43	1940	64,6
N/S	9-Aug	2079	2040	69,2	4,30	85	1960	65,3
A/S		2110	2060	70,1	5,90	15	1900	63,2
N/S	10-Aug	2020	1960	67,3	5,50	91	1880	62,4
D/S		2128	2120	70,7	6,00	83	1840	60,9
A/S		2090	2090	69,5	4,30	80	1940	64,6
N/S	11-Aug	2060	1960	68,6	4,00	94	1910	63,5
D/S		2000	2100	66,7	4,30	41	1960	65,3
A/S		2000	2060	66,7	4,00	40	1930	64,2

N/S	12-Aug	2040	2050	68,0	4,00	20	1950	65,0
D/S		2000	2010	66,7	3,20	30	1900	63,2
A/S		1965	1990	65,5	2,75	70	1710	55,4
N/S	13-Aug	1970	1950	65,7	3,00	42	1840	60,9
D/S		1990	2000	66,3	3,60	60	1900	63,2
A/S		1890	1870	62,8	2,50	56	1850	61,3
N/S	14-Aug	1970	1950	65,7	3,20	40	1860	61,6
D/S	15-Aug	1910	1880	63,5	3,80	30	1750	57,1
A/S		1980	1950	66,0	4,20	47	1920	63,9
N/S	16-Aug	1950	1960	65,0	3,50	61	1890	62,8
D/S		2020	2070	67,3	5,10	78	1930	64,2
A/S		1975	2000	65,8	3,40	83	1850	61,3
N/S	17-Aug	1930	1960	64,2	3,80	48	1800	59,3
D/S		1920	1960	63,9	5,00	83	1950	65,0
A/S		1930	1900	64,2	3,90	55	1880	62,4
D/S	18-Aug	1840	1840	60,9	2,70	70	1790	58,8
A/S		2000	2020	66,7	4,30	70	1860	61,6
N/S	19-Aug	2030	2040	67,7	4,50	82	1950	65,0
D/S		2000	1950	66,7	3,20	85	1940	64,6
A/S		1980	2000	66,0	4,20	54	1900	63,2
N/S	20-Aug	1950	1970	65,0	3,80	63	1880	62,4
D/S		1960	1970	65,3	3,20	57	1880	62,4
A/S		1950	1960	65,0	3,20	25	1840	60,9
N/S	21-Aug	1880	1870	62,4	2,80	75	1860	61,6
D/S		1910	1920	63,5	3,20	41	1810	59,7
A/S		1940	1930	64,6	3,40	25	1800	59,3
N/S	22-Aug	1800	2050	59,3	4,50	54	1930	64,2
D/S		2050	2150	68,3	6,20	71	1980	66,0
A/S		2100	2240	69,8	8,30	94	1940	64,6
N/S	23-Aug	2000	2070	66,7	4,90	40	1900	63,2
D/S		1965	2000	65,5	3,60	23	1830	60,5
A/S		1920	1880	63,9	3,00	44	1870	62,0
N/S	24-Aug	1930	1950	64,2	3,50	51	1870	62,0
D/S		1975	2000	65,8	3,80	88	1830	60,5
A/S		1900	1910	63,2	2,50	45	1800	59,3
N/S	25-Aug	1900	1950	63,2	3,00	30	1840	60,9
D/S		1950	1940	65,0	3,10	55	1800	59,3
A/S		1940	1930	64,6	3,00	27	1870	62,0
N/S	26-Aug	1920	1910	63,9	2,75	52	1720	55,8
D/S		2000	2050	66,7	5,00	54	1900	63,2
A/S		1920	1900	63,9	3,12	36	1780	58,4
N/S	27-Aug	1900	1870	63,2	3,00	20	1820	60,1
D/S		1935	1890	64,4	3,10	45	1900	63,2
A/S		1930	1880	64,2	3,00	64	1810	59,7
N/S	28-Aug	1880	1890	62,4	2,90	78	1880	62,4
D/S		1970	1960	65,7	3,75	50	1890	62,8
A/S		1900	1820	63,2	2,50	86	1880	62,4
N/S	29-Aug	1950	1970	65,0	4,50	66	1870	62,0
D/S		1970	1980	65,7	3,60	68	1900	63,2
A/S		1940	1940	64,6	3,00	31	1820	60,1
N/S	30-Aug	1980	1990	66,0	3,70	36	1830	60,5
A/S		2000	2040	66,7	3,20	67	1940	64,6
N/S	31-Aug	2050	2030	68,3	4,30	49	1840	60,9
D/S		1900	1900	63,2	3,10	20	1810	59,7
A/S		1870	1880	62,0	2,90	26	1840	60,9
N/S	1-Sep	1920	1880	63,9	3,80	25	1940	64,6
D/S		2050	2070	68,3	4,20	38	2030	67,7
A/S		1860	1860	61,6	2,50	51	1920	63,9
N/S	2-Sep	1940	1945	64,6	4,00	25	1810	59,7
D/S		1955	2000	65,1	3,20	69	1950	65,0
A/S		1950	2020	65,0	3,80	59	1910	63,5

N/S	3-Sep	1980	2010	66,0	3,20	87	1920	63,9
D/S		2200	2400	72,7	6,00	87	2000	66,7
A/S		2150	2180	71,3	5,00	84	2050	68,3
N/S	4-Sep	2090	2050	69,5	3,20	30	1970	65,7
D/S		1950	2000	65,0	2,90	35	1720	55,8
A/S		1860	1880	61,6	2,50	46	1820	60,1
N/S	5-Sep	1940	1940	64,6	3,30	57	1860	61,6
D/S		1910	1960	63,5	2,80	31	1840	60,9
A/S		1800	1850	59,3	2,70	18	1760	57,6
N/S	6-Sep	1920	1940	63,9	2,30	19	1790	58,8
D/S		1970	1990	65,7	3,50	73	1840	60,9
D/S	7-Sep	1890	1880	62,8	3,00	73	1800	59,3
A/S		1910	1900	63,5	2,70	55	1780	58,4
N/S	8-Sep	1950	1990	65,0	3,00	71	1910	63,5
D/S		1900	1920	63,2	2,80	45	1900	63,2
A/S		1900	1900	63,2	2,60	23	1810	59,7
N/S	9-Sep	1930	1970	64,2	3,30	44	1860	61,6
D/S		1830	1800	60,5	2,80	47	1810	59,7
A/S		1870	1840	62,0	2,80	20	1730	56,3
N/S	10-Sep	1870	1860	62,0	3,00	20	1630	51,5
D/S		1920	1910	63,9	3,50	45	1830	60,5
A/S		1890	1870	62,8	3,20	41	1780	58,4
N/S	22-Sep	2040	2060	68,0	3,70	75	1910	63,5
D/S		2030	2045	67,7	4,00	76	1890	62,8
A/S		2100	2200	69,8	7,60	76	1960	65,3
N/S	23-Sep	2050	2130	68,3	3,90	65	1880	62,4
D/S		2080	2110	69,2	4,20	58	1940	64,6
A/S		1950	1960	65,0	3,00	87	2000	66,7
N/S	24-Sep	2000	2000	66,7	3,30	55	1880	62,4
D/S		2050	2090	68,3	3,50	65	1930	64,2
A/S		1930	1920	64,2	3,00	80	1880	62,4
N/S	25-Sep	1890	1880	62,8	3,00	83	1870	62,0
D/S		1930	1920	64,2	3,30	40	1890	62,8
A/S		1900	1890	63,2	3,00	33	1780	58,4
N/S	26-Sep	1900	1910	63,2	3,20	35	1730	56,3
D/S		1890	1910	62,8	3,30	45	1810	59,7
N/S	28-Sep	1930	1880	64,2	3,90	80	1830	60,5
D/S		1950	1960	65,0	3,80	58	1900	63,2
A/S		1950	1880	65,0	3,00	54	1820	60,1
N/S	29-Sep	1980	1940	66,0	4,00	35	1840	60,9
D/S		1980	2000	66,0	3,85	65	1940	64,6
A/S		1940	1980	64,6	3,50	55	1880	62,4
N/S	30-Sep	1920	1910	63,9	3,10	29	1870	62,0
D/S		1910	1900	63,5	3,20	27	1890	62,8
A/S		1910	1880	63,5	3,90	30	1770	58,0
N/S	1-Oct	1900	1900	63,2	2,99	23	1780	58,4
A/S		1920	1950	63,9	3,00	26	1830	60,5
N/S	2-Oct	1880	1940	62,4	3,10	24	1870	62,0
D/S		2020	2150	67,3	6,00	21	1900	63,2
A/S		1890	1900	62,8	3,10	19	1780	58,4
N/S	3-Oct	1950	1980	65,0	3,10	57	1860	61,6
D/S		1930	1940	64,2	3,30	76	1980	66,0
A/S		1940	1910	64,6	2,80	70	1930	64,2
N/S	4-Oct	1980	2000	66,0	3,80	80	1870	62,0
D/S		2100	2200	69,8	6,75	87	1960	65,3
A/S		2030	2070	67,7	3,80	65	1840	60,9
N/S	5-Oct	1960	1970	65,3	3,50	62	1880	62,4
D/S		2015	2070	67,2	4,40	71	1890	62,8
A/S	6-Oct	2000	2010	66,7	4,00	67	1880	62,4

N/S	7-Oct	2030	2120	67,7	4,50	90	2030	67,7
D/S		1900	1930	63,2	3,30	63	1880	62,4
A/S		1960	1980	65,3	3,80	66	1910	63,5
N/S	8-Oct	1950	2050	65,0	4,00	76	1950	65,0
D/S		1910	1920	63,5	3,20	57	1830	60,5
A/S		1940	2010	64,6	3,30	50	1920	63,9
N/S	9-Oct	1880	1850	62,4	3,00	54	1900	63,2
D/S		1930	1950	64,2	3,40	40	1890	62,8
A/S		1970	1900	65,7	2,95	20	1900	63,2
N/S	10-Oct	1960	2030	65,3	4,00	44	1940	64,6
D/S		1930	1970	64,2	3,30	88	1840	60,9
A/S		1940	1980	64,6	3,00	84	1950	65,0
N/S	11-Oct	1915	1910	63,7	3,00	74	1830	60,5
D/S		1990	2000	66,3	3,80	61	1870	62,0
A/S		1950	2080	65,0	3,50	56	2060	68,6
N/S	12-Oct	1910	1880	63,5	2,80	86	1850	61,3
D/S		1920	1900	63,9	3,20	75	1810	59,7
A/S		1920	1930	63,9	2,80	85	1910	63,5
N/S	13-Oct	1930	1980	64,2	3,30	23	1780	58,4
D/S		1910	1930	63,5	3,00	20	1800	59,3
A/S		1940	2000	64,6	3,60	45	1960	65,3
N/S	14-Oct	1920	1940	63,9	3,30	68	1910	63,5
D/S		1900	1900	63,2	3,30	82	1900	63,2
A/S		1700	1770	54,9	3,40	70	1970	65,7
N/S	15-Oct	1880	1910	62,4	3,20	45	1820	60,1
D/S		1950	1900	65,0	4,40	50	1870	62,0
A/S		1920	1950	63,9	3,20	75	1830	60,5
N/S	16-Oct	1984	1960	66,1	3,90	56	1810	59,7
D/S		1950	1970	65,0	4,00	50	1840	60,9
A/S		2040	2100	68,0	4,40	70	1800	59,3
N/S	17-Oct	2000	2050	66,7	5,60	89	1970	65,7
D/S		2026	2120	67,5	6,20	35	1930	64,2
A/S		2080	2230	69,2	5,50	51	1950	65,0
N/S	18-Oct	1950	1910	65,0	4,80	70	1810	59,7
D/S		1890	1890	62,8	4,00	50	1870	62,0
A/S		2000	2060	66,7	6,10	25	1924	64,0
N/S	19-Oct	1950	1930	65,0	5,70	22	1940	64,6
D/S		1900	1910	63,2	4,30	74	1820	60,1
A/S		1960	2040	65,3	4,80	66	1870	62,0
N/S	20-Oct	1930	1900	64,2	4,50	93	1890	62,8
D/S		1950	1950	65,0	4,00	29	1810	59,7
A/S		2040	2050	68,0	6,70	68	1920	63,9
N/S	21-Oct	2000	2010	66,7	5,70	60	1900	63,2
D/S		2000	2050	66,7	6,80	80	1890	62,8
A/S		2000	2050	66,7	6,50	60	1900	63,2
N/S	22-Oct	1980	1980	66,0	5,70	85	1880	62,4
D/S		1940	1930	64,6	4,30	69	1950	65,0
A/S		1985	2030	66,2	5,50	85	1900	63,2
N/S	23-Oct	2040	2040	68,0	6,00	85	1960	65,3
D/S		2040	2110	68,0	7,50	71	1950	65,0
A/S		1900	1900	63,2	3,50	21	1800	59,3
N/S	24-Oct	1900	1850	63,2	3,00	38	1830	60,5
D/S		1970	2010	65,7	4,20	53	1880	62,4
A/S		1980	2030	66,0	4,50	65	1890	62,8
N/S	25-Oct	2030	2120	67,7	6,20	75	1970	65,7
D/S		1950	2000	65,0	4,80	94	1880	62,4
A/S		1980	1970	66,0	4,40	75	1820	60,1
N/S	26-Oct	1950	1950	65,0	4,20	75	1880	62,4
D/S		1950	1930	65,0	4,50	77	1880	62,4
A/S		1910	1910	63,5	5,50	40	1810	59,7

N/S	27-Oct	1990	2020	66,3	4,90	68	1870	62,0
D/S		1970	1990	65,7	4,50	85	1870	62,0
A/S		1950	1940	65,0	3,90	87	1800	59,3
N/S	28-Oct	1990	2040	66,3	4,90	67	1830	60,5
D/S		1970	1990	65,7	5,00	88	1930	64,2
A/S		2050	2040	68,3	4,70	70	1900	63,2
N/S	29-Oct	1970	2010	65,7	5,10	81	1880	62,4
D/S		1930	1910	64,2	4,60	87	1670	53,5
A/S		2100	2120	69,8	5,50	80	1970	65,7
N/S	30-Oct	2020	2110	67,3	5,20	76	1940	64,6
D/S		1940	1920	64,6	4,15	57	1800	59,3
A/S		2000	2010	66,7	4,50	67	1870	62,0
N/S	31-Oct	1900	1820	63,2	3,30	75	1880	62,4
D/S		1920	1970	63,9	4,40	23	1850	61,3
A/S		1980	2040	66,0	4,00	39	1880	62,4
N/S	1-Nov	1930	1900	64,2	3,80	54	1810	59,7
D/S		2020	2100	67,3	7,00	50	1910	63,5
N/S	2-Nov	2030	2090	67,7	6,80	80	1950	65,0
D/S		1940	1950	64,6	4,90	53	1900	63,2
N/S	3-Nov	1940	1970	64,6	3,20	26	1850	61,3
A/S		2150	2230	71,3	10,00	86	1970	65,7
N/S	4-Nov	2000	2090	66,7	8,00	99	1930	64,2
N/S	5-Nov	1885	1940	62,6	4,50	75	1850	61,3
A/S		2090	2200	69,5	4,87	65	1920	63,9
N/S	6-Nov	2010	2030	67,0	4,65	85	1890	62,8
A/S		1940	1940	64,6	4,00	67	1850	61,3
N/S	7-Nov	1925	1930	64,1	4,15	55	1820	60,1
A/S	8-Nov	2130	2150	70,7	7,80	80	1940	64,6
N/S	9-Nov	2000	1950	66,7	5,10	40	1810	59,7
D/S		1990	2020	66,3	5,15	72	1700	54,9
A/S		2130	2250	70,7	9,50	81	1990	66,3
N/S	10-Nov	2030	2060	67,7	5,30	93	1900	63,2
D/S		1990	2020	66,3	5,30	80	1860	61,6
A/S		2040	2200	68,0	6,80	1,5	2000	66,7
N/S	11-Nov	2010	2150	67,0	5,30	75	1980	66,0
D/S		1960	1960	65,3	4,20	80	1890	62,8
A/S		1770	1770	58,0	9,50	65	1630	51,5
N/S	12-Nov	1900	1900	63,2	4,50	30	1750	57,1
D/S		1910	1900	63,5	4,40	54	1820	60,1
A/S		2050	2080	68,3	7,80	80	1930	64,2
N/S	13-Nov	2060	2030	68,6	8,50	90	1900	63,2
D/S		1990	2080	66,3	5,70	72	1960	65,3
A/S		1950	1980	65,0	3,90	37	1850	61,3
N/S	14-Nov	1960	2000	65,3	5,30	68	1820	60,1
D/S		2020	2100	67,3	8,20	76	1960	65,3
A/S		2124	2200	70,6	15,00	89	2090	69,5
N/S	15-Nov	1900	1900	63,2	4,20	21	1750	57,1
D/S		2090	2120	69,5	7,40	66	2000	66,7
A/S		2060	2150	68,6	8,80	67	2000	66,7
N/S	16-Nov	1990	2050	66,3	5,00	41	1940	64,6
D/S		1940	2000	64,6	5,30	51	1960	65,3
A/S		2200	2350	72,7	16,00	25	1920	63,9
N/S	17-Nov	1990	2020	66,3	5,20	55	1940	64,6
D/S		2150	2300	71,3	12,00	84	2090	69,5
A/S		1890	1800	62,8	5,90	87	1920	63,9
N/S	18-Nov	2000	2010	66,7	6,80	57	1940	64,6
D/S		1980	2020	66,0	5,80	84	1920	63,9
A/S		1970	1960	65,7	5,10	60	1800	59,3
N/S	19-Nov	1940	1820	64,6	4,50	57	1820	60,1
D/S		1920	1940	63,9	4,90	27	1830	60,5
A/S		1900	1900	63,2	5,00	29	1840	60,9

N/S	20-Nov	1925	1910	64,1	5,00	27	1830	60,5
D/S		1985	2010	66,2	7,30	65	1960	65,3
N/S	21-Nov	2020	2100	67,3	10,10	75	1940	64,6
D/S		2020	2100	67,3	7,60	86	1930	64,2
N/S	23-Nov	1940	1920	64,6	6,50	81	1900	63,2
D/S		1960	1940	65,3	7,50	65	1860	61,6
A/S		1900	1850	63,2	5,30	30	1810	59,7
N/S	24-Nov	1970	1980	65,7	7,30	60	1880	62,4
D/S		1984	2000	66,1	9,20	66	1940	64,6
A/S		2025	2140	67,5	10,79	79	1880	62,4
N/S	25-Nov	1950	2000	65,0	6,60	46	1800	59,3
D/S		1900	1900	63,2	5,50	30	1700	54,9
A/S		1920	1900	63,9	5,50	36	1790	58,8
N/S	26-Nov	1965	1970	65,5	6,20	57	1800	59,3
D/S		1870	1900	62,0	5,50	45	1700	54,9
A/S		1870	1850	62,0	4,30	52	1720	55,8
N/S	27-Nov	1940	1950	64,6	5,70	20	1780	58,4
D/S		2000	2000	66,7	5,40	54	1800	59,3
A/S		2000	2010	66,7	6,80	80	1970	65,7
A/S	28-Nov	2000	2050	66,7	8,20	40	1930	64,2
D/S	29-Nov	1970	1980	65,7	7,40	90	1900	63,2
A/S		1980	2000	66,0	8,10	48	1900	63,2
N/S	30-Nov	1920	1976	63,9	7,75	27	1850	61,3
D/S		1980	1980	66,0	7,20	77	1810	59,7
A/S		2000	2040	66,7	5,40	74	1900	63,2
N/S	1-Dec	1920	1890	63,9	6,70	51	1850	61,3
D/S		1975	2020	65,8	6,50	33	1900	63,2
A/S		1950	1990	65,0	5,10	82	1900	63,2
N/S	2-Dec	1970	1970	65,7	6,70	73	1800	59,3
D/S		1950	1930	65,0	7,00	55	1910	63,5
A/S		2000	2050	66,7	8,40	75	1930	64,2
N/S	3-Dec	2020	2000	67,3	8,60	92	1870	62,0
D/S		2000	2040	66,7	9,30	79	1940	64,6
A/S		2000	2050	66,7	9,10	87	1940	64,6
N/S	4-Dec	1980	1970	66,0	8,00	85	1880	62,4
D/S		2000	2040	66,7	9,50	81	1990	66,3
A/S		2000	2050	66,7	7,50	70	1980	66,0
N/S	5-Dec	1980	1950	66,0	10,00	83	1880	62,4
A/S		2030	1990	67,7	4,00	41	1710	55,4
N/S	7-Dec	1950	1970	65,0	6,70	58	1880	62,4
D/S		2000	2040	66,7	4,80	72	1900	63,2
A/S		1930	1890	64,2	4,95	22	1730	56,3
N/S	8-Dec	2000	2050	66,7	6,70	81	1940	64,6
D/S		2020	2060	67,3	7,50	70	2000	66,7
A/S		2000	1980	66,7	5,60	85	1910	63,5
N/S	9-Dec	2000	2050	66,7	3,57	65	1880	62,4
D/S		1900	1820	63,2	4,70	36	1800	59,3
A/S		1940	1960	64,6	4,60	35	1630	51,5
N/S	10-Dec	1940	1940	64,6	6,30	65	1850	61,3
D/S		1960	2020	65,3	7,50	93	1930	64,2
A/S		2040	2100	68,0	6,50	51	1900	63,2
N/S	11-Dec	2020	2080	67,3	6,20	62	2000	66,7
D/S		1960	2020	65,3	4,80	41	1910	63,5
A/S		2000	2030	66,7	4,90	33	1800	59,3
N/S	12-Dec	1990	2060	66,3	6,15	48	1930	64,2
D/S		1920	1950	63,9	4,80	25	1870	62,0
A/S		1970	1970	65,7	5,80	45	1820	60,1
N/S	13-Dec	2040	2150	68,0	8,60	78	2020	67,3
D/S		2010	2015	67,0	9,00	91	1930	64,2
A/S		2000	2020	66,7	6,50	90	1840	60,9

	N/S		1970	2030	65,7	5,10	86	2060	68,6
	D/S	14-Dec	1960	1950	65,3	4,90	25	1890	62,8
	A/S		1930	1910	64,2	5,50	33	1820	60,1
	N/S		2010	2100	67,0	8,00	45	2000	66,7
	D/S	15-Dec	1890	1900	62,8	5,25	70	1830	60,5
	A/S		2000	2020	66,7	6,00	40	1800	59,3
	N/S		1980	2000	66,0	6,70	62	1960	65,3
	D/S	16-Dec	1975	2020	65,8	8,00	66	1910	63,5
	A/S		1950	1960	65,0	6,00	51	1900	63,2
	N/S		1970	2000	65,7	6,70	62	1870	62,0
	D/S	17-Dec	1950	1960	65,0	6,00	41	1840	60,9
	A/S		1920	1970	63,9	6,00	52	1890	62,8
	N/S		1920	1870	63,9	5,00	46	1770	58,0
	D/S	18-Dec	1900	1900	63,2	6,70	21	1650	52,5
	A/S		1950	1990	65,0	8,30	66	1810	59,7
	N/S		2000	2010	66,7	9,70	79	1860	61,6
	D/S	19-Dec	1900	1900	63,2	8,00	80	1780	58,4
	A/S		1720	1720	55,8	8,00	51	1780	58,4
	N/S		1920	1890	63,9	6,00	74	1830	60,5
	D/S	20-Dec	1980	1980	66,0	8,80	67	1780	58,4
	A/S		1940	1940	64,6	7,60	74	1850	61,3
	N/S		1950	1960	65,0	7,45	51	1840	60,9
	D/S	21-Dec	1960	1980	65,3	7,50	48	1800	59,3
	A/S		2000	2050	66,7	6,80	81	1900	63,2
	N/S		1950	1910	65,0	6,15	39	1830	60,5
	D/S	22-Dec	1940	1970	64,6	10,80	66	1800	59,3
	A/S		2030	2160	67,7	10,00	72	1920	63,9
	N/S		1980	2000	66,0	7,90	81	1850	61,3
	D/S	23-Dec	2000	2020	66,7	8,70	94	1850	61,3
	A/S		2010	2080	67,0	7,40	43	1930	64,2
	N/S		2000	1980	66,7	7,90	43	1830	60,5
	D/S	24-Dec	1940	1970	64,6	7,20	34	1570	48,4
	A/S		2020	2100	67,3	8,10	68	2020	67,3
	N/S		1980	2020	66,0	5,80	38	1820	60,1
	D/S	25-Dec	2000	2070	66,7	7,10	56	2010	67,0
	A/S		2020	2060	67,3	8,10	93	2020	67,3
	N/S		1940	2000	64,6	6,80	77	1890	62,8
	D/S	26-Dec	1990	2100	66,3	9,00	50	1950	65,0
	A/S		2010	2050	67,0	8,80	53	1850	61,3
	N/S		1870	1920	62,0	6,20	46	1870	62,0
	D/S	27-Dec	1930	1910	64,2	5,80	45	1750	57,1
	A/S		1910	1940	63,5	5,60	32	1860	61,6
	N/S		1900	1880	63,2	10,00	73	1870	62,0
	D/S	28-Dec	2080	2170	69,2	9,80	84	2070	68,9
	A/S		1995	2050	66,5	9,00	60	1960	65,3
	N/S		2000	2010	66,7	8,80	61	1900	63,2
	D/S	29-Dec	2020	2070	67,3	13,50	67	1900	63,2
	A/S		2060	2120	68,6	14,20	93	1940	64,6
	N/S		1960	2020	65,3	7,50	50	1890	62,8
	D/S	30-Dec	1960	2020	65,3	7,80	51	1860	61,6
	A/S		2025	2100	67,5	4,80	89	1960	65,3
	N/S		2000	2080	66,7	7,50	67	1920	63,9
	D/S	31-Dec	1950	1960	65,0	5,50	52	1940	64,6
	A/S		1970	1980	65,7	5,50	70	1890	62,8
Year 2008	N/S		2000	2070	66,7	6,00	42	1960	65,3
	D/S	1-Jan	2020	2080	67,3	7,20	92	1930	64,2
	A/S		2040	2060	68,0	6,70	80	1960	65,3
	N/S		2040	2110	68,0	8,50	83	1910	63,5
	D/S	2-Jan	2040	2140	68,0	9,90	73	1940	64,6
	A/S		2040	2050	68,0	10,20	84	1960	65,3

N/S	3-Jan	2064	2100	68,7	13,00	66	1990	66,3
D/S		2050	2110	68,3	8,70	85	1980	66,0
A/S		2100	2100	69,8	8,00	95	1990	66,3
N/S	4-Jan	1990	1940	66,3	6,80	87	1960	65,3
D/S		2010	2090	67,0	6,30	55	1970	65,7
A/S		1990	2030	66,3	6,50	26	1920	63,9
N/S	5-Jan	1990	1950	66,3	6,00	39	1930	64,2
D/S		2050	2120	68,3	8,00	94	1960	65,3
A/S		1990	2040	66,3	8,80	95	1910	63,5
N/S	6-Jan	2050	2150	68,3	11,00	89	2000	66,7
D/S		2100	2120	69,8	12,60	90	2060	68,6
A/S		2070	2100	68,9	12,00	94	2010	67,0
N/S	7-Jan	2080	2180	69,2	12,36	81	2000	66,7
D/S		2120	2270	70,4	16,00	87	2150	71,3
A/S		2070	2100	68,9	11,30	86	2020	67,3
N/S	8-Jan	2090	2180	69,5	11,60	84	2030	67,7
D/S		2040	2150	68,0	11,00	87	2020	67,3
A/S		2040	2030	68,0	8,70	85	1990	66,3
N/S	9-Jan	2050	2180	68,3	10,90	86	2000	66,7
D/S		1955	2010	65,1	5,90	54	1970	65,7
A/S		1975	2020	65,8	6,90	23	1950	65,0
N/S	10-Jan	1950	1960	65,0	5,00	29	1850	61,3
N/S	11-Jan	1930	1980	64,2	5,00	76	1790	58,8
D/S		1970	2020	65,7	5,80	64	1780	58,4
A/S		1940	1950	64,6	5,80	56	1900	63,2
N/S	12-Jan	1900	1920	63,2	5,00	54	1850	61,3
D/S		1970	2000	65,7	6,00	54	1800	59,3
A/S		2100	2070	69,8	10,25	100	1930	64,2
N/S	13-Jan	1990	2000	66,3	5,00	100	1950	65,0
D/S		2040	2150	68,0	8,60	68	1950	65,0
A/S		1840	2020	60,9	4,85	22	1690	54,4
N/S	14-Jan	1980	2020	66,0	6,50	55	1910	63,5
D/S		1860	1920	61,6	5,50	70	1890	62,8
A/S		2000	2120	66,7	7,00	77	1950	65,0
N/S	15-Jan	1900	1900	63,2	6,30	59	1940	64,6
D/S		2040	2040	68,0	7,30	40	1900	63,2
A/S		1970	2020	65,7	5,70	34	1860	61,6
N/S	16-Jan	1870	1890	62,0	4,20	67	1890	62,8
D/S		1900	2040	63,2	4,40	33	1870	62,0
A/S		2030	2180	67,7	6,00	86	1970	65,7
N/S	17-Jan	1950	2030	65,0	6,50	36	1900	63,2
D/S		1950	2000	65,0	6,00	54	1950	65,0
A/S		1950	1980	65,0	4,50	47	1870	62,0
N/S	18-Jan	1950	2010	65,0	5,00	65	1930	64,2
D/S		1980	1960	66,0	6,50	38	1850	61,3
A/S		2020	2120	67,3	7,20	45	2000	66,7
N/S	19-Jan	1980	2040	66,0	6,00	76	1900	63,2
D/S		1840	1900	60,9	4,30	41	1700	54,9
A/S		1960	1990	65,3	6,00	31	1800	59,3
N/S	20-Jan	2005	2060	66,8	7,00	89	1900	63,2
D/S		2050	2100	68,3	10,00	71	1950	65,0
A/S		2020	2110	67,3	7,18	60	1940	64,6
N/S	21-Jan	1960	2020	65,3	6,00	35	1920	63,9
D/S		1900	1940	63,2	5,50	42	1850	61,3
A/S		1950	1990	65,0	6,50	50	1860	61,6
N/S	22-Jan	2030	2060	67,7	9,50	89	1900	63,2
D/S		2050	2170	68,3	10,00	73	1970	65,7
A/S		1950	2010	65,0	6,00	74	1950	65,0
N/S	23-Jan	2080	2020	69,2	6,50	54	1900	63,2
D/S		2000	2130	66,7	5,00	36	1950	65,0
A/S		1910	1880	63,5	4,40	25	1810	59,7

N/S	24-Jan	1945	1980	64,8	6,00	54	1930	64,2
D/S		2000	2170	66,7	6,50	75	1950	65,0
A/S		1920	1980	63,9	5,70	90	1950	65,0
N/S	25-Jan	1970	1980	65,7	6,80	85	1900	63,2
D/S		1980	2010	66,0	5,60	33	1920	63,9
A/S		1900	1980	63,2	4,50	33	1880	62,4
N/S	26-Jan	2010	2080	67,0	7,20	68	1970	65,7
D/S		1900	1940	63,2	4,80	21	1750	57,1
A/S		1920	1980	63,9	5,60	30	1810	59,7
N/S	27-Jan	1960	2010	65,3	6,20	31	1910	63,5
D/S		1900	1880	63,2	5,60	30	1910	63,5
A/S		1900	1910	63,2	6,70	28	1820	60,1
N/S	28-Jan	1930	1910	64,2	7,25	57	1900	63,2
D/S		1920	1940	63,9	5,50	78	1900	63,2
A/S		2000	1980	66,7	7,40	63	1800	59,3
N/S	29-Jan	2060	2080	68,6	9,40	77	1980	66,0
D/S		2050	2100	68,3	9,00	91	2010	67,0
A/S		2020	2050	67,3	6,50	87	1990	66,3
N/S	30-Jan	1970	2000	65,7	6,60	73	1950	65,0
D/S		1990	2010	66,3	8,00	31	1880	62,4
A/S		2020	2100	67,3	11,20	72	1950	65,0
N/S	31-Jan	2060	2100	68,6	11,00	90	1980	66,0
D/S		2120	2180	70,4	12,00	91	2070	68,9
D/S	1-Feb	1900	1960	63,2	4,50	21	1580	48,9
A/S		1970	1990	65,7	4,90	22	1930	64,2
N/S	2-Feb	1950	1920	65,0	6,20	25	1900	63,2
D/S		1910	1920	63,5	6,00	40	1900	63,2
A/S		1960	1950	65,3	6,00	25	1880	62,4
N/S	3-Feb	1940	1920	64,6	5,50	50	1850	61,3
D/S		1920	1970	63,9	4,80	52	1870	62,0
A/S		1940	1930	64,6	3,60	52	1850	61,3
N/S	4-Feb	1840	1830	60,9	5,20	100	1870	62,0
D/S		1990	2020	66,3	5,90	95	1900	63,2
A/S		1980	2000	66,0	4,85	68	1850	61,3
N/S	5-Feb	2000	2070	66,7	6,00	92	1940	64,6
D/S		2000	2040	66,7	6,50	90	1900	63,2
A/S		2050	2070	68,3	5,60	93	1900	63,2
N/S	6-Feb	1990	2010	66,3	5,00	86	1910	63,5
D/S		1900	1940	63,2	5,20	71	1900	63,2
A/S		1920	1980	63,9	8,00	82	1900	63,2
N/S	7-Feb	1950	1920	65,0	5,30	27	1850	61,3
D/S		2040	2100	68,0	8,70	23	1930	64,2
A/S		2030	2080	67,7	8,00	70	1940	64,6
N/S	8-Feb	1990	2050	66,3	7,30	90	1920	63,9
D/S		1910	1950	63,5	5,60	65	1850	61,3
A/S		2000	2060	66,7	5,00	65	1940	64,6
N/S	9-Feb	1910	1900	63,5	4,20	65	1900	63,2
D/S		1950	1940	65,0	5,00	39	1900	63,2
A/S		1940	1950	64,6	5,00	87	1880	62,4
N/S	10-Feb	1920	1970	63,9	6,20	91	1820	60,1
D/S		1950	1980	65,0	5,50	69	1850	61,3
A/S		1930	1920	64,2	5,00	20	1860	61,6
N/S	11-Feb	1950	2000	65,0	5,00	29	1880	62,4
D/S		1950	1920	65,0	4,20	26	1900	63,2
A/S		1920	1940	63,9	4,50	30	1880	62,4
N/S	12-Feb	1880	1920	62,4	4,30	51	1940	64,6
D/S		1900	1930	63,2	5,50	56	1880	62,4
N/S	13-Feb	1890	1940	62,8	5,00	40	1810	59,7
A/S		1900	1940	63,2	4,50	44	1850	61,3
N/S	14-Feb	1860	1860	61,6	4,70	30	1820	60,1
D/S		1820	1830	60,1	5,00	38	1880	62,4
A/S		2000	2040	66,7	7,00	46	1900	63,2
N/S	15-Feb	1980	1940	66,0	5,60	57	1880	62,4
D/S		2080	2100	69,2	6,80	35	1850	61,3
A/S		1930	1880	64,2	4,50	32	1810	59,7

N/S	16-Feb	1920	1950	63,9	6,00	46	1850	61,3
D/S		1820	1850	60,1	4,80	21	1800	59,3
A/S		1900	1920	63,2	4,20	32	1920	63,9
N/S	17-Feb	1970	1960	65,7	5,00	28	1830	60,5
D/S		1940	1940	64,6	4,50	30	1880	62,4
A/S		2000	2040	66,7	5,10	53	1940	64,6
N/S	18-Feb	1840	1860	60,9	5,00	54	1880	62,4
A/S		1920	1950	63,9	5,00	20	1820	60,1
N/S	19-Feb	1980	1980	66,0	8,00	70	1850	61,3
A/S		1900	1920	63,2	5,00	25	1820	60,1
D/S	20-Feb	2000	2020	66,7	5,00	96	2000	66,7
A/S		1970	2020	65,7	6,60	95	1940	64,6
N/S	21-Feb	2130	2100	70,7	10,00	72	1940	64,6
D/S		1920	1940	63,9	5,60	53	1900	63,2
A/S		1920	2100	63,9	3,60	44	1900	63,2
N/S	22-Feb	2020	2020	67,3	4,00	35	1880	62,4
D/S		1900	1920	63,2	4,60	45	1900	63,2
A/S		1980	2020	66,0	5,00	32	1940	64,6
N/S	23-Feb	1980	1980	66,0	5,00	27	1900	63,2
D/S		1900	1885	63,2	4,50	37	1850	61,3
A/S		1890	1880	62,8	3,00	25	1820	60,1
N/S	24-Feb	1900	1920	63,2	4,50	51	1800	59,3
D/S		1950	2040	65,0	5,00	46	1880	62,4
A/S		2000	2020	66,7	6,00	57	1900	63,2
N/S	25-Feb	1950	1940	65,0	5,50	56	1900	63,2
D/S		1950	1990	65,0	6,00	59	1910	63,5
A/S		1970	1970	65,7	5,00	54	1900	63,2
N/S	26-Feb	1930	1920	64,2	5,00	50	1880	62,4
D/S		1920	1900	63,9	5,00	45	1860	61,6
A/S		2000	1980	66,7	5,80	57	1900	63,2
N/S	27-Feb	1900	1900	63,2	4,70	65	1860	61,6
D/S		1910	1940	63,5	4,30	52	1870	62,0
A/S		1920	1890	63,9	3,00	47	1850	61,3
N/S	28-Feb	1960	1950	65,3	3,80	25	1920	63,9
D/S		2000	2020	66,7	4,00	24	1950	65,0
N/S	29-Feb	1950	1920	65,0	3,70	35	1900	63,2
A/S	1-Mar	1900	1900	63,2	3,50	35	1880	62,4
N/S	2-Mar	1900	1880	63,2	3,60	55	1870	62,0
D/S		2000	2000	66,7	4,00	39	1940	64,6
A/S		1950	1960	65,0	5,00	42	1900	63,2
N/S	3-Mar	1890	1920	62,8	6,00	35	1800	59,3
D/S		1930	1940	64,2	4,00	56	1890	62,8
A/S		2010	2050	67,0	5,10	72	1900	63,2
N/S	5-Mar	1990	2020	66,3	5,00	50	1820	60,1
D/S		1950	1900	65,0	3,90	30	1850	61,3
A/S		1870	1920	62,0	2,80	37	1860	61,6
N/S	6-Mar	1980	2000	66,0	4,00	70	1890	62,8
D/S		1990	1990	66,3	3,80	62	1910	63,5
A/S		2000	2050	66,7	3,70	93	1980	66,0
N/S	7-Mar	1990	2020	66,3	6,00	60	1900	63,2
D/S		2050	2000	68,3	4,70	83	1920	63,9
A/S		1970	2000	65,7	3,80	83	1900	63,2
N/S	8-Mar	2060	2100	68,6	7,90	82	2000	66,7
D/S		1920	1900	63,9	3,80	84	1920	63,9
A/S		1940	1900	64,6	4,50	65	1860	61,6
N/S	9-Mar	2000	2020	66,7	6,80	70	1920	63,9
D/S		1920	1950	63,9	4,00	67	1880	62,4
A/S		1980	2050	66,0	3,60	33	1840	60,9
N/S	10-Mar	2040	1960	68,0	3,80	34	1920	63,9
D/S		2000	1950	66,7	3,00	28	1880	62,4
A/S		2000	2000	66,7	3,82	66	1890	62,8

N/S	11-Mar	1970	1950	65,7	3,80	71	1900	63,2
D/S		2010	2020	67,0	4,90	71	1880	62,4
A/S		2050	2200	68,3	5,25	40	1970	65,7
N/S	12-Mar	1900	1910	63,2	4,00	40	1930	64,2
D/S		2020	2000	67,3	5,00	32	1900	63,2
A/S		1900	1900	63,2	4,80	53	1850	61,3
N/S	13-Mar	2050	2000	68,3	4,00	82	1900	63,2
D/S		2000	2050	66,7	7,00	74	1850	61,3
A/S		2000	2050	66,7	6,00	45	1900	63,2
N/S	14-Mar	1930	1930	64,2	4,00	44	1890	62,8
D/S		1870	1880	62,0	3,10	55	1880	62,4
A/S		1970	1950	65,7	4,30	43	1800	59,3
N/S	15-Mar	2000	1980	66,7	5,00	72	1900	63,2
D/S		2020	2060	67,3	5,90	81	1960	65,3
A/S		1910	1940	63,5	4,20	85	1800	59,3
N/S	16-Mar	2000	2020	66,7	6,00	84	1900	63,2
D/S		2040	2140	68,0	5,50	81	2000	66,7
A/S		1990	2010	66,3	3,60	43	1950	65,0
N/S	17-Mar	1950	2000	65,0	4,00	22	1920	63,9
D/S		1880	1910	62,4	3,00	28	1840	60,9
A/S		1950	1900	65,0	2,50	24	1820	60,1
N/S	18-Mar	1880	1900	62,4	2,60	21	1810	59,7
D/S		1860	1780	61,6	2,64	48	1830	60,5
A/S		1880	1920	62,4	2,40	29	1880	62,4
N/S	19-Mar	1880	1900	62,4	2,60	25	1850	61,3
D/S		1870	1900	62,0	2,70	21	1760	57,6
A/S		1950	1920	65,0	4,00	22	1800	59,3
N/S	20-Mar	2000	1980	66,7	4,00	57	1850	61,3
D/S		1980	2020	66,0	3,60	40	1900	63,2
N/S	21-Mar	1920	1980	63,9	4,00	38	1670	53,5
D/S		1970	2000	65,7	3,20	43	1820	60,1
A/S		2050	2020	68,3	4,90	30	1900	63,2
N/S	22-Mar	1900	1920	63,2	2,80	30	1850	61,3
D/S		1900	1910	63,2	3,20	25	1800	59,3
A/S		2020	1970	67,3	3,10	23	1820	60,1
N/S	23-Mar	1870	1870	62,0	2,60	27	1840	60,9
D/S		1890	1830	62,8	3,10	25	1800	59,3
A/S		1850	1850	61,3	3,20	34	1790	58,8
N/S	24-Mar	1930	1980	64,2	2,70	40	1880	62,4
D/S		1900	1900	63,2	3,20	25	1830	60,5
A/S		1880	1870	62,4	3,00	48	1800	59,3
N/S	25-Mar	1905	2000	63,3	2,60	25	1890	62,8
N/S	27-Mar	1870	1920	62,0	3,10	63	1870	62,0
D/S		1900	1880	63,2	3,80	37	1850	61,3
A/S		1920	1950	63,9	3,20	32	1830	60,5
N/S	28-Mar	1950	1970	65,0	4,50	32	1820	60,1
D/S		2000	1950	66,7	4,00	62	1880	62,4
A/S		1920	1900	63,9	4,00	52	1850	61,3
N/S	29-Mar	1900	1920	63,2	3,80	40	1800	59,3
D/S		1920	1900	63,9	3,50	46	1820	60,1
A/S		1860	1850	61,6	3,00	30	1780	58,4
N/S	30-Mar	1890	1900	62,8	3,20	25	1780	58,4
D/S		1900	1900	63,2	4,00	46	1800	59,3
A/S		1900	1940	63,2	2,70	48	1820	60,1
N/S	31-Mar	1900	1900	63,2	4,20	56	1820	60,1
D/S		1915	1900	63,7	4,00	35	1720	55,8
A/S		1960	2030	65,3	3,60	46	1890	62,8
N/S	1-Apr	1980	1980	66,0	4,00	30	1900	63,2
D/S	2-Apr	1910	1880	63,5	3,60	63	1880	62,4
A/S		2000	2020	66,7	5,70	35	1840	60,9
N/S	3-Apr	1930	1950	64,2	3,90	84	1850	61,3
D/S		1850	1850	61,3	4,00	42	1870	62,0
A/S		1900	1920	63,2	2,20	21	1820	60,1

N/S	4-Apr	2120	2020	70,4	4,00	68	1900	63,2
A/S		2020	2000	67,3	3,20	41	1950	65,0
N/S	5-Apr	2050	2020	68,3	5,00	63	1900	63,2
D/S		2100	2120	69,8	8,20	89	1920	63,9
A/S		2020	2000	67,3	11,00	82	1990	66,3
N/S	6-Apr	1900	1880	63,2	4,00	43	1880	62,4
D/S		1920	1920	63,9	3,00	40	1800	59,3
A/S		2000	2020	66,7	4,20	45	1950	65,0
N/S	7-Apr	2000	2030	66,7	4,30	63	1900	63,2
D/S		2010	2100	67,0	4,20	56	1970	65,7
A/S		1990	2000	66,3	3,80	75	1950	65,0
N/S	8-Apr	2000	2050	66,7	5,10	51	1960	65,3
D/S		2100	2170	69,8	8,00	21	1830	60,5
A/S		2100	2000	69,8	4,80	58	2000	66,7
N/S	9-Apr	2030	2050	67,7	4,60	48	2000	66,7
D/S		1980	2000	66,0	3,80	21	1860	61,6
A/S		2070	2030	68,9	4,30	60	1900	63,2
N/S	10-Apr	1990	2000	66,3	3,80	72	1920	63,9
D/S		1920	1920	63,9	3,60	40	1830	60,5
A/S		2100	2110	69,8	2,70	23	1900	63,2
N/S	11-Apr	2000	2040	66,7	3,00	33	1980	66,0
D/S		1990	1980	66,3	0,80	22	1900	63,2
A/S		1870	1900	62,0	2,80	44	1820	60,1
N/S	12-Apr	1900	1860	63,2	2,70	32	1850	61,3
D/S		1980	1990	66,0	3,70	35	1900	63,2
A/S		1940	1960	64,6	2,20	38	1850	61,3
N/S	13-Apr	2000	2170	66,7	4,20	15	1880	62,4
D/S		1920	1950	63,9	4,20	55	1900	63,2
A/S		1890	1870	62,8	2,00	65	1880	62,4
N/S	14-Apr	1900	1930	63,2	2,30	26	1860	61,6
D/S		1970	2000	65,7	3,20	22	1900	63,2
A/S		1900	1900	63,2	2,50	37	1880	62,4
D/S	15-Apr	1900	1900	63,2	3,10	27	1880	62,4
N/S	16-Apr	1930	1900	64,2	3,00	35	1820	60,1
D/S		1900	1900	63,2	3,20	53	1820	60,1
A/S	17-Apr	2020	1960	67,3	4,00	66	2030	67,7
N/S	18-Apr	1990	1950	66,3	4,90	77	1900	63,2
D/S		1970	2020	65,7	3,00	88	1940	64,6
A/S		1880	1830	62,4	2,50	63	1860	61,6
N/S	19-Apr	1900	1900	63,2	3,20	40	1850	61,3
D/S		1840	1900	60,9	2,60	25	1800	59,3
A/S		1820	1780	60,1	2,50	22	1750	57,1
N/S	20-Apr	1900	1900	63,2	3,20	25	1850	61,3
D/S		1880	1850	62,4	2,90	33	1820	60,1
A/S		1920	1900	63,9	3,00	23	1880	62,4
N/S	21-Apr	1930	1920	64,2	3,30	29	1860	61,6
D/S		1880	1900	62,4	2,40	23	1820	60,1
A/S		1930	1990	64,2	2,20	30	1910	63,5
N/S	22-Apr	1900	1900	63,2	3,00	30	1800	59,3
D/S		1840	1940	60,9	2,50	23	1930	64,2
A/S		1840	1860	60,9	2,40	27	1810	59,7
N/S	23-Apr	1990	2000	66,3	3,80	60	1820	60,1
D/S		1940	1980	64,6	4,00	60	1850	61,3
A/S		2000	2140	66,7	10,56	76	1970	65,7
N/S	24-Apr	2040	1960	68,0	7,00	70	1920	63,9
D/S		1960	1980	65,3	4,20	35	1950	65,0
A/S		2100	2170	69,8	6,00	44	2040	68,0
N/S	25-Apr	2160	2080	71,6	6,50	48	2000	66,7
D/S		1900	1920	63,2	3,20	30	1940	64,6
A/S		1830	1900	60,5	1,00	45	1800	59,3
N/S	26-Apr	1920	1910	63,9	3,50	32	1890	62,8
D/S		1890	1920	62,8	3,20	36	1850	61,3
A/S		1910	1890	63,5	2,80	78	1850	61,3

N/S	27-Apr	1900	1900	63,2	3,00	27	1830	60,5
D/S		1970	1960	65,7	3,20	56	1810	59,7
A/S		1900	1900	63,2	3,20	45	1800	59,3
N/S	28-Apr	1930	1910	64,2	2,50	25	1810	59,7
D/S		1950	1940	65,0	3,20	38	1800	59,3
A/S		1900	1900	63,2	3,10	45	1800	59,3
N/S	29-Apr	2010	1970	67,0	3,00	76	1840	60,9
D/S		1910	1900	63,5	3,70	50	1870	62,0
A/S		1910	1930	63,5	3,60	34	1830	60,5
N/S	30-Apr	1920	1900	63,9	3,20	32	1750	57,1
D/S		1900	1950	63,2	4,00	22	1750	57,1
A/S		1900	1920	63,2	3,20	30	1800	59,3
N/S	1-May	2000	2030	66,7	5,40	88	1920	63,9
D/S		1880	1880	62,4	2,60	49	1870	62,0
A/S		1900	1900	63,2	3,80	30	1800	59,3
N/S	2-May	1900	1890	63,2	3,20	47	1820	60,1
D/S		1870	1900	62,0	3,50	39	1800	59,3
A/S		1980	1940	66,0	3,40	42	1830	60,5
N/S	3-May	1960	1980	65,3	3,70	55	1850	61,3
D/S		1990	2020	66,3	4,40	61	1920	63,9
A/S		1880	1850	62,4	2,00	27	1900	63,2
N/S	4-May	1850	1820	61,3	2,40	21	1870	62,0
D/S		1900	1900	63,2	3,80	50	1820	60,1
A/S		1860	1800	61,6	2,50	25	1880	62,4
N/S	5-May	1800	1820	59,3	2,60	38	1780	58,4
D/S		1950	1980	65,0	2,50	57	1730	56,3
A/S		1840	1830	60,9	2,50	38	1800	59,3
N/S	6-May	1900	1960	63,2	3,50	34	1850	61,3
N/S	7-May	1830	1800	60,5	3,90	37	1780	58,4
D/S		1900	1900	63,2	3,20	25	1800	59,3
A/S		1850	1900	61,3	3,00	26	1820	60,1
N/S	8-May	1930	1910	64,2	4,90	48	1860	61,6
D/S		1950	1910	65,0	6,10	40	1840	60,9
A/S		1980	2000	66,0	5,50	80	1880	62,4
N/S	9-May	1950	1950	65,0	3,20	69	1900	63,2
D/S		2010	1980	67,0	5,00	73	1900	63,2
A/S		2000	1960	66,7	4,30	70	1880	62,4
N/S	10-May	1990	1960	66,3	4,70	45	1910	63,5
D/S		1970	2000	65,7	5,20	3,2	1900	63,2
A/S		2000	2000	66,7	5,10	66	1900	63,2
N/S	11-May	2020	2000	67,3	6,20	80	1910	63,5
D/S		2000	2000	66,7	5,00	53	1900	63,2
A/S		1900	1880	63,2	3,40	72	1880	62,4
N/S	12-May	1900	1920	63,2	4,80	33	1890	62,8
D/S		1970	2030	65,7	4,30	66	1870	62,0
A/S		1950	1940	65,0	4,60	72	1860	61,6
N/S	13-May	1900	1910	63,2	3,90	95	1840	60,9
D/S		1910	1860	63,5	5,00	40	1820	60,1
A/S		2000	2000	66,7	5,00	72	1880	62,4
N/S	14-May	2000	2020	66,7	6,00	90	1920	63,9
D/S		2100	2060	69,8	8,50	80	1980	66,0
A/S		2150	2270	71,3	7,50	90	2000	66,7
N/S	15-May	2050	2050	68,3	8,50	90	2000	66,7
D/S		2040	2010	68,0	4,80	71	1950	65,0
A/S		2080	2120	69,2	5,60	83	1920	63,9
N/S	16-May	1990	2000	66,3	8,00	80	1900	63,2
D/S		1840	1850	60,9	3,20	68	1850	61,3
A/S		1950	1960	65,0	3,10	36	1800	59,3
N/S	17-May	1850	1890	61,3	3,60	60	1780	58,4
D/S		1920	1900	63,9	3,50	55	1820	60,1
A/S		1910	1870	63,5	3,40	32	1800	59,3
N/S	18-May	1870	1910	62,0	4,50	40	1790	58,8
D/S		1950	1950	65,0	3,20	38	1850	61,3
A/S		2030	2100	67,7	6,00	77	1900	63,2
N/S	19-May	2100	2090	69,8	4,50	90	1850	61,3
D/S		1950	1900	65,0	2,00	60	1800	59,3
A/S		1850	1900	61,3	3,00	37	1780	58,4
	AVERAGE	1964	1975	65,4	5,11	61	1862	61,6

Table D7. Data for dilution test at tail thickener

<i>Before Floc</i>			<i>After Floc</i>		
Time	Solid (U/F) %	Torque	Time	Solid (U/F) %	Torque
00:30	61	8	01:30	70	15
01:00	61	7	02:00	67	13
02:00	61	7	02:30	66	13
04:30	62	3	03:00	66	13
06:30	69	5	04:00	66	13
08:30	63	1	05:30	65	10
11:30	59	1	07:00	66	10
13:30	59	1	07:30	65	10
14:30	61	2	09:00	60	17
15:00	64	2	21:00	60	17
17:30	63	2	22:30	62	26
19:00	62	2	00:00	66	29
22:30	63	3	01:30	66	32
23:00	63	3	03:30	67	36
23:30	63	3	05:00	66	33
00:30	64	4	07:00	62	31
02:00	62	5	09:00	65	21
03:30	60	3	09:30	65	24
04:30	61	2	10:00	64	13
05:30	63	3	10:30	63	10
06:30	60	3	11:30	62	10
08:30	64	4	12:00	63	10
09:00	64	4	13:30	64	13
10:00	66	5	14:30	65	13
11:00	65	8	16:00	63	18
12:00	65	9	21:00	64	15
14:30	66	10	22:00	64	10
16:00	65	8	01:00	67	14
16:30	64	8	01:30	66	13
17:00	64	7	02:00	64	11
18:00	64	5	04:30	65	11
18:30	64	5	12:00	65	10
19:00	64	5	21:00	72	16
19:30	64	7	23:30	70	10
20:00	64	7	08:00	72	13
20:30	64	5	08:30	70	11
21:00	64	7	09:00	69	10
21:30	65	7	10:30	68	10
22:00	65	8	12:30	68	9
23:00	66	8	13:00	68	9
23:30	65	8	14:00	68	11
00:30	64	8	15:30	67	11
08:30	67	8	16:00	67	10
10:00	65	7	21:00	70	20
10:30	67	7	22:00	70	19
11:30	67	7	23:30	67	16
12:30	66	6	01:00	66	15
00:00	72	12	01:30	66	13
01:30	68	10	03:30	67	17
03:00	67	9	06:00	66	17
03:30	67	9	06:30	64	16
04:00	66	8	09:00	61	13

05:00	63	8	10:00	63	13
06:00	63	8	11:00	64	16
08:30	63	9	12:30	65	13
09:30	62	8	13:30	63	10
10:30	62	7	16:00	62	10
11:00	62	7	16:30	63	10
12:00	61	7	17:00	63	12
13:30	65	6	17:30	63	12
15:00	63	5	22:30	62	10
16:00	65	7	23:30	60	9
16:30	63	8	00:30	61	5
20:00	65	15	03:30	67	4
20:30	64	15	06:30	60	7
21:00	64	13	09:00	61	9
21:30	65	12	11:00	63	10
03:30	65	49	12:30	63	10
04:30	65	43	14:00	64	11
08:30	63	16	15:00	60	7
09:30	61	11	16:30	60	7
13:00	67	16	17:30	58	8
14:00	64	16	20:00	62	6
14:30	64	17	20:30	61	7
20:30	68	18	21:00	60	7
22:30	64	14	22:00	59	3
23:00	64	12	22:30	59	2
00:00	62	10	23:30	64	3
01:30	62	10	01:30	69	8
03:00	67	10	03:30	60	2
05:00	69	15	06:00	61	4
06:30	68	15	08:00	61	5
20:30	70	9	10:30	62	8
Average	64	9	12:00	62	8
			14:30	62	11
			17:30	61	13
			18:30	60	11
			19:00	60	11
			20:00	61	12
			20:30	61	13
			21:30	63	15
			22:00	62	12
			22:30	62	9
			Average	64	13

Table D8. Data for tail thickener without dilution

Time	Solid (U/F) %	Torque
06:00	59	1
07:00	60	3
09:00	61	3
09:30	61	3
10:30	61	4
11:30	62	5
13:00	63	9
20:30	73	2
23:30	76	21
00:00	73	17
08:30	71	21
14:30	70	18
16:00	70	19
21:30	67	13
23:00	66	10
01:30	66	10
05:00	67	8
05:30	66	8
15:00	66	4
16:00	65	5
17:00	65	5
21:30	67	10
22:00	66	9
00:00	68	5
01:30	65	5
02:30	65	5
05:00	65	7
06:30	66	5
11:00	66	5
13:00	65	5
14:00	65	7
14:30	65	7
15:00	65	7
17:00	65	9
18:30	66	11
20:00	65	10
22:00	64	8
23:00	61	10
00:00	61	8
01:00	61	7
02:00	61	7
04:30	62	3
06:30	69	5
08:30	63	1
10:00	61	1
11:30	59	1
13:30	59	1
14:30	61	2
15:00	64	2
17:30	63	2
20:30	62	2
22:30	63	3
23:00	63	3
23:30	63	3
Average	65	7

APPENDIX E

Table E1. Data for Zn capacity test with flocculant addition

Time		Sampling heights (m)			Torque	Density (g/l)
		1	2	3		
09:30	Pulp Weight (g)	2064	2269	2297	4,9	2,119
	Solid weight(g)	1,73	1,45	7,62		
	% Solid	0,08	0,06	0,33		
10:40	Pulp Weight (g)	2260	2244	2247	7,7	2,147
	Solid weight(g)	1,16	2,66	7,75		
	% Solid	0,05	0,12	0,34		
11:40	Pulp Weight (g)	2321	2281	2370	6,4	2,16
	Solid weight(g)	1,35	2,98	23,2		
	% Solid	0,06	0,13	0,98		
12:40	Pulp Weight (g)	2274	2347	2351	6,7	2,149
	Solid weight(g)	1,67	2,24	102,4		
	% Solid	0,07	0,10	4,36		
13:35	Pulp Weight (g)	1761	2313	3258	8,5	2,159
	Solid weight(g)	0,61	1,33	379,19		
	% Solid	0,03	0,06	11,64		
14:30	Pulp Weight (g)	2251	2306	2480	10,5	2,188
	Solid weight(g)	2,86	1,77	1078,32		
	% Solid	0,13	0,08	43,48		
15:00	Pulp Weight (g)	2332	2311	3321	11,1	2,189
	Solid weight(g)	3,32	1,61	1358,96		
	% Solid	0,14	0,07	40,92		
16:00	Pulp Weight (g)	2391	2401	2397	16,3	2,224
	Solid weight(g)	4,28	2,8	1020,35		
	% Solid	0,18	0,12	42,57		
	AVERAGE	0,09	0,09	18,08		
					9,01	2,17

Table E2. Data for Zn capacity test without flocculant addition

Time		Sampling heights (m)			Torque	Density (g/l)
		1	2	3		
08:30	Pulp Weight (g)	2385	2381	2453	1,85	2,207
	Solid weight(g)	19,83	18,02	103,72		
	% Solid	0,83	0,76	4,23		
09:30	Pulp Weight (g)	2398	2399	2686	2,22	2,198
	Solid weight(g)	24,39	12,99	405,12		
	% Solid	1,02	0,54	15,08		
10:30	Pulp Weight (g)	2395	2378	3705	2,60	2,227
	Solid weight(g)	26,37	18,39	1810,7		
	% Solid	1,10	0,77	48,87		
12:30	Pulp Weight (g)	2376	2391	4247	3,06	2,246
	Solid weight(g)	25,28	17,91	2522		
	% Solid	1,06	0,75	59,38		
13:30	Pulp Weight (g)	2371	2388	4278	3,80	2,272
	Solid weight(g)	20,26	13,73	2562		
	% Solid	0,85	0,57	59,89		
14:30	Pulp Weight (g)	2321	2388	4332	4,53	2,302
	Solid weight(g)	15,02	64,39	2765,52		
	% Solid	0,65	2,70	63,84		
15:30	Pulp Weight (g)	2377	2321	4350	5,06	2,329
	Solid weight(g)	22,4	65,4	2688,18		
	% Solid	0,94	2,82	61,80		
	AVERAGE	0,92	1,27	44,73		

Table E3. Data for bed level measurements at two conditions.

With Flocculant		Without Flocculant	
Time	Bed Level %	Time	Bed Level %
06:00	0,012	06:00	0,010
07:00	0,012	07:00	0,010
08:00	0,012	08:00	0,010
09:00	0,012	09:00	0,010
10:00	0,012	10:00	0,010
11:00	0,012	11:00	0,010
12:00	0,012	12:00	0,010
13:00	0,012	13:00	0,010
14:00	0,012	14:00	0,010
15:00	0,012	15:00	0,010
16:00	0,012	16:00	0,010

APPENDIX F

Table F1. Data for laboratory settling tests without flocculant usage and with H₂O₂ addition

No Floc			No Floc - r			No Floc+H2O2			No Floc+H2O2 - r		
Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)
0	1000	30.0	0	1000	30.0	0	1000	30.0	0	1000	30.0
0.2	990	29.7	0.2	990	29.7	0.2	990	29.7	0.2	990	29.7
0.3	980	29.4	0.3	980	29.4	0.3	970	29.1	0.3	970	29.1
0.5	970	29.1	0.5	960	28.8	0.5	940	28.2	0.5	940	28.2
0.7	955	28.7	0.7	950	28.5	0.7	920	27.6	0.7	910	27.3
0.8	940	28.2	0.8	940	28.2	0.8	890	26.7	0.8	880	26.4
1.0	930	27.9	1.0	930	27.9	1.0	870	26.1	1.0	860	25.8
1.2	920	27.6	1.2	920	27.6	1.2	840	25.2	1.2	830	24.9
1.3	910	27.3	1.3	910	27.3	1.3	810	24.3	1.3	810	24.3
1.5	900	27.0	1.5	900	27.0	1.5	790	23.7	1.5	780	23.4
1.7	890	26.7	1.7	890	26.7	1.7	760	22.8	1.7	750	22.5
1.8	880	26.4	1.8	880	26.4	1.8	740	22.2	1.8	730	21.9
2.0	870	26.1	2.0	870	26.1	2.0	710	21.3	2.0	700	21.0
2.2	860	25.8	2.2	860	25.8	2.2	680	20.4	2.2	670	20.1
2.3	850	25.5	2.3	850	25.5	2.3	660	19.8	2.3	650	19.5
2.5	840	25.2	2.5	840	25.2	2.5	630	18.9	2.5	630	18.9
2.7	825	24.8	2.7	830	24.9	2.7	605	18.2	2.7	605	18.2
2.8	815	24.5	2.8	820	24.6	2.8	580	17.4	2.8	575	17.3
3.0	805	24.2	3.0	810	24.3	3.0	560	16.8	3.0	550	16.5
3.2	795	23.9	3.2	800	24.0	3.2	540	16.2	3.2	530	15.9
3.3	785	23.6	3.3	790	23.7	3.3	520	15.6	3.3	510	15.3
3.5	770	23.1	3.5	780	23.4	3.5	500	15.0	3.5	500	15.0
3.7	760	22.8	3.7	770	23.1	3.7	485	14.6	3.7	490	14.7
3.8	750	22.5	3.8	760	22.8	3.8	470	14.1	3.8	470	14.1
4.0	740	22.2	4.0	750	22.5	4.0	450	13.5	4.0	440	13.2
4.2	730	21.9	4.2	740	22.2	4.2	440	13.2	4.2	430	12.9
4.3	720	21.6	4.3	725	21.8	4.3	420	12.6	4.3	415	12.5
4.5	710	21.3	4.5	710	21.3	4.5	415	12.5	4.5	410	12.3
4.7	700	21.0	4.7	705	21.2	4.7	410	12.3	4.7	405	12.2
4.8	690	20.7	4.8	695	20.9	4.8	405	12.2	4.8	400	12.0
5.0	680	20.4	5.0	680	20.4	5.0	395	11.9	5.0	390	11.7
5.3	660	19.8	5.3	670	20.1	5.3	375	11.3	5.3	375	11.3
5.7	640	19.2	5.7	650	19.5	5.7	355	10.7	5.7	360	10.8
6	620	18.6	6	630	18.9	6	340	10.2	6	340	10.20
6.5	590	17.7	6.5	600	18.0	6.5	310	9.30	6.5	315	9.45
7	560	16.8	7	570	17.1	7	290	8.70	7	290	8.70
7.5	530	15.9	7.5	540	16.2	7.5	275	8.25	7.5	275	8.25
8	500	15.0	8	505	15.2	8	270	8.10	8	265	7.95
8.5	480	14.4	8.5	490	14.7	8.5	265	7.95	8.5	260	7.80
9	460	13.8	9	465	14.0	9	260	7.80	9	255	7.65
9.5	440	13.2	9.5	440	13.2	9.5	255	7.65	9.5	250	7.50
10	420	12.6	10	420	12.6	10	250	7.50	10	245	7.35
11	400	12.0	11	400	12.0	11	246	7.38	11	242	7.26
12	370	11.1	12	370	11.1	12	240	7.20	12	238	7.14
13	340	10.20	13	340	10.20	13	238	7.14	13	235	7.05
14	315	9.45	14	318	9.54	14	232	6.96	14	232	6.96
16	280	8.40	16	272	8.16	16	228	6.84	16	229	6.87
18	265	7.95	18	259	7.77	18	221	6.63	18	223	6.69
20	260	7.80	20	250	7.50	20	217	6.51	20	219	6.57
22	255	7.65	22	245	7.35	22	212	6.36	22	213	6.39
24	250	7.50	24	240	7.20	24	210	6.30	24	210	6.30
26	245	7.35	26	237	7.11	26	207	6.21	26	206	6.18
28	238	7.14	28	232	6.96	28	204	6.12	28	204	6.12
30	233	6.99	30	230	6.90	30	202	6.06	30	202	6.06
35	229	6.87	35	225	6.75	35	199	5.97	35	200	6.00
40	224	6.72	40	220	6.60	40	197	5.91	40	198	5.94
45	220	6.60	45	216	6.48	45	195	5.85	45	196	5.88
50	216	6.48	50	213	6.39	50	193	5.79	50	195	5.85
55	213	6.39	55	213	6.39	55	191	5.73	55	193	5.79
60	213	6.39	60	213	6.39	60	190	5.70	60	191	5.73
70	213	6.39	70	213	6.39	70	190	5.70	70	191	5.73
80	213	6.39	80	213	6.39	80	190	5.70	80	191	5.73
90	213	6.39	90	213	6.39	90	190	5.70	90	191	5.73
120	213	6.39	120	213	6.39	120	190	5.70	120	191	5.73

Table F2. Data for laboratory settling tests with anionic type flocculant as Hydrifloc 9130.

Dosage 6 g/ton			Dosage 6 g/ton - r			Dosage 18 g/ton			Dosage 18 g/ton - r		
Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)
0	1000	30.0	0	1000	30.0	0	1000	30.0	0	1000	30.0
0.2	850	25.5	0.2	850	25.5	0.2	370	11.1	0.2	500	15.0
0.3	780	23.4	0.3	750	22.5	0.3	340	10.2	0.3	410	12.3
0.5	680	20.4	0.5	600	18.0	0.5	320	9.60	0.5	340	10.2
0.7	590	17.7	0.7	550	16.5	0.7	308	9.24	0.7	330	9.90
0.8	520	15.6	0.8	520	15.6	0.8	300	9.00	0.8	320	9.60
1.0	480	14.4	1.0	500	15.0	1.0	290	8.70	1.0	310	9.30
1.2	430	12.9	1.2	440	13.20	1.2	285	8.55	1.2	300	9.00
1.3	410	12.3	1.3	420	12.60	1.3	283	8.49	1.3	292	8.76
1.5	390	11.7	1.5	400	12.00	1.5	280	8.40	1.5	285	8.55
1.7	380	11.4	1.7	380	11.40	1.7	278	8.34	1.7	280	8.40
1.8	370	11.1	1.8	370	11.10	1.8	275	8.25	1.8	275	8.25
2.0	360	10.80	2.0	365	10.95	2.0	272	8.16	2.0	273	8.19
2.2	350	10.50	2.2	355	10.65	2.2	270	8.10	2.2	270	8.10
2.3	345	10.35	2.3	345	10.35	2.3	268	8.04	2.3	265	7.95
2.5	340	10.20	2.5	340	10.20	2.5	263	7.89	2.5	262	7.86
2.7	335	10.05	2.7	335	10.05	2.7	260	7.80	2.7	260	7.80
2.8	330	9.90	2.8	325	9.75	2.8	257	7.71	2.8	258	7.74
3.0	325	9.75	3.0	320	9.60	3.0	255	7.65	3.0	255	7.65
3.2	322	9.66	3.2	318	9.54	3.2	252	7.56	3.2	253	7.59
3.3	318	9.54	3.3	316	9.48	3.3	250	7.50	3.3	251	7.53
3.5	315	9.45	3.5	315	9.45	3.5	248	7.44	3.5	250	7.50
3.7	310	9.30	3.7	313	9.39	3.7	246	7.38	3.7	248	7.44
3.8	308	9.24	3.8	311	9.33	3.8	244	7.32	3.8	246	7.38
4.0	305	9.15	4.0	308	9.24	4.0	242	7.26	4.0	245	7.35
4.2	302	9.06	4.2	304	9.12	4.2	240	7.20	4.2	243	7.29
4.3	300	9.00	4.3	300	9.00	4.3	238	7.14	4.3	242	7.26
4.5	298	8.94	4.5	297	8.91	4.5	236	7.08	4.5	241	7.23
4.7	295	8.85	4.7	295	8.85	4.7	234	7.02	4.7	240	7.20
4.8	292	8.76	4.8	293	8.79	4.8	232	6.96	4.8	239	7.17
5.0	290	8.70	5.0	291	8.73	5.0	230	6.90	5.0	236	7.08
5.3	285	8.55	5.3	288	8.64	5.3	230	6.90	5.3	235	7.05
5.7	283	8.49	5.7	285	8.55	5.7	228	6.84	5.7	232	6.96
6	280	8.40	6	282	8.46	6	225	6.75	6	230	6.90
6.5	275	8.25	6.5	280	8.40	6.5	223	6.69	6.5	229	6.87
7	270	8.10	7	277	8.31	7	221	6.63	7	226	6.78
7.5	265	7.95	7.5	272	8.16	7.5	220	6.60	7.5	222	6.66
8	262	7.86	8	267	8.01	8	218	6.54	8	221	6.63
8.5	260	7.80	8.5	261	7.83	8.5	215	6.45	8.5	220	6.60
9	258	7.74	9	258	7.74	9	213	6.39	9	218	6.54
9.5	255	7.65	9.5	256	7.68	9.5	212	6.36	9.5	217	6.51
10	252	7.56	10	254	7.62	10	211	6.33	10	214	6.42
11	249	7.47	11	252	7.56	11	209	6.27	11	211	6.33
12	244	7.32	12	249	7.47	12	207	6.21	12	210	6.30
13	240	7.20	13	245	7.35	13	205	6.15	13	209	6.27
14	238	7.14	14	242	7.26	14	203	6.09	14	205	6.15
16	232	6.96	16	237	7.11	16	201	6.03	16	203	6.09
18	230	6.90	18	233	6.99	18	199	5.97	18	200	6.00
20	225	6.75	20	229	6.87	20	198	5.94	20	199	5.97
22	221	6.63	22	225	6.75	22	197	5.91	22	199	5.97
24	220	6.60	24	223	6.69	24	195	5.85	24	198	5.94
26	219	6.57	26	220	6.60	26	194	5.82	26	197	5.91
28	215	6.45	28	217	6.51	28	192	5.76	28	196	5.88
30	215	6.45	30	215	6.45	30	191	5.73	30	195	5.85
35	210	6.30	35	213	6.39	35	190	5.70	35	195	5.85
40	210	6.30	40	211	6.33	40	190	5.70	40	194	5.82
45	209	6.27	45	210	6.30	45	190	5.70	45	193	5.79
50	208	6.24	50	209	6.27	50	190	5.70	50	192	5.76
55	208	6.24	55	208	6.24	55	190	5.70	55	191	5.73
60	206	6.18	60	207	6.21	60	190	5.70	60	191	5.73
70	205	6.15	70	207	6.21	70	190	5.70	70	191	5.73
80	205	6.15	80	207	6.21	80	190	5.70	80	190	5.70
90	205	6.15	90	207	6.21	90	190	5.70	90	190	5.70
120	205	6.15	120	207	6.21	120	190	5.70	120	190	5.70

Dosage			Dosage			Dosage			Dosage		
28 g/ton			28 g/ton - r			38 g/ton			38 g/ton - r		
Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)
0	1000	30.0	0	1000	30.0	0	1000	30.0	0	1000	30.0
0.2	330	9.90	0.2	400	12.0	0.2	330	9.90	0.2	340	10.2
0.3	305	9.15	0.3	350	10.5	0.3	305	9.15	0.3	310	9.30
0.5	291	8.73	0.5	330	9.90	0.5	290	8.70	0.5	295	8.85
0.7	281	8.43	0.7	320	9.60	0.7	280	8.40	0.7	285	8.55
0.8	275	8.25	0.8	310	9.30	0.8	270	8.10	0.8	278	8.34
1.0	270	8.10	1.0	295	8.85	1.0	265	7.95	1.0	272	8.16
1.2	265	7.95	1.2	290	8.70	1.2	260	7.80	1.2	268	8.04
1.3	260	7.80	1.3	280	8.40	1.3	255	7.65	1.3	265	7.95
1.5	255	7.65	1.5	275	8.25	1.5	252	7.56	1.5	260	7.80
1.7	251	7.53	1.7	272	8.16	1.7	250	7.50	1.7	256	7.68
1.8	249	7.47	1.8	270	8.10	1.8	245	7.35	1.8	253	7.59
2.0	245	7.35	2.0	268	8.04	2.0	242	7.26	2.0	251	7.53
2.2	242	7.26	2.2	265	7.95	2.2	240	7.20	2.2	250	7.50
2.3	241	7.23	2.3	263	7.89	2.3	238	7.14	2.3	247	7.41
2.5	240	7.20	2.5	261	7.83	2.5	236	7.08	2.5	245	7.35
2.7	239	7.17	2.7	258	7.74	2.7	234	7.02	2.7	244	7.32
2.8	235	7.05	2.8	255	7.65	2.8	233	6.99	2.8	242	7.26
3.0	234	7.02	3.0	252	7.56	3.0	232	6.96	3.0	240	7.20
3.2	232	6.96	3.2	251	7.53	3.2	231	6.93	3.2	239	7.17
3.3	231	6.93	3.3	250	7.50	3.3	230	6.90	3.3	237	7.11
3.5	230	6.90	3.5	248	7.44	3.5	229	6.87	3.5	235	7.05
3.7	229	6.87	3.7	246	7.38	3.7	228	6.84	3.7	233	6.99
3.8	228	6.84	3.8	244	7.32	3.8	227	6.81	3.8	232	6.96
4.0	226	6.78	4.0	242	7.26	4.0	226	6.78	4.0	231	6.93
4.2	225	6.75	4.2	241	7.23	4.2	225	6.75	4.2	230	6.90
4.3	224	6.72	4.3	240	7.20	4.3	224	6.72	4.3	229	6.87
4.5	223	6.69	4.5	239	7.17	4.5	223	6.69	4.5	228	6.84
4.7	222	6.66	4.7	238	7.14	4.7	222	6.66	4.7	227	6.81
4.8	221	6.63	4.8	237	7.11	4.8	221	6.63	4.8	226	6.78
5.0	220	6.60	5.0	236	7.08	5.0	220	6.60	5.0	225	6.75
5.3	218	6.54	5.3	235	7.05	5.3	219	6.57	5.3	224	6.72
5.7	216	6.48	5.7	234	7.02	5.7	218	6.54	5.7	222	6.66
6	215	6.45	6	232	6.96	6	217	6.51	6	221	6.63
6.5	212	6.36	6.5	230	6.90	6.5	216	6.48	6.5	220	6.60
7	211	6.33	7	228	6.84	7	215	6.45	7	219	6.57
7.5	210	6.30	7.5	225	6.75	7.5	214	6.42	7.5	218	6.54
8	219	6.57	8	223	6.69	8	213	6.39	8	216	6.48
8.5	208	6.24	8.5	222	6.66	8.5	212	6.36	8.5	214	6.42
9	207	6.21	9	221	6.63	9	211	6.33	9	212	6.36
9.5	205	6.15	9.5	220	6.60	9.5	210	6.30	9.5	211	6.33
10	203	6.09	10	219	6.57	10	209	6.27	10	209	6.27
11	202	6.06	11	218	6.54	11	208	6.24	11	208	6.24
12	201	6.03	12	215	6.45	12	207	6.21	12	207	6.21
13	200	6.00	13	212	6.36	13	206	6.18	13	206	6.18
14	198	5.94	14	211	6.33	14	205	6.15	14	205	6.15
16	196	5.88	16	210	6.30	16	204	6.12	16	204	6.12
18	195	5.85	18	208	6.24	18	203	6.09	18	203	6.09
20	193	5.79	20	205	6.15	20	202	6.06	20	202	6.06
22	192	5.76	22	204	6.12	22	201	6.03	22	201	6.03
24	191	5.73	24	203	6.09	24	200	6.00	24	200	6.00
26	191	5.73	26	202	6.06	26	200	6.00	26	199	5.97
28	191	5.73	28	201	6.03	28	200	6.00	28	198	5.94
30	190	5.70	30	201	6.03	30	200	6.00	30	197	5.91
35	190	5.70	35	201	6.03	35	196	5.88	35	195	5.85
40	190	5.70	40	200	6.00	40	196	5.88	40	194	5.82
45	189	5.67	45	200	6.00	45	195	5.85	45	193	5.79
50	189	5.67	50	200	6.00	50	195	5.85	50	192	5.76
55	189	5.67	55	200	6.00	55	195	5.85	55	191	5.73
60	189	5.67	60	199	5.97	60	194	5.82	60	191	5.73
70	189	5.67	70	199	5.97	70	193	5.79	70	191	5.73
80	189	5.67	80	199	5.97	80	192	5.76	80	191	5.73
90	189	5.67	90	199	5.97	90	191	5.73	90	191	5.73
120	189	5.67	120	199	5.97	120	191	5.73	120	191	5.73

Table F3. Data for laboratory settling tests with anionic type flocculant as Cytac A-100.

Dosage 6 g/ton			Dosage 6 g/ton - r			Dosage 18 g/ton			Dosage 18 g/ton - r		
Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)
0	1000	30.0	0	1000	30.0	0	1000	30.0	0	1000	30.0
0.2	920	27.6	0.2	930	27.9	0.2	490	14.7	0.2	480	14.4
0.3	870	26.1	0.3	880	26.4	0.3	430	12.9	0.3	420	12.6
0.5	800	24.0	0.5	810	24.3	0.5	400	12.0	0.5	390	11.7
0.7	750	22.5	0.7	760	22.8	0.7	385	11.6	0.7	375	11.3
0.8	710	21.3	0.8	700	21.0	0.8	370	11.1	0.8	365	11.0
1.0	670	20.1	1.0	650	19.5	1.0	360	10.8	1.0	360	10.8
1.2	630	18.9	1.2	610	18.3	1.2	355	10.7	1.2	355	10.7
1.3	580	17.4	1.3	570	17.1	1.3	350	10.5	1.3	350	10.5
1.5	560	16.8	1.5	540	16.2	1.5	345	10.4	1.5	345	10.4
1.7	510	15.3	1.7	510	15.3	1.7	340	10.2	1.7	340	10.2
1.8	490	14.7	1.8	480	14.4	1.8	335	10.1	1.8	335	10.1
2.0	465	14.0	2.0	460	13.8	2.0	332	9.96	2.0	330	9.90
2.2	450	13.5	2.2	445	13.4	2.2	329	9.87	2.2	327	9.81
2.3	430	12.9	2.3	435	13.1	2.3	325	9.75	2.3	324	9.72
2.5	415	12.5	2.5	430	12.9	2.5	322	9.66	2.5	321	9.63
2.7	405	12.2	2.7	420	12.6	2.7	320	9.60	2.7	319	9.57
2.8	395	11.9	2.8	410	12.3	2.8	318	9.54	2.8	317	9.51
3.0	389	11.7	3.0	405	12.2	3.0	316	9.48	3.0	315	9.45
3.2	384	11.5	3.2	400	12.0	3.2	314	9.42	3.2	314	9.42
3.3	379	11.37	3.3	395	11.9	3.3	312	9.36	3.3	313	9.39
3.5	375	11.25	3.5	390	11.7	3.5	310	9.30	3.5	311	9.33
3.7	370	11.10	3.7	385	11.6	3.7	308	9.24	3.7	310	9.30
3.8	368	11.04	3.8	382	11.46	3.8	306	9.18	3.8	307	9.21
4.0	365	10.95	4.0	380	11.40	4.0	303	9.09	4.0	305	9.15
4.2	362	10.86	4.2	378	11.34	4.2	301	9.03	4.2	304	9.12
4.3	360	10.80	4.3	375	11.25	4.3	300	9.00	4.3	303	9.09
4.5	357	10.71	4.5	371	11.13	4.5	299	8.97	4.5	302	9.06
4.7	355	10.65	4.7	369	11.07	4.7	298	8.94	4.7	301	9.03
4.8	352	10.56	4.8	365	10.95	4.8	296	8.88	4.8	300	9.00
5.0	350	10.50	5.0	362	10.86	5.0	294	8.82	5.0	298	8.94
5.3	348	10.44	5.3	359	10.77	5.3	292	8.76	5.3	295	8.85
5.7	346	10.38	5.7	355	10.65	5.7	291	8.73	5.7	293	8.79
6	342	10.26	6	350	10.50	6	290	8.70	6	291	8.73
6.5	338	10.14	6.5	345	10.35	6.5	288	8.64	6.5	289	8.67
7	333	9.99	7	340	10.20	7	285	8.55	7	286	8.58
7.5	330	9.90	7.5	335	10.05	7.5	282	8.46	7.5	283	8.49
8	328	9.84	8	331	9.93	8	280	8.40	8	281	8.43
8.5	324	9.72	8.5	328	9.84	8.5	279	8.37	8.5	280	8.40
9	320	9.60	9	322	9.66	9	276	8.28	9	279	8.37
9.5	318	9.54	9.5	320	9.60	9.5	273	8.19	9.5	278	8.34
10	315	9.45	10	315	9.45	10	271	8.13	10	275	8.25
11	311	9.33	11	310	9.30	11	270	8.10	11	272	8.16
12	307	9.21	12	305	9.15	12	268	8.04	12	270	8.10
13	301	9.03	13	301	9.03	13	264	7.92	13	268	8.04
14	299	8.97	14	299	8.97	14	261	7.83	14	265	7.95
16	292	8.76	16	292	8.76	16	260	7.80	16	262	7.86
18	289	8.67	18	287	8.61	18	258	7.74	18	260	7.80
20	284	8.52	20	281	8.43	20	255	7.65	20	258	7.74
22	280	8.40	22	278	8.34	22	252	7.56	22	254	7.62
24	276	8.28	24	275	8.25	24	251	7.53	24	252	7.56
26	272	8.16	26	272	8.16	26	250	7.50	26	251	7.53
28	270	8.10	28	269	8.07	28	249	7.47	28	250	7.50
30	268	8.04	30	265	7.95	30	247	7.41	30	249	7.47
35	262	7.86	35	261	7.83	35	245	7.35	35	247	7.41
40	259	7.77	40	258	7.74	40	242	7.26	40	243	7.29
45	256	7.68	45	253	7.59	45	241	7.23	45	241	7.23
50	252	7.56	50	251	7.53	50	240	7.20	50	240	7.20
55	250	7.50	55	250	7.50	55	240	7.20	55	240	7.20
60	249	7.47	60	249	7.47	60	240	7.20	60	240	7.20
70	248	7.44	70	248	7.44	70	240	7.20	70	240	7.20
80	247	7.41	80	247	7.41	80	240	7.20	80	240	7.20
90	246	7.38	90	246	7.38	90	240	7.20	90	240	7.20
120	246	7.38	120	246	7.38	120	240	7.20	120	240	7.20

Dosage			Dosage			Dosage			Dosage		
28 g/ton			28 g/ton - r			38 g/ton			38 g/ton - r		
Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)
0	1000	30.0	0	1000	30.0	0	1000	30.0	0	1000	30.0
0.2	440	13.2	0.2	450	13.5	0.2	400	12.0	0.2	405	12.2
0.3	400	12.0	0.3	390	11.7	0.3	390	11.7	0.3	390	11.7
0.5	380	11.4	0.5	370	11.1	0.5	375	11.3	0.5	370	11.1
0.7	370	11.1	0.7	360	10.8	0.7	360	10.8	0.7	360	10.8
0.8	360	10.8	0.8	352	10.6	0.8	350	10.5	0.8	350	10.5
1.0	350	10.5	1.0	345	10.4	1.0	345	10.4	1.0	345	10.4
1.2	345	10.4	1.2	340	10.2	1.2	340	10.2	1.2	340	10.2
1.3	340	10.2	1.3	335	10.1	1.3	335	10.1	1.3	335	10.1
1.5	335	10.1	1.5	330	9.90	1.5	330	9.9	1.5	330	9.9
1.7	332	10.0	1.7	325	9.75	1.7	325	9.8	1.7	325	9.8
1.8	327	9.8	1.8	322	9.66	1.8	322	9.7	1.8	320	9.6
2.0	322	9.66	2.0	319	9.57	2.0	319	9.6	2.0	317	9.5
2.2	318	9.54	2.2	317	9.51	2.2	317	9.5	2.2	314	9.4
2.3	315	9.45	2.3	314	9.42	2.3	315	9.5	2.3	312	9.4
2.5	312	9.36	2.5	312	9.36	2.5	312	9.4	2.5	310	9.3
2.7	310	9.30	2.7	310	9.30	2.7	310	9.3	2.7	308	9.2
2.8	308	9.24	2.8	308	9.24	2.8	307	9.2	2.8	306	9.2
3.0	305	9.15	3.0	306	9.18	3.0	305	9.2	3.0	304	9.1
3.2	304	9.12	3.2	304	9.12	3.2	302	9.06	3.2	302	9.06
3.3	302	9.06	3.3	302	9.06	3.3	300	9.00	3.3	300	9.00
3.5	300	9.00	3.5	301	9.03	3.5	298	8.94	3.5	298	8.94
3.7	298	8.94	3.7	300	9.00	3.7	296	8.88	3.7	296	8.88
3.8	295	8.85	3.8	298	8.94	3.8	295	8.85	3.8	294	8.82
4.0	293	8.79	4.0	296	8.88	4.0	294	8.82	4.0	292	8.76
4.2	292	8.76	4.2	294	8.82	4.2	293	8.79	4.2	291	8.73
4.3	290	8.70	4.3	292	8.76	4.3	292	8.76	4.3	290	8.70
4.5	288	8.64	4.5	291	8.73	4.5	291	8.73	4.5	289	8.67
4.7	286	8.58	4.7	290	8.70	4.7	290	8.70	4.7	288	8.64
4.8	284	8.52	4.8	289	8.67	4.8	289	8.67	4.8	287	8.61
5.0	282	8.46	5.0	288	8.64	5.0	288	8.64	5.0	286	8.58
5.3	280	8.40	5.3	287	8.61	5.3	287	8.61	5.3	284	8.52
5.7	279	8.37	5.7	285	8.55	5.7	285	8.55	5.7	282	8.46
6	278	8.34	6	283	8.49	6	283	8.49	6	280	8.40
6.5	276	8.28	6.5	281	8.43	6.5	281	8.43	6.5	279	8.37
7	275	8.25	7	279	8.37	7	280	8.40	7	277	8.31
7.5	273	8.19	7.5	277	8.31	7.5	278	8.34	7.5	275	8.25
8	272	8.16	8	275	8.25	8	276	8.28	8	273	8.19
8.5	271	8.13	8.5	273	8.19	8.5	274	8.22	8.5	271	8.13
9	268	8.04	9	271	8.13	9	272	8.16	9	270	8.10
9.5	265	7.95	9.5	270	8.10	9.5	270	8.10	9.5	269	8.07
10	263	7.89	10	269	8.07	10	268	8.04	10	268	8.04
11	261	7.83	11	268	8.04	11	266	7.98	11	265	7.95
12	260	7.80	12	265	7.95	12	264	7.92	12	262	7.86
13	258	7.74	13	263	7.89	13	262	7.86	13	260	7.80
14	257	7.71	14	261	7.83	14	261	7.83	14	258	7.74
16	256	7.68	16	259	7.77	16	260	7.80	16	255	7.65
18	255	7.65	18	257	7.71	18	257	7.71	18	253	7.59
20	253	7.59	20	255	7.65	20	254	7.62	20	251	7.53
22	251	7.53	22	253	7.59	22	252	7.56	22	250	7.50
24	250	7.50	24	251	7.53	24	251	7.53	24	248	7.44
26	249	7.47	26	250	7.50	26	250	7.50	26	246	7.38
28	248	7.44	28	249	7.47	28	249	7.47	28	244	7.32
30	247	7.41	30	248	7.44	30	248	7.44	30	242	7.26
35	245	7.35	35	246	7.38	35	245	7.35	35	241	7.23
40	243	7.29	40	243	7.29	40	243	7.29	40	240	7.20
45	241	7.23	45	242	7.26	45	241	7.23	45	239	7.17
50	241	7.23	50	242	7.26	50	240	7.20	50	238	7.14
55	241	7.23	55	242	7.26	55	239	7.17	55	237	7.11
60	241	7.23	60	242	7.26	60	239	7.17	60	236	7.08
70	241	7.23	70	241	7.23	70	239	7.17	70	235	7.05
80	241	7.23	80	241	7.23	80	239	7.17	80	235	7.05
90	241	7.23	90	241	7.23	90	239	7.17	90	235	7.05
120	241	7.23	120	241	7.23	120	239	7.17	120	235	7.05

Table F4. Data for laboratory settling tests with anionic type flocculant as Magnafloc 1011.

Dosage 6 g/ton			Dosage 6 g/ton - r			Dosage 18 g/ton			Dosage 18 g/ton - r		
Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)
0	1000	30.0	0	1000	30.0	0	1000	30.0	0	1000	30.0
0.2	940	28.2	0.2	950	28.5	0.2	480	14.4	0.2	490	14.7
0.3	930	27.9	0.3	930	27.9	0.3	430	12.9	0.3	410	12.3
0.5	920	27.6	0.5	900	27.0	0.5	400	12.0	0.5	395	11.9
0.7	910	27.3	0.7	890	26.7	0.7	375	11.3	0.7	375	11.3
0.8	900	27.0	0.8	880	26.4	0.8	365	11.0	0.8	365	11.0
1.0	880	26.4	1.0	860	25.8	1.0	355	10.7	1.0	355	10.7
1.2	850	25.5	1.2	840	25.2	1.2	347	10.4	1.2	345	10.4
1.3	800	24.0	1.3	800	24.0	1.3	342	10.3	1.3	340	10.2
1.5	750	22.5	1.5	760	22.8	1.5	338	10.1	1.5	335	10.05
1.7	700	21.0	1.7	710	21.3	1.7	332	10.0	1.7	330	9.90
1.8	650	19.5	1.8	650	19.5	1.8	329	9.87	1.8	325	9.75
2.0	620	18.6	2.0	620	18.6	2.0	325	9.75	2.0	320	9.60
2.2	600	18.0	2.2	590	17.7	2.2	321	9.63	2.2	315	9.45
2.3	580	17.4	2.3	570	17.1	2.3	317	9.51	2.3	310	9.30
2.5	570	17.1	2.5	560	16.8	2.5	312	9.36	2.5	308	9.24
2.7	550	16.5	2.7	540	16.2	2.7	311	9.33	2.7	306	9.18
2.8	530	15.9	2.8	520	15.6	2.8	308	9.24	2.8	305	9.15
3.0	520	15.6	3.0	510	15.3	3.0	305	9.15	3.0	302	9.06
3.2	500	15.0	3.2	500	15.0	3.2	303	9.09	3.2	300	9.00
3.3	480	14.4	3.3	470	14.1	3.3	301	9.03	3.3	297	8.91
3.5	440	13.2	3.5	430	12.9	3.5	300	9.00	3.5	295	8.85
3.7	430	12.9	3.7	420	12.6	3.7	298	8.94	3.7	293	8.79
3.8	415	12.5	3.8	410	12.3	3.8	296	8.88	3.8	291	8.73
4.0	410	12.3	4.0	405	12.2	4.0	294	8.82	4.0	289	8.67
4.2	405	12.2	4.2	400	12.0	4.2	292	8.76	4.2	287	8.61
4.3	400	12.0	4.3	395	11.85	4.3	290	8.70	4.3	285	8.55
4.5	395	11.9	4.5	390	11.70	4.5	289	8.67	4.5	283	8.49
4.7	390	11.7	4.7	380	11.40	4.7	287	8.61	4.7	282	8.46
4.8	385	11.6	4.8	375	11.25	4.8	286	8.58	4.8	281	8.43
5.0	380	11.40	5.0	370	11.10	5.0	285	8.55	5.0	280	8.40
5.3	375	11.25	5.3	365	10.95	5.3	283	8.49	5.3	278	8.34
5.7	370	11.10	5.7	362	10.86	5.7	280	8.40	5.7	276	8.28
6	365	10.95	6	359	10.77	6	278	8.34	6	273	8.19
6.5	360	10.80	6.5	356	10.68	6.5	275	8.25	6.5	270	8.10
7	355	10.65	7	354	10.62	7	272	8.16	7	268	8.04
7.5	350	10.50	7.5	351	10.53	7.5	270	8.10	7.5	265	7.95
8	345	10.35	8	348	10.44	8	268	8.04	8	263	7.89
8.5	340	10.20	8.5	345	10.35	8.5	265	7.95	8.5	261	7.83
9	338	10.14	9	342	10.26	9	262	7.86	9	259	7.77
9.5	333	9.99	9.5	338	10.14	9.5	260	7.80	9.5	257	7.71
10	329	9.87	10	332	9.96	10	259	7.77	10	254	7.62
11	322	9.66	11	326	9.78	11	257	7.71	11	252	7.56
12	317	9.51	12	321	9.63	12	255	7.65	12	250	7.50
13	312	9.36	13	316	9.48	13	252	7.56	13	248	7.44
14	309	9.27	14	312	9.36	14	250	7.50	14	245	7.35
16	300	9.00	16	308	9.24	16	248	7.44	16	242	7.26
18	292	8.76	18	300	9.00	18	245	7.35	18	240	7.20
20	289	8.67	20	294	8.82	20	241	7.23	20	237	7.11
22	283	8.49	22	289	8.67	22	239	7.17	22	234	7.02
24	278	8.34	24	285	8.55	24	237	7.11	24	231	6.93
26	272	8.16	26	281	8.43	26	234	7.02	26	230	6.90
28	269	8.07	28	276	8.28	28	232	6.96	28	230	6.90
30	265	7.95	30	271	8.13	30	231	6.93	30	230	6.90
35	260	7.80	35	264	7.92	35	230	6.90	35	229	6.87
40	254	7.62	40	258	7.74	40	229	6.87	40	227	6.81
45	250	7.50	45	252	7.56	45	227	6.81	45	225	6.75
50	247	7.41	50	249	7.47	50	226	6.78	50	224	6.72
55	243	7.29	55	244	7.32	55	225	6.75	55	223	6.69
60	240	7.20	60	240	7.20	60	224	6.72	60	223	6.69
70	237	7.11	70	238	7.14	70	223	6.69	70	222	6.66
80	235	7.05	80	235	7.05	80	223	6.69	80	222	6.66
90	234	7.02	90	233	6.99	90	223	6.69	90	222	6.66
120	234	7.02	120	233	6.99	120	223	6.69	120	222	6.66

Dosage			Dosage			Dosage			Dosage		
28 g/ton			28 g/ton - r			38 g/ton			38 g/ton - r		
Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)
0	1000	30.0	0	1000	30.0	0	1000	30.0	0	1000	30.0
0.2	420	12.6	0.2	430	12.9	0.2	380	11.4	0.2	370	11.1
0.3	390	11.7	0.3	390	11.7	0.3	340	10.2	0.3	335	10.1
0.5	365	11.0	0.5	370	11.1	0.5	325	9.8	0.5	320	9.6
0.7	355	10.7	0.7	355	10.7	0.7	315	9.5	0.7	310	9.30
0.8	350	10.50	0.8	345	10.4	0.8	310	9.30	0.8	302	9.06
1.0	340	10.20	1.0	340	10.2	1.0	300	9.00	1.0	297	8.91
1.2	330	9.90	1.2	335	10.1	1.2	295	8.85	1.2	292	8.76
1.3	325	9.75	1.3	330	9.9	1.3	290	8.70	1.3	289	8.67
1.5	320	9.60	1.5	325	9.8	1.5	287	8.61	1.5	285	8.55
1.7	315	9.45	1.7	320	9.6	1.7	284	8.52	1.7	282	8.46
1.8	310	9.30	1.8	315	9.45	1.8	282	8.46	1.8	281	8.43
2.0	306	9.18	2.0	310	9.30	2.0	280	8.40	2.0	278	8.34
2.2	296	8.88	2.2	302	9.06	2.2	279	8.37	2.2	275	8.25
2.3	293	8.79	2.3	297	8.91	2.3	277	8.31	2.3	272	8.16
2.5	291	8.73	2.5	292	8.76	2.5	275	8.25	2.5	271	8.13
2.7	290	8.70	2.7	288	8.64	2.7	272	8.16	2.7	270	8.10
2.8	289	8.67	2.8	284	8.52	2.8	271	8.13	2.8	269	8.07
3.0	287	8.61	3.0	281	8.43	3.0	269	8.07	3.0	268	8.04
3.2	285	8.55	3.2	279	8.37	3.2	268	8.04	3.2	266	7.98
3.3	283	8.49	3.3	277	8.31	3.3	266	7.98	3.3	264	7.92
3.5	280	8.40	3.5	275	8.25	3.5	265	7.95	3.5	262	7.86
3.7	277	8.31	3.7	273	8.19	3.7	263	7.89	3.7	261	7.83
3.8	274	8.22	3.8	270	8.10	3.8	262	7.86	3.8	260	7.80
4.0	270	8.10	4.0	268	8.04	4.0	261	7.83	4.0	259	7.77
4.2	268	8.04	4.2	266	7.98	4.2	260	7.80	4.2	258	7.74
4.3	265	7.95	4.3	264	7.92	4.3	259	7.77	4.3	257	7.71
4.5	263	7.89	4.5	262	7.86	4.5	258	7.74	4.5	255	7.65
4.7	272	8.16	4.7	270	8.10	4.7	257	7.71	4.7	253	7.59
4.8	268	8.04	4.8	266	7.98	4.8	256	7.68	4.8	252	7.56
5.0	266	7.98	5.0	264	7.92	5.0	254	7.62	5.0	251	7.53
5.3	264	7.92	5.3	262	7.86	5.3	252	7.56	5.3	250	7.50
5.7	260	7.80	5.7	260	7.80	5.7	251	7.53	5.7	249	7.47
6	258	7.74	6	257	7.71	6	250	7.50	6	248	7.44
6.5	256	7.68	6.5	255	7.65	6.5	249	7.47	6.5	247	7.41
7	254	7.62	7	253	7.59	7	247	7.41	7	243	7.29
7.5	251	7.53	7.5	250	7.50	7.5	245	7.35	7.5	242	7.26
8	249	7.47	8	248	7.44	8	243	7.29	8	241	7.23
8.5	248	7.44	8.5	247	7.41	8.5	242	7.26	8.5	240	7.20
9	246	7.38	9	246	7.38	9	241	7.23	9	239	7.17
9.5	244	7.32	9.5	244	7.32	9.5	240	7.20	9.5	237	7.11
10	242	7.26	10	242	7.26	10	238	7.14	10	235	7.05
11	240	7.20	11	239	7.17	11	237	7.11	11	233	6.99
12	238	7.14	12	237	7.11	12	235	7.05	12	231	6.93
13	236	7.08	13	235	7.05	13	232	6.96	13	230	6.90
14	234	7.02	14	233	6.99	14	231	6.93	14	229	6.87
16	233	6.99	16	232	6.96	16	230	6.90	16	227	6.81
18	232	6.96	18	231	6.93	18	228	6.84	18	223	6.69
20	231	6.93	20	230	6.90	20	226	6.78	20	221	6.63
22	230	6.90	22	229	6.87	22	224	6.72	22	220	6.60
24	228	6.84	24	228	6.84	24	223	6.69	24	219	6.57
26	227	6.81	26	227	6.81	26	222	6.66	26	219	6.57
28	226	6.78	28	226	6.78	28	221	6.63	28	219	6.57
30	225	6.75	30	225	6.75	30	220	6.60	30	219	6.57
35	222	6.66	35	221	6.63	35	218	6.54	35	217	6.51
40	220	6.60	40	218	6.54	40	218	6.54	40	217	6.51
45	219	6.57	45	217	6.51	45	218	6.54	45	216	6.48
50	218	6.54	50	217	6.51	50	218	6.54	50	216	6.48
55	218	6.54	55	217	6.51	55	218	6.54	55	216	6.48
60	218	6.54	60	217	6.51	60	218	6.54	60	216	6.48
70	218	6.54	70	217	6.51	70	218	6.54	70	216	6.48
80	218	6.54	80	217	6.51	80	218	6.54	80	216	6.48
90	218	6.54	90	217	6.51	90	218	6.54	90	216	6.48
120	218	6.54	120	217	6.51	120	218	6.54	120	216	6.48

Table F5. Data for laboratory settling tests with nonionic type flocculant as N-300.

Dosage 6 g/ton			Dosage 6 g/ton - r			Dosage 18 g/ton			Dosage 18 g/ton - r		
Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)
0	1000	30.0	0	1000	30.0	0	1000	30.0	0	1000	30.0
0.2	900	27.0	0.2	900	27.0	0.2	750	22.5	0.2	730	21.9
0.3	835	25.1	0.3	845	25.4	0.3	540	16.2	0.3	550	16.5
0.5	775	23.3	0.5	785	23.6	0.5	430	12.9	0.5	420	12.6
0.7	725	21.8	0.7	705	21.2	0.7	400	12.0	0.7	400	12.0
0.8	645	19.4	0.8	635	19.1	0.8	380	11.4	0.8	370	11.1
1.0	595	17.9	1.0	575	17.3	1.0	365	11.0	1.0	360	10.8
1.2	545	16.4	1.2	535	16.1	1.2	355	10.7	1.2	350	10.5
1.3	505	15.2	1.3	495	14.9	1.3	345	10.4	1.3	340	10.20
1.5	465	14.0	1.5	455	13.7	1.5	335	10.1	1.5	330	9.90
1.7	435	13.1	1.7	425	12.8	1.7	330	9.90	1.7	325	9.75
1.8	420	12.6	1.8	415	12.5	1.8	325	9.75	1.8	320	9.60
2.0	405	12.2	2.0	395	11.9	2.0	320	9.60	2.0	315	9.45
2.2	395	11.9	2.2	385	11.55	2.2	315	9.45	2.2	310	9.30
2.3	385	11.6	2.3	375	11.25	2.3	311	9.33	2.3	306	9.18
2.5	380	11.4	2.5	370	11.10	2.5	307	9.21	2.5	302	9.06
2.7	370	11.1	2.7	365	10.95	2.7	304	9.12	2.7	299	8.97
2.8	365	11.0	2.8	360	10.80	2.8	301	9.03	2.8	295	8.85
3.0	360	10.8	3.0	355	10.65	3.0	298	8.94	3.0	292	8.76
3.2	355	10.65	3.2	350	10.50	3.2	295	8.85	3.2	290	8.70
3.3	350	10.50	3.3	345	10.35	3.3	292	8.76	3.3	288	8.64
3.5	345	10.35	3.5	342	10.26	3.5	290	8.70	3.5	286	8.58
3.7	342	10.26	3.7	340	10.20	3.7	288	8.64	3.7	284	8.52
3.8	340	10.20	3.8	338	10.14	3.8	286	8.58	3.8	282	8.46
4.0	335	10.05	4.0	336	10.08	4.0	284	8.52	4.0	280	8.40
4.2	333	9.99	4.2	333	9.99	4.2	282	8.46	4.2	278	8.34
4.3	329	9.87	4.3	330	9.90	4.3	280	8.40	4.3	276	8.28
4.5	327	9.81	4.5	328	9.84	4.5	279	8.37	4.5	274	8.22
4.7	325	9.75	4.7	326	9.78	4.7	277	8.31	4.7	271	8.13
4.8	321	9.63	4.8	323	9.69	4.8	275	8.25	4.8	269	8.07
5.0	317	9.51	5.0	320	9.60	5.0	274	8.22	5.0	268	8.04
5.3	315	9.45	5.3	317	9.51	5.3	272	8.16	5.3	266	7.98
5.7	310	9.30	5.7	313	9.39	5.7	269	8.07	5.7	265	7.95
6	305	9.15	6	310	9.30	6	267	8.01	6	264	7.92
6.5	300	9.00	6.5	305	9.15	6.5	263	7.89	6.5	263	7.89
7	295	8.85	7	300	9.00	7	261	7.83	7	261	7.83
7.5	290	8.70	7.5	295	8.85	7.5	259	7.77	7.5	260	7.80
8	287	8.61	8	290	8.70	8	257	7.71	8	258	7.74
8.5	284	8.52	8.5	285	8.55	8.5	254	7.62	8.5	255	7.65
9	281	8.43	9	280	8.40	9	251	7.53	9	252	7.56
9.5	277	8.31	9.5	277	8.31	9.5	250	7.50	9.5	250	7.50
10	275	8.25	10	274	8.22	10	249	7.47	10	246	7.38
11	270	8.10	11	271	8.13	11	246	7.38	11	244	7.32
12	266	7.98	12	267	8.01	12	243	7.29	12	242	7.26
13	262	7.86	13	263	7.89	13	241	7.23	13	240	7.20
14	258	7.74	14	260	7.80	14	239	7.17	14	238	7.14
16	253	7.59	16	255	7.65	16	236	7.08	16	236	7.08
18	247	7.41	18	251	7.53	18	232	6.96	18	233	6.99
20	244	7.32	20	247	7.41	20	230	6.90	20	231	6.93
22	241	7.23	22	243	7.29	22	229	6.87	22	229	6.87
24	237	7.11	24	239	7.17	24	228	6.84	24	227	6.81
26	235	7.05	26	235	7.05	26	227	6.81	26	226	6.78
28	233	6.99	28	231	6.93	28	225	6.75	28	225	6.75
30	231	6.93	30	228	6.84	30	224	6.72	30	224	6.72
35	226	6.78	35	225	6.75	35	221	6.63	35	222	6.66
40	225	6.75	40	224	6.72	40	220	6.60	40	220	6.60
45	224	6.72	45	223	6.69	45	219	6.57	45	220	6.60
50	223	6.69	50	221	6.63	50	219	6.57	50	219	6.57
55	222	6.66	55	220	6.60	55	219	6.57	55	219	6.57
60	221	6.63	60	220	6.60	60	219	6.57	60	219	6.57
70	221	6.63	70	220	6.60	70	219	6.57	70	219	6.57
80	221	6.63	80	220	6.60	80	219	6.57	80	219	6.57
90	221	6.63	90	220	6.60	90	219	6.57	90	219	6.57
120	221	6.63	120	220	6.60	120	219	6.57	120	219	6.57

Dosage			Dosage			Dosage			Dosage		
28 g/ton			28 g/ton - r			38 g/ton			38 g/ton - r		
Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)
0	1000	30.0	0	1000	30.0	0	1000	30.0	0	1000	30.0
0.2	450	13.5	0.2	440	13.2	0.2	425	12.8	0.2	430	12.9
0.3	400	12.0	0.3	400	12.0	0.3	360	10.8	0.3	365	11.0
0.5	370	11.1	0.5	375	11.3	0.5	345	10.4	0.5	345	10.4
0.7	355	10.7	0.7	355	10.7	0.7	335	10.1	0.7	330	9.9
0.8	340	10.2	0.8	340	10.20	0.8	310	9.30	0.8	315	9.45
1.0	330	9.90	1.0	325	9.75	1.0	305	9.15	1.0	307	9.21
1.2	324	9.72	1.2	320	9.60	1.2	297	8.91	1.2	300	9.00
1.3	318	9.54	1.3	315	9.45	1.3	293	8.79	1.3	295	8.85
1.5	311	9.33	1.5	312	9.36	1.5	289	8.67	1.5	292	8.76
1.7	305	9.15	1.7	307	9.21	1.7	285	8.55	1.7	287	8.61
1.8	301	9.03	1.8	302	9.06	1.8	281	8.43	1.8	284	8.52
2.0	298	8.94	2.0	299	8.97	2.0	277	8.31	2.0	280	8.40
2.2	295	8.85	2.2	296	8.88	2.2	275	8.25	2.2	276	8.28
2.3	292	8.76	2.3	293	8.79	2.3	273	8.19	2.3	274	8.22
2.5	289	8.67	2.5	290	8.70	2.5	270	8.10	2.5	272	8.16
2.7	286	8.58	2.7	286	8.58	2.7	267	8.01	2.7	270	8.10
2.8	284	8.52	2.8	284	8.52	2.8	265	7.95	2.8	267	8.01
3.0	281	8.43	3.0	282	8.46	3.0	264	7.92	3.0	266	7.98
3.2	279	8.37	3.2	280	8.40	3.2	263	7.89	3.2	265	7.95
3.3	278	8.34	3.3	278	8.34	3.3	261	7.83	3.3	264	7.92
3.5	276	8.28	3.5	275	8.25	3.5	259	7.77	3.5	262	7.86
3.7	274	8.22	3.7	273	8.19	3.7	257	7.71	3.7	261	7.83
3.8	272	8.16	3.8	271	8.13	3.8	256	7.68	3.8	259	7.77
4.0	271	8.13	4.0	270	8.10	4.0	255	7.65	4.0	257	7.71
4.2	270	8.10	4.2	269	8.07	4.2	254	7.62	4.2	256	7.68
4.3	269	8.07	4.3	268	8.04	4.3	253	7.59	4.3	255	7.65
4.5	268	8.04	4.5	266	7.98	4.5	252	7.56	4.5	254	7.62
4.7	266	7.98	4.7	265	7.95	4.7	251	7.53	4.7	253	7.59
4.8	264	7.92	4.8	263	7.89	4.8	250	7.50	4.8	252	7.56
5.0	262	7.86	5.0	261	7.83	5.0	248	7.44	5.0	250	7.50
5.3	261	7.83	5.3	260	7.80	5.3	246	7.38	5.3	249	7.47
5.7	259	7.77	5.7	258	7.74	5.7	245	7.35	5.7	247	7.41
6	258	7.74	6	257	7.71	6	244	7.32	6	245	7.35
6.5	255	7.65	6.5	256	7.68	6.5	242	7.26	6.5	244	7.32
7	252	7.56	7	254	7.62	7	240	7.20	7	243	7.29
7.5	251	7.53	7.5	252	7.56	7.5	237	7.11	7.5	241	7.23
8	249	7.47	8	250	7.50	8	236	7.08	8	238	7.14
8.5	247	7.41	8.5	248	7.44	8.5	235	7.05	8.5	236	7.08
9	246	7.38	9	247	7.41	9	234	7.02	9	235	7.05
9.5	244	7.32	9.5	246	7.38	9.5	233	6.99	9.5	234	7.02
10	241	7.23	10	244	7.32	10	232	6.96	10	233	6.99
11	240	7.20	11	242	7.26	11	230	6.90	11	231	6.93
12	239	7.17	12	240	7.20	12	228	6.84	12	229	6.87
13	237	7.11	13	238	7.14	13	226	6.78	13	227	6.81
14	234	7.02	14	236	7.08	14	225	6.75	14	226	6.78
16	231	6.93	16	233	6.99	16	223	6.69	16	225	6.75
18	229	6.87	18	230	6.90	18	220	6.60	18	224	6.72
20	227	6.81	20	228	6.84	20	217	6.51	20	222	6.66
22	226	6.78	22	226	6.78	22	216	6.48	22	221	6.63
24	224	6.72	24	224	6.72	24	215	6.45	24	219	6.57
26	222	6.66	26	222	6.66	26	214	6.42	26	218	6.54
28	221	6.63	28	220	6.60	28	214	6.42	28	217	6.51
30	221	6.63	30	218	6.54	30	214	6.42	30	215	6.45
35	220	6.60	35	218	6.54	35	214	6.42	35	215	6.45
40	219	6.57	40	217	6.51	40	213	6.39	40	215	6.45
45	219	6.57	45	216	6.48	45	213	6.39	45	213	6.39
50	217	6.51	50	216	6.48	50	212	6.36	50	213	6.39
55	217	6.51	55	214	6.42	55	211	6.33	55	213	6.39
60	217	6.51	60	214	6.42	60	209	6.27	60	213	6.39
70	217	6.51	70	214	6.42	70	207	6.21	70	213	6.39
80	217	6.51	80	214	6.42	80	207	6.21	80	213	6.39
90	217	6.51	90	214	6.42	90	207	6.21	90	213	6.39
120	217	6.51	120	214	6.42	120	207	6.21	120	213	6.39

Table F6. Data for laboratory settling tests with mixture of anionic and nonionic flocculant types

M-1011 & N-300						A-100 & N-300					
Dosage			Dosage			Dosage			Dosage		
18 g/ton			18 g/ton - r			18 g/ton			18 g/ton - r		
Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)
0	1000	30,0	0	1000	30,0	0	1000	30,0	0	1000	30,0
0,2	455	13,7	0,2	460	13,8	0,2	450	13,5	0,2	440	13,2
0,3	435	13,1	0,3	445	13,4	0,3	435	13,1	0,3	430	12,9
0,5	420	12,6	0,5	430	12,9	0,5	420	12,60	0,5	420	12,6
0,7	410	12,3	0,7	420	12,6	0,7	410	12,30	0,7	410	12,30
0,8	400	12,0	0,8	410	12,3	0,8	400	12,00	0,8	395	11,85
1,0	390	11,7	1,0	400	12,0	1,0	390	11,70	1,0	380	11,40
1,2	380	11,4	1,2	390	11,70	1,2	380	11,40	1,2	365	10,95
1,3	370	11,1	1,3	380	11,40	1,3	370	11,10	1,3	355	10,65
1,5	360	10,8	1,5	370	11,10	1,5	360	10,80	1,5	345	10,35
1,7	350	10,5	1,7	360	10,80	1,7	354	10,62	1,7	335	10,05
1,8	345	10,4	1,8	350	10,50	1,8	348	10,44	1,8	331	9,93
2,0	340	10,20	2,0	340	10,20	2,0	342	10,26	2,0	327	9,81
2,2	335	10,05	2,2	335	10,05	2,2	338	10,14	2,2	323	9,69
2,3	330	9,90	2,3	330	9,90	2,3	334	10,02	2,3	320	9,60
2,5	325	9,75	2,5	325	9,75	2,5	330	9,90	2,5	317	9,51
2,7	320	9,60	2,7	321	9,63	2,7	326	9,78	2,7	314	9,42
2,8	317	9,51	2,8	317	9,51	2,8	321	9,63	2,8	311	9,33
3,0	314	9,42	3,0	313	9,39	3,0	316	9,48	3,0	308	9,24
3,2	311	9,33	3,2	309	9,27	3,2	311	9,33	3,2	305	9,15
3,3	308	9,24	3,3	305	9,15	3,3	306	9,18	3,3	301	9,03
3,5	305	9,15	3,5	302	9,06	3,5	301	9,03	3,5	297	8,91
3,7	302	9,06	3,7	299	8,97	3,7	296	8,88	3,7	293	8,79
3,8	299	8,97	3,8	296	8,88	3,8	291	8,73	3,8	289	8,67
4,0	297	8,91	4,0	293	8,79	4,0	286	8,58	4,0	285	8,55
4,2	295	8,85	4,2	290	8,70	4,2	283	8,49	4,2	281	8,43
4,3	293	8,79	4,3	287	8,61	4,3	280	8,40	4,3	278	8,34
4,5	291	8,73	4,5	284	8,52	4,5	277	8,31	4,5	275	8,25
4,7	289	8,67	4,7	282	8,46	4,7	274	8,22	4,7	272	8,16
4,8	287	8,61	4,8	280	8,40	4,8	271	8,13	4,8	269	8,07
5,0	285	8,55	5,0	278	8,34	5,0	268	8,04	5,0	266	7,98
5,3	283	8,49	5,3	276	8,28	5,3	265	7,95	5,3	263	7,89
5,7	281	8,43	5,7	274	8,22	5,7	262	7,86	5,7	260	7,80
6	280	8,40	6	272	8,16	6	259	7,77	6	257	7,71
6,5	279	8,37	6,5	270	8,10	6,5	257	7,71	6,5	255	7,65
7	278	8,34	7	268	8,04	7	255	7,65	7	253	7,59
7,5	277	8,31	7,5	267	8,01	7,5	253	7,59	7,5	251	7,53
8	276	8,28	8	266	7,98	8	251	7,53	8	249	7,47
8,5	275	8,25	8,5	265	7,95	8,5	249	7,47	8,5	247	7,41
9	274	8,22	9	264	7,92	9	247	7,41	9	245	7,35
9,5	273	8,19	9,5	263	7,89	9,5	244	7,32	9,5	243	7,29
10	271	8,13	10	262	7,86	10	241	7,23	10	241	7,23
11	269	8,07	11	260	7,80	11	238	7,14	11	239	7,17
12	267	8,01	12	258	7,74	12	236	7,08	12	237	7,11
13	265	7,95	13	256	7,68	13	234	7,02	13	236	7,08
14	263	7,89	14	254	7,62	14	232	6,96	14	235	7,05
16	261	7,83	16	252	7,56	16	230	6,90	16	234	7,02
18	259	7,77	18	251	7,53	18	228	6,84	18	233	6,99
20	258	7,74	20	250	7,50	20	226	6,78	20	232	6,96
22	257	7,71	22	249	7,47	22	224	6,72	22	231	6,93
24	256	7,68	24	248	7,44	24	223	6,69	24	230	6,90
26	255	7,65	26	247	7,41	26	222	6,66	26	228	6,84
28	254	7,62	28	246	7,38	28	221	6,63	28	226	6,78
30	253	7,59	30	245	7,35	30	220	6,60	30	224	6,72
35	252	7,56	35	245	7,35	35	219	6,57	35	222	6,66
40	252	7,56	40	245	7,35	40	218	6,54	40	220	6,60
45	251	7,53	45	244	7,32	45	217	6,51	45	219	6,57
50	251	7,53	50	244	7,32	50	216	6,48	50	218	6,54
55	251	7,53	55	244	7,32	55	216	6,48	55	218	6,54
60	251	7,53	60	244	7,32	60	215	6,45	60	218	6,54
70	251	7,53	70	244	7,32	70	215	6,45	70	217	6,51
80	251	7,53	80	244	7,32	80	215	6,45	80	217	6,51
90	251	7,53	90	244	7,32	90	215	6,45	90	217	6,51
120	251	7,53	120	244	7,32	120	215	6,45	120	217	6,51

H-9130 & N-300

Dosage			Dosage		
18 g/ton			18 g/ton - r		
Time, min	Pulp vol, ml	Settling height (cm)	Time, min	Pulp vol, ml	Settling height (cm)
0	1000	30,0	0	1000	30,0
0,2	425	12,8	0,2	410	12,3
0,3	405	12,2	0,3	390	11,7
0,5	395	11,9	0,5	380	11,40
0,7	385	11,6	0,7	370	11,10
0,8	375	11,3	0,8	360	10,80
1,0	365	11,0	1,0	350	10,50
1,2	355	10,7	1,2	340	10,20
1,3	345	10,4	1,3	335	10,05
1,5	335	10,1	1,5	330	9,90
1,7	330	9,90	1,7	325	9,75
1,8	325	9,75	1,8	318	9,54
2,0	320	9,60	2,0	311	9,33
2,2	315	9,45	2,2	304	9,12
2,3	310	9,30	2,3	297	8,91
2,5	300	9,00	2,5	287	8,61
2,7	290	8,70	2,7	277	8,31
2,8	280	8,40	2,8	267	8,01
3,0	270	8,10	3,0	257	7,71
3,2	260	7,80	3,2	247	7,41
3,3	255	7,65	3,3	242	7,26
3,5	252	7,56	3,5	237	7,11
3,7	249	7,47	3,7	232	6,96
3,8	246	7,38	3,8	229	6,87
4,0	243	7,29	4,0	226	6,78
4,2	240	7,20	4,2	223	6,69
4,3	238	7,14	4,3	221	6,63
4,5	236	7,08	4,5	219	6,57
4,7	234	7,02	4,7	217	6,51
4,8	232	6,96	4,8	215	6,45
5,0	230	6,90	5,0	214	6,42
5,3	228	6,84	5,3	213	6,39
5,7	225	6,75	5,7	212	6,36
6	223	6,69	6	211	6,33
6,5	221	6,63	6,5	210	6,30
7	218	6,54	7	209	6,27
7,5	215	6,45	7,5	208	6,24
8	212	6,36	8	207	6,21
8,5	209	6,27	8,5	205	6,15
9	206	6,18	9	203	6,09
9,5	203	6,09	9,5	201	6,03
10	201	6,03	10	199	5,97
11	199	5,97	11	198	5,94
12	197	5,91	12	197	5,91
13	195	5,85	13	196	5,88
14	193	5,79	14	195	5,85
16	191	5,73	16	194	5,82
18	189	5,67	18	193	5,79
20	188	5,64	20	192	5,76
22	187	5,61	22	191	5,73
24	186	5,58	24	190	5,70
26	185	5,55	26	189	5,67
28	184	5,52	28	188	5,64
30	183	5,49	30	187	5,61
35	181	5,43	35	185	5,55
40	179	5,37	40	183	5,49
45	177	5,31	45	181	5,43
50	177	5,31	50	181	5,43
55	177	5,31	55	180	5,40
60	175	5,25	60	180	5,40
70	175	5,25	70	180	5,40
80	175	5,25	80	180	5,40
90	175	5,25	90	180	5,40
120	175	5,25	120	180	5,40

VITA

Name and Last Name : Ayşe Nihan ŞAHİN
Date of Birth : 16.07.1983
Place of Birth : Tokat
Mental Status : Single
Language : English (Advanced), German (Basic)

EDUCATION

2001 - 2005 : Hacettepe University (B.S.)
1997 - 2001 : Sokullu Mehmet Paşa Super High School

JOB EXPERIENCES

From 2006 : Continue at Çayeli Bakır İşletmeleri A.Ş.