

T. R.
VAN YUZUNCU YIL UNIVERSITY
INSTITUTE OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF FISHERIES ENGINEERING

**THE COMPARISON OF UNDERGROUND AND DESALINATION SEA WATERS
USING DUE TO THE LACK OF FRESHWATER SOURCES IN ZUWARAH
(LIBYA)**

M.Sc. THESIS

PREPARED BY: Haidir Farhat SUBKA
SUPERVISOR: Prof. Dr. Fazıl ŞEN

VAN-2017

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ACCEPTANCE AND APPROVAL PAGE

This thesis entitled “The Comparison of Underground and Desalination Sea Waters Using Duo to the Lack of Freshwater Sources in Zuwarah (Libya)” prepares by HAIDIR FARHAT SUBKA under supervision of Prof. Dr. FAZIL ŞEN in the department of Fisheries Engineering has been accepted as a M.Sc. Thesis

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THESIS STATEMENT

All information presented in the thesis was obtained according to the ethical behaviors and academic rules frame. And also, all kinds of statement and source of information that does not belong to me in this work prepared in accordance with the rules of theses, were cited to the source of information absolutely.



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Haidir Farhat SUBKA

ABSTRACT

THE COMPARISON OF UNDERGROUND AND DESALINATION SEA WATERS USING DUE TO THE LACK OF FRESHWATER SOURCES IN ZUWARAH (LIBYA)

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In this study, some water quality parameters were analyzed to investigate water quality changes in Zuwarah city (Libya). The measurements and laboratory analyses were made on water samples taken from 22 sampling points monthly between March-September 2017. In the study, coliform bacteria, EC, pH, DO, TDS, salinity, TH, Ca, Mg, Na, K, NH₄, HCO₃, SO₄, Cl, NO₃, NO₂, PO₄, Fe, CU, Zn and Pb measurements and observations, parameters were studied to determine by laboratory analysis.

The average of the parameters examined in this study throughout the study, for tap water and underground water, were coliform bacteria not detected in tap water, but in underground it has not been detected and in some other point there is high value U=1300-2000 CFU/100, EC as T=351.47 µs/cm, U=3689.81 µs/cm, pH as T=7.43, U=7.37, DO as T=7.89 mg/L, U=5.48 mg/L, TDS as T= 196.93 mg/L, U=2380.44 mg/L, salinity as T=0.14 ‰, U=1.04 ‰, TH as T=94.44 mg/L, U=1416.74 mg/L, Ca as T=25.72 mg/L, U=444.35 mg/L, Mg as T=7.38 mg/L, U=74.57 mg/L, Na as T=31.11 mg/L, U=207.93 mg/L, K as T=94.44 mg/L, U=1416.74 mg/L, NH₄ as T=0.01 mg/L, U=1.77 mg/L, HCO₃ as T=18.62 mg/L, U=113.34 mg/L, SO₄ as T=22.73 mg/L, U=868.22 mg/L, Cl as T=81.88 mg/L, U=591.45 mg/L, NO₃ as T=6.82 mg/L, U=21.53 mg/L, NO₂ as T=0.11 mg/L, U=0.44 mg/L, PO₄ as T=0.14 mg/L, U=0.78 mg/L, Fe as T=0.07 mg/L, U=0.31 mg/L, Cu as T=0.09 mg/L, U=0.02 mg/L, Zn as T=0.17 mg/L, U=0.25 mg/L and Pb as T=0.02 mg/L, U=0.06 mg/L have been identified. Generally, tap water is not polluted and it has suitable quality, but for underground water is not.

Keywords: Desalination seawater, Libya, Underground water, Water quality, Zuwarah.

ÖZET

SU SIKINTISI NEDENİYLE ZUWARAH (LİBYA) ŞEHRİNDE KULLANILAN YER ALTI SULARI İLE DENİZ SUYUNUN DESALİNİZASYONU İLE ELDE EDİLEN SULARIN KARŞILAŞTIRILMASI

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Yüksek Lisans Tezi, Su Ürünleri Mühendisliği Anabilim Dalı
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Bu çalışma Zuwarah (Libya) şehrinin içme sularının kalitesini araştırmak amacıyla yapılmıştır. Ölçümler ve laboratuvar analizleri Mart-Eylül 2017 arasında aylara göre 22 örnekleme noktasından alınan su numuneleri üzerinde yapıldı. Çalışmada, koliform bakteri, elektriksel iletkenlik, pH, çözünmüş oksijen, toplam çözünmüş katılar, tuzluluk, toplam sertlik, kalsiyum, magnezyum, sodyum, potasyum, amonyum, bikarbonat, sülfat, klorür, nitrat, nitrit, fosfat, demir, bakır, çinko ve kurşun ölçümleri ve gözlemleri, parametreleri laboratuvar analizleri ile belirlenmeye çalışılmıştır. Bu çalışmada araştırma boyunca incelenen musluk sularında koliform bakteri tespit edilememişken yer altı sularında bazı noktalarda mevcut iken bazılarında tespit edilememiştir. İncelenen parametrelerin ortalamaları değerleri koliformda $U=1300-2000$ CFU/100, EC için $T=351.47$ $\mu\text{s/cm}$, $U=3689.81$ $\mu\text{s/cm}$, pH için $T=7.43$, $U=7.37$, DO için $T=7.89$ mg/L, $U=5.48$ mg/L, TDS için $T=196.93$ mg/L, $U=2380.44$ mg/L, tuzluluk için $T=\%0.14$, $U=\%1.04$, TH için $T=94.44$ mg/L, $U=1416.74$ mg/L, Ca için $T=25.72$ mg/L, $U=444.35$ mg/L, Mg için $T=7.38$ mg/L, $U=74.57$ mg/L, Na için $T=31.11$ mg/L, $U=207.93$ mg/L, K için $T=94.44$ mg/L, $U=1416.74$ mg/L, NH_4 için $T=0.01$ mg/L, $U=1.77$ mg/L, HCO_3 için $T=18.62$ mg/L, $U=113.34$ mg/L, SO_4 için $T=22.73$ mg/L, $U=868.22$ mg/L, Cl için $T=81.88$ mg/L, $U=591.45$ mg/L, NO_3 için $T=6.82$ mg/L, $U=21.53$ mg/L, NO_2 için $T=0.11$ mg/L, $U=0.44$ mg/L, PO_4 için $T=0.14$ mg/L, $U=0.78$ mg/L, Fe için $T=0.07$ mg/L, $U=0.31$ mg/L, Cu için $T=0.09$ mg/L, $U=0.02$ mg/L, Zn için $T=0.17$ mg/L, $U=0.25$ mg/L ve Pb için $T=0.02$ mg/L, $U=0.06$ mg/L olarak tespit edilmiştir. Genel olarak, Zuwarah Şehri'nin (Libya) musluk suyunun kirli olmadığı ve insani tüketim amaçlı içme ve kullanma suyu olarak uygun kaliteye sahip olduğu, ancak yeraltı suyunun birçok kriter açısından uygun olmadığı sonucuna varılmıştır.

Anahtar kelimeler: Deniz suyu arıtma, Libya, Su kalitesi, Zuwarah, Yeraltı suyu.

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SYMBOLS AND ABBREVIATIONS

Some symbols and abbreviations used in this study are presented below, along with description.

CFU	Colony-Forming Unit
cm	Centimeter
D	Desalination Sea Water
DO	Dissolved Oxygen
EC	European Commission
EC	Electrical Conductivity
EEC	European Economic Community
EPA	Environmental Protection Agency
FAO	Food And Agriculture Organization
GWP	Global Warming Potential
km	Kilometer
L	Liter
LNCSM	Libyan National Centre For Standardization And Metrology
m³	Cubic Meter
mg	Milligram
mm	Millimeter
NDWQS	National Drinking Water Quality Standard
OECD	Organization For Economic Co-Operation And Development
ppt	Parts Per Thousand
S	Sea Water
T	Tape Water
TDS	Total Dissolved Solids
TH	Total Hardness
TSE	Turkish Standards Institution
U	Underground Water

UN United Nations
WHO World Health Organization
μS Micro Siemens



1. INTRODUCTION

Water is the essence of life. The search for extra-terrestrial life starts with the search for water. The Earth without water is a planet without life. The water covers approximately two-thirds of the planet and for more than 65% of the human body. Water is the essential ingredient in the complex chemistry that makes all life on Earth possible. Of all the World's water, less than 3% occurs as freshwater but most of this is locked in the ice-caps and glaciers or deep underground. Only 1% of this freshwater (0.03% of total water) is available as liquid water at the Earth surface. Water is the critical natural resource which underpins all social and economic activity (Anonymous, 2013).

Rapid socio-economic development over the past several decades in the world, adverse effects of human activities on natural ecosystems, seriously threaten fragile landscape ecology and water resources (Lomsadze et al., 2017). Water resources are important to both society and ecosystems. To maintain our health, human will need a reliable clean drinking water. We also need water for agriculture, energy production, recreation and manufacturing. Freshwater is the most important resource for mankind, crosscutting all social, economic and environmental activities (Bouwer, 2002; Pimentel et al., 2004).

At the beginning of the 21st century, the world faces a water quality crisis resulting from continuous population growth, urbanization, land use change, industrialization, food production practices, increased living standards and poor water use practices and wastewater management strategies. It is essential that wastewater management be considered as part of an integrated, full life cycle, ecosystem-based management system that operates across all three dimensions of sustainable development (social, economic and environmental), geographical borders, and includes both freshwater and marine waters (Corcoran et al., 2010).

During recent years, knowledge gaps on drinking water-related gastrointestinal illness have been identified, especially for non-epidemic cases. Pathogen contamination of drinking water during distribution has been suggested to contribute to these cases, but the risk factors are not yet fully understood (Säve-Söderbergh, 2017). In particular, the risk

factors that may contribute to endemic gastrointestinal illness are poorly understood. This is alarming, since these cases are believed to account for the majority of all drinking water-related infections (Westrell et al., 2010).

Presently, problems raised by supplying of fresh water do not concern only arid countries but also rather well watered countries: demand for water increases by about 4% per year while natural resources remain the same. Search a difference seems to be quite reassuring; but more than 97% of potential water supplies are found in oceans and not directly available. Under these conditions, it was logical to think of making these important reserves available, which has led, in the past decades, to rapid development of the desalination techniques (Bouaichaoui et al., 2012).

Water demand management, ensuring minimum water for daily consumption, water resource planning, and ground water depletion are the common concern in the rapidly urbanized mega cities around the world and the challenge is much higher in the developing countries to address and mitigate such primary water problems. In 2014, closely 3.9 billion people, or 54% of the global population lived in cities, and by 2050, two-thirds of the global population will be living in cities, which will generate 55% additional water demand in the world (OECD, 2012; UN-DESA, 2012). The future water condition will be impossible to manage unless the world cities are able to address the present water challenges including water security, demand management, conservation, equity, water efficiency and sustainable consumption (Arfanuzzaman and Rahman, 2017).

Human activities have consumed or polluted a lot of water. At a global scale, most of the water use occurs in agricultural production, but there are also substantial water volumes consumed and polluted in the industrial and domestic sectors (Hoeskstra et al., 2011). Agriculture is, by far, the largest freshwater consumer, accounting for more than 70% of world's water withdrawals (UNEP, 2007). Because of agriculture's huge water usage and its significant contribution as a source of chemical missions in to fresh water, it is considered central to future at tempts to address global stress on water quantity and quality (Herath et al., 2013). Since the beginning of the Industrial Revolution, unlimited development, mass production, and ever-increasing consumption have been the rule of the day. A major consequence of this mindset is the phenomenon of water shortage, brought

about by the massive usage of water. Recently, international awareness of the serious nature of the problems related to water shortage has increased to a great degree (Cha et al., 2017).

More than 50% of people on the planet now live in cities, with 30% of all city dwellers residing in slums (UNWWD, 2015). Urban populations are projected to increase to a total of 6.3 billion by 2050 (WHO/UNICEF, 2012). Developing countries account for 93% of urbanization globally, 40% of which is the expansion of slums. By 2030, the urban population in Africa and Asia will double (UN, 2011).

Approximately 80% of the global human population is affected by either water scarcity or water insecurity (Vörösmarty et al., 2010). Even when the estimation of freshwater scarcity is made using a blue water footprint instead of blue water availability (i.e., by considering treated wastewater as newly available freshwater), the worldwide water shortage remains a critical issue (Hoekstra et al., 2012). In view of this issue, wastewater reuse/recycling, rain water harvesting, and seawater use have been extensively researched as viable solutions (Tal, 2006; Grant et al., 2012). Considering that, on the one hand, over half of the world's population lives in coastal areas that cover only 10% of the earth's land surface (Hinrichsen, 1998). And, on the other hand, that seawater accounts for 97.5% of all water resources on the planet (Shannon et al., 2008). The use of seawater appears to be the best solution (Liu et al., 2016).

In 2014, Turkey endured the driest year since 1961 (RTMFA, 2014). According to projections by the Turkish Statistical Institute (TÜİK), Turkey's population will reach nearly 90 million in 2030, and the water potential will decrease from 1652m³ to 1244m³ per capita per year. According to the (Falken mark Index) which classifies countries in terms of their per capita water potential, Turkey is 'water stressed' since it has 1000-1500 m³ of water potential per capita. According to the same scale, if Turkey's per capita water potential were to fall below 1000 m³, the country would be considered 'water scarce' and measures to ensure more efficient use of water resources would be needed (Wolf et al., 2003). The decline in the water levels of dam reservoirs has also caused problems for hydroelectric power generation. The time it takes for these reservoirs to reach their former

capacities may even prevent some hydroelectric power plants from generating power (Bayazit and Avcı, 1997).

Libya's most pressing environmental issue is water scarcity. The agricultural sector consumes more than 80% of total water supplies, while crop water productivity is exceedingly low (Alghariani, 2006). Libya's water scarcity, with only 104 m³ available per person per year, is exacerbated by low rainfall and a rapidly increasing population. With no perennial rivers or streams, the main water source is groundwater. Development of alternative sustainable sources of water is needed to avoid severe future water deficits (Wheida and Verhoeven, 2007). Over 20 desalination plants were built in the past two decades with a capacity of 480.000 m³/day and an average production of 190.000 m³/day (UNEP, 2013).

Drink water is no longer the cheap commodity that we can get free of nature. As the problems of pollution of the aquatic environment in the world, we are forced to spend large amounts of money to provide safe drinking water by treating water to remove and sterilize various pollutants to get rid of microbes that cause diseases. Our growing needs and water we are wasting means that we deprive future generations of their right to access pure natural water (Sarih, 2017).

The problem of water is not limited to the shortage of water in the world, but it is found that even the available water may be inaccessible. It is possible that water is available but not suitable for direct drinking. It may be contaminated or require some operations to meet the international standards of drinking.

In this study we review the problem of water shortage and some solutions that are available and that may be effective and useful. The scarcity of potable water is not limited to some peoples or to some countries. The most important problem is that this dilemma is not for a specific time period (past, present and future), but it is continuous with the existence of the human race, and because "Allah" has distinguished us from other beings, we must do some actions such as reducing the amount of waste, finding sustainable water sources.

As one of the solutions to the problem of water shortage in the world found that desalination of seawater may be the solution, and here we review this method in general in

the world, and especially in the study area because of the lack of water sources, and the study of the comparison between groundwater available with water that reaches homes from sea water desalination.





2. LITERATURE REVIEW

García-Ruiz et al. (2011), water resource availability in the Mediterranean has already been affected by environmental change, and is seriously jeopardized in future environmental, economic, and demographic scenarios. Most global hydrological models are based on expected trends in precipitation and temperature. However, a number of studies have demonstrated the influence of land cover on river discharge and water resources and increased water use pressure resulting from economic growth and urban expansion.

Vörösmarty et al. (2000), the effects of increasing water demand exceed those of global warming. Some areas with scarce water resources will be particularly at risk, above all if they are subject to strong population growth, as is the case for the Maghreb region (Algeria, Tunis, and Morocco). Changing water resources and demand will necessitate improved management, water economy, and water recycling policies. Such an extremely complex problem will need the development of interdisciplinary teams with the participation of engineers, climatologists, hydrologists, human and physical geographers and general environmentalists.

Maarouf and Girrieow. (2017), water is the cornerstone and nerve of life for all creatures, human, animals and plants. We use water in drinking, cooking, cleaning, watering and anything related to our daily life. Water is a problem that threatens the future of humankind, not only in Libya but, in general, the planet, which is in fact a global problem that is emerging in the 21st century due to the scarcity of water resources on the one hand and the rise of population development on the other. In addition to our modern problem of climate change that the best known on behalf of global warming due to environmental pollution and the increase of carbon dioxide in the atmosphere. Since 90% of Libya is located under the desert climate region characterized by scarcity of rainwater (Al-Mahdawi, 1998). New sources of water should be sought by desalinating seawater, which covers more than two thirds of the Earth's surface. The majority of the world is turning to seawater desalination as an alternative to increasing water resources.

Çavuş et al. (2017), It has been investigated whether different water resources, distributed to networks as drinking water in the center of Van, are appropriate to

consumption according to physical, chemical and microbiological analyzes. Turbidity, electrical conductivity, temperature, dissolved oxygen, pH was measured in the water received from the network water. Biological oxygen demand, chemical oxygen demand, calcium, magnesium, total hardness, total alkalinity, chloride, carbonate, bicarbonate, nitrite, nitrate, ammonia, phosphorus, zinc, copper, nickel, cobalt, cyanide, fluoride, aluminum, iron, potassium, manganese, molybdenum and microbiological analyzes were analyzed at the laboratory. The results were generally found to be appropriate for the values given in Turkey regulations on drinking water.

Dahdah and Mitsos. (2014), the global demand for a steady, economical supply of fresh water continues to increase. One of the main known modes of increasing the existing water supply is seawater desalination; a proven process that can reliably convert the seemingly limitless supply of seawater to high-quality water suitable for human consumption. Already, desalination plants operate in more than 120 countries in the world, including Saudi Arabia, the United Arab Emirates, Spain, Greece and Australia.

Liu et al. (2015), as a result of limited water resources or water shortages, many cities need to get water from water-rich regions located hundreds or thousands of miles away (Muller, 2000; Gleick, 2001). Long-distance water diversion projects require the construction of large amounts of production infrastructure; meanwhile, the extraction, processing, and transport of water consume large amounts of energy (Morrison et al., 2009). Consequently, these processes will produce large amounts of carbon emissions that should not be ignored. In some coastal arid areas, desalination is a common way to gain access to water. Currently, desalination has been used in many parts of the world including the Middle East, North Africa, the United States, and Europe. Desalination largely alleviates the pressure on freshwater resources in these areas. However, the operation of desalination plants requires large quantities of energy and can have adverse impacts on the environment (Raluy et al., 2006).

Youssef et al. (2014), world water resources are mainly salty 97.5% and fresh water 2.5%. Salty water is found in oceans, seas and some lakes while fresh water is either stored underground 30% or in the form of ice / snow covering mountainous regions, Antarctic and Arctic 70% but only 0.3% is usable by humans (Thu, 2010). With this limited amount of

usable fresh water, desalination offers the means to meet the increasing demand for fresh water. Several parameters affect the selection of desalination systems including; quality of salty water to be desalinated, salinity level of produced potable water, input energy, environmental impact and cost. Desalination technology is increasingly becoming important to meet the increasing worldwide water demand. Various technologies are available but they suffer from various drawbacks like large power input and high CO₂ emissions.

Bulum (2015), some water quality and pollution parameters were analyzed to investigate water quality changes in Bendimahi Stream Van-Turkey. The in situ measurements and laboratory analyses were made on water samples taken from 6 sampling points on the Bendimahi Stream monthly, between December 2012 and November 2013. In the study, water temperature, pH, conductivity, dissolved oxygen, oxygen saturation, salinity, turbidity, freeze, calcium, magnesium, total hardness, chloride, carbonate and bicarbonate, total alkalinity, nitrite, nitrate, ammonium, sulfate, phosphor, potassium, aluminum, iron, manganese, copper, zinc, chromium, cyanide, fluorine were analyzed. Generally, Bendimahi stream is not polluted and it has suitable quality in respect to drinking and using by people, aquaculture and irrigation.

Şekerci (2011), some water quality and pollution parameters were analyzed to investigate water quality changes in Karasu Stream which inflows to Lake Van-Turkey. In the study, turbidity, water temperature, dissolved oxygen, dissolved oxygen saturation, conductivity, pH, calcium, magnesium, total hardness, total alkalinity, carbonate and bicarbonate, chloride, salinity, nitrate, nitrite, ammonium, ammonia, phosphorus, Sulphate were analyzed during research. carbonate were not encountered. Karasu Stream is in I. and II. water quality classes all of water quality criteria except for pH and turbidity according to Turkish standards.

Smith et al. (2007), rapid industrial development and population growth in the arid Arabian Gulf countries of Kuwait, Saudi Arabia, Bahrain, Qatar and the United Arab Emirates, had led to a large and growing need for freshwater. Desalination of seawater is a reliable solution for that vital need. Therefore, the construction of more seawater desalination plants along the coast of the Gulf is to be expected. The world's largest

seawater desalination plant with a production capacity of more than 1 million m³ of water per day started to operate in 1983 at Al Jubail on the coast of Saudi Arabia (150 km NW of the island of Bahrain). The removal of water from seawater also produces brine, containing salt concentrations up to 2.5 times of the seawater salinity, to be disposed of into the Arabian Gulf through an outfall. In total, the desalination plants built along the west coast of the Gulf are discharging their brine waste stream in excess of 3.4 million m³ per day.

Mahmoudi et al. (2017), the need for fresh water is considered as a critical international problem, according to the World Water Council, 17% of the world population will be living in short of the fresh water supply by 2020. The demand for alternative sustainable water sources including ground water, desalinated water and recycled water is increased, in recent years. As a result, the implementation of desalination plants is growing on a large scale(Charcosset, 2009).

Bayram (2016), some water quality parameters were analyzed to investigate water quality changes in Güzelkonak Stream (Gevaş-Van, Turkey). The in situ measurements and laboratory analyses were made on water samples taken from five sampling points on the Stream Bed monthly, between January 2013 and December 2013. In the study, water temperature, pH, conductivity, DO, oxygen saturation, salinity, turbidity, color, smell, and, freeze in situ measurements and observations, calcium, magnesium, total hardness, chloride, carbonate and bicarbonate, total alkalinity, nitrite, nitrate, ammonium, ammonia, sulfate, phosphor, potassium, aluminum, iron, manganese, copper, zinc, chromium, cyanide, fluorine, parameters were studied to determine by laboratory analysis. Generally, Güzelkonak stream is not polluted and it has suitable quality in respect to drinking and using by people, aquaculture and irrigation criteria.

Rahmanian et al. (2015), the drinking water quality was investigated in suspected parts of Perak State, Malaysia to ensure the continuous supply of clean and safe drinking water for the public health protection. In this regard, a detailed physical and chemical analysis of drinking water samples was carried out in different residential and commercial areas of the State. The obtained values of each parameter were compared with the standard values set by the World Health Organization (WHO) and local standards such as National Drinking Water Quality Standard (NDWQS). The values of each parameter were found to

be within the safe limits set by the WHO and NDWQS. Overall, the water from all the locations was found to be safe as drinking water.

Bouaichaoui (2012), from a technical and economic standpoint, seawater desalination as an alternative source of potable water has become particularly attractive due to continuous innovations in the relevant technologies leading to a very significant reduction of desalination costs. Desalination is an energy-intensive process. Over the long term, desalination with fossil energy sources would not be compatible with sustainable development: fossil fuels reserves are finite and must be conserved for other essential uses whereas demands for desalted water would continue to increase. Furthermore, the combustion of fossil fuels would produce large amounts of greenhouse gases and toxic emissions. The use of this non-conventional water resource is a strategic issue because seawater is regarded as an inexhaustible resource.

Wibowoa et al. (2017), fresh water is one of the most important human needs. Preservation and availability of freshwater are demanded to ensure the human life. To address the threat of water shortages and ensure the continuous availability of fresh water, it is needed the right strategy that should be tailored to the local potential and characteristics of each country. Indonesia possesses abundant seawater resources. Two-thirds area of Indonesia is sea. Therefore, seawater desalination becomes one of potential method to overcome the water crisis in the future (Khawaji et al., 2008). Seawater desalination refers to the removal of salts and minerals to produce fresh water (Eltawil et al., 2009).

Kaplan et al. (2011), the drinking water quality is associated with the conditions of the water supply networks, the pollution and the contamination of groundwater with pollutants of both anthropogenic and natural origin. The concentrations of the investigated heavy metals (As, Cu, Cd, Cr, Pb, Ni and Hg) in the drinking water samples from Tunceli/Turkey were found the heavy metals concentrations in water samples did not exceed the values of WHO (World Health Organization), EC (Europe Community), EPA (Environment Protection Agency) and TSE-266 (Turkish Standard) guidelines. It was concluded that drinking waters in Tunceli contain low heavy metal levels. Because, there is no industrial zone in and around city of Tunceli.

Abdel-Aal et al. (2015), in this century, the most crucial problem afflicting people around the world is global water scarcity. The rapid growth in population has resulted in greater demand on the quantity of drinking water, leading to catastrophic water shortage in arid and water-stressed region areas (Shannon et al., 2008). It is projected that by year 2030, the global needs of water would increase to 6900 billion m³ from the current 4500 billion m³ (Misdan et al., 2012). So, about 53% increase in the amount of drinking water is needed by year 2030. Consequently, the present surface water resources will no longer be sufficient to meet the future needs for mankind.

Peck and Smith (2017), water is essential for thermoelectric power generation, and electrical power is used to treat and distribute water, in what is called the energy–water (or electricity–water) nexus (Scott et al., 2011). Water is used for cooling, removing waste heat in a power generation cycle, and the electricity sector is second only to agriculture in water use within the United States (USGS, 2017). Water shortages and occurrences of drought have been increasing in recent years, especially in the arid western US, with California facing some of the most extreme water scarcity (CNRA, 2016).

Ait-Kadi (2016), the new United Nations (UN) development agenda fully recognizes the importance of managing water for sustainable development. Recent research led by Oxford University, initiated by GWP in collaboration with the Organization for Economic Co-operation and Development (OECD), has also positioned water at the center of economic development. Thus, notions of the importance of water in development are no longer intuitive; the evidence base is strong and puts water at the heart of the development process (Sadoff et al., 2015).

Seyhan (2016), in this study, some water quality and pollution parameters were analyzed to investigate water quality changes in Deliçay Stream in Turkey. The in situ measurements and laboratory analyses were made on water samples taken from 4 sampling points on the Deliçay Stream monthly, between December 2012 and November 2013. In the study, water temperature, pH, conductivity, dissolved oxygen, oxygen saturation, salinity, turbidity, freeze, calcium, magnesium, total hardness, chloride, carbonate and bicarbonate, total alkalinity, nitrite, nitrate, ammonium, sulfate, phosphor, potassium, aluminum, iron, manganese, copper, zinc, chromium, cyanide, fluorine were

analyzed. Generally, Deliçay stream is not polluted and it has suitable quality in respect to drinking and using by people, aquaculture and irrigation.

Brelsford and Abbott (2017), per capita water consumption is on the decline in many US cities, but water scarcity is still a growing concern due to increasing population, non-urban demands, and concerns about environmental variability. Many water management agencies are now including non-price based forms of demand management as tools for ensuring sufficient water supply to serve the needs of growing cities (Olmstead and Stavins, 2009). These tools include: building codes and other policies to address the water intensity of new construction, incentives to encourage installation of water-saving appliances or remove thirsty landscaping, informational campaigns, watering restrictions, and increased water waste enforcement actions (Postel, 2000).

Liu et al. (2016), global water security is a severe issue that threatens human health and well-being. Finding sustainable alternative water resources has become a matter of great urgency. For coastal urban areas, desalinated seawater could serve as a freshwater supply. However, since 20-30% of the water supply is used for flushing waste from the city, seawater with simple treatment could also partly replace the use of freshwater. Considering that most modern urbanized cities fulfill these criteria, the next generation of water supply systems could consist of a freshwater supply coupled with a seawater supply for sustainable urban development.

Wheeler et al. (2017), the supply of fresh water is finite and, in many locations, sufficiently scarce such that it is not possible to satisfy all competing uses. The challenge of reconciling supply and demand will intensify as global water extractions are expected to increase 55% by 2050. This raises concerns about future trends in global water security; defined as the ability to safeguard access to water for livelihoods and development, to protect against water pollution and water-related disasters, to preserve ecosystems, and to help ensure peace and political stability.

Şen and Aksoy (2015), in terms of quality and clean drinking water in our world in an age in which there is an increasing impoverishment, it is of paramount importance to protect natural resources, which must be well managed and kept clean. We should also implement due measures for the protection and rehabilitation of the available resources.

When Bulakbası stream in Turkey is classified in terms of drinking, in respect to water, temperature, DO, OS, EC, pH, chloride, calcium, hardness, nitrate, nitrite, ammonia, sulfate, phosphorus, potassium, copper, aluminum, total iron, zinc, chromium, and cyanide, it can be first-class, and with regard to magnesium, it may be first and second class, and the manganese can be second quality class. In terms of fisheries, P_2O_5 and alkalinity are only slightly above the first quality class. Bulakbası stream has the first quality in terms of other parameters. With respect to analysis and measurement of all parameters; it is suitable quality of water for both salmon and other species. In point of irrigation, it is considered as second quality class with respect to EC, magnesium, and alkalinity and first-class in terms of other parameters. Irrigation water is a quality that can be used easily. It would be much more tempting to say that Bulakbası, in Iğdır as a drinking water supply for the surrounding settlements can be considered to possess features that are suitable for potable water and favorable for trout and carp farming

Karatayev et al. (2017), there are also higher demands for water especially in the Ural-Caspian and Aral-Syrdarya river basins due to the need to get rid of salt in the soil. With over 45% of water resources in Kazakhstan being inflows from neighboring countries, high demands and inefficiencies in agricultural water use, and growing population and climate change, water resource availability in Kazakhstan in the near future could be significantly hampered. This could be further complicated by future energy sector water demands. The remainder of this section aims to highlight current issues regarding trans boundary water resources, agricultural water use and water for energy. The water resource demand associated with this level of production is estimated at 13.4 km^3 annually, and constitutes about 69% of total water demand of the country. As a result of high water use inefficiencies, about two-thirds of the water withdrawals for the agricultural sector is lost during transport, with only 3.8 km^3 per year effectively used for irrigating crops. According to FAO data, an average of 3500 m^3 of water is used to produce 1 ton of crops in Kazakhstan, and to produce the same amount of food, it took 1300 m^3 of water in Poland, 1000 m^3 in the United States, 790 m^3 in the United Kingdom and 660 m^3 in France (Nurbekoy et al., 2016).

Atici et al. (2016), microbiological, physical, and chemical characters of drinking water supplied from city of Ercis Van-Turkey, were analyzed. Temperature, turbidity, conductivity, dissolved oxygen, biological oxygen demand, chemical oxygen demand, calcium, magnesium, total hardness, total alkalinity, free chloride, carbonate, bicarbonate, nitrite, nitrate, ammonia, phosphorus, zinc, copper, nickel, cobalt, cyanide, fluoride, aluminum, iron, potassium, manganese, molybdenum, silicon and microbiological parameters were analyzed in the laboratory. The results were evaluated according to Turkish Regulation of Surface Water Quality Management, Turkish Water Pollution Control Regulations, TS 266, Turkish Regulation on Water Intended for Human Consumption.



3. MATERIALS AND METHODS

3.1. Materials

3.1.1. The study area

Estimated Population of Libya is 6.355.000 in 2010 and total surface area is 1.759.540 km², and it is located on the North African coast, stretching 1800 km along the Mediterranean Sea between Tunisia and Egypt. It is also bordered by Algeria, Niger, Chad and Sudan (Figure 1). More than 90% of Libya is desert or semi-desert; rainfall in this interior region is less than 100 mm per year. The coastal plains are home to the majority of Libya's population and contain the country's only arable land, which amounts to under 2% of the total land area. Rainfall is over 300 mm per year in the northern Tarabulus region (Jabal Nafusah and Jifarah Plain) and in the northern Benghazi region (Jabal al Akhdar). The climate is Mediterranean along the coast, and transitions abruptly to the south, where desert temperatures are hot and rainfall is rare and irregular. Important environmental issues in study area is water scarcity, arable land availability and desertification, oil development and pollution progress, as defined by the United Nations millennium development goal 7 indicators (UN-WWAP, 2015).

Zuwarah city is a port city in northwestern Libya, with a population of around 80,000. It is situated 102 km west of Tarabulus and 60 km from the Tunisian border. Zuwarah sea water desalination plant located (Almnqhob area), 9 km east of the city, 95 km west of Tarabulus. Libya overlooks the coast of the Mediterranean Sea and is characterized by the sea calm, and the lack of salts in its waters. The waters of the Mediterranean Sea are another precious resource of natural raw materials that Allah has blessed our country. It is possible to benefit from it if the creative potential and minds are available to the same extent that we benefit from the oil wealth (Belhaj, 2011).



Figure 1. The study area Zuwarah city, Libya.

3.1.2. Sampling points and properties

When sampling points are determined, factors such as settlement areas, waste discharge areas, other sources participating in the source, accessibility to the sampling point, security situation, characteristic of being able to represent the general characteristics of the sample point.

At the Zuwarah city, 22 sampling points, 10 samples from tap water, 10 from underground water, 1 from company of desalination and 1 from sea water. Which are evaluated to be possible for relatively easy to access, have been determined in order to be able to give information about the general characteristics of water resources and to receive water samples for analyzing in the laboratory environment (Figure 2).

The selection of tap water has been taken in the living and vital areas in which most of the population is located. As for the groundwater, it has been reintroduced in the nearest places that are exploited for the human element. As for desalinated water, from the company itself and the sea water from the beaches overlooking the city.



Figure 2. Sampling points Zuwarah, Libya.

3.2. Method

3.2.1. Study time

The study covers a 7 month period. The sampling were started on March 2017 and ended on September 2017. Month after month during the study period it had been taken 88 samples. In situ measurements were made the samples from the underground water 10, houses tap water 10, desalination seawater Plant Company 1 and from sea water 1 in (March, May, July and September).

3.2.2. Taking water samples

The samples were collected for each sample point in half-liter bottles. Two samples were collected for each sample point (one of them for heavy metal analysis, has been added nitric acid for the preservation of its natural and other of them bottles for the rest of the analyzes). Water samples were stored in refrigerator conditions at +4 ° C until analyzed in vitro (Sadeem Laboratory). The plastic bottles were of excellent quality and fully packed so that no differences occur when loading or transferring samples to the analysis laboratory.

3.2.3. Methods used in the analysis of water samples

In water measurements pH, EC, DO and salinity were done with multimeter device. Ca, Mg, TH, CL and HCO_3 , were analyzed using Titrimetric methods. NO_2 , NO_3 , NH_4 , SO_4 , K, Na, Fe, Cu, Zn and Pb were determined by spectrophotometer. In the field and laboratory measurements and analyzes Golterman et al. (1978), and Greenberg et al. (1992) have been used.

3.2.3.1. Total coliforms

Total coliforms were determined by USEPA Membrane Filtration Method (MF) m-Endo Method 8074 was used with m-Endo Broth PourRite Ampule (Figure 3) (HACH, 2012).



Figure 3. (MF) m-Endo device, petri dish, microscope.

3.2.3.2. Electrical conductivity, total dissolved solids and salinity

EC, salinity and TDS were recorded with USEPA Direct Measurement Method using HQ40D multimeter device (Figure 4) with Method 8160 (HACH, 2012).

3.2.3.3. pH

pH, were recorded with USEPA Electrode Method using HQ40D multimeter device (Figure 4) with Method 8156 (HACH, 2012).

3.2.3.4. Dissolved oxygen

DO, were recorded with Direct Measurement Method using HQ40D multimeter device (Figure 4) with Method 10360 (HACH, 2012).



Figure 4. HQ40D multimeter device

3.2.3.5. Total hardness, calcium and magnesium

The analysis of total hardness was analyzed with Titration Method using Digital Titrator (Figure 5) Method 8213, and with ManVer 2 Hardness Indicator Powder Pillow.

The analysis Hardness Calcium Titration Method using EDTA Digital Titrator (Figure 5) Method 8204 was used with CalVer 2 Calcium Indicator Powder Pillow.

Magnesium is not included in the results but must be present for a sharp end point. If magnesium is not present, add one to two drops of Magnesium Standard Solution, 10-g/L as CaCO_3 to the sample before the test is started. Calcium and magnesium were calculated by used ASTM D1126-1. Each analysis was taken in duplicate and the results were given in mg/L (HACH, 2012; ASTM, 2009).

3.2.3.6. Bicarbonate

For analysis Bicarbonate, was analyzed with Sodium Hydroxide Method using Digital Titrator (Figure 5) Method 8205 with Phenolphthalein Indicator Powder Pillow (HACH, 2012).

3.2.3.7. Chloride

For analysis Chloride was used Silver Nitrate Method using Digital Titrator (Figure 5) Method 8207, was used Chloride 2 Indicator Powder Pillow (HACH, 2012).



Figure 5. Digital titrator using in the analysis.

3.2.3.8. Sodium and potassium

For analysis Sodium and Potassium was used BWB-XP A five channel digital flame photometer (Figure 6). (BWB Technologies)



Figure 6. BWB-XP A five channel digital flame photometer.

3.2.3.9. Ammonium

For analysis ammonium was used Salicylate Method Powder Pillows using DR1900 portable spectrophotometer (Figure 7) Method 8155 was used with Ammonia Salicylate powder (HACH,2012).



Figure 7. DR1900 portable spectrophotometer.

3.2.3.10. Sulfate

For analysis Sulfate was used USEPA SulfaVer 4 Method Powder Pillows using DR2800 Spectrophotometer (Figure 8) Method 8051 was used with SulfaVer 4 Reagent Powder Pillow (HACH,2012).

3.2.3.11. Nitrate

For analysis Nitrate was used Chromotropic Acid Method Test 'N Tub Vials using DR2800 Spectrophotometer (Figure 8) Method 10020 was used with NitraVer X Reagent B Powder Pillow (HACH,2012).

3.2.3.12. Nitrite

For analysis Nitrite was used USEPA Diazotization Powder Pillows using DR2800 Spectrophotometer (Figure 8) Method 8507 was used with NitriVer 3 Nitrite Reagent Powder Pillow (HACH,2012).

3.2.3.13. Phosphate

For analysis phosphate was used USEPA PhosVer 3 (Ascorbic Acid) Method Powder Pillows using DR2800 Spectrophotometer (Figure 8) Method 8048 was used with PhosVer 3 phosphate Powder Pillow (HACH,2012).



Figure 8. DR2800 Spectrophotometer.

3.2.3.14. Iron, Copper, Zinc and Lead

Analysis of Fe, Cu, Zn and Pb were used High-Resolution Continuum Source Atomic Absorption Spectrometer (HR-CS AAS) contrAA 700 device (Figure 9).



Figure 9. High-Resolution Continuum Source Atomic Absorption Spectrometer device contrAA 700.

3.2.4. Statistical methods

The analyzes were performed as one for each criterion (parameter). The arithmetic averages of the repetitions were calculated and tabulated as month by month data. The statistical calculations and controls used in the evaluation of the obtained data were performed by Yıldız et al. (2011), by using the Microsoft Excel 2007 program with the standard errors on the right of the average values in the tables.





4. RESULTS

4.1. Coliform Bacteria

In the samples of tap water (T), Desalination Seawater Company (D) and sea water(S) were not determined coliform bacteria, while underground water (U) some were not determined, but the others are contaminated (Table 1).

Table 1. Coliform bacteria in U (CFU/100)

Months	Sampling Points									
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
3	0	1300	0	0	0	2000	0	0	0	0
5	0	1300	0	0	0	2000	0	0	0	0
7	0	1300	0	0	0	2000	0	0	0	0
9	0	1300	0	0	0	2000	0	0	0	0
Average	0.0	1300	0.0	0.0	0.0	2000	0.0	0.0	0.0	0.0
Mine	0.0	1300	0.0	0.0	0.0	2000	0.0	0.0	0.0	0.0
Max	0.0	1300	0.0	0.0	0.0	2000	0.0	0.0	0.0	0.0

4.2. Electrical conductivity

In the samples of tap water and the desalination seawater, the lowest value was measured as 204.23 $\mu\text{s}/\text{cm}$ and the highest value was 1093.67 $\mu\text{s}/\text{cm}$ and in the sea water was minimum 56164.21 $\mu\text{s}/\text{cm}$ and maximum 56248.00 $\mu\text{s}/\text{cm}$ (Table 2).

Table 2. The EC in T, D and S ($\mu\text{s}/\text{cm}$)

Months	Sampling Points											
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D	S
3	341.93	251.17	204.23	215.11	254.52	298.67	1073.47	233.91	308.88	247.95	261.33	56164.21
5	321.73	261.27	234.53	255.51	264.62	318.87	1093.67	274.31	298.78	278.25	261.33	56207.83
7	308.88	251.35	234.00	248.90	254.52	298.67	1090.22	233.91	341.80	247.95	261.00	56248.00
9	329.08	261.09	230.76	221.72	257.88	302.40	1077.26	247.38	331.70	258.10	261.22	56204.38
Average	325.41	256.22	225.88	235.31	257.89	304.65	1083.66	247.38	320.29	258.06	261.22	56206.11
Mine	308.88	251.17	204.23	215.11	254.52	298.67	1073.47	233.91	298.78	247.95	261.00	56164.21
Max	341.93	261.27	234.53	255.51	264.62	318.87	1093.67	274.31	341.80	278.25	261.33	56248.00

While underground water the lowest value was 1412.51 $\mu\text{s}/\text{cm}$ and the highest value 5501.38 $\mu\text{s}/\text{cm}$ (Table 3).

Table 3. The EC in U ($\mu\text{s}/\text{cm}$)

Months	Sampling Points									
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
3	4084.30	4444.53	4215.58	5481.08	5375.60	1460.11	1653.93	3882.03	2608.99	3622.73
5	4054.00	4457.83	4355.88	5501.38	5345.91	1470.41	1694.23	3912.33	2598.69	3643.03
7	4084.30	4444.53	4215.86	5481.08	5375.60	1412.51	1653.93	3882.86	2608.57	3622.73
9	4058.90	4449.00	4355.60	5487.85	5365.70	1422.81	1667.35	3911.50	2600.00	3629.16
Average	4070.38	4448.97	4285.73	5487.85	5365.70	1441.46	1667.36	3897.18	2604.06	3629.41
Mine	4054.00	4444.53	4215.58	5481.08	5345.91	1412.51	1653.93	3882.03	2598.69	3622.73
Max	4084.30	4457.83	4355.88	5501.38	5375.60	1470.41	1694.23	3912.33	2608.99	3643.03

4.3. pH

In the samples of tap water and the desalination seawater, the lowest value was measured as 7.12 and the highest value was 7.85 and in the sea water was minimum 7.13 and maximum 7.15 (Table 4).

Table 4. pH in T, D and S

Months	Sampling Points											
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D	S
3	7.28	7.24	7.20	7.29	7.46	7.42	7.36	7.50	7.25	7.27	7.55	7.15
5	7.25	7.29	7.16	7.35	7.50	7.50	7.39	7.41	7.27	7.24	7.51	7.13
7	7.12	7.54	7.65	7.85	7.83	7.54	7.42	7.41	7.43	7.65	7.51	7.13
9	7.15	7.49	7.61	7.79	7.79	7.46	7.39	7.45	7.41	7.62	7.52	7.13
Average	7.20	7.39	7.41	7.57	7.65	7.48	7.39	7.44	7.34	7.45	7.52	7.14
Mine	7.12	7.24	7.16	7.29	7.46	7.42	7.36	7.41	7.25	7.24	7.51	7.13
Max	7.28	7.54	7.65	7.85	7.83	7.54	7.42	7.50	7.43	7.65	7.55	7.15

While underground water the lowest value was 7.13 and the highest value 8.10 (Table 5).

Table 5. pH in U

Months	Sampling Points									
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
3	7.98	7.19	7.15	7.15	7.25	7.30	7.4	7.20	7.25	7.35
5	8.10	7.14	7.13	7.19	7.22	7.38	7.42	7.22	7.27	7.33
7	8.10	7.15	7.15	7.14	7.47	7.38	7.31	7.64	7.54	7.33
9	8.00	7.18	7.14	7.18	7.44	7.35	7.35	7.62	7.52	7.33
Average	8.05	7.17	7.14	7.17	7.35	7.35	7.37	7.42	7.40	7.34
Mine	7.98	7.14	7.13	7.14	7.22	7.30	7.31	7.20	7.25	7.33
Max	8.10	7.19	7.15	7.19	7.47	7.38	7.42	7.64	7.54	7.35

4.4. Dissolved Oxygen

In the samples of tap water and the desalination seawater, the lowest value was measured as 7.20 mg/L and the highest value was 8.38 mg/L and in the sea water was minimum 7.46 mg/L and maximum 7.79 mg/L (Table 6).

Table 6. DO in T, D And S (mg/L)

Months	Sampling Points											
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D	S
3	8.00	8.20	7.67	8.10	8.17	8.25	7.20	7.29	7.84	8.38	7.85	7.46
5	8.19	7.91	7.79	8.03	8.11	8.23	7.25	7.34	7.76	8.21	7.89	7.52
7	8.23	8.07	7.73	8.00	8.09	8.25	7.22	7.31	7.80	8.30	7.85	7.79
9	8.04	8.04	7.73	8.07	8.15	8.24	7.23	7.32	7.80	8.29	7.86	7.73
Average	8.12	8.06	7.73	8.05	8.13	8.24	7.23	7.32	7.80	8.30	7.86	7.63
Mine	8.00	7.91	7.67	8.00	8.09	8.23	7.20	7.29	7.76	8.21	7.85	7.46
Max	8.23	8.20	7.79	8.10	8.17	8.25	7.25	7.34	7.84	8.38	7.89	7.79

While underground water the lowest value was 3.79 mg/L and the highest value 7.65 mg/L (Table 7).

Table 7. DO in U (mg/L)

Months	Sampling Points									
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
3	7.11	5.20	3.67	4.42	5.00	4.81	7.38	7.40	5.13	3.79
5	6.99	5.05	3.83	4.57	4.88	4.99	7.25	7.65	5.10	4.12
7	7.20	6.56	3.77	4.49	4.99	4.81	7.38	7.52	5.13	3.90
9	7.08	6.41	3.74	4.50	4.89	4.87	7.33	7.53	5.12	4.00
Average	7.10	5.81	3.75	4.50	4.94	4.87	7.34	7.53	5.12	3.95
Mine	6.99	5.05	3.67	4.42	4.88	4.81	7.25	7.40	5.10	3.79
Max	7.20	6.56	3.83	4.57	5.00	4.99	7.38	7.65	5.13	4.12

4.5. Total Dissolved Solids

In the samples of tap water and the desalination seawater, the lowest value was measured as 121.18 mg/L and the highest value was 616.57 mg/L and in the sea water was minimum 35709 mg/L and maximum 35973 mg/L (Table 8).

Table 8. TDS in T, D and S (mg/L)

Months	Sampling Points											
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D	S
3	126.25	150.81	121.18	161.13	137.14	179.08	571.36	161.74	184.61	149.80	156.70	35709.00
5	176.95	143.70	128.99	140.53	145.54	175.38	601.52	150.87	164.33	153.04	143.73	35973.00
7	155.54	147.38	124.14	150.89	141.64	179.02	616.57	155.76	174.31	150.07	146.39	35834.00
9	146.96	147.13	126.03	150.77	141.04	175.44	586.41	156.85	174.63	152.77	154.00	35847.00
Average	151.43	147.26	125.09	150.83	141.34	177.23	593.97	156.31	174.47	151.42	150.21	35840.75
Mine	126.25	143.70	121.18	140.53	137.14	175.38	571.36	150.87	164.33	149.80	143.73	35709.00
Max	176.95	150.81	128.99	161.13	145.54	179.08	616.57	161.74	184.61	153.04	156.70	35973.00

While underground water the lowest value was 941.06 mg/L and the highest value 3644.18 mg/L (Table 9).

Table 9. TDS in U (mg/L)

Months	Sampling Points									
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
3	2570.27	2833.29	2755.92	3552.14	3379.39	978.21	1109.12	2522.26	1684.71	2300.54
5	2594.56	2853.01	2787.76	3520.88	3421.38	941.06	1084.31	2503.89	1663.16	2331.54
7	2582.23	2820.44	2770.37	3536.64	3644.18	954.22	1120.50	2510.78	1675.37	2314.36
9	2582.60	2840.16	2773.30	3536.38	3602.19	965.05	1095.70	2515.37	1672.50	2318.00
Average	2582.42	2836.73	2771.84	3536.51	3511.79	959.64	1102.41	2513.08	1673.94	2316.11
Mine	2570.27	2820.44	2755.92	3520.88	3379.39	941.06	1084.31	2503.89	1663.16	2300.54
Max	2594.56	2853.01	2787.76	3552.14	3644.18	978.21	1120.50	2522.26	1684.71	2331.54

4.6. Salinity

In the samples of tap water and the desalination seawater company, the lowest value was measured as 0.11 ppt and the highest value was 0.26 ppt (Table 10).

Table 10. Salinity in T and D (ppt)

Months	Sampling Points										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D
3	0.15	0.13	0.11	0.11	0.12	0.15	0.26	0.14	0.14	0.12	0.14
5	0.15	0.13	0.11	0.11	0.13	0.15	0.26	0.14	0.14	0.12	0.14
7	0.15	0.13	0.11	0.11	0.13	0.15	0.26	0.14	0.14	0.12	0.14
9	0.15	0.13	0.11	0.11	0.13	0.15	0.26	0.14	0.14	0.12	0.14
Average	0.15	0.13	0.11	0.11	0.13	0.15	0.26	0.14	0.14	0.12	0.14
Mine	0.15	0.13	0.11	0.11	0.12	0.15	0.26	0.14	0.14	0.12	0.14
Max	0.15	0.13	0.11	0.11	0.13	0.15	0.26	0.14	0.14	0.12	0.14

In the sea water was minimum 34.72 ppt and maximum 34.80 ppt, while underground water the lowest value was 0.40 ppt and the highest value 2.04 ppt (Table 11).

Table 11. Salinity in U and S (ppt)

Months	Sampling Points										
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	S
3	0.97	1.12	1.14	0.94	2.04	0.40	0.76	0.86	0.95	1.21	34.72
5	0.95	1.13	1.14	0.95	2.04	0.40	0.76	0.86	0.95	1.21	34.8
7	0.96	1.13	1.14	0.95	2.04	0.41	0.76	0.86	0.95	1.21	34.76
9	0.96	1.12	1.14	0.95	2.04	0.40	0.76	0.86	0.95	1.21	34.76
Average	0.96	1.13	1.14	0.95	2.04	0.40	0.76	0.86	0.95	1.21	34.76
Mine	0.95	1.12	1.14	0.94	2.04	0.40	0.76	0.86	0.95	1.21	34.72
Max	0.97	1.13	1.14	0.95	2.04	0.41	0.76	0.86	0.95	1.21	34.8

4.7. Total Hardness

In the samples of tap water and the desalination seawater company, the lowest value was measured as 70.06 mg/L and the highest value was 183.65 mg/L and in the sea water was minimum 6754.38 mg/L and maximum 6796.11 mg/L (Table 12).

Table 12. TH in T, D and S (mg/L)

Months	Sampling Points											
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D	S
3	97.89	78.47	72.51	71.77	89.88	88.94	183.65	91.11	81.67	80.79	78.96	6754.38
5	100.09	80.07	70.06	70.06	90.08	90.08	180.16	90.08	100.09	80.07	80.07	6796.11
7	99.04	79.07	71.09	70.12	90.00	89.08	181.27	91.11	93.21	80.48	79.04	6778.66
9	98.94	79.50	71.48	71.71	89.96	89.95	182.54	90.77	90.65	80.38	79.99	6771.83
Average	98.99	79.28	71.29	70.92	89.98	89.51	181.91	90.77	91.41	80.43	79.52	6775.25
Mine	97.89	78.47	70.06	70.06	89.88	88.94	180.16	90.08	81.67	80.07	78.96	6754.38
Max	100.09	80.07	72.51	71.77	90.08	90.08	183.65	91.11	100.09	80.79	80.07	6796.11

While underground water the lowest value was 400.36 mg/L and the highest value 2091.76 mg/L (Table 13).

Table 13. TH in U (mg/L)

Months	Sampling Points									
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
3	1934.07	1720.44	1668.87	2091.76	1758.62	405.71	517.85	1757.31	1004.17	1323.46
5	1921.73	1721.55	1661.49	2081.87	1761.58	400.36	520.47	1761.58	1000.90	1321.19
7	1929.20	1720.50	1664.36	2086.43	1760.09	403.16	519.81	1758.63	1002.07	1322.64
9	1926.60	1721.49	1666.00	2087.20	1760.11	402.91	518.21	1760.26	1003.00	1322.00
Average	1927.90	1721.00	1665.18	2086.82	1760.10	403.04	519.09	1759.45	1002.54	1322.32
Mine	1921.73	1720.44	1661.49	2081.87	1758.62	400.36	517.85	1757.31	1000.90	1321.19
Max	1934.07	1721.55	1668.87	2091.76	1761.58	405.71	520.47	1761.58	1004.17	1323.46

4.8. Calcium

In the samples of tap water and the desalination seawater company, the lowest value was measured as 16.03 mg/L and the highest value was 32.06 mg/L (Table 14).

Table 14. Ca in T and D (mg/L)

Months	Sampling Points										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D
3	32.06	20.03	20.05	24.03	28.05	24.05	28.06	32.05	28.04	20.06	20.03
5	32.06	20.04	16.03	24.05	28.05	32.06	32.06	28.05	28.05	20.04	16.03
7	30.08	19.60	18.09	24.30	27.60	28.05	30.18	28.39	27.98	20.06	18.27
9	30.04	19.62	17.99	24.29	28.03	28.06	29.94	31.71	27.99	20.04	17.78
Average	31.06	19.82	18.04	24.17	27.93	28.06	30.06	30.05	28.02	20.05	18.03
Mine	30.04	19.60	16.03	24.03	27.6	24.05	28.06	28.05	27.98	20.04	16.03
Max	32.06	20.04	20.05	24.30	28.05	32.06	32.06	32.05	28.05	20.06	20.03

In the sea water was minimum 540.13 mg/L and maximum 541.03 mg/L, while underground water the lowest value was 64.12 mg/L and the highest value 625.19 mg/L (Table 15).

Table 15. Ca in U and S (mg/L)

Months	Sampling Points										
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	S
3	608.98	547.90	619.08	612.93	536.13	62.74	123.16	622.71	322.11	390.39	540.13
5	609.16	545.03	617.17	609.16	537.02	64.12	120.23	625.19	320.61	392.75	541.03
7	608.98	546.44	618.22	610.84	536.41	63.60	121.81	623.53	321.82	391.39	540.44
9	609.09	546.65	618.16	611.36	536.84	63.27	121.62	624.49	320.98	391.82	540.82
Average	609.05	546.51	618.16	611.07	536.6	63.43	121.71	623.98	321.38	391.59	540.61
Mine	608.98	545.03	617.17	609.16	536.13	62.74	120.23	622.71	320.61	390.39	540.13
Max	609.16	547.90	619.08	612.93	537.02	64.12	123.16	625.19	322.11	392.75	541.03

4.9. Magnesium

In the samples of tap water and the desalination seawater company, the lowest value was measured as 2.28 mg/L and the highest value was 27.57 mg/L and in the sea water was minimum 1312.37 mg/L and maximum 1322.02 mg/L (Table 16).

Table 16. Mg in T, D and S (mg/L)

Months	Sampling Points											
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D	S
3	6.74	6.90	5.44	2.85	4.81	7.00	27.57	2.68	2.82	7.45	7.02	1312.37
5	4.86	7.29	7.29	2.43	4.86	2.43	24.30	4.86	7.29	7.29	9.72	1322.02
7	5.80	7.31	6.29	2.28	5.11	4.61	25.71	4.90	5.66	7.37	8.10	1318.07
9	5.80	7.40	6.44	2.68	4.84	4.82	26.16	2.80	5.03	7.36	8.63	1316.19
Average	5.80	7.23	6.37	2.56	4.91	4.72	25.94	3.81	5.20	7.37	8.37	1317.16
Mine	4.86	6.90	5.44	2.28	4.81	2.43	24.30	2.68	2.82	7.29	7.02	1312.37
Max	6.74	7.40	7.29	2.85	5.11	7.00	27.57	4.90	7.29	7.45	9.72	1322.02

While underground water the lowest value was 29.16 mg/L and the highest value 136.26 mg/L (Table 17).

Table 17. Mg in U (mg/L)

Months	Sampling Points									
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
3	100.37	85.53	29.86	136.26	101.94	60.45	51.05	49.13	48.52	84.64
5	97.21	87.49	29.16	136.09	102.07	58.32	53.46	48.60	48.60	82.63
7	99.18	86.43	29.29	136.23	102.12	59.32	52.35	48.95	48.18	83.83
9	98.94	86.54	29.72	136.10	101.87	59.45	52.07	48.77	48.91	83.42
Average	98.93	86.50	29.51	136.17	102.00	59.39	52.23	48.86	48.55	83.63
Mine	97.21	85.53	29.16	136.09	101.87	58.32	51.05	48.60	48.18	82.63
Max	100.37	87.49	29.86	136.26	102.12	60.45	53.46	49.13	48.91	84.64

4.10. Sodium

In the samples of tap water and the desalination seawater company, the lowest value was measured as 15.9 mg/L and the highest value was 26.3 mg/L (Table 18).

Table 18. Na in T and D(mg/L)

Months	Sampling Points										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D
3	22.70	20.40	20.20	19.70	16.44	25.70	123.61	19.29	20.58	22.86	22.13
5	23.10	20.30	18.90	20.40	15.90	26.30	124.30	18.50	19.90	23.12	21.90
7	22.90	20.40	19.19	20.05	16.17	26.00	123.95	18.89	20.24	23.00	22.00
9	22.90	20.40	19.91	20.05	16.17	26.00	123.96	18.90	20.24	22.98	22.23
Average	22.90	20.38	19.55	20.05	16.17	26.00	123.96	18.90	20.24	22.99	22.07
Mine	22.70	20.30	18.90	19.70	15.90	25.70	123.61	18.50	19.90	22.86	21.90
Max	23.10	20.40	20.20	20.40	16.44	26.30	124.30	19.29	20.58	23.12	22.23

In the sea water was minimum 11150 mg/L and maximum 11160 mg/L, while underground water the lowest value was 74.31 mg/L and the highest value 451.13 mg/L (Table 19).

Table 19. Na in U and S (mg/L)

Months	Sampling Points										
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	S
3	74.31	224.82	233.49	291.17	451.13	149.10	166.00	108.77	150.28	227.34	11150.48
5	75.60	228.00	235.00	295.00	449.00	149.10	164.20	105.50	153.80	226.40	11160.00
7	74.95	226.41	234.24	293.00	450.10	150.00	165.10	107.13	152.04	226.87	11150.00
9	74.96	226.40	234.25	293.20	450.00	149.40	165.00	107.20	152.00	227.00	11159.52
Average	74.96	226.41	234.25	293.09	450.06	149.40	165.08	107.15	152.03	226.90	11155.00
Mine	74.31	224.82	233.49	291.17	449.00	149.10	164.20	105.50	150.28	226.40	11150.00
Max	75.60	228.00	235.00	295.00	451.13	150.00	166.00	108.77	153.80	227.34	11160.00

4.11. Potassium

In the samples of tap water and the desalination seawater company, the lowest value was measured as 0.9 mg/L and the highest value was 15.8 mg/L and in the sea water was minimum 500.5 mg/L and maximum 510.0 mg/L (Table 20).

Table 20. K in T, D and S (mg/L)

Months	Sampling Points											
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D	S
3	1.20	1.00	2.20	2.00	1.20	1.70	15.60	1.40	1.60	1.58	0.90	500.50
5	1.40	0.90	2.20	1.90	1.30	1.70	15.80	1.20	1.70	1.50	1.00	510.00
7	1.30	1.00	2.10	1.90	1.20	1.80	15.70	1.30	1.60	1.60	1.00	505.20
9	1.30	0.96	2.10	1.90	1.20	1.70	15.70	1.30	1.60	1.55	0.90	505.30
Average	1.30	0.97	2.15	1.93	1.23	1.73	15.70	1.30	1.63	1.56	0.95	505.25
Mine	1.20	0.90	2.10	1.90	1.20	1.70	15.60	1.20	1.60	1.50	0.90	500.50
Max	1.40	1.00	2.20	2.00	1.30	1.80	15.80	1.40	1.70	1.60	1.00	510.00

While underground water the lowest value was 19.9 mg/L and the highest value 85.0 mg/L (Table 21).

Table 21.K in U (mg/L)

Months	Sampling Points									
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
3	26.70	60.30	50.10	63.60	83.90	22.30	21.80	26.70	20.50	57.90
5	27.00	67.00	47.00	61.00	85.00	22.20	19.90	23.70	22.50	60.10
7	27.00	64.30	49.70	62.00	84.60	22.00	20.00	25.40	21.00	58.50
9	26.90	63.00	47.50	62.60	84.30	22.10	20.70	25.00	20.70	59.50
Average	26.90	63.65	48.58	62.30	84.45	22.15	20.60	25.20	21.18	59.00
Mine	26.70	60.30	47.00	61.00	83.90	22.00	19.90	23.70	20.50	57.90
Max	27.00	67.00	50.10	63.60	85.00	22.30	21.80	26.70	22.50	60.10

4.12. Ammonium

In the samples of tap water and the desalination seawater company, the lowest value was measured as 0.01 mg/L and the highest value was 0.05 mg/L and in the sea water was minimum 0.09 mg/L and maximum 0.10 mg/L (Table 22).

Table 22.NH₄ in T, D and S (mg/L)

Months	Sampling Points											
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D	S
3	0.02	0.02	0.01	0.03	0.01	0.02	0.02	0.01	0.03	0.01	0.01	0.10
5	0.01	0.01	0.02	0.01	0.03	0.03	0.05	0.01	0.02	0.01	0.01	0.09
7	0.02	0.01	0.02	0.02	0.03	0.02	0.04	0.01	0.02	0.02	0.02	0.10
9	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.01	0.02	0.01	0.01	0.09
Average	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.01	0.02	0.01	0.01	0.10
Mine	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.01	0.01	0.09
Max	0.02	0.02	0.02	0.03	0.03	0.03	0.05	0.01	0.03	0.02	0.02	0.10

While underground water the lowest value was 0.01 mg/L and the highest value 4.30 mg/L (Table 23).

Table 23.NH₄ in U (mg/L)

Months	Sampling Points									
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
3	4.00	3.40	3.20	2.20	4.10	0.20	0.01	0.10	0.50	0.04
5	4.20	3.20	3.10	2.00	4.30	0.24	0.01	0.10	0.60	0.03
7	4.10	3.20	3.10	2.00	4.20	0.20	0.01	0.09	0.55	0.04
9	4.10	3.26	3.10	2.10	4.20	0.21	0.01	0.09	0.55	0.03
Average	4.10	3.27	3.13	2.08	4.20	0.21	0.01	0.10	0.55	0.04
Mine	4.00	3.20	3.10	2.00	4.10	0.20	0.01	0.09	0.50	0.03
Max	4.20	3.40	3.20	2.20	4.30	0.24	0.01	0.10	0.60	0.04

4.13. Bicarbonate

In the samples of tap water and the desalination seawater company, the lowest value was measured as 12.11 mg/L and the highest value was 50.67 mg/L (Table 24).

Table 24.HCO₃ in T and D (mg/L)

Months	Sampling Points										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D
3	19.65	14.94	12.87	18.04	14.23	14.38	49.41	12.11	13.00	17.10	11.84
5	19.09	15.23	12.17	17.45	14.78	13.97	50.67	12.25	14.23	16.88	11.99
7	19.37	15.08	12.52	17.75	14.50	14.10	50.00	12.20	13.70	17.00	12.00
9	19.37	15.10	12.50	17.74	14.51	14.25	50.08	12.16	13.53	16.98	11.85
Average	19.37	15.09	12.52	17.75	14.51	14.18	50.04	12.18	13.62	16.99	11.92
Mine	19.09	14.94	12.17	17.45	14.23	13.97	49.41	12.11	13.00	16.88	11.84
Max	19.65	15.23	12.87	18.04	14.78	14.38	50.67	12.25	14.23	17.10	12.00

In the sea water was minimum 127.76 mg/L and maximum 128.67 mg/L, while underground water the lowest value was 85.34 mg/L and the highest value 128.21 mg/L (Table 25).

Table 25.HCO₃in U and S (mg/L)

Months	Sampling Points										
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	S
3	111.20	119.54	118.31	126.47	127.52	86.37	109.24	113.82	101.67	119.55	127.76
5	110.12	120.55	116.67	125.88	128.21	85.34	110.45	114.66	100.35	120.80	128.67
7	110.66	120.00	117.50	126.20	128.10	86.00	109.85	114.20	101.00	120.10	128.20
9	110.70	120.10	117.48	126.15	127.63	85.70	109.84	114.28	101.02	120.25	128.23
Average	110.67	120.05	117.49	126.18	127.87	85.85	109.85	114.24	101.01	120.18	128.22
Mine	110.12	119.54	116.67	125.88	127.52	85.34	109.24	113.82	100.35	119.55	127.76
Max	111.20	120.55	118.31	126.47	128.21	86.37	110.45	114.66	101.67	120.80	128.67

4.14. Sulphate

In the samples of tap water and the desalination seawater company, the lowest value was measured as 5.20 mg/L and the highest value was 150.83 mg/L and in the sea water was minimum 2492 mg/L and maximum 2500 mg/L (Table 26).

Table 26.SO₄in T, D and S (mg/L)

Months	Sampling Points											
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D	S
3	8.23	5.20	5.70	10.09	6.37	12.78	150.83	6.06	10.55	12.03	5.77	2492
5	8.11	5.25	5.65	10.23	6.44	12.90	150.32	6.09	10.80	11.78	5.54	2500
7	8.15	5.20	5.60	10.20	6.40	13.00	150.60	6.11	10.50	11.00	5.70	2496
9	8.19	5.21	5.65	10.12	6.41	12.88	150.55	6.08	10.75	11.25	5.61	2496
Average	8.17	5.22	5.65	10.16	6.41	12.89	150.58	6.09	10.65	11.52	5.66	2496
Mine	8.11	5.20	5.60	10.09	6.37	12.78	150.32	6.06	10.50	11.00	5.54	2492
Max	8.23	5.25	5.70	10.23	6.44	13.00	150.83	6.11	10.80	12.03	5.77	2500

While underground water the lowest value was 297 mg/L and the highest value 1739 mg/L (Table 27).

Table 27. SO₄ in U (mg/L)

Months	Sampling Points									
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
3	1123.00	1148.00	1077.00	1734.00	912.00	300.00	146.88	1088.00	445.00	703.55
5	1125.00	1145.00	1076.00	1739.00	912.00	297.00	147.00	1088.00	447.00	709.00
7	1125.00	1147.00	1077.00	1736.00	910.00	300.00	147.00	1090.00	447.00	705.00
9	1124.00	1146.00	1076.00	1737.00	911.00	299.00	146.96	1089.60	446.00	707.00
Average	1124.25	1146.50	1076.50	1736.50	911.25	299.00	146.96	1088.90	446.25	706.14
Mine	1123.00	1145.00	1076.00	1734.00	910.00	297.00	146.88	1088.00	445.00	703.55
Max	1125.00	1148.00	1077.00	1739.00	912.00	300.00	147.00	1090.00	447.00	709.00

4.15. Chloride

In the samples of tap water and the desalination seawater company, the lowest value was measured as 60.79 mg/L and the highest value was 148.18 mg/L and in the sea water was minimum 19753 mg/L and maximum 19800 mg/L (Table 28).

Table 28. Clin T, D and S (mg/L)

Months	Sampling Points											
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D	S
3	86.60	72.84	65.20	60.79	70.82	84.00	146.33	77.40	81.70	70.30	77.12	19753.00
5	87.22	73.44	65.23	61.90	72.51	83.56	148.18	79.12	80.64	69.99	76.90	19800.00
7	87.00	73.10	65.20	61.35	71.66	83.80	147.30	78.30	81.20	70.00	77.00	19776.00
9	86.82	73.18	65.21	61.34	71.67	83.76	147.21	78.22	81.14	70.29	77.02	19777.00
Average	86.91	73.14	65.21	61.35	71.67	83.78	147.26	78.26	81.17	70.15	77.01	19776.50
Mine	86.60	72.84	65.20	60.79	70.82	83.56	146.33	77.40	80.64	69.99	76.90	19753.00
Max	87.22	73.44	65.23	61.90	72.51	84.00	148.18	79.12	81.70	70.30	77.12	19800.00

While underground water the lowest value was 230.00 mg/L and the highest value 1160.32 mg/L (Table 29).

Table 29. Cl in U (mg/L)

Months	Sampling Points									
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
3	550.10	640.00	647.69	537.40	1158.47	230.00	432.18	488.65	542.34	687.86
5	540.56	640.89	650.21	539.77	1160.32	230.00	430.76	490.11	540.99	690.12
7	545.40	641.00	649.00	538.60	1159.40	231.00	431.00	489.30	541.65	690.00
9	545.26	640.11	648.90	538.57	1159.41	230.00	431.94	489.46	541.70	687.98
Average	545.33	640.50	648.95	538.59	1159.40	230.25	431.47	489.38	541.67	688.99
Mine	540.56	640.00	647.69	537.40	1158.47	230.00	430.76	488.65	540.99	687.86
Max	550.10	641.00	650.21	539.77	1160.32	231.00	432.18	490.11	542.34	690.12

4.16. Nitrate

In the samples of tap water and the desalination seawater company, the lowest value was measured as 0.6 mg/L and the highest value was 55.1 mg/L (Table 30).

Table 30. NO₃ in T and D (mg/L)

Months	Sampling Points										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D
3	1.00	1.00	1.30	2.10	1.40	2.30	55.10	0.90	1.60	2.20	0.70
5	1.00	0.90	1.40	2.10	1.40	2.20	54.00	0.70	1.60	2.30	0.60
7	0.90	1.00	1.40	2.00	1.30	2.20	54.50	0.80	1.70	2.30	0.70
9	0.96	0.96	1.37	2.10	1.40	2.20	54.60	0.80	1.60	2.20	0.60
Average	0.97	0.97	1.37	2.08	1.38	2.23	54.55	0.80	1.63	2.25	0.65
Mine	0.90	0.90	1.30	2.00	1.30	2.20	54.00	0.70	1.60	2.20	0.60
Max	1.00	1.00	1.40	2.10	1.40	2.30	55.10	0.90	1.70	2.30	0.70

In the sea water was minimum 10.50 mg/L and maximum 10.85 mg/L, while underground water the lowest value was 5.0 mg/L and the highest value 33.2 mg/L (Table 31).

Table 31. NO₃ in U and S (mg/L)

Months	Sampling Points										
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	S
3	5.00	14.10	11.80	10.88	41.00	33.20	37.70	7.70	26.00	27.60	10.85
5	5.10	14.40	11.50	11.10	41.80	33.00	37.90	7.90	25.34	27.60	10.67
7	5.10	14.30	11.80	11.00	41.50	33.00	37.70	7.80	25.70	27.50	10.50
9	5.05	14.20	11.70	10.98	41.40	33.00	37.90	7.80	25.65	27.50	10.68
Average	5.06	14.25	11.70	10.99	41.43	33.05	37.80	7.80	25.67	27.55	10.68
Mine	5.00	14.10	11.50	10.88	41.00	33.00	37.70	7.70	25.34	27.50	10.50
Max	5.10	14.40	11.80	11.10	41.80	33.20	37.90	7.90	26.00	27.60	10.85

4.17. Nitrite

In the samples of tap water and the desalination seawater company, the lowest value was measured as 0.01mg/L and the highest value was 1.00 mg/L and in the sea water was minimum 0.03mg/L and maximum 0.02 mg/L (Table 32).

Table 32. NO₂ in T, D and S (mg/L)

Months	Sampling Points											
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D	S
3	0.01	0.01	0.01	0.01	0.02	0.01	0.95	0.03	0.02	0.02	0.01	0.03
5	0.01	0.01	0.01	0.01	0.01	0.01	0.95	0.03	0.01	0.02	0.01	0.03
7	0.01	0.02	0.02	0.01	0.01	0.01	1.00	0.02	0.01	0.02	0.01	0.02
9	0.01	0.01	0.01	0.01	0.01	0.01	0.96	0.02	0.01	0.02	0.01	0.02
Average	0.01	0.01	0.01	0.01	0.01	0.01	0.97	0.03	0.01	0.02	0.01	0.03
Mine	0.01	0.01	0.01	0.01	0.01	0.01	0.95	0.02	0.01	0.02	0.01	0.02
Max	0.01	0.02	0.02	0.01	0.02	0.01	1.00	0.03	0.02	0.02	0.01	0.03

While underground water the lowest value was 0.02 mg/L and the highest value 0.78 mg/L (Table 33).

Table 33.NO₂ in U (mg/L)

Months	Sampling Points									
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
3	0.02	0.30	0.33	0.63	0.71	0.62	0.26	0.08	0.77	0.64
5	0.03	0.29	0.33	0.63	0.75	0.62	0.26	0.07	0.77	0.67
7	0.03	0.30	0.32	0.64	0.73	0.64	0.27	0.08	0.78	0.66
9	0.02	0.29	0.32	0.63	0.73	0.62	0.26	0.07	0.77	0.65
Average	0.03	0.3	0.33	0.63	0.73	0.63	0.26	0.08	0.77	0.66
Mine	0.02	0.29	0.32	0.63	0.71	0.62	0.26	0.07	0.77	0.64
Max	0.03	0.3	0.33	0.64	0.75	0.64	0.27	0.08	0.78	0.67

4.18. Phosphate

In the samples of tap water and the desalination seawater company, the lowest value was measured as 0.02 mg/L and the highest value was 0.87 mg/L (Table 34).

Table 34.PO₄in T and D (mg/L)

Months	Sampling Points										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D
3	0.03	0.10	0.07	0.02	0.10	0.09	0.87	0.05	0.08	0.04	0.02
5	0.03	0.11	0.07	0.02	0.10	0.09	0.87	0.05	0.08	0.03	0.02
7	0.02	0.11	0.06	0.03	0.11	0.10	0.86	0.05	0.08	0.03	0.02
9	0.02	0.10	0.06	0.02	0.10	0.09	0.86	0.05	0.08	0.03	0.02
Average	0.03	0.11	0.07	0.02	0.10	0.09	0.87	0.05	0.08	0.03	0.02
Mine	0.02	0.10	0.06	0.02	0.10	0.09	0.86	0.05	0.08	0.03	0.02
Max	0.03	0.11	0.07	0.03	0.11	0.10	0.87	0.05	0.08	0.04	0.02

In the sea water was minimum 0.48 mg/L and maximum 0.50 mg/L, while underground water the lowest value was 0.02 mg/L and the highest value 1.24 mg/L (Table 35).

Table 35.PO₄in U and S (mg/L)

Months	Sampling Points										
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	S
3	0.50	1.13	1.24	1.20	1.00	0.72	0.02	0.03	0.82	1.19	0.50
5	0.55	1.13	1.24	1.20	0.90	0.72	0.02	0.04	0.82	1.19	0.48
7	0.50	1.15	1.23	1.21	0.90	0.73	0.03	0.03	0.84	1.20	0.49
9	0.50	1.13	1.23	1.20	0.90	0.72	0.02	0.03	0.82	1.19	0.49
Average	0.51	1.14	1.24	1.20	0.93	0.72	0.02	0.03	0.83	1.19	0.49
Mine	0.50	1.13	1.23	1.20	0.90	0.72	0.02	0.03	0.82	1.19	0.48
Max	0.55	1.15	1.24	1.21	1.00	0.73	0.03	0.04	0.84	1.20	0.50

4.19. Iron

In the samples of tap water and the desalination seawater company, the lowest value was measured as 0.01mg/L and the highest value was 0.22mg/L and in the sea water was same value all time as 0.02 mg/L (Table 36).

Table 36. Fe in T, D and S (mg/L)

Months	Sampling Points											
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D	S
3	0.06	0.22	0.02	0.03	0.16	0.13	0.02	0.01	0.01	0.08	0.01	0.02
5	0.06	0.22	0.02	0.03	0.16	0.13	0.02	0.01	0.01	0.08	0.01	0.02
7	0.06	0.22	0.02	0.03	0.16	0.13	0.02	0.01	0.01	0.08	0.01	0.02
9	0.06	0.22	0.02	0.03	0.16	0.13	0.02	0.01	0.01	0.08	0.01	0.02
Average	0.06	0.22	0.02	0.03	0.16	0.13	0.02	0.01	0.01	0.08	0.01	0.02
Mine	0.06	0.22	0.02	0.03	0.16	0.13	0.02	0.01	0.01	0.08	0.01	0.02
Max	0.06	0.22	0.02	0.03	0.16	0.13	0.02	0.01	0.01	0.08	0.01	0.02

While underground water the lowest value was 0.01 mg/L and the highest value 1.78 mg/L (Table 37).

Table 37. Fe in U (mg/L)

Months	Sampling Points									
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
3	0.03	0.03	0.38	0.05	0.01	0.40	0.12	0.02	1.78	0.25
5	0.03	0.03	0.38	0.05	0.01	0.40	0.12	0.02	1.78	0.25
7	0.03	0.03	0.38	0.05	0.01	0.40	0.12	0.02	1.78	0.25
9	0.03	0.03	0.38	0.05	0.01	0.40	0.12	0.02	1.78	0.25
Average	0.03	0.03	0.38	0.05	0.01	0.40	0.12	0.02	1.78	0.25
Mine	0.03	0.03	0.38	0.05	0.01	0.40	0.12	0.02	1.78	0.25
Max	0.03	0.03	0.38	0.05	0.01	0.40	0.12	0.02	1.78	0.25

4.20. Copper

In the samples of tap water and the desalination seawater company, the lowest value was measured as 0.06mg/L and the highest value was 0.17 mg/L (Table 38).

Table 38. Cu in T and D (mg/L)

Months	Sampling Points										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D
3	0.07	0.08	0.10	0.10	0.09	0.07	0.10	0.14	0.10	0.13	0.17
5	0.08	0.08	0.11	0.10	0.08	0.07	0.11	0.14	0.09	0.14	0.17
7	0.06	0.07	0.10	0.11	0.10	0.07	0.11	0.13	0.09	0.15	0.16
9	0.07	0.08	0.10	0.10	0.09	0.07	0.10	0.13	0.09	0.14	0.16
Average	0.07	0.08	0.10	0.10	0.09	0.07	0.11	0.14	0.09	0.14	0.17
Mine	0.06	0.07	0.10	0.10	0.08	0.07	0.10	0.13	0.09	0.13	0.16
Max	0.08	0.08	0.11	0.11	0.10	0.07	0.11	0.14	0.10	0.15	0.17

In the sea water was minimum 0.09 mg/L and maximum 0.10 mg/L, while underground water the lowest value was 0.01 mg/L and the highest value 0.04 mg/L (Table 39).

Table 39. Cu in U and S (mg/L)

Months	Sampling Points										
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	S
3	0.03	0.01	0.02	0.02	0.04	0.01	0.01	0.01	0.02	0.02	0.10
5	0.02	0.03	0.01	0.04	0.01	0.01	0.02	0.01	0.03	0.01	0.09
7	0.03	0.02	0.02	0.03	0.02	0.02	0.01	0.01	0.03	0.02	0.09
9	0.02	0.02	0.01	0.03	0.03	0.01	0.01	0.01	0.02	0.01	0.09
Average	0.03	0.02	0.02	0.03	0.03	0.01	0.01	0.01	0.03	0.02	0.09
Mine	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.09
Max	0.03	0.03	0.02	0.04	0.04	0.02	0.02	0.01	0.03	0.02	0.10

4.21. Zinc

In the samples of tap water and the desalination seawater company, the lowest value was measured as 0.07mg/Land the highest value was 0.35 mg/L (Table 40).

Table 40. Zn in T and D (mg/L)

Months	Sampling Points										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D
3	0.35	0.08	0.11	0.11	0.35	0.17	0.05	0.25	0.07	0.18	0.07
5	0.35	0.07	0.11	0.12	0.36	0.17	0.04	0.27	0.08	0.17	0.07
7	0.34	0.08	0.10	0.12	0.35	0.18	0.04	0.26	0.08	0.17	0.08
9	0.34	0.08	0.10	0.11	0.35	0.17	0.04	0.26	0.07	0.17	0.07
Average	0.35	0.08	0.11	0.12	0.35	0.17	0.04	0.26	0.08	0.17	0.07
Mine	0.34	0.07	0.10	0.11	0.35	0.17	0.04	0.25	0.07	0.17	0.07
Max	0.35	0.08	0.11	0.12	0.36	0.18	0.05	0.27	0.08	0.18	0.08

In the sea water was minimum 0.07 mg/L and maximum 0.08 mg/L, while underground water the lowest value was 0.02 mg/L and the highest value 1.31 mg/L (Table 41).

Table 41. Zn in U and S (mg/L)

Months	Sampling Points										
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	S
3	0.02	1.30	0.04	0.02	0.02	0.07	0.01	0.01	0.75	0.24	0.08
5	0.03	1.31	0.04	0.01	0.02	0.08	0.01	0.01	0.74	0.26	0.07
7	0.03	1.30	0.05	0.02	0.02	0.07	0.02	0.02	0.75	0.25	0.08
9	0.02	1.30	0.04	0.01	0.02	0.07	0.01	0.01	0.74	0.25	0.07
Average	0.03	1.30	0.04	0.02	0.02	0.07	0.01	0.01	0.75	0.25	0.08
Mine	0.02	1.30	0.04	0.01	0.02	0.07	0.01	0.01	0.74	0.24	0.07
Max	0.03	1.31	0.05	0.02	0.02	0.08	0.02	0.02	0.75	0.26	0.08

4.22. Lead

In the samples of tap water and the desalination seawater company, the lowest value was measured as 0.01mg/L and the highest value was 0.05 mg/L (Table 42).

Table 42. Pb in T and D (mg/L)

Months	Sampling Points										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	D
3	0.02	0.01	0.01	0.03	0.04	0.03	0.02	0.03	0.02	0.04	0.04
5	0.02	0.01	0.02	0.03	0.04	0.02	0.01	0.03	0.02	0.04	0.05
7	0.02	0.01	0.02	0.03	0.03	0.02	0.03	0.02	0.03	0.03	0.04
9	0.02	0.01	0.01	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.04
Average	0.02	0.01	0.02	0.03	0.04	0.02	0.02	0.03	0.02	0.04	0.04
Mine	0.02	0.01	0.01	0.03	0.03	0.02	0.01	0.02	0.02	0.03	0.04
Max	0.02	0.01	0.02	0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.05

In the sea water the value was same all time as 0.03 mg/L, while underground water the lowest value was 0.03 mg/L and the highest value 0.10 mg/L (Table 43).

Table 43. Pb in U and S (mg/L)

Months	Sampling Points										
	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	S
3	0.04	0.04	0.10	0.06	0.06	0.10	0.04	0.03	0.09	0.09	0.03
5	0.04	0.05	0.09	0.06	0.07	0.09	0.04	0.03	0.09	0.08	0.03
7	0.03	0.04	0.07	0.07	0.06	0.10	0.03	0.04	0.10	0.09	0.03
9	0.03	0.04	0.08	0.06	0.06	0.09	0.03	0.03	0.09	0.08	0.03
Average	0.04	0.04	0.09	0.06	0.06	0.10	0.04	0.03	0.09	0.09	0.03
Mine	0.03	0.04	0.07	0.06	0.06	0.09	0.03	0.03	0.09	0.08	0.03
Max	0.04	0.05	0.10	0.07	0.07	0.10	0.04	0.04	0.10	0.09	0.03



5. DISCUSSION AND CONCLUSIONS

5.1. Discussion

The values derived from the analyzes are composed of tap water analyzes, underground water analyzes, water analyzes of the desalination company, and last but not least, sea water analyzes.

The study was conducted according to the study's objective, which was between the results of tap water analyzes and underground water analyzes. In addition, some comparisons was made of the values between sea water, underground water, tap water and desalination company water.

The mean values obtained from this study were evaluated according to LNCSM (Libyan National Center for Standardization and Metrology) (LNCSM, 2016), WHO (World Health Organization) (WHO, 2017), EEC (European Economic Community) (EEC, 2015) and TSE (Turk Standardlari Enstitusu) (TS 266, 2005), and the differences in our data were determined.

5.1.1. Coliform bacteria

The average coliform bacteria value was determined as 0 CFU/100 mL in tap water, and in underground water values were between 0 and 2000 CFU/100 mL in this study (Table 44). The tap water values was suitable, but underground water values is not suitable according to LNCSM, WHO, EEC, TSE.

5.1.2. EC

The EC depends on the total amount of dissolved matters in water and give an idea of the ionic richness of the water. Water with higher ionic concentration has also higher EC values (Şen and Aksoy, 2015). In drinking water EC rise in indicator of pollution or mixing of sea water (Çetinkaya, 2003).

The EC value in the tap water was determined as 351.47 ± 249.73 $\mu\text{s}/\text{cm}$, and in the underground water as 3689.81 ± 1339.54 $\mu\text{s}/\text{cm}$. When comparing the analyzes with the standard specifications of some local and international organizations, tap water is identical to WHO and TSE, they are considered to be suitable drinking water according to the above

mentioned organizations (WHO and TSE). For underground water, some differences were found with standard specifications, and therefore are not suitable for use in drinking water or this waters should be refined. The EC values was reported by (Çavuş et al., 2017) as 578.7 $\mu\text{s}/\text{cm}$ in van (Turkey) drinking waters and (Atici et al., 2016) as 313.0 $\mu\text{s}/\text{cm}$ in Ercis (Turkey) drinking waters. These values are similar to our water values, but different to underground waters.

5.1.3.pH

Chemical reaction and most of biological activities are controlled with pH (Tebtent, 1998). The higher the pH increases the toxic the effect of ammonia is (Çetinkaya, 2003).

The average pH value in the tap water was determined as 7.43 ± 0.18 , and in the underground water values were determined as 7.37 ± 0.26 . When comparing the analyzes with the standard specifications of some local and international organizations, tap water is identical to LNCSM, WHO, EEC and TSE, they are considered to be suitable drinking water according to the above mentioned organizations. For underground water it has also been found to conform to standard specifications. The pH value in Bulakbasisteam (Turkey) was found as 8.23 (Şen and Aksoy, 2015), as 6.95 in Ercis (Turkey) drinking waters (Atici et al., 2016) and as 7.43 in van drinking waters in Turkey (Çavuş et al., 2017).

5.1.4.DO

The amount of DO in natural waters is an indicator of whether the water sources healthy. Oxygen saturated waters have a good taste. Therefore waters should be ventilated (Tebbut, 1998; Çetinkaya, 2003).

The average DO value in the tap water was determined as 7.89 ± 0.36 mg/L, and in the underground water as 5.48 ± 1.35 mg/L. The result of tap water DO value is identical toWHO.For underground water it has also been found to conform to standard specifications. The value was determined as 12.9 mg/L (Şen and Aksoy, 2015), as 10.86 mg/L (Bulum, 2015), as 8.83 mg/L (Bayram, 2016), as 10.06 mg/L (Seyhan, 2016), as 7.0 mg/L (Atici et al., 2016) and as 5.61 mg/L (Çavuş et al., 2017).

5.1.5.TDS

The average TDS value in the tap water was determined as 196.93 ± 135.08 mg/L, and in the underground water values as 2380.44 ± 859.66 mg/L. When comparing the analyzes with the standard specifications of some local and international organizations, it was reported that the maximum limit of LNCSM 500 mg/L, WHO 1000 mg/L. Thus, the result of tap water is identical to LNCSM and WHO, they are considered to be suitable drinking water according to the above mentioned organizations. For underground water, some differences were found with standard specifications, and therefore are not suitable for use in drinking water. So, it have to be refined.

5.1.6.Salinity

The average salinity value in the tap water was determined as $\text{‰}0.14 \pm 0.04$ ppt and in the underground water values were determined as $\text{‰}1.04 \pm 0.40$ ppt. WHO is notified as $\text{‰}0.5$ the value. Thus, the result of tap water is suitable for drinking to WHO. Underground water was found higher than WHO value, so underground water is not suitable, it is purified for drinking.

5.1.7.Total hardness, Ca and Mg

In TH, Ca and Mg is very important. TH is important criteria in drinking waters. In terms of human health, they have important functions besides forming kidney stones. They prevent the infract and blood coagulation, also strengthen immune system, teeth and bone structure (Çetinkaya, 2003; Atabey, 2015). In this study average TH, Ca and Mg values were determined as 94.44 ± 30.88 CaCO₃mg/L, 25.72 ± 4.82 mg/L, 7.38 ± 6.48 mg/L in tap waters, respectively. These values were found in underground water sample as 1416.74 ± 565.12 CaCO₃mg/L, 444.35 ± 203.42 mg/L and 74.57 ± 31.15 mg/L, respectively (Table 44). The tap waters samples were suitable for drinking according to LNCSM, WHO and TSE, but underground water samples found not suitable for drinking.

5.1.8.Na

The average Na value in the tap water was determined as 31.11 ± 31.44 mg/L, and in the underground water values were determined as 207.93 ± 103.03 mg/L. The maximum

permissible Na value was reported as 200 mg/L by LNCSM and WHO, as between 75-150 mg/L by EEC and as 175 mg/L by TSE. Our result of tap waters is appropriate for drinking according to these organization. But underground waters average value was found abit above these values.

5.1.9.K

The lack of K in drinking water can cause anorexia, nausea, vomiting and digestive system problems (Atabey, 2015).

The average Kvalue in the tap water was determined as 2.95 ± 4.31 mg/L, and in the underground water values as 43.40 ± 22.19 mg/L. The maximum standard specifications were declared by LNCSM, EEC and TSEas 12 mg/L and by WHO as 5 mg/L, the result obtained from tap water is suitable for drinking, but underground water value is appropriate for drinking. The K value reported as 4.84 mg/L (Çavuş et al., 2017) and 4.4 mg/L (Atici et al., 2016).

5.1.10.NH₄

Ammonium and Ammonia can convert into water one other. Ammonium is dangerous because of organic based and toxic to all living organism. It impairs the taste of water and causes bad smelling problems. If there is ammonium in water, it indicates that there may be an infiltration of waste water (Çetinkaya, 2003).

The average NH₄value in the tap water was determined as 0.01 ± 0.009 mg/L, and in the underground water 1.77 ± 1.70 mg/L. The value was reported as 1.5 mg/LWHO and by EEC and TSE as 0.5 mg/L. Our tap water value is suitable for drinking according to these organization, but the underground water is not (Table 44).

5.1.11. NO₃ and NO₂

Nitrate and nitrite are produced by nitrification and de-nitrification processes that occurs after decomposition of nitrogenous substances by loacteria in natural waters. If there is excessively nitrate, algae and aquatic plants increase. As a result of this situation, DO decrease in the water. Nitrite arises in water which has low DO and more organic matter problem. The presence of NO₃ in water absolutely undesirable. It is toxic to all organisms (Çetinkaya, 2003). In this study, the tap water values was found as 6.82 ± 16.12 mg/L NO₃

and 0.11 ± 0.28 mg/L NO_2 . In the underground waters, NO_3 was determined as 21.53 ± 12.67 mg/L and NO_2 as 0.44 ± 0.26 mg/L. while maximum permissible NO_3 values was reported as 45 mg/L by LNCSM and 50 mg/L by WHO, EEC and TSE, maximum value for NO_2 was notified as 3 mg/L by LNCSM and WHO, as 0.1 mg/L by EEC and 0.5 mg/L by TSE. In terms of NO_3 and NO_2 our values of tap and underground waters are suitable for drinking (Table 44). It is known that if there is more than 50 mg/L of NO_3 in drinking water of the infants, it may cause cyanosis disease made the weakness, and also excessive NO_2 may cause blue body disease. It is both carcinogenic to itself and effective in formation carcinogenic nitrosamines (Atabey, 2015).

5.1.12. HCO_3

CO_3 and HCO_3 are the main components in formation of alkalinity. Alkalinity has important impact on buffering capacity of water (Çetinkaya, 2003).

The average HCO_3 value in the tap water was determined as 18.62 ± 10.83 mg/L, and in the underground water values were determined as 113.34 ± 12.04 mg/L. WHO has reported the maximum value for drinking water as 50 mg/L (Table 44). And our value of tap water is suitable, but is not appropriate in underground value.

5.1.13. SO_4

Sulphate are major pollutants due to taste, smell, toxicity and corrosions (Şen and Aksoy, 2015).

The average SO_4 value in the tap water was determined as 22.73 ± 43.23 mg/L, and in the underground water values as 868.22 ± 457.35 mg/L. Some local and international organizations such as LNCSM, WHO, EEC and TSE maximum permissible SO_4 value is reported as 250 mg/L, tap water is suitable for drinking according to the LNCSM, WHO, EEC and TSE, but the underground water is not proportionate to use as drinking water (Table 44). The Sulphate value were reported as 57.12 mg/L in Bulakbası stream, Turkey (Şen and Aksoy, 2015), as 28.7 mg/L in van drinking waters (Çavuş et al., 2017), as 5.94 mg/L in Ercis drinking waters, Turkey (Atici et al., 2016).

5.1.14. Cl

Chlorine is not present in natural waters as gaseous, but from of chloride or salt. Chlorine is one of the important indicators a healthy drinking water (Çetinkaya, 2003). It also may be an indicator of sewage mixture and taste threshold value is between 250-500 mg/l. the contrition of higher than 250 mg/l generates a bitter taste (Tebbut, 1998).

The average Cl value in the tap water was determined as 81.88 ± 23.39 mg/L, and in the underground water as 591.45 ± 229.08 mg/L (Table 44).LNCSM, WHO and EEC have permitted until 250 mg/L, tap water is suitable but underground water is not for drinking according to these organizations.

5.1.15. PO₄

Phosphorus has a role in energy transfer and due to there is in nucleic acid, it is required for a symptom of pollution (Çetinkaya, 2003). There is in the structure of proteins and enzymes and conducts their activities (Atabey, 2015).

The average PO₄value of tap water was determined as 0.14 ± 0.24 mg/L, and underground water as 0.78 ± 0.44 mg/L. Our values both tap and underground waters are comply with WHO 3 mg/L value. PO₄ value was reported as 0.23 mg/L (Şen and Aksoy, 2015), as 0.51 mg/L (Atici et al., 2016), as 0.17 mg/L (Çavuş et al., 2017).

5.1.16. Fe

The iron function the metabolism, transport of oxygen and electron in the body. Iron deficiency may cause fatigue, shortness of breath, jaundice, headache, anemia, sleep irregularity, quick nail breaks and hair loss. The presence of excessive iron in water gives a metallic taste to the water, and in human body, it cause liver failure, stomach cramps, dizziness and vomiting (Atabey, 2015).

The average Fe value in the tap water was determined as 0.07 ± 0.07 mg/L, and in the underground water values as 0.31 ± 0.51 mg/L. It has been reported that the maximum standard specifications LNCSM and WHO 0.3 mg/L, and EEC and TSE 0.2 mg/L (Table 44). Our result obtained from tap water is suitable, and from underground waters are in upper limits. In Bulakbasi stream, Turkey it was reported 0.01mg/L (Şen and Aksoy, 2015),

as 0.01 mg/L in drinking water of Ercis Turkey (Atici et al., 2016) and as 0.015 mg/L in van drinking water, Turkey (Çavuş et al., 2017).

5.1.17. Cu

Copper cause the taste problems in water it may lead to anemia, eczema, it is deficiency and excessive amount may lead liver and kidney damage (Atabey, 2015).

The average Cu value in the tap water was determined as 0.09 ± 0.02 mg/L, and in the underground water values as 0.02 ± 0.009 mg/L. It has been found that the maximum standard specifications for some local and international organizations such as LNCSM 1 mg/L, and WHO and EEC 2 mg/L (Table 44). The result obtained from tap and underground water is suitable for drinking according to these organizations.

5.1.18. Zn

The presence of zinc is required in water for human about 6-15 mg/day. It is deficiency may cause the dwarfism, skin and hair problem, fatigue, diarrhea, anorexia, learning disorder. If there are over 3 mg/L in water, it may negative effect on our health. Excess of zinc in water, may cause vascular problems and anoxia (Atabey, 2015).

The average Zn value in the tap water was determined as 0.17 ± 0.10 mg/L, and in the underground water values as 0.25 ± 0.41 mg/L. LNCSM and WHO granted maximum up to 3 mg/L. Our tap and underground water samples zinc values were found suitable with these organization for drinking (Table 44). It was reported as 0.169 mg/L in Bulakbası stream, Turkey (Şen and Aksoy, 2015), 0.01 mg/L in Ercis drinking waters (Atici et al., 2016) and 0.163 mg/L in van drinking waters (Çavuş et al., 2017).

5.1.19. Pb

The lead (Pb) is highly poisonous metal. It enters to red blood cells firstly, after it accumulate in hard tissues such as bones and teeth. In the red blood cells, it cause anemia faling the place of iron, also it may cause hearing impairment, stomach aches, kidney and brain inflammation, in fertility and cancer (Atabey, 2015). In this study, Pb was determined as 0.02 ± 0.008 mg/l in tap water and as 0.06 ± 0.02 mg/l in underground water (Table 44). The maximum standard specifications was reported as 0.005 mg/L by LNCSM, and as 0.01

mg/L by WHO and EEC. Our tap and underground water samples lead (Pb) values were found not suitable according to these organization.

To compare all of our data with the highest permissible values recommended by national and international organization such as LNCSM, WHO, EEC and TSE. The tap water is identical with the desalination water in full match with the observation that there are some tests difference in the values but in general and according to the approved standards mentioned above, to drink, keep in mind that lead analysis has a slight increase. As for the comparison of tap water with underground water, there is a difference in the values of some analyzes, despite their conformity with the standards in some analyzes, but generally cannot be exploited as drinking water.

It is very clear that when comparing seawater with tap water, there is a total difference to fit with standard drinking standards. When comparing desalinated seawater with sea water, we find a huge difference in values, but the purpose of this comparison is to explain the quality of seawater desalination and the extent of utilization of seawater as one of solutions to the problem of water shortage in the world.

Table 44. All parameter compares standard specifications

PARAMETER	UNIT	T	U	D	S	LNCSM	WHO	EEC	TSE
Coliform Bacteria	CFU/100 ml	0	0-2000	0	0	0	0	0	-
EC	µs/cm	351.47	3689.81	261.22	56206	-	1500	-	2500
PH	-	7.43	7.37	7.52	7.13	6.5-8.5	6.5-8.5	6.5-9.5	6.5-9.5
DO	mg/L	7.89	5.48	7.86	7.625	-	>3	-	-
TDS	mg/L	196.93	2380.44	150.20	35841	500	1500	-	2500
Salinity	ppt	0.14	1.04	0.14	34.76	-	0.5	-	-
Total Hardness	mg/L	94.44	1416.74	79.515	6775.24	200	500	-	-
Calcium	mg/L	25.72	444.35	18.02	540.60	-	300	-	200
Magnesium	mg/L	7.38	74.57	8.36	1317.16	-	50	-	50
Sodium	mg/L	31.11	207.93	22.07	11155	200	200	150	175
Potassium	mg/L	2.95	43.40	0.95	505.25	12	5	12	12
Ammonium	mg/L	0.01	1.77	0.01	0.095	-	1.5	0.5	0.5
Bicarbonate	mg/L	18.62	113.34	11.92	128.22	-	50	-	-
Sulphate	mg/L	22.73	868.22	5.66	2496	250	250	250	250
Chloride	mg/L	81.88	591.45	77.01	19776.50	250	250	250	-
Nitrate	mg/L	6.82	21.53	0.65	10.68	45	50	50	50
Nitrite	mg/L	0.11	0.44	0.01	0.03	3	3	0.1	0.5
Phosphate	mg/L	0.14	0.78	0.01	0.49	-	3	-	-
Iron	mg/L	0.07	0.31	0.01	0.02	0.3	0.3	0.2	0.2
Copper	mg/L	0.09	0.02	0.17	0.09	1	2	2	-
Zinc	mg/L	0.17	0.25	0.07	0.08	3.0	3.0	-	-
Lead	mg/L	0.02	0.06	0.04	0.03	0.005	0.01	0.01	-

5.2. Conclusions

The studies and tests obtained have shown many important points that must be mentioned both at the level of local or on the international level and multi-faceted was the study in more than one subject, but all of the same address where it was clarified the issue of water shortage in the world and proposed ways to mitigate this disaster orientation the definition desalinate sea water as one of the solutions used to provide drinking water for human and laboratory study of water in the study area to demonstrate their advantages and disadvantages without neutral.

Drinking water is not available to meet our growing needs, and it is expected that it will not be available even to our thirst in the future. Our planet is covered with water and it is not suitable for use and drinking, but thanks to advanced technology, this process has facilitated the drinking of seawater, but as everything in the world has the Positives and Negatives, this process also has.

Laboratory tests and analyzes led to the clarification and simplification of the comparison between the tap water used by people in the study area and underground water for human use, and found many differences and obvious differences with the specifications of tap water and underground water. This variation leads to the fact that tap water is suitable for drinking and human use, unlike the underground water, which should not be used as drinking water but can be used for other purposes that benefit people. If the need for drinking is needed, it needs some adjustment and purification to suit the purpose of use.

In terms of tap water we find that the general water rate is suitable according to the standard specifications, with the precautionary precautions to be taken in some places of sampling, we found that there are some tests are higher in values compared to their counterparts in other tap water, although still under the standards of the organizations Local and international.

As for the underground water they all do not fit in total with the standard specifications, with a clear contrast between the values when compared to each other.

These reasons lead to the exploitation of that sea water desalination, in the existing circumstances available in the study area, is the most suitable and more useful to meet the need for community drinking water.



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APPANDIX

EXPANDED TURKISH SUMMARY

(GENİŞLETİLMİŞ TÜRKÇE ÖZET)

SU SIKINTISI NEDENİYLE ZUWARAH (LİBYA) ŞEHRİNDE KULLANILAN YER ALTI SULARI İLE DENİZ SUYUNUN DESANİLAZASYONU İLE ELDE EDİLEN SULARIN KARŞILAŞTIRILMASI

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Tez Danışmanı: Prof. Dr. Fazıl ŞEN

Su hayatın kaynağıdır. Su yoksa hayat da yoktur. Dünyayı 2-3 kez kaplamasına rağmen, kullanılabilir su oldukça kısıtlıdır. Dünyadaki suyun %3'ü tatlısudur ve bu suyun da sadece %1 (%0.03'ü)'i kullanılabilir tatlısu durumundadır. Üstelik insanoğlu bu kıt kaynağı elinden geldiği kadar hor kullanmaktadır.

21. Yüzyılda dünya su krizleriyle karşı karşıya gelmeye başlamıştır. Bu nedenle son yıllarda suların iyi yönetilmesi için çeşitli stratejiler geliştirmeye ve suyun kullanımını iyileştirme çabaları artmıştır. Çünkü insanların %80'i su kıtlığı ile karşı karşıya gelmektedir. Türkiye de nüfus artışı, küresel ısınma ve suların kirletilmesi gibi nedenlerle su sıkıntısı çekmeye başlayan ülkeler arasındadır.

Libya su varlığı açısından ciddi problemleri olan bir konumda yerleşmiştir. Türkiye'de kişi başına yıllık 1570 m³civarında su düşerken, bu miktar Libya'da sadece 104 m³ tür. Bu nedenle Libya'da içme amaçlı ortalama günlük su üretimi 190.000 m³/gün olan 20 kadar deniz suyundan arıtma yoluyla tatlısu elde edilen tesisler kurulmuştur. Dünya'da da deniz suyunun arıtılması yolu son yıllarda bir çözüm yolu olarak ön plana çıkmaktadır.

Bu çalışmada su kalite kriterlerinin incelenmesi, deniz suyundan arıtma yoluyla içme suyu temini, dünyada giderek artan miktarlarda temiz su ihtiyaçları gibi konularda farklı çalışmalar incelenmiştir.

Bu çalışma Dünya ve Libya'daki su sıkıntısı nedeniyle deniz suyundan arıtma yoluyla ve kuyulardan elde edilen suların mevcut durumlarının gözden geçirilmesi ve mevcut sorunlara çözüm yollarının gözden geçirilmesi amacıyla yapılmıştır.

Çalışmanın yapıldığı Zuwarah, Libya'nın kuzeybatısında Trablus'a 102 km, Tunus sınırına 60 km mesafede olan, 80.000 nüfuslu bir şehirdir. Zuwarah deniz suyu arıtma tesisleri şehrin 9 km doğusundadır. Şehrin içme suyu genellikle denizden su arıtma yoluyla elde edilmektedir. Ancak şehrin farklı bölgelerinde açılmış olan kuyulardan da içme suyu elde edilmektedir.

Çalışma, biri deniz suyu, 1 tanesi arıtma tesisi, 10 tanesi yeraltı suyu ve 10 tanesi de şehrin farklı yerlerinden olmak üzere toplam 22 örnekleme noktasında, Mart-Eylül 2017 arasında yürütülmüştür. Örnekleme yerleri seçilirken yerleşim yerleri, atıksu deşarj bölgeleri, diğer su kullanım ihtiyaçları göz önüne alınarak belirlenmiştir.

Örnekler yarımşar litrelik ikişer adet plastik şişeye alınmış ve analiz edilinceye kadar +4°C'de buzdolabında muhafaza edilmiştir.

Bu tez çalışmasında da pH, elektriksel iletkenlik, çözünmüş oksijen ve tuzluluk multimetre ile yerinde ölçümlerle, kalsiyum, magnezyum, toplam sertlik, klor ve bikarbonat titrimetrik analizlerle, nitrit, nitrat, amonyum, sülfat, potasyum, sodyum, demir, bakır, kurşun ve çinko ise spektrofotometre ile Golteman ve ark. (1978) ve Greenberg ve ark. (1992)'ya göre analiz edilmiştir. Toplam koliform analizleri ise USEPA membran filtrasyon metodu ile yapılmıştır. Elde edilen parametrelerin değerlendirilmesinde Yıldızve ark. (2011)'de verilen istatistik yöntemler Microsoft Excell 2007 programı kullanılarak analiz edilmiştir.

Yapılan koliform analizleri sonucunda özellikle kuyu sularının büyük bir kısmında bulaşma tespit edilmiş, ancak musluk sularında, deniz suyu ve deniz suyundan arıtılmış sulara herhangi bir bulaşmaya rastlanılmamıştır.

Elektriksel iletkenlik musluk sularında 204.23-1093.67 $\mu\text{s}/\text{cm}$ arasında; kuyu sularında 1412.51-5501.38 $\mu\text{s}/\text{cm}$ arasında bulunmuştur.

pH musluk sularında 7.12-7.85, kuyu sularında 7.13-8.10; çözünmüş oksijen musluk sularında 7.20-8.38 mg/L iken, kuyu sularında 3.79-7.65 mg/L; TDS musluk sularında

121.18-616.57 mg/L, kuyu sularında 941.06-3644.18 mg/L; tuzluluk %0.11-0.26 ve 0.40-2.04 arasında belirlenmiştir.

Titrimetrik analizler sonucu musluk sularında ve kuyu sularında belirlenen sırasıyla en düşük ve en yüksek değerler Ca için 16.03-32.06 mg/L ve 64.12-625.19 mg/L; Mg için 2.28-27.57 mg/L ve 29.16-136.26 mg/L; toplam sertlik için 70.06-183.65 mg/L ve 400.36-2091.76 mg/L; klor için 65.20-148.18 mg/L ve 230.00-1160.32 mg/L olarak belirlenmiştir.

Çalışma boyunca en düşük ve en yüksek değerler 15.9-451.13 mg/L Na; 0.9-85.0 mg/L K; 0.01-4.30 mg/L NH₄; 12.11-128.11 mg/L HCO₃; 5.2-1739.0 mg/L SO₄; 0.7-55.0 mg/L NO₃; 0.01-1.00 mg/L NO₂; 0.02-1.24 mg/L PO₄; 0.01-1.78 mg/L Fe; 0.01-0.17 mg/L Cu; 0.04-1.31 mg/L Zn; 0.01-0.1 mg/L Pb olarak belirlenmiştir.

Bu çalışmadan elde edilen veriler Libya Standartları ve Meteoroloji Merkezi (LNCSM), Dünya Sağlık Örgütü (WHO), Avrupa Birliği Standartları Komisyonu (EEC) ve Türk Standartları Enstitüsü (TSE) standartlarına göre ve Van Gölü Hazvazsında yapılmış bazı çalışmalar dikkate alınarak değerlendirilmiş ve uygunluğu hakkında karar verilmiştir.

Tüm parametreler ve örneklerin alındığı yerler dikkate alındığında kuyu sularının içme suları standartlarına birçok parametre açısından uymadığı belirlenmiş ve mevcut şartlar altında çok iyi arıtma ve dezenfeksiyon yapılmadıkça kullanılmaması gerektiği düşüncesi oluşmuştur.

Deniz suyundan arıtılarak kullanılan suların kuyu sularına göre içme ve kullanma açısından daha elverişli olduğu ve Libya, WHO, Avrupa Komisyonu ve TSE'ye göre uygun sayılabilecek kriterlere sahip olduğu görülmüştür.

Ancak bütün içme sularının kurşun açısından problemli olduğu belirlenmiştir.



CURRICULUM VITAE

Haidir Farhat SUBKA was born in Tarabulus capital of Libya in 1987. He completed primary and secondary school in Zuwarah city in west of Libya. He was graduated from Environmental and Water Resources Division, Architecture And Construction Engineering Major, Faculty of Engineering Technology, Zuwarah, in 2008. He was registered for Master of Science program in Department of Fisheries Engineering, Van Yüzüncü Yıl University Turkey in 2015.

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