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Using Treated Waste Water in Northern Cyprus Concrete industry for Saving the Natural Water Resources

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ABSTRACT: *The construction industry appears to be responsible for the consumption of huge amount of fresh water. Approximately 150 liters water is required for 1m3 of concrete without considering other applications of water at the concrete industry. The mixing of water which is fit for drinking purpose is fit for concreting, but about 97 percent of water is held in the oceans, while only 3 percent is fresh water. The concrete industry has serious impact on the environment with regard to consumption of water. Nowadays, The architectures and engineers consider to minimize the damaging of the environment and saving the natural resources for the future generations. In the water consumption is the one of the important key for humans, according to the concrete industry has to be found the alternative ways to save our natural water. This research is invvestigated the effects of using treated water in cvoncrete and also show the way to use treatec water in concrete for northern cyprus concrete industry when establishing sustainable construction strategies for improving the sustainable development.*

Keywords*: natural water, treated water, concrete industry & sustainable development*

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I. INTRODUCTION

Water consumption is critical considering the never decreasing demand on water due to industrilization and global population growth where fresh water consumption demand is increasing significantly where the various effluents are disposed and generated in order to protect the enviroment by not endangering the enviroment [1]. Therefore the envorement is not endangered if the well treated effuluents are used in making concrete. On the otherhand using those effluents is a great advantage on demanding of using fresh water in generating concretes. In addition, using effluents in generating concretes will effect conservation of human health and the enviroment in a positive way [2] . Nature itself withing everyliving organism depends and evolves arround water. Thus it makes usage of waste water production unavoidable depending on the demands of domestic, agricultural and industrial purposes [3]. Production of waste water is a great opportunity in some parts of the World where the supply of water is disappointingly insufficient [4]. On the other hand, the resource that is possible to create by the reuse of effluents can satisfy the industrial water consumption demands in an acceptable manner of practice[5].

Besides the demand of water, concrete is one of the most demanded material worldwide where the industries of concrete depends on not impairing their societal and enviromental responsibilities to assist a sustainable development without endangering the enviroment considering the fact of generating air pollution within enourmously used natural materials such as water. The technology in this era makes production of cement available and effective. However, many CO_2 and other green-house gasses are released in to atmosphere in and every production of cement where those chemicals are surely effecting the global warming via air pollution. The cement industry estimated to be producing about 1.4 billion ton of CO_2 in 1995 is reffered to be equal to the emmision of CO_2 gas as equivalent as to the 300 milion automobiles which significantly indicates the air pollution in 7% worldwide by the production of CO_2 via production of cement [5,6]. On the other half annualy the concrete indsutry demands and consumes no less than one billion tons of mixing water and vast of water is not only used in producing, the fresh water is also used for curing concrete and ready concrete. More over the vast quantity of water is used to clean truck mixers, concrete pumps , other equipments and for aggregation [5] . In general, the demand of usage of cement via construction activities leads an enourmous amount of water demand whereas these significant demands allows dangering enviroment considering global warming therefore, an additional resource is sought to be generated in order to not to endanger enviroment in which reuse of water will make a great significance in the industry of cement [7,8].

According to the previous studies in which reported that usage of waste water in the concrete industry leads a possible future to a declaration of waste watar reusage in cocnrete and in the concrete industry[9]. There

are various studies that indicates the advantage utilizing the wastewater usage in the concrete mixtures in lab scales where the waste water is tested and evaluated in considering variety of different waste water types as raw sewage ,treated wastewater [10-13]. In addition evaluated the tests on preliminary treated waste water, secondary treated waste water and finally on tertiary treated waste water leads to conclusion that the usage of waste water in concretes satisfies the codes and the standards of generating concretes [8]. Briefly the lab scale experiments of three types of treated waste water within the treated effluents makes it possible in producing concrete matching the building concrete codes and requirements [14]. The significance of the increasing population growth with the increasing demand on the concrete makes it unavoidable to figure and to provide a sustainable and environmental friendly concrete production in which brings effective advantages on usage of concrete considering the endless population growth effecting the resources of water via taking significance on the risks of scarcity of water [15] . World population doubled in between the dates of 1956 to 1999, where it indicated a growth of from three billion to six billion. United States Census Bureau indicated that the future world population by 2043 indicates to become nine billion which is a possible increase of 50% related to 1999 [16] . Therefore the vast demand of water will lead to a new method of recycling and conservation of water as in to satisfy the need for water in world.

Scarcity of water is the possible greatest envorimental risk and a problem in many countries [15]. Considering the account for the freshwater, it is only 2.5% of the Earths water in which most of the water is frozen either in glaciers or in ice caps [16]. The following remaing fresh water that is unfrozen may be mainly found as a groundwater resource and within presenting a small amount of fraction above the ground and or in the air [17].

Estimatedly, in U.S the consumption of fresh water points to 15,000 m3 /s (340,000 mgd) and considering the consumption only 29% is consumpted yet the remaining 71% is directed back to the natüre where these amounts indicates to 10,600 m^3 /s (240,000 mgd) in which 14% is used only in domestic and commercial water[18]. On the other hand in Middle East, an individiual consumption varies from less than 50 m^3 up to 100.00 m^3 per year in the areas where there is humid and the area is population is not dense [16-17]. World wide the construction industry by itself consumes more than over one trillion gallons of water per year without any usage of wash or curing water. Lastly this research aims to highlight the objectives in consideration to state the current knowledge of the usage of wastewater in the industry of producing concrete following by highlighting the performance of water from different stages of sewage treatment plant in producing concrete.

1. Previous Research To Reuse Wastewater In Concrete

The demand on concrete is immense in which it is one of the mostly needed material in construction. Morelikely, usage of concrete can be referred as second to water in demanding of usage. Worldwide concrete use per year is estimated as 5 billion cubic yards. Therefore the more concrete demand leads to the more water resource demand due to manufacturing and curing of concretes. Accordingly to the provision of IS 10262–2009, indicates that 1 m3 of concrete leads to a demand of 1861 litres water on that account 1 m3 of concrete demands 150 litres of water [20].In producing concrete with an acceptable quality including the required spesifications, due to strengthening the concrete, water is a major material that plays a crucial role in generating the concrete. Since the water is being used long before in the history as a construction material, water still takes the lead on importance in the construction. Henceforth, considering the demand on water leads to the consideration of scarce on water resources. More over, according to the predictions of the United Nations (UN) and World Metrological Organization (WMO), in 2025 half of the human will be facing scarce of water and will live in locations that fresh water is no longer enough. However, In this era of construction fresh water is almost available and easy to provide everywhere across the globe in which concrete industry demands on water is immense and concrete industry uses the resources of water freely [16-18]. On the contrast of the immense usage of fresh water, there is a potential scarce of water. There is a change of situation in freshwater where it is only available on Earths water in 2.5% in which main part of this water is frozen in a glacier and in ice caps. Considering the rest of the remaing fresh water that is not frozen are found as ground water where minority part of the water presents as a surface water and-or in the air [19].The cycle of population growth obviously required an immense demand for concrete due to be used in the infrastructure industry where reffered to a great increase in the usage of fresh water in order to manufacture concrete [16,17]. Accordingly to the increase of demand on usage of water, considering the immense need of one trillion gallons of water is demanded to manufacture and to cure the concrete per year leads to consideration of prevailing conditions of potable fresh water resources and to the possible scarce of fresh water resources [18,19]. Therefore, it is crucially important to aim to reduce water's consumption within preventing to waste the water in all possible sectors such as: construction and infrastructure indurtries. Thus, in order to confront this dilemma, variety of alternatives may applied [17,19].Firstly, in order to save or to reduce the usage of fresh water treatment of waste water may be applied. However, people may not feel comfortable to accept it as a drinking water but on contrast by treating the waste water an enermous amount of water is possible to provide and satisfy the demand of the construction industry.In

genereal, if a water is suitable for human consumption it leads to an acceptance where it is also suitable to use in construction due to curing and mixing [20]. However, accordingly to the concrete technology literatüre, many variable tests have been conducted and succeed in resultts of using treated waste water. Despite of the little experimental evidence of treated waste water considering the mechanical and durability effects of biologically treated waste water, it refers to a possible conclusion in overcoming the adverse effeccts of the enviroment by the disposal of treated water. In the previous studies many different inevstigations and experimental studies had been made. In the treated waste water usage in concrete studies treated waste water replaced by tap water (0%, 25%, 50% and 100%) and by using 1:2:4 (Cement: fine and coarse aggregate) mixture within a w/c ratio of 0,6, three cubes of 100mm casted in which results pointed that in 3-28 days, as the percentage of waste water increased, the compressive strength increased relatively in the mix. Considering a three months of period, results refered that the potable water concrete and treated wastewater concrete's have a similar compressive strength. Therefore the results indicated that treated wastewater was 1.5% greater in comparison to the concrete that is cured in potable water [21]. Following to an experimental study, concrete treated with wastewater and resulted in showing that the treated wastewater had no negative effect on concrete. Besides, stated to a point where there was a decrease of compressive strength up to 9% in which the potable water is replaced by the tap water in the process of concrete mixing. Further more, the decrease of 9% in compressive strength result gained in also using waste water in between the 3rd and the 28th day of experiment. Briefly showed that biologically treated wastewater is comparable in concrete mixing with potable water accordingly to the results of the setting time, mortar and strength [8].On subsequently applied tests on concrete involving the usage of treated wastewater in concrete mixting pointed out the result that the strength of the compressive is on increase when treated wastewater is mixed with the concrete and to compare when the potable water is mixed with potable water. To determine the feasibileness of the treated wastewater in concrete mixing the test's setting timeand compressive strength were analysed and resulted in that the setting time of treated wastewater increases in comparison to the potable water in concrete mixing [22].

In addition, studies evaluated the mechanical properties within the other properties of the concrete in which in the studies the treated wastewater was used in mixing in concrete. A cocncrete cube casted within using preliminary, secondary, tertiary treated wastewater and by using tap water underlined no affect on slump and density. However, with a decrease in the water quality pointed to an increase in setting times. When the concrete is mixed with primarily and secondarily treated water, the results indicated a lower strength in early days up to one year. Also at the early concrete ages of 3 to 7 days, the mix in tertiary treated water showed a h'gher strenght of concrete in comparison to the concrete that is mixed with the tap water [12].In a study where usage of biologically treated wastewater in concrete mixing and curing is studied by performing mechanical and physical tests on mortar and on a concrete cube of specimens. Moreover durabilty tests of concrete were taken into consideration and evaluated. In mixing and curing the concrete primarily and secondarily treated water is used and showed that there is a 17% increase in concrete mixed and cured in compared to concrete mixed and cured by using tap water up to 180 days. Therefore a minimized reduction was pointed in concrete considering the concrete mixed and cured in primarily treated water in 180 days. In addition, in usage of secondarily treated water the mixing and curing in concrete pointed to a decrease from 9% to 18% in compressive strength. Considering the absorption of the water in the concrete which is mixed with the tap water and treated with wastewater can be referred as to be identical and by curing the concrete in secondary water showed an increase in the absorbtion of the specimen where all these results reffered to the feasibleness of biologically treated water considering the usage in the industry of concrete production [7].

Furthermore, in other conducted tests, wastewater frim the textile industry in concrete mixing was used. Considering the concrete that is mixed with both treated and untreated textile water were in comparison to the concrete that is mixed with potable water. The results of the conducted test indicated that both treated and untreated tectile water is possible to be used in mixing for construction purposes in only adding an admixture of calcium nitrate. Sivakumar and Nirmalkumar. By considering the usage of industrial wastewater, it will also help the problem of great disposal wastewater into enviroment. Accordingly to the tests in usage of wastewater that is provided from the car washing stations analysed and compared both mechanical properties and durability aspects of high strength concrete with the non-fresh water in which the results indicated a decrease in compressive strength in 25% and 100% substitution of wastewater when compared to the control mixture within 7 up to 28 days. Briefly, concrete mixed with 50% substitution of wastewater and concrete mixed in tap water in manners of compressive strengt was comparable [23].Considering the polyvinyl acetate wastewater (PVAW) mixed in concrete, compressive strength showed an increase despite of all matters and indicated the feasibility of concrete in polyvinyl acetate wastewater (PVAW). Further more, evaluations were made on the properties of mechanical and durability properties of the PVAW mixed in concrete. In addition pointed on an increase in which slump values have been increased by the increase of polyvinyl acetate wastewater percanctage in the mix concrete. In contrast, the slump that is provided by a different fraction of PVAWin concrete pointed out a lower percentage compared to the control mix concrete. There was also a decrease in strength when PVAW is

increased yet the concrete mix in PVAW indicated more strength in comparison to the control mix concrete [24]. In applying reuse of concrete wash water in order to produce fresh concrete, studies observed and indicated the result of when silica and additive mixtures are added to the concrete samples, there was a decrease in compressive strength in which compared to the variety of concrete mixes obtained by mixtures made by wash water or mixture of tap water and or concrete wash water[25]. The samples of concrete strength were made by an acceptable limit as per ASTM C94 by using wash water and or tap water [26].Following by producing samples made with drinking water and or domestic wastewater pointed the fact on tensile strength in which resulted in 28 days, all of the samples indicated 96-100% of the tensile strength considering the control samples within considering the setting time showed a reduction by 30 minutes in which it was consistent according to the ASTMC191 standard [27].Hence the study aimed to determine the feasibleness of usage of the wastewater before the chlorination in order to produce and cure the concrete in the wastewater plants[25]. Usage of concrete wash water used to produce concrete therefore the results pointed out that the concrete wash water is acceptable to use in producing the fresh concrete where the research underlined the strength, flexural strength, abrasion resistance, chloride resistance and carbonation resistance of treated wastewater concrete (10%, 25%, 50% and 100% replacement with Tap water) and made comparisons in between the results to the control concrete. Therefore the feasibilness of use of waste water achieved in the studies also lead to reduce in consumption of fresh water considering the disposal problem of the industrial wastewater[26]

2. Health Assessment Of Wastewater

In reuse of water, certain aspects must be taken in order to prevent any kind of disease spread including pathogenic microorganisms in which may exist in raw domestic waste water. Whereas feces of infected human or wide range of waterborne organisms in which can be transmitted by fecal or oral and also can be transmitted by consumption of these waste waters. Therefore assuring the water quality the aspects of ; the degree of expected human contact with the reclaimed water, the range of microbiological and chemical concentration , range of water treatment process within the sampling and monitoring protocols to assure the water quality requirements play a critical role in endangering enviroment within the living organisms that enrols in the natüre [19].

Further more, the most significant concern in considering the chemicals released by the industries is the unexpected and disappointing effects of those chemicals on health via long term exposing of low concentrations in which often released by the concrete industries. Despite of the fact that many variety of those chemicals are toxic in high levels, many other chemicals can be very toxic at low levels where all these chemicals released into the enviroment are referred to be as pollutants[18]. Therefore according to EPA, there are 126 identified analytes that are reffered to be as priority pollutants. In which in extreme cases pointed to chemicals being able to mimiccking hormones where have been shown an effect of disturbing the endocrine system of aquatic animals[19].

Considering all these possible endangers, the states of The states of Arizona, California, Florida, Hawaii, Nevada, Texas, and Washington applies their own water reuse regulation depending on several sectors of industry. To produce concrete the referring wastewater treatment units are suggested to be secondary treatment within including disinfection , BOD5 (≤ 30mg/l), TSS (≤30mg/l), fecal coliforms (≤200 CFU/100ml), and Cl2 residual (1mg/l Cl2 residual (minimum). Lastly it is important to reduce the workers contact to the minimum where increasing the disinfection to the higher point [18].

3. North Cyprus And Nıcosıa Central Treatment Plant (Lctp)

Northern Cyprus is estimated to be one-third of the island which covers an area of approximately 3355km^2. The island has a population of 300.000 of livestock and a population of 260.000 inhabitants [28]. NC has half of the coastline of island within her boundaries. And related with the increase in the population, as it occurs in world in NC the water usage has been increased [29-31]. Therefore, shortfall of water became an issue to confront. The weather conditions in the world and accordingly in NC plays a crucial role in the resources of water where water is affected by drought or decrease in rainfall via decrease in water resources and leads to a harder process of purification of water. In addition, considering the over use or over-abstraction of water from the ground water resources led to an increased degree of salinization in aquifiers of coastal area in which followed by depletion in interior level [31,32]. To confront the situation occurred, in order to supply the agricultural sector 18 damns constructed and 23 damns were constructed to recharge the located regions aquifers. Briefly, in total 41 dams were constructed. In addition, to recharge water to the aquifiers, a diversion of surplus water supply from wet regions are used and the aquifiers are applied in Lefkosa Main Region which has a 20-km-long surface flow. To the regions that has shortfall of water, considering the evoporation effects, small-modarate scale desalination projects are applied. In addition,depending on more reliable resoures within excluding the weather conditions, the cost of the projects comes with a cost of about 1 United States dollar (USD)/m^3[33,34].

In Lefkosa Central Treatment Plant (LCTP) , there are 20,000 m^3/day of flow of wastewater that is treated up to secondary level. Besides 12,000 m^3 of the total 20,000 m^3 of the waste water is flows from the souther part of Cyprus. Considering the weather conditions, the level of the treatment varies in between %60 to %90. Further more, the treatment process of waste water becomes more difficult in summer due to increase in the evaporation effects (1000 mm/year) where the amount of the waste water is reduced. On the other hand during the winter, conditions changes therefore, the winter conditions such as storm or rain affects the waste water treatment conditions causing lack of treatment of waste water in desired level due to the capacity limitation. In General, Lefkosa has 30km^2 of coverage area. In which the cesspools are involved in waste water collection sysytem for the last 10 years. However, after apllying the EU development plan, it helped sewage system to be managed up to %60. The completion of the sewage system of the city is expected to provide provide 20 million cubic meters (MCM) per year and unfortunately it is going to be insufficient [35].As an EU member, lefkosa has an obligation due to satisfy the Directive refered as 91/271/EEC in which it has a concern of urban wastewater treatment(1991) depending on the commission amend on Directive 98/15/EC (1998) due to upgrading and protecting the enviroment. Besides, agglomerations which is more than 2000 population equivalence (PE) have to be identified by the member states. Doubtlesly, depending on the directive requirements will lead members to establish and to complete new following sewage systems in those cities in order to provide a collection of substantial amount of waste water. As to follow the EU directive, before disposing waste water to the sensible areas, the waste water must be treated up to secondary level. Despite of the water deficiency increase, in agricultural sector taking the opportunity to reuse the effluent water therefore targetting on reduction of the water stress in the aquifiers. Besides, once completing the sewage systems of the cities, the reuse of waste water is expected to contribute to the water supply about 20MCM in Lefkosa in year 2025. Therefore it is going to affect the usage of fresh water amount in the cultivating lands [33,36].

According to the studies on waste water reuse indicated that, compared to the cost of desalinated water cost, tertiary treatment cost provides a less cost and also the studies refered to reuse of effluent water as a greater reliable water resource [37]. Estimatedly tertiary treatment of effluent water cost is 0.2 USD/m^3 and in comparison the late desalination cost in NC is around 1 USD/m^3. In agricultural sector due to achieve specific purposes, the treated effluent water may be used [38]. Considering the weather conditions such as: drought seasons in which the safe yields of the aqufiers has limitation accordingly causing a decline in the process of recharge [39].

4. Reuse The Wastewater In Constructıon Industry At Nc

Accordingly to the increased demand on need of water in the mediterranean countries includong the irrigation sector, precious studies indicated that the treated or safe waste water reuse should be applied into practice in a large scale [41,42]. More over, usage of the effluent water is a great alternative in order to confront the water shortage and an important component of the IWRM leading in to the contribution of the protection of the enviroment [43,44].Compared to the cost of desalinated water, the tertiary treatment of waste water provides a lower cost where it is inevitable to treat the water up to secondary level depending of the Urban Wastewater Treatment Directive (UWTD) 91/271/EEC [40]. NC is one part of the island that obtained EU membership due to the reunification of island in which demands satisfying the nessesities in the obligations directive.Usage of water depends on the needs and accordingly may be provided in connection of the demanding intention of use in which considering the public health, high quality of water required in domestic use. However, lower-quality of water is suitable to use in agricultural nescessities. On the other hand, considering the edible crops irrigation requires an healthy care due to preventing the health problems that is possible to be caused by the effluents [38] . Construction industry is developing greater day by day in NC therefore taking the advantage of opportunity to apply waste water in concrete will aid less usage of fresh water in which will not effect the resource of fresh water usage ratio. Therefore usage of waste water under the suitable and required conditions will prevent endangering the human health. Considering the researches in other countries despite of waste water effecting the performance of concrete, in this era of technology it is achieved to find the solution due to increasing the concrete performance to the maximum.

6.Applyıng The Real Illustratıon Of An Applıcatıon To Reuse The Wastewater In The Housıngs:

This application is done by theoretically, because the main aim of this report will be provided for reducing the fresh water usage in concrete industry. On the other hand, North cyprus authoritiy cannot be controlled the wastewater trement plant in each cities. Such as kyrenia and guzelyurt are example for it. Continuously produce and monitoring the nicosia waste treatment plant by supporting EU fundings. The following sections are given information about nicosia wastewater treatment plant production. It has to be highlighted that all these informations are confirmed by Nicosia Turksih Municipality.

6.1 Nıcosıa Wastewater Trement Plant Productıon:

This Operation Report covers the period of **March 2019** from new nicosia wastewater treatment plant. **All these information is provided by Nicosia Turkish Municipality** . This section of the report is investigated march 2019 treated water report to apply in the emtan deluxe villa project to achieve minimize the fresh water consumption in concrete industry at north cyprus. The following part of this section is identified the part of the wastewater to clean up to use again;

6.1.1. Inlet flow

The total inlet flow during the reporting period was as follows:

Table 1. The total inlet flow of March 2019 period

Period	Quantity according to the inlet flowmeter [m³]	Quantity of septage/internal [m³]	Quantity of inlet waste water [m³/d]
01/03 – 31/03/2019	1 240 430	16 455	1 223 975
	Minimum registered [m³/d]	**Maximum registered [m³/d]**	**Daily average [m³/d]**
	25 562	42 871	39 483

6.1.2.Energy consumption

The following table shows the overall consumption during the reporting period as well as the average daily consumption:

Table 2. Electrical consumption of March 2019 period

Period	Total [kWh/month]	Daily average [kWh/d]
01/03 – 31/03/2019	860952	30748

6.1.3 Residues

6.1.3.1Screenings & Sievings

The residues from the screens and the sieves are collected into containers and transferred to the available disposal site of the Municipality of Nicosia. The following quantities were removed from the influent waste water during the reporting period:

Table 3. The amount of screening and sieving in March 2019 period

Period	Total [kg]	Daily average [kg/d]
01/03 – 31/03/2019	104540	3372

6.1.3.2 Grit and Grease

The following quantities were removed from the influent waste water during the report period:

Table 4. the amount of Grit & Grease in March 2019 period

Period	GRIT	
01/03 – 31/03/2019	**Total [kg]**	**Daily average [kg/d]**
	24220	781
	GREASE	
	Total [m³]	**Daily average [m³/d]**
	50	1.6

6.1.3.3 Sludge

The following quantities were treated on different stages of process during the report period:

Table 5. the amount of treated sludge in March 2019 period

Period	Excess sludge Hf10 / Hf20 [m³]	Thickened sludge Kf10 / Kf20 [m³]	Sludge from Sludge Storage Tank Jf10 / Jf20 [m³]	Dewatered sludge [m³ / ton]
01/03 – 31/03/2019	73920	9635	9900	-1464

6.1.4 Plant performance

The plant performance within the reporting period was as follows:

Table 6. the average removal efficiency in March 2019 period

Period	COD (%)	BOD (%)	TN (%)	TP (%)
01/03 – 31/03/2019	98	>99	87	96

6.2 EMTAN DELUXIA PROJECT DETAILS

Type A villa has 4 bedrooms and 4 bathrooms, which covers 260m^2 indoor area and 100m^2 outdoors area, so totally has gross area of 360m^2. Also it has outer curtain walls around the plot, which are all made of reinforced concrete. This building concrete grade is applied C25 and C30 according to Turkish standards. The figure is shown the view of the villa in Kyrenia below.

Figure 1. Emtan Villa view

Generally the emtan civil engineers are responsible to calculate the total amount of materials requirements for each projects. Table 7 is provided the total amount of the concrete requirements for the villa in the below;

Table 7. The concrete amounts have been illustrated for this villa in m^3.

Locality (Title)	**Amount (m^3)**
Lean Concrete on Gravel (Under the Foundation)	$24m^3$
Foundation	$71m^3$
Tie Beams (Above the Foundation)	$18m^3$
Lean Concrete on Gravel (Above the Foundation)	$24m^3$
Ground Floor Columns	$7m^3$
Ground Floor Slabs and Beams	$43m^3$
First Floor Columns	$7m^3$
First Floor Slabs and Beams	$32m^3$
Parapet Walls (On the Roof)	$12m^3$
Mortar for Bricks (For Installation)	$8m^3$
Interior Plasters	$9m^3$
Exterior Plasters	$16m^3$
Screed Concrete (For Floors)	$40m^3$
Outer Curtain Walls (Foundation)	$7m^3$
Outer Curtain Walls	$24m^3$
Total	$342m^3$

6.3 INVESTIGATION FOR BENEFITS ON NORTH CYPRUS

Groundwater is the main source of water resources, and provides about 75.5% of the total available water resources in NC. This reveals that a shortage of water recharge into the aquifers would intensify water scarcity in NC. Therefore, the excessive exploitation of groundwater might lead to a large drawdown of water, which could, in turn, make NC vulnerable to water scarcity for a long period of time. Water recharge into the aquifer takes place slowly and can take several years until it maintains its initial level before drawdown, and a large drawdown would increase the number of years. The construction sector consumes the one of the major portion of water resources in NC; by supplying the recycled treated water into concrete industry, the water that was initially supplied could be channeled for other domestic use, thereby reducing the groundwater exploitation. Approximately $1m^3$ concrete mix needs 150kg water specially for C20 and C30 concrete grades according to Turkish Standards (TS). The Turkish Nicosia Munipillary average daily production results is shown that the daily average screening and sieving water amunt is 3372 kg. According to total amount of concrete needs $342m^3$ from Emtan villa concretes requirements. If the identification is made for this amount of concrete, the following results can be found for the amount of water required in total concrete mixes. 1m3 required = approximately 150kg, So $342m^3$ * 150kg= **51300 kg water needings** for emtan villa. The daily average cleaning water overall 15 days times (51300/3372=15.21 days) can be build up the amount of concrete required for the villa. Only march 2019 period; Nicosia wastewater treatment plant can be provided 2 villas water needs for concrete structures.

If this result is not satisfied to apply for reuse the wastewater in concrete industry at North Cyprus; this amount of fresh water can be used by 374 persons per day for their needs such as drinking water, showers, washing and etc. This result can be calculated by the world static institute water report provides that every person needs average 137 kg water for their needs. An other reason to reuse the water in concrete industry is; it helps to minimize the damage in natural water resources in the island. At the same time, it will not affected the sea life anymore. It is important to remind that Sustainability is considered on Economical, environmental and human cases together. This research is done by mainly considered on Human and environmental impacts. As a result of reusing wastewater in concrete industry for The main benefits to North Cyprus,

- Fresh water consumption will be decreased.
- Minimize the damage for natural resources

Based on the provided research the government of NC should take a step forward in planning a long-term system for waste water management. Due to the importance of saving our water, since the majority of sectors are using drinking water for different purposes such as agricultural and public areas. In which the tariffs of water for agricultural purposes are between 0.04 to 0.15 USD per Cubic Meter, and that depends mostly on the source of the water as well as the location [32,35]. Water used for irrigation purposes are free of charge in rural areas to mitigate poverty. Where in the same time the quality of the water is vary in NC. The aquifers near the coasts are affected by interference of seawater, where the NaCl concentrations at some areas reaches around 5000 ppm, and that makes water not suitable for drinking or for agricultural purposes due to huge reduction in water quality [33]. Presently, some private institutions supplying homes with purified water using 19-liter bottles, in which it costs around 1.7 USD per bottle. The benefiting sectors of this water supply is the local industry, agricultural, and tourism sector. Protect the natural water resources for Future Generations. Also some previous studies showed that the re-use of safe wastewater schemes should be adopted and implemented on a large scale, because the need of water increased in the Mediterranean countries for irrigation reasons [41,42]. Moreover, the reprocess of flowing out water is necessary to over come the shortage of water, in which it is one of the IWRM elements, and that leads to environmental protection and enhancement [43,44]. The tertiary wastewater treatment gives a lower cost as compared to desalinated water, bearing in mind that up to secondary level of treatment is unavoidable, and that based on Urban Wastewater Treatment Directive (UWTD) 91/271/EEC[40]. Urban Wastewater Treatment Directive (UWTD) includes the collection, treatment, and removing of wastewater from agglomerations, and in the same time treatment and discharge of biodegradable wastewater from specific industrial sectors. NC is part of Cyprus in which it will obtain the EU membership, when the reunion of the island took place, therefore, commitment is essential to meet the necessities of this Instructions [40].

6.4 STRATEGY FOR REUSE THE WASTEWATER IN NORTH CYPRUS

It is really important to set up own strategy for long term in North Cyprus. Specially wastewater is the main critical case for our island. It should be highlighted that water is the main resource for human life. This is the reason that North Cyprus government is the main actor to get action for wastewater management cases.

- Goverment has to be get serious decision in the parliment cases such as set up new wastewater management regulations
- Find out the way to provide the concrete industry for reuse the wastewater in the concrete productions. Such as set up the company which the goverment will be responsible or make an aggreement with public or international companies to use these water in concrete industry for providing construction industry.

II. CONCLUSION & RECOMMENDATION

This research helps to improve the wastewater usage in North Cyprus. It is a guide and shows the idea how can be applied to the daily life to use the treated water and also provides the decision makers will be considered in North Cyprus Regulation systems. This report is helped to recommend for applying wastewater management cases in North cyprus, due to encountering to the situation where freshwater is descreased all over the world. So it must be considered for our island.Therefore, the beginning of new challenge management procedures through the establishment of a water entıty, applying the productiveness of the available water containing the better usage of pricing and water conservation evaluates and the water quality checks. However, North Cyprus will be taken decision for long term projects to find the implementation of wastewater and water management systems. On the other hand, everyone has to clearly understand that all the citizens have the responsibility and obligation to arrange the usage of water resources in a serious manner in order to provide the effort for wastewater case. From the information provided in this paper it is apparent that the potential of improvement in Cyprus in regards to wastewater treatment and reuse is possible and the challenges are there to be faced successfully. Despite of challenges, considering the possible benefits of reuse or treating the wastewater requires government awareness that this application does not only environment friendly but a great opportunity to use both fresh water and waste water resources wisely within saving more fresh water by

replacing fresh water with treated wastewater in the construction sector. Simply this application will allow less demand on fresh water saving it for the nature and citizens therefore increased demand on treated wastewater which will not allow any risks neither to the community nor to the environment.

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