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Wastewater Treatment Plants in Libya: Challenges and Future Prospects

Salahaldein Alsadey[1, *], Omran Mansour[2]

[1]Department of Civil Engineering, Faculty of Engineering, Bani Waleed University, Bani Walid City, Libya
[2]Department of Environmental Science, Faculty of Sciences, Bani Waleed University, Bani Walid City, Libya

Abstract

A growing concern stretching across the entire globe is wastewater treatment. It is a chronic situation that is certainly becoming a greater concern due to rapid growth in population and urbanization in developing nations. As such, authorities are increasing efforts to enhance wastewater treatment plans in order to enhance water resources and generate sufficient water. Nevertheless, the number of developing countries that face pollution in the form of wastewater is still high. Libya is one of such nations, especially in its urban regions. The aim of this study is to highlight the current scenario and challenges of managing wastewater in Libya. The later sections are exclusively dedicated to proposed recommendations at the government level that may address Libya' wastewater issues. Findings show a gradually increasing wastewater trend in developing nations following a rise in their population annually. A summary of reviewed historical investigations show that poor government plans, mismanaged wastewater, and human and industrial wastes are among the important challenges that hampers sustainable management in most nations especially Libya. It is vital to consider potential approaches such as improving wastewater management and supply demand. Furthermore, the participation of local residents via increased awareness may be one of the supportive methods to solve the challenges. In order to conserve the cleanliness of our environment, it is important to have efficient use of wastewater along with sustainable environmental and economic management.

Keywords

Wastewater, Treatment, Sustainable Management, Plant, Libya

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1. Introduction

The awareness on minimizing the discharge of pollutants into the environment started in the late 19th century. Libya is essentially a desert-filed nation with little source of freshwater, with only 5% of the country receiving more than 100mm of rain annually. For a long time, Libya tapped into groundwater reserves. However, there is an ongoing rise in demand and more groundwater aquifers become brackish as a result of seawater seeping in. Certain outlying regions do not have systems and waste water is discharged into the waste water canal system without prior treatment [1]. According to officials from the General Company for Water and Sewerage state, there are 36 wastewater treatment larger plants in Libyan major cities, with only 9 of them functioning. Non-functioning sewage stations in Tripoli has resulted in a spill of over 1,275,000 cubic meters of untreated water into the sea daily [2]. In general, wastewater is used water which includes soaps, food scraps, human waste, chemicals and oils. In domestic houses, this includes water from washing machines, toilets, showers, bathtubs, dishwashers and sink [3, 4]. The industry and business sector also have their fair share of used water that needs to be treated. Storm runoff is also part of wastewater. Contrary to the fact that most people think rainwater that runs down the road during the storm is

* Corresponding author
E-mail address: salahalsadey@yahoo.com (S. Alsadey)

clean, storm runoff that wash off rooftops, roads and parking lots can negatively affect groundwater [5]. Clean water is vital for our health as well as for a dust-free environment. Water that enters the train must be treated by waste water treatment plant before being discharged into the environment. The most important reason for doing this is to make discharged water reusable again. The removal of all forms of dangerous elements is the next part of suppling clean water to users, including humans, animals, fishing industry and plants. This study's significance is to compile comprehensive information regarding Libya's wastewater treatment plants. The wastewater treatment plants' challenges and respective solutions are also explored. Lastly, as a civil engineering researcher, this would give me a better understanding of Libya's wastewater treatment plants. This study focuses on evaluation of the Libyan wastewater treatment plants and conclude by identifying the problems and obstacles facing the wastewater in Libya.

2. Water Resources in Libya

Libya is a nation within the Maghreb region of North Africa, bordered by Sudan to the southeast, Mediterranean Sea to the north, Chad to the south, Egypt to the East, Tunisia to the northwest and Algeria to the west. Water sources in Libya come from four sources: groundwater, providing almost 95% of the country's needs; surface water is 2%, including rainwater and dam constructions; desalinated sea water is 2%; and wastewater recycling is 1% [6]. Despite the fact that Libya is rich in groundwater resources, it still requires proper treatment and management. The man-made River Project was first coined back in the late 1960s while work on its construction started in the year 1984.

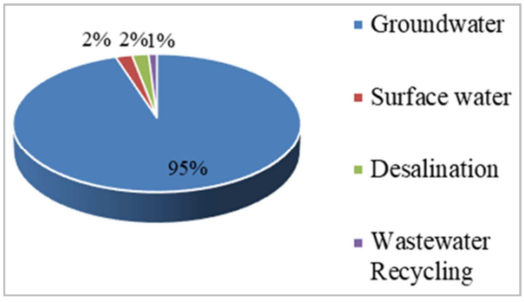

Figure 1. Percentages of available water in Libya in1998.

3. Libya's Wastewater Treatment Issue

Waste is a by-product of most human activity. Developments in the economy and the accompanying rise in standards of living of nations caused a rise in production of solid and water waste. The many forms of liquid waste that are loosely grouped as agricultural, domestic and industrial waste can range from relatively non-toxic to very toxic wastewater [7]. Irregular house scheming, industrialization, and rapid urbanization caused an increased in wastewater, which thus led to poor water quality in Libya.

Wastewater is essentially used water that needs to undergo treatment prior to discharge into another body of water, in order to reduce pollution of the water source [1]. Most of the water utilized by industries, business and homes needs to undergo treatment prior to discharge back into the environment. Nature can actually withstand minute amounts of pollution and waste. However, billions of gallons of sewage and wastewater that are produced on a daily basis would most definitely overwhelm nature. In this case, pollutants in waste water is reduced by treatment plants to a level that is tolerable by nature.

The global mortality due to lack of access to clean water and proper sanitation is approximately two million children annually [8]. The world's poorer communities also pay more for their use of water compared to developing nations. Despite the abundant availability of water around the world, there is uneven distribution of water and logistic challenges for its transportation. Certain nations utilize more than their fair share of water due to population growth, irrigation, etc, without proper handling of water [9]. As towns bustle into cities, the rapid surge in population growth puts more pressure onto the environment and negatively affects the supply of fresh water [10-14]. Around the world, there is now growing awareness that the issue of human waste demands better management. In response to growing demand of cleaner water and better sanitation services, there is now an increase in waste water treatment plants. The construction of water treatment plant requires proper solutions. The current study will shade some light into the history of water waste treatment especially in Libya, types, functions and design perquisites of waste water treatment plant, importance of waste water treatment plant, current waste water disposal and techniques utilised. This study also differentiate ancient and modern ways of water treatment besides discussing the government policies and development towards obtaining clean water by using modern techniques of water treatment.

4. Wastewater Treatment

A city's waste water treatment plant system is composed of pumping stations, waste water treatment plant, waste water pipe and canal. Certain outlying areas lack systems and as such, waste water does not undergo treatment prior to discharge into the waste water canal system [15]. The main objective of waste water treatment is to eliminate most of the

suspended solids prior to release of remaining water (also known as effluent) into the environment [16]. Approximately 60% of suspended solid is eliminated from wastewater via primary treatment. Secondary treatment removes about 90% of suspended solid from waste water and thus waste water is useable after being treated. Wastewater originate from different sources such as agriculture, domestic and industrial origins. The issue of water disposal gained prominence as society transformed from nomadic cultures to raising more permanent sites. The development of cities required other steps to solve waste water problems [17]. However, the existence of larger plants in major cities surrounded by agricultural areas summarised in Table 1 [1], makes the cost of treated water conveyance minimal.

Table 1. Technical Details of Wastewater Treatment Plants in Libya.

Treatment plants	Installation year	Design capacity m^3/day	Existing capacity m^3/day	Remarks
Ejdabya	1988	15,600	5,000	-
Benghazi A	1965	27,300	-	Out of order
Benghazi B	1977	54,000	-	Provisional test
Al-merg A	1964	1,800	-	Out of order
Al-merg B	1972	1,800	-	Out of order
Al-beada	1973	-9,000	-	Under construction
Tobruk A	1963	1,350	-	Out of order
Tobruk B	1982	33,000	-	Out of order
Derna	1965	4,550	-	Out of order
Derna	1982	-8,300	-	Under construction
Sirt	1995	-26,400	-	Under construction
Abo-hadi	1981	1,000	600	-
Al-brega	1988	3,500	2,700	-
Zwara	1980	41,550	-	Not used
Sebrata	1976	6,000	-	Out of order
Sorman	1991	-20,800	-	Under construction
Zawia	1976	-6,800	-	Under construction
Zenzour	1977	6,000	-	Not used
Tripoli A	1966	27,000	-	Out of order
Tripoli B	1977	110,000	20,000	-
Tripoli C	1981	110,000	-	
Tajoura	1984	1,500	500	-
Tarhouna	1985	3,200	1,260	-
Gheraan	1975	3,000	-	
Yefren	1980	1,725	173	-
Meslata	1980	3,400	-	Not used
Khomes	1990	8,000	-	Not used
Ziliten	1976	6,000	-	Out of order
Misrata A	1967	1,350	-	Out of order
Misrata B	1982	24,000	12,000	-
East Garyat	1978	500	-	Out of order
West Garyat	1978	150	-	Out of order
Topga	1978	300	-	Out of order
Shourif	1978	500	-	Out of order
Sebha A	1964	1,360	-	Out of order
Sebha B	1980	47,000	24,000	-
Total capacities	*546,435*		*66,233*	

5. Outcomes and Discussions

5.1. Wastewater Management System in Libya

Waste water system refers to a sewerage system linked to the line of sewers, treatment works or pumping stations, disposable pipes and other equipment or structures intended to collect, convey, pump or dispose treatment sludge, sewage or effluent. Primarily, the sewerage system is developed to collect and move waste water from domestic activities of institutions, commercial areas and/or households. The sewage needs to undergo treatment before the water is allowed to return to the environment [18]. The management infrastructure and waste water development of Libya was mostly built by developers with the aim of serving their own scheme. Most of the time, the need of proper management is surpassed by the pressure of constrained budgets and short time for completion of project.

At present, the management of primary sewerage system in Libya is handled by the general company for water and wastewater in Libya. It is also under the purview of the Housing and Utilities Government Ministry, which also makes sure that the waste water undergoes treatment

based on environmental standards prior to release into the public waterway system. There are roughly 200 wastewater treatment plants that are built all over the nation. However, only a handful of the total number of plants are operational while the remaining others are undergoing repairs. Production of water that is appropriate for agricultural usage is the basis of design for most wastewater treatment plants [19]. The biggest operating wastewater treatment plants are situated in Sirte, Tripoli and Misurata, with a design capacity of 21,000, 110,000 and 24,000 m3/day, respectively [20]. In addition, a majority of the remaining wastewater facilities are small and medium sized plants with a design capacity of approximately 370 to 6700 m3/day. Approximately, the volume of treated wastewater is 1,324,054 m3/day. Out of this total volume, the amount of treated wastewater is only 145,800 m3/day or 11% of the initial wastewater. The remainder of wastewater is released into the sea, black wells and artificial lagoons without being treated [21].

5.2. Development of Wastewater Treatment Sector in Libya

The setting of policies related to sewerage and sanitary board facilities in main towns and appropriate planning need to be done. The slow sand filters that were cheap and easily build can be set up. There was a sharp rise in demand for water following the development of Libya, especially around Tripoli and other large cities. In response to this, it was necessary to set up novel water treatment plants to generate millions of litres of water supply in the cities. Initially, the sewerage service was managed by the Environmental health and Engineering unit under the Ministry of Health. However, in practice, the sewerage facilities in urban locations were run by the municipal authorities, especially for building new residential areas or township. It is important that the government plan to develop Libya's sewerage sector be in line with the country's physical and economic growth.

6. Conclusions

As the rate of pollution increase, the population in cities of the coast and the diversity of activities increase. This is especially the case in big cities such as the Benghazi city and capital city Tripoli. A few conclusions can be drawn based on the detailed study of the wastewater treatment plants in Libya. Wastewater is interfered by other forms of water that are collected in sewage networks. This raises the pressure on water treatment plants, which are already limited in number, to reuse them in fields of irrigation, agriculture, forest establishment, desertification control and others. Most streams of sewage that travel towards coastal lakes or the sea are untreated, thus leading to a rise in harmful water pollutants that endanger marine neighbourhoods. Furthermore, there is definitely a rise in the spreading of water-borne diseases, distortion of the coastlines and unpleasant smells. As in the case of Tajura, most sewage travel towards the groundwater. This lead to their wells and groundwater being the most polluted in the nation. All cities in Libya, especially those in the coastal region, should treat their wastewater and set up wastewater plants throughout the nation. Inefficiencies of treatment plants and drainage networks of cities are not up to good standards. Potentials of using water that are well treated should be explored for irrigation, anti-desertification efforts and agricultural industries. Proactive cooperation between all parties and authorities is necessary to address wastewater treatment issues and spur good management practices.

7. Recommendations

Sewerage network in cities should be completed or improved. The quantity of wastewater treatment plants should be increased, while ensuring their capacity and management are also up to good standards. All water should be treated following quality assured practices prior to release into the sea. Returned water can also be re-used for other activities such as agricultural industry and anti-desertification activities. Professional audit teams should be formed to investigate wastewater treatment plants that are out-of-service, whereby detailed reports on the technical status of these plants can be outlined and addressed accordingly. The government can also step up to lead initiatives that promote the reuse and recycling of water by encouraging more academic studies in the field of water reuse.

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