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Upgrading of the Existing Wastewater Treatment Plants in Egypt Using Discfilter

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Abstract

Wastewater can be used after treatment. Using of the treated wastewater depends on the quality of the final effluent. The implementation of new wastewater treatment plants is very expensive; hence, upgrading of existing wastewater treatment plants can be considered as a suitable alternative. In this study, upgrading of wastewater treatment plant in Kom Hamada was evaluated by adding discfilter to improve the quality of the final effluent. TSS, BOD_5, COD, and helminth eggs were obtained for the influent and effluent over a period of four months. The average removal efficiencies of TSS, BOD_5, and COD were found to be 79.98 %, 28.17 %, and 30.4 % respectively. The helminth eggs were totally removed. The effluent obtained after using discfilter was suitable for irrigation according to the Egyptian regulations for reuse of treated wastewater.

Keywords: Discfilter; Helminth Eggs; Tertiary Treatment; Wastewater Treatment

1. Introduction

Wastewater collected from municipalities and communities is treated, then returned in most cases to receiving waters or to the land or reused (Metcalf & Eddy, 2003). Municipal wastewater treatment is an important task worldwide due to the rapid increase in population and demand for industrial products resulting into high wastewater volumes and treatment costs (Mondala et al., 2011). If polluted wastewater is disposed or reused, it will transfer diseases, mainly helminthiasis (Jimenez, 2005). The main constituents that must be removed from wastewater are organic matter, suspended solids, and pathogens (Ahmed et al., 2013). There are many different measures of water quality, and the quality of the water often depends upon its use (Russell, 2006). Dissolved oxygen is an essential parameter that is used to determine the water quality. Dissolved oxygen is important because it determines what happens in the water, whether the water is clean or not. Biochemical oxygen demand (BOD) and chemical oxygen demand (COD) are the main parameters used to indicate the ability of wastewater to be degraded. BOD_5 is a measure of how much dissolved oxygen is consumed by aerobic bacteria in 5 days at 20^oC. It is the broad measure of the strength of the organic matter in a waste stream. COD is chemical oxygen demand and is measured chemically by digestion with acid (Russell, 2006). Depending upon the waste stream, there may be a consistent relationship between COD and BOD, but it is highly waste dependent (Russell, 2006). Total solids content is also from the important physical characteristics of wastewater. Among total solids content, total suspended solids (TSS) is the most parameter used. It is defined as the portion of the total solids retained on a filter with a specified pore size, measured after being dried at a specified temperature (Metcalf & Eddy, 2003). Egypt has many wastewater treatment plants which are used to treat wastewater before being disposed. Most of these wastewater treatment plants have preliminary, primary, and secondary treatment processes. These processes can achieve good removal of COD, BOD, and TSS. However, the effluent in most cases has a quality that is not suitable for direct reuse. As Egypt is currently facing water scarcity problems and water resources show signs of water quality deterioration, there is an essential need for the benefits of wastewater reuse (Abdel-Shafy at al., 2002; Feng et al., 2004). Total water consumption for Egyptian industries was 3.6 billion cubic meter per year at the year 2000, and is estimated to reach 5.6 billion cubic meter per year by the year 2017 (El-Gohary, 2002; Abd El-Salam et al., 2010). As a result, attention has been directed towards upgrading the existing wastewater treatment plants to improve the water quality of the final effluent. Wastewater reuse could effectively contribute to fill the increasing gap between water demand and water supply (Liberti et al., 1991). In the 1980s, the reuse of wastewater became a policy in Egyptian water resources management practice (Hussein et al., 2011). Thus, treated wastewater can be reused in irrigation if its quality conforms to what stated by Egyptian regulations. Generally, to meet the standards for unrestricted irrigation, conventional secondary treatment must be followed by tertiary treatment of the effluent (Bixio et al., 2006; Zanetti et al., 2010). Tertiary treatment can

be defined as a further treatment step that is used to improve the quality of wastewater, so that it can be reused (Tertiary Treatment, 2013). In this study, upgrading of existed wastewater treatment plant was investigated using discfilter.

2. Experimental procedure

The chosen wastewater treatment plant is located in Kom Hamada. The treatment train in this plant consists of screens, grit removal, oxidation ditches, settling tanks, and chlorine contact tank. The average daily flow of this wastewater treatment plant is 10,000 m^3/d. Table 1 shows the characteristics of the influent and effluent wastewater.

Table 1. The characteristics of influent and effluent wastewater before upgrading

Parameter	Value
Influent BOD_5	~ 800 mg / l
Influent TSS	~ 750 mg / l
Effluent BOD_5	< 60 mg / l
Effluent TSS	< 50 mg / l
Effluent PH	~ 6-9

Discfilter was added to the existing treatment train. Table 2 shows the specification of the discfilter used. The discfilter model used in this study was HSF 1702/01. It was installed in a channel between the secondary settler and the chlorination contact tank.. In comparison to other rotary filters, the discfilter have various advantages: the best ratio of filter area to floor space, the ability to deal with large flow rates, and a relatively low price. Because of its remarkable compactness, the discfilter is specially suited to the continuous pressure filtration process, which is becoming generally more important (Schweigler et al., 1990). Discfilter is appropriate for a variety of applications including tertiary wastewater filtration, water reuse, Phosphorus removal, membrane pretreatment, and stormwater treatment (Hydrotech Discfilter, 2013). Discfilter consists of: (a) Central drum where the influent wastewater enters the system, (b) Discs in which the influent wastewater flows by gravity from the drum, (c) Microscreen filter panels on both sides of the discs to separate solids and water, (d) Backwash spray nozzles to remove the retained solids inside the disc, (e) Backwash pump which feeds the high pressure spray nozzles with the filtered water, (f) Backwash trough for collecting dirty backwash water. Water to be treated flows by gravity into the filter segments from the center drum. The media mounted on both sides of the partially-submerged discs separates the solids from the water. The filtered water flows through the disc media into the collection tank. Once solids have accumulated on the inside of the media, the discs are cleaned by the countercurrent backwash system (Hydrotech Discfilter, 2013). TSS, BOD_5, COD, and Helminthes eggs (HE) were measured in the influent and effluent to disc filter, to indicate the efficiency of using this system as a tertiary treatment. All wastewater analytical methods used in this study conformed to standard American methods for the examination of water and wastewater (2005), and all results were obtained in duplicate.

Figure 1. Discfilter

Table 2. Technical specification of Discfilter

Filter model	HSF 1702/01
Pump motor power	0.75 KW
Filter area	2.8 m^2
Maximum submergence	55%
No. of filter segments	3
No. of filter panels	2x12

3. Results and Discussion

The removal efficiencies of TSS, BOD_5, COD, and Helminth eggs (HE) were investigated for about four months. The results of influent, effluent, and removal efficiencies of TSS, BOD_5, and COD are shown in Figures 2, 3, and 4. Helminth eggs was investigated in 16 samples over the total period as shown in Figure 5. The results showed a good removal efficiencies of TSS, BOD_5, and COD. Moreover, discfilter was able to withstand the variation of the influent quality by providing a roughly constant effluent quality. Helminth eggs are the infective agents for the types of worm diseases known globally as helminthiases. Helminths eggs are microscopic (around 20 to 80 µm for those that are important in the sanitary field) and are contained in variable amounts in wastewater (Helminth eggs, 2013). Helminth eggs infect humans through: (a) Ingestion of food crops polluted with wastewater sludge or excreta, (b) Direct contact with polluted sludge or fecal material, and (c) Ingestion of polluted meat or fish (Helminth eggs, 2013). Discfilter was able to totally remove helminth eggs. This can be due to the filtration ability of the discfilter, which was able to prevent the passage of these eggs.

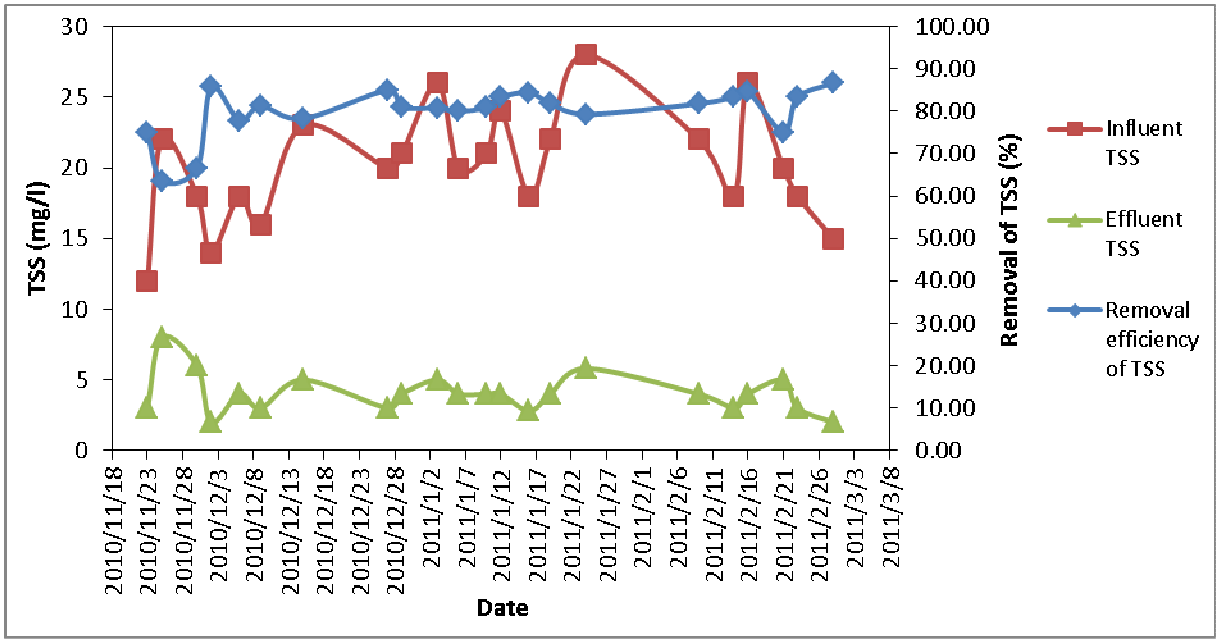

Figure 2. Influent, Effluent, and Removal Efficiency of TSS

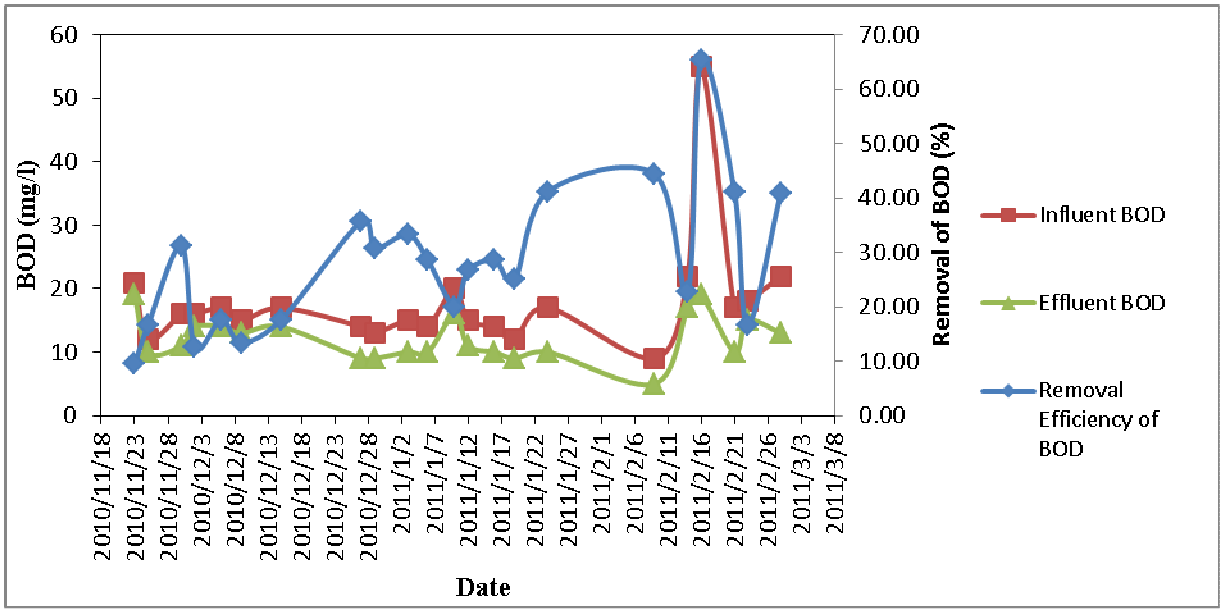

Figure 3. Influent, Effluent, and Removal Efficiency of BOD_5

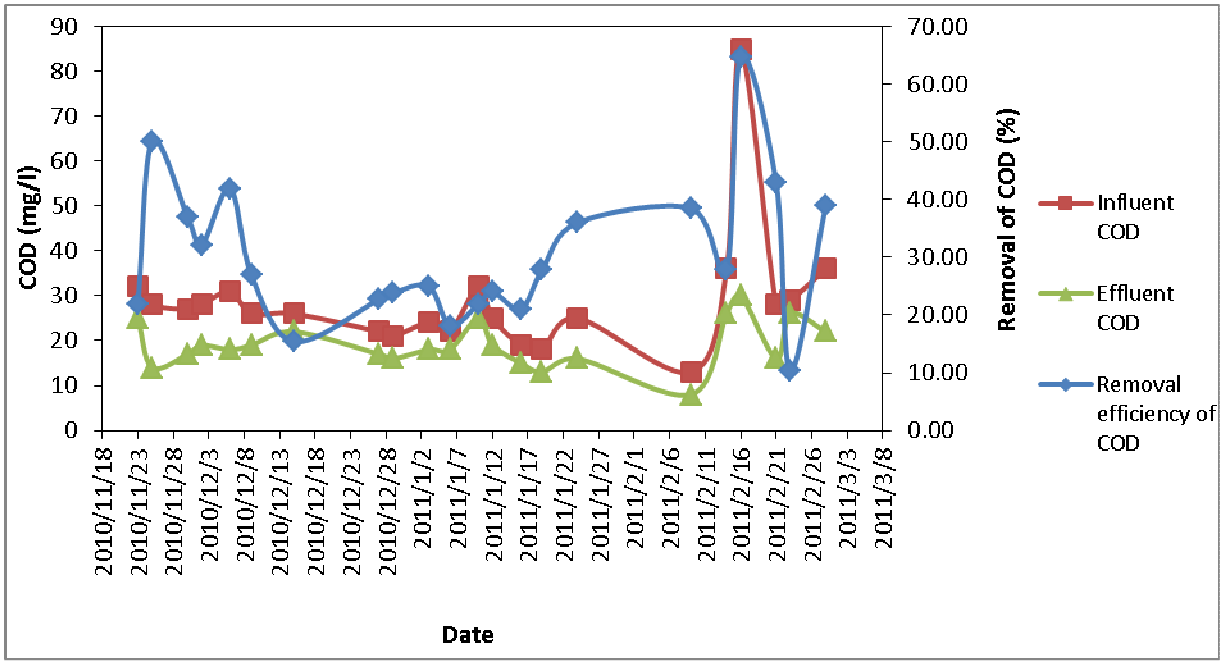

Figure 4. Influent, Effluent, and Removal Efficiency of COD

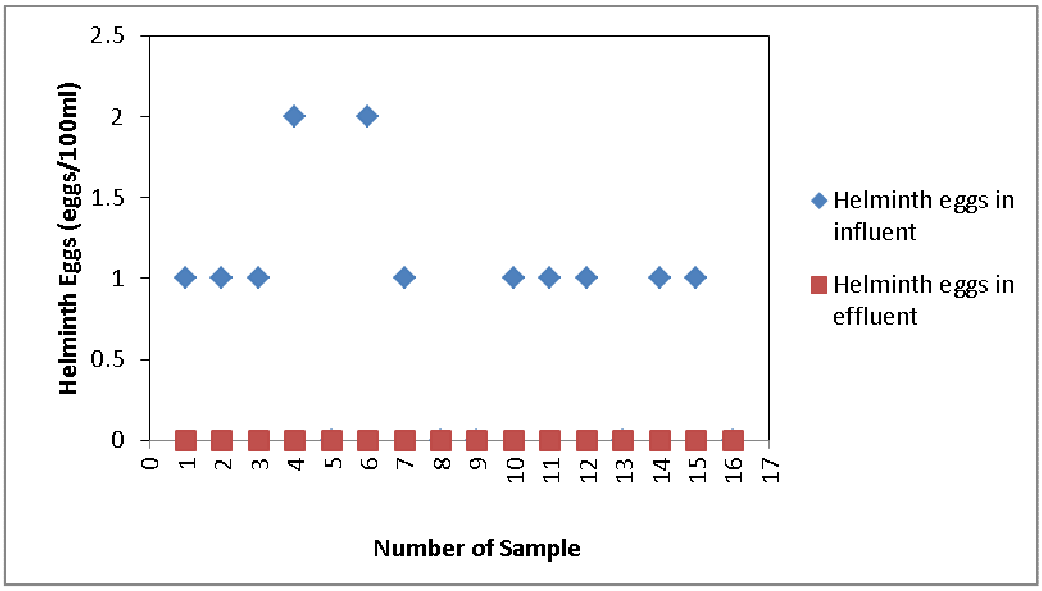

Figure 5. Influent and Effluent of Helminth eggs

7. Conclusion

The conclusions obtained on treatment of wastewater using disc filter are as follows;

1) Discfilter achieved good removal efficiencies of TSS, BOD_5, and COD from wastewater, and was able to achieve a complete removal of helminth eggs.

2) Values of TSS, BOD_5, and COD in effluent obtained after using discfilter were below the maximum concentration limits stated by the Egyptian regulations for reuse of wastewater in irrigation.
3) Discfilter was able to withstand the variation in the influent quality.
4) Discfilter can be used in upgrading of the existing wastewater treatment plants in Egypt.

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