The Control of Algae in the Effluent of Oxidation Ponds

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Abstract

Algae or tetrads growing in any aerated lagoon systems, ponds or wastewater treatment plants can increase both the TSS and the CBOD5 of the effluent. This can cause false high BOD and TSS levels in final effluent permits. Excess algae can also create nuisance surface scum, poor water clarity, and noxious odors. If the algae make its way into the drinking water source, it also can impact taste.The objective of this research is to examine the use and performance of vacuum filters to control the problem of algae in oxidation ponds. The problem of algae in the effluent of oxidation ponds, that it increases once more the TSS in the effluent again.Samples were collected during the study period, which was one month. This month was recorded from 25 September to 23 October. The collected samples were tested and analyzed in the Wastewater treatment plant laboratory of Sarabium. The measured parameters were TSS and BOD, which refers to the algae concentration in the oxidation lagoons.The effluent of the TSS after the polishing lagoons was not abiding the Environmental Laws. After the use of vacuum filter, the concentration of the effluent was all in range between 13 mg/l. to 49 mg/l. That's why, it is recommended to use vacuum filters with lagoons to control the TSS, thus control the Algae concentration.

Introduction

Algae with its different colors and types, Blue-green, red, yellow and brown colored algae in many ponds and lagoons have been more widespread than in previous years due to higher temperatures and less oxygen transfer in ponds and lagoons, lowered rainfall, and runoff interference. Algae or tetrads growing in any aerated lagoon systems, ponds or wastewater treatment plants can increase both the TSS and the CBOD5 of the effluent. This can cause false high BOD and TSS levels in final effluent permits. Excess algae can also create nuisance surface scum, poor water clarity, and noxious odors. If the algae make its way into the drinking water source, it also can impact taste. **(1)**

Not all algae are alike though. Many times the algae or cyanobacteria and tetrads that grow in wastewater ponds and lagoons are often times due to an excess of BOD instead of excess nutrient levels. We have worked with paper mills that actually are limited by nutrients, most often Nitrogen. This impacts the flocs forming bacteria. Tetrads and cyanobacteria can fix nitrogen from the sunlight, so they will then overtake the lagoons and cause serious TSS problems. Addition of nitrogen to these lagoons based upon BOD loading made the problems disappear quickly. Normal flocs forming bacteria can then grow consume excess BOD and out-compete and starve out the algae and tetrads. **(2)**

The objective of this research is to examine the use and performance of vacuum filters to control the problem of algae in oxidation ponds. The problem of algae in the effluent of oxidation ponds, that it increases once more the TSS in the effluent again. The wastewater was examined in this research in Sarabium wastewater treatment plant, Ismailia city, Egypt. The maximum capacity for the wastewater treatment plant is 180,000 m^3/ d. The surface area of the wastewater treatment plant is 860 feddan.

Literature Review

Treatment of municipal, industrial, and agricultural wastes employing stabilization ponds or lagoons has found increasing application within the past 20 or 30 years. Where land values are not excessive, the low cost of construction and operation and the demandfor less technical competence in their operation compared with more sophisticated treatmentfacilities make lagooning, in one form or the other, the method of choice for thestabilization of many different types of waste materials.Algae in wastewater treatment ponds can be managed by several methods, as the vacuum filters, micro strainers and centrifuges. In this research, Vacuum filters were usedto control Algae. These filters are mechanically simple filters, which are continuous. Cake thickens can be controlled, residual cake moisture can be consistent. They are wide range of materials of construction. The type of vacuum filter used is the BHS Pocket filter. **(3)**

Fig (1): The BHS vacuum filter examined in the Lab.

Oswald and Goluekeexperimented with centrifuges to determine the effect of feed throughput rates, cell concentration, rotational velocity, underflow discharge rates, power requirements, etc. Removal of algae from the influent algal culture (concentration200 mg/1) ranged from 84 percent at a throughputrate of 100 ppm to about 64 percent at 385 ppm at rotationalvelocities of 3000 to 3300 rpm. The details of theeffect of throughput rate, the disc angle and the rotationalspeed of bowl on power requirements are given in the reference.The authors estimated that the minimum power requirementfor concentrating algal culture at a concentrationof 200 mg/1 to be about 2.7×103 kwh per ton (dry weight)of algae. The power requirements could be halved by doublingthe initial algal concentration.**(4)**

Golueke and Oswald3'6 reported on the results of dewatering algal slurry using four different centrifuges, namely, The Byrd solid bowl, the Tolhurst solid bowl, the DeLaval, and the MercoBowl (Dorr-Oliver) centrifuges. Exceptfor the Byrd centrifuge, excellent results were obtained. At a feed rate of 2 to 4 ppm with an initial solids concentrationof about 1100 mg/1, the centrifuged slurry wasfound to have a solid concentration of about 12 percent.The percent removal was about 78 percent. **(5)**

Though successful application of micro strainers in the removal of algae from raw water supplies has been reported, their use with pond effluents appears to be very much limited. Golueke and Oswald3 carried out pilot scale experiments to evaluate the use of micro strainers in algae removal. Flow rates varied from 50 to 100 g p m and the micro strainer was rotated at 10, 20, and 30 rpm. Only very small amounts of algae were removed even with the addition of filter aids, a decrease of flow rates, and slowing of the rotational speed of the filter.**(6)**

Attempts to dewater algal slurry with a vacuum filterwere found to be unsuccessful by Golueke and Oswaldbecause of the inability to form a cake of sufficient thicknessto permit its removal. The California Department ofWater Resources experimented with a continuous belt vacuumfilter. It was found that at a belt speed of 2.9 ft/minand with a vacuum of 15 to 20 inches of mercury, the unitcould produce sludge containing 18 to 25 percent solidsand remove 90 to 95 percent of the influent suspensions.Average concentration of solids in the effluent was about300 mg/1 which necessitated recycling of the effluent fromthe unit.**(7)**

Materials and Methods

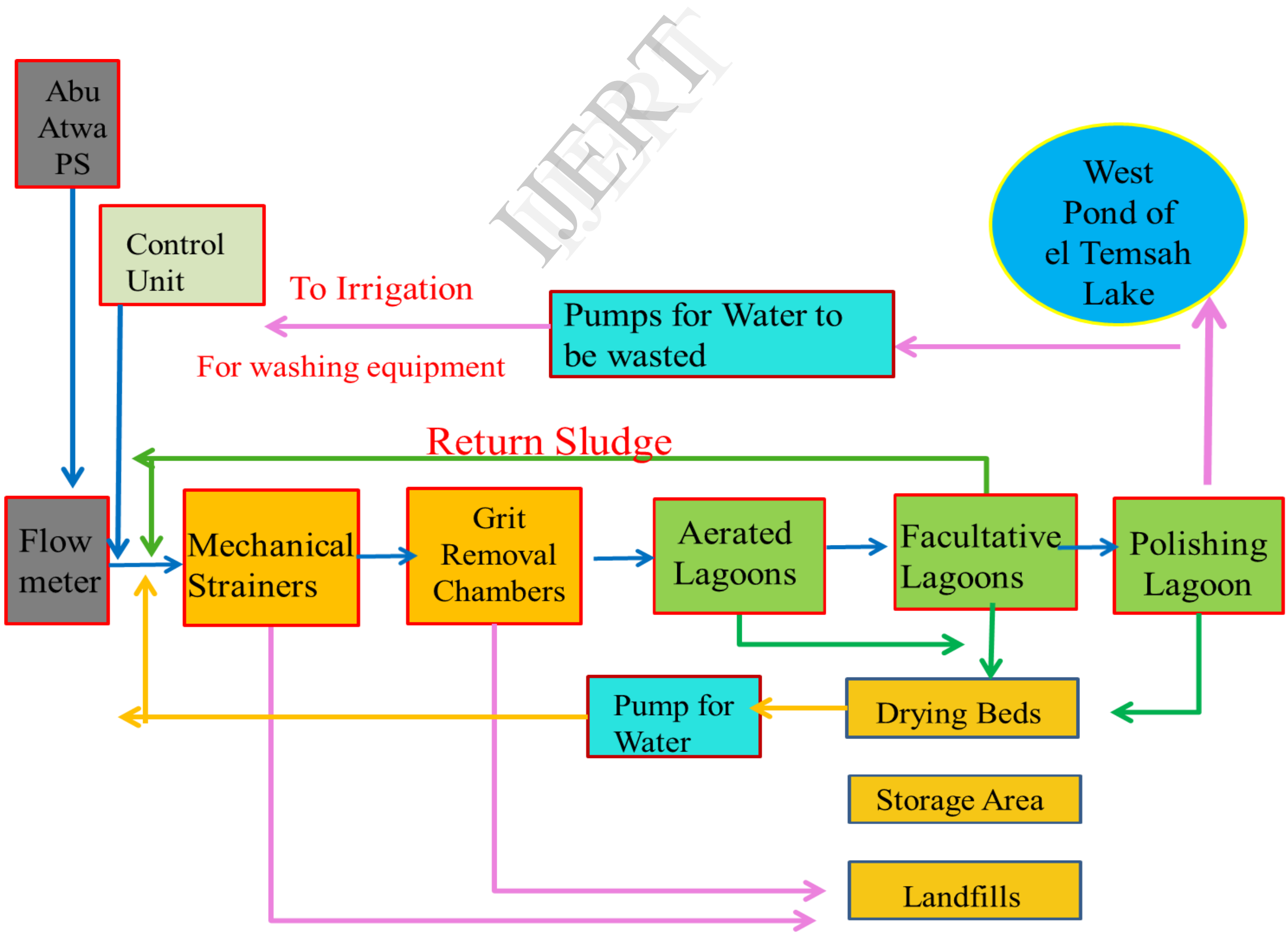
The wastewater come flowing to Sarabium wastewater treatment plant from Abu Attwa pump station, through a diameter of 1200 mmreinforced concreteforce main, with 11 km in length. The raw wastewater has characteristics of TSS 240 mg/l and BOD 270 mg/l. The wastewater then enters to a Deceleration Chamber passing through an approach channel. The wastewater then passes through mechanical screens. Solids more than 2.2 cm are retained on the sieves of the screen. After that, wastewater passes to the Conventional Grit removal Chambers where all types of grits are removed. The first oxidation pond is the aerated lagoon, where the wastewater remains for 24 hours to assure the removal of offensive and bad odors, by activating the aerobic bacteria and increasing the concentration of dissolved oxygen needed for the oxidation of organic matter. Wastewater then, passes to the Facultative Lagoons, which has a retention time of five days. In this pond, bacteria were fed on suspended organic matter and turn it to inorganic matter. Finally the wastewater moves to the Polishing Lagoons, where the wastewater stays for a five days. Samples were collected before the Grit Removal

Chamber and after the polishing lagoons to be test for a BOD and SS. Vacuum filter were added after the polishing lagoon and samples were collected after the vacuum filters to be examined.

Table (1): The descrption of treatment ponds.

Types of Ponds	Number of Ponds	Dimensions	Aerators
Aerated	2	4.3*114*70	20 double speed
Facultative	2	4.3*114*400	20 speed
Polishing	2	3.5*118*490	NA

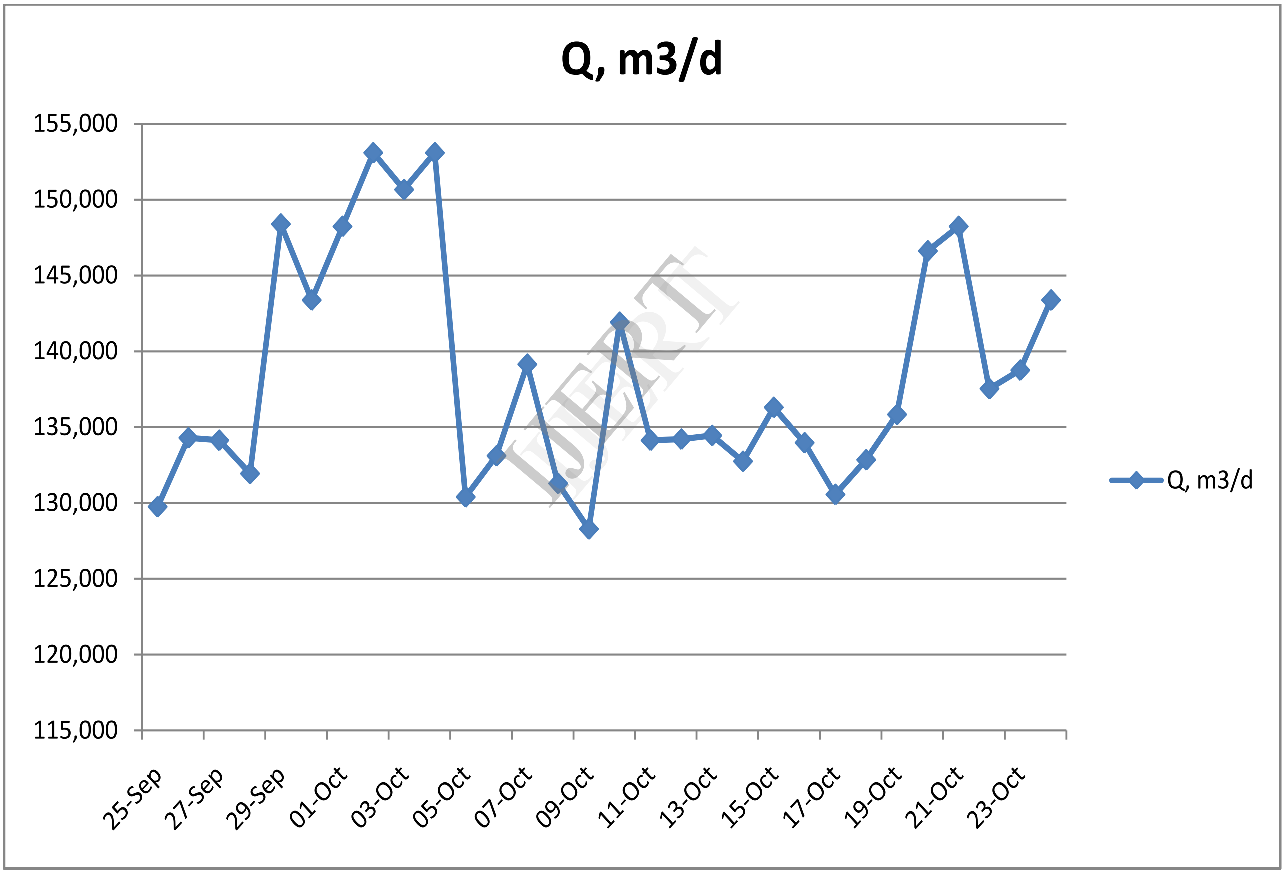
Fig (1): The flow diagram for the wastewater treatment plant.



Results and Discussion

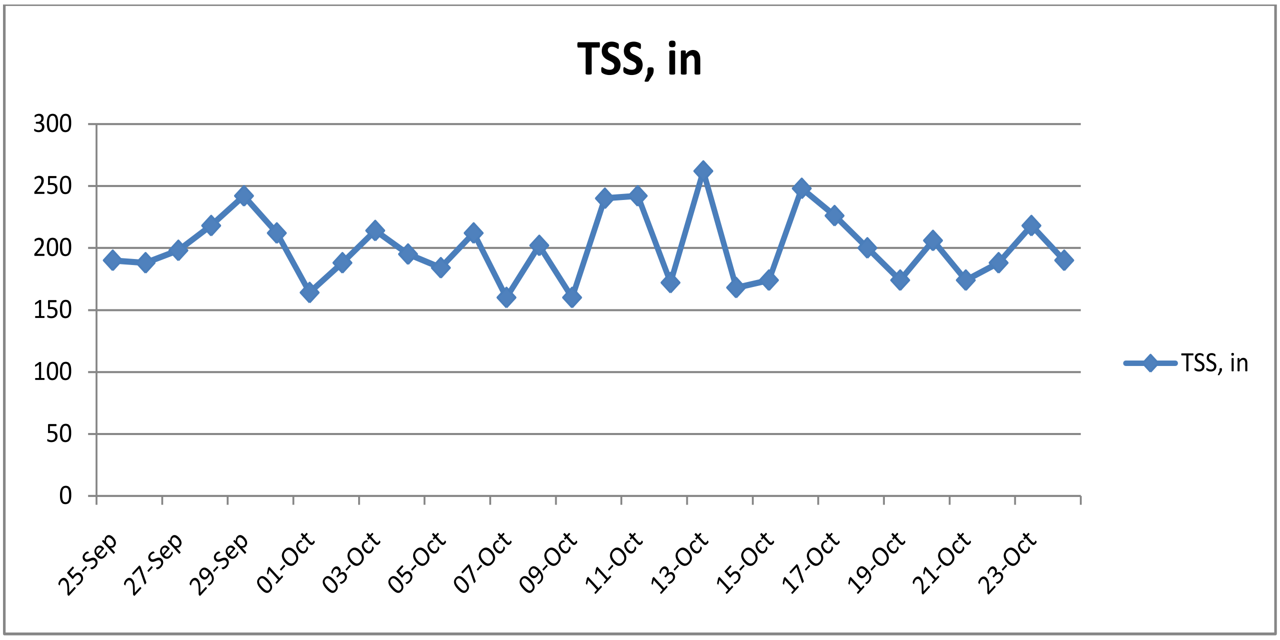
Samples were collected during the study period, which was one month. This month was recorded from 25 September to 23 October. The collected samples were tested and analyzed in the Wastewater treatment plant laboratory of Sarabium. The measured parameters were TSS and BOD, which refers to the algae concentration in the oxidation lagoons.

Fig (2): The Fluctuations of the Flow



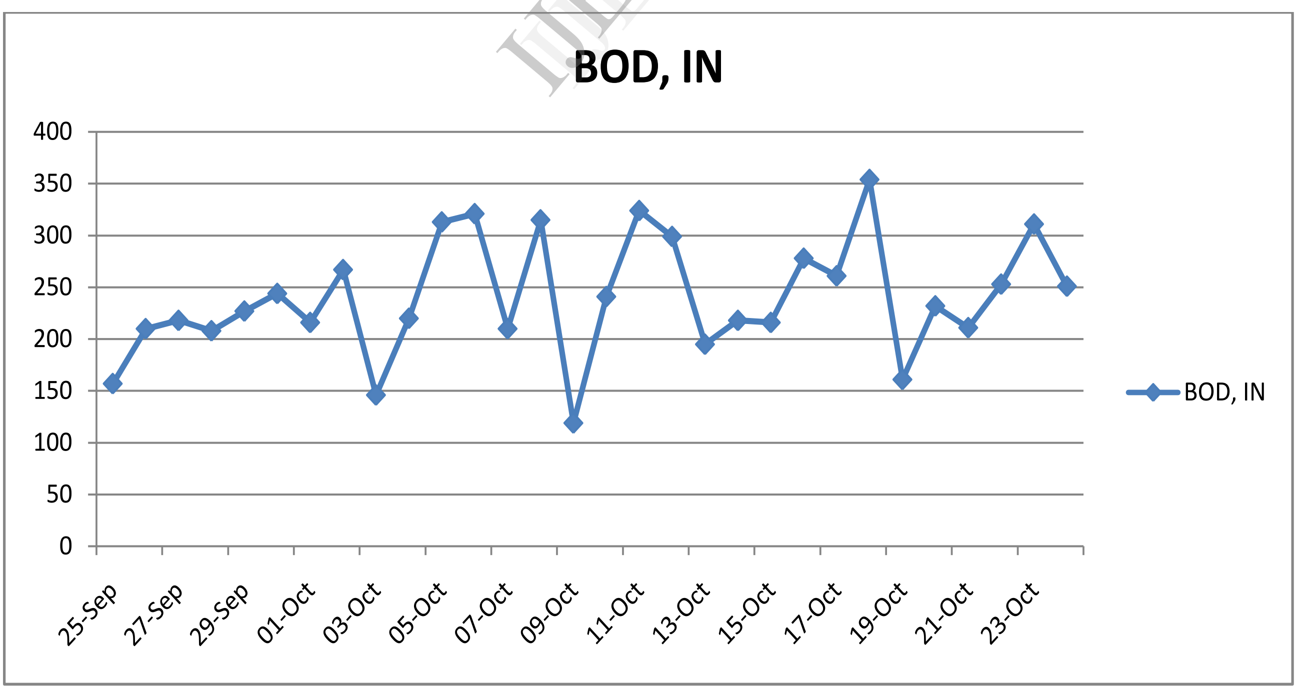
The influent discharge was found to be from 129,000 m^3/d to 154,000 m^3/d through this month.

Fig (3): The concentration of TSS in the influent wastewater.



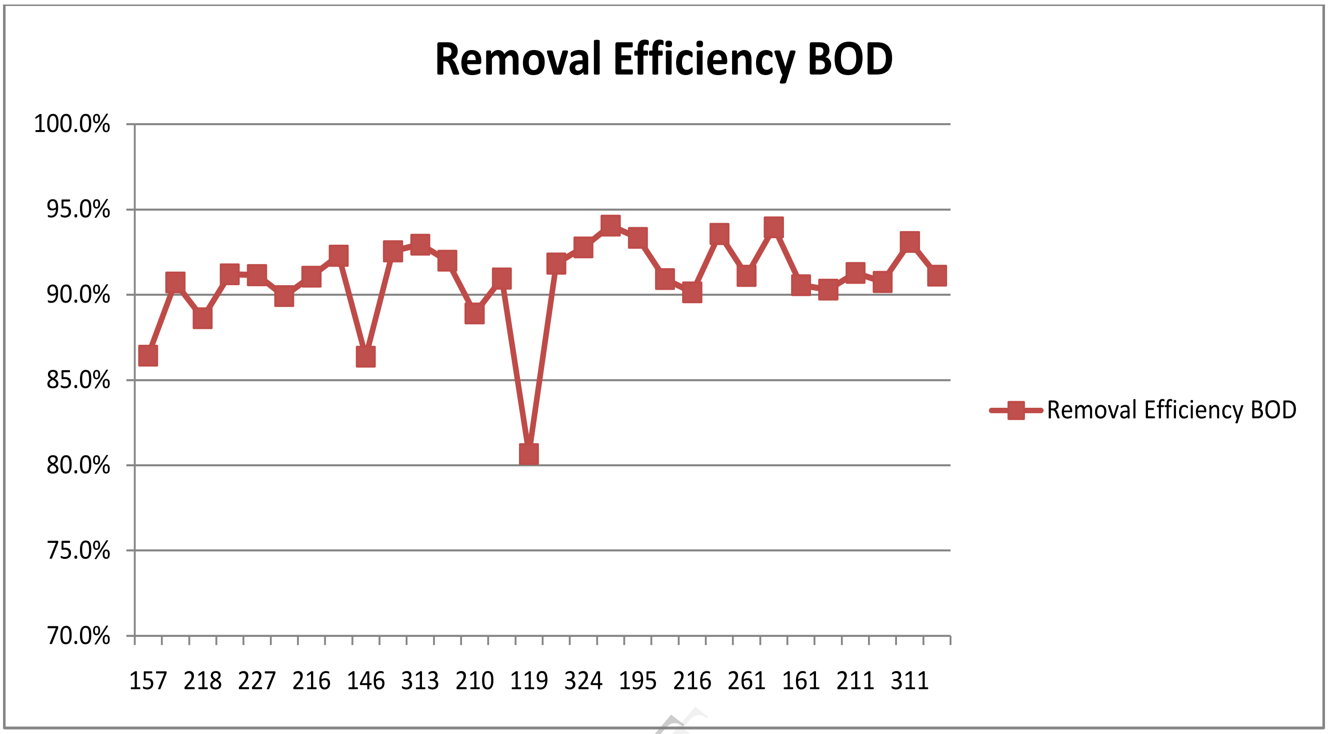
The concentration of TSS in the influent wastewater ranged from 153 mg/l. to 265 mg/l.

Fig (4): The concentration of BOD in the influent wastewater.



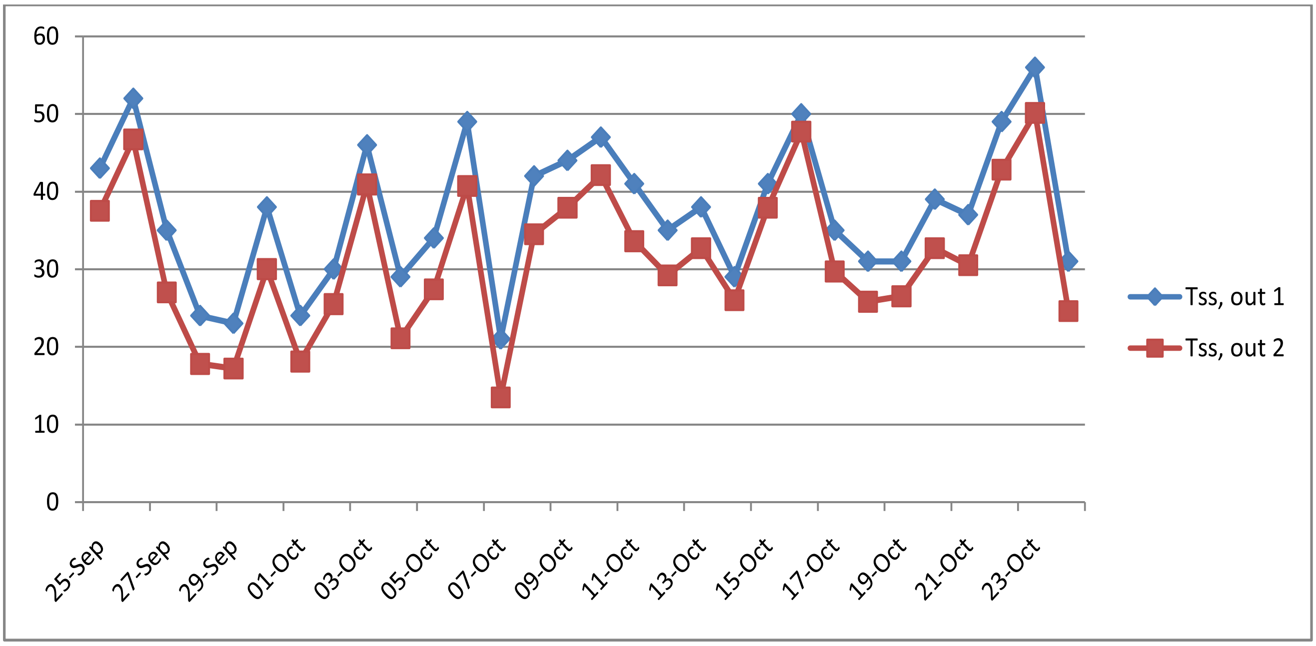
The concentration of BOD in the influent wastewater ranged from 120 mg/l. to 350 mg/l.

Fig (5): The Removal Ratio of BOD.



The removal ratio of BOD ranged between 81% and 94%. The system showed high removal efficiency for the BOD in wastewater. The concentration of BOD in the effluent ranged from 13 mg/l to 26 mg/l compared to an influent from 120 mg/l to 350 mg/l.

Fig (6): The concentration of TSS 1 and 2.



The effluent TSS 1 refers to the samples collected after the polishing lagoons. The concentration of TSS 1 ranged between 25 mg/l to 56 mg/l. The TSS 2 refers to the effluent concentration after the vacuum filter. The concentration of TSS 2 ranged between 13 mg/l to 49 mg/l.

Conclusions and Recommendations

After the analysis of the previous results, we can sum up the following conclusions:

1. The removal ratio of the BOD ranged from 81% to 94%, when the influent ranged from 120 mg/l to 350 mg/l.
2. The concentration of TSS in the effluent after the polishing lagoon was found to be from 25 mg/l to 56 mg/l. However, this means that the TSS increases sometimes than the limits (50mg/l).
3. The concentration of TSS in the effluent after the vacuum filter was found to be from 13 mg/l to 49 mg/l, which in return does not exceed the Environmental limits.

According to the previous conclusion, it is required to add a vacuum filter after the polishing lagoons to control and assure that the concentration of the algae in the effluent of Oxidation lagoons. Algae or tetrads growing in any aerated lagoon systems, ponds or wastewater treatment plants can increase both the TSS and the BOD5 of the effluent. According to the Environmental laws the BOD concentration in the effluent should not increase 60 mg/l, which was achieved in this study. However for the TSS, its concentration in the effluent should not exceed 50 mg/l. The effluent of the TSS after the polishing lagoons was not abiding the Environmental Laws. After the use of vacuum filter, the concentration of the effluent was all in range between 13 mg/l. to 49 mg/l. That's why, it is recommended to use vacuum filters with lagoons to control the TSS, thus control the Algae concentration.

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