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AEROBIC AND ANAEROBIC TREATMENT FOR GREYWATER USING LARGE SCALE MODEL

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ABSTRACT

Reuse of wastewater supports the sustainability, reduces the global environmental pollution and saves money. Greywater is waste water that contain very low amount of organics as it is wash water. This type of waste water can be reused after treatment for irrigation or toilet flushing which reduces the consumption of drinkable water. Treatment of greywater requires special concerns to ensure the validity of its reuse without harmful effects on public health. Therefore, this study adopts development of a large scale model of multi-stages greywater treatment system. The system involved aerobic and anaerobic treatment systems. The results exhibited that the quality of greywater improved with time under the aerobatic treatment efficiently. Moreover, removal efficiency value of BOD and COD are close because most of the organic pollutant in the wastewater are biodegradable and it could be disintegrates by bacteria. In addition, the result indicated that the controlled aeration process reduces the amount of organic material leaving the septic tank by 90% or more. These promising findings increase the concern to reuse this type of wastewater in Iraq.

Keywords: Greywater, Treatment, Sustainability, Aerobic, Anaerobic.

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1. INTRODUCTION

Recycling of waste materials supports sustainability [1, 2], reduces the environmental pollution [3-5], and help development of economy [6-14]. Nowadays, reduction of water resources compared to the increase in population creates a serious problem over the world [15]. Finding alternatives is in high demand. Reuse of greywater which is wash water represents suitable alternative to reduce the drinkable water demand [15]. Public wastewater can be classified to yellow/brown water and greywater. Among these, yellow and brown water express urine and fecal sewages. However, greywater represents urban waste water free from toilets pollutions. The sources of greywater include water from showers, baths, washbasins, laundries, kitchens, and sinks. Among the three waste water types (yellow, brown, and grey), greywater considered to be suitable for reuse due to its availability and low contaminants. However, greywater attained from kitchens shall be excluded as it contains organics. Practical and economical reuse of greywater requires source separation. Greywater can be reused for toilet flushing and irrigation. Generally, greywater includes a small concentration of BOD, nitrogen and phosphorous. Treatment of waste water is a complicated operation [16-24]; over that, treatment of greywater is more complicated [23]. A number of studies were performed in the domain of greywater treatment and reuse [15, 25-32]. However, to the best knowledge of the authors, no such a study covered adopted greywater treatment using large scale treatment model with several stages. In addition, two recent and sophisticated review studies were performed in this domain [33, 34]; both show no such study. Therefore, adoption of the present approach is an essential objective to fill the gap in this area.

2. EXPERIMENTAL WORK

This study depends on experimental approach involving manufacturing of two large scale models for waste water treatment: anaerobic and aerobic treatment systems. The first system (anaerobic) consist of septic fiberglass tank with capacity of 5000 l and 2.5m in depth. Anaerobic bacteria, which are always present in greywater, digest some of the organic solids in this tank. Clarified wastewater in the middle of the septic tank flows by displacement into the leaching bed for further treatment in the soil layer. The second system (aerobic) consists of four phases. The first phase represents a pretreatment stage which consists of two fiberglass tanks each with capacity if 1000 l connected in series. These tanks are utilized to remove the large solids and other undesirable substances from the greywater; this stage acts much like a septic system. The second stage (aeration stage) involved a fiberglass tank (1000 l in capacity) where the aerobic bacteria digest the biological wastes in the greywater. The third (settling stage) is adopted to allow any undigested solids to settle. This forms a sludge which must be periodically removed from the system. The fourth stage (disinfecting stage), in this stage chlorine is mixed with the water to produce an antiseptic output. The measurements of BOD and COD were performed in predetermined times accurately. The measurements of BOD were performed using electronic DO-meter. The COD values were determined using standard method.

3. BOD AND COD RESULTS UNDER AEROBIC TREATMENT

Results of BOD_5 measurements are shown in Figure 1. The values of influent-BOD_5 ranged from 278 mg/l to 306 mg/l (average value of 271 mg/l); whereas, the values of effluent-BOD_5 ranged from 72 mg/l to 165 mg/l (average value of 112 mg/l). Figure 2 illustrates the removal efficiency with time. The removal efficiency increased from 40.7% after 8 hour of treatment to 76.5% after 32 hour of treatment; the average value of removal efficiency was found to be 58%.

Figure 3 illustrates the effect of aerobic treatment on COD values. The results show that the values of influent-COD ranged from 113 mg/l to 201 mg/l (average value of 147 mg/l); whereas, the values of effluent-COD ranged from 303 mg/l to 418 mg/l (average value of 336 mg/l). Figure 4 illustrates the COD removal efficiency with time. The average COD removal efficiency was found to be 54%.

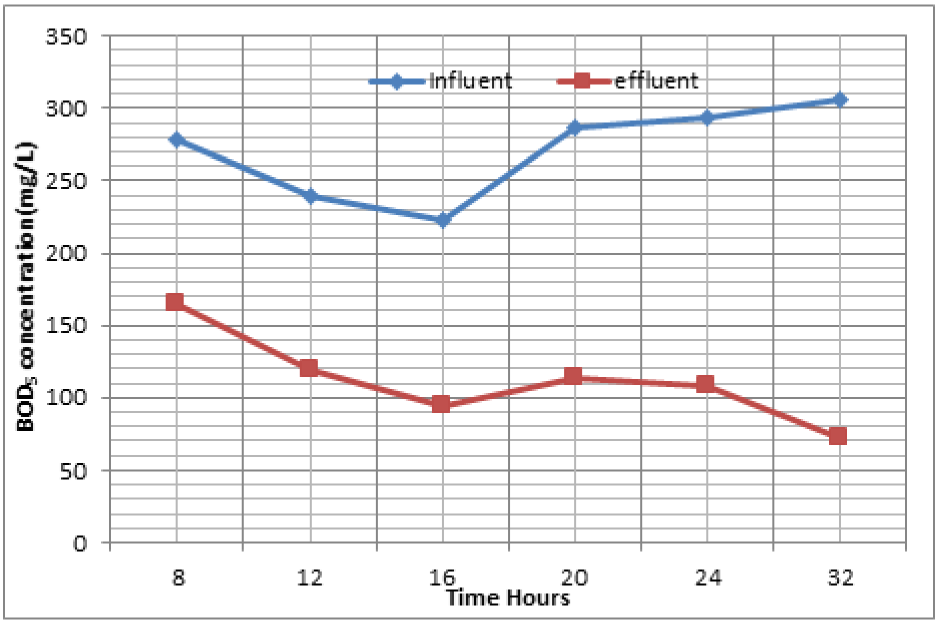

Figure 1 effect of aerobic treatment on influent and effluent BOD values with time

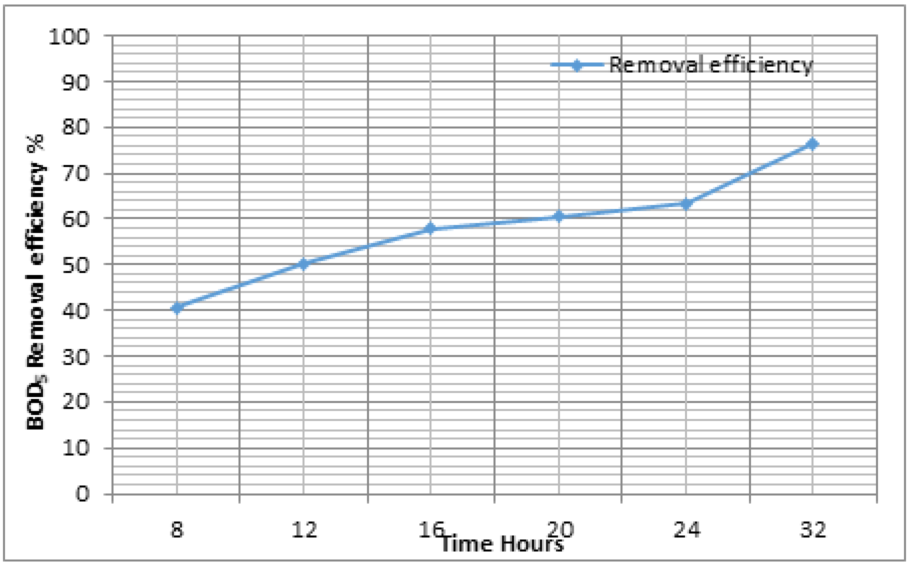

Figure 2 BOD removal efficiency values with time under aerobic treatment

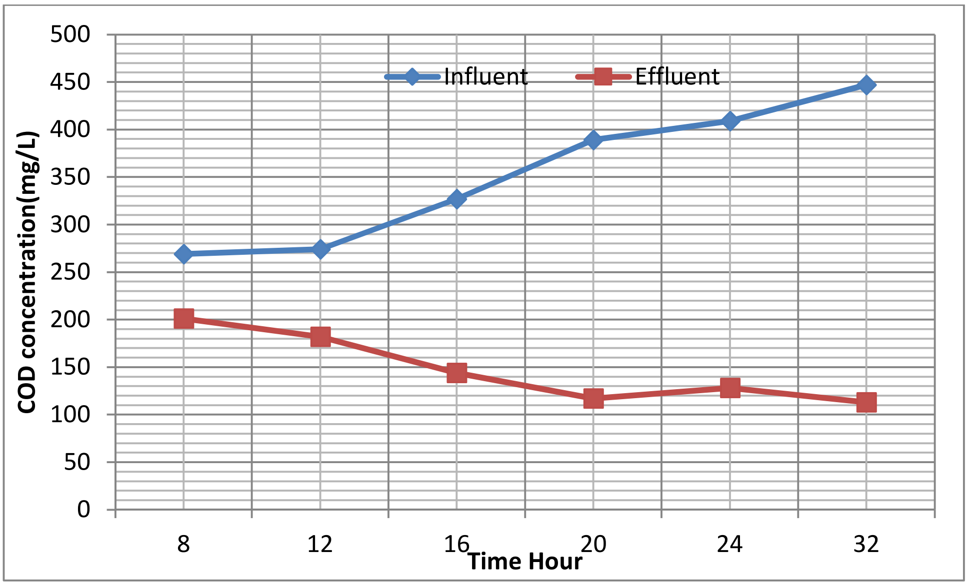

Figure 3 effect of aerobic treatment on influent and effluent COD values with time

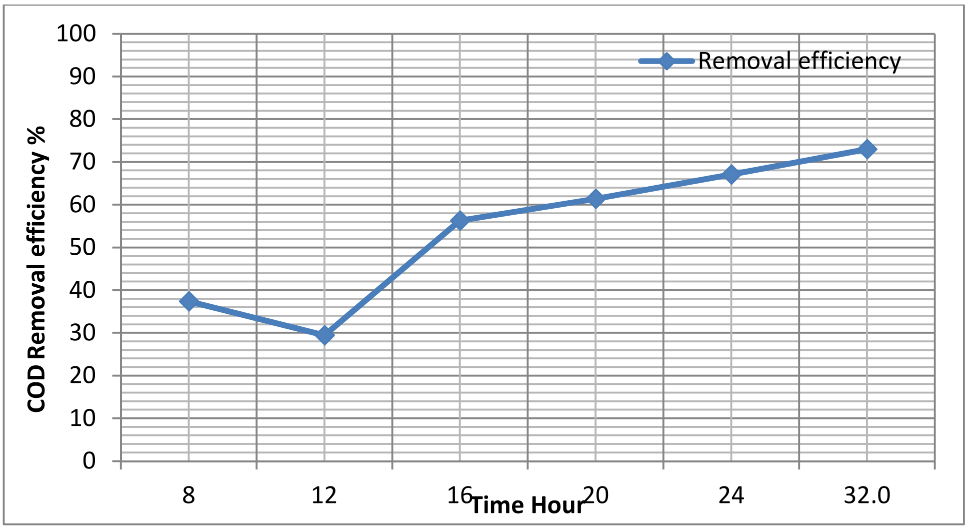

Figure 4 COD removal efficiency values with time under aerobic treatment

The results exhibited that the quality of greywater improved with time under the aerobatic treatment efficiently. Moreover, removal efficiency value of BOD and COD are close because most of the organic pollutant in the wastewater are biodegradable and it could be disintegrates by bacteria. These findings increase the concern to reuse this type of wastewater in Iraq.

4. BOD AND COD RESULTS UNDER ANAEROBIC TREATMENT

Under anaerobic treatment, the values of influent-BOD_5 ranged from 246 mg/l to 398 mg/l (average value of 305 mg/l); whereas, the values of effluent-BOD_5 ranged from 184 mg/l to 211 mg/l (average value of 201 mg/l) as shown in Figure 5. The removal efficiency of BOD increased from 17.8% after 2 days of treatment to 53.7% after 12 days of treatment; the average value of removal efficiency was found to be 32%.

Figure 7 illustrates the effect of anaerobic treatment on COD values. The results show that the values of influent-COD ranged from 296 mg/l to 447 mg/l (average value of 430 mg/l); whereas, the values of effluent-COD ranged from 198 mg/l to 287 mg/l (average value of 230 mg/l). Figure 8 illustrates the COD removal efficiency with time. The average COD removal efficiency was found to be 32%.

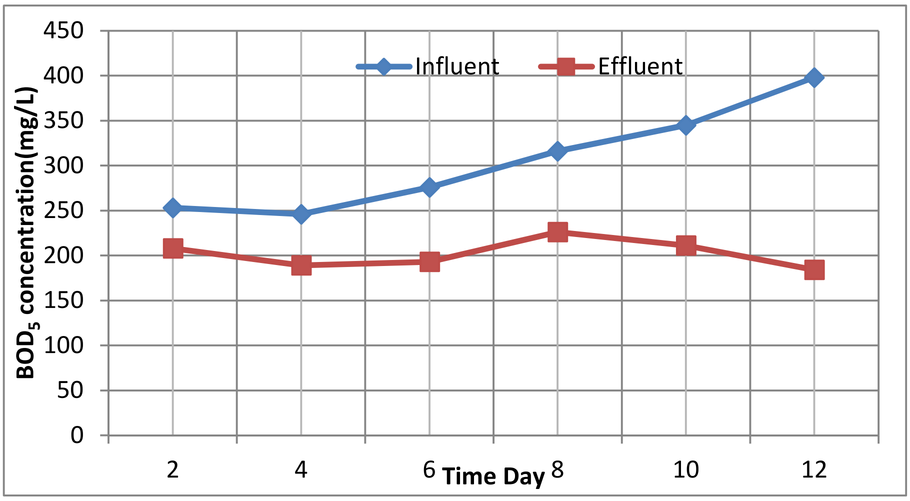

Figure 5 effect of anaerobic treatment on influent and effluent BOD values with time

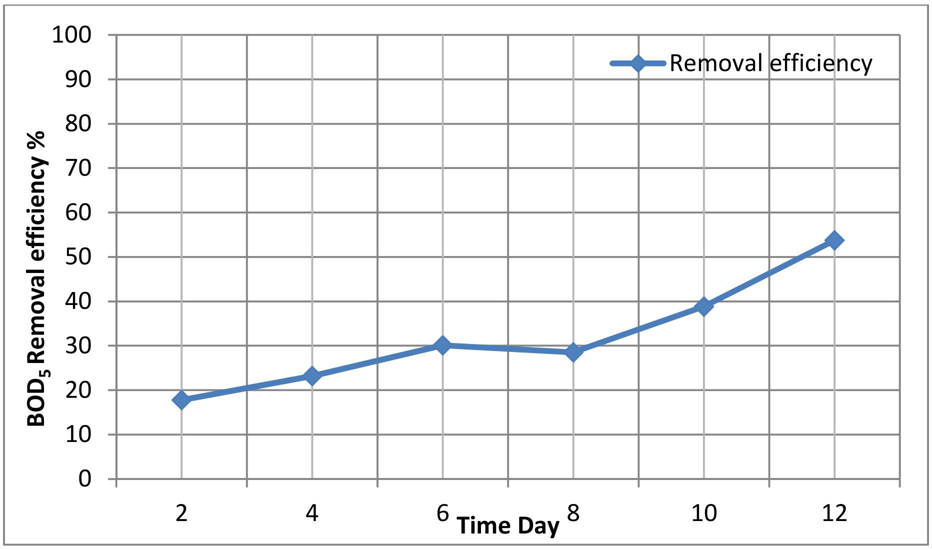

Figure 6 BOD removal efficiency values with time under anaerobic treatment

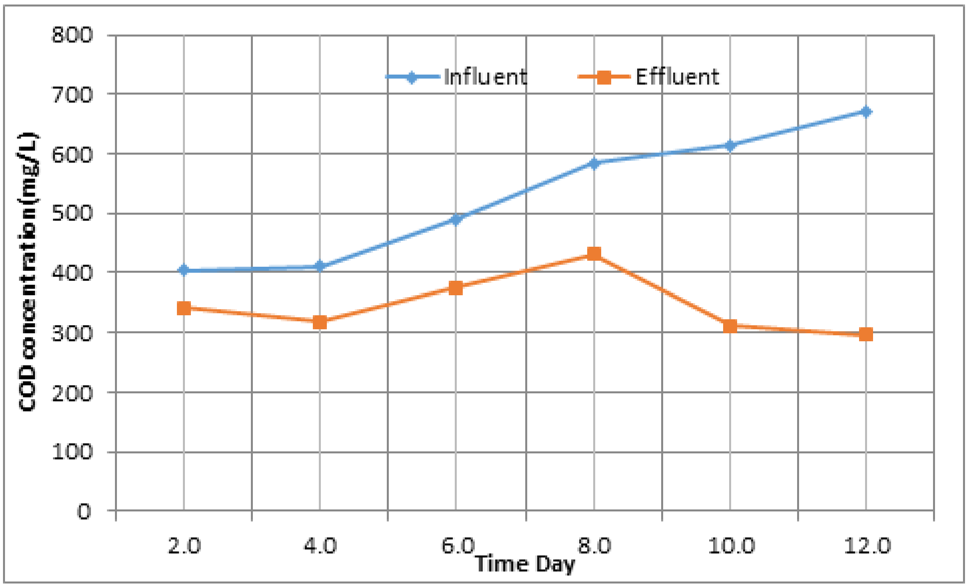

Figure 7 effect of anaerobic treatment on influent and effluent COD values with time

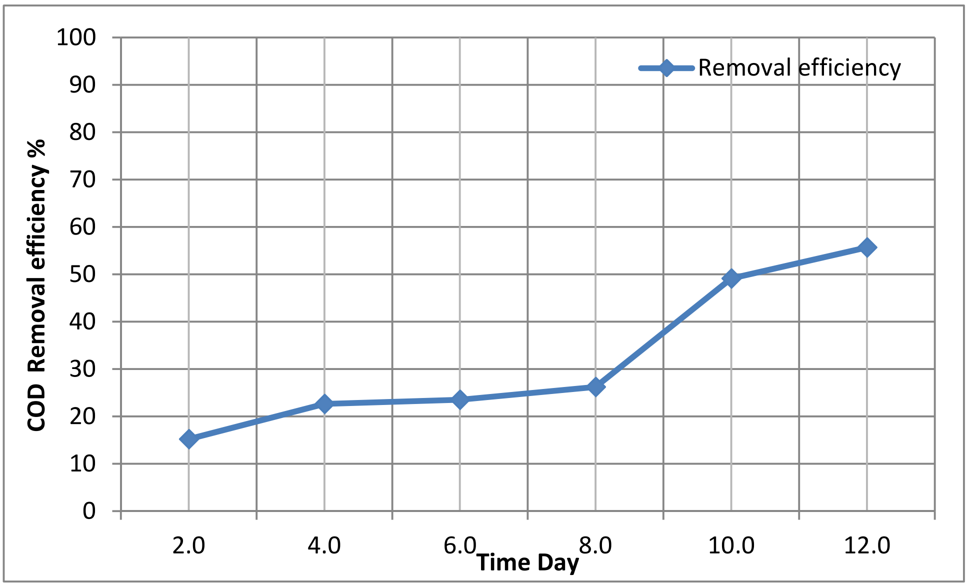

Figure 8 COD removal efficiency values with time under anaerobic treatment

5. CONCLUSION

The present study covered manufacturing of large scale model of multi-stages greywater treatment system involving aerobic and anaerobic systems. The manufactured system was utilized to treat greywater in real conditions. The results exhibited that the quality of greywater improved with time under the aerobatic treatment efficiently. Moreover, removal efficiency value of BOD and COD are close because most of the organic pollutant in the wastewater are biodegradable and it could be disintegrates by bacteria. In addition, the result indicated that the controlled aeration process reduces the amount of organic material leaving the septic tank by 90% or more. These promising findings increase the concern to reuse this type of wastewater in Iraq.

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