APPLICATION OF TRICKLING FILTER WITH HYBRID BIOFILM SUPPORT MEDIA IN THE TREATMENT OF PETROLEUM EFFLUENT

***[1]Okan, O. L., [1]Ugonabor, V. I., [1]Onu, C. E. and [1]Chinedu J. U.**

[1]Department of Chemical Engineering, Nnamdi Azikiwe Univeriesty P.M. B. 5025 Awka, Nigeria.

Email and Phone Number: okantega@gmail.com, +234-8139603395;
vi.ugonabo@unizik.edu.ng, +234-80334810820
ce.onu@unizik.edu.ng,+234-8062407999
cj.umembamalu@unzik.edu.ng +234-8060210050

ABSTRACT

The use of biological trickling filter (TF) system in the treatment of petroleum effluent using Luffa cylindrica-polystyrene hybrid as biofilm support medium for microbiological growth was evaluated. The efficiency of the treatment process was measured in terms of turbidity, chemical oxygen demand (COD) and biological oxygen demand (BOD_5). The TF was set up with Luffa cylindrica-polystyrene hybrid biofilm support. The pilot scale trickling system was performed at an ambient temperature and the effluent from the system was measured for turbidity, COD and BOD_5. The result showed that the turbidity of the effluent was reduced to 94 % at a hydraulic retention time of 6 hrs. The COD was also reduced from 327-26 mg/l at 6 hrs. representing 92 % reduction in the COD value. The results obtained also showed that the TF achieved 78 % reduction in BOD_5.Therefore, the biological trickling filter treatment process appears to be a promising wastewater treatment method for petroleum effluent with respect to the turbidity, COD and BOD_5 removal.

Keywords: *Luffacyllindrica, polystyrene, trickling filter, petroleum effluent, biofilms*

INTRODUCTION

The increasing worldwide energy demand makes the processing of petroleum and the generation of petroleum wastewater important issues (Aljuboury *et al*.,2017). The treatment of industrial wastewater is important study area in environmental engineering. These waste streams are difficult to treat due to large concentrations of oil. The constituents of effluent in refinery wastewater are dependent on the quality of crude oil involved. Petroleum refineries produce large volumes of effluent including oil well produced water brought to the surface during oil drilling. This often contain a recalcitrant compound and rich in organic pollutants therefore cannot be treated easily and difficult to be treated biologically (Vendramel *et al.*, 2015). Petroleum effluent are a major source of water pollution and are wastewater originating from industries primarily engaged in refining crude oil, manufacturing fuels and lubricants (Wake *et al.*, 2005) and petrochemical intermediates (Harry *et al.*, 1995).

Large amounts of wastewaters are generated in the petroleum industry which contain various range of contaminants such as oil, phenols, sulfides, dissolved solids, suspended solids, toxic metals and biological oxygen demand (BOD)-bearing materials, etc (Santos *et al.,* 2016). Management and treatment of these complex wastewaters are a great problem (Tyagi *et al.,* 1993).

Several methods such as chemical oxidation (Hu G *et al.*, 2015), biological techniques (Wang. *et al.*, 2015), coagulation (Farajnezhad and Gharbani, 2012) adsorption (Al Hashemi, 2015), microwave-assisted catalytic wet air oxidation (Sun *et al.*, 2008) and membranes (Shariati*et al.*, 2011) have been employed in the treatment of petroleum effluents.

The problems associated with most of these techniques are high investment along with maintenance costs, secondary pollution (generation of toxic sludge, etc.) and complicated treatment procedure (Sunil et al., 2013). Physicochemical treatments such as coagulation/flocculation processes are generally found to be unable to remove some kind of pollutants. While advanced oxidation process can be effective for the removal of emerging compounds, but the processes can lead to the formation of oxidation intermediates which are mostly unknown at this stage (Kumar et al., 2009). In adsorption processes, the disadvantages associated with activated carbon such as high regeneration cost, intra-particle resistance in adsorption process and poor mechanical strength (Kumar et al., 2009) makes it not suitable for the treatment of petroleum effluent.

Due to the inherent limitations of the existing treatment processes, trickling filter present a good alternative since it is simple, reliable, low-cost, effective in treating high concentrations of organic material, relatively low power requirement and requires moderate skill and technical expertise to operate the system (Amenu, 2014).

A trickling filter is an aerobic wastewater treatment process commonly used for industrial effluents and domestic sewage treatment. Its operation consists of passing the effluent to be treated over a fixed bed of support medium. A biological film usually grows on the surface of the medium. The biological activity of the film will stabilize the organic constituents of the effluent. The biofilm is made to bein contact with the flowing wastewater, and exposed to the air for oxygen uptake.

Many works have been reported on the use of various filter media in trickling filter application. The effectiveness of cotton stick (Mian et al., 2017), Polyurethane (Ahmed, 2012), plastic (Morton &Auvermann, 2001) as filter media in tricking filter has been investigated in the past.

The use of polymer (polystyrene) and *Luffa cyllindrica* fruit as a support medium instead of the stones traditionally used for this purpose is the proposed innovation inthis research. The fibrous *Luffa cyllindrica* offers a great surface forbiological film fixation, with very hard fibrous structure, and when hydrated it degrades very slowly and can act as stimulant for the growth of microorganisms. For this reason, it was devised that the fibrous *Luffa cyllindrica* fruit used in combination with polystyrene could be used to perform this extra function as a medium in trickling filters. The polystyrene provides the stability while the fibrous *Luffa cyllindrica* aid the growth of micro-organism in the film.

MATERIALS AND METHOD

Material Collection and Preparation

Petroleum effluent sample was collected from oil facilities in Ubeji Warri Delta state, and preserved using concentrated sulphuric acid before use.The *Luffa cyllindrica* fruit was collected from Agbor Delta state and treated with 0.5N NaOH for four days. It was later sun dried to obtain fibrous biofilm support medium. Also the polystyrene were collected from Eke-Awka market, treated with 0.5N NaOH for three days and allowed to sun dry.

Experimental Setup of the Trickling filter

Conical shaped reactor body was made up of stainless steel. Its diameter 25cm and length from top to end 152.6 cm. In order to provide enough pressure to meet the design standard hydraulic load, a submersible centrifugal pump of 0.5hp was placed in the tank and connected to fixed nozzles above the columns. The influent in the collection tank was fed to the pipe system above to the constant head feed reactor, were the flow rates was adjusted with the help of control valves to adjust the constant hydraulic flow rate passing through the constant head feed reactor, then trickled downward with the aid of a distribution system made of PVC was installed at the top of reactor to spread petroleum effluent uniformly over filter media. Agricultural material (*Luffa cyllindrica*) and plastic (polystyrene) were used as hybrid filter media in the trickling filter system for microbial growth. Filter media was placed vertically in trickling filter system, and was supported by plastic sieve at the bottom of the filter column to create ventilation. There was a continuous recycling process from the biofilm reactor tank to the collection tank for effective treatment of the petroleum effluent. 6 inches depth drainage layer was constructed at the bottom of reactor for ventilation and for outflow of the waste water from the reactor tank for final sedimentation. A settling tank was provided for collecting and settling waste water.

Figure 1: Diagram of a Constructed Aerobic Trickling Filter

Development of Biofilm and Petroleum Effluent Treatment

To achieve good quality of treated petroleum effluent a healthy and active growth of biofilm layer was necessary. The *Luffa cyllindrica and polymer* was placed in the reactor tank as filter media, the petroleum effluent was trickled over the filter media for development of biofilm. The filter was operated for 30 days for development of biofilm as a startup period. The trickling filter was calibrated and operated at different flow rates. The reactor was run for 6hrs daily for five months using different media with the petroleum wastewater. The hybrid of *Luffa cyllindrica and polystyrene* was used in the experiment for the treating petroleum effluent. After the development of biofilm growth on the media, bacteriological evaluation of the effluent was carried out. Isolation and biochemical techniques were employed to identify pathologenic organism. Continuous recirculation process was done during the experimental periods in order to achieve the treatment efficiency.

Wastewater Sample Characterization

Wastewater samples of influent and effluent were taken and analyzed using standard wastewater analysis, (APHA, 2012). Effluent samples were collected from the opening of the recycling pipe at every hour interval of flow. The analysis carried out were; pH, turbidity, total suspended solids (TSS), total dissolved solid (TDS), Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD). These were carried out according to the American Public Health Association standard methods (APHA 2012).

i. pH Measurement

The pH meter was switched on at least 30 minutes before the test. Buffer solutions of 2.0, 6.0, 8.0 and 10 pH were prepared according to the National Bureau of Standards (NBS, US) and were standardized using a digital pH meter. pH meter was calibrated to 4, 6 and 8 using the buffer and by adjusting the calibration knob. The electrode was inserted into the sample to take the sample pH.

Precautions were taken by ensuring that the electrode was rinsed after removing from each buffer and sample. The pH of the sample appears digitally and is recorded.

ii. Total Suspended Solids (TSS)

An empty beaker was weighed in a digital weighing balance. 5 mL of the petroleum effluent sample was poured into the weighed beaker and heated to dryness in an oven at 100°C. The beaker was then cooled in a desiccator and then reweighed.

Total solid (TS) = $\frac{W_2 - W_1}{V}$ (2.1)

Where; W_1= weight of empty beaker; W_2= weight of beaker and sample after heating to dryness; V= volume of petroleum effluent

iii. Total Dissolved Solids (TDS)

Petroleum effluent sample of 5ml was measured and filtered using a filter paper. The filtered petroleum effluent sample was poured into a weighed 50mL empty beaker. The sample in the beaker was then heated to dryness in an oven at 100°C. It was further cooled in a desiccators, thereafter, its weight was taken in a digital weighing balance. The dissolved solid was calculated using eqn 2.2.

Dissolved solid (DS) = $\frac{W_2 - W_1}{V}$ (2.2)

Where; w_1= titre value of petroleum effluent sample; W_2= weight of beaker and sample after heating to dryness; V= volume of petroleum effluent

iv. Chemical Oxygen Demand (COD)

Petroleum effluent sample of 10ml was pipetted into a 250 mL conical flask. 5 mL of 0.025N potassium dichromate ($K_2Cr_2O_7$), 15 mL of concentrated sulphuric acid, 40 mL of distilled water (to dilute the mixture) and 7 drops of phenanthroline ferrous sulphate indicator were added to the conical flask in that order. The mixture was allowed to cool and thereafter titrated with 0.025N ferrous ammonium sulphate. The initial greenish blue colour of the solution turns to orange. A blank sample of distilled water was also titrated with 0.025N ferrous ammonium sulphate. The chemical oxygen demand was then calculated using eq. (2.3).

COD = $\frac{(A - B) \times N \times 8000}{V} - 0.23$ (2.3)

Where, A= titer value of the petroleum effluent

B= titre value of blank solution

V= volume of petroleum effluent

N = normality of the titrant

Chloride correction factor = 0.23

Constant = 8000

v. Biological Oxygen Demand (BOD)

BOD_5 was analyzed using 1000mg/l stock solution of the water samples were poured into a 300ml BOD bottle and mixed with distilled water until it overflowed and was then stopped. Another standard 300ml bottle was filled with distilled water to represent the blank. The initial dissolved oxygen concentration of the blank and diluted sample was determined using dissolved oxygen, DO, meter. Both bottles were stored at 20^0 C in the incubator for 5 days, the amount of dissolved oxygen remaining in the sample were measured with a DO meter. The biological oxygen demand was then calculated using eq. (2.4)

$BOD_5 = \frac{D_1 - D_2}{P}$ (2.4)

Where, D_1= DO of diluted sample immediately after preparation, mg/l; D_2 = DO of diluted sample after 5 days incubation of 20^oC, mg/l; P = decimal volumetric fraction of sample used.

Performance of Trickling Filter on Petroleum Effluent

The effluent was accessed by the results gotten from the petroleum effluent before and after treatment. The flow rate was maintained at 125 m3/ml, 175m3/ml and 250 m^3/ml. The samples were analyzed for BOD_5, COD and Turbidity. All the laboratory analysis for the samples were done according to World Health Organization (WHO, 2018).

Effect of Process Variables

1. Concentration of Petroleum Effluent

According to the modified procedure reported by Mian et al., (2017). The experiment was conducted at a constant pH and flow rate and at room temperature. Initial concentration of 100 mg/L of petroleum effluent was prepared. 0.1N HCl and 0.1 N NaOH was used to adjust the pH of the effluent to 6.0. The trickling filter was set after priming the centrifugal pump. The petroleum effluent was pumped into the settling tank from which it will be later transferred to the collection tank that is at constant head. The flow rate of the collection was adjusted and the waste water was allowed to trickle into the reactor containing the biofilm support media from which the removal of organic contaminants was done. The effluent from the biofilm support was allowed to settle in a settling tank. The BOD_5, COD, TSS, TDS and Turbidity of the influent and the final effluent was measured at 5 days interval.

2. Effect of Flow Rate of The Petroleum Effluent

The experiment was conducted at a constant concentration and pH of 100 mg/L and 6.0 respectively and at room temperature. Flow rates of 125 m3/s, 175m3/s and 250 m^3/s of petroleum effluent was considered in this study. The trickling filter was set after priming the centrifugal pump. The petroleum effluent was pumped into the settling tank from which it was later transferred to the collection tank that is at constant head. The flow rate of the collection was adjusted and the waste water was allowed to trickle into the reactor containing the biofilm support media from which the removal of organic contaminants was done. The effluent from the biofilm support was allowed to settle in a settling tank. TheBOD_5, COD, TSS, TDS and Turbidity of the influent and the final effluent will be measured at 5 days interval.

3. pH of the Petroleum Effluent

According to the modified procedure reported by (Mian et al., 2017). The experiment was conducted at a constant concentration and flow rate of 125 m3/s, 175m3/s and 250 m3/s and at room temperature. pH of 4.0, 6.0 and 8.0 of petroleum effluent was considered in this study. 0.1N HCl and 0.1 N NaOH will be used to adjust the pH of the effluent to a desired value. The trickling filter was set after priming the centrifugal pump. The petroleum effluent was be pumped into the settling tank from which it was be later transferred to the collection tank that is at constant head. The flow rate of the collection will be adjusted to 250 m3/ml and the waste water was allowed to trickle into the reactor containing the biofilm support media from which the removal of organic contaminants was done. The effluent from the biofilm support was allowed to settle in a settling tank. The BOD5, COD, TSS, TDS and Turbidity of the influent and the final effluent was measured at 5 days interval.

RESULTS AND DISCUSSIONS

Performance of Trickling Filter on Petroleum Effluent

The performance of the trickling filter using *Luffa cyllindrica – Polystyrene* as biofilm support are shown in Figs. 3.1-3.3. According to Fig. 3.1, the percentage turbidity of the different concentrations of the PE was plotted against the hydraulic retention time in order to get the treatment efficiency. It shows that for 100mg/l, the amount of turbidity removal increased as the time of treatment increased from 0.02 hour to 6 hours. At 0.02hr, the percentage turbidity removed from the system was 36.65 %. This increased to 93.3 % at 2 hrs and to 93.3 % at 5 hours. The maximum turbidity removed by the system was 93.33% at 6 hrs.Increase in concentration of the effluent results to lower removal efficiency. Increased in concentration means that more substrate (crude oil) are in the petroleum effluent. At higher initial PE concentration, the trickling filter will take more time to treat the effluent than when the concentration is less.

Fig. 3.2 shows the percentage COD removal by the trickling filter using *Luffa cyllindrica* as biofilm support at different initial PE concentrations. It shows that for 100 mg/l, as the time of treatment increased from 0.02 to 1 hr, the percentage removal of COD increased from 9-70 %. The percentage of COD removal increased to 92.7 % at 6 hours. 100 mg/l performed better than 200 mg/l and 200 mg/l performed better than 300 mg/l and so on. Increasing concentration of PE lowers the % COD removal from the system.

Fig.4.3 shows the percentage removal of BOD_5 with respect to time of treatment. In the same way, for 100 mg/l, the percentage removal of BOD_5 increased with time from 36.65 % at 0.02 hr to 78.33% at 6 hrs. The BOD_5removal was also observed to vary across the different concentrations.

Fig 3.4 shows the percentage removal of TSS with respect to time of the treatment. For 100mg/l, the percentage removal of TSS decreases with of time from 48% at 0.02 hrs to 24% at 6 hrs. The removal was also observed to vary across the different concentrations.

In the same way, Fig 3.5 shows the percentage removal of TDS with respect to time of the treatment. For 100mg/l, the percentage removal of TDS decreases as time increases from 64% at 0.02 hrs to 20% at 6 hrs. The removal was also observed to vary across the different concentrations. Variation in treatment efficiency was recorded due to the accumulation of slough-off material or degradation of solids from filter media during the operation of the trickling filter system. The decrease in efficienciesof TSS and TDS with increasing flow rate may be due tothe higher hydraulic loading rate, which may reduce theresidence time of WW in a trickling filter, which reducesthe contact between liquid and biofilm.This was contracted with results reported by (Mian et al., 2017) having a average TSS removal efficiency achieved to be 47, 46, 48, and 44 % at flow rates of 2.6,3.8, 1.7, and 4.6 m3/hr and TDS average removal efficiency of 28, 29, 32, and 25% at flow rates of 2.6, 3.8, 1.7, and4.6 m3/hr, respectively.

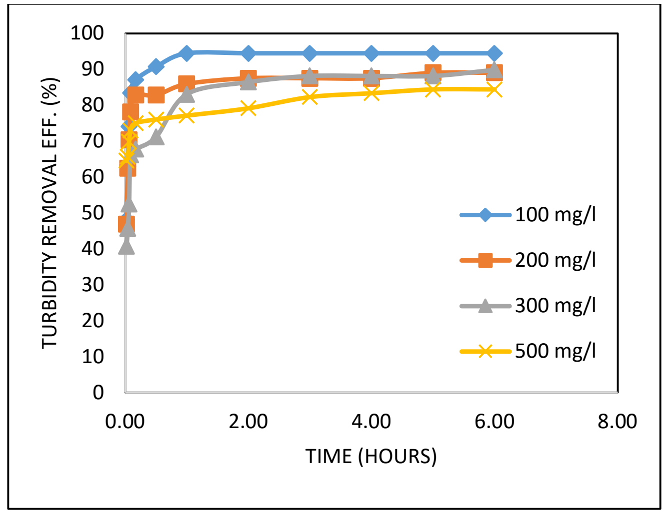

Fig. 3.1: Percentage removal of Turbidity from PE using Luffa cyllindrica – Polystyrene

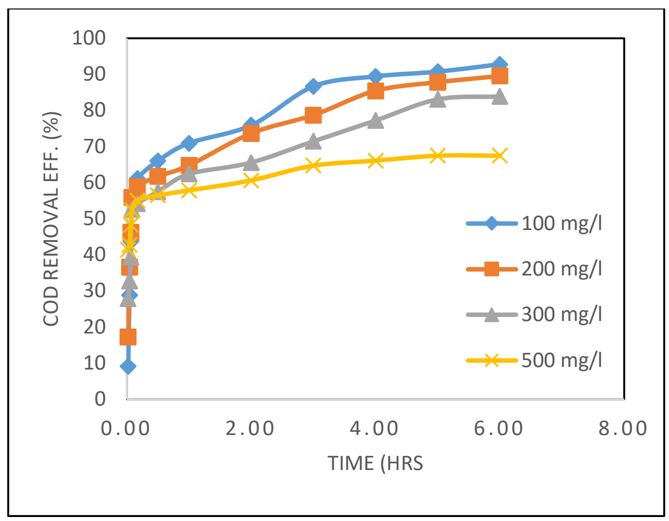

Fig. 3.2: Percentage removal of COD from PE using hybrid media

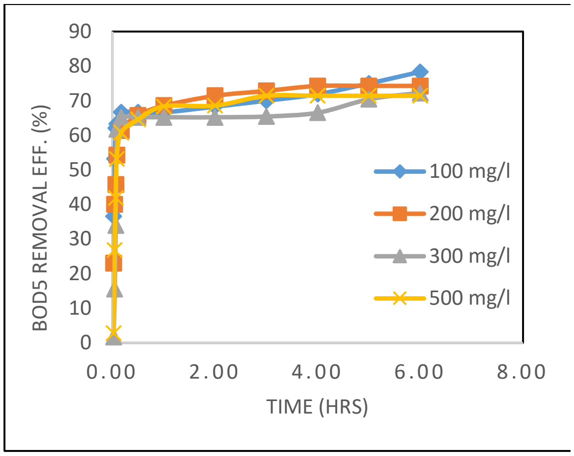

Fig. 3.3: Percentage removal of BOD_5 from PE using hybrid media

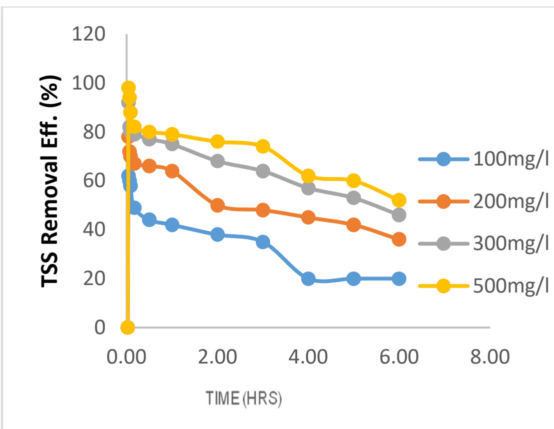

Fig. 3.4: Percentage removal of TSS from PE using hybrid media

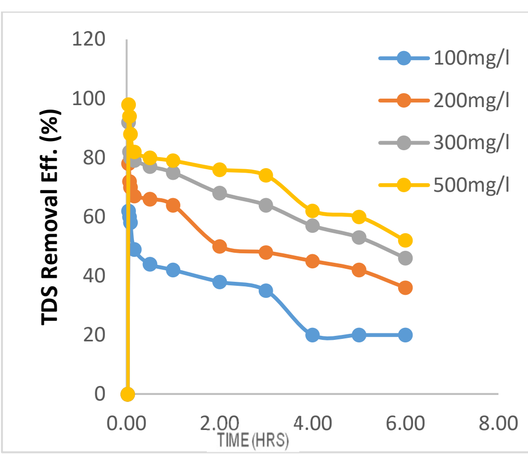

Fig. 3.5: Percentage removal of TDS from PE using hybrid media

Effect of petroleum effluent concentration

The effect of petroleum effluent initial concentration on the performance of the trickling filter using *Luffa cyllindrica* as biofilm support are shown in Fig.3.6 (turbidity), Fig. 3.7 (COD) and Fig. 3.8 (BOD_5). According to Fig. 3.6, increasing the initial concentration of the petroleum effluent results in less removal of substrate from the solution. Lower concentration (100 mg/l) of PE gave better performance than the higher initial concentrations (500 mg/l). Also, at 100 mg/l initial concentration, there was fast removal of crude oil from the effluent at initial stage. At 0.02 hrs, the concentration of PE in the solution was 48.18 %. This increased to 90.74 % at 0.5 hrs and peaks at 1 hr with 94.44 % of the substrate removed. This observation was the same with 200, 300 and 500 mg/l of PE.

Fig. 3.7 shows the effect of concentration of PE on COD. According to Fig. 3.7 there was fast removal of the substrate from the solution between 0.02 hr to 2 hrs. For 100 mg/l initial concentration, at 0.02 hr, 0.794 % of COD was removed from the solution. This increased to 62.90 at 0.5 hr and then to 92.12 at 6hrs. The observations were the same for 200, 300 and 500 mg/l at the same operating conditions. It however mean that the TF performs better at lower concentration. This is because at higher concentrations, there are quit great numbers of crude oil molecule and with poor bioavailability results in poor treatment efficiency.

Fig. 3.8 shows the effect of PE on BOD_5. At 0.02 hrs for 100 mg/l initial concentration of PE, the value of BOD_5 was 29.62 %. This increased to 62.96 at 0.5 hrs and to 75.92 at 6 hrs. There was also an increase in BOD_5 removal with time at 200, 300 and 500 mg/l. However, 300 mg/l performed better than other initial concentrations.

Higher BOD and COD removal efficiencies were due to higher oxygen availability. The oxygen is used to maintain the aerobic zone in the outer portion of the slime layer, which cause the organic substrates (petroleum effluent) to degrade. However, low BOD and COD removal efficiencies were due to low oxygen availability, which resulted in increased slime layer thickness and caused anaerobic zone maintenance in the outer portion of this slime layer. The anaerobic zone caused a decrease in the full degradation of the PE before being discharged from the trickling filter system (Imran *et al.,* 2016; Mian *et al.,* 2017).

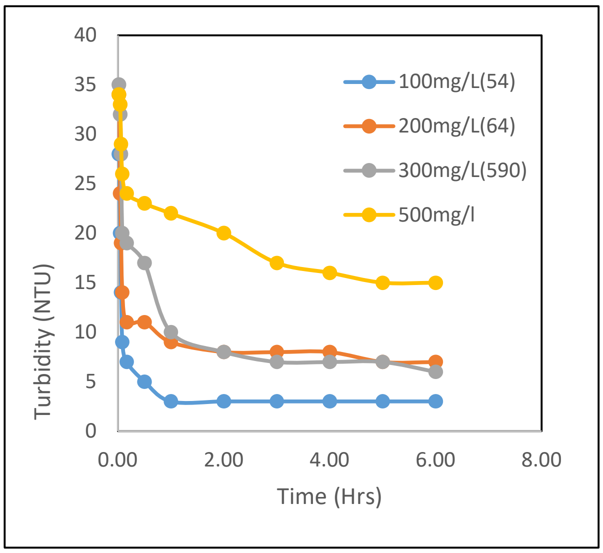

Fig. 3.6: Effect of concentration of PE on Turbidity

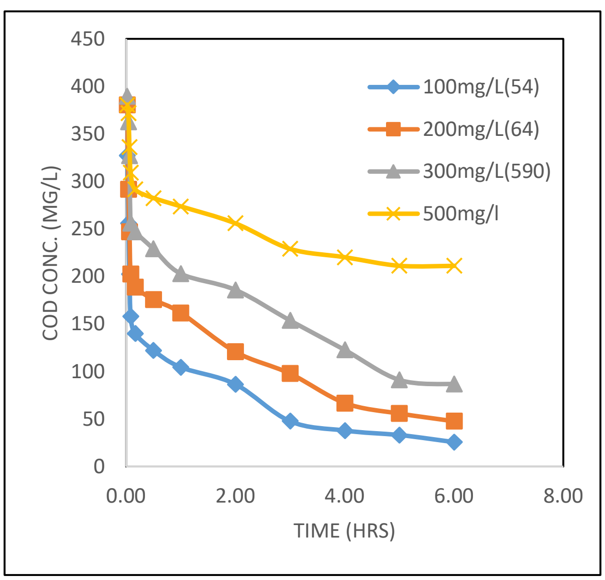

Fig. 3.7: Effect of concentration of PE on COD

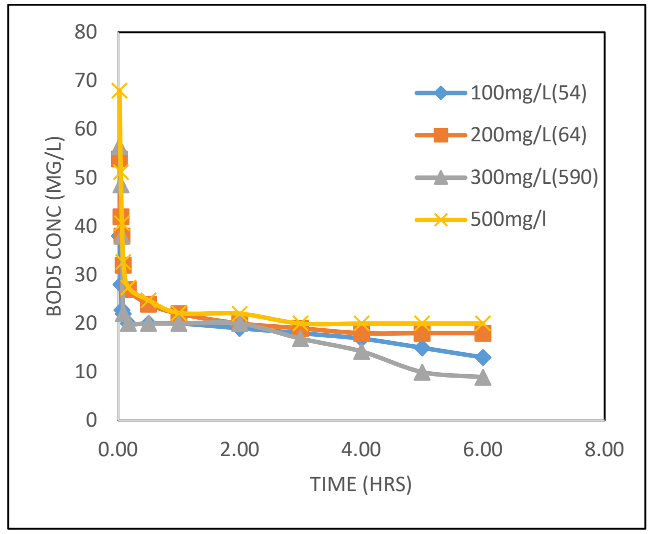

Fig. 3.8: Effect of concentration of PE on BOD_5

Effect of pH of petroleum effluent

The effect of pH of solution on the treatment of petroleum effluent using *Luffacyllindrica* as biofilm support are shown in Figs. 3.9-3.11. This was done at the following conditions: ambient temperature of 30 °C, flow rate of 175 ml/s (0.000175 m^3/s), and 100 mg/l concentration of PE. According to Fig.3.9, increasing the pH of the solution tend to increase the removal of the turbidity. At pH of 4.0, 6.0 and 8.0, and retention time of 0.02 hrs, the turbidity of the solution were 8.82, 59.25 and 15.24 NTU, respectively. At 1 hr and at the same pH, the turbidity of the solution were 70.59, 87.03 and 76.27 NTU, respectively. The maximum turbidity obtained at 6 hours were 88.23, 92.59 and 88.13 NTU for 4.0, 6.0 and 8.0 pH, respectively.

Fig. 3.10 shows the effect of pH of PE on COD. It showed that as the pH of the solution increased from 4.0 to 6.0, the COD of the system increased too. However, beyond 6.0, the COD decreased. Therefore pH of 6.0 was the maximum pH at which the TF removed the PE from the solution. This in in agreement with the report of Haimanot and Hartmut (2013), who reported pH of between 6.3-7.0 as the best pH for TF performance.

Fig. 3.11 shows the effect of PE treatment by TF on BOD_5. This also showed that the value of BOD_5 for the TF system increased from 4.0 to 6.0 and then decreased. The BOD_5 obtained at 0.02 hrs at 4.0, 6.0 and 8.0 were 14.94, 58.97 and 0.881 %, respectively. At 1 hr, the BOD_5 removal at these same pH values were 62.96, 67.61 and 79.38 %, respectively. At 6 hrs, the maximum BOD_5 removal at these pH values were 81.48, 83.33 and 81.44 % respectively.

The reduction of turbidity at higher could be due to the increased solubility of crude oil in the aqueous solution and the abundance of hydroxyl ion (OH^-) on the solution which limits the removal of the turbidity from the system.

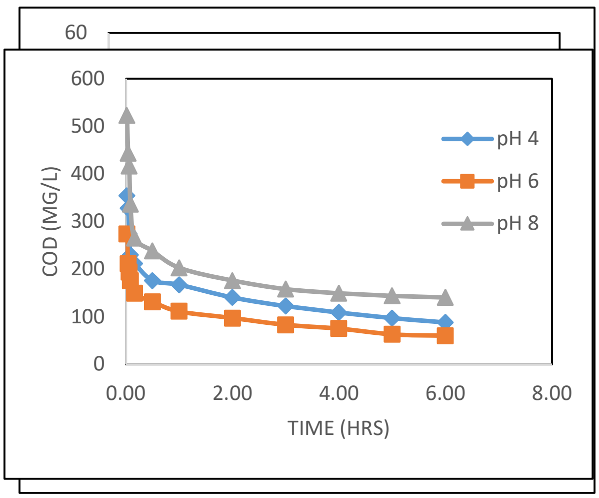

Fig. 3.9: Effect of pH of PE on turbidity

Fig. 3.10: Effect of pH of PE on COD

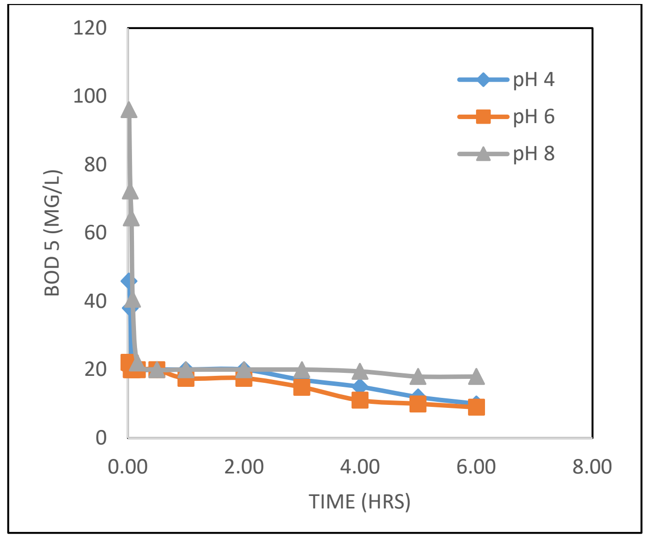

Fig. 3.11: Effect of pH of PE on BOD_5

Effect of effluent flow rate

The effect of flow rate of the effluent on the treatment efficiency using *Luffacyllindrica* as biofilm support are shown in Figs. 3.12-3.14. This was done at the following conditions: ambient temperature of 30 ºC, 100 mg/l concentration of PE and pH of 6.0. The flow rates considered were 125 ml/s (0.000125m^3/s), 175 ml/s(0.000175m^3/s) and 250 ml/s (0.000250 m^3/s). Fig. 3.12 shows the effect of flow rate of PE on turbidity. At flow rate of 125 ml/s, the turbidity of the effluent at 0.02 hrs and 1 hr were 46 and 12 NTU. The turbidity later decreased to 3 NTU at 6 hrs. These observations were the same for 175 and 250 ml/s. However, comparing the different flow rates at the same conditions it was observed that at 0.02hrs, the turbidity recorded were 46, 77 and 85 NTU for 125, 175 and 250 ml/s, respectively. At 1 hr, the turbidity recorded were 12, 16 and 24 for 125, 175 and 250 ml/s, respectively. At 6 hrs, it was 3, 7 and 11 for 125, 175 and 250 ml/s, respectively.

Fig. 3.13 shows the effect of flow rate of PE on COD. It shows that increasing the hydraulic retention time from 0.02 hrs to 6 hours decreases the COD from 488 mg/l to 88 mg/l at 125 ml/s flow rate. Comparing the three flow rates studied, it shows that at 0.02 hrs, the COD of the effluent were 488, 764 and 835 mg/l for 125, 175 and 250 ml/s, respectively. At 1 hr, the COD decreased to 185, 256 and 292 mg/l for 125, 175 and 250 ml/s, respectively. At 6 hrs retention time, the COD values were 86, 134 and 176 mg/l for 125, 175 and 250 ml/s, respectively.

Fig. 3.14 shows the effect of flow rate of PE on BOD_5. Comparing the effects of the different flow rates on the efficiency of BOD_5, it shows that at 0.02 hrs, the values of BOD_5 obtained for 125, 175 and 250 ml/s were 86, 167 and 189 mg/l, respectively. At 1 hr, the BOD_5 obtained for 125, 175 and 250 ml/s were 20, 22 and 27 respectively. These decreased further to 20, 20 and 22 for 125, 175 and 250 ml/s, respectively at 6 hrs. This shows that at 6 hrs, 91.5, 91.5 and 90 % of the total BOD_5 in the effluent was removed.

This decrease observed for the parameters (Turbidity, COD and BOD_5) as the flow rates increased is as a result of the high hydraulic packing in the trickling filter which in turn reduced residence time in the TF.

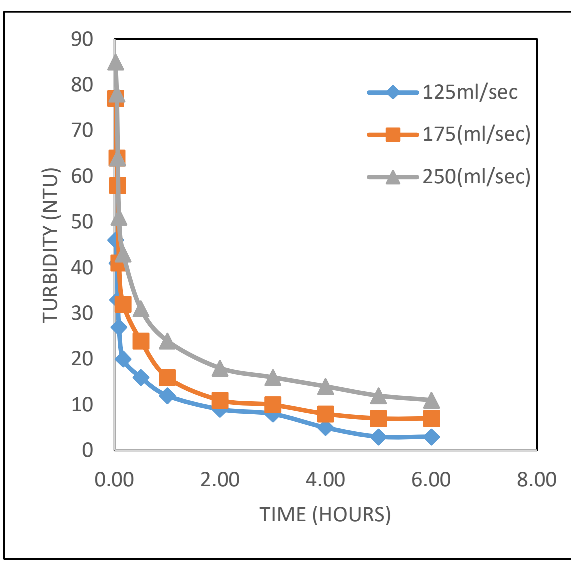

Fig. 3.12: Effect of flow rate of PE on turbidity

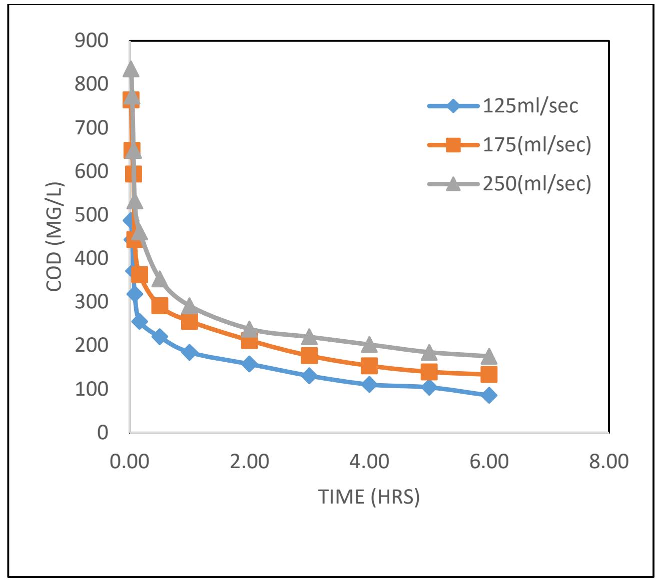

Fig. 1.13: Effect of flow rate of PE on COD

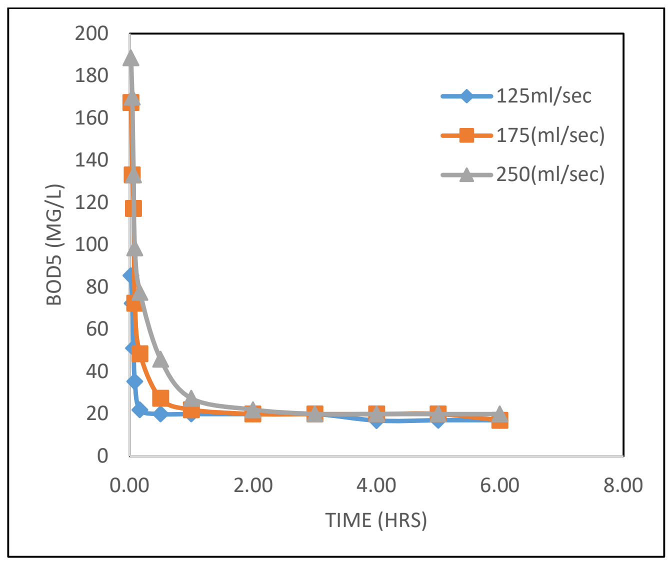

Fig. 3.14: Effect of flow rate of PE on BOD_5

CONCLUSION

A pilot scale biological trickling filter system was set up and used to treat petroleum effluent.*Luffa cyllindrica*- Polystyrene was used as hybrid biofilm support media.The effect of the process variables showed that the turbidity, COD and BOD_5 values were influenced by the parameters studied. The initial concentration of the petroleum effluent decreased as the hydraulic retention time increased. The turbidity, COD and BOD_5 of the effluent decreased as the flow rates of the effluent increased. The maximum pH obtained from the system was 6.0.The maximum turbidity, COD and BOD_5 removed at 6 hours period was between 87-94 %, 75-92% and 70-78 %, respectively. Therefore, the biological trickling filter treatment process appears to be a promising wastewater treatment method for petroleum effluent with respect to the turbidity, COD and BOD_5 removal.

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