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The Conventional Oil-Water Separator as A Polluter Due to Lack of Maintenance – A Case Study

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ABSTRACT: In addition to the common knowledge that lack of maintenance of conventional oil-water separators causes release of excessive amounts of oil in the effluent wastewater, this study has revealed that excessive amounts of other pollutants are released alongside the oil. The disappearance of fishes from a stream in the Niger Delta after the continual discharge of the wastewater of a company prompted this study. The company has a conventional oil-water separator but no maintenance was done on it, five months after commissioning. Research methods include sampling of the effluent wastewater for a period of two weeks (ten working days) and analysis of the wastewater for pH, oil & grease content, total suspended solids, total dissolved solids, sulfate and chloride contents. Results showed that the concentration of total dissolved solids was consistently less than the regulatory limit but much higher than the concentration obtained at the commissioning of the separator. Results showed that the oil & grease content, chloride, sulfate and total suspended solids concentrations were consistently higher than the regulatory limits and also much higher than the concentrations obtained at the commissioning of the separator. Results showed that the pH values of the effluent wastewater were consistently outside the optimum range for survival of aquatic life. Monthly maintenance of the separator and further treatment of its effluent wastewater were recommended for protection of the environment and public health.

KEYWORDS: Wastewater treatment; pollution; wastewater management; waste disposal; environmental protection; environmental regulations

1.0 INTRODUCTION

An incident involving a conventional oil-water separator that operated for over a period of five months without maintenance proved that lack of maintenance could make the separator a source of pollution to the environment especially in developing countries where the oil-water separator is the common treatment facility for wastewater.

The conventional oil-water separator removes of oil and suspended solids from wastewater. The US Environmental Protection Agency (2005) stated that conventional oil-water separators are gravity oil-water separators which rely on differences in specific gravity to separate oil and suspended solids from a wastewater stream.

The disappearance of fishes from a stream in the Niger Delta after the continual discharge of wastewater by a company for over a period of five months without maintenance of its conventional oil-water separator prompted this work. The common knowledge is that when an oil-water separator is not maintained it will cause release of excessive oil in its effluent wastewater. Washbay Solutions (2023) reported that when an oil-water separator is not properly and regularly maintained, oil and debris will clog the separator and make it useless resulting to release of higher amount of oil in the effluent wastewater

The oil-water separator is designed to be maintained periodically. There is no standard period for the maintenance of oil-water separator worldwide. Washbay solutions (2023) recommended the following maintenance procedure for new conventional oil-water separators stating that after one month of operation the separator should be inspected and the inlet area cleaned as follows:

- Turn off the influent water to the separator
- Open the unit cover
- Remove and dispose of any oil in accordance with the company and legal procedures
- Drain water out of the separator
- Measure and record the height of the leftover solids to serve as a framework for scheduling future maintenance and cleaning
- Remove the solids. If necessary, dispose of the solids
- Clean the media plates using low pressure hose without allowing any spill or debris on the ground
- Check the separator for damage and repair if needed

Proper functioning of oil-water separators requires regular maintenance and when oil-water separators are not regularly maintained they become clogged with oil and debris and cause the release of higher quantity of oil in the wastewater effluent (TanksDirect 2024). Therefore, this work deduced from the aforesaid that if the release of higher amount of oil in the wastewater effluent of a separator occurs due to delay in maintenance or lack of maintenance of the separator, then

the release of higher amounts of other pollutants will occur alongside the oil, especially when the oil and other pollutants were in the same wastewater or if they were generated by the same process. This prompted this work to analyze the effluent of the separator for the following parameters – pH, oil & grease content, total suspended solids, total dissolved solids, chloride and sulfate content. Samples of the wastewater effluent were collected daily at 11:00 AM daily for two weeks (ten working days) and tested in the laboratory for the aforesaid parameters.

pH is one of the factors that affect the availability of fish in surface water bodies. EnviroTech (2024) stated that pH is critical to water ecosystems with majority of marine or river animals preferring a pH between 6.5 and 9.0 as pH values outside that range will result in reduced birthing, hatching and survival rates, thus endangering aquatic life.

Oil & grease affect the presence of aquatic life in surface water bodies. Unicert (2024) stated that oil is toxic and oil pollution has devastating effect on water ecosystems, spreading over the surface and depriving water plants and animals of oxygen, preventing photosynthesis, disrupting food chains and harming plants and animals in the water

The amount of suspended solids also affects the presence of fish in surface waters. www.state.ky.us (2024) stated that suspended solids clog fish gills either killing them or reducing their growth rate, reducing light penetration, photosynthesis and dissolved oxygen.

The concentration of chloride in water affects aquatic life. Misouri Department of Natural Resources (2024) stated that chloride at low amounts can negatively affect aquatic life structure, diversity and productivity while at high amounts it is toxic to fish and other aquatic organisms. Xia (2023) reported that high chloride concentration increases the corrosive effect of water and causes severe damage to freshwater ecosystems and aquatic habitats.

The amount of total dissolved solids in water also affects aquatic life. The US Environmental Protection Agency (2012) stated that aquatic life may not survive in water containing very low amounts of total dissolved solid or very high amounts of total dissolved solids.

Sulfate content in waster is another threat to aquatic life. Saltworks (2024) stated that sulfate levels in wastewater require close monitoring and moderations because sulfate can kill aquatic life, feed algae blooms and cause severe disruption to aquatic ecosystems

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2.0 MATERIALS AND METHODS

Samples of the effluent wastewater from the separator were collected by 11:00 AM every day for two weeks (10 working days) and analyzed using analytical methods adopted from the American Society for Testing and Materials (ASTM), American Public Health Association **(**APHA), US Environmental Protection Agency (USEPA). Measurement of pH and total dissolved solids were done in-situ with the aid of the multi-parameter data logger (Hama model HI991300). The results of the wastewater analysis are presented in Figures 1 to 10.

3.0 RESULTS

The effluent regulatory limits for the parameters (Nigerian Federal Environmental Protection Agency Act (FEPA) 1991) analyzed in the effluent wastewater from the separator are stated in Table 1. The initial results of the separator effluent analysis (same parameters) presented by the company as obtained at the commissioning of the separator are also presented in Table 1.

Table 1. Regulatory limits for the parameters analyzed in the wastewater samples

Parameters	Initial results of the wastewater effluent analysis obtained at commissioning of the separator	Regulatory limits (Nigerian FEPA Act 1991)
pH	**5.1**	**6.00 – 9.00**
Total suspended solids (mg/l)	**21 mg/l**	**30 mg/l**
Total dissolved solids (mg/l)	**109 mg/l**	**2000 mg/l**
Chloride (mg/l)	**230 mg/l**	**600 mg/l**
Sulfate (mg/l)	**245 mg/l**	**500 mg/l**
Oil & grease (mg/l)	**8.7 mg/l**	**10 mg/l**

The results of the analysis of the effluent wastewater samples collected on day 1 of the study are presented in Figure 1.

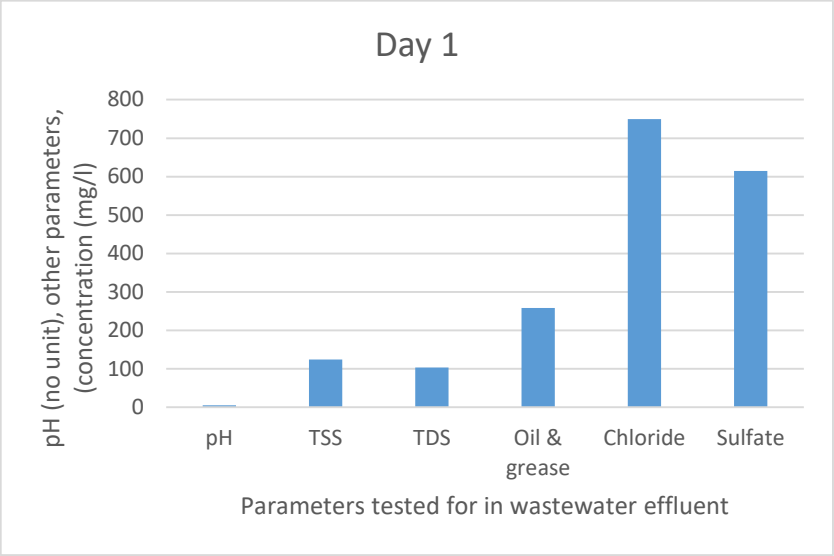

Figure 1: Results of wastewater analysis – Day 1

The results of the analysis of the effluent wastewater samples collected on day 2 are as presented in Figure 2

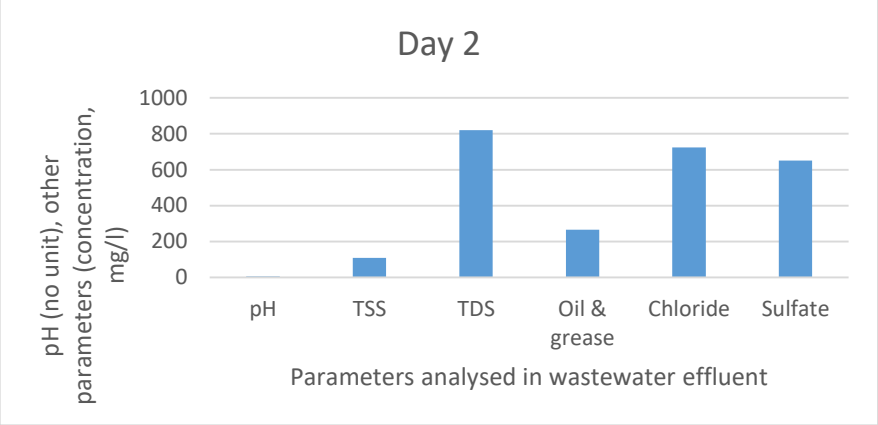

Figure 2: Results of wastewater analysis – Day 2

The results of the analysis of the effluent wastewater samples collected on day 3 are as presented in Figure 3

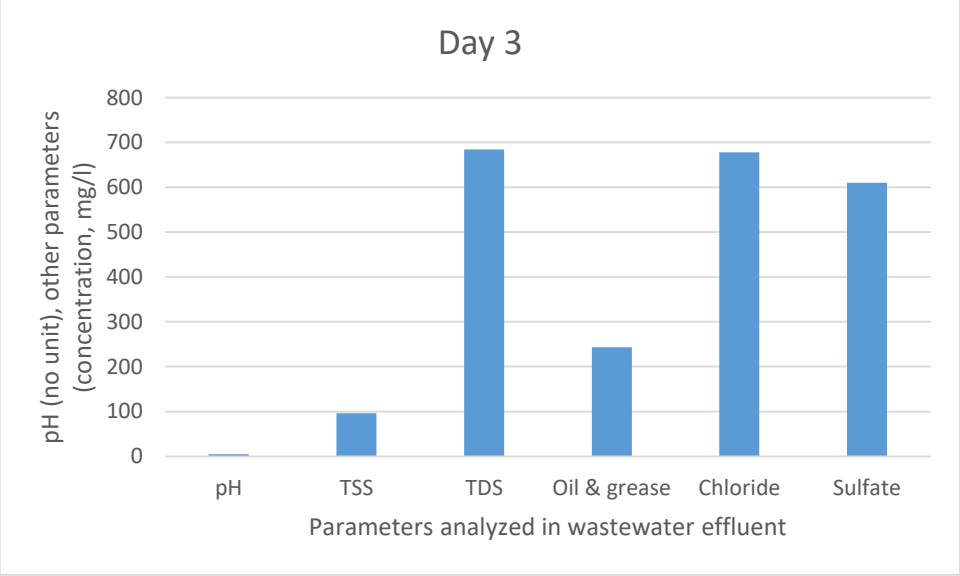

Figure 3: Results of wastewater analysis – Day 3

The results of the analysis of the effluent wastewater samples collected on day 4 are as presented in Figure 4.

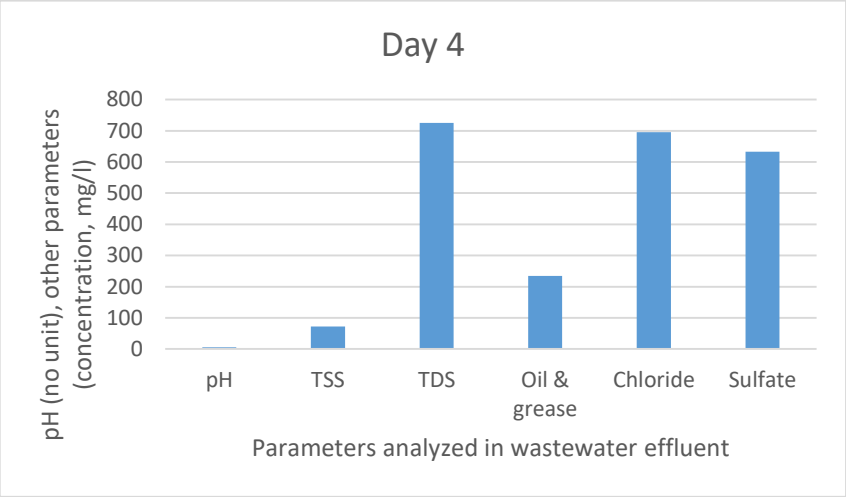

Figure 4: Results of wastewater analysis – Day 4

The results of the analysis of the effluent wastewater samples collected on day 5 are as presented in Figure 5.

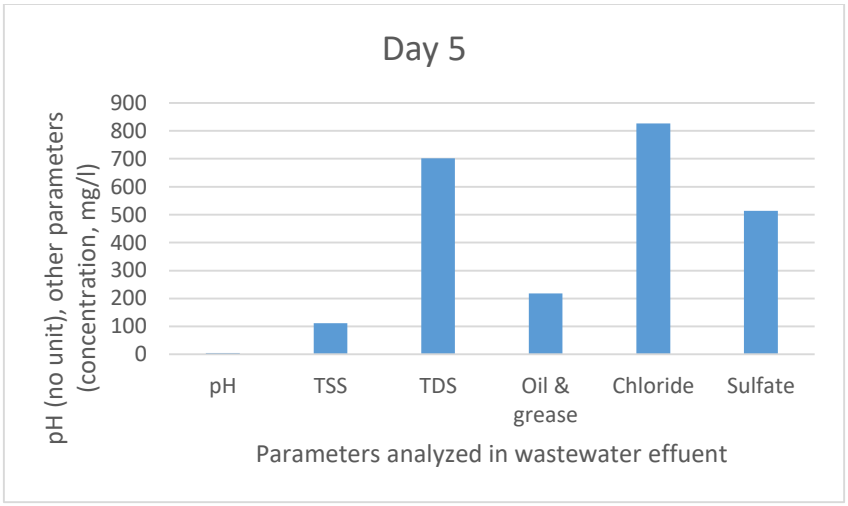

Figure 5: Results of wastewater analysis – Day 5

The results of the analysis of the effluent wastewater samples collected on day 6 are as presented in Figure 6.

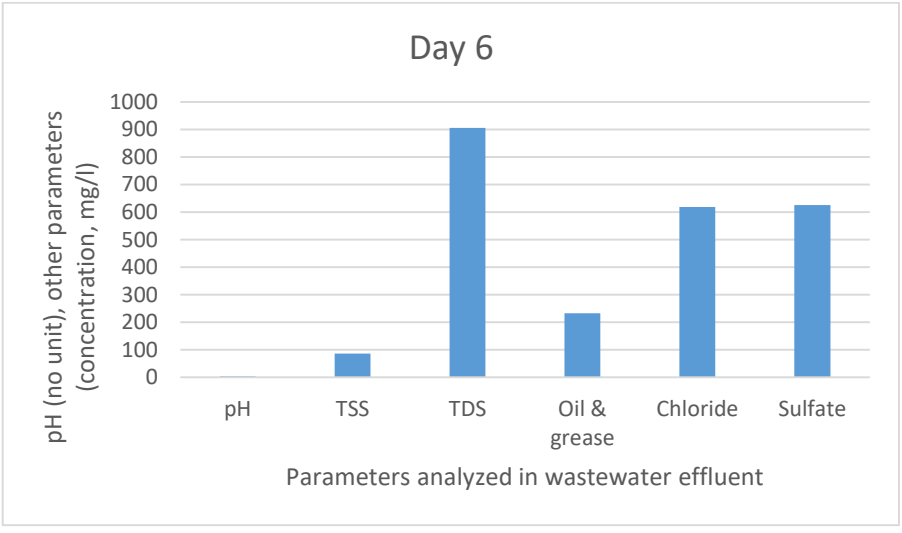

Figure 6: Results of wastewater analysis – Day 6

The results of the analysis of the effluent wastewater samples collected on day 7 are as presented in Figure 7.

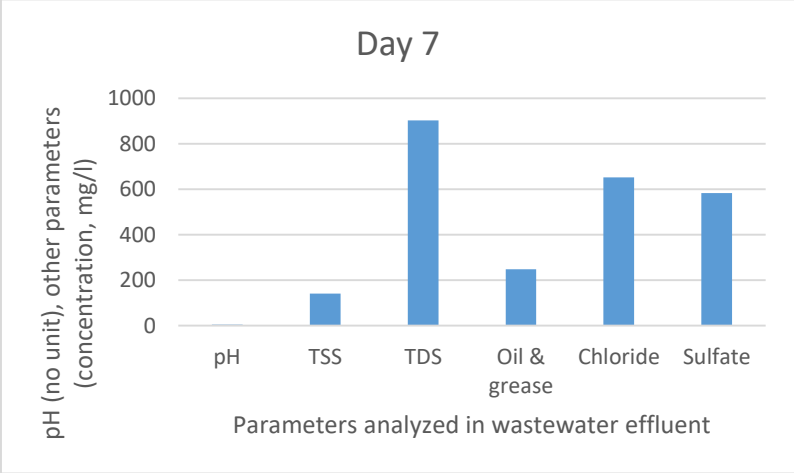

Figure 7: Results of wastewater analysis – Day 7

The results of the analysis of the effluent wastewater samples collected on day 8 are as presented in Figure 8.

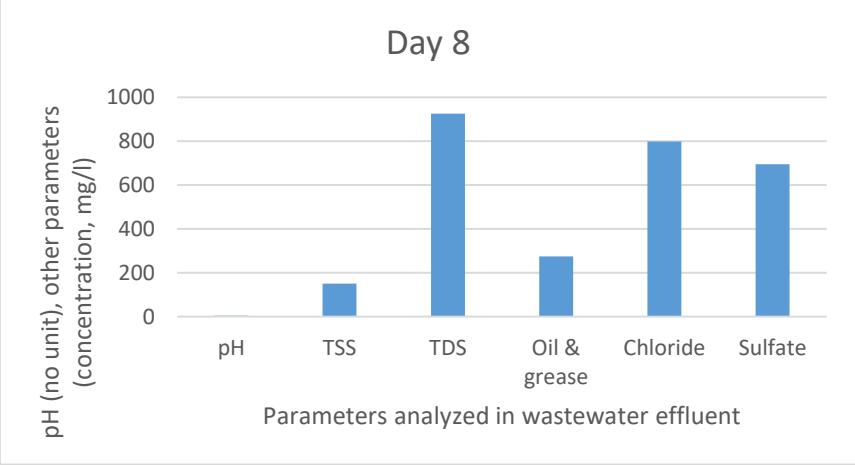

Figure 8: Results of wastewater analysis – Day 8

The results of the analysis of the effluent wastewater samples collected on day 9 are as presented in Figure 9.

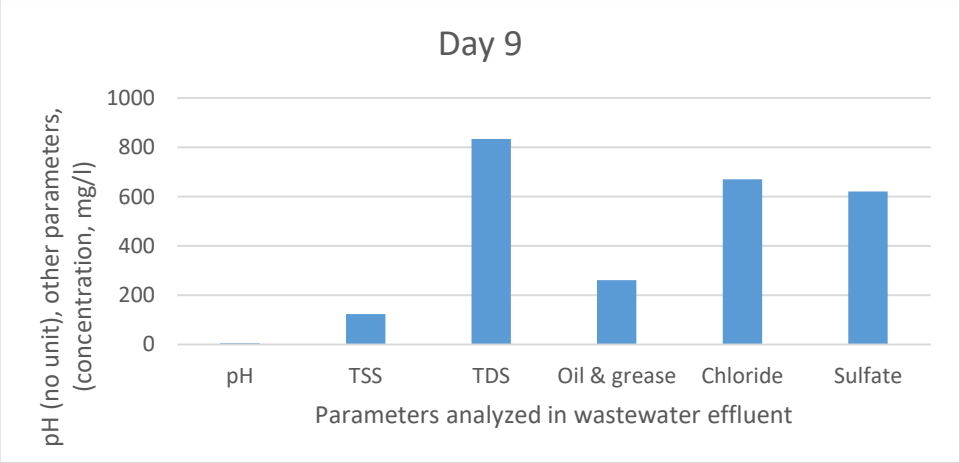

Figure 9: Results of wastewater analysis – Day 9

The results of the analysis of the effluent wastewater samples collected on day 10 are as presented in Figure 10.

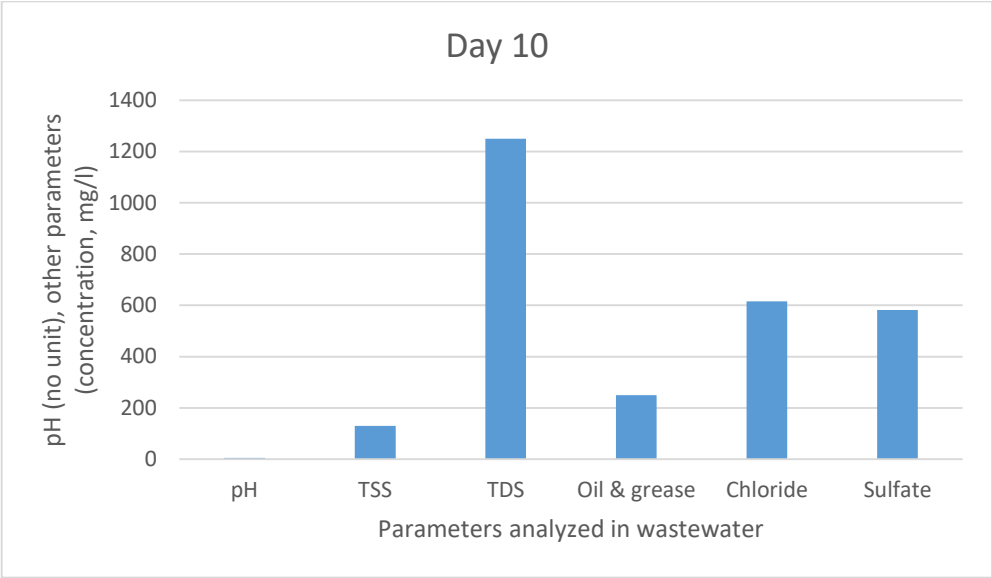

Figure 10: Results of wastewater analysis – Day 10

4.0 DISCUSSION

The results presented in Figures 1 to 10 are very significant. The results have confirmed that when an oil-water separator is not maintained or regularly maintained, it will release excessive amount of oil alongside excessive amounts of other pollutants in the effluent. Therefore, failure to regularly maintain the separator can make it useless and become a source of pollution of the environment, especially in developing countries where the oil-water separator is the common treatment facility for wastewater. TanksDirect (2024) stated that the proper functioning of oil-water separator requires regular maintenance as lack of maintenance will cause release of higher level of oil in the effluent.

The results showed that the values of the oil & grease content (Figures 1 to 10) are consistently higher than the regulatory limit and also higher than the initial oil & grease content (Table 1) obtained at the commissioning of the separator. This is dangerous to aquatic life. Unicert (2024) stated that oil & grease interfere with biological life in surface water with devastating effect on water ecosystems, hindering dissolution of oxygen, disrupting food chain, harming and killing aquatic plants and animals. Mokif, Jasim and Abdulhusain (2022) reported that oily wastewater consists of substances that are hazardous to aquatic life, especially hindering their growth.

It is also evident from Figures 1 to 10 that the pH of the effluent from the separator is consistently outside the optimum range (Table 1) for survival of aquatic life. Fondriest Environment Learning Center (2024) stated that the preferred pH range for aquatic life is 6.5 to 9 and that if the pH value of water is too high or too low the aquatic organisms in the water will die.

The results showed that the values of the total dissolved solids (Figures 1 to 10) are consistently within the regulatory limit but consistently much higher than the initial value (Table 1) obtained at the commissioning of the separator. This change from low value of total dissolved solids to much higher values of total dissolved solids for a period of five months is not good for the survival of aquatic life. Envirosciinquiry (2024) stated that constant amounts of minerals in the water is required for aquatic life as changes in the amounts of dissolved solids can be harmful because concentrations of total dissolved solids that are too high or too low, limit the growth of aquatic life and cause the death of many aquatic organisms.

It is evident from Figures 1 to 10 that the chloride concentrations are consistently higher than the regulatory limit and also higher than the initial amount (Table 1) obtained at the commissioning of the separator. High concentration of chloride in water is dangerous to aquatic life. Misouri's Department of Natural Resources (2024) reported that chloride is a serious threat to Missouri's freshwater lakes and streams because it is toxic to fish and other aquatic life.

Figures 1 to 10 showed that the concentrations of sulfate are consistently higher than its regulatory limit and also higher than the initial amount of sulfate (Table 1) obtained at the commissioning of the separator. High concentration of sulfate is dangerous to aquatic life. Wang and Zhang (2019) reported that high sulfate concentration can cause death of aquatic life.

Furthermore, Figures 1 to 10 showed that the concentrations of total suspended solids are consistently higher than the regulatory limit and the initial amount of total suspended solids (Table 1) obtained at the commissioning of the separator. Du et al (2022) stated that total suspended solids are made up of inorganic substances, organic substances and

microorganisms which are insoluble in water stressing that high concentration of total suspended solids have large negative impact on the optical properties of water, photosynthesis and the habitats of aquatic organisms.

Future work will involve investigating the source of the increase in the values of the affected pollutants in relation to the initial values obtained at commissioning of the separator. Limitations encountered in this work include funding and equipment.

5.0 CONCLUSION

It is evident from the aforesaid that the wastewater exiting the separator into the stream is not good for the survival of aquatic life. Maintenance of the oil-water separator should be done monthly and further treatment of the wastewater from the separator is required for protection of the environment and public health.

The Government should empower the regulatory agencies with well-equipped Laboratories for wastewater and air pollution analysis. The regulatory agencies should undertake the sampling and analysis of wastewater for all companies to ensure proactive testing and enforcement of regulatory limits of pollutants.

Presently, companies analyze their wastewater and send reports to the regulatory agencies. This is not good enough because the results can be compromised. Alternatively, the regulatory agencies should sample the wastewater from the companies and engage independent laboratories to analyze the wastewater.

Government should take punitive measures against companies that have no wastewater treatment plant.

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