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Research Article

THE INFLUENCE OF SILICONE ANTIFOAM FROM LEATHER AND DYING WASTE WATER EFFLUENT ON TURBIDITY AND CHEMICAL OXYGEN DEMAND IN BOMPAI INDUSTRIAL ESTATE KANO REGION NIGERIA

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ABSTRACT

This study investigates the influence of silicone antifoam agent on waste water from Gashash leather and Nigerian Spinning and Dying industries (NSD). Waste water from the outlet of the industries were collected and analyzed for physicochemical parameters. Silicone antifoam was added to the wastewater to determine the impact of the silicone antifoam on turbidity and chemical oxygen demand (COD) concentrations. The result shows that both turbidity and COD values significantly increased even when small concentration of the silicone antifoam was added. Further, independent t-test was used to identify the variance between the mean value of the wastewater from leather, spinning and dying industries, the results indicated that there are no significant differences (observed t 0.544, critical t 2.015, and p value 0.589) between the waste water in leather and dying industries.

Keywords: Silicone antifoam, turbidity, COD, Independent sample t-test

INTRODUCTION

Industrial pollution is one of the problems facing Nigeria and effluent generated by the industries is one of the sources of surface water pollution [1, 2]. Industries consume large quantities of water and discharge considerable amount of quantities of waste water during their production process [3]. Development of industrial civilization has led to a considerable deterioration of the main element of the environment. Dynamic growth of global industrial output and an increase rate of non-renewable resources are manifestations of activities that may pose a serious threat to life on earth [4]. Industrial waste generally has assumed exponential increases as a result of rapid growth of industrial development in the urban centres where large volume of effluent are generated due to multiple production of goods in the industrial sectors [5]. Surface water of many industries in the developing countries is becoming heavily polluted by industrial effluent which is either directly discharge or partially treated in to the water body [6].

Pollution from industrial discharges and waste water are one of the main causes of irreversible ecosystem degradation [7]. Disposal of sewage to the surface water become a necessity as soon as industries are established, the outcome was a deterioration of standard of many rivers and their water become useless for either domestic consumption or industrial uses [8]. Depending on the type and amount of effluent being generated from different type of industries, it could be concluded that, areas that find its location close to industries are heavily polluted with industrial effluents and produce greater negative effects on the environment [9, 10, 11].

The gradual decline in the availability of freshwater in Kano Region is due to the rapid urbanization coupled with high population growth that leads to high demand of such resource, as a result the use of sewage and other industrial effluent for various purposes is on the rise particularly during the dry season. Kano State Environmental Protection Agency has made it mandatory for all industries operating in her jurisdiction to have primary treatment plant within their premises. The State government had since 1990's proposed to establish central secondary treatment plant that will treat all industrial waste at a central location to safe standard before release in to the environment. The problem statement is that, the absence of designated collection points where industries can safely dispose their waste has resulted in uncontrolled situation and indiscriminate dumping of waste in to the environment. This waste, besides polluting the surface water, it poses damage to environment directly or indirectly, this practice has resulted in conflict with the local people on the edge of the industrial layout.

Silicone antifoams are one of the commercial silicone products which are used for form control in an aqueous system. The silicone antifoams usually consist of mixture of polydimethysiloxane and hydrophobed silica. Silicone antifoam has been widely used in many industries to control foaming problems that occur in the process systems or in waste water effluent. Silicone comprises a multitude of technical products whose property controlling component consist of polyorganosiloxanes which consist of linear or cyclic siloxane and represent the major portion of commercially available silicones. Foams are agglomeration of gas bubbles separated from each other by thin liquid film, they belongs to the aggregation of two phases, gases dispersion in liquid films. Silicone antifoam is used to curb surface foams from occurring in wastewater effluent.

In this study, we examined the effects of the use of the antifoam on turbidity, chemical oxygen demand (COD) and silica values in the waste water effluent generated by leather and dying industries in Bompai Industrial estate Kano Region Nigeria.

MATERIALS AND METHODS

Two stations were selected which includes Gashash Tannery and Nigerian Spinning and Dying (NSD) industries in Bompai Industrial estate, Kano Region, Nigeria. Samples were carried out at the effluent outlet from discharge pipe at both station and the frequency of sampling was once daily in the morning on the alternate days each month for two consecutive months. Samples were collected in triplicates at each station. Samples were collected using grab sampling in clean polyethylene bottle after proper rinsing 2-3 times. All samples were kept in a 1 L glass bottle which has been rinsed with the samples. 6 beakers each containing 200 mL of sample were treated with 6 different concentration of silicone antifoams at 0.01 mg/L, 0.03 mg/L, 0.05 mg/L, 0.10 mg/L, and 0.20 mg/L. In order to provide greater data confidence from the analytical procedure regarding bias and variability appropriate quality-assurance and quality-control (QA/QC) on water samples were ensured. The QA/QC were followed to ensure that data products are of documented high quality and reproducible. The overall data quality is assessed through precision, accuracy and comparability.

An Independent sample *t*-test was used to compare the mean (average value) of two variables. The null hypothesis says that the two means do not differ from one another significantly (there are no differences between the mean) against alternative hypothesis that the two means are not the same. Calculated *t*-value can be computed using the equation below:

$$t = \frac{\overline{x - \mu}}{s_{\bar{x}}} = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$$

Where t is the test statistics (Student's t distribution) for $\bar{x}$ is the mean sample, μ is the population means, S is the standard deviation of the sample and n is the sample size.

Independent sample *t*-test can be computed using the equation below when unequal variance is assumed.

$$t = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

When equal variance is assumed independent *t*-test can be computed using the equation below:

$$t = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{s_p^2}{n_1} + \frac{s_p^2}{n_2}}}$$

Where t – test statistic (Student's t distribution), $\bar{x}$ is the mean of the paired difference for the sample, s_p^2 is the standard error of the mean of the paired differences for the sample and *n1* and *n2* are the number of the paired difference values.

RESULT AND DISCUSSIONS

Table 1 presents the results water samples of laboratory analysis from Gashash tannery and Nigerian Spinning and Dying industries. The given values are the average of 3 samples. The turbidity values of 4.1667 NTU was recorded in leather waste water which was slightly lower when compared with effluent from dying industry. The COD value was much higher in Gashash leather waste water with 56.475 mg/L as compared to NSD industry with 25.033 mg/L.

Parameter	unit	Gashash Leather	NSD Dyeing
Turbidity	NTU	4.1667	4.25
pH		7.389	7.115
COD	mg/L	56.475	25.033
BOD_5	mg/L	15.409	6.95
TSS	mg/L	3.8	5.625
Hg	mg/L	0.00675	0.0056
Cd	mg/L	0.01	0.001
Cr^{+6}	mg/L	0.001	0.01
As	mg/L	0.001	0.0026
Cn	mg/L	0.01	0.02
Pb	mg/L	0.064	0.02
Cr^{+3}	mg/L	0.01	0.015
Cu	mg/L	0.1044	0.0625
Mn	mg/L	0.043	0.04
Ni	mg/L	0.275	0.02
Sn	mg/L	0.305	0.43
Zn	mg/L	0.174	0.095
B	mg/L	0.775	0.03
Fe	mg/L	0.735	0.4425
Phenol	mg/L	0.192	0.138
Free Chlorine	mg/L	0.2675	0.21
SO_4	mg/L	0.02	0.3
Oil &Grease		2	7.025
Foam		yes	yes

Table 1: Result of laboratory analysis of Gashash and NSD waste water

Table 2 presented the concentration of silicone antifoam (ppm) which indicated that small amount of concentration of silicone antifoam increase the the mean of turbidity value. The turbidy level was 4,667 NTU when there is no addition of silcone antifoam, when 0.01 ppm of antifoam was added the turbidity level increased to 16.333 NTU. The higher the concentration of silicone antifoam added, the more tubib the wastewater effluent became.

Silicone Antifoam Conc (ppm)	Turbidity (NTU)
0(control)	4.667
0.01	16.333
0.03	36.667
0.05	56.667
0.1	102.167
0.15	154.667
0.2	184.333

Table 2: The influence of silicone antifoam on turbidity level

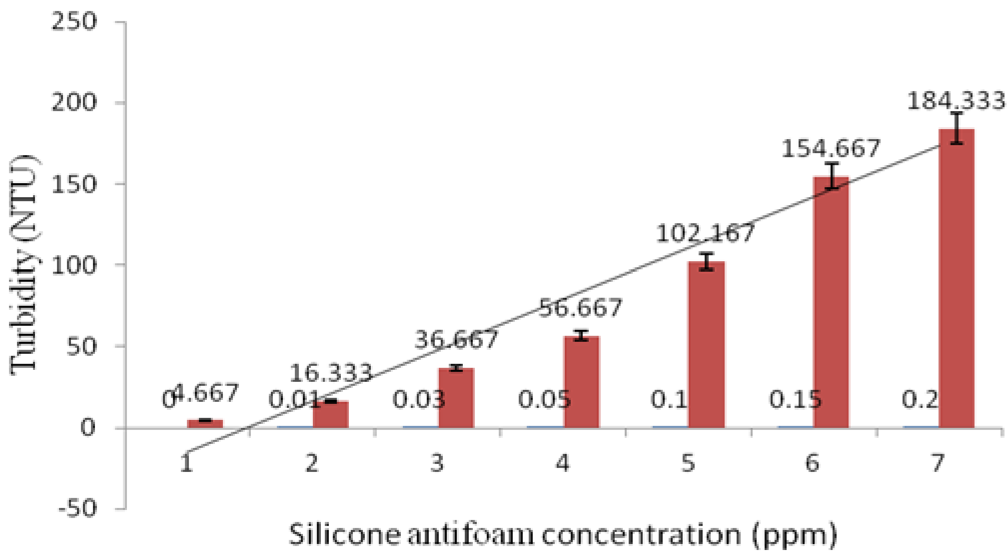

Figure 1: The relationship between concentration of silicone antifoam and turbidity value

The silicone antiform concentration in relation to chemical oxygen demand showed that the antiform concentration at 0.01, 0.03,0.05, 0.1, 0.15 and 0.20 increased (Table 3). Antifoarm concentration of 0.01 increased COD with 50%, at 0.03 ppm of silicone antifoam COD increase to138.3% which exceeded the value of World Health Organization of COD in wastewater. Figure 2 spresent the high slope value which indicated that the addition of silicone antifoam significantly increasess the wastewater effluent COD value.

Silicone Antifoam Conc (ppm)	COD (mg/L)
0(control)	49.67
0.01	90.50
0.03	138.83
0.05	248.66
0.1	469.83
0.15	723.17
0.20	931.17

Table 3: The influence of silicone antifoam on Chemical Oxygen Demand (COD) level

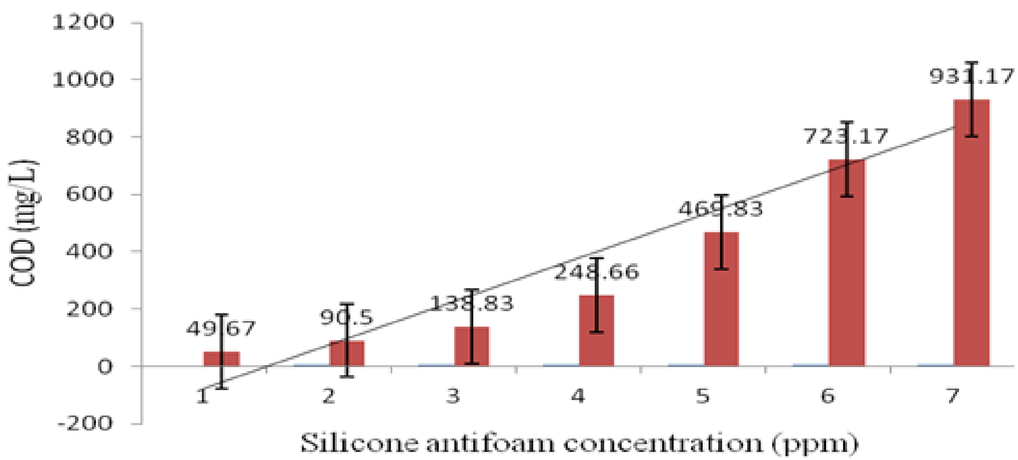

Figure 2: The relationship between concentration of silicone antifoam and COD value

An Independent t-test was applied on the data set to test the hypothesis that there is significant differences in the mean value of waste water between Gashash leather and Nigerian Spinning and dying industries. The result obtained was presented on Table 4.

Difference	1.495
t (Observed value)	0.544
|t| (Critical value)	2.015
DF	44
p-value (Two-tailed)	0.589
alpha	0.05

Table 4: Independent *t*- test result

The decision was that, the null hypothesis was fail to be rejected because the critical *t* value was greater than the observed *t* value and the *p* of 0.589 value was greater that the alpha value of 0.05. This showed that the concentration of waste water in Gashash leather industry is the same with the waste water in the Nigeria Spinning and dying (NSD) industry.

CONCLUSION

Turbidity and chemical oxygen demand showed a positive gradient with silicone antifoam concentration. Industrial waste generally has assumed an exponential increases as a result of rapid growth of industrial development in the urban centres where large volume of effluent are generated due to multiple production of goods in the industrial sectors. Surface water of many industrial countries are becoming heavily polluted by industrial effluent which are either directly discharge or partially treated in to the water body. Polluting industrial discharges and waste water are one of the main causes of irreversible ecosystem degradation. Depending on the type and amount of effluent being generated from different type of industries, it could be concluded that, areas that find its location close to industries are heavily polluted with industrial effluents and produce greater negative effects on the environment.

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