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Research Paper

EFFECT OF DISINFECTANTS ON AEROBIC SEWAGE DEGRADATION USING DETTOL AND IZAL AS CASE STUDY

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Disinfection is considered to be the primary mechanism for the inactivation/destruction of pathogenic organisms to prevent the spread of diseases and of which some of the organisms maybe needed for degradation as occurring in septic tank. This work investigated the effects of disinfectants on aerobic sewage degradation using Dettol and Izal as case study. Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Fecal coliform were used to determine the effectiveness of the two disinfectants. Sewage for analysis were collected from the University of Nigeria Nsukka treatment plant for laboratory analysis. Five 4 Litres containing sewage having different dose in ml of the two disinfectants (Dettol and Izal) of 0.5, 1.0, 1.5, 2.0, and 2.5 with one control were established.Samples for analysis were obtained for 4 weeks for each disinfectants having interval of 3 days. Short and Long term effects of the disinfectants were studied and the results were analyzed using Turkey-Kramer multiple comparison test. The pattern of changes reflecting the effect of the respective disinfectants on faecal colony of coliform shows the pattern for Izal is similar to that of Dettol, regression coefficient were the same. Maximum effects were observed at concentrations 1.5 ml for either Izal and Dettol. Resistance of colony to higher concentration of disinfectant was observed with the respective disinfectants on prolonged study. Addition of 1ml can be seen as the critical dosage. The low COD values observed at 0.5 ml or 1 ml suggest the presence of high faecal colony, likely due to tolerance or inhibitory effects. Low BOD values were observed with addition of 1 ml confirms that the dosage is the critical dosage since it suggest that lower biomass requiring oxygen for oxidation was present in the sample at this dosage. This is also reflected in the COD assessment. From comparism of the disinfectants effect shows usage of Izal recorded higher disinfectant effect compared to Dettol.

Keywords: BOD, COD, Sewage degradation, Disinfection, Fecal coliform, Waste water

INTRODUCTION

Disinfection is considered to be the primary mechanism for the inactivation/destruction of pathogenic organisms to prevent the spread

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of waterborne diseases to downstream users and the environment. The organisms of concern in domestic wastewater include pathogenic enteric bacteria, viruses, helminths and their eggs, and protozoan cysts. In order for disinfection to be effective, wastewater must first be adequately pretreated to remove suspended solids and organic material. If an attempt is made to disinfect inadequately treated wastewater, the organic compounds can "steal" the disinfectant and allow pathogens to survive. Pathogens are associated with suspended solids, and removing the suspended solids is quite an effective way to remove pathogens. Pathogens can also "hide" within the suspended solids, making it more difficult for the disinfectant to come into contact with the pathogens (Gross and Deal (Eds.), 2000).

The ultimate goal of wastewater treatment and disinfection is to produce an effluent of such quality (dependent upon final use) that minimal additional controls are needed to manage any human health, agricultural or environmental risks and the need for disinfection will depend on its intended uses. When reuse involves high-level risks of exposure for humans or livestock, that water will require disinfection processes to achieve the treatment levels set in the Guidelines for Environmental Management: Use of Reclaimed Water (EPA Victoria, 2002, Publication 464.1). Uses that involve a low risk of direct exposure will generally not require effluent to undergo a specific disinfection process.

Discharges of effluent to surface waters will generally need disinfection. This reduces potentially harmful micro-organisms in wastewater to a level consistent with achieving the water quality objectives set in the SEPP (Waters of Victoria), for the protection of human health.

The process of killing pathogenic bacteria in the wastewater effluent is known as disinfection. Disinfection is the final step in the treatment process, and is necessary to provide a measure of bacteriological safety to the public. Disinfection is now required for most wastewater systems. Chlorination is the most common means of killing disease-causing bacteria.

While chlorine is used primarily for disinfection in wastewater treatment, it also has other uses in the treatment process. Chlorine can be used to kill filter fly larvae in trickling filters. It is also used to inhibit filamentous bacteria growth in activated sludge processes. Chlorine is sometimes used for odor control in collection systems. The growing concern regarding chlorine and chlorine by-products in wastewater effluents has resulted in the requirement to de-chlorinate to remove chlorine before it is discharged to the environment.

MATERIALS AND METHODS

Sewage for analysis were collected from the University of Nigeria Nsukka treatment plant for laboratory analysis. Five 4 L capacity sewage containers having different dose in ml of the two disinfectants (Dettol and Izal) of 0.5 ml, 1.0 ml, 1.5 ml, 2.0 ml, and 2.5 ml with one control were established. The sewage was collected with a 25 L gallon and where properly shook and poured into the different 4 L buckets. Immediately the sewage was poured, samples were collected and tested for the

following parameters which included: BOD, COD and Total Coliform.

Samples for analysis were obtained for 4 weeks for each disinfectants spanning for 2 month in all. Also, room temperature of the laboratory were obtained at each day of analysis having detention time of 3 days.

Method of Analysis

All the sewage samples collected for laboratory analysis were analyzed immediately they were brought into the laboratory. All the analysis were based on the standard methods (APHA, 1985).

Laboratory Determination

Fecal Coliform (FC) was determined using standard total coliform Most Probable Number (MPN) tests while Chemical Oxygen Demand (COD) was determined using Stannous chloride.

Biochemical Oxygen Demand (BOD)

For the BOD, six 310 ml BOD bottles were filled with the samples in ratio 2:310. The DO_1 and DO_5 were read from the probe meter and recorded. The bottles are placed on top a magnetic stirrer to effectively circulate the available oxygen present in the sample to obtain adequate results. After five days incubation, dissolved oxygen was again determined for the second six set of bottles for using the same probe meter and process.

Fecal Coliform Tests

In carrying out the experiment, double strength of lactose as nutrient medium was prepared by dissolving 37.5 g of lactose both in 250 ml of distilled water. 10 ml of the medium was pipetted into 18 set of test tubes, 3 test tubes for each sample. Then equal volume of distilled water was added to the remaining portion of the medium as single strength. 5 ml of the single strength medium was pipetted into another 36 set of small test tubes. 10 ml portion of the samples were inoculated into the 16 set of the remaining test tubes each respectively.

The tubes were inoculated at 37^0 C for 48 h. The tubes with gases were recorded as positive tests indicating the presence of faecal coliform bacteria in water, where the number of coliform corresponding to the positive tubes were read from MPN table.

Chemical Oxygen Demand (COD)

The procedure of COD was carried out by first weighing of 0.4 g portion of mercury sulphate ($HgSO_{4)}$ and placed in the labeled reflux flask 0.0 ml, 0.5 ml, 1.0 ml, 1.5 ml, 2.0 ml and 2.5 ml, 20 ml of the sample were pipette to the flask and 20 ml of distilled water in one other flask, which served as blank; 10 ml standard potassium dichromate $K_2C_2O_7$ solution was added with a volumetric pipette to six bottles, 0.0 ml, 0.5 ml, 1.0 ml, 1.5 ml, 2.0 ml and 2.5 ml, with some granules of glass beads (which was previously heated to 60^0C in a furnace).

The flasks were connected to the condensers and 30 ml sulphuric acid was gently added through the top of the condenser with a 50 ml beaker via a glass funnel. Heat was applied for 2 h, after which the condensers were washed with distilled water to 150 ml level. After cooling, add three drops of ferrous indicator was added to the mixture and stirred. A blue-green color changes to reddish-brown as the mixture was titrated with Standard ferrous ammonium sulphate as the point of the titration.

RESULTS AND DISCUSSION

In Table 1 , the effect of different disinfectant concentration – Izal and Dettol on faecal coliform count of different periods of exposure are reported. Results shows statistical significant difference (P< 0.05) difference in count with respective disinfectants at different concentration .With Dettol on short term, significantly (P< 0.05) lower counts were observed with different concentration of Dettol compared to control. Concentration 2.5 ml recorded the most difference whereas 1.0 ml recorded the least difference. With short term Izal, significantly P (0.05) lower counts were also recorded and observed for respective concentrations used. However, the least difference was observed with 0.5 ml whereas 1.5 ml recorded the highest difference. Counts observed for 1.5 ml compared with values observed for 2.5 ml.

Long term treatment with Dettol recorded significantly (P<0.05) lower counts after treatment compared to count observed for control group. Only treatment with 1.0 ml, 1.5 ml, 2.0 ml on treatment with Izal recorded lower counts compared to counts observed with control group. Counts observed with 2.5 ml or 0.5 ml recorded significantly (P<0.05) high counts compared to values observed for control groups.

In Table 2, the effect of different concentration of respective disinfectants over different periods are represented. Statistical assessment showed that significantly (P<0.05) difference were recorded in the COD removal over different periods at different concentrations. With short term treatment with Izal significantly (P<0.05) lower values were observed with increasing concentrations compared to values observed for control .All values obtained for different concentration of Dettol for short term treatment were significantly (P<0.05) greater than observed for control. COD Removal values observed for 1.5, 2.0,2.5 ml's respectively on long term treatment were significantly (P<0.05) greater

Table 1: Effect of Different Concentration of Disinfectant on Faecal Coliform Level Over Different Periods

Concentration of Disinfectants (ml)	Long Term Effect (Dettol)	Short Term Effect (Dettol)	Long Term Effect (Izal)	Short Term Effect (Izal)
0.0	89.03±.03	80.87±.02	78.17±.03	118.03±.03
0.5	81.27±.03	38.03±.03	80.87±.03	97.77±.03
1.0	69.33±.03	60.03±.03	61.27±.03	90.37±.03
1.5	17.17±.03	30.13±.03	64.17±.03	82.47±.03
2.0	86.73±.03	40.03±.03	32.72±.03	85.87±.03
2.5	25.03±.03	25.03±.03	87.03±.03	82.63±.03

Table 2: Effect of Different Concentration of Disinfectant over Different Period of Treatment of COD

Concentration of Disinfectants (ml)	Long Term Effect (Dettol)	Short Term Effect (Dettol)	Long Term Effect (Izal)	Short Term Effect (Izal)
0.0	25.03±.03	03.63±.03	41.37±.03	17.17±.03
0.5	00.00±.00	13.77±.03	40.37±.03	14.87±.03
1.0	25.27±.03	17.27±.03	39.87±.03	06.53±.03
1.5	45.37±.03	35.07±.03	43.83±.03	04.07±.03
2.0	48.77±.03	30.63±.03	45.10±.03	03.87±.03
2.5	34.67±.03	23.53±.03	45.17±.03	01.17±.03

than values observed for control. This pattern was observed for usage of Dettol on long term with COD values for 1.5 ml, 2.0 ml, 2.5 ml. However, 0.5 ml with Dettol usage recorded zero COD Removal.

Table 3, results of BOD after treatment with different concentrations of disinfectants and over different periods are represented. Statistical significant ($P<0.05$) difference were observed with different concentration and over different periods with prolonged treatment with Izal significantly ($P<0.05$) lower values were observed with increasing concentrations used compared to values observed with control.

The values observed with long term treatment with Dettol did not follow this pattern.

Table 3: Effect of Different Concentration of Disinfectants over Different Period of Treatment of BOD

Concentration of Disinfectants (ml)	Long Term Effect (Dettol)	Short Term Effect (Dettol)	Long Term Effect (Izal)	Short Term Effect (Izal)
0.0	46.03±.03	30.67±.03	66.67±.03	27.63±.03
0.5	36.33±.03	00.00±.00	52.47±.03	15.87±.03
1.0	39.87±.03	20.23±.03	23.87±.03	04.63±.03
1.5	50.10±.03	34.77±.03	13.47±.03	13.83±.03
2.0	52.40±.03	28.47±.03	04.47±.03	17.37±.03
2.5	54.47±.03	22.63±.03	04.20±.05	24.73±.03

Only treatment with 0.5 ml and 1.0 ml recorded significantly (P<0.05) lower values compared to that observed for control, others recorded higher values. With short term treatment with Izal values observed with different concentrations used were significantly (P<0.05) lower than observed for control. This pattern was observed for short term usage with Dettol except for 1.5 ml treatment.

DISCUSSION

Resistance of colony to higher concentration of disinfectant was observed with the respective disinfectants on prolonged study. Addition of 1 ml can be seen as the critical dosage. This has been defined as the dosage above which chemicals were totally toxic to microbes (Ignatius Ip *et al* , 2004).

Figure 1: A Graph Showing Long Term Effect of the log of Coliform Count (N/N_o) using Dettol at Different Concentrations

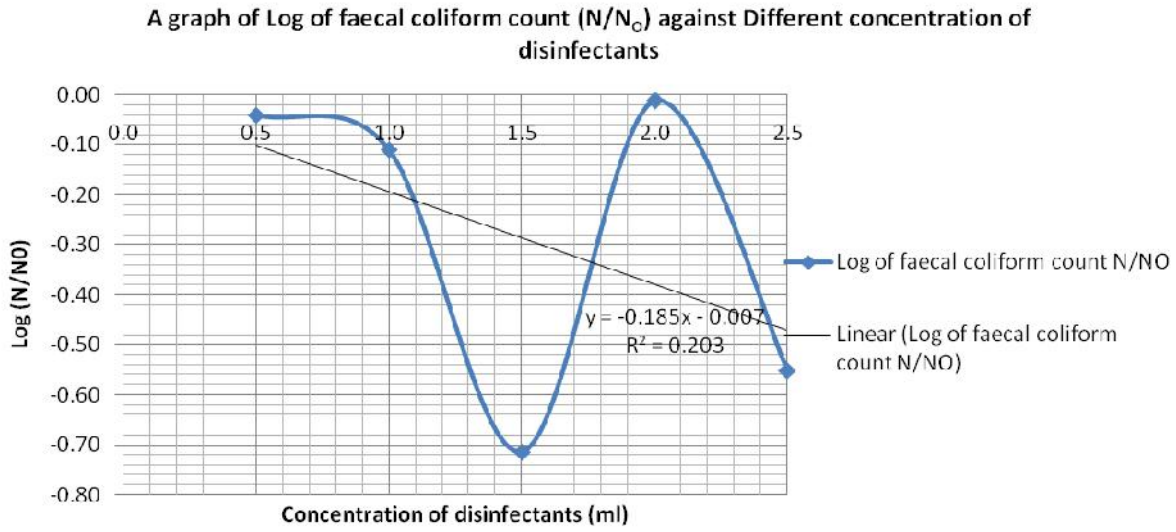


Figure 2: A Graph Showing Long Term Effect of the log of Coliform Count (N/No) Using Izal at Different Concentrations

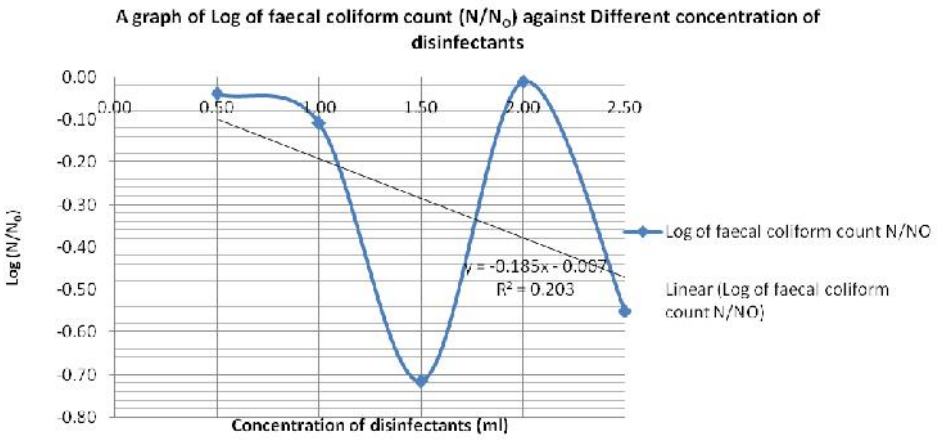


Figure 3: A Graph Showing Short Term Effect of the Log of Coliform Count (N/No) Using Dettol at Different Concentrations

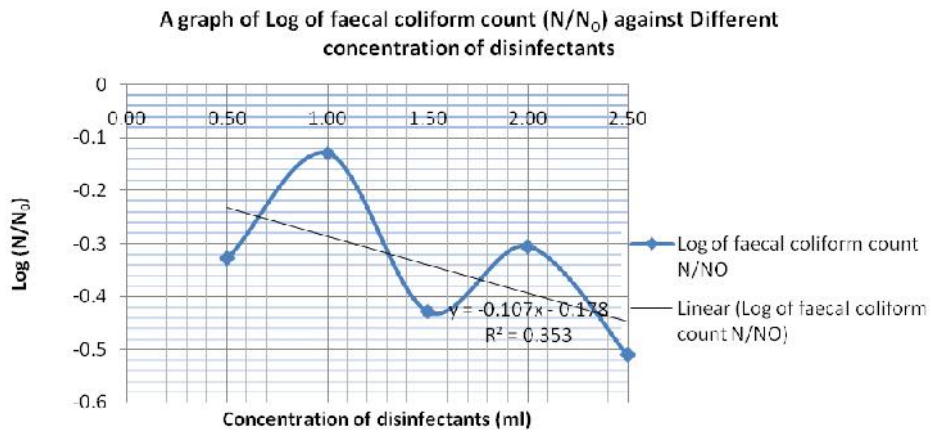


Figure 4: A Graph Showing Short Term Effect of the Log of Coliform Count (N/No) Using Izal at Different Concentrations

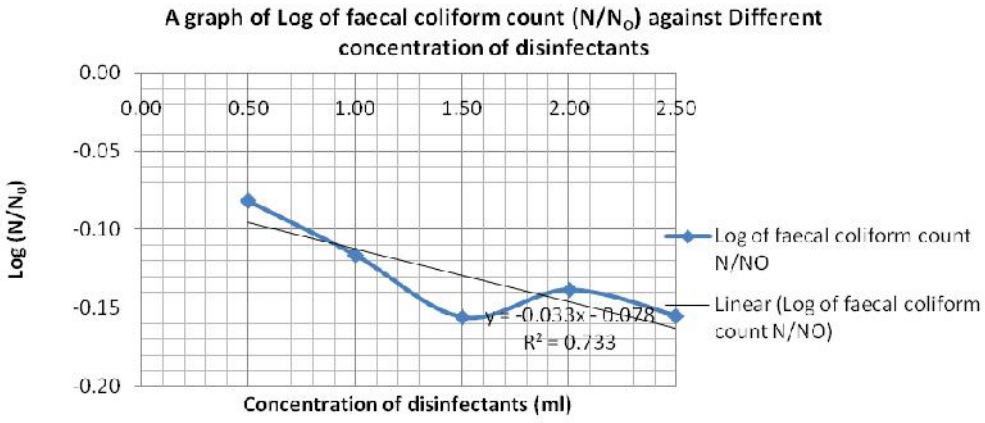


Figure 5: A Graph Showing Short Term Effect of the log of COD (C/Co) using Izal at Different Concentrations

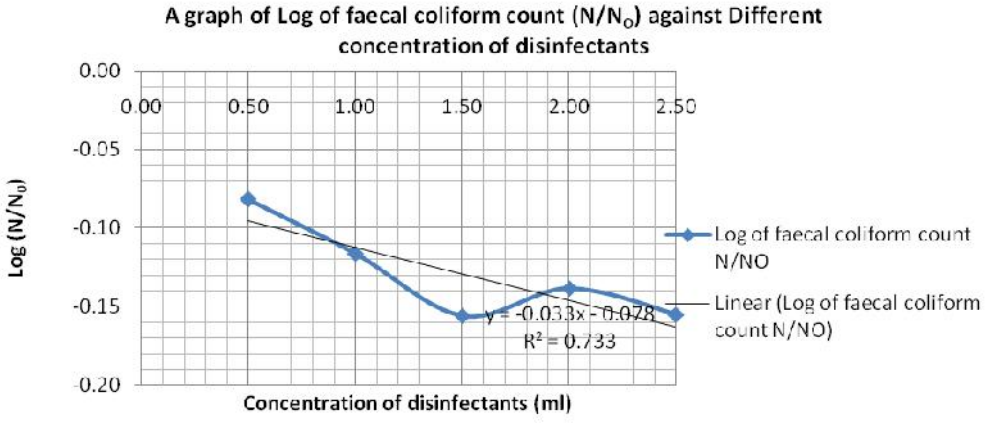


Figure 6a: A Graph Showing Short Term Effect of the Log of COD (C/Co) using Dettol at Different Concentration

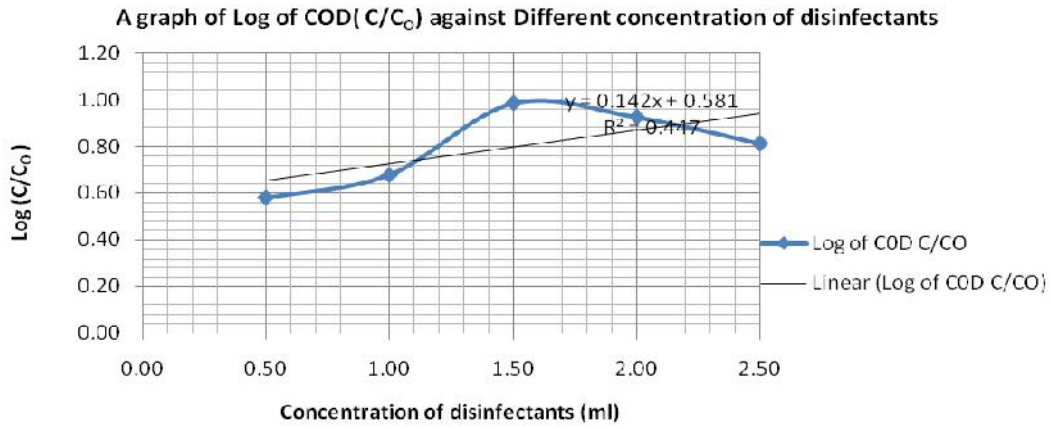


Figure 6b: A Graph Showing Long Term Effect of the Log of COD (C/Co) using Izal at Different Concentrations

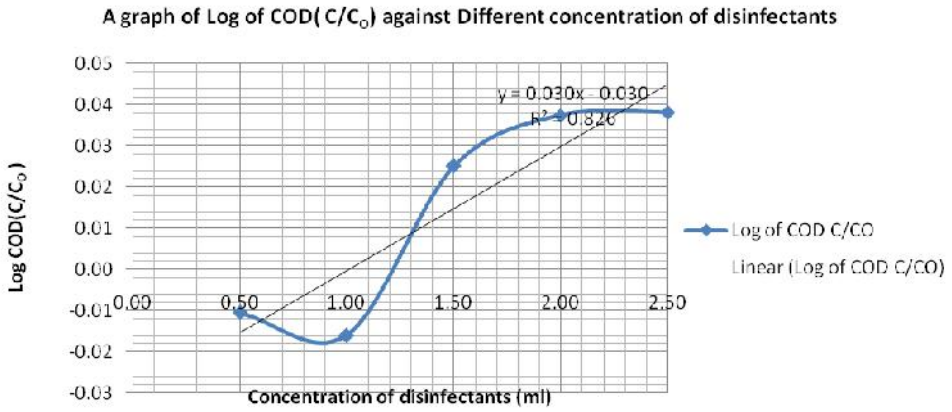


Figure 7: A Graph Showing Long Term Effect of the Log of COD (C/Co) Using Dettol at Different Concentrations

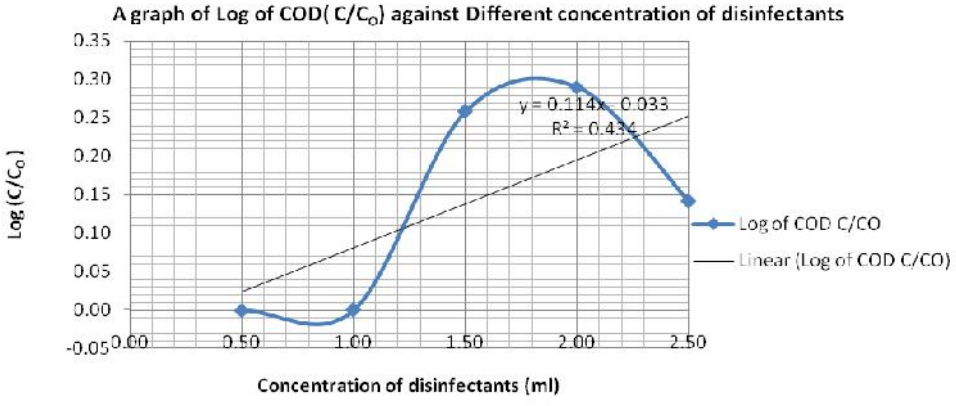


Figure 8: A Graph Showing Short Term Effect of the Log of BOD (C/Co) using Izal at Different Concentrations

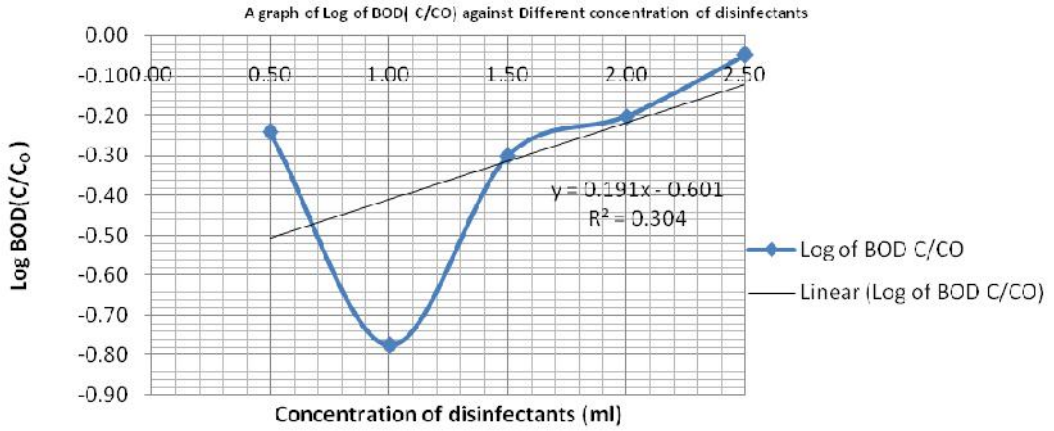


Figure 9: A Graph Showing Short Term Effect Of The Log Of BOD (C/Co) Using Dettol At Different Concentrations

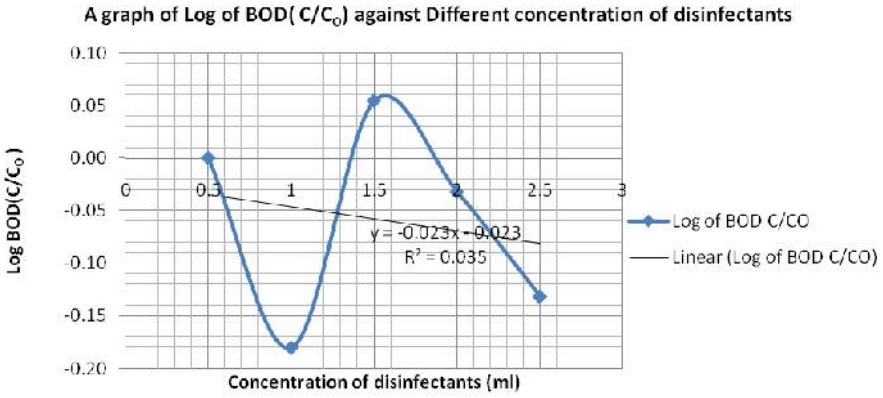


Figure 10: A Graph Showinglong Term Effect of the Log of BOD (C/Co) using Izal at Different Concentrations

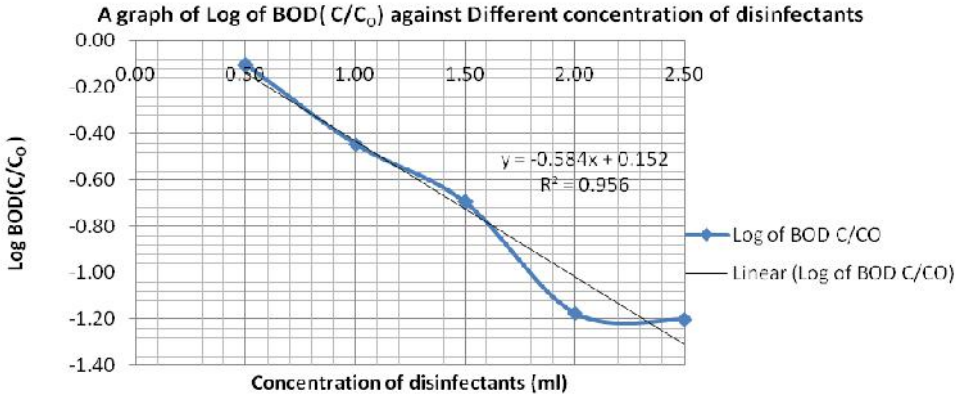
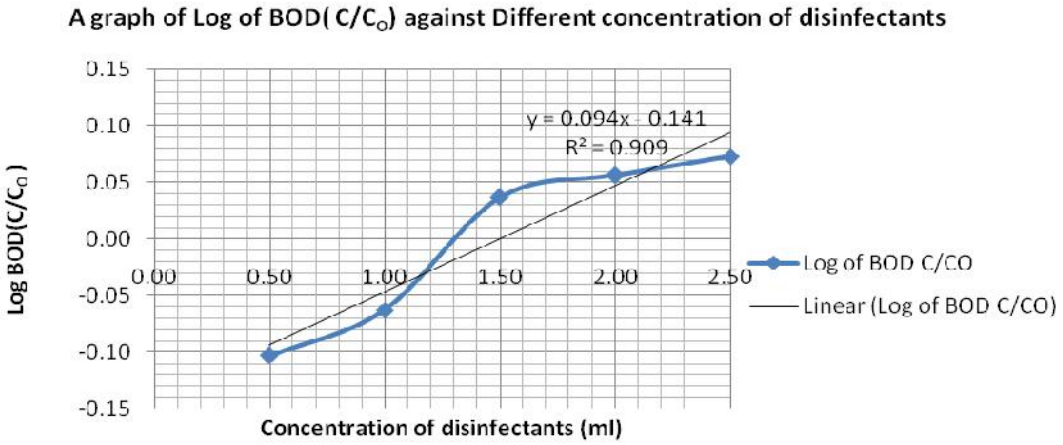


Figure 11: A Graph Showing Long Term Effect of the Log of BOD (C/Co) using Dettol at Different Concentrations



The low COD values observed at 0.5 ml or 1 ml suggest the presence of high faecal colony, likely due to tolerance or inhibitory effects. This observation has earlier been reported in a study of the effect of marine holding tank chemicals on the performance of septic tank (Novac *et al.*, 1990).

The low BOD values observed with addition of 1 ml confirms that the dosage is the critical dosage since it suggest that lower biomass requiring oxygen for oxidation was present in the sample at this dosage. This is also reflected in the COD assessment. From comparison of the disinfectants effect as shown in Figures 8 and 9, usage of Izal recorded higher disinfectant effect compared to usage of Detttol. This conform to the age long assertion that phenolic disinfectants has the highest disinfectant effect.

CONCLUSION

From this study, it has been observed that usage of disinfectants in septic tank should be under taken by informed persons. The usage of excess dosage has advantage of enhancing septic tank health as well as usage of dosage below critical values. This can only be determined after adequate study by an expert.

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