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Effect of Disinfectant on Anaerobic Degradation of Wastewater

Prof. J.C Agunwamba[1], Oge Sunday Oge[2], Dr. Cyril Sunday Ume[3], Ugwuanyi, Samuel Ekene[4]
[1, 2] University of Nigeria Nsukka
[3] Federal University Ndufu Alike Ikwo Ebonyi State(FUNAI)
[4] Institute Of Management And Technology (IMT) ENUGU

Abstracts

A field experiment to investigate the effects of disinfectant on anaerobic degradation of sewage was carried out using wastewater. It was found that disinfectant is not completely favorable to degradation of sewage. Sewage was collected from the University Of Nigeria Nsukka treatment plant and transferred into six (6) clean four (4) Litre white bucket with mouth covered and black polythene bag to prevent the interference of sun-light and oxygen. To five (5) of the samples contained in the four (4) litre buckets , 0.5ml, 1.0ml, 1.5m, 2.0ml, 2.5ml, of each of the two (2) disinfectants (Izal and Dettol) were added with the last serving as a control sample, stirred initially and covered all through the experiment which lasted for one (1) month each.

The experimental run was divided into two set, set A with Dettol dosed and set B with Izal dosed. Samples collected twice a week for analysis and the parameters checked for included: Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Fecal Coliform (FC). It was observed that addition of disinfectant on sewage can make wastewater characteristic increase the organic content present in sewage and may later decrease the degradation or make the bacteria weak.

Keywords: *coliform, sampling, WHO,NSDWQ.*

Background of Study

Disinfectants are substances that are applied to non-living objects to destroy microorganisms that are living on the objects. Disinfection is the primary mechanism for the inactivation/destruction of pathogenic organisms to prevent the spread of waterborne diseases to downstream users and the environment. The organisms found in domestic wastewater include pathogenic enteric bacteria, viruses, helminthes 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. (M.A. Gross and N.E. Deal, eds.2000).

Faecal coliforms are a type of bacteria that originate in warm blooded animals, and they can be used as an indicator for the presence of pathogenic microbs or can also be used to indicate the level of disinfection needed (Schneider, 2009). However there is substantial evidence that bacteria growth occurs with increasing storage time and different disinfectants have been employed in disinfecting wastewater and they are chloramine, chlorine, hydrogen peroxide, UV light, etc. The chemical and physical quality of sewage will heavily influence what type of disinfectant method is most suitable (Winward, 2007). For example, presence of organic matter and suspended solid in sewage can affect efficiency of disinfection and disinfectant demand. Organic material generally reacts with disinfectant and therefore a greater initial dose is needed to achieve a total inactivation of bacteria (Ronen et al., 2010). It was also found that larger particles can help shield bacterial from disinfection (Winward et al., 2007). 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.

Scope of work

The scope of this study involves the application of different dose of disinfectants (Dettol and Izal) into five (5) different each and with the aid of a control sample, their effects be monitored. The sewage used was

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collected from the treatment plant at the University of Nigeria Nsukka.

Research objectives

1. To Investigate the effect of addition of disinfectant on sewage degradation.
2. To know the factors which causes degradation of sewage water.
3. To determine the efficiency removal of wastewater characteristic

Methodology

Collection of samples and description of experimental set-up

Sewage for analysis were collected from the University of Nigeria Nsukka treatment plant for laboratory analysis. Six experimental set ups labeled A, B, C, D, E, F were constructed in the sanitary laboratory. Each set up contained four litres of sewage. The A set up served as control without dettol and Izal while B,C,D,E,F, set up contained 0.5ml, 1ml, 1.5ml, 2ml and 2.5ml of dettol and Izal differently. The sewage was collected with a 25litre gallon and where properly shook and poured into six different 4Litre buckets with mouth covered to prevent the interference of air.

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

Table 3.1: Detailed Description of various set up

Experimental set up	Size (litre)	Dettol (ml)	Izal (ml)	Vol. of Disinfectant by %
A	4	0	0	0
B	4	0.5	0.5	0.12
C	4	1.0	1.0	0.02
D	4	1.5	1.5	0.04
E	4	2.0	2.0	0.05
F	4	2.5	2.5	0.06

Methods of analysis.

All the sewage samples collected for laboratory analysis were analyzed immediately they were brought into the sanitary laboratory. Owing to time limitation, samples which could not be analyzed on the collection day were preserved in the refrigerator incubator and analyzed the following day. All the analysis were based on the standard methods (APHA, 1985).

Laboratory determination

Dissolved Oxygen (DO) of the sample (Raw sewage with the disinfectants) and that of the first day were obtained using dissolved oxygen meter (probe meter).The initial DO_1 and of sample(s) were obtained with a probe meter as earlier stated with a ratio 2:310 as the decimal fraction while that of the sample were just collected as DO and recorded.

Fecal coliform(FC) was determined using standard total coliform most probable number (MPN) tests while chemical oxygen demand (COD), suspended solids(SS) and pH were determined using Stamous chloride, Gravimetric methods and pH meter respectively.

Biochemical oxygen demand (BOD)

For the biochemical oxygen demand, six 310ml 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 37.5g of lactose both in 250ml of distilled water. 10ml 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.5ml of the single strength medium was pipetted into another 36 set of small test tubes. 10ml 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 48hours. 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 most probable number(MPN) table.

Chemical oxygen demand (COD)

The procedure of COD was carried out by first weighing of 0.4g portion of mercury sulphate ($HgSO_4$) and placed in the labeled reflux flask 0.0ml, 0.5ml, 1.0ml, 1.5ml, 2.0ml and 2.5ml, 20ml of the sample were pipette to the flask and 20ml of distilled water in one other flask, which served as blank; 10ml standard potassium

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dichromate $K_2C_2O_7$ solution was added with a volumetric pipette. To six bottles 0.0ml, 0.5ml, 1.0ml, 1.5ml, 2.0ml and 2.5ml, with some granules of glass beeds (Which was previously heated to 60^0C in a furnace).

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

PH

At every collection day (3days), the pH of all the six samples are obtained using a hand-held PH meter.

Calculation of parameters

Biochemical oxygen demand (BOD)

BOD of the samples were calculated using the;

BOD= $(D1 - D2)/p$

Where $D1$ = Dissolved oxygen of sample diluted in 15 minutes after preparation of (BOD_1).

$D2$= Dissolved oxygen of diluted sample after 5 days incubation (BOD_5)

P= Decimal fraction of sample used = $2/310$ = 0.00645310

Total coliform MPN tests

The index is obtained from the positive MPN index table. In the table the positive table value are in the first column while the corresponding MPN index are in the second column.

Chemical oxygen demand (COD)

COD at the various samples can be calculated using the formula

Mg/L COD = $((a - b) * N * 8000) \Big/ ml\ of\ sample$

Where a= ml of Fe (NH_4) $(SO_4)_2$ in blank sample titration = 28.00ml (varied)

b = ml of Fe (NH_4) $(SO_4)_2$ in sample titration = value varied

N= Normality of Fe (NH_4) $(SO_4)_2$ = 0.10N (varied)

Result and discussion

Presentation of results

The results obtained in this research shows the variation of COD, BOD and Total coliform (TC) of sewage dosed with the two disinfectants (Dettol and Izal respectively) with Days from start-up.

Chemical Oxygen Demand

Table 4.1.0 COD removal results for short time effect (Izal)

Vol. of disinfectant (ml)	initial COD(mg/l)	Final COD(mg/l)	COD Removal (%)
0.0	207.8	136	35
0.5	238	172	28
1.0	257.8	180	30
1.5	273.21	208	24
2.0	292.45	224	23
2.5	333.62	252	25

Table 4.1.1: COD removal results for long time effect (Izal)

Vol. of disinfectant (ml)	initial COD(mg/l)	Final COD(mg/l)	COD Removal (%)
0.0	207.8	152	27
0.5	238	168	30
1.0	257.8	160	38
1.5	273.21	216	21
2.0	292.45	323	20
2.5	333.62	224	33

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Table 4.1.2 COD removal results for short time effect (Dettol)

Vol. of disinfectant (ml)	initial COD(mg/l)	Final COD(mg/l)	COD Removal (%)
0.0	72.8	55	25
0.5	149	102	32
1.0	185.6	127	31
1.5	229.3	91	60
2.0	262	95	64
2.5	407.7	120	71

Table 4.1.3: COD removal results for long time effect (Dettol)

Vol. of disinfectant (ml)	initial COD(mg/l)	Final COD(mg/l)	COD Removal (%)
0.0	72.8	69.0	5
0.5	149	146	2
1.0	185.6	173	7
1.5	229.3	200	13
2.0	262	192	27
2.5	407.7	154	62

In Table 4.1.0 above, the effect of different concentration of disinfectants over a period of exposure is represented. Statistical assessment showed that significantly ($r^2 = 0.707$) difference were recorded in the COD removal over a period at different concentration. With short term treatment with Izal, lower values were observed with increasing concentrations compared to values observed for control. Whereas on prolonged treatment (one month), higher values were observed with the values almost closing on with the COD removal observed for control. All values obtained for different concentration of Dettol for short term treatment were significantly ($r^2 = 0.706$) greater than observed value for prolonged treatment ($r^2 = 0.200$). however, 2.5ml with Dettol usage recorded higher COD removal. For prolonged treatmentl, COD removal values observed with Dettol usage varied in the range of 5%, 7% and 62% respectively, whereas higher efficiency removal were observed with increasing concentration of disinfectants from 0.0ml to 2.5ml. however, it is possible that low removal efficiency was due to the dissolved organic carbon as microbial degradation take place.

Biochemical Oxygen Demand

Table 4.2.0: BOD removal results for short time effect (Izal)

Vol. of disinfectant (ml)	initial BOD(mg/l)	Final BOD(mg/l)	BOD Removal (%)
0.0	43.3	27	38
0.5	56.6	37	35
1.0	46.6	40	14
1.5	50	30	40
2.0	53.3	37	27
2.5	50	37	27

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Table 4.2.1: BOD removal results for long time effect (Izal)

Vol. of disinfectant (ml)	initial BOD(mg/l)	Final BOD(mg/l)	BOD Removal (%)
0.0	43.3	30	69
0.5	56.6	50	18
1.0	46.6	36.67	29
1.5	50	43.33	40
2.0	53.3	36.67	50
2.5	50	30	67

Table 4.2.2: BOD removal results for short time effect (Dettol)

Vol. of disinfectant (ml)	initial BOD(mg/l)	Final BOD(mg/l)	BOD Removal (%)
0.0	63	50	21
0.5	70	64	9
1.0	83	67	20
1.5	70	53	24
2.0	77	60	22
2.5	87	67	23

Table 4.2.3: BOD removal results for long time effect (Dettol)

Vol. of disinfectant (ml)	initial BOD(mg/l)	Final BOD(mg/l)	BOD Removal (%)
0.0	63	27	58
0.5	70	43	38
1.0	83	33	60
1.5	70	33	52
2.0	77	40	48
2.5	87	47	46

In Table 4.2.0 and 4.2.1, Result of BOD after treatment with different concentrations of disinfectants are represented. With short term (two weeks) treatment with Izal, lower values of BOD were observed with increasing concentration of disinfectant or decreasing was due to fluctuation in organic loading as a result of increased coagulation introduced by the application of disinfectants. In Table 4.2.2, result of BOD removal with short term (two weeks) treatment with Dettol is represented. BOD removal was best observed when 1.5ml of disinfectant were added to the sample. The low BOD values observed with addition of 0.5ml 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.

For prolonged treatment (one month) higher BOD removal was favored when dosed with 1.0ml of disinfectants compared to control. However, it was observed that there was a decreasing values of BOD removal from 52%, 42% and 46% with increasing values of disinfectants from 1.5ml, 2.0ml to 2.5ml of respective sample. BOD efficiency removal varied greatly during the time course due to fluctuation in organic loading. Hence, the presence of organic matter and suspended solid in sewage can affect efficiency of disinfection and disinfectants demand (Winward et al.,2007).

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Fecal Coliform

Table 4.3.0: FECAL COLIFORM (FC) removal results for short time effect (Izal)

Vol. of disinfectant (ml)	initial FC MPN/100	Final MPN/100	FC Removal (%)
0.0	460	120	74
0.5	240	14	94
1.0	1100	28	98
1.5	1100	28	97
2.0	2400	240	90
2.5	2400	240	90

Table 4.3.1: FECAL COLIFORM (FC) removal results for long time effect (Izal)

Vol. of disinfectant (ml)	initial FC MPN/100	Final FC MPN/100	FC Removal (%)
0.0	460	150	67
0.5	240	93	61
1.0	1100	28	97
1.5	1100	75	93
2.0	2400	11	100
2.5	2400	64	97

Table 4.3.2: FECAL COLIFORM (FC) removal results for short time effect (Dettol)

Vol. of disinfectant (ml)	initial MPN/100	Final FC MPN/100	FC Removal (%)
0.0	460	9	98
0.5	75	7	91
1.0	210	9	96
1.5	64	3	95
2.0	240	9	96
2.5	93	7	92

Table 4.3.3: FECAL COLIFORM (FC) removal results for long time effect (Dettol)

Vol. of disinfectant (ml)	initial FC MPN/100	Final FC MPN/100	FC Removal (%)
0.0	460	7	98
0.5	75	14	81
1.0	210	39	82
1.5	64	28	56
2.0	240	11	95
2.5	93	64	31

In Table 4.3.0 and 4.3.1 above, the effect of different concentration of respective disinfectant over different period of exposure are reported. Result shows statistical insignificant difference (r^2 =0.366),refer to anova table. Difference in count with respective disinfectants at different concentration, with Izal on short term (two weeks) treatment, it can be seen that concentration of 1ml recorded the most values in removal of organism, whereas 1.5ml and 2.5ml recorded the least difference. However, on prolonged treatment with Izal, resistance of fecal coliform to lower concentration was observed. Only treatment with 1.5ml and 2.5ml of Izal recorded higher counts compared to counts observed with control. Addition of 2.0ml can be seen as the critical dosage. This has been defined as the dosage above which chemical were total toxic to microbes (Ignatius et al., 2004).

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In Table 4.3.2 above, with Dettol on short term insignificant (r^2 =0.366), lower counts were observed with different concentration of Dettol compare to control. Higher count were observed with concentration of 1.0ml and 2.0ml of Dettol. Whereas on prolonged treatment (one month) with Dettol recorded insignificant (r^2 =0.276), lower counts after treatment compared to count observed for control were observed with increasing concentration of disinfectant, which maybe as a result of disinfectants been less effective in reducing the organism.

Graphical representation.

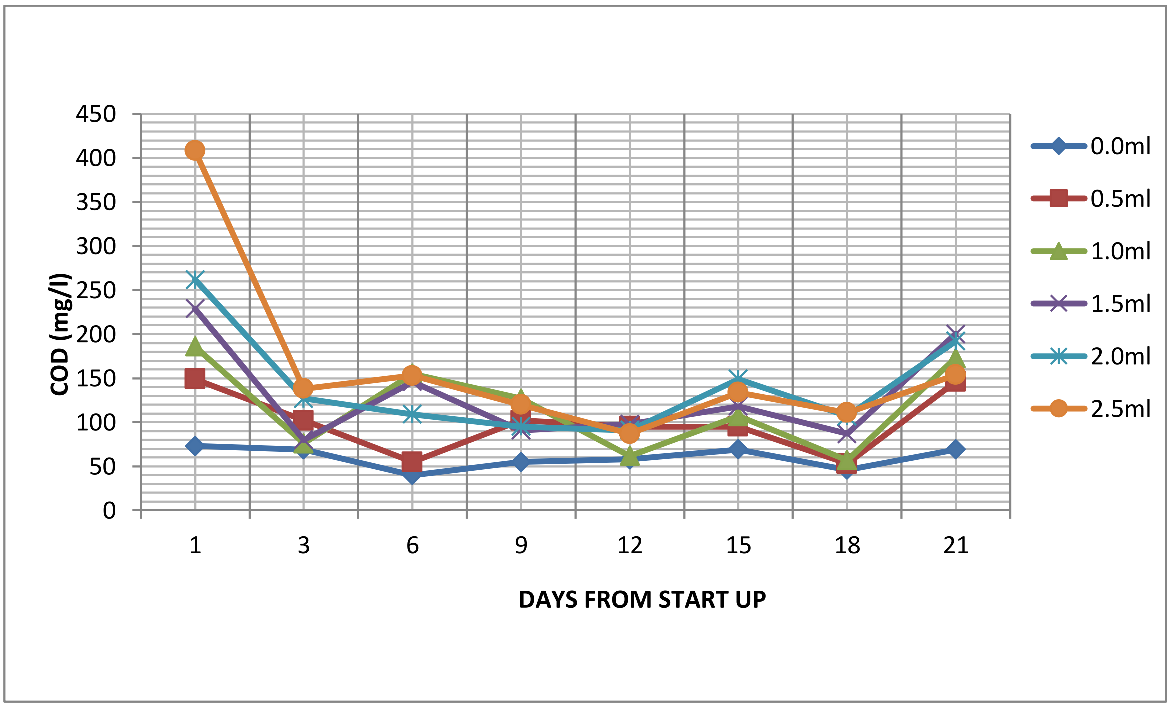

Fig.4.1: Variation of COD concentration Dettol dosed.

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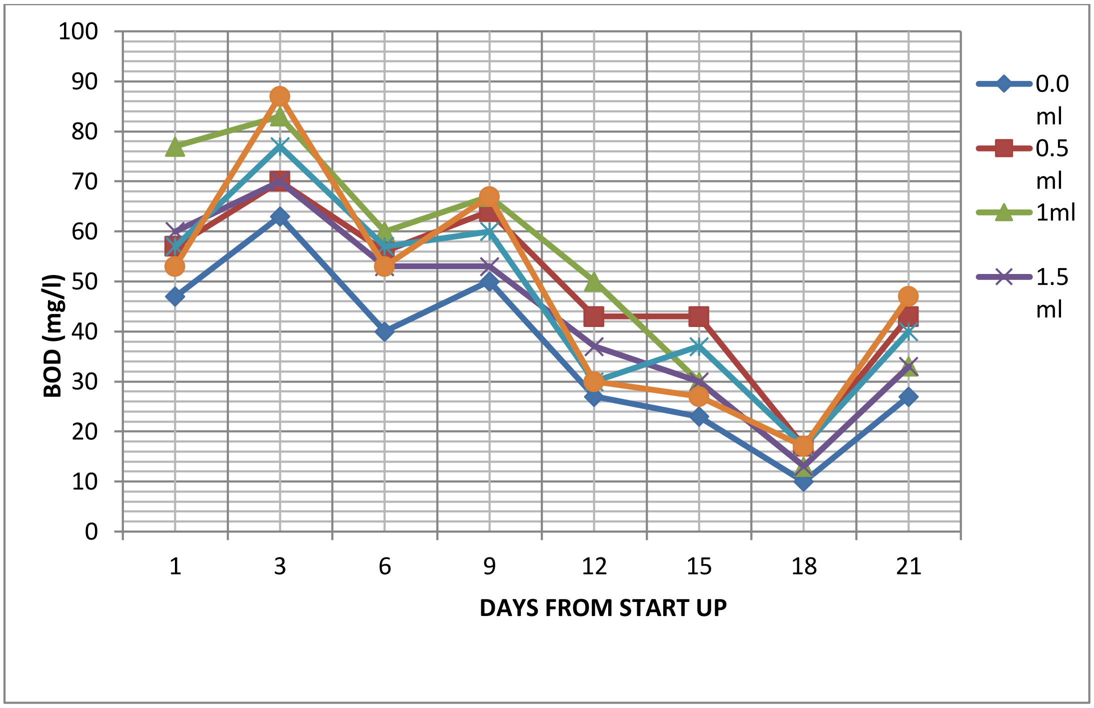

Fig.4.2: Variation of BOD Concentration dettol dosed.

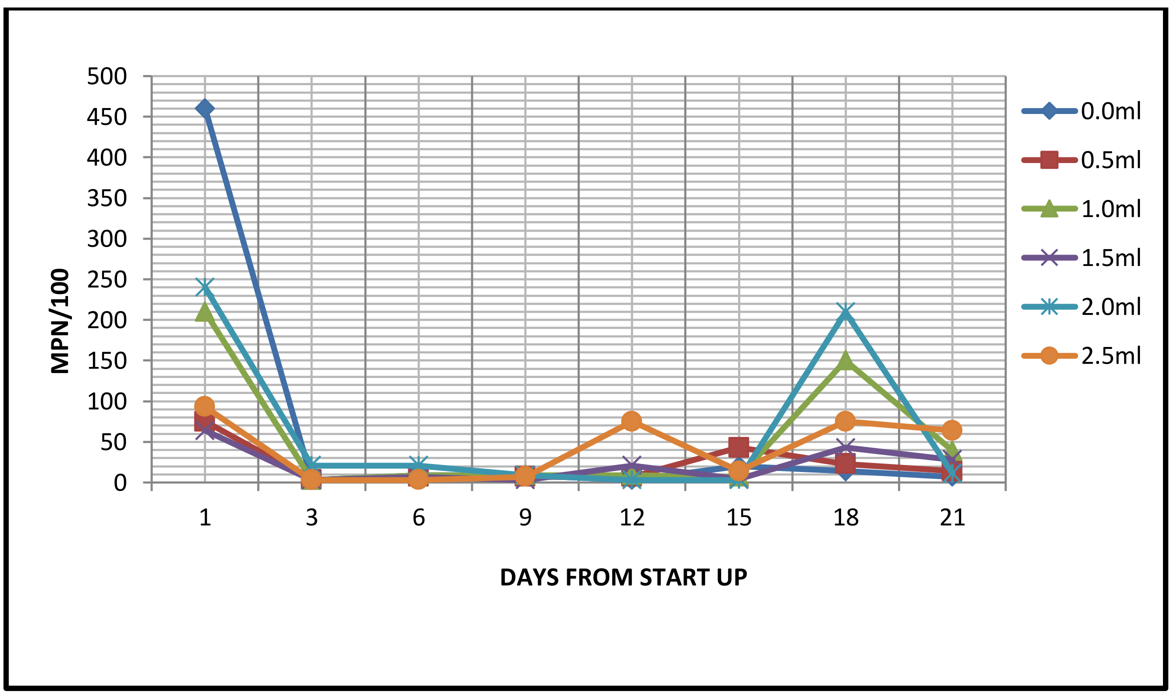

Fig.4.3: Variation of fecal Coliform Concentration Dettol dosed.

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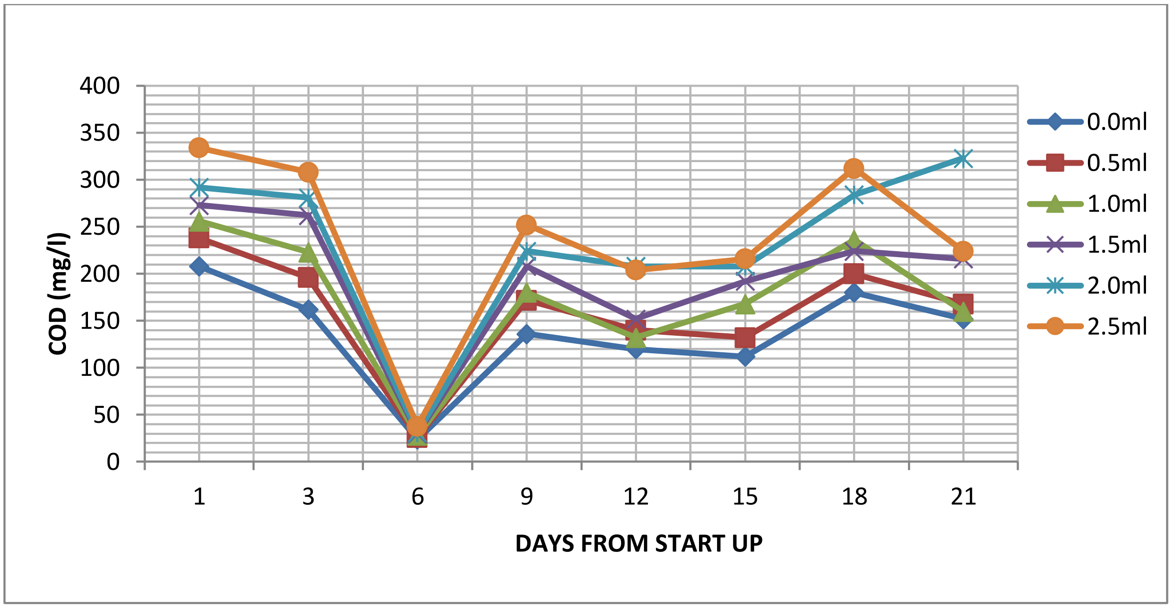

Fig.4.5: Variation of COD Concentration Izal dosed

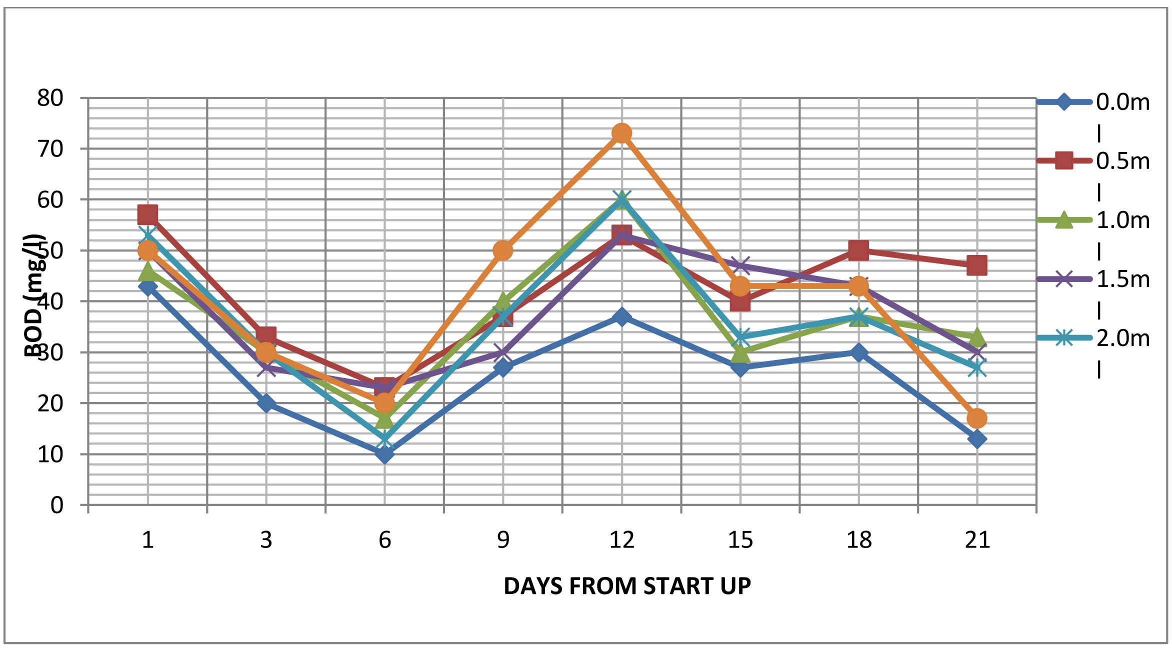

Fig.4.6: Variation of BOD Concentration Izal dosed.

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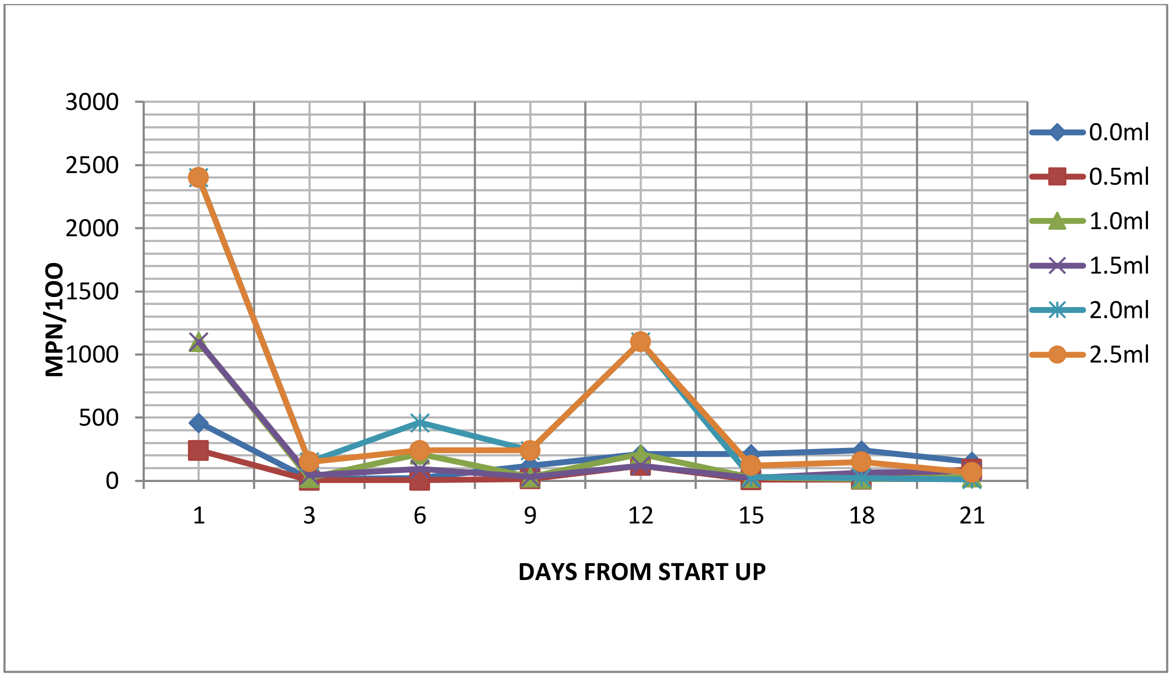

Fig.4.7: Variation of fecal Coliform Concentration Izal dosed

Conclusion

1 . Continuous use of disinfectants at recommended concentration are not enough to completely destroy the bacteria which can affects the degradation.
2 . Disinfectants do have an adverse effect on BOD and COD. Therefore BOD and COD removal is lowered as the doses of disinfectants are increased.
3 . The efficiency of disinfection and disinfectant demand were affected due to the presence of organic matter and suspended solid present in sewage.
4. Fecal coliform concentrations are regained when the disinfectants become less effective.
5. The P^H of the samples increases with time thereby increasing the activation energy in sewage.
6. Dissolved oxygen where greatly influenced with the effect of disinfectants and also with temperature.
7. There is a large day-to-day variation in sewage strength in container.

Recommendation

1. The combine use of disinfectant (Dettol and Izal) should be ascertained to know their effect.
2. The use of disinfectants should be reduced especially when it will eventually have contacts with sewage or when its use cannot be avoided, proper dilution to be made after usage to reduce its effect.

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Regression for COD combined

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.617[a]	.381	.353	49.450

a. Predictors: (Constant), Dis infectant

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	33078.375	1	33078.375	13.527	.001[a]
	Residual	53796.250	22	2445.284		
	Total	86874.625	23			

a. Predictors: (Constant), Dis infectant

b. Dependent Variable: COD

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	52.750	31.920		1.653	.113
	Dis infectant	74.250	20.188	.617	3.678	.001

a. Dependent Variable: COD

Regression for Efficiency of COD combined

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.207[a]	.043	.000	17.080

a. Predictors: (Constant), Dis infectant

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	287.042	1	287.042	.984	.332[a]
	Residual	6417.917	22	291.723		
	Total	6704.958	23			

a. Predictors: (Constant), Dis infectant

b. Dependent Variable: % Efficiency

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Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	41.667	11.025		3.779	.001
	Dis infectant	-6.917	6.973	-.207	-.992	.332

a. Dependent Variable: % Efficiency

Regression for Coliform Combined

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.544[a]	.296	.264	59.351

a. Predictors: (Constant), Dis infectant

b. Dependent Variable: Coliform

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	32560.667	1	32560.667	9.244	.006[a]
	Residual	77495.167	22	3522.508		
	Total	110055.833	23			

a. Predictors: (Constant), Dis infectant

b. Dependent Variable: Coliform

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-56.417	38.311		-1.473	.155
	Dis infectant	73.667	24.230	.544	3.040	.006

a. Dependent Variable: Coliform

Regression for Efficiency of Coliform

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.113[a]	.013	-.032	17.262

a. Predictors: (Constant), Dis infectant

b. Dependent Variable: % Efficiency

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ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	84.375	1	84.375	.283	.600[a]
	Residual	6555.583	22	297.981		
	Total	6639.958	23			

a. Predictors: (Constant), Dis infectant

b. Dependent Variable: % Efficiency

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	80.583	11.143		7.232	.000
	Dis infectant	3.750	7.047	.113	.532	.600

a. Dependent Variable: % Efficiency

Regression (Short time COD)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.840[a]	.706	.677	34.265

a. Predictors: (Constant), Dis infectant

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	28227.000	1	28227.000	24.042	.001[a]
	Residual	11740.667	10	1174.067		
	Total	39967.667	11			

a. Predictors: (Constant), Dis infectant

b. Dependent Variable: COD

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.333	31.279		.043	.967
	Dis infectant	97.000	19.783	.840	4.903	.001

a. Dependent Variable: COD

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Regression (Short time Efficiency of COD)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.597[a]	.356	.291	14.493

a. Predictors: (Constant), Dis infectant

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1160.333	1	1160.333	5.525	.041[a]
	Residual	2100.333	10	210.033		
	Total	3260.667	11			

a. Predictors: (Constant), Dis infectant

b. Dependent Variable: % Efficiency

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	66.833	13.230		5.052	.000
	Dis infectant	-19.667	8.367	-.597	-2.350	.041

a. Dependent Variable: % Efficiency

Regression (Short time Coliform)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.605[a]	.366	.303	75.216

a. Predictors: (Constant), Dis infectant

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	32656.333	1	32656.333	5.772	.037[a]
	Residual	56574.667	10	5657.467		
	Total	89231.000	11			

a. Predictors: (Constant), Dis infectant

b. Dependent Variable: Coliform

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Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-97.000	68.663		-1.413	.188
	Dis infectant	104.333	43.426	.605	2.403	.037

a. Dependent Variable: Coliform

Regression Short time Efficiency of Coliform)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.346[a]	.120	.032	6.437

a. Predictors: (Constant), Dis infectant

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	56.333	1	56.333	1.360	.271[a]
	Residual	414.333	10	41.433		
	Total	470.667	11			

a. Predictors: (Constant), Dis infectant

b. Dependent Variable: % Efficiency

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	99.167	5.876		16.876	.000
	Dis infectant	-4.333	3.716	-.346	-1.166	.271

a. Dependent Variable: % Efficiency

Regression (Long Time COD)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.448[a]	.200	.120	56.369

a. Predictors: (Constant), Dis infectant

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ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7956.750	1	7956.750	2.504	.145[a]
	Residual	31774.167	10	3177.417		
	Total	39730.917	11			

a. Predictors: (Constant), Dis infectant

b. Dependent Variable: COD

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	104.167	51.457		2.024	.070
	Dis infectant	51.500	32.544	.448	1.582	.145

a. Dependent Variable: COD

Regression (% Efficiency of COD Long Time)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.199[a]	.040	-.056	15.704

a. Predictors: (Constant), Dis infectant

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	102.083	1	102.083	.414	.534[a]
	Residual	2466.167	10	246.617		
	Total	2568.250	11			

a. Predictors: (Constant), Dis infectant

b. Dependent Variable: % Efficiency

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16.500	14.336		1.151	.277
	Dis infectant	5.833	9.067	.199	.643	.534

a. Dependent Variable: % Efficiency

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Regression (Long Term Coliform)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.525[a]	.276	.203	38.175

a. Predictors: (Constant), Dis infectant

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5547.000	1	5547.000	3.806	.080[a]
	Residual	14573.667	10	1457.367		
	Total	20120.667	11			

a. Predictors: (Constant), Dis infectant

b. Dependent Variable: Coliform

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-15.833	34.849		-.454	.659
	Dis infectant	43.000	22.041	.525	1.951	.080

a. Dependent Variable: Coliform

Regression (Long Term % Efficiency of Coliform)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.285[a]	.081	-.011	21.790

a. Predictors: (Constant), Dis infectant

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	420.083	1	420.083	.885	.369[a]
	Residual	4748.167	10	474.817		
	Total	5168.250	11			

a. Predictors: (Constant), Dis infectant

b. Dependent Variable: % Efficiency