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BACTERIA AND ITS GOOD BENEFITS IN CHEMICAL PROCESS INDUSTRY EFFLUENTS TREATMENTS

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ABSTRACT

The pollution status of the effluents from chemical process industry was studied qualitatively by using bacteria during a period of one year. The study of bacteria benefits observed has been calculated in the pilot scale laboratory and has been revalidated with similar applications cited. The treatment efficiency of bacteria, Pseudomonos sp., Klebsiella sp., and E. coli was in the range of 85-90%.

***KEYWORDS**: Bio- Monitoring, Industrial Effluents, Water Characteristics, Heavy Water Plant*

Article History

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INTRODUCTION

Industries release their effluents into the water bodies which may alter the physico -chemical characters. The basic constituents which can pose a threat to the environment are mainly temperature, pH, Total Dissolved Solids (TDS), Hydrogen Sulphide (H_2S), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Oil and Grease, Chloride (Cl^-), and Sulphate (SO_4), etc.

Biological degradation and subsequent assimilation of impurities present in raw wastewater by groups of primitive organisms, strongly dominated by bacteria constitute the preliminary phase in the purification process.

Recently the multiple treatment systems comprising different microbial applications are also in operation to complete and purify the effluents. A large amount of waste discharged from eight largest industries such as oil, cement, textile, steel, pulp and paper, tannery, and distillery industries generates a variety of gases, liquids and solid waste which leads long time intervention into the environment, human, animals, and plants (Chandra and Chaudhary, 2013). The rapid increase in population and urbanization have considerably increased the rate of water pollution (Qasim and Mane., 2013).

Ray (1978) proposed a forced logical system for the treatment of industrial effluents, and showed 95% efficiency in the purification process . Friedman *et al.* (1977) recorded a system consisting of a pond covered with a duckweed mat able to purify the waste water in a joint performance with the bacteria. Generally, bacterial growth with industrial wastewaters was shown to be effective, and of low cost for the removal of pollutants. Bioremediation of tannery effluents is an attractive environment friendly, safe and cost -effective alternative technology to conventional methods. Microbes in the environment play an important role is cycling and destroying them through bio-degradation (Aneez, M. et al., 2011).

Pilot Experimental Work: The three (3) bacterial species :*Pseudomonas sp*., *Klebsiella sp*., and *E.coli*. were incubated in 250 ml of conical flask containing nutrient agar medium. The oil (0.1,0.2,0.3,0.4, and 0.5%)was added, and after every two days of incubation, the protein and carbohydrate levels were estimated and the removal of oil was also estimated. The efficiency of algal and bacterial species in the reduction of BOD, COD, Sulphide, and TDS was analyzed.

Results and Discussions: Based on the pilot plant observation and results validating above data good practice plants have been cited below. The samples analysis, comparison at one of the Heavy Water Plants at Manuguru has been validated. The influence of bacteria on the removal of oil and grease was studied on the 6 days of incubation period because, the active absorption period was observed in 6 days. The results obtained are reported in table 1-6.

From Table 1: It was found that decrease in the growth of *Pseudomonas sp*. was taking place with the substantial increase in the oil and grease concentration. The appreciable amount of carbohydrates, proteins, and lipids was seen to decreased on the amendment. The carbohydrate content was seen 1.5 mg/g in 0.1% oil and it was nil in 0.5% oil the amendment. Protein content was 1.5 mg/g in 0.1% and it was nil when 0.5% oil was added. The lipid content was observed to be 0.6 mg/g in 0.1% oil and it was nil at 0.5% oil. The percentage of reduction in oil and grease was 40 initially (when 0.1% oil was added) and nil (zero %) when 0.5% oil was added.

From Table 2: It was observed that the increased oil and grease concentration substantially decreased the growth of *Klebsiella sp*. Similarly, a gradual reduction in carbohydrate, protein, and lipid content was also decreased. The carbohydrate content was seen 2.0 mg/g in 0.1% oil while it was nil when 0.5% oil was added. The protein content was 2.1 mg/g in 0.1% oil, whereas it was zero when 0.5% oil was added and also lipids content was found 0.6 mg/g in 0.1% oil, and nil when 0.5% oil amended. The percentage of reduction was 25 in the initial oil concentration while it was nil when 0.5% oil was added.

From Table 3: The decrease in the growth of *E.coli* was noticed by the substantial increase in the oil amendment. Similarly, a gradual reduction in carbohydrate, protein, and lipid content was observed while increasing oil concentration, the lipid content was 0.5 mg/g in 0.1% oil amendment and it was nil when 0.5% oil was added. The carbohydrate content was noticed initially 2.1 mg/g of 0.1% oil amendment while it was zero when 0.5% oil was added. Protein content was seen varying from 1.1 mg/g to zero with the corresponding addition of oil from 0.1% to 0.5% respectively. The percentage of reduction of the initial concentration of oil and grease was 20 at 0.1% oil addition and nil when 0.5% oil was added.

Table 1: Influence of *Pseudomonas sp*. on Effluent with oil and Grease after 6 Days of Incubation

Oil & Grease Concentration	Growth	Carbohydrate Content (mg/g)	Protein Content (mg/g)	Lipids Content (mg/g)	Percent Reduction of Oil & Grease
Control	3+	2.10	1.7	0.8	-
0.1%	2+	1.50	1.5	0.6	40%
0.2%	2+	0.95	1.2	0.5	25%
0.3%	1+	0.50	0.5	0.3	15%
0.4%	1+	0.00	0.0	0.0	0%
0.5%	0	0.00	0.0	0.0	0%

Table 2: Influence of *Klebsiella Sp.* on the Removal of Oil and Grease after 6 Days of Incubation

Oil & Grease Concentration	Growth	Carbohydrate Content (mg/g)	Protein Content (mg/g)	Lipids Content (mg/g)	Percent Reduction of Oil & Grease
Control	3+	2.5	2.8	0.5	-
0.1%	2+	2.0	2.1	0.6	25%
0.2%	1+	1.5	1.5	0.4	15%
0.3%	1+	1.0	0.6	0.1	05%
0.4%	0	0.0	0.0	0.0	0%
0.5%	0	0.0	0.0	0.0	0%

Table 3: Influence of *E.Coli* on the Removal of Oil and Grease after 6 Days of Incubation

Oil & Grease Concentration	Growth	Carbohydrate Content (mg/g)	Protein Content (mg/g)	Lipids Content (mg/g)	Percent Reduction of Oil & Grease
Control	3+	2.8	1.70	0.7	-
0.1%	2+	2.1	1.10	0.5	20%
0.2%	2+	1.6	0.75	0.3	15%
0.3%	1+	1.0	0.40	0.0	08%
0.4%	1+	0.4	0.00	0.0	0%
0.5%	0	0.0	0.00	0.0	0%

From the Table 4, the treatment with *Pseudomonas sp*. for the improvement of effluent quality was studied, and reported during 6 days of incubation. BOD levels were decreased over 2 to 4 days and by a 100% at 4 days of incubation. COD levels were decreased substantially and reached 100% at the last incubation. Sulphide levels were noted 100 ppm after 6 days of incubation giving 96% removal efficiency. TDS levels were decreased to 10 ppm, 5 ppm, and 0 ppm in 2, 4, and 6 days of incubation, and Oil and grease levels were decreased to zero after 4 days of incubation.

From Table 5, the treatment of *Klebsiella sp.* on the improvement of effluent quality was studied and adopted during 6 days of incubation. The BOD levels were decreased from 2 to 4 days, and 80% decrease was noted, but after 6 days it gave 100% removal. COD levels were decreased from 2 to 6 days substantially and found after 6 days of incubation 100% removal was recorded. Oil and grease levels were decreased from 2 to 6 days, and 100% decreased was recorded in 6 days of incubation. Sulphide levels were decreased from 2 to 6 days ,and 96% decrease was observed in 6 days of incubation. TDS levels were decreased from 2 to 6 days, and 90% decrease was recorded after 6 days of incubation.

The treatment of *E.coli* for the improvement of effluent quality was studied and reported during 6 days of incubation. The BOD levels were seen to be decreased from 2 to 6 days and 90% decrease was noted on 6 days of incubation. COD levels were decreased from 2 to 6 days and 93% reduction in COD level was recorded. Sulphide levels were decreased from 2 to 6 days of incubation and 93% decrease was noted at its last incubation. Sulphide levels were observed to be decreased from 2 to 6 days and 92% decrease was noted on 6 days of incubation. TDS levels were decreased from 2 to 6 days and 90% decrease was recorded after 6 days of incubation. Oil and grease levels were seen 3 ppm and 2 ppm, respectively after 2 and 4 days of incubation and after 6 days of incubation, a 100% decrease was noted(Table 6).

Table 4: Treatment Efficiency by Using *Pseudomonas Sp* on Effluent Water of Chemical Process Plant at Manuguru

Parameter	Days of Incubation				Percent Removal after Last Incubation
	00	02	04	06	
BOD (ppm)	08 - 10	04	00	00	100%
COD (ppm)	20 – 30	10	05	00	100%
Sulphide (ppm)	2000 – 2500	1500	500	100	96%
TDS (ppm)	40 – 50	10	05	00	100%
Oil & Grease (ppm)	06 - 08	03	00	00	100%

Table 5: Treatment Efficiency by Using *Klebsiella Sp* on Effluent Water of Chemical Process Plant at Manuguru

Parameter	Days of Incubation				Percent Removal after Last Incubation
	00	02	04	06	
BOD (ppm)	08 - 10	04	02	00	100%
COD (ppm)	20 – 30	10	04	00	100%
Sulphide (ppm)	2000 – 2500	1000	500	100	96%
TDS (ppm)	40 – 50	20	10	05	90%
Oil & Grease (ppm)	06 - 08	03	02	00	100%

Table 6: Treatment Efficiency by Using *E.Coli* on Effluent Water of Chemical Process Plant at Manuguru

Parameter	Days of Incubation				Percent Removal after Last Incubation
	00	02	04	06	
BOD (ppm)	08 - 10	06	03	01	90%
COD (ppm)	20 – 30	10	06	02	93%
Sulphide (ppm)	2000 – 2500	1500	1000	300	92%
TDS (ppm)	40 – 50	20	10	05	90%
Oil & Grease (ppm)	06 - 08	03	02	00	100%

DISCUSSIONS

Microorganisms exist in nature as members of complex, mixed communities. The microbial communities in industrial wastewater bioreactors can be used as model systems to study the evolution of new metabolic pathways in natural ecosystems. Aquatic environment forms an interface, connecting the terrestrial environment and human population. In addition, such aquatic systems serves as sink receiving waste and bacteria from different sources (Czekalski et al. 2015).

The microorganisms in these bioreactors compete for different carbon sources, and constantly have to evolve new metabolic capabilities for survival. Thus, industrial bioreactors should be a rich source of novel biocatalysts (Bramucci and Nagarajan, 2000). The patterns of related bacterial biomass are assessed in the present study in relation to the contaminant concentration. The biological system was the effective on highly diluted oil contaminated with water because mineral based oils are adsorbed by the microorganisms faster than they can be metabolized (Tabakian *et al.*, 1978). The presence of bacteria indicates the pollution status of the untreated tannery effluent suggesting that it should be treated before its disposal using the biological method particularly native and non-native bacteria for comparing their degrading efficiency and the bio-treated water can be reused for the agricultural and aqua-cultural purposes (Noorjahan, 2014).

It has been shown that the majority of pathogenic microbes is derived faecally, which include bacteria, viruses, and protozoa (Leclerc et al., 2001). The point sources (PS) of contamination,mainly include untreated/undertreated sewage, hospitals, and industries (Cabral, 2010). The application of Pseudomonas sp. strains' activities catalyze the increasing hydrolysis of oil and grease waste; it can be considered as pretreatment to decrease organic matter concentration, color, and suspended solids. Arora *et al.*(1982) explained the alternative biological remediation of oil decomposition by soil microflora and related to the oxygen transfer. Manning and Sridar (1983) studied the joint activity of chemical coagulant and algal – bacterial system and found decreases in the interfacial tension between the dispersed oil phase in industrial effluents. In many refineries, suspended growth systems, such as a conventional activated sludge (CAS) process are applied to treat refinery waste water (Tellez *et al*, 2002). Xianling *et al*. (2005) explained that the biological treatment system can be easy to operate and can treat a large amount of waste water in a space which was as small as possible. Xian *et al*. (2006) investigated alternative to CAS process by using B350M and B350 group microorganism immobilized on carriers in a pair of biological aerated film (BAF). Kodama *et al*. (2008) studied the gram-negative, mesophilic bacterial strain, designated 1-1B^{T}, which degraded polycyclic aromatic hydrocarbons, and isolated from petroleum-contaminated seawater during a bioremediation experiment. Stamper *et al.* (2008) found that low concentrations of oily wastewater components were mineralized even in the presence of more abundant substrates such as, synthetic gray water containing vegetable oil, detergent, gelatin and starch.

CONCLUSIONS

The use of bacteria provides good biological agents for removal of oil and grease. The efficiency of these biological organisms was observed high, when the oil concentration was low. The biological organisms were also capable in reduction of BOD, COD, TDS, and sulphides and the efficiency were increased with retention time. This is simply a pilot scale experimentation designed and organized in the controlled conditions. The large scale application of bacteria for the treatment of large volumes of industrial effluents is possible only after redesigning the experiment and optimizing the conditions for its application.

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