December 2008 Volume 3 Issue 3

Trade Science Inc.

Environmental Science

An Indian Journal

Current Research Papers

ESAIJ, 3(3), 2008 [268-270]

Effect of lubricant oil sludge on soil

Elsa Marric, Abhaya Kumar Dalai*

Department of Botany, Ravenshaw University, Cuttack-753003, Orissa, (INDIA)

E-mail: dalaikabhaya_e@rediffmail.com

Received: 4th September, 2008 ; Accepted: 9th September, 2008

ABSTRACT

The extent of change of soil property by the dumping of oil sludge coming out from lubricant oil reprocessing industries was studied. The soil samples considered were under long duration impact (10 years of exposure to oil sludge), short duration impact (5 years of exposure to oil sludge) with or without amendment to observe recovery of pollution effect. The effect of oil sludge was evaluated on the basis of oil content of the contaminated soil. With increase of the exposure of oil sludge there was increase in the content of oil in the soil. Soil was changing towards acidic due to oil sludge. Reduction of microbial population with duration of exposure was significant. Lime treatment was found to recover the soil from oil sludge effect.

KEYWORDS

Lubricant oil sludge;
Microbial population;
Soil parameters.

INTRODUCTION

Soil is the major habitat of terrestrial microorganisms. Higher numbers of microbes occur in the organically rich surface layer than in the underlying mineral soil. Majority of microbial population is found in the upper 6-12 inch of soil[1]. The extent of microbial population depends on pH, organic matter, temperature, moisture content, etc. The change in the soil condition imposes selection pressure on microbial types. The type(s) that can adapt the soil condition is found to be available in that particular soil.

Fertility of soil depends on the presence and activity of microbes. But the most important threat to soil fertility is the agricultural practices and direct or indirect effect of industries. Spillage of oily sludge is one amongst many.

Lubricating oil sludge is the waste of lubricant oil reprocessing industries. It may be generated by sedimentation process in the bottom of crude oil and heavy black oil storage tanks, in sludge separation units, in vacuum distillation or thin film evaporation units. The oily sludge generated by waste oil recycling industries is categorized as hazardous waste[2].

The spillage of oily sludge into lands has effect on soil microflora, because it creates a different environment for the microbes than the natural one. Sensitivity of soil microflora to petroleum hydrocarbons is a factor of quantity and quality of oil spilled and previous exposure of native soil microbes to oil[3]. Both the light and medium crude oil can exert acute or chronic toxicity or both, on soil properties and microflora[4]. Petroleum hydrocarbon utilizers can tolerate oil-contaminated environments because such microbes possess the capacity to utilize the oil as energy sources[5].

EXPERIMENTAL

Specification of site

Soil samples were collected from five selected sites of Jagatpur Industrial Estate of Cuttack city, Orissa. The sites were selected on the basis of the duration of exposure of the soil to oily sludge (with or without treatment).

Sample of long duration impact was collected from the site where oily sludge was dumped for long 10 years. Sample of short duration impact was chosen from the site where sludge was dumped for 5 years. Sample of

short duration impact with amendment was taken from a site where there was lime treatment to sludge dumped for 5 years. Sample of instant impact was considered from the site where unprocessed black lubricant oil spill over from the reserve drums kept on coal dust fills. Control soil sample was taken from 1km away from the dumping site of oil sludge.

Collection and preparation of sample

The soil was sampled at different sites as mentioned in the previous section at a depth of 15 - 20cm after removing 15cm thick upper layer. The soil samples collected in polythene bags were air dried in the lab and were kept in plastic bottles.

Microbial analysis and soil characterization

The samples were analyzed for bacterial density by standard plate count method. The routine measurements of physical parameters of soil such as pH, moisture content and conductivity of soil were carried out following Rao[6]. For pH determination, 1: 5 : soil: water suspension was considered and the same suspension was used to measure the conductivity. The oil content of the soil was measured by a modified method[7].

RESULT AND DISCUSSION

The colour and texture of the collected soil samples were depicted in TABLE 1 and figure 1.

The control soil sample was clay sandy with fine grains. With the exposure of soil to oil sludge the colour as well as the texture was found to change. The soil could not be grinded into fine grains.

The industrial area from which sample was collected is situated at the bank of Mahanadi River. So, the control soil was fine textured clay sandy. With the long exposure of soil to oil sludge, the texture and colour of soil were changed.

Effect of oil sludge on certain physical parameter of soil was depicted in TABLE 2.

With increased duration of exposure of soil to oil sludge, there was an increase in soil oil content. Moisture content was found to decrease with duration of exposure of soil to oil sludge. pH of the soil samples were also indicative of oil sludge contamination turning the soil to slightly acidic state. Though conductivity of the soil solution was found to decrease in the soil exposed to oil sludge for 5 years, the conductivity of the soil sample under long duration impact was found to be very high (1.98 m mho/cm).

TABLE 1: Colour and texture of the soil samples

Sample	Duration of exposure to oily sludge (year)	Colour	Texture
Control	-	Brown	Fine clay sandy
Long duration impact	10	Brownish black	Clay
Short duration impact	5	Brownish black	Coarse silt
Short duration with amendment	5	Gray ash	Silt
Instant impact	0	Black	Clay loam

TABLE 2: Effect of oil sludge on physical parameters and microbial population of soil

Duration of exposure to oily sludge (year)	Oil content (%)	Moisture content	pH	Conductivity (in m mho/cm)	Microbial population (CFU/ gm of soil)
0 (Control)	0	4.7	6.578	0.149	136.63×10^4
5	5.8	4.2	5.685	0.091	77.25×10^4
10	27.9	1.5	5.617	1.98	14.37×10^2

Data are mean of 3 samples

Figure 1: Colour and texture of the soil samples- A: Control sample B: Long duration impact sample C: Short duration impact sample, D: Short duration with amendment sample E: Instant impact sample

Dumping of oily sludge for longer duration at a site caused horizontal and vertical mobility of soil thereby increasing the oil content of soil[8]. The acidic pH status of soil due to oil sludge contamination observed in this investigation corroborates the finding of Amadi et al.[4]. Decrease of conductivity of soil sample with oil sludge contamination is a general rule. But high conductance measured in long duration impact soil may be attributed to its increased clay content which was used at higher level in reprocessing before seven years.

Effect of oil sludge on microbial population is depicted in TABLE 2. Colony forming units (CFU) per gram of control soil was found to be high (136.36×10^4).

TABLE 3: Change of physical parameters and microbial population due to amelioration of oil sludge by lime

Duration of exposure to oily sludge (year)	Oil content (%)	Microbial population (CFU/ gm of soil)	Moisture content	pH	Conductivity (in m mho)
5	5.8	77.25×10^4	4.2	5.685	0.091
5*	0	134.63×10^4	13.5	6.020	0.095
0(Control)	0	136.63×10^4	4.7	6.578	0.149

*With treatment Data are mean of 3 samples

TABLE 4: Instant effect of lubricant oil on soil

Duration of exposure to oily sludge (year)	Oil content (%)	Microbial population (CFU/ gm of soil)
0(Control)	0	136.63×10^4
0(Instant)	8.8	130.5×10^4
5	5.8	77.25×10^4

Data are mean of 3 samples

The microbial population was found to be less in the soil exposed to oil sludge for longer duration. There was a reduction of 44% of microbial population within five years under oil sludge effect. Longer duration of oil sludge exposure was found to decrease the microbial population to a level of 0.1% of the control.

The result of this investigation corroborates the common observation that oil sludge inhibits the microbial population. Labud et al.[8] have demonstrated the toxic effect of hydrocarbon on microbial biomass. Amadi et al.[4] also demonstrated the chronic effect of oil spill on microflora.

The effect of lime treatment on oil sludge pollution was considered in terms of change of certain physical parameters and change in microbial population. Soil samples collected from sites with oil sludge dumped for five years with or without lime treatment showed change in oil content, pH, conductivity and microflora (TABLE 3).

With lime treatment, the oil content of the soil under the influence of oil sludge was found to reduce to undetectable amount. The moisture content of the soil was found to be enhanced by 3 times. There was recovery of soil from acidic state towards that of control soil. The soil condition was recovered with respect to microbial population. However, there was negligible change in conductivity.

Embar et al.[9] demonstrated recovery of microbial population in the soil affected by oil sludge.

Instant effect of unprocessed black lubricant oil on soil was studied with a view to know whether the oil had any instant effect on microbial population.

TABLE 4 shows the effect of unprocessed black lubricant oil on soil. Interestingly it was marked that crude lubricant oil had no instant negative impact on microbial population though oil content of the soil sample had been increased appreciably than that of soil with 5 years of oil sludge exposure.

CONCLUSION

There was increase in the oil content of soil with increase of duration of exposure to the oil sludge. Moisture content and pH were found to be indicator of oil sludge contamination.

Out of all the parameters taken into consideration for noting the effect of oil sludge on soil, the microbial population was found to be more remarkable indicator to study the effect of oil sludge on soil.

ACKNOWLEDGEMENTS

The authors are thankful to Head of the Department of Botany and Vice Chancellor of Ravenshaw University for providing necessary laboratory facilities to undertake this investigation.

REFERENCES

[1] S.K.Beebi, P.S.Latha, V.Sarala; Indian J.Env.Prot., **25**, 4 **(2005)**.
[2] S.K.Mohanty; 'Environment and Pollution Laws', Universal Law Publishing Co.Pvt.Ltd., New Delhi, **(2004)**.
[3] I.Bossert, A.S.Bartha; 'Hydrocarbons in soil ecosystems', Petroleum Microbiology, Ed.R.M.Atlas, Macmillan, New York, 453-474 **(1984)**.
[4] A.Amadi, S.D.Abbey, A.Nma; Water, Air and Soil Pollution, **86**, **(1996)**.
[5] H.Song, X.Wang, R.Bartha; Appl.Environ. Microbiol., **56**, 3 **(1990)**.
[6] K.S.Rao; 'Practical Ecology', Anmol Publications; New Delhi, **(1993)**.
[7] S.K.Thimmaiah; 'Standard Methods of Biochemical Analysis', Kalyani Publishers, New Delhi, **(1999)**.
[8] V.Labud, C.Garcia; T.Hernandez; Chemosphere, **66**, 10 **(2007)**.
[9] K.Embar, C.Forgacs, A.Sivan; Biodegradation, **17**, 4 **(2006)**.