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Bio Remediation of Petroleum Contaminated Landfill Dump Sites

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Retraction

Retraction: Bio Remediation of Petroleum Contaminated Landfill Dump Sites (*IOP Conf. Ser.: Mater. Sci. Eng.* **1145 012010)**

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[1] Cabanac G, Labbé C and Magazinov A 2021 arXiv:[2107.06751v1](#)

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Bio Remediation of Petroleum Contaminated Landfill Dump Sites

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Abstract. Bioremediation is the process using living organisms to clean up contaminated soil. The main advantage of bio remediation is that it allows soil to be treated without being excavated or transported. The rate at which microorganism degrade contaminants is influenced by specific contaminants and their concentration, oxygen supply, moisture, temperature, pH value, nutrients supply and bio augmentation. Treatability studies are conducted to determine the effectiveness of treatment process performance. In this project work, the work is carried out in three phases. In the first phase, the landfill sites in and around Chennai are visited to collect samples. The site characterization and soil analysis are done for five landfill sites. In the second phase, the soil samples collected are subjected to nutrient bio remediation. The effect of pH, temperature and biomass concentration is studied over a period of 30 days. The optimum condition for a good remediation of contaminated soil is achieved.

Keywords: Landfill site, solid waste, bioremediation

1. Introduction

Wastes are generated from domestic activity and industrial activity in different ways. The disposal method might reflect conveniences, cost of disposal, and available technology for disposal. The quality of ground water is adversely affected by waste disposal methods. The most of contamination is the disposal of the solid waste either domestic or industrial on open land. Water-soluble substances pollute ground water and soil resources. The degree of severity is the hydrologic properties of aquifers. The type and amount of waste disposed, disposal and treatment methods adapted and even the climate.

Solid waste in any form from civil community or industry is disposed on land. Municipalities are responsible for collection and dump the waste material on engineered landfill, so that proper treatment technologies are used to prevent pollution. An assessment of landfill sites is necessary to rehabilitation of such sites.

The following points are to be taken into consideration while assessment of land fill sites.

- Identification of land fill sites.



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- Description of the site.
- Quantification and sampling.
- Assessment of the site based on the type of waste, soil and water samples.

2. Literature Review

Previous investigations on the various oil eating bacteria, the cloning and growing specified microbes, metabolic characteristic of the fungi, microbes, and bacterial on soil contaminated with total hydrocarbons (THC), the nature of cell growth under required conditions and case studies on bioremediation work under taken are surveyed from journals, abstracts and internet.

Reports and article by [1], [2] and [3] were scrutinized to understand the nature and metabolism work of bacteria and microbes.

Abstract on remediation case studies were referred to plan the work before trials [4] and [5].

[6] reported bioremediation from hydrocarbon contaminated soils. [7], [8], [9] and [10] worked on the production of pseudomonas growing on carbon courses and brought out the microbial activity on contaminated soil.

3. Bio Remediation

Bioremediation uses the living organisms to clean up contaminated soil or water. Bioremediation usually refers to the use of microorganisms. The main types of bioremediation are Bio simulation, Bio augmentation and Intrinsic Bio remediation. All three types of Bioremediations can be used at the site of contamination (insitu bioremediation) or a contamination removed from the original site (exsitu). In the case of contaminated soil, sediments, or sludge, it can involve land tilling in order to make the nutrients and oxygen more available to the microorganisms.

A typical bacterial cell is made up of 50% carbon, 20% Oxygen, 14% Nitrogen, 8% Hydrogen, 1% potassium, 1% Sulphur, 0.2 % iron, 0.5% each of calcium, Magnesium and Chloride. If any of these are in short supply the cell growth is hindered. Therefore, additional nutrition is to be supplied to effect desired growth and decontamination of the soil pollutants.

The aim of the project is to assess the landfill sites in and around Chennai to ascertain the conditions of soil and to subject a representative sample collected to bioremediation to prove the detoxification of the contaminated soil. The parameters used to study are pH, moisture, nutritional variation, biomass concentration and temperature of the environment. A model for prediction of the bioprocess under various conditions of operation is planned.

The statistical analysis provided by NEERI 2006 is given in Table 1. The solid waste of Chennai contains very high humidity, a small percentage of non-recyclable materials and a high percentage of organic matter. This study shows that it is very possible to use compost or bioremediation in solid waste.

Table 1. Statistical analysis

S. No	Waste Generation	Results
1.	Moisture content	47 %
2.	pH value	6.2 to 8.1 %
3.	Flexible matter at 550 °C	42.62 %
4.	Carbon	22.72 %
5.	Nitrogen content	0.88 %
6.	Phosphorus as P ₂ O ₅	0.44 %
7.	Potassium as K ₂ O	0.89 %
8.	C / N Rate	29.25
9.	Calorie count per kJ / kg	2594

All sections of the municipality have scientifically sound waste removal sites. Land of 50 hectares of Alandur, Pallavaram and Tambaram Municipalities was purchased for Rs. 113.28 kg in Venkatamangalam village by converting it into a modern compost heap that separates waste. In

addition, Tambaram Municipality has identified 55 Acres in the Nallur area of Sriperumbudur Taluk and 25 Acres in Panchaipothivakkam village, Chengalpattu Taluk. In the Ambattur municipality 30 hectares of land have been identified in the Vengal area. In Kathivakkam Municipality, a 5.5 Acre site has been identified in the village of Manali. Tiruvottiyur and Kathivakkam Municipalities are currently using a 12-acre landfill site in Sathangadu and Tiruvottiyur Council has taken steps to remove 10 acres from the sewage treatment plant. Madhavaram Municipality has identified an area of 4.7 Acres in Vadaperumbakkam and 4.93 Acres in Manali and is taking steps to acquire it. Pammal Municipality has taken steps to acquire 10.20 Acres of poromboke land in the Northern District for this purpose. Valasaravakkam Municipality has taken steps to acquire land. Figure 1 shows the Bioremediation reactor.

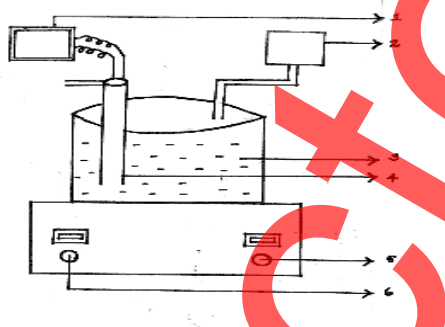


Figure 1. Bio Remediation Reactor

1 - pH meter; 2 - Nutrient broth feed Tank; 3 - Soil waste under remediation; 4 - Probe for pH electrode; 5 - Magnetic stirrer / speed control; 6 - Magnetic stirrer / heating control

Cleaned dried glass trough of size 0.6- diameter and 0.30-diameter height is taken and placed on an automatic stirrer cum heater. pH probes are provided to measure the PH variation during the progress of remediation of soil. One Kg of the soil is taken in the trough. The nutrient broth prepared with the required constitutions and required culture medium is taken in the feed tank. Initial sample of the soil before starting remediation is taken and analysed for TPH using photo calorimeter. The entire culture medium prepared is added to the soil and time noted. The entire soil mass is covered with a filter paper. Sampling was done at regular intervals of 3 days period and analysed for reduction in TPH content. The experiment is continued for 45 days to record changes in TPH. The initial BOD and COD are determined. The BOD and COD after the experimentation is also determined.

The per capita solid waste disposal in Chennai is about 0.585 kg per day. Town panchayats and panchayat unions are about 0.493 and 0.293 kg per head per day. The total of solid waste per day generated and disposed around Chennai are as follows in Table 2.

Table 2. Total solid waste generated and disposed around Chennai

S.No	Locations	Tonnes
1.	Chennai City	3400
2.	Municipalities	2050
3.	Town Panchayats	550
4.	Panchayat Unions	540
TOTAL CMA		6540

Table 3. Samples of solid waste generated

Characteristics	Sample I	Sample II	Sample III	Sample IV	Sample V
Moisture %	1.9	2.0	1.8	1.8	2.2
Volatile Matter %	1.4	1.6	1.8	1.5	2.0
pH	5.94	10.56	9.89	10.16	9.67
Conductance (mho)	0.70	1.32	0.97	1.47	0.85
COD (ppm/g)	800	747	1134	700	720
BOD (ppm/g)	122	110	150	107	115
Na (ppm/g)	22	26	20	30	18
K (ppm/g)	32	40	36	42	24
Ca (ppm/g)	35	34	45	48	23
Mg (ppm/g)	152	141	227	159	150

All municipal areas have identified scientifically sound waste disposal sites. 50 acres of ordinary land were purchased from Alandur, Pallavaram and Tambaram municipalities for Rs. 113.28 kg in Venkatamangalam village to do the same with a modern compost yard that brings intentionally separated waste. Table 3 shows Samples of solid waste generated. In addition, the Tambaram Municipality has identified an average of 55 Acres in the Nallur area of Sriperumbudur Taluk and 25 Acres in Panchaipothivakkam village, Chengalpattu Taluk. In the case of the Ambattur Municipality, 30 hectares of land have been identified in the Vengal area.

4. Conclusion

An assessment study was undertaken at five landfill sites in and around Chennai. The quantity and characteristics of wastes dumped are studied. Assessment of existing collection methods and dumping yard treatment activities are studied. Physical and chemical analysis of MSW is done after collecting representative samples. Composting, vermi composting, incineration, Biomethanation and land forming are some of the remedial measures undertaken by Municipalities.

The Bio medical waste, PVC, Petroleum contaminated soil, rubber and tires and not separated before dumping into landfill sites. When incineration takes place as a common practice to reduce the volume of MSW, they release petroleum rich products and particulate pollutants to the atmosphere. Also, hazardous chemicals mostly hydrocarbons and organic and inorganic material go into ground water.

References

- [1] G. M. Cole, *Petroleum Hydrocarbons*, Assessment and Remediation of Petroleum Contaminated Sites, pp 37–74, May 2018.
- [2] G. Holliday and L. Deuel, *Guidebook for Waste and Soil Remediation: For Nonhazardous Petroleum and Salt Contaminated Sites*, 2009.
- [3] *Soil Chemistry*, Guidebook for Waste and Soil Remediation: For Nonhazardous Petroleum and Salt Contaminated Sites, pp 7–15, 2009.
- [4] *Soil Amendments*, Guidebook for Waste and Soil Remediation: For Nonhazardous Petroleum and Salt Contaminated Sites, pp 69–86, 2009.
- [5] *Clean Closure Techniques*, Guidebook for Waste and Soil Remediation: For Nonhazardous Petroleum and Salt Contaminated Sites, pp 87–106, 2009.

- [6] M. L. Allan and L. E. Kukacka, *Remediation options for a chromium contaminated landfill using cementitious grouts*, Apr. 1995.
- [7] M. Hempel and J. Thoeming, *Remediation Techniques for Hg-Contaminated Sites*, Mercury Contaminated Sites, pp. 113–130, 1999.
- [8] D. Devikanniga, A. Ramu, and A. Haldorai, Efficient Diagnosis of Liver Disease using Support Vector Machine Optimized with Crows Search Algorithm, *EAI Endorsed Transactions on Energy Web*, p. 164177, Jul. 2018. doi:10.4108/eai.13-7-2018.164177
- [9] H. Anandakumar and K. Umamaheswari, Supervised machine learning techniques in cognitive radio networks during cooperative spectrum handovers, *Cluster Computing*, vol. 20, no. 2, pp. 1505–1515, Mar. 2017.
- [10] P. Wood, *Remediation Methods for Contaminated Sites*, Assessment and Reclamation of Contaminated Land, pp 115–139, Jan. 2001.