Microbiological and Physico-chemical Characteristics of the soils of Waste Collection Sites in Umunneochi Local Government Area of Abia State Southeast Nigeria.

Ochuba C.O[1],Ememe N.M[1] ,Nwangwu B.C[1],and Ironua C.S[1]

[1]Soil Science Division, National Root Crops Research Institute Umudike
PMB 7006, Umudike, Abia State, Nigeria

Obismo2007@yahoo.com

Abstract

Soils from waste collection sites in umunneochi local government area of Abia state Nigeria were sampled to determine the physico-chemical qualities and microbial densities before waste products are discarded into their appropriate dumpsites. Standard analytical methods were utilized in the study. A high microbial density in the range of 2.1 x 10^4 to 1.2 x 10^6 cfu/g was observed in the samples. Total fungal count was generally less than the bacterial population. The physico-chemical qualities of the soil appear to be above acceptable standards. Temperature ranged from 24. 5 to 28 while pH was between 3. 2 to 7.1.The value for Organic matter was 2. 08% which was found to be conducive for chelate development, and could allow leachates from the decomposed waste to invade the ground water table.

IJSER

Keywords: Microbial density, Dumpsite, Chelate formation, Soils, Bacterial population.

1. Introduction

The ecosystem of the soil contains microorganisms that are flexible in the degradation and humification of organic substances. In addition it acts as a sink for the adsorption and absorption of ions, as well as a medium for rebuilding vegetation and normal land use. Over a long time, large levels of wastes from municipal sewage treatment, agricultural procedures and businesses, homes and many establishments have been disposed in landfill sites. If organic and natural waste is permitted to accumulate and is also exposed to weather, its decomposition produces a noxious odour, thus constituting a health risk [1] discovered that if the leachate found its way into the natural waters, it becomes a serious hazard to the ecosystem. In addition they equally discovered the existence of separate disposal systems for solid and liquid waste materials and that apart from cold or arid climates, most soils give a suitable environment for biodegradation of waste materials. The soil texture in collection point will most times determine the

contamination of the vicinity. Soils with high permeability above shallow water table will improve the percolation of leachates into groundwater thereby triggering pollution. Thus storage sites shouldn't be positioned in such vicinity. Soils with low porosity and poor permeability are more suitable as the pollutants are held for a bit longer to permit for degradation and natural attenuation of the chemical constituents in leachates. In addition, any vicinity where soils have high erosion potentials also needs to be averted as this may lead to cleansing away of waste constituents resulting in contamination of other vicinities.

2. Materials and Methods

The samples were collected from different parts of Umunneochi local Government Area of Abia state southeast Nigeria. The sites was visited once a week and triplicate samples were collected from various parts of the system during 12 months period, from January 2015 to December 2016 with the use of a spade and hand augur, 2g of soil samples were taken from depths of 0-15cm and 105 - 120cm in polyethylene bags within the perimeter of each refuse collection point [2]. After collection of samples, they were immediately taken to the laboratory for proper examination and analysis}. The control samples were collected from an area remote at least 25m away and up slope from each refuse collection point.

Average value of three replicates was used for every determination. Temperature, pH level were taken immediately after the soil samples were collected. Phosphorus was determined using the molybdenum blue colour method and Organic carbon content by walkley-black wet oxidation method. The particle size of each soil sample was determined by hydrometer method.

Standard pour plate technique as described elsewhere [3] was used to determine the total bacterial colony forming units (cfu) and fungal population. Appropriate dilution of the soil samples were plated in Nutrient agar plates (difco) for total bacterial counts and potato dextrose agar (difco) for fungal population. The nutrient agar plates were incubated at 27 degrees Celsius for 48hr while the potato dextrose agar were incubated at ambient temperature for five days. Plates that were selected for counting contain between 30 and 3000 colonies.

Attributes of the isolates were determined microscopically by gram staining and by various biochemical methods according to determinative schemes of [4] and [5] for bacterial isolates. The organisms were also determined by reference to Bergey's Manual of Systematic and Determination Bacteriology. Pure fungi isolates were determined using the needle mount method to observe the reproductive system structures. Final identification of isolates was done by comparing the results of cultural land morphological characteristics with those of known taxa.

3. Results and Discussion

Physico-chemical parameters

Temperatures of soils at various depths within the waste collection sites ranged from 24.5 to 28 degrees celcuis. Upsurge in temperatures above the critical value can result in reduction in the dissolved oxygen level while increasing the biological oxygen demand of organisms in that soil area. The pH value was between 3.2 and 7.1.It has been identified that highly alkaline and highly acidic soils are not suiltable for waste materials dumpsites. The soils of leru were highly acidic with mean pH of 3.0 and 3.4. At such levels, there is an increase in micronutrient solubility and mobility and also an increase in heavy metal concentration in the soil [6], thereby making them unsuitable for waste dumpsites.
A high level of organic matter content (2.08%) was found to be favorable for soil chelate formation, increased exchange capabilities as well as increased infiltration of surface water to avoid surface flooding [7].

The mean texture class for the soils at the sites was found to be sandy loam. Extreme and low sand fractions (>70% and <40%) as seen in all the sites except in site 3 make the soils non-suitable for waste collection site , being that they are rapidly permeable and may allow large levels of leachate from the decomposed waste to invade the ground water table. Whenever a landfill area is underlain by gravel, there is certainly extreme risk of contaminants being carried right down to the underground water table. Sand has a high percolation rate, but will not provide sufficient safety against ground water. Similarly, almost all of the sites didn't meet up with the textural requirement of waste collection sites given that they contain mean clay fractions higher than 31%.

High clay concentrations (>31%) encourage surface water flooding and land pollution [8].

Surface water which infiltrates the soil cover escalates the rate of waste decomposition and finally triggers a leachate to leave the solid waste and create pollution problems [1]. For cover materials, soils with very friable consistency are good, soil with loose and firm consistency is fair, while soils with very stable consistency are poor [9]: sandy loam, loam, silt loam and sandy clay loam are good soil texture for cover materials.

Table 1: Microbial Population Profile of Some Sites

			Soil Samples	
	Station	**Depth of soil**	**TBC**	**TFC**
1.	Leru	0-15cm 105-120cm	3.1 x l0^5 5.9x10^4	1.6x10^4 2.1 x l0^4
2	Gariki	0-15cm 105-120cm	1.2 x l0^6 3.0 x l0^4	0 9.4xl0^3
3.	Nkwoagu	0-15cm 105- 120cm	6.4 x l0^4 2.1 x l0^3	1.1 x l0^4 6.3 x l0^2
4.	Orie Ngodo	0-15cm 105- 120cm	1.3 x l0^5 2.1 xl0^3	1.2 x 10^5 2.3 x l0^3
5.	Umuchieze	0-15cm 105-120cm	2.1 x l0^4 3.3 x l0^2	1.3 x10^4 8.0 x l0^2
6.	Nneato	0- 15cm 105- 120cm	3. 6 x l0^5 7.9 x l0^4	1.4 x 10^s 7.3 x 10^3
7.	Umuaku	.0-15cm 105-120cm	4.9 x l0^5 5.3 x 10^4	1.9 x 10^4 5.9 x l0^3
8.	Mbala	0-15cm 105-120cm	5.2 x l0^5 5.4 x 10^3	7.1 x l0^4 2.8 x l0^2

There was appreciable variance in the microbial populace of soils of waste collection sites as shown in the Table. Total bacterial population went from2.0 x 10^4 to 1.2 x 10^6 cfu/g with Gariki producing the highest population and Moore House the lowest population at the soil depth of 0-15cm) while total counts at soil depths of 105-120cm gave between 3.3 x 10^2 to 7.9 x 10^4 cfu/g . Total fungal count was generally lower than the bacterial population. The value ranges from 0 to 1.4 x 10^5 cfu/g. This observation corroborates the fact that fungi are normally more resident and abundant in terrestrial soil compared to aquatic ecosystems. On the other hand,[10] showed that the volume of microbial biomass and the quantity of carbon and nitrogen mineralized per unit of microbial biomass relies on the type of soil texture. Pseudomonas, Bacillus, Serratia, Micrococcus, Proteus, Streptococcus, Escherichia coli, Staphylococcus, and Chromo bacterium species were identified to be dominant in the soil. Various genera of fungi were also isolated in this research. They include Fusarium, Enicillium, Aspergillums, Aspergillum fumigates, Yeast, Mucor and Rhizopus species. Generally, almost all of the microorganisms retrieved in this study are soil inhabiting microorganisms which form symbiotic associations in the soils. Their occurrence in the soil signifies a considerable portion of nutrients which is continually shunted into growth periods of plants through the system [11]. There activities are stimulated by saprophytes feeding on decaying organic matter. Also, their input to soil quality especially in the production of carbon(IV)oxide, excretion of nitrogen, or aeration of soil resulting from burrowing activities, communition of leaves, grazing of fungal mycelium are very well recorded.[12]. Moreover, microorganisms are irreplaceable in the alteration and degradation of artificial organic compounds and natural waste materials. Soil organisms are helpful as signals of changes in soil quality [13]. Worrisome enough is the fact that if the soil microorganisms are unsuccessful in their functions as gums and cementing providers that stabilize aggregates [14], the soil texture, in combination with variations in the structure and moisture levels, may affect the permeability and may allow large volumes of leachate from the decomposed waste to get into the ground water table. These leachates may penetrate the soil cover and create pollution problems.

REFERENCES

1. E. O. Ekundayo, and V. O. Fodeke Microbial densities and physicochemical qualities of some crude oil flow stations saver pit effluents in the Niger Delta Basin of Southern Nigeria. Environmental Monitoring and Assessment, 2000, 63(3): 523 – 530.
2. N. O. Isirimah. Understanding the nature, properties and sources of waste for

IJSER

Quality Environment Tom and Hardy publication Ltd. 2002.

3. H. W. Seeley, and P. J. Van Demark. Microbes in action. A laboratory manual of microbiology, W. H. Freeman and Company, USA. 1981. 42pp.
4. R. E. Buchanan, and N. E Gibbons. "Bergey's Manual of Determinative Bacteriology" 8th edition William and Wilkins Baltimore, MD, 1974.
5. S. T. Cowan, and K. J. Steel. Medical Bacteria,2th edition Cambridge University Press, 1994.
6. R. Kumar. Evaluation of soil resource data for waste disposal soil survey and Land Evaluation, 1987, 7(3): 147 – 165.
7. E. O. Ekundayo, and A. A. Fagbami. Land use/Land cover and its association with soil of the Oyo State in Southern Nigeria. *International Journal of Tropical Agriculture.* 1996, 14:21 – 33.
8. E. O. Ekundayo. Suitability of waste disposal sites for refuse disposal in Benin City, Nigeria. *Nigerian Journal of Soil Science*. 2003, 13:21 – 27.
9. F. G. Loughry. The use of soil science in sanitary landfill selection and management Geoderma. 1973, 10: 131 – 139.
10. J. Hassink. Effect of soil texture on the size of the microbial biomass and on the amount of C and N mineralization per unit of microbial biomass in Dutch grassland soils. Soil Biol. Biochem. 1994, 26, 1573 – 1581.
11. K. H. Domsch. Biological aspects of soil fertility. In: proc. Int. seminar on soil Environment and fertility Management in intensive Agriculture . Tokyo Japan, 1977, pp 737 – 743.
12. C. A. M. Van Gestel. And N. M. Van Straalen. Ecoxoxicological test systems for terrestrial. Invertebrates. In Ecotoxicology of soil organisms.. Donker, M. G., Eijsackers, H. and Heimbach, F(eds). Lewis publishers. 1994, pp. 205 – 228.
13. A. C. Kennedy, and K. L. Smith. Soil microbial diversity and the sustainability of agricultural soils. Plant soil, 1995. 170: 75 – 8.

.
.

IJSER