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A study on the environment protection and the effect of solid waste material dumping on environment

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Abstract

The impact of rapid industrialization around the globe and unsafe waste management practices have become increasingly significant within the last two decades as the disclosed number of un-engineered facilities and contaminated sites steadily grow and the anticipated remediation costs increase. A new service sector is emerging across the world in waste containment, soil remediation and environmental restoration. The need to accomplish the tasks given in environmental restoration and waste management places a new responsibility on the services of the environmental engineer. It requires collaboration between geotechnical and environmental engineers. This paper deals with the detailed study of the impact of solid waste dumping on the Geo-Environment. The case study done helps to actual visualization of the effects of the same!

Keywords: industrialization, remediation, Geo-Environment, responsibility.

INTRODUCTION

Any material that is thrown away or discarded as useless and unwanted is considered as Solid Waste. Solid Waste is considered to be a direct pollutant to various environmental factors while it also shows many indirect or silent effects on the environment.

Historical Background

The Solid Waste is being produced since our ancient times. However, the components and severness of the waste is changing. The materials which were included solid waste at those times were simple and many of them were biodegradable. Nowadays, due to the advancement in the science and technology, the solid waste includes many hazardous, non-biodegradable, toxic materials. Hence the problems due to solid waste are becoming more and more severe.

This lead to the detailed study and inventions in the processing of solid waste and their proper disposal. The choice of effective methods for solid waste processing can be best decided only after the study of hazardous impacts of solid waste on life.

The solid waste disposal is a major problem in developing countries along with developed nations.

Classification of Solid Waste according to sources

The principle sources of Solid Waste are :

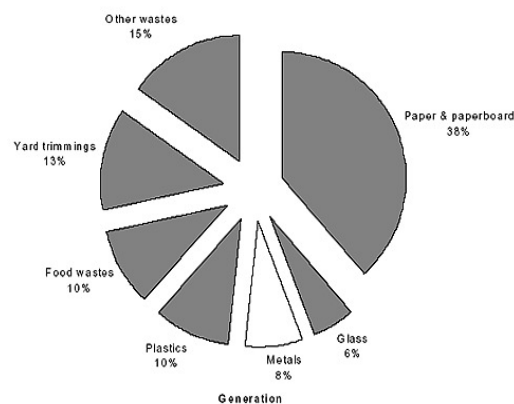
- 1) Municipal Waste
- 2) Industrial And Commercial Waste
- 3) Building and Demolition Waste

Municipal Solid Waste

It is the waste collected from the town or city. It is subdivided as Municipal Solid Waste

1. Refuse
 - I. Garbage [Example- highly decomposabile food waste]
 - II. Rubbish[Ex.- Waste easily non-degradable like rubber, glass, metal etc.]

2. Trash [Bulky waste material which requires special handling, like electronic]



Hazardous Nature of Solid Waste

The solid wastes produces various hazardous effects on life as well as on environment. Some of the major effects are as follows :

- 1) Disease spread
- 2) Mosquito development
- 3) Development of other vector species
- 4) Strong odor spread in entire area
- 5) Leachate formation
- 6) Gas formation
- 7) Infertility of soil
- 8) Destruction of local ecosystem.

Methods of Disposal

There are various conventional methods of solid waste disposal. The hierarchy of methods to be adopted is given. This hierarchy is based on environmental principles and implies that waste, depending on its characteristics, should be handled by different methods. It is generally known that the hierarchy has to be

applied in a flexible way and it is only meant as a guideline to achieve the best environmental solution in long term.

Dumping of Solid Waste

Dumping of solid waste is a very effective and fissible method for the disposal. Although it is at last in the hierarchy, it is widely used all over the world.

Conventional Process of Dumping

The dumping of solid waste can be made effective by implementing it in the proper scientific and engineering manner. The process of dumping of solid waste is as follows :

Collection of Solid Waste :- The collection of solid waste is generally done at the various levels. The waste producing in housings is collected at those local points. And from there the entire mass of waste is collected in Municipal Waste. The aid of various instruments, vehicles is taken for the proper collection of solid waste. Collection includes temporary storage, transfer to a collection vehicle.

Transportation :- The collected waste is transported to the disposal site. The care is taken while the transportation of waste in order to avoid any mishap due to waste i.e. it is carried in closed container etc. The vehicles like collection trucks, front loader, rear loader, side loader etc. are used for the transportation.

Dumping :- The actual process of dumping initiates with the selection of dumping site. Usually, the dumping site is so selected that it should be away from human habitat. The wastelands, barren farms, stone quarries which are not in use presently, wells etc. are considered as sites for the dumping of waste.

Before dumping, the waste is to be processed to reduce its hazards , also the energy can be recovered from the waste and the part of waste can be recycled. However, in most of the cases, the waste is directly dumped without any processing.

Geo- Environment

As the solid waste is practically dumped in the soil, the most affected factors by the hazardous impact of the solid waste is Geo-Environment. This Geo- Environmental impact deals with all the factors in the environment which ultimately reflects on all living beings.

Components of Geo- Environment

Basically, all the natural resources on earth are a part of Geo-Environment. The major effect of solid waste dumping is observed in the following components :

- 1) Soil
- 2) Ground Water
- 3) Water bodies
- 4) Atmosphere

Inter-relationship between components

- The soil is media in which solid waste is dumped practically.

- Soil is media for the ground water flow also.
- The waste traces from dumped solid waste, mixes with the ground water flow.
- This groundwater somewhere ahead mixes with water body which contaminates the entire water body.
- The dumping of solid waste encourages the decomposition of organic waste which leads to formation of gases like Methane etc. which are evolved in atmosphere, which in larger quantity may help the problems like global warming.
- It also affects the surrounding ecosystem of dumping site as well as the path along which these waste traces flow.
- During the rainy season, the surface runoff over the dumping site, also leads to the flow of waste traces to the low lying aquatic body and pollution of soil at every places from where it flows due to percolation of water.

Impact of Solid Waste Dumping on Geo-Environment

Leachate Containment :- Solid Waste dumping generates highly contaminated liquid called as Leachate. Past practices in dumping site relied on the natural ability of soil to filter and absorb the pollutants. Some leachate results directly from the moisture and decomposition of garbage and other putrescible material in the waste material, but much of it may come from runoff or surface water that first infiltrates the field and percolates downwards through the waste dumped.

If leachate then reaches and mixes with ground water and seeps out of the field into a nearby stream or lake, significant environmental damage can occur. Generally as more water infiltrates and flows through the landfill, more pollutants are leached.

Gas Formation

- 50% of the municipal solid waste in the landfill site gets broken down by bacteria for energy.
- This is done by aerobic or anaerobic fermentation.
- The degradable organic matter gets broken down into a stabilized organic residue (or compost), and water and carbon dioxide, the latter contributing to the composition of landfill gas.
- The waste quickly becoming anoxic due to the high oxygen demand for bacterial respiration in sanitary landfills.
- Anaerobic fermentation of organic matter will take place if sufficient moisture is present.
- With complete absence of oxygen, true anaerobic microorganisms, including methanogens, become established.
- Organic acids and hydrogen in the waste are then metabolized forming methane and carbon dioxide.
- If the methane migrates to areas of the landfill, which are operating under aerobic conditions, it may be oxidized to CO by methanotrophic bacteria.

Change in characteristics of Soil

Dumping of solid waste leads to change in following properties of soil :

- 1) Odor
- 2) Water content
- 3) Permeability
- 4) Bearing capacity

- 5) Porosity
- 6) Degree of saturation
- 7) Alkalinity
- 8) pH

The above mentioned changes are adverse by agricultural point of view. This decreases the fertility of soil.

Natural Micro-organisms habitat loss

Dumping of waste, destructs the habitat of some beneficial micro-organisms like bacteria due to change in chemical environment. It can be observed by the odor coming from the soil after rain of water sprinkled.

Loss of Biodiversity

The growth of plants on dumping site or nearby dumping site is of only restricted type. Only few species of plants are observed on such sites, which are susceptible to the dumped waste. No other plant species can survive, the same effect can be observed in birds, animals and ground worms also.

Bioaccumulation

The concentration of hazardous substances in the waste, through the available plants, increases up to the top of food chain. It's a very dangerous effect later on.

Aesthetical Appearance

The dumping site are always surrounded by the garbage, with scavenging animals and such unwanted things along with the strong odour. This may lowered the aesthetical importance of land.

CASE STUDY

Location of site

The dumping site visited is "Bilaspur city" in Chhattisgarh. It is situated at Western side of Kolhapur near Rankala lake. It is surrounded by housing from three sides and one side faces Rankala lake at some distance.

Dumping Details

The stone quarry was in use as municipal solid waste dumping site from 2002 – 2004, near about 26 months.

The rate of disposal of waste during these months is 150T/day .

The unit weight of solid waste is considered as 400-600 kg/m³

It can be imagined, that what a tremendous volume of waste was dumped during a short period of 26 months.

Hazards on Geo-Environmental Surrounding Leachate Formation

The leachate is observed to be generated due to the waste dumping which mixes to a small 'Nala' through which it enters the Rankala lake. Hence highly responsible for the pollution of Rankala

lake. However, the fact is , the same water contaminated with leachate is used for agricultural watering. The leachate has a natural flow with ground water due to elevation difference. It has got a full chance to mix with groundwater flow because of slope towards the Rankala lake.

Gas Formation :- The saturated water during rainy season exactly above the dumping site, shows the bubbles of gases, indicating the formation of gases due to waste.

·Biodiveristy Loss :- Only 3-4 species of plants can be observed. Especially, these are the plants which only grows at highly polluted soil. There is a lack of a well balanced ecosystem.

·Infertility of Soil :-The soil is of no use from agriculture point of view. It has loosen the fertility already.

Micro-organism habitat loss :-During rainy season, it is peculiarly observed that there is no standard smell of soil, which usually comes due to reaction of micro-organisms on sprinkling of water. This indicates the disturbance in regular life cycle of micro-organisms in soil

Components of Landfill Gas

Landfill gas, also known as LFG, is composed of the following: 50-60% methane (CH₄)30-40% carbon dioxide (CO₂)10% Nitrogen. Small amounts of non-methane volatile organic compounds (VOCs)

The Clean Air Act states current EPA regulations, which require that many larger landfills collect and combust the landfill gas. Instead of allowing landfill gas to enter the atmosphere, it can be collected preventing methane from migrating into the atmosphere and contributing to local smog and global climate change. In order to comply, companies may flare the gas, or install an appropriate system to use it. The latter turns pollution into a renewable cost-effective resource, with many financial benefits. However, regulations on the gaseous emissions from landfill sites, particularly the hazardous components, are deficient.

Benefits of gas collection

Health

Collecting and processing the gas prevents the variety of toxic gases from entering the atmosphere and affecting the health of the local population. The air would be cleaner, and it also helps to reduce odours. For details of the potential health effects of landfill gas.

Generating Power

300 cubic foot of landfill gas can be produced per minute (cfm) from 1 million tons of municipal solid waste in a landfill site. If this gas is successfully collected, appropriate utilisation could generate 7,000,000 kilowatt hours (kWh) per year. This is enough energy to power 700 homes for a year. This source of power is also extremely reliable, as the landfills do generate the gas 24 hours a day, 7 days a week, and can do for 10 years or more.

Local economy:

More money can be brought into the area by the selling the gas collected. More jobs can also be created, as gas collection and utilisation processes require designing and construction of appropriate systems, and people to operate them. The costs of

producing electricity from landfill gas are low and very competitive with costs for other renewable resources. Revenue is provided covering the costs of the projects, so they can even be competitive with non-renewable electricity sources.

CONCLUSION

The subject discussed in this paper and the case study done, clears the impact of solid waste dumping on Geo-Environment. The effects are easily seen because of solid waste. But there are many more invisible effects of improper solid waste dumping on life. Instead of only economic point of view, the environmental conservation should be given the priority for such activities. As the problem is directly related with the life, the strict actions to be taken for the same. If the things are done in proper engineering manner, the severness of the problem can be reduced.

The use of some geo-synthetic materials ,the treatment to waste before dumping, are some ways to neutralize the long term effects of waste. The rules made for such activities should be implemented strictly. The new methods of dumping and treating waste are to be implemented. Such steps towards the dumping site developments will definitely lead the welfare of human being by means of Environmental Conservation!

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