THE BIOREACTOR LANDFILL - AN INNOVATION IN SOLID WASTE MANAGEMENT

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ABSTRACT:

Despite having a lot of methods in management and disposal of municipal solid waste but due to one or more reasons which made them to lag behind but bioreactor landfill is one of the ideal landfill that has gained high attention. Bioreactor landfill is having all the features which are required in nowadays as it is accelerated and stabilized way for waste management. Bioreactor landfill allows most active landfill management that understands the biological, chemical and physical processes which are involved in the landfill environment. This paper presents an overall view of bioreactor about the processes which are involved the phases, future-scope. As far now it is most sited method in management and disposal of municipal wastes and it has been successful upto maximum level. As for the cost it has been proven economical and having future scope upto great extent.

Keywords: Bioreactor landfill, Municipal solid waste management, Leachate recirculation, Biodegradation of solid waste.

INTRODUCTION:

The generation of solid waste has became a focusing issue over globe. Due to the enhance growth in the population over short period of time. Which in- turn increased the overall growth in solid waste generation which turns some of the serious threatful questions to the impact to the environment as well as to human health. Due to this threatening behavior of solid waste generation lot and lots of techniques came to the eye as: Incineration, Land-filling, Recycling process etc. One of the most commonly used disposing municipal solid waste in Asian countries is open dumping .(Gupta and Joshi 1990)

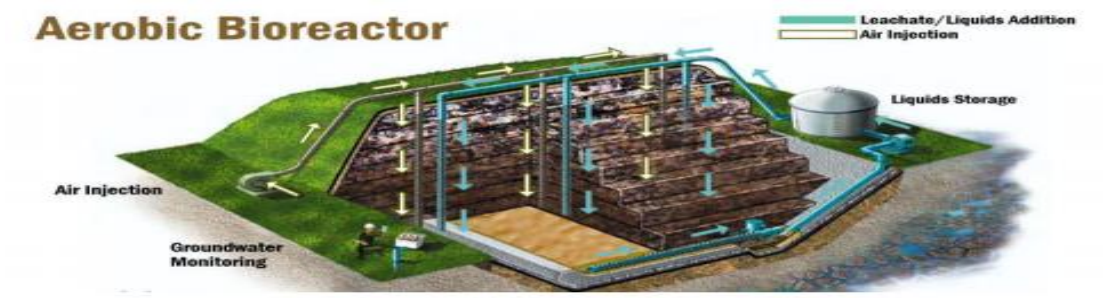
Due to which it creates much infectious diseases in Asian countries as per records by medical authorities. By the threats and conditions above mentioned, it made researchers to put some efforts to find-out some methods which can have less or zero impact on environment as well as on human health in these methods one of the method is Bioreactor landfill. The biometric landfill is defined as a scientific approach which allows overall management of landfill with physical, chemical and biological and with adequate management of lechate and energy form gas recovery. (Alam and Alam 2014)

It is very popular in developed countries and now making appearance to Asian countries also. Bioreactor landfills are utilized to intensify production of gas, stabilization of waste etc. Bioreactor mainly deals with the recollection of the already collected lechate. This landfill is an accelerated process of decomposition. First experiment on recirculation of lechate in bioreactor landfill was in Poland in 1975). (Joseph 2014) This reactor provides more controlled conditions by which emission of green house gas gets reduced and helps in improving the environment and surrounding areas in terms of controlled odor and methane gas emission. (Warith 2002)

TYPES OF BIOREACTOR LANDFILLS:

AEROBIC BIOREACTOR LANDFILL:

Leachate is being removed in a Bioreactor landfill from the lower layer. And then it is being again circulated in controlled conditions in a bioreactor from the stored tanks. To promote aerobic reactions, the air is being fed to the waste by using horizontal or vertical wells that promotes stabilization of waste. The air which is being injected to the said bioreactor should be in a tight controlled conditions. If it doesn't happen the uncontrolled air may results in increasing the temperature which can result in fire and explosive accidents at the site. As this condition became an issue so it becomes costly to provide controlled air conditions. For the extraction of landfill gas from the site, high air pressure is needed to penetrate forcefully through the waste .Optimum moisture levels are being obtained by adding re-circulated leachate or from other sources. As it needs above 35-40% of moisture for proper conversation of waste to methane gas is being done because of the anaerobic bacteria or by the action of bacteria. Hence in this methane is being trapped so to decrease the green house gas percentage. (Alam and Alam 2014)



(Mirosława KASZUBSKA et.al 2017)

HYBRID BIOREACTOR LANDFILL:

In hybrid bioreactor landfill a more rapid deplication of waste material occurs as the process of aerobic and anaerobic processes are taking part together , in the upper part . In the lower part of the land as aerobic reaction takes place , gas gets collected . As the hybrid works well than that of individual aerobic and anaerobic

reactions , also there are some of the chemicals and the by-products of chemicals which gets treated as well . (Alam and Alam 2014)

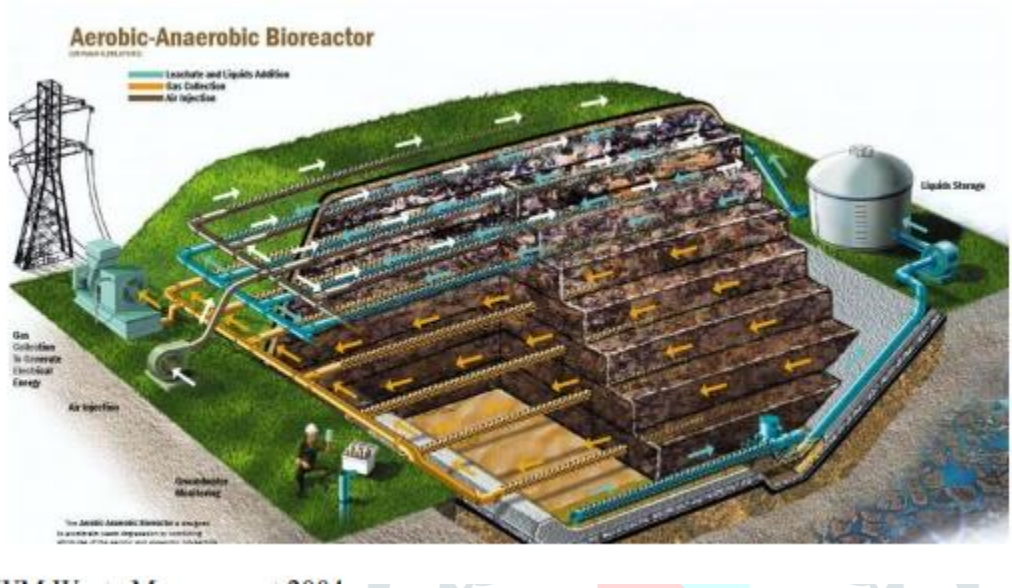


Image source (Mirosława KASZUBSKA et.al 2017)

PHASES:

In the Bioreactor landfill the process includes five phase:

Initial adjustment phase:

Nitrate and oxygen gets consumed in the phase of aerobic process. For the microbial activities the source of carbon is sugar. The percentage of oxygen present is pretty low. Bacteria's which are required for methogenesis are abundantly present in municipal solid wastes. For the development of enough moisture content which is needed an accolimanation period of being observed.

TRANSITION PHASE :

With the consumption of oxygen which gets caged inside a landfill. A change from anaerobic micro-organisms became dynamic. The movement of electron acceptor happens from oxygen to nitrates and sulphates. The hydrolytic and fermentative micro-organisms hydrolyze polymers for example: Starchs , fats and proteins . The underlying results of polymer hydrolysis are dissolvable sugar, amino-acids, long chain carboxylic acids and glycerol. Before the finish of this stage, quantifiable convergences of COD and unpredictable natural acids can be distinguished in the leachate. Furthermore, the aminoacids can be distinguished because of the hydrolysis and of protein mixes.

ACID FORMATION PHASE:

During the primary phase of this stage, the intermediate delivered from phase second, for example sugars, amino-acids, long chain carboxylic acids and glycerol are further matured into short chain of carboxylic acids, carbon-dioxide and hydrogen. At very low hydrogen concentration the short chains of carboxylic acids gets converted to leachate thermodynamically. The growth of biomass is affiliated with acid produced by bacteria, the predominal features of this phase are of rapid consumption of substrate and nutrients.

METHANE FERMENTATION PHASE:

In this phase the bacteria which is responsible for the methogensis and the reduction of sulphate are present in anaerobic degradation. The bacteria which are responsible for the conversation of hydrogen and co2 into methane are the hydrophilic methanogenci bacteria. Rapid increase in the production of methane gas 50-60% of gas constitute is of methane. Increase in PH, by the precipitation process heavy metals are being removed BOD and COD values gets degraded due to the presence of organic matter in the leachate declines. Carbondioxide and hydrogen sulphide gets formed by the bacterial action of sulphate reducing bacteria on acetic acids, hydrogen and higher volatile fatty acids.

MATURATION PHASE:

During this maturation phase stabilization of waste organic matter takes place which is easily biodegdrable. Limiting of nutrients and available substrate takes place. At lower concentration the strength of leachate stays constant and the production of gas goes down sharply. Oxidized species and the oxygen shows re-emerge can be notice on time consuming rate. There it shows a rise in the rate of cellouse plus hemi-cellolose hydrolysis. Convertion of bio-degradeable matter gradually occur at very low level. (Elagroudy, Abdel-razik, and Warith 2008)

PROCESSES INVOLVED IN BIOREACTOR LANDFILL:

- **PHYSICAL PROCESS.**
- **CHEMICAL PROCESS.**
- **BIOLOGICAL PROCESS.**

These are the three processes which gets involved into the total process of bioreactor these three processes are responsible for

FUTURE SCOPE AND COST ANALYSIS:

FUTURE SCOPE: As by the growing population municipal solid waste generation gets at its peak so, management of this huge waste got the attention of all. As there are lot of conventional ways to dump or to manage the waste but all those posed threatful effects on human health as well as to the environment. So it became necessary to move for some other technique or method. As far as bioreactor landfill is considered it is upto the expectation in all the worrying fields which was created by waste materials as well as by other management methods. Hence bioreactor landfill is having bright future scope.

COST ANALYSIS: The cost of bioreactor landfill is difficult to predict although lot of attempts had been made but all with different results . Full scale operating bioreactors reports an annual cost saving that varies from $75,000 to $5000,000. Bioreactor landfill are favorable economically. However the recovered landfill space can be efficiently used and post closure care issues gets resolved, bioreactor landfill proves to be effective in cost .(Debra R . Reinhart et.al 2002)

LITERATURE REVIEW:

(Warith and Li 2014): In this paper it is stated that a positive in the effective rate of biological degradedation when on addition of supplied material with recirculation of lechate.

(Benson and Lane 2007): In this paper it is stated that all landfills in North-America weather bioreactor or recirculation operations are same as that of conventional landfills. So design and establishment needs to get modified for better workout with minimum hazards to nature.

(Joseph 2014): In this paper its concluded that the evidence of rapid settlement which effects the layers in both lysimeters. With high organic loads and strong leachate was formed . Odor can be reduced by incorporating a closed system of recirculation.

(Warith and Li 2014): In this paper it is stated that why it is necessary for innovative landfills to achieve the accelerated stabilization by adding additional lechate or other liquid materials.

(Tolaymat et al. 2012): In this paper site specifications i.e. Lo, average moisture content for (22-76 days) were computed. It is found that Lo values were not different for the 76 days old than younger age one.

(Elagroudy et al. 2008): In this paper some of the equations were formed to understand and to describe biodegradation as well as settlement under aerobic , anaerobic and in both the aerobic –anaerobic conditions.

CONCLUSION:

Bioreactor landfill is the most innovative landfill which gets borne due to the threat-full issues which got emerge due to the conventional landfills . In this paper an effort has been made to understand the aspects which are related to bio-reactor landfill like why It is important for Asian countries to adopt . What are the things need to keep in mind while construction and other quries related to bioreactor landfill, what are the things need to get advanced to make it a problem solver for the problems which are related to conventional landfill or open site dumping .

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