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Technologies of Municipal Solid Waste Remediation

Need of Bio-remediation in Lucknow

[1]Ataulla Khan, [2]Prabhat Kumar Rao
[1] Final Year Student of M.U.R.P, [2]Assistant Professor
Faculty of Architecture and Planning
Dr. A P J Abdul Kalam University, Lucknow, India

Abstract: Solid Waste Management is defined as the discipline associated with control of generation, storage, collection, transport or transfer, processing and disposal of solid waste materials in a way that best addresses the range of public health, conservation, economics, aesthetic, engineering and other environmental considerations. The primary goal of SWM is reducing and eliminating adverse impacts of waste materials on human health and environment to support economic development and superior quality of life. Today Solid Waste Management is an aggravating problem in urban areas of our country due to rapid population growth, coupled by an economic boom that encourages the consumption of goods and hence waste generation. The local governing bodies namely municipalities and municipal corporations are responsible for providing SWM services in the urban areas. In most of the urban areas, insufficient funds, use of obsolete and/or inefficient technologies, lack of public awareness, and proper infrastructure had resulted in poor state of SWM. All this is changing with launching of new initiatives such as the Swachh Bharat Mission-Urban, publishing of Solid Waste Management Rules, 2016 and organizing Swachh Survekshan. Lucknow city with a population of 34 lakhs is adding up to 50% additional generation of waste i.e., 1812 TPD in the last 20 years. There is improper disposal of solid waste in the city.

Index Terms **– Solid Waste Management, Municipal Solid Waste, Garbage Vulnerable Points, Refuse Derived Fuel, Waste Remediation Techniques, Bio Remediation Model.**

I. INTRODUCTION

Municipal Solid Waste (MSW) is the trash or garbage that is discarded day to day in a human settlement. According to MSW Rules 2000 MSW includes commercial and residential wastes generated in a municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes. The Lucknow city with population of 34 lakh, is adding on commercial centers and new urban extensions providing housing & services resulting into 50% additional generation of waste about 1812TPD in last 20 years. It has highest per capita waste generators about 33% of total waste in Uttar Pradesh & requires a strategic plan for waste generated by its urban areas. Improper disposal of solid waste in open areas/315 GVPs & 3 non-scientific dumping grounds.

The total estimated waste generated in Lucknow is 1812 TPD. Waste is generated from various sources which is being managed effectively by the SWM systems established in the city. There are residential, commercial, industrial and institutional establishments. Lucknow Municipal Corporation has outsourced a third-party organization, M/s Eco green Energy Private Ltd for collection and transportation of wastes from residential as well as commercial establishments. It is evident that wet waste forms a major part of the residential/domestic waste. Inert waste and recyclables come next respectively. The awareness of the people to recover recyclables is high and a significant quantity of the recyclables is segregated and sold to the kabadiwallas. Waste segregation still remains a big problem.

The wastes are taken to the transfer stations. Biomedical waste generated in hospitals, nursing homes and clinics includes used syringes, cotton, human and animal tissues, apart from domestic waste. The biomedical waste is collected, transported and incinerated by M/s SMS Water grace Mediwaste Management Pvt ltd. The Construction and Demolition wastes generated is generally used in reconstruction activities or for filling up of the low-lying areas.

Primary Storage Units constructed with brick wall on four sides are currently at dilapidated conditions and secondary storage has formed Garbage Mountains of 8m height. There are 49PCTS located to compact waste for reducing waste volume & transport cost which are temporary systems. At Shivri village a centralized waste processing and treatment center has been setup. Shivri houses a compost yard, a Refuse Derived Fuel (RDF) generation unit and a scientifically designed sanitary landfill. Eco green has been appointed to operate and manage these plants at Shivri.

II. TECHNOLOGIES OF WASTE REMEDIATION

Below is the brief of existing technologies used for waste remediation:

1 Bio-mining

Bio-mining/Landfill-mining and reclamation (LFMR) is a process whereby solid wastes which have previously been land-filled are excavated and processed. The function of landfill mining is to reduce the amount of landfill mass encapsulated within the closed landfill and/or temporarily remove hazardous material to allow protective measures to be taken before the landfill mass is replaced. In the process, mining recovers valuable recyclable materials, a combustible fraction, soil, and landfill space. The aeration of the landfill soil is a secondary benefit regarding the landfill's future use. The combustible fraction is useful for the generation of power. The overall appearance of the landfill mining procedure is a sequence of processing machines laid out in a functional conveyor system. The operating principle is to excavate, sieve and sort the landfill material.

2 Gasification

It is a process that converts organic or fossil-based carbonaceous materials into carbon monoxide, hydrogen and carbon dioxide. This is achieved by reacting the material at high temperatures (>700 °C), without combustion, with a controlled amount of oxygen and/or steam. The resulting gas mixture is called syngas (from synthesis gas or synthetic gas) or producer gas and is itself a fuel. The power derived from gasification and combustion of the resultant gas is considered to be a source of renewable energy if the gasified compounds were obtained from biomass.

3 Pyrolysis

It is a thermochemical decomposition of organic material at elevated temperatures without the participation of oxygen. It involves the simultaneous change of chemical composition and physical phase and is irreversible. The word is coined from the Greek-derived elements pyro "fire" and lysis "separating".

4 Incineration

It is the process of combustion of organic material such as waste with energy recovery is the most common Waste to Energy implementation. The method of using incineration to convert municipal solid waste (MSW) to energy is a relatively old method of waste-to energy production. Incineration generally entails burning an RDF to boil water which powers steam generators that make electric energy to be used in homes and businesses.

5 Biomethanizations

The word mechanization means the decomposition of organic matters using microorganisms without oxygen or under anaerobic conditions. This process involves the participation of multiple bacteria who will transform together with the organic waste in biogas. The biogas is composed of 2/3 methane CH4 and around 1/3 of CO2 and small amount of other gas.

6 Composting

Waste materials that are organic in nature, such as plant material, food scraps, and paper products, are increasingly being recycled. These materials are put through a composting and/or digestion system to control the biological process to decompose the organic matter and kill pathogens. The resulting stabilized organic material is then recycled as mulch or compost for agricultural or landscaping purposes.

7 Capping of landfill

The landfill cap includes an impervious clay liner, complete with an engineered drainage system. This is covered by a layer of clean soil and plants, which is sloped to prevent rainwater and surface water from infiltrating into the disposed waste. Landfill Capping is the most common form of remediation because it is generally less expensive than other technologies and effectively manages the human and ecological risks associated with a remediation site.

III. NEED FOR BIO-REMEDIATION IN LUCKNOW

Municipal Solid Waste is transported to the various open dumpsites within the city. There are 21 closed and 2 active dumping sites in the city. Such open dumping poses environmental and health hazards as these open dumps are becoming sources of air, water and ground contamination and pollution. Bio-remediation helps in reclaiming the land for other purposed like any commercial or recreational activity within the purview of applicable rules and regulations. As it produces ZERO emission and most cost-effective solution for the city.

IV. BIO-REMEDIATION

Bioremediation is the use of microorganisms to destroy or immobilize waste materials. It is a process to detoxification of parent compound and conversion to a product that is no longer hazardous to human health and the environment. Bioremediation is less expensive and more sustainable than other remediation alternatives. Bio-remediation has two types1. In-situ bioremediation is the in-place treatment of a contaminated site and 2. Ex-situ bioremediation is the treatment of contaminated soil or water that is removed from a contaminated site. The project selected: In-situ bioremediation. In In-situ process, there are three types among that the process is adopted is Bio-augmentation as this one is low cost and sustainable process.

Table IV.1: Three types of In-situ Bio-remediation processes

Type	Benefits	Limitation	Factors to be considered
Bio sparging	Cost-effective	Environmental constraints	Biodegradative abilities of indigenous microorganism
Bio venting	Non-passive and relatively passive	Extended treatment time	Presence of metal and other inorganics
Bio- augmentations	Natural attenuation	Monitoring difficulties	Chemical solubility and geological factors

V. SITE IDENTIFICATION

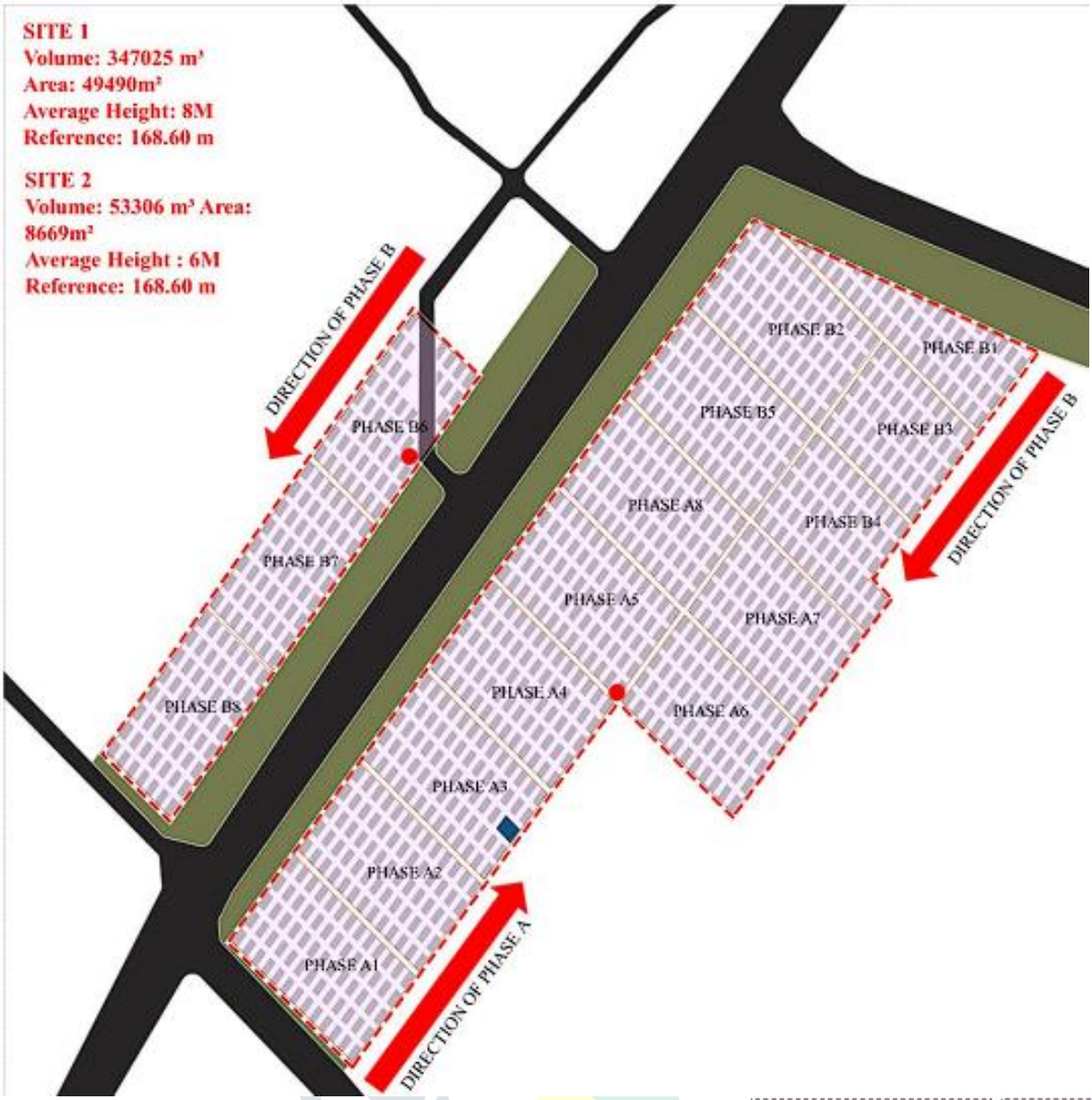
The Ghaila dumping site is 20 km far from the city. The dumping of the waste started approximately 9-10 years back. The dumping site is easily accessible by the NH-230 and Sub-arterial road on the western and eastern periphery. The dumping site is very close to the Dubagga Mandi.

Fig V.1: Dubagga Dumping Site

VI. BIO-REMEDIATION MODEL FOR DUBAGGA

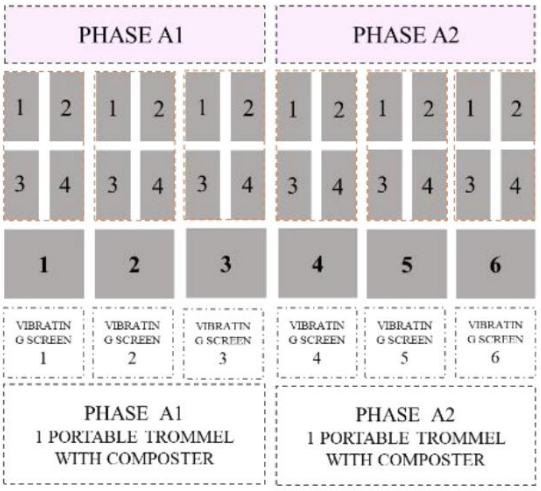
Adoption of technology for remediation is dependent on the following parameters:

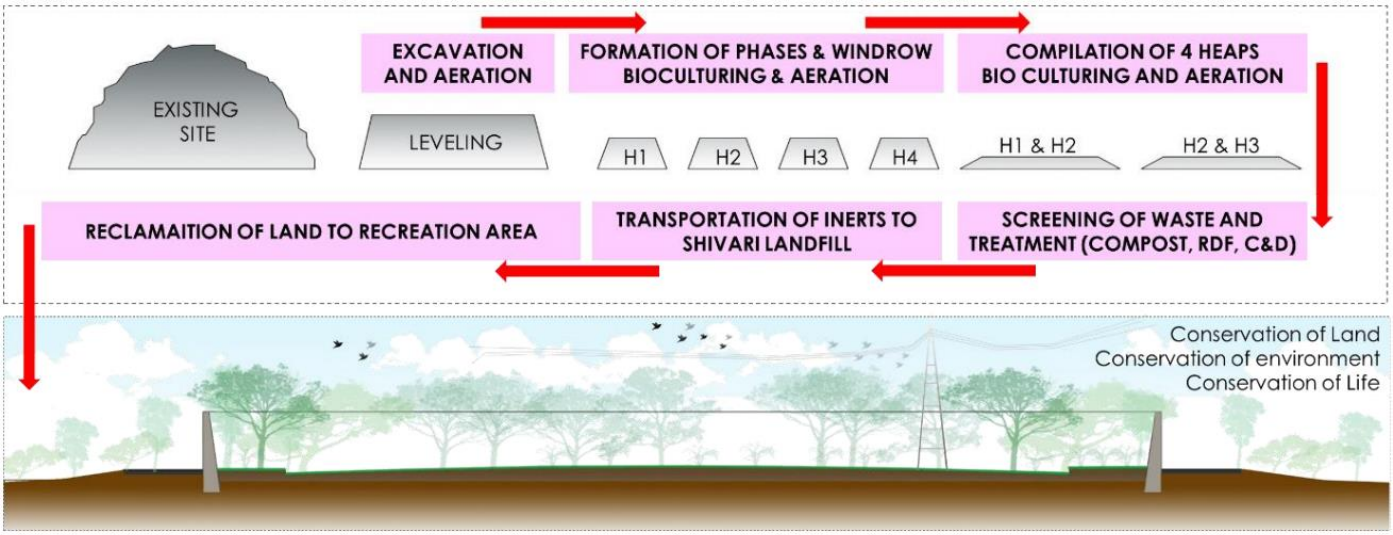
1. COMPOSITION OF WASTE - 75% of waste on-site consist of compost and inert.
2. QUANTUM OF WASTE - 4.2 lakh of waste is currently accumulated on site
3. SUPPORT INFRASTRUCTURE - engineering feasibility and operations and viability within financial inputs.
4. LEGAL AND ENVIRONMENTAL FRAMEWORK - permissions and approvals from the UPPCN/ CPCB as mandated needs to be obtained by in for speedy action.
5. PROCESSING EFFICIENCY - important decision-making on the adoption of technology.
6. COST-EFFECTIVENESS - the quantity of dump process, the value of land recovered.



In general, as the average windrow shape is between an oval and trapezoid a factor of 0.66 is assumed to estimate windrow volumes, therefore the equation for volume of the windrow is:

SITE 1: Volume = 5M X 5M X 10M =250
No of Heaps= 960
Total Volume= 960 x165=2,40, 000 m3
SITE 2: Volume = 5M X 5M X 10M = 250
No of Heaps= 192
Total Volume= 192 X 99 =48,800 m3





VI. RESULTS AND DISCUSSION

1 Social

Firstly, about 3300 residents of Ghaila village live near the poor solid waste management of the city. Approximately 519 houses are living among the stink, polluted air, and water. Then to improve the aesthetics of the site and surroundings. It will help generate employment opportunities. It will enhance the quality of life: better living conditions for the surrounding population. Also, it will prevent unplanned and unauthorized constructions.

2 Economic

It will reduce land values due to which previously development was hampered.

Reduced costs will attribute to

Firstly, landfill closure. Secondly, post-closure care and monitoring. Lastly, identification, purchase and construction of new landfill sites.

Revenue from

1. Organic substances- fines & coarse
2. Recyclable & reusable materials
3. Combustibles
4. Reclaim soil, stones & rubbles, etc.
5. Reclaimed land
6. The project cost is cheapest: method of treating mixed legacy waste.

We found out that for every addition of year the generation of solid waste increases and it is proportional to the population too. By seeing and observing the past trend there is rapid increment of solid waste for every 5 years which is a serious concern and required immediate focus from all sides which include the general people, politician, stakeholders, NGOs and businessmen.

VII. Acknowledgment

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