

Odour Monitoring And Management In Municipal Landfill Site

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Abstract

Odour is defined as perception of unpleasant smell, by certain substances, in very small concentrations, to stimulate chemical sense receptors (sense of olfaction). Landfill sites for municipal solid waste management is the one of the many odour generating activities, which affects the quality of life, particularly residential areas in the neighbourhood. Complaints about unpleasant odour are frequently received from nearby localities that are affected due odourous nature of activities in landfill sites. So that it is necessary to control, monitor and manage landfill site to reduce odour. To begin with one needs to identify the odour source(s) and generation cycle of odour to be investigated before suggesting/adopting suitable remedial measures, regulations for sampling & monitoring techniques.

Keywords: *Odour, solid waste management, Landfill sites.*

1- INTRODUCTION

In India due to unplanned cities, increase in urban population and inadequate waste management in cities the residential areas located nearby MSW landfills may be subjected to unpleasant odour depending on practicing technology used and prevailing meteorological conditions.

Many odour generating activities like manufacturing units (such as pharmaceuticals, distilleries, meat processing, chemical etc) and municipal waste related activities (ex. sewage, drains and municipal solid waste) generate odour. Municipal Solid wastes (Management & Handling) Rules, 2016 provided regulatory aspects/provision about site selection for landfill site, facilities provided at landfill site, specification for landfilling, pollution prevention, water quality monitoring, ambient air quality monitoring, plantation at landfill site, closure of landfill site/ post closure, etc. In regulatory provisions, regulation of ambient air quality monitoring related about odour control by installation of landfill gas control system

including gas collection system at landfill site to minimize odour generation, prevent off-site migration of gases. The concentration of methane gas at the landfill site shall not exceed 25 LEL.

2- TERMINOLOGY USED

Odour- Odour is defined as perception of smell by certain substances, in very small concentrations, to stimulate chemical sense receptors.

Odour Detection Threshold- Odour detection threshold is the lowest Odourant concentration necessary for detection by a normally 50 percentage of the population, this concentration is defined as 1 odour unit.

Odourant- A substance which stimulates a human olfactory system so that an odour is perceived.

Odour Intensity- The strength of an odour perceived above its threshold limit. It is determined by an odour panel and is described in hedonic tone.

Hedonic Tone- Hedonic tone is the scale to which an odour is perceived as pleasant or unpleasant. Such perceptions differ

widely from person to person. Hedonic tone scale varies from -4 (very unpleasant) to +4(very pleasant). Zero represents neutral smell.

Odour Character- Odour character is basically allows one to distinguish between different odours. Odour may not cause any direct damage to health but the toxic stimulants may lead to ill effects on the respiratory system. Secondary effects of discomfort are commonly observed. Very strong odour can start nasal irritation & breathing problems among the individuals.

Odour Concentration- it is measurement in odour units (OU) in one cubic meter of gas at standard conditions and assigned the dimension of odour units per cubic meter (OU/M).

Odour Emission - The number of odour units per second discharged from a specific source

3- PROCESSES GENERATING ODOUR MSW LANDFILL SITE

The processes which generating odour in Indian MSW landfill site are classified as:

i. Volatilization- It is an important mechanism for odour emissions and occurs when odourants of a dissolved or pure substance evaporate and mix to an adjacent gas layer which is in immediate contact of waste at surface, this action results in immediate transport into the atmosphere.

ii. Biodegradation- It is the disintegration of organic matter present in solid waste by bacteria, fungi or other biological means. The decomposition of biodegradable

substances proceed through both aerobic (in present of oxygen) and anaerobic process (in absence of oxygen). Anaerobic processes generate more odourous compounds.

iii. Photo-Decomposition- Photolysis, or photodecomposition are chemical reactions induced by physical energy. In this process a chemical compound is broken down by photons. Particularly in tropical climatic countries such as India receives enormous solar flux which accelerates the rate of biodegradation and volatilization thereby increases odour nuisance.

iv. Hydrolysis- municipal solid waste generally has high moisture content. Hydrolysis is the reverse of a condensation. In condensation reaction two molecules combine into a bigger one and eject a water molecule. Thus hydrolysis adds water to break down, whereas condensation builds up by removing water. The water soluble odourants pass to leachate which gives rise to odour emission through volatilization.

v. Combustion- Combustion is a energy producing chemical reaction that takes place between a fuel and an oxidizing agent. Energy generated is in the form of heat and light. In a MSW landfill site auto burning may also occur due to produced methane and the heat generated at the dump site trigger the ignition automatically producing odourous gases. Few of odourants with their offensive odour tabulated in table 1.

Table 1: Odourants and offensive odour

S.No.	Odourant(compound name)	Description of offensive odour
1	Ammonia	Pungent, Irritating
2	Hydrogen sulphide	Rotten eggs
3	Methyl Mercaptan	Rotten Cabbage
4	Ethyl Mercaptan	Decayed Cabbage
5	Dimethyl sulphide	Decayed Cabbage
6	Butyric acid	Rancid butter
7	Methane	Odourless

8	VOCs (total)	Odour influenced by the dominating compound
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4- MEASUREMENT OF ODOUR

For measurement of odour, there are no specific regulations or guidelines for collection of odour samples however following three methods of analysis of odour adopted worldwide.

- ♣ European EN 13725:2003
- ♣ Australian / New Zealand AS/NZS43232
- ♣ ASTM 679-043 standards

5- WORLDWIDE ODOUR MONITORING METHODS

Worldwide there are various methods for monitoring of odour depending on the objective(s) of the survey, the three key methods observed are:

- a) Measurement of odour concentration
- b) Measurement of odour exposure
- c) Measurement of odourous substances in air.

Worldwide, for analytical analysis of odourous gases emitting from municipal solid waste landfill sites, are classified in five groups

- i. Reduced Sulphur Odourants (RSO) i.e. (Methyl Mercaptan, Ethyl Mercaptan, Dimethyl Sulphide, Hydrogen Sulphide)
- ii. Volatile fatty acids
- iii. Carbonyls
- iv. Nitrogenous odourants (inorganic)
- v. Volatile organics (non-methanogenic organics (NMOC) & Contaminants of Potential Concern (COPCS))

6- SITUATION ANALYSIS OF LANDFILL SITE IN INDIA

In concern to odour and odour management of landfill site in India. From study of surveys carried out earlier by different agencies reveals fact of odour nuisance as a common problem in almost all landfill sites in varying degree and intensity. factors responsible for odour nuisance include lack of awareness on waste collection & segregation at source & at disposal site i.e. inefficient management of MSW. Prime factors responsible for

odourous environment around MSW landfills are listed below:

1. Lack of segregation of waste at source-waste separation at source (i.e. house, shop, commercial and institutional levels) into biodegradable, non-biodegradable, recyclable solid waste. So that waste quantity to be disposed off in landfill site reduces and biodegradable waste may treated suitably to reduce odour.
2. Non-biodegradable waste such as plastics, metals, E- waste, C & D waste, hazardous waste are not efficiently segregated at the source thereby adding to MSW load
3. The area allotted for MSW disposal is inadequate to handle to the growing volume of MSW generation.
4. Non-compliance of land use plans /buffer zone restrictions around landfill sites.
5. The landfill sites are not properly designed, operated and maintained.
6. Lack of technical expertise and appropriate institutional arrangement.
7. Indifferent attitude of citizens towards waste management.

7- PREVENTIVE MEASURES FOR ODOUR AT MSW LANDFILL SITE

As we known fact that odours are generated through biochemical activity on biodegradable constituents of MSW at landfill sites, below are the preventive measures that can be adopted at the different stages of MSW management,

- A. Site selection and design for Odour control
- B. Efficient and effective Operational management
- C. Minimization of odour release through physical prevention
- D. Odour counteractants
- E. Vegetative covers

The preventive measures for odour control as proposed in 2017 in CPCB publication “Odour Monitoring & Management in Urban MSW Landfill sites” discussed below

A. Odour control by site selection and design

Site selection and designing of landfill site helps in reduction of odour at the initial stage of the project by scientific analysis of available data. The factors to be considered while designing and selecting a site are-

- i. The area of land for the disposal site shall be assessed considering the projected population growth over the next 20 years and more.
- ii. It is better to develop more than one site for a city. It provides better accessibility of the site, reduces transport cost of waste and minimizes the time duration of waste at primary collection centre.
- iii. The selected land for land fill site should be free from influence of other odorous sources.
- iv. Topography and other geological conditions should be considered.
- v. Selection of landfill site should be as per urban development planning. Suitable buffer zone created to restrict new commercial and residential activity near the disposal site.
- vi. Green belt development in the buffer zone should be mandatory.

B. Operational Management

Prevention and minimisation of odour releases can be achieved by adopting odour control practices at operational level of landfill site. Operational measures of MSW landfill site may be as given below:

- i. Municipal solid waste acceptance
Each landfill site will have its own waste acceptance criteria depending upon facilities and technology available with them.
- ii. Municipal solid waste handling
The segregation of waste at source (point of generation) to be promoted. Pre-processing (sorting) of waste helps in

enhancing the efficiency of treatment process and land utilization.

iii. Area of active cell (Tipping area)

The size of tipping area needs to be optimized for minimizing the odour release from MSW. It must be sufficient to allow waste to be tipped and compacted as well as to allow received waste to be tipped without delay. Globally accepted tipping area is 900 m² to 1200 m², However the USEPA working plan prescribe it between 625 m² to 1600 m². For India it is recommended to adopt (higher) global norms.

iv Rapid and effective capping

The design of landfill be such that rapid and effective capping shall be done to prevent fugitive release of gases.

v. Design of LGF collection system and operation

Careful planning to be made to minimise escape of odourous gases, temporarily and permanently, from potential odour generating areas.

vi Leachate Management

Leachate storage or collection, drainage to the leachate treatment plant complete process shall be leak proof.

vii. Maintenance of LFG (collection and capping)

There must be a leaks identification system in landfill site.

C. Minimization of Odour Release through Physical Prevention

The physical prevention of the odour release may be achieved by adopting different technique adopted for various processes and stages of waste.

i. For Tipping and loading operations:

Globally adopted practice is to carry out tipping and loading operation in a closed building having slightly negative inner air pressure with remote controlled fast acting doors to reduce the odour nuisance in the tipping area. Maximum waste handling and storage time should be limiting to 24 hrs. Odourous gases within operation building also be treated.

ii. For active and passive area sources

Capping of the areas with suitable cover shall be adopted to control potential odour generation. Different types of capping material available with varied efficiency.

iii. Onsite sorting of waste

When ever onsite sorting of waste is required, it should be done in properly designed closed system having vents for emitted gases.

D. Odour counteractants

The counter-actants use for prevention of odour release from MSW Landfill site includes:-

i. Masking agents

Terpenic compounds and few oxygenated molecules like coumarin masks the odourous emission and blocks some specific mal-odourous receptors.

ii. Surfactants

Amphipathic molecules such as alcohols, glycerol and esters compounds increase the solubility of odourous compound in aqueous media, hence reducing the odour emission.

iii. Neutralizers

Aliphatic and aromatic aldehyde reacts with odourous compounds including viz. Ammonia, TRS etc. which decrease the odourous emission. More over fibre degrading enzyme and plant extracts have also been used as a neutralizer.

E. Vegetative cover

Good plantation cover forms a surface capable of absorbing odourous gases also reduces odours. Leaves, in a tree crown, absorbs pollutants, thus effectively reduce

odourous compound concentrations near MSW landfill site.

8- REFERENCES

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