Odour Regulation - A solution to control odour from Municipal Solid Waste Management Plant.

[1] **Karthik Kumar V,** [2] **Justin K Mathews,**[3] **Karthik H,** [4] **Gowtham DH,** [5]**Amruth K**
[1][2][3][4]BE Students, Dept. of Civil Engineering, [5] Assistant professor
[1][2][3][4] [5] The Oxford College of Engineering, Bangalore, Karnataka, India

[1][2][3][4] [5] greenpro.1001@gmail.com

1. ABSTRACT

India is a fast growing developing country consisting of large city population in many numbers. Along with increase in population generation of waste is highly proportional. Management of these rejects in a sustainable procedure without harming the neighbours is very important. Bengaluru City generates about 4000 metric tonnes per day of MSW within the jurisdiction of Bruhat Bangalore Mahanagara Palike (BBMP), which is responsible to provide and administer the urban infrastructure and other civic amenities of the Greater Bengaluru Metropolitan area having a population of over 10 million. Handling and management of this huge quantity of municipal waste is a challenge for the urban local body (ULB) about environmental, social and techno-financial aspects.

The paper consists of proposing a method of controlling the odour produced in the solid waste treatment plant especially for the wet solid waste along with increasing the rate of composting in a conventional manner. It also included to determine the causes of malodours, to identify the most common odorants in municipal waste, properties they consist, how they can be affected and ways to prevent them to the maximum magnitude.

The solution is under testing so it cannot with certainty be determined if the suggestions will reduce or prevent emission of odour. After studying recent research papers, the method proposed in this project would be an efficient suggestion and could be implemented with ease even if it is required to change the current treatment procedure of the municipal solid waste management plants of the city. Odour emission could be regulated by avoiding the turning operation and maintaining the factors affecting composting within the permissible limits. This can be done by maintain the required temperature, moisture content by the principle of transfer of heat and aeration within the pile from the method proposed.

Keywords: Odour, Composting, Solid waste, Windrow, static aerated pile, Conduction, Aeration, Leachate, Fourier's Law, Decomposition, Heat absorption and Transfer System (HATS), Regulation, Water.

2. INTRODUCTION

With mounting urban population and industrialization gigantic amount of waste generation, the odour problem has been assuming unpleasant quantity. Cities without proper hygiene facilities is a major cause of odour problem. Public is affected by odour in a number of ways leading to numerous complex health problems. sturdy, unpleasant or attacking odour can barricade with a person's pleasure of life especially if they are frequent. Windrow composting technology is known to produce strong odour features as a result of which the plants using this technology is a disadvantage from the community around the plant.

Municipal solid waste plants were facing the consequences of conventional treatment techniques, whereby the odour that are generated from these elements have been found, in many cases, to be a risk to public health and the environment. Towns with gigantic population is facing the pollution especially odour produced by organic decomposition in treatment plants, this is even severe for the neighbours of the plants.

To maintain the appealing value of the environment there is requirement of new technology which are to be adopted to regulate the odour. This method of regulation should be natural and friendly which are used to improve decomposition rate of organic waste. Decomposing the solid waste without working on them until composting is fully done is been seen that odour produced is moderately less and thereby odour regulation is achieved. To improve acceptance of the plants among the population, it is desirable to mitigate their environmental impression by incorporating essential pollution control measures. In this regard an improved version of the windrow composting technology was developed for continuous supply of air, maintaining optimum temperature and moisture content into the rotting pile of waste. This process on one hand reduces or eliminates possibility of anaerobic conditions and on the other, provides for extremely simple and cheap method of odour control.
It also eliminates the need for weekly turnings of the organic solid waste piles and thereby decreases the operating costs related to treatment of decomposition. With harmless environmental footprint this is suggested as an affordable and appropriate technology option for the Indian conditions where rapidly developing communities in the urban boundaries are demanding equally better quality of life.

Objectives:

- The main objective is to become familiar with aerated static pile compost operations and equipment.
- To study the various processes taking place in a solid waste processing plant and its limitations in controlling odour.
- To study the various problems caused to residents staying near the plant.
- To determine the suitability of finished products for various compost end uses.
- To propose a method to control the odour

Motivation for the study:

The present scenario of solid waste disposal in India is pathetic especially in cities. On top of that we daily read about agitation by people to close the solid waste treatment plants. This motivated us into finding the root cause of this problem. We found in our studies that the odour produced from solid waste treatment plants is the primal cause of closure of the treatment plants. In order to tackle this problem, we found that Heat Absorption and Transfer System Composting is a very good process which will make our plants odour free. Hence, we have done a pilot scale project on HATS.

3. METHODOLGY

HATS- Heat, Absorption and Transfer System is a new technique adopted in this project. The purpose of this technique is to maintain all the required factors as stated before at optimal conditions and levels. This helps in increasing the rate of composting as well as reduces the no. turns for piles in the windrow section which is the prime cause of odour production in the plant. It follows the following principles to attain faster composting and regulates odour

- Principle of conduction.
- Principle of aeration.

Using the above working principles, the method used here transfers and absorbs the heat from the waste(Conduction) depending on the condition through heat conducting material which in turn is heated or cooled by using water. The water is heated using copper coils provided within the HAT. This also reduces the moisture content to optimal level at faster rate. Aeration is attained by providing the same principle used in aerated static pile composting. Thus, this method helps in faster decomposing of wet waste as well as reduce the odour formation.

Material used:

Copper sheet, Mica sheet, PVC pipes, Photovoltaic cell, Wires and Cable, Electrical wires, Copper coils.

Key Components:

- HAT: Heat absorption and Transfer medium: Heat Absorption and Transfer System (HAT) is the heart and soul of the odour control management system. It resembles a shape a square mould having dimension of (2000*2000) mm and (1000*1000) mm at the bottom and top respectively. The height of each HAT is 1 meter and has water storage capacity of 1750 litres. It is made up of mica coated copper in order to provide thermal conductivity and simultaneously act as an insulator. HAT holds a copper coil inside which is electrically connected to heat the water to the required temperature. It has also got water distribution pipes which are connected from overhead tank beside the windrow area.
- Aeration pumps: provision of Oxygen
- Voltage Regulators: Control water temperature in HAT
- Solar panels: generation of electricity
- Inlets and outlets: For water input and Discharge
- Aeration Regulators: controlling degree of hotness to aeration
- Leachate Collector: collecting Leachate

Working:

- Water is made to flow from the overhead tank to each individual HAT system through water distribution pipes.
- Discharge of water into HAT is controlled by valves provided at inlets of HAT system.
- The water supplied to the HAT is heated using the copper coils provided in the HAT system.
- The water is heated to the required temperature using voltage regulators provided in the system.
- If the temperature in the waste pile exceeds the optimum temperature, the water supplied to the HAT is not heated thus absorbing the heat from the pile by the principle of conduction.
- Fresh batch of water is supplied to HAT in either of the following cases
- When the temperature exceeds optimum temperature to be maintained in the pile.
- When water loses its minerality due to repetitive heat and cooling.
- Thermometers are installed at regular intervals throughout the pile and subsequent temperatures are noted to regulate temperature in the windrow.

- In order to provide better aeration in the windrow which helps in faster decomposing, aeration cylinders (perforated PVC Pipes) are provided.
- The air is supplied to the aeration pipes by using air blowers from pump house and the pressure is regulated using pressure valves.
- The leachate produced in the process is collected in Leachate Sump by providing slopes towards the drains between the windrows.

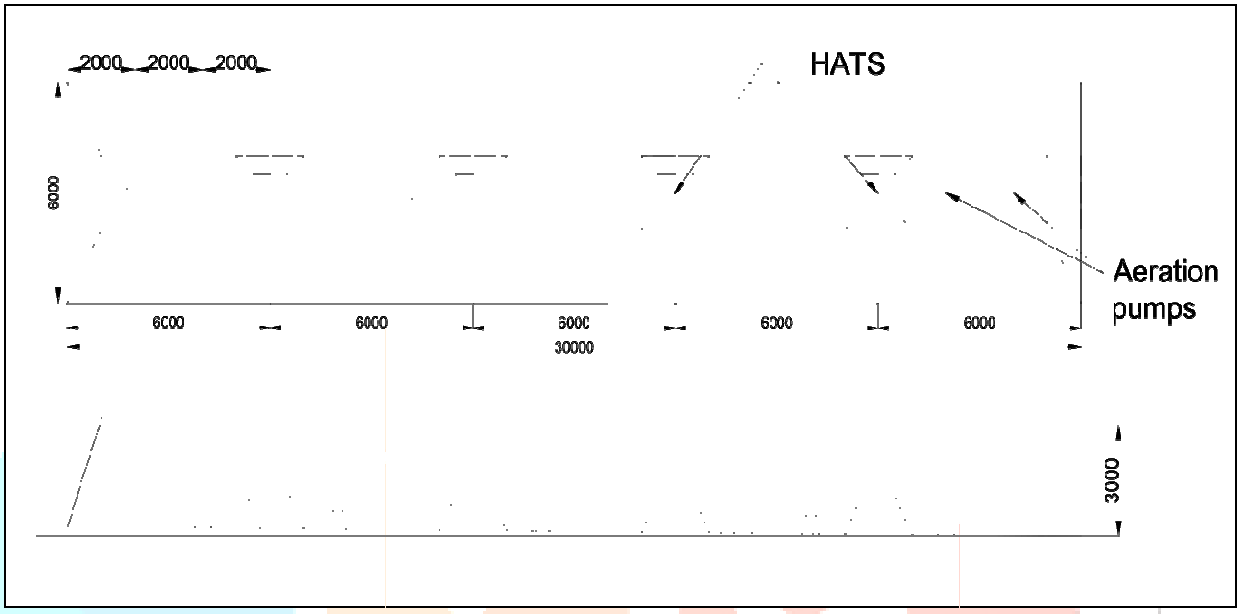

FIGURE 1TYPICAL WINDROW SECTION

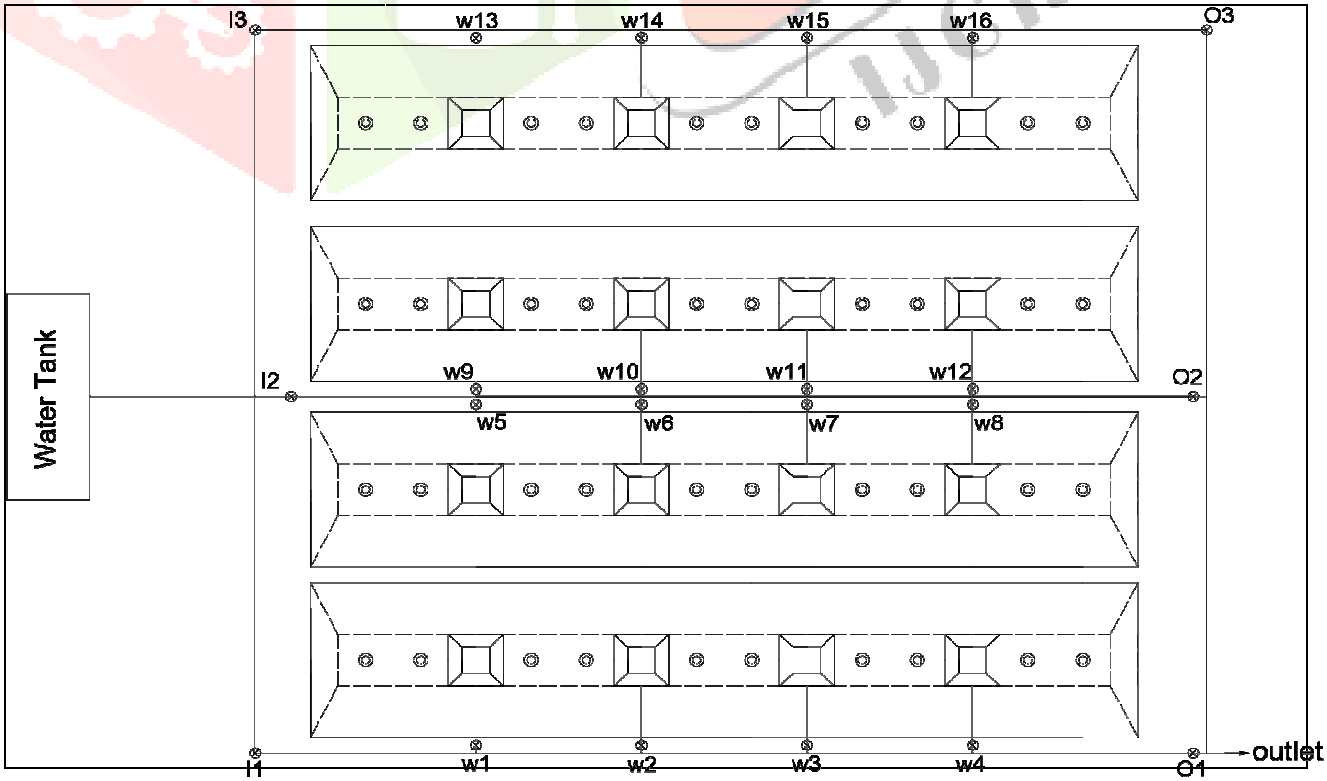

Figure 2WATER DISTRIBUTION SYSTEM

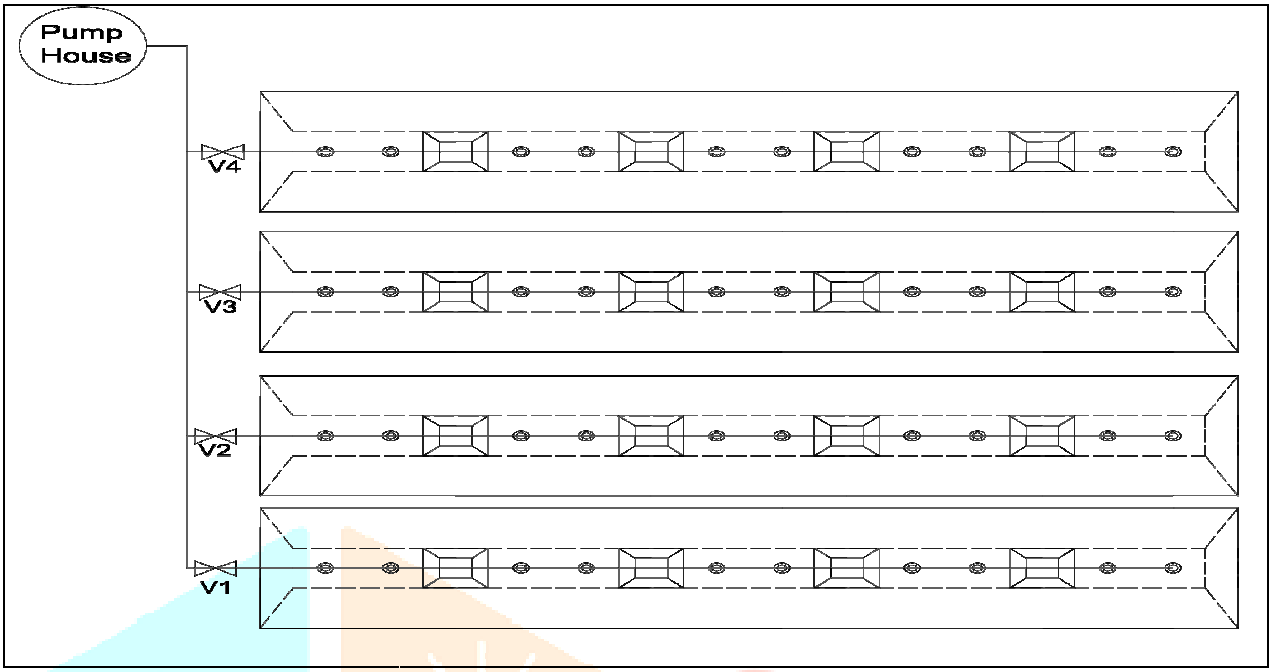

FIGURE 3AERATION SYSTEM

Advantages:

- The windrow area can be significantly reduced which in turn helps in reducing the area required for plant.
- The tedious process of turning over is reduced which is the mother of all odours in the plant.
- The rate of composting is increased which helps us in getting the end product in shorter time.
- No use of chemicals to increase the rate of composting or to reduce the odour.
- Maintenance of **"HAT" is** very easy and there is no need of frequent replacement of the system.
- Volume of waste composted is more thus it increases the capacity of plant to take the waste.
- Highly effective with all types of odour.
- It solves the main reason for shutting down of plants in Bangalore **-ODOUR** and thus makes it people friendly as well as provides a safe environment for labours in the plant.

Disadvantages:

- Requires additional installation of the components
- Initial cost is more
- Requires skilled labour for operation
- Ambient temperatures and weather conditions influence windrow

4. TEST RESULTS AND DISCUSSIONS

- Odour Emission: emission of odour is greatly reduced to about 80% to 90% that compared with the recent technologies.
- Rate of composting: Compost can be achieved within 12 to 20 days of work.
- Capacity of windrow: Windrow capacity of taking in solid waste is of about 100 to 120 tons for an individual windrow pile, which is more than what is being practised now.
- Turning Operation: Tedious process of turning the pile of Windrow is completely eliminated.
- Use of chemicals: Chemicals either Inorganic or organic are not used.

	Windrow	**Aerated Static Pile**	**HAT System**
Capacity tons per day	100 to 200	More than 30	More than 50
Composting Time	8 to 24 weeks	2 to 8 weeks	2 to 4 weeks
Curing Time	3 to 6 weeks	2 to 4 weeks	2 to 3 weeks
Odour Production	High	Medium	Low
Leachate Production	High	Medium	Low
Electric Consumption	Low	Medium	High
Investment Cost	Low to medium	Medium	Medium to high
Operation Cost	Low	Low to medium	Medium
Maintenance Cost	Low	Low to medium	Medium
Efficiency of working	Low	Medium	High

5. CONCLUSIONS

To maintain the appealing value of the environment there is requirement of new technology which are to be adopted to regulate the odour. In order to save the hazardous affects and the beauty of environment caused due to odour, solution is very much essential and we have it.

With harmless environmental footprint this is suggested as an affordable and appropriate technology option for the Indian conditions where rapidly developing communities in the urban boundaries are demanding equally better quality of life.

The results have also proved that the method proposed is environmental friendly which is easy to maintain and aonetime investment as well.

6. REFERENCES

I. H. Tan, Y. Zhao, Y. Ling and X. Wang, “Emission characteristics and variation of volatile odorous compounds in Waste Management”, 2017.

II. N. Bindra, B. Dubey and A. Dutta, “Technological and life cycle assessment of organics processing odour control technologies,” science of the Total Environment, Vols. 527-528, pp. 401-412, 2015.

III. F. Lucernoni, F. Tapparo, L. Capelli and S. Sironi, “Evaluation of an Odour Emission Factor (OEF) to estimate odour emissions from landfill surfaces,” Atmospheric Environment, vol. 144, pp. 8799, 2016.

IV. H. Zhang, F. Schuchard, G. Li, J. Yang and Q. Yang, "Emission of volatile sulphur compounds during composting of municipal solid waste (MSW)," Waste Management, vol. 33, pp. 957-963, 2013.

V. K. Barbusinski, K. Kalemba, D. Kasperczyk, K. Urbaniec and V. Kozik, "Biological methods for odour treatment A review," Journal of Cleaner Production, vol. 152, pp. 223-241, 2017.

VI. B.Mills, "Review of Methods for Odour Control," pp. 147-152, 1994.

VII. Asit Nema "static aerated pile composting – an odour free option" Foundation for Greentech Environmental Systems1 G178, Sarita Vihar, New Delhi 110 076.

VIII. Joshi & Ahmed, Cogent Environmental Science (2016) "Status and challenges of municipal solid waste management in India", Department of Civil Engineering, Jamia Millia Islamia, Jamia Nagar, New Delhi 110025, India.

IX. Douglas R Hartsock, Gerry Crotau and Jeff Gage "UNIFORM AERATION OF COMPOST MEDIA" National Waste Processing Conference Proceedings ASME 1994

X. Ellen B. Huffman, James E. Shelton, Julia D. Bellamy Black & Veatch "PILOT-SCALE TESTING OF THE AERATED STATIC PILE COMPOSTING PROCESS" Charlotte, North Carolina.