STATIC AERATED PILE COMPOSTING – AN ODOUR FREE OPTION

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ABSTRACT

Windrow composting technology is known to have strong odour emission feature as a result of which the plants based on this technology often experience resistance from the community where they are set up. The odour envelope that develops expands over a radius of 2-3 km around the plant and causes adverse psychosomatic health impacts on the residents. This is attributed to creation of anaerobic conditions in the core of the windrows which is essentially due to inadequate energy inputs for meeting the commensurate oxygen requirement of the rotting waste. Several plants have been closed down primarily due this reason and one of the most pertinent examples is that of Thane near Mumbai. In order to improve acceptance of the plants among the host communities, it is desirable to mitigate their environmental impact by incorporating essential pollution control measures. In this regard an improved version of the windrow composting technology was developed by the Corp of Engineers of the US Army which provides for continuous supply of air through an embedded pipe into the rotting pile of waste. The foul air is then treated in a rather down-to-earth low cost bio-filter. This arrangement on one hand reduces or eliminates possibility of anaerobic conditions and on the other, provides for extremely simple and cheap method of air pollution control. It also eliminates the need for weekly turnings of the rotting piles and thereby minimises the operating costs associated with the material moving machinery. With an innocuous environmental footprint this is suggested as an affordable and appropriate technology option for the Indian conditions where rapidly developing communities in the urban peripheries are demanding equally better quality of life.

Key words

Windrow, static aerated pile composting, odour control, bio-filter

INTRODUCTION

Composting is considered to be technically the least complicated or risky option for treatment of bio-degradable waste. It is practiced in various forms across the world for treatment of municipal solid waste, and yard and farm waste. Fundamentally it involves stabilisation of the degradable or putrecible waste into a form closure to humus or peat soil. It is a natural, ongoing process that is a common occurrence in both manmade and natural environments and is carried out by friendly bacteria which could be of either aerobic or anaerobic type. Composting of waste can be achieved under natural conditions as well as under accelerated and controlled conditions in a treatment plant. A schematic of natural composting process is shown in Exhibit 1. Anaerobic composting has been traditionally practiced by gardening enthusiasts at home who typically burry the kitchen and garden waste into a pit and recover the stabilised and mature compost after about 8-12 months. During last two decades anaerobic composting reactor designs have been evolved such as KOMPOGAS wherein waste with high dry solid content is degraded to derive biogas and compost, however they involve high capital expenditure as well as a high degree of care in preparing the feedstock.

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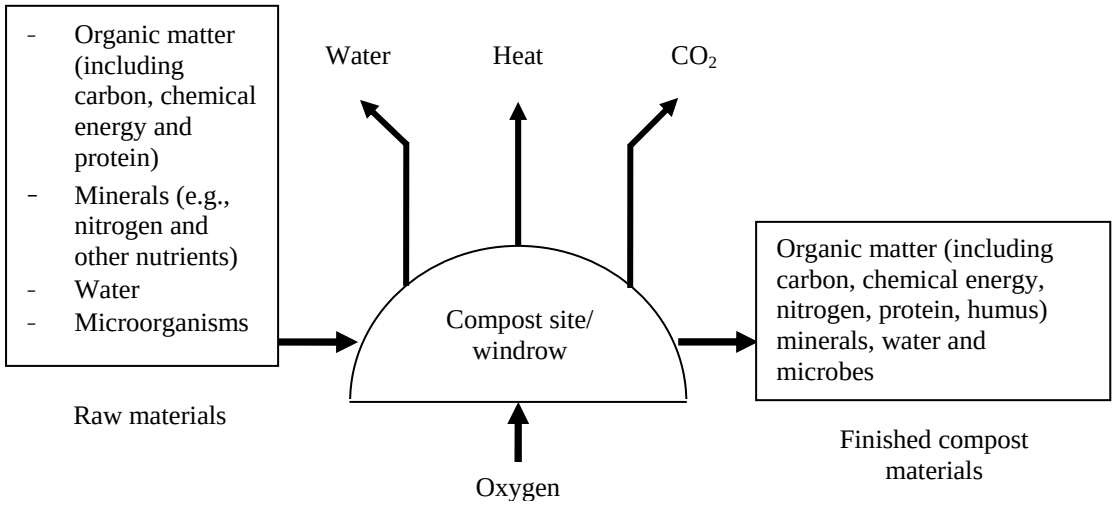
On the other hand there is the fairly faster option of aerobic composting process wherein waste decomposition is carried out under oxygen supply conditions. Broadly there are three technology options for aerobic composting viz. windrow, static aerated pile and in-vessel composting. Windrow composting has been widely adopted in India because of its rather simplistic scheme and apparently affordable cost. In-vessel composting has not been attempted in India due to the involved complexities and high capital and operating costs. However, there is an intermediate option of aerated static pile composting which has simplicity of the windrow composting technology and several advantages of an accelerated system like that of in-vessel technology. A brief profile of this technology vis-à-vis the widely adopted windrow composting technology is presented in this paper. The objective of this paper is to promote adoption of this next higher order technology option under the Indian context for the centralised municipal facilities which offers certain inherent benefits and makes it more appropriate and acceptable for the habitations in the vicinity of the plants.

EXHIBIT 1: THE NATURAL COMPOSTING PROCESS



The Carbon, chemical energy, protein and water in the finished compost is less than that in the raw materials. The finished compost has more humus. The volume of the finished compost is 50% or less of the volume of raw material.

Source : Decision Maker's Guide to Solid Waste Management, Vol. II (EPA 530-R-95-023), 1995.

WINDROW COMPOSTING AND ITS LIMITATIONS

Windrow composting as typically practiced in India comprises a four phase process of (a) prolonged rotting of mixed solid waste, (b) separation of non-degradables (c) curing/maturing of compost, and finally (d) grading of finished product according to particle sizes.

The first phase of rotting involves staking of mixed municipal solid waste in long rows (20-30m long) - 2m wide and 1.5-3m high. Over a period of 3-4 weeks the waste is allowed to

decompose while the processes is accelerated by turning the waste once a week from outside to the centre. The turning is essential and carried out with multiple objectives of (a) exposing the waste in the centre to atmospheric oxygen, thereby accelerating its decomposition, and (b) bringing the outer layers to the core where temperature build up over next one week (>55°C) enables pathogen destruction. In the second phase, the decomposed material is screened for removal of contraries, large objects, etc. which constitute the rejects and need to be safely disposed of into a sanitary landfill. This is followed by curing phase for about 4 weeks where the partially stabilised waste is again staked in 1m wide and 1m high rows typically 20-30m long. Regular turnings during this phase help in rapid stabilisation and maturing of compost. Subsequent phase involves processing through multiple screenings for grading into typically 4 mm particle size of finished compost. Exhibit 2 presents the raw waste windrows during the first phase and the partially stabilised waste during the curing phase.

EXHIBIT 2: WINDROWS OF MIXED MSW AND MATURING COMPOST

As stated earlier, the advantages of this technology are its simplicity and lower capital cost for equipment and machinery. Apparently for these factors this technology option has been widely promoted in India during last couple of years. However, there are several inherent limitations of this technology because of which it is not a favoured option under demanding boundary conditions e.g., proximity to habitations, need for higher quality of finished product, etc. Some of the major limitations are discussed in the paragraphs that follow.

Problem of odour

Windrow composting in its basic form does not have an inherent odour control feature which is caused due to formation of anaerobic conditions in the core of a pile of waste. Whenever the pile is turned, the entrapped malodorous gases are released into the environment which causes severe discomfort to the residents in the vicinity of the plants. For a large scale plant, the turning operation is an every day feature and thereby the odour emission is also a continuous feature. All plants are invariably characterised by an odour envelope of 2-3km radius and the affected communities are found to be experiencing psychosomatic ill-effects e.g., headache, nausea, lack of appetite, etc. As a result, construction and operation of

compost plant based on this technology is increasingly being resisted by the affected communities across the country. For instance, for this very reason the plant at Thane (near Mumbai) had to be completely dismantled in 2002-03 under court intervention (Nema, 2006). Similar problems are being experienced in other composting plants e.g., Trivendrum, Vijayawada, Puri, etc.

Interestingly, in order to control odour, several agencies are offering customised bacterial consortia which are required to be sprayed as a seed on the rotting waste in windrows. While this provides temporary respite, it also entails an additional operating cost on the municipality or the plant operator.

Higher operating costs

Turning of windrows involves considerable fuel/energy inputs for turners, front end loaders, etc. Secondly this also entails higher wear and tear of the material moving machinery and consequent repairs and maintenance. These factors together translate into higher operating costs.

Quality of compost

The scheme typically adopted in Indian plants does not include pre-processing and sorting operations, instead mixed waste is allowed to decompose in a rather unregulated/uncontrolled way and sorting is carried out in the second phase. In a way this approach is resorted due to technical difficulties in separating the mixed and moist waste. As a result, quality of the finished compost from the point of view of heavy metals, toxins, glass, sharps, etc. is not guaranteed.

Secondly, in spite of having a fleet of turners, there is no guarantee that all windrows will be turned uniformly on a regular basis. All parts of the waste piled up in the windrows may not be subjected to a temperature of over 55°C for a period of 7-10 days and thus desirable level of pathogen and weed seed destruction may not be achieved.

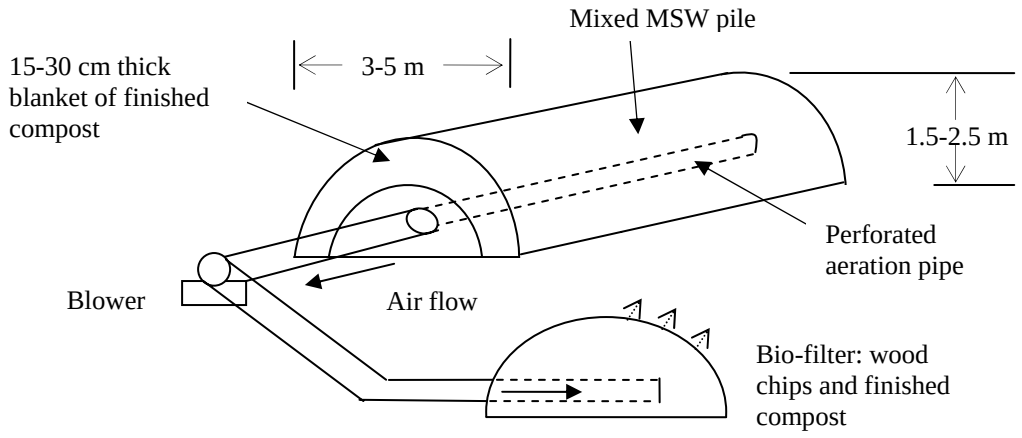
STATIC AERATED PILE AND ITS BENEFITS OF

Aerated static pile composting is an improved version of windrow composting wherein, as shown in Exhibit 3, an air pipe is provided underneath to augment oxygen supply and thereby prevent formation of anaerobic conditions. Typically air is drawn through the pile with the help of a blower. The blower capacity is determined according to the established oxygen demand characteristics of the rotting waste. The air flow rates can be adjusted according to the stage of rotting and the temperature attained in the core of the waste. To this effect, as an option appropriate probes can be inserted in the piles which are then coupled with a micro-processor to the blower. Furthermore, a blanket of 15-30cm thick layer of finished compost or wood chips is placed all around the windrow to provide insulation. The air thus drawn through the pile is then passed through a bio-filter (comprising moist heap of tree bark, wood

chips and compost) for removal of odorous chemical substances e.g., volatile organic carbon, mercaptans etc. These arrangements offer following benefits:

- Full control over intensity and duration of aeration, enabling better control of process parameters, especially temperature of composting mass
- Continuous oxygen supply eliminates formation of anaerobic conditions and thereby potential odour problems
- Collection of foul air stream and its further treatment for odour control in the bio-filter
- Uniform sustained heating of waste leading to destruction of plant pathogens & weed seeds
- Accelerated decaying, leading to higher throughput and lower area requirement for the plant
- Reduced operational costs as mechanised turnings are not required. Optimisation possible by regulating air flow, and finally
- This makes the entire operations more acceptable to the communities in the vicinity

EXHIBIT 3: AERATED STATIC PILE FOR COMPOSTING MSW



Source : Decision Maker's Guide to Solid Waste Management, Vol. II (EPA 530-R-95-023), 1995.

This technology serves as a robust option under almost all situations, particularly where land is limited and/or even where a habitation is close by. At the outset, incorporation of a fixed aeration system may be perceived to be leading to higher capital and recurring cost, however this would be offset to a large extent as a result of reduced turning requirements and by avoiding purchase of bacterial solutions for odour control which, as stated in the earlier section is typically the case in simple windrow composting.

CONCLUSIONS

Fundamentally static aerated pile composting technology is an improved form of the conventional windrow composting technology. It offers inherent advantages of odour control,

accelerated decomposition as well as better control over the entire process. The feature of reduction of odour to a large extent helps in making the environmental footprint of a plant innocuous, and thereby more acceptable to the community in its vicinity. On the ladder of available technology options it represents the next higher order option compared to the windrows composting. In terms of capital and operating costs as well, the static aerated pile option falls almost in the same range as the windrow composting. As a matter of fact, its operating costs are perceived to be lower than the windrow composting system because of elimination of the turning operations. In view of its superior features, this option is far more appropriate under the Indian context where urban landscapes are changing rapidly and where communities (even in peripheral settlements) are increasingly demanding improved quality of life, least of all, uncontaminated and odour free air.

References

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