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Monitoring of Oxygen Profile during Composting of Municipal Solid Waste

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Oxygen is an important parameter to be monitored during the process of composting. The efficiency of aerobic composting process is mainly dependent on the amount of oxygen that is provided to windrows by proper turning. This study was designed with the main objective to monitor the oxygen profile during composting of municipal solid waste and observe variation in oxygen profile of windrows in which different inoculums were added. It was concluded from this study that the amount of oxygen % was decreased at thermophilic stage and increased at mesophilic stage. The oxygen and temperature of the compost windrow are inversely proportional to each other. The oxygen % were measured at the top of each treatment at two depths of approximately 1 and 4 feet by using OT (Oxygen/ temperature) meter.

Keywords: Oxygen profile; windrow; B. cereus.

1. INTRODUCTION

Waste should be used as a source to improve yields of agriculture [1]. The commercial and domestic waste is termed as municipal solid waste. Solid waste management is a major issue [2]. The disposal of solid waste is usually done by unscientific methods. An effective system to

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eliminate solid waste is very important now a days. Composting is a best way of compost stabilization [3]. The stabilization of compost requires special conditions of oxygen and moisture. Composting is a degradation of bio-waste and its stabilization under optimized conditions [4]. The end product of composting is a stable compost that can be used as a soil conditioner and bio fertilizer. Composting can be broadly classified as aerobic and anaerobic composting [5].

Aerobic composting methods are widely used to degrade organic wastes. Aerobic composting consists of a controlled biological process and mechanical screening thereafter. The biological process is the most critical component of aerobic composting process [6]. Hence it is to be properly understood and regularly monitored to derive maximum benefits from the composting process. Oxygen is the basic need of microbes. It increases the metabolic rate [7].

2. METHODOLOGY

The experiment was conducted in Lahore compost Pvt Ltd. The compost windrow (14 feet width x 70 length 5 feet height) contain total 60 tons of municipal organic waste including four layer materials of screen matter, cow dung, food + vegetable waste, and sugarcane waste, respectively, 15 tons for each material. The purpose of preparing four windrows was to treat them with different inoculums and to check the effect of inoculum on the percentage of oxygen as well. Four treatments of compost with different inoculums were used: A (treated with 1 Litre molasses + two strain of *Bacillus cereus*), B (treated with *Bacillus cereus* strains), C (treated with BST commercial inoculum), and D (control without any inoculant). 1 litre bacterial inoculum were diluted with 9 litres of water and sprayed on windrows. The oxygen was monitored on daily basis from different heights by using OT meter. The readings of oxygen were taken by the probe at height of 4 feet and 1 foot. Three reading were taken daily from 4 feet and 1 foot after proper mixing of windrow. The SPSS was used to analyse the readings; average value was calculated for each windrow.

3. RESULTS AND DISCUSSION

The compost was prepared after 2.5 months of composting process. The oxygen was decreased at the start of thermophilic stage (Fig. 1) but with increase in time interval it started to increase (Fig. 2). The variation in oxygen profile was observed in all experimental windrows.

The initial composting started with thermophilic temperature and oxygen was decreased (Table 1), but when the mesophilic conditions dominated at the middle and end of process the amount of oxygen increased (Table 2).

Table 1. Oxygen profile of compost during 1st month

Windrows	Oxygen (%)			
	Week 1	Week 2	Week 3	Week 4
A	11.01±0.80	11.16±0.90	11.36±1.00	11.65±1.10
B	11.10±0.80	11.05±0.92	11.49±1.02	11.49±1.01
C	11.96±0.91	11.20±0.94	11.47±1.034	11.26±1.05
D	9.86±0.95	10.19±0.97	10.50±1.040	10.58±1.09
Significance with df 3 and 7	NS	NS	NS	NS

Table 2. Oxygen profile of compost during 2nd month

Windrows	Oxygen (%)			
	Week 5	Week 6	Week 7	Week 8
A	12.00±1.27	11.43±1.00	11.38±0.94	11.03±0.79
B	11.36±1.20	11.24±1.00	11.28±0.90	11.06±0.75
C	11.06±1.21	10.77±1.01	10.60±0.81	10.27±0.79
D	11.03±1.00	10.27±1.00	10.02±0.80	10.08±0.70
Significance with df 3 and 7	NS	NS	NS	NS

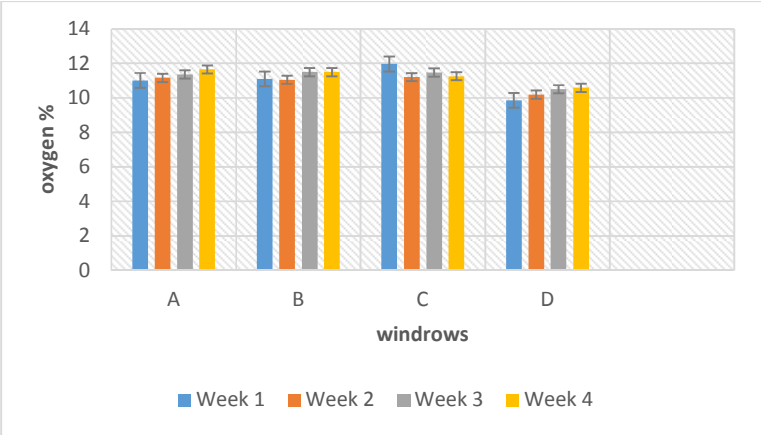

Fig. 1. Variation in oxygen profile of composting during 1st month
The standard error of mean value is represented by error bar

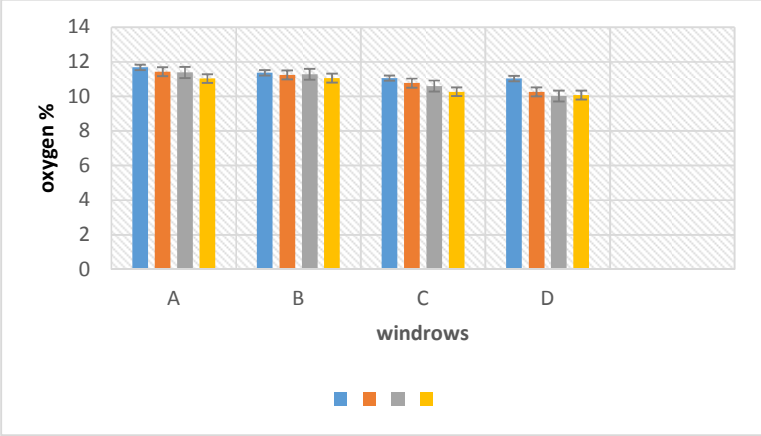

Fig. 2. Variation in oxygen profile during 2nd month of composting
The standard error of mean value is represented by error bar

Fig. 3. Measurement of oxygen % by OT meter
The amount of oxygen measured by OT meter, the percentage of oxygen was 12 during second month of composting

There is inverse relationship observed between oxygen and temperature, as the amount of oxygen reduces when temperature of the windrow increases [8]. The decline in oxygen percentage was observed (Fig. 1). The sufficient amount of oxygen is very important in aerobic composting as it only contains aerobic bacteria [9]. Proper turning of windrow is important to provide aeration. Ghao et al. [10] reported that large amount of oxygen at the start of composting must be necessary and it can be achieved by proper turning. The different inoculums did not affect the percentage of oxygen. There was not much variation observed when windrows having different inoculums were compared.

4. CONCLUSION

It was concluded from this study that the amount of oxygen was reduced at the start of composting

when thermophilic conditions were dominated in the windrow, it started to increase when the mesophilic phase appeared. The oxygen was maintained by proper turning with wheel loaders. There was no effect of inoculum observed on the percentage of oxygen.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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