International Journal of Chemical Engineering Research.
ISSN 0975-6442 Volume 9, Number 1 (2017), pp. 1-6

http://www.ripublication.com

Aerobic Composting: Studies on Variation in Parameters

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Abstract

In the current investigation, solid food waste is treated aerobically. Studies are carried out on variation in parameters like pH, moisture content, organic content and temperature. The parameters were measured by using conventional chemical analysis methods in laboratory. pH of the composting material changed from 6 at an ambient stage to 5.5 at mesophilic stage. The pH rapidly increased to 8.5 during thermophilic phase. It again fell to 6 during cooling period. Moisture content at ambient stage was 58 percent. This afterwards changed to 40 percent during cooling stage. The organic content decreases from ambient to mesophilic stage. This cooling indicates decomposition of organic waste. The temperature increased from 25^{o}C in ambient stage to 40^{o}C in mesophilic stage. It increases to 54^{o}C in thermophilic stage. The investigation can help in controlling the paramaters for maximum decomposition of waste.

Keywords: Decomposition, composting, solid waste, biodegradation, microbial degradation.

1. INTRODUCTION

Solid waste consists of garbage, ashes, rubbish, dust etc. Garbage includes all sort of putrescible organic wastes obtained from kitchens, hotels, restaurants, etc. in the form of waste food articles, vegetables and fruit peelings, etc. It also includes animal dung, grass and leaves, bird excreta. Ashes are incombustible waste products obtained from houses, industries, hearths and furnaces. Rubbish includes all the non- putrescible waste including ashes[1]. Solid waste can be also classified as organic and inorganic. The solid waste can be disposed of by methods like controlled tipping, land filling, sea dumping, pulverization, incineration and composting. In composting, the

putrescible organic matter present in the waste is digested or decomposed aerobically/anaerobically. Various investigators have carried out investigations on solid waste treatment. Studies are reported on aerobic and anaerobic treatment methods[2-4]. The studies indicated that anaerobic method reduces the sludge volume significantly[5-7]. The method can be nuisance to nearby people and workers due to unpleasant odour. Investigation is also reported on aerobic thermophilic composting of municipal solid waste by Asnani[8]. These studies indicated that the value of the parameters like pH, moisture content, temperature, C/N ratio and volume reduction were within the desired limits during the composting. Nowadays vermicomposting is the commonly practiced solid waste management method. Many investigations and case studies are reported on vermicomposting[9,10]. It has advantages over aerobic and anaerobic composting. The space requirement for vermicomposting is comparable with aerobic and anaerobic methods. It is less than aerobic method. The problem of unpleasant and unhealthy smell is reduced to a great extent. In the current investigation, solid food waste is treated aerobically. Studies are carried out on variation in parameters like pH, moisture content, organic content and temperature.

2. METHODOLOGY

Food waste was spread in tank. The size of the bed was designed by providing bed depth of 160 mm. The proportion of bed material was as given below: The quantities of raw materials was used for bed preparation: Raw food waste RFW (185 kg), Soil S (20 kg), Cow dung CD (10kg), Water W (22 L). Raw food waste was spread with design bed size and 160 mm thick depth. The composting bed was covered with dry grass and leaves to avoid odor and breeding of pathogen vectors such as flies, mosquitoes neatly. Cow dung slurry (1kg cow dung with 5 liter water) was sprinkled throughout the bed thoroughly, after every 4 days period and turned it upside down. A representative sample from bed will be taken for analysis of physicochemical parameters in laboratory. The beds took about 60 days time for complete degradation; the processed aerobic compost was black, light in weight and free from bad odor.

3. RESULTS AND DISCUSSION

3.1 Variation in pH

As shown in fig. 1, pH of the composting material changed from 6 at an ambient stage to 5.5 at mesophilic stage. The pH rapidly increased to 8.6 during thermophilic phase. It again fell to 6 during cooling period. The action of microorganisms on carbohydrates may be the reason behind the initial drop in pH at the mesophillic stage. Ammonia production can be reason for increase in pH during thermophilic stage. Progressive utilization of organic acids and increase in the mineral constituents keeps the pH high till the end of the process.

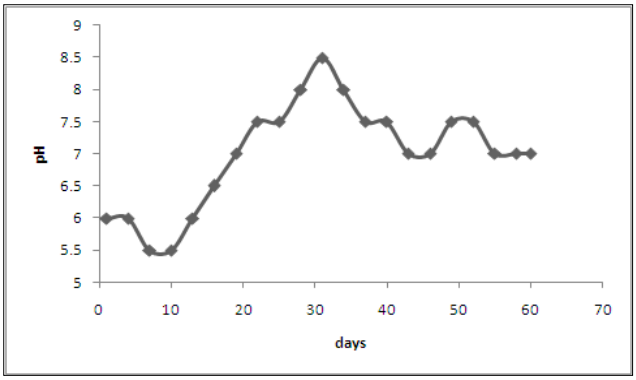

Fig. 1. Variation in pH

3.2 Variation in moisture content

As shown in fig. 2, moisture content at ambient stage was 58 percent. This afterwards changed to 40 percent during cooling stage. The optimum moisture content in composting varies from 30 percent to 70 percent. At higher percentages; water displaces much of air from the pores of compost. The low percent of moisture reduces microbial degradation. The heat generated in metabolism and air flow reduces moisture content towards end.

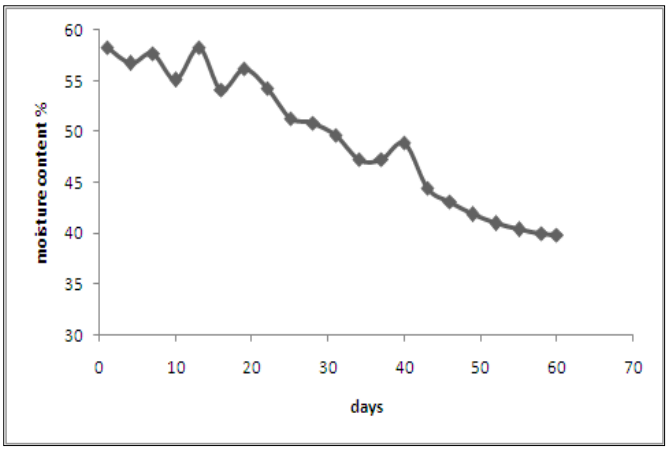

Fig. 2. Variation in moisture content

3.3 Variation in organic content

It can be seen from fig.3 that the organic content decreases from ambient to mesophilic stage. This cooling indicates decomposition of organic waste. In the present studies, it decreased from 65 to 48 percent. The organic carbon was being decomposed by the microbial biomass present in the compost. Part of the carbon in the decomposing residues evolved as carbon dioxide and part was assimilated by the microorganisms.

3.3 Variation in temperature

The temperature increased from 25 ºC in ambient stage to 40ºC in mesophilic stage. It rises to 54ºC in thermophilic stage, where it fluctuated between 40 to 54ºC for two weeks and then gradually decreased to 39 ºC at cooling stage. Initially, the oxidative action of microorganisms is responsible for rise in temperature. As mesophilic population increases, temperature rises. As temperature rises above 40ºC, these mesophilic bacteria are replaced by thermophilic bacteria. The variation in temperature and temperature difference between ambient and bed temperature is shown in fig.4 and 5 respectively.

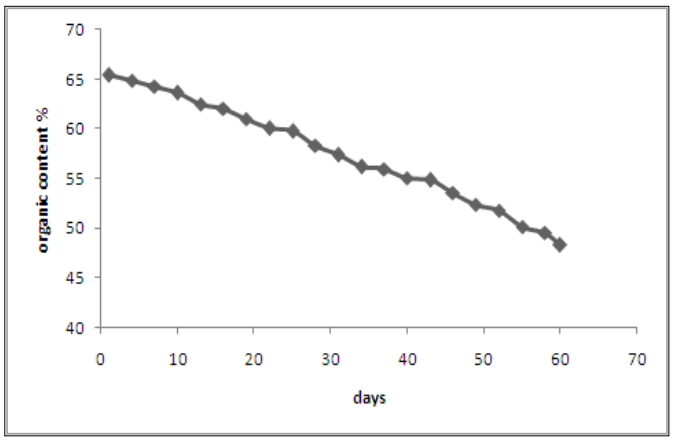

Fig. 3. Variation in organic content

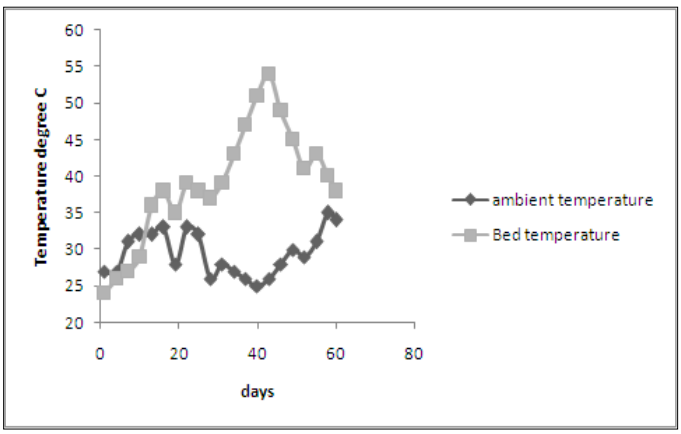

Fig. 4. Variation in ambient and bed temperature

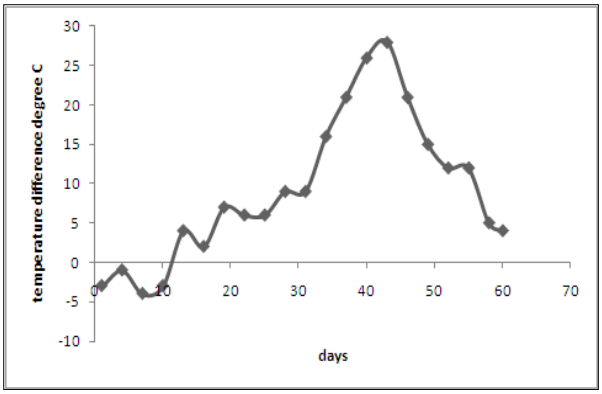

Fig. 5. Variation in temperature difference.

4. CONCLUSION

In the current investigation, solid food waste is treated aerobically. Studies are carried out on variation in parameters like pH, moisture content, organic content and temperature. pH of the composting material changed from 6 at an ambient stage to 5.5 at mesophilic stage. The pH rapidly increased to 8.5 during thermophilic phase. It again fell to 6 during cooling period. Moisture content at ambient stage was 58 percent. This afterwards changed to 40 percent during cooling stage. The organic content decreases from ambient to mesophilic stage. This cooling indicates decomposition of organic waste. The temperature increased from 25^{o}C in ambient stage to 40^{o}C in mesophilic stage. It increases to 54^{o}C in thermophilic stage.

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