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Rapid composting of biodegradable waste through passive aeration

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Abstract
Composting of municipal solid waste (MSW) as a part of Bio-processing is of much concern. Since it gives sanitary approach for processing as well as enables geochemical cycling of the nutrients. However, due to the quality of the compost formed, there is no sufficient demand for it. Moreover, due to low yield of compost and mechanization used in its preparation, the resultant cost is not affordable by the farmers. Pretreatment of MSW with NaOH and Na_2CO_3, as observed from chemical oxygen demand of the supernatant shows more carbon solubilization from the waste.

Keywords: Municipal solid waste, alkaline treatment, Ca $(OH)_2$, compost

Introduction
Composting is a process of bio-degradation of organic components, is an age old process practiced in India and China. Earlier practices were limited to pit composting named as Bangalore and Indore processes. Subsequently aerobic composting approaches were developed and are being adopted. Degradation of organic fraction is primarily a function of degree of polymerization of lignocellulose. During composting in a limited period (30-45 days), degradation of bio-degradable is limited to easily degradable components of MSW such as hay and straw, vegetables and fruits waste. Degradation of lignocellulosic materials, through the biochemical activity, is a very slow process and moreover physico-chemical composition limits its degradation. It has been reported that alkaline and acid treatments have potential for reducing degree of polymerization (Chou, 1986) [3]. Hence to increase the biodegradability, investigations were carried out with the objectives, to asses the effect of chemical treatment on biodegradation *vis-à-vis* development of approaches to increase the yield of compost.

Materials and Methods
Laboratory scale composting experiments were carried out using MSW procured from urban areas under Ranchi Municipal Corporation. While collecting the samples, one full load of container was obtained and following the quartering method, approximately 50 kg of sample was stored for lab experiments on composting.
The collected material was prepared for composting by separating inert, plastics and glass. After separation, the remaining waste was dried at 100± 5°C and ground to 2mm-particle size for chemical analysis.
Pretreatments were given to MSW by immersing MSW in 5.0 liter beakers overnight in 1% and 0.1% solution of Na_2CO_3, NaOH and Ca $(OH)_2$ respectively. The supernatant was used for estimating soluble Chemical Oxygen Demand (COD) to enable to observe the influence on carbon solubilization from the waste. Samples analysis was carried out at 3rd, 9th, 15th, 22nd and 30th days.

Results and Discussion
MSW is heterogenous material comprising compostable, inert and non- biodegradable fraction. Composting is the net result of degradation of organic matter. In conventional composting carried for the limited period (upto 30-40 days), degradation of fruit, food, and vegetable wastes, green leaves and partial degradation of hay & straw occurs. Large fraction of organics comprising lignocellulosic material gets slowly degraded and requires extended period. Mechanical–biological treatment (Muller, *et al*., 1998) [2] and chemical treatment (Chau, 1986) [3] were studied for enhancing biodegradation of organic matter. Degradation of organic matter (cellulose) in terms of cellulase activity in relation with the temperature has been studied and it was observed that cellulase activity is optimum at a temperature between

40-50ºC (Bhoyar and Bhinde, 1982) [1].
MSW used in the study has C/N ratio of approximately 56.13 indicating its suitability for composting. In the present study, feasibility of pretreatment using alkaline treatments was assessed for the extent of carbon solubilization from MSW in a supernatant from alkaline treatment as chemical oxygen demand. Ca $(OH)_2$ being relatively cheaper, is used for alkaline treatment for field scale study. Results of chemical analysis for composting on MSW with lime treatment indicate that alkaline treatment gives enhanced degradation as evident from the organic matter content and fermentable organic matter (Table 1).

Table 1: Chemical Analysis of Samples from Control and Experimental Lab Scale Study

		pH	Conductivity mS/cm at 25^{0}C	Moisture	LOI	OC	TN	TP	TK	FOS
3rd day	Control	7.8	0.94	23.30	29.20	16.90	0.21	0.71	0.71	28.97
	Experimental	7.5	2.25	28.50	27.30	15.80	0.20	0.75	0.75	26.35
9th day	Control	7.7	1.75	33.50	28.96	15.20	0.22	0.76	0.76	28.46
	Experimental	7.8	1.99	32.90	26.44	14.69	0.23	0.77	0.77	25.04
15th day	Control	7.6	2.91	30.00	26.40	16.70	0.25	0.76	0.76	23.40
	Experimental	8.1	2.89	31.60	25.58	17.54	0.23	0.76	0.76	23.60
22nd Day	Control	7.5	0.71	32.03	26.27	15.30	0.24	0.78	0.78	23.13
	Experimental	8.5	2.98	31.45	24.98	16.10	0.25	0.78	0.78	20.95
30th Day	Control	7.9	0.87	29.30	17.00	9.90	0.27	0.78	0.78	19.90
	Experimental	9.0	3.10	29.90	18.70	10.80	0.25	0.82	0.82	13.80

All parameters except pH are expressed in % on wet/wet basis.
LOI-Loss on ignition; OC- Organic carbon TN- Total Nitrogen; TP- Total Phosphorous;
TK- Total potassium; FOS- Fermentable organic substance

Conclusions

Alkaline treatment to MSW for enhancing degradation of lignocellulosic fraction is possible through alkaline treatment. Hence, in order to achieve biodegradation with the chemical treatment of MSW, alkaline treatment is a feasible option which can be used to enhance degradation of organic matter. However, detailed investigations regarding temperature of composting and duration of alkaline treatment need be undertaken to assess for establishing the concentration of alkali addition.

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