Additives aided composting of green waste: Effects on organic matter degradation, compost maturity, and quality of the finished compost

Jagdish Gabhane a, SPM. Prince William a,⇑, Rajnikant Bidyadhar b, Priya Bhilawe a, Duraisamy Anand a, Atul N. Vaidya a, Satish R. Wate a

a Solid and Hazardous Waste Management Division, National Environmental Engineering Research Institute, Nehru Marg, Nagpur, Maharashtra, India
b Abhijeetgroup, Chaklabana, Chandwa, Jharkhand, India

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The effect of various additives such as fly ash, phosphogypsum, jaggery, lime, and polyethylene glycol on green waste composting was investigated through assessing their influence on microbial growth, enzymatic activities, organic matter degradation, bulk density, quality of finished compost including gradation test, heavy metal analysis, etc. A perusal of results showed that addition of jaggery and polyethylene glycol were helpful to facilitate composting process as they significantly influenced the growth of microbes and cellulase activity. The quality of finished compost prepared from jaggery and polyethylene glycol added treatments were superior to other composts, wherein reduction in C/N ratio was more than 8% in jaggery treatment. All other parameters of compost quality including gradation test also favored jaggery and polyethylene glycol as the best additives for green waste composting.

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1. Introduction

Composting is one of the best-known processes for the biological stabilization of solid organic wastes by transforming them into a safer and more stabilized material (compost) that can be used as a source of nutrients and soil conditioner in agricultural applications (García-Gómez et al., 2005; Kuhlman, 1990). Normally, composting is a labor intensive and time consuming process which makes it unattractive for entrepreneurship prospects. However, recent days have witnessed a renewal of interest in composting due to the advancements in composting technology. Techniques such as mechanical–biological composting (MBC), co-composting using additives, rapid composting using accelerators and microbial inoculums have made composting easy and opened avenues for entrepreneurship in waste management sector.

Additives are usually mixtures of different amounts of various microorganisms, mineral nutrients, or readily available forms of carbon, enzymes and pH-balancing compounds that are meant to enhance microbial activity when the additive is in contact with the waste material (Himanen and Hänninen, 2009). The effects chemical additives such as coal fly ash, wood ash, green liquor dregs, bauxite, natural zeolites, and kaoline on composting of municipal solid waste, green waste, sludge, catering waste have been extensively studied by different researchers (Belyaeva and Haynes, 2009; Koivula et al., 2004; Kurola et al., 2011; Villaseñor et al., 2011; Wong et al., 1997; Zambrano et al., 2010). Wong and Fang (2000) found a positive effect of lime on composting by increasing temperature and CO2 evolution without any negative effects on microbial community. Himanen and Hänninen (2009) studied the effect of commercial additives containing sulfates and oxides of iron, magnesium, manganese, and calcium hydroxide on composting. Similarly, Yu and Huang, 2009 studied the effect of sodium acetate on composting of food waste and found an increase in microbial activity as the result of sodium acetate application.

Although various chemical additives have been tested for their efficiency in composting, use of sugar as an additive in composting process has not been explored so far. Sugar as a carbon source can promote the growth of degrading microbes and hasten composting process. Similarly, the role of surfactants on composting process also needs to be explored further, although its role on cellulase activity has been studied extensively. Application of polyethylene glycol in enzymatic hydrolysis of lignocellulose is studied by Borjesson et al. (2007), he found that polyethylene glycol increased the rate of enzymatic conversion of cellulose and decreased the amount of enzyme needed. However, its effects on composting are not known.

Addition of surfactant Tween 80 and biosurfactant rhamnolipid to the composting substrate had stimulatory effects on the microbial population of bacteria, actinomycetes and fungi, and composting occurs rapidly (Shi et al., 2006). Although previous works have