Enhanced humification by carbonated basic oxygen furnace steel slag – II. Process characterization and the role of inorganic components in the formation of humic-like substances

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\textbf{Article info}

\textbf{Abstract}

Enhanced humification by abiotic catalysts is a potentially promising supplementary composting method for stabilizing organic carbon from biowastes. In this study, the role of steel slag in the transformation of humic precursors was directly characterized by measuring the variance in dissolved organic carbon (DOC), spectroscopic parameters (E\textsubscript{600}), and the concentration and molecular weight change of humic-like substances (HLS) during the process. In addition, a mechanistic study of the process was explored. The results directly showed that steel slag greatly accelerated the formation of HLS. The findings indicate that Fe(III)- and Mn(IV)-oxides in steel slag act as oxidants and substantially enhance the polycondensation of humic precursors. Moreover, the reaction appears to suppress the release of metals from steel slag to a certain extent under acidic conditions. This can be attributed to the cover of HLS on the external surface of steel slag, which is significant for its environmentally sound reuse.

\textbf{Keywords:}

Steel slag
Abiotic humification
Humic-like substances
Metal oxides
Polycondensation

1. Introduction

Composting and compost utilization are important technologies for stabilizing organic matter from biowastes (e.g., municipal solid waste, sewage sludge, agricultural waste), and humification enhancement during composting is a critical factor in terms of reducing potential greenhouse gas emission (as sink of C and N) (Binner et al., 2011). The enhancement in humification by abiotic catalysts, a particularly promising supplementary method, can shorten composting time (Brunetti et al., 2008; Bulosan-Atendido et al., 2005; Kanno et al., 2011). This is an important issue in terms of overcoming the problems associated with conventional composting, such as the time required to achieve maturation (90–365 days) (Alfano et al., 2008) and the high energy consumption (aeration and moisture content maintenance, for instance), to produce humic substances (HS) which could be used as soil conditioners. In a previous study (Qi et al., 2012), humic-like acid (HLA) formed in the presence of carbonated basic oxygen furnace (BOF) steel slag (hereafter referred as “steel slag”) was found to be strikingly similar to HLAs formed in the presence of zeolite and birnessite (e.g., highly aromatic, high molecular weight), and enhancing effect of steel slag on humification using some model humic precursors (catechol, glycine and glucose) was experimentally verified.