Thermodynamic Analysis on the oxidative pyrolytic treatment of Electric Arc Furnace Dust-TBBA blends

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Abstract

This contribution reports a thermodynamic assessment for the bromination of electric arc furnace dust (EAFD) by products sourced from thermal degradation of tetrabromobisphenol A (TBBA); i.e., the most widely deployed brominated flame retardants. Upon TBBA's pyrolysis, HBr is released in conjunction with several volatile organic compounds leaving a solid carbonaceous residue. EAFD contains appreciable quantities of zinc, iron and lead oxides. These oxides can react with HBr to form volatile metal bromides when the EAFD is added to the TBBA as a bromination agent. The selective bromination of zinc and lead contained in EAFD was thermodynamically evaluated using FACTSAGE software under both oxidative and inert pyrolytic conditions while considering the effects of several variables. These factors span temperature, loads of TBBA, presence of oxidizing agent, and the effect of presence of other common EAFD's constituents such as sodium, potassium, calcium, silicon and sulphur. It was found that a 100% extraction (based on thermodynamic feasibility) of both zinc and lead can be achieved for a mixture containing 60% EAFD and 40% TBBA (contaminated with minor amounts of iron) when pyrolyzed under inert conditions. However, when a thermal treatment is performed in the presence of oxygen, complete thermodynamic-based recovery of zinc and lead recoveries can be achieved at a lower temperature with no iron content. Removal of sodium and potassium chloride from EAFD prior to pyrolysis by washing, under oxidizing condition, can also result in a profound selectivity in zinc and lead bromination. The behavior of other elements during bromination process was also discussed.