

EMISSIONS OF GASES, POLYCYCLIC AROMATIC HYDROCARBONS AND BROMINATED POLLUTANTS DURING THERMAL DEGRADATION OF WASTE PRINTED CIRCUIT BOARDS

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ABSTRACT

Electronic waste is one of the fastest growing waste streams in the world due to the rapid pace of technology enhancement and development. The exponential growth of electronic waste contributes to a rapid increase in the rate of contaminants and waste entering landfills. This fact implies the need for an appropriate management of waste electrical and electronic equipment (WEEE). Printed circuit boards (PCB) are one of the most complex constituents of WEEE, with a mixture of both valuable and/or hazardous elements. Thermal treatments represent an interesting alternative to recycle this kind of waste, but particular attention has to be paid to the potential emissions of toxic by-products. In this study, the emissions from thermal degradation of printed circuit boards (with and without metals) have been studied using a laboratory scale reactor, under oxidizing and inert atmosphere at 600 and 850 °C. The study comprises the analysis of gases, halogens and hydrogen halides, carbon oxides, light hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), chlorinated phenol, chlorinated benzenes and brominated phenols, among other semivolatile compounds, as well as polybromo- and polychloro- dibenzo-p-dioxins and furans and dioxin-like polychlorobiphenyls. The maximum formation of PAHs was found in pyrolysis at 850 °C, naphthalene being the most abundant. High levels of 2-, 4-, 2,4-, 2,6- and 2,4,6-bromophenols were found, especially at 600 °C. Emissions of PCDD/Fs and dioxin-like PCBs were very slow and much lower than that of PBDD/Fs, due to the higher bromine content of the samples. Combustion at 600 °C was the run with the highest PBDD/F formation: the total content of eleven 2,3,7,8-substituted congeners (tetra- through heptaBDD/Fs) was 7240 and 3250 ng WHO₂₀₀₅-TEQ/kg sample, corresponding to the sample with and without metals, respectively.

Keywords: Printed circuit board, WEEE, pyrolysis, combustion, dioxin.

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