Catalytic Pyrolysis for Reducing Dioxin Content in Fly Ash Generated from Municipal Waste Incinerators

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Around 200,000 tons of fly ash are generated from 25 large-scale municipal waste incinerators annually in Taiwan. Fly ash contains substantial amounts of dioxins, chloride, and heavy metals, necessitating great attention to its treatment. Currently, the main method used for final disposal of fly ash is solidification with cement/chelate agent/water. Despite its advantages of low cost and simplicity, this method results in a 40-50% increase in mass after solidification, leading to a significant increase in landfill space required. Among 25 large-scaled waste incinerators, two have undergone renovations following technological advancements and the original activated carbon injection systems have been replaced with catalytic filter bags for dioxin removal, and sodium bicarbonate has been used to replace calcium hydroxide for reducing HCl and SO_x emissions. Hence, two acid removal systems are employed domestically, i.e., using calcium-based slurry or sodium bicarbonate as alkaline. In the subsequent air pollution control devices (APCDs), these substances are collected and become part of the fly ash, thereby affecting the composition of fly ash. This study aims to investigate the efficacy of catalytic pyrolysis for reducing PCDD/F content in calcium-based fly ash and sodium-based fly ash, respectively. The study also explores the effect of applying hydrogen as a carrier gas on PCDD/Fs and chloride removal. The goal is to reduce the dioxin concentration to meet the European waste recycling standard. This would allow the treated fly ash to be used as a cement additive for utilization. Preliminary results indicate that sodium-based fly ash generally exhibits a higher dioxin removal rate if compared with calcium-based fly ash. When operated at 350°C without a catalyst, higher than 98% PCDD/F reduction was achieved for both calcium-based and sodium-based fly ash with H_2 as carrier gas. Moreover, when operated in the presence of Pd/C catalyst at 350°C for 15 minutes, the concentration of PCDD/Fs in washed fly ash was reduced to 0.01 ng TEQ/g. As a result, the concentration of PCDD/Fs in fly ash can be effectively reduced to meet the proposed European waste end-point standard (20 pg TEQ/g) by combining washing process with catalytic pyrolysis. Detailed research findings and the mechanism of PCDD/F destruction will be presented in this presentation.

Keywords: Dioxin, Calcium-based fly ash, Sodium-based fly ash, Catalytic pyrolysis