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Emission of Polychlorinated Naphthalenes during Thermal Related Processes

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Due to the structural similarity of polychlorinated naphthalenes (PCNs) to those of dioxins, PCNs exhibit toxicological properties similar to dioxins (Olivero-Verbel et al., 2004). Based on their high toxicity, persistence, bioaccumulation, and long-distance transmission, PCNs were also selected as a candidate POP for the UN-ECE (United Nations Economic Commission for Europe) POP protocol (Lerche et al., 2002). In addition, some studies suggested that PCNs contributed a greater proportion of the dioxin-like activity than polychlorinated biphenyls (PCBs) and polychlorinated dibenzo-p-dioxins/dibenzofurans (PCDD/Fs) contributed in some locations (Kannan et al., 1998). However, the identification and quantitation for PCN sources are very scarce compared with PCDD/Fs. Understanding the emission levels and developing the emission inventory of PCNs is important for regulatory and source reduction purposes.

In this study, several potential sources were preliminarily investigated for PCN release. Coking process (CP), iron ore sintering (IOS), and electric arc furnace steel making units (AF) were selected due to their huge activity level of industrial production in China. Municipal solid waste incineration (MSWI) and medical waste incineration (MWI) were also investigated because of the possible high concentration of PCNs in stack gas. Two plants were investigated for each thermal related process, except for MWI with one incinerator was investigated. The stack gas samples were collected by automatic isokinetic sampling system (Isostack Basic, TCR TECORA, Milan Italy). Isotope dilution high resolution gas chromatography coupled with high resolution mass spectrometry (HRGC/HRMS) technique was used for the identification and quantitation of PCN congeners.

The concentrations of PCNs from the selected thermal processes were determined in this study. The average concentrations of total PCNs were 26 ng Nm-3 for CP, 65 ng Nm-3 for IOS, 720 ng Nm-3 for AF, 443 ng Nm-3 for MSWI, and 45 ng Nm-3 for MWI. The emission factors of PCNs were derived, and the average values were 6 μg tonne-1 for CP, 42 μg tonne-1 for IOS, 2980 μg tonne-1 for AF, 1354 μg tonne-1 for MSWI, and 937 μg tonne-1 for MWI, which could be helpful for estimating the annual emission amounts of PCNs from the investigated sources. However, since the investigated plant numbers for each process are limited, there might be large uncertainties when developing the PCN emission inventory.

From the obtained data in the preliminary investigation, it could be seen that these investigated sources are worthy of further concerns for PCN emission. Further investigation on PCN release from thermal related process is still in process.

References

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