

Open dumping site in Asian developing countries: A potential source of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans

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Abstract: Open landfill dumping areas for municipal wastes in Asian developing countries have recently received particular attention with regard to environmental pollution problems. Because of the uncontrolled burning of solid wastes, elevated contamination by various toxic chemicals including dioxins and related compounds in these dumping sites has been anticipated. In this study, concentrations of polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and coplanar polychlorinated biphenyls (PCBs) were determined in soils from dumping sites in the Philippines, Cambodia, India, and Vietnam. Residue concentrations of PCDD/Fs and coplanar PCBs in dumping site soils were apparently greater than those in soils collected in agricultural or urban areas far from dumping sites, suggesting that dumping sites are potential sources of PCDD/Fs and related compounds. Observed PCDD/F concentrations in soils from dumping sites in the Philippines and Cambodia were comparable or higher than those reported for dioxin-contaminated locations in the world (e.g., near the municipal waste incinerators and open landfill dumping sites). Homologue profiles of PCDD/Fs in dumping site soils from the Philippines and, to a lesser extent, from Cambodia and India reflected patterns of samples representing typical emissions, while profiles of agricultural or urban soils were similar to those of typical environmental sinks. This result suggests recent formation of PCDD/Fs in dumping site areas and that open dumping sites are a potential source of dioxins in Asian developing countries. Uncontrolled combustions of solid wastes by waste pickers, generation of methane gas, and low-temperature burning can be major factors for the formation of dioxins in dumping sites. Elevated fluxes of PCDD/Fs to soils in dumping sites were encountered in the Philippines, Cambodia, India, and Vietnam-Hanoi, and these levels were higher than those reported for other countries. Considerable loading rates of PCDD/Fs in the dumping sites of these countries were observed, ranging from 20 to 3900 mg/yr (0.12-35 mg TEQ/yr). PCDD/F concentrations in some soil samples from the Philippines, Cambodia, India, and Vietnam-Hanoi exceeded environmental guideline values, suggesting potential health effects on humans and wildlife living near these dumping sites. The estimated intakes of dioxins via soil ingestion and dermal exposure for children were higher than those for adults, suggesting greater risk of dioxin exposure for children in dumping sites. To our knowledge, this is the first comprehensive study on PCDD/Fs contamination in open dumping sites of Asian developing countries. On the basis of the result of

this study, we have addressed a new environmental issue that open dumping sites are potential sources of PCDD/Fs and related compounds, and dioxin contamination in dumping sites may become a key environmental problem in developing countries.

Index Keywords: Combustion; Contamination; Environmental impact; Organic compounds; Solid wastes; Toxic materials; Dumping sites; Pollution control; dioxin; methane; polychlorinated dibenzodioxin; polychlorinated dibenzofuran; toxic substance; landfill; PCDD; PCDF; soil pollution; waste disposal; article; Asia; burn; developing country; dumping; incineration; landfill; pollution; soil analysis; soil pollution; solid waste; urban area; waste disposal; Administration, Cutaneous; Administration, Oral; Adult; Asia; Benzofurans; Child; Child Welfare; Developing Countries; Environmental Monitoring; Environmental Pollutants; Humans; Incineration; Polychlorinated Biphenyls; Refuse Disposal; Risk Assessment; Soil Pollutants; Tetrachlorodibenzodioxin; Asia

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