REMEDIATION METHODS AND CONTROL TECHNOLOGY

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In this session remediation methods deal with removing dioxins from the environment after contamination from various sources and control technology is concerned with preventing dioxins from entering the environment from these sources. Nearly 20 papers will be presented in the posture session associated with this oral session. These are excellent papers containing a wealth of information that enlarge on the subjects discussed in the oral presentations. There are 3 papers on dioxin and PCB removal using hot water or ethanol washing, 3 on biodegradation technology and an interesting paper by MAYER on mechanical grinding of polluted material that may entail destruction of PCDD/F.

CHANG discusses the use of steeler's dust as a Fenton-like advanced oxidation agent to degrade dioxins in contaminated water. The Fenton reagent refers to a mixture of hydrogen peroxide and ferrous salts which is an effective oxidant for hazardous organic compounds. In this study steeler's dust was used as the source of the zero-valent ion. Steeler's dust is a very abundant byproduct (over 1 million tons/year). Over 91% is reused as road-fill material and in steel making process. Using a laboratory reactor and various concentrations of the dust and hydrogen peroxide it was demonstrated that this method was very effective in treating dioxin contaminated water. Degradation levels as high as 70% were reached in 2 hours reaction time.

NOMA indicates that incinerator ashes in Japan with high concentrations of dioxins are land filled in control-type disposal sites with leachate treatment. He describes dioxin removal efficiencies in different kinds of leachate treatment facilities of four landfills and the relationship between dioxins and other parameters such as SS, COD, BOD, and TOC. The treatment processes vary in capacity, biological treatment method and activated carbon absorption system. In comparing raw leachates with effluents he finds dioxin concentrations ranged from 2.1 to 130 pg-TEQ/L in raw leachates , while those in the final effluents ranged from 0.0067 to 1.1pg-TEQ/L. Removal rates after total treatment were nearly 100%. At one facility the total amount of dioxins removed was 143,136 pg-TEQ/day while that accumulated in the sludge generated by the treatment process was 144,000 pg-TEQ/day. This 100% transfer of dioxins from the water to the sludge thus creates a disposal problem.

KASHIWAGI reports results for the BCD chemical dechlorination process effective to remediate soils contaminated by PCB and PCDD/F compounds. In the treatment method reported here, NaHCO3 is added to a contaminated soil and treated at 350-400C under nitrogen. Reported here are the results of laboratory tests to study effectiveness of PCDD/F removal in low temperature, short-time treatments and results of a pilot plant test of the methods studied. The results showed that NaHCO3 was involved in the dechloination of highly chlorinated compounds, rather than it promoted desorption of PCDD/F compounds from the soil. At 400C, 7800pg-TEQ/g was

decreased to 80pg-TEQ/g with heating alone, but with 3% NaHCO3 it was reduced to 19pg-TEQ/g. Similar results were obtained in the pilot plant for a 60-minute test on 75kg of soil.

WOO describes research to maximize the trichloroethylene (TCE) elimination capacity and efficiency of a gas phase TCE biofiltration process by adopting appropriate feeding methods of toluene to a biofilter inoculated with P. putida F1. This system produces dioxygenase enzyme that oxidizes and co-metabolizes TCE. The TCE elimination efficiency was limited by competitive inhibition and dioxygenase enzyme activity. It was found that step or intermittent feeding of the toluene enhanced the TCE elimination capacity and efficiency.

CHELEPTCHIKOV describes a study of water in sub critical conditions as a solvent for extraction of PCDD/Fs from extremely high-contaminated soil and sediment. Hot water under sufficient pressure to maintain a liquid state has a drop in polarity that greatly enhances the solubility of hydrophobic organic compounds. Two different types of high-contaminated samples were used, soil from Vietnamese (Agent Orange) and sediment from as chemical plant desilter. Good recovery was obtained from the soil and low recovery from the sediment. In both cases the total concentration of PCDD/F were noticeably reduced. To confirm this additional experiments were carried out on the soil and sediment samples in which the samples were spiked with labeled dioxins.

KIM reports that although many types of microorganisms have shown degradation ability there has been no report on natural products that have activity for detoxification of environmental samples containing dioxins. Stevia extract from the Stevia rebaudiana shrub has shown an ability to degrade dioxins. His study is concerned with detoxification of soil and fly ash. Experiments with contact times of 3 days, using spiked dioxin samples and both homogenous and heterogeneous reactions between the stevia extract and solid ash or ash extract gave degradation efficiencies of 46.4% and 68.8% respectively. The average degradation efficiency in soil samples is 80.8%. It was concluded that degradation capability of the stevia extract varies with the dioxin levels and sample matrices. The mechanism of degradation is unknown.

ABE has applied the successful technology of recovering zinc from zinc-plated steel by vacuum heating at high temperatures to decontamination of soils and ashes containing dioxins. Since heavy toxic metals, such as Zn, Cd and Pb evaporate from soil they can be removed as well with this technology. New equipment capable of heating samples in vacuum up to 1200C was constructed. The gaseous fractions evaporated from the sample are passed through a gas-cracking chamber where the organic compounds from the sample are pyrolyzed to smaller molecules. Two soil samples containing 6300 and 5500pg-TEQ/g of dioxins were processed at 800C and 1000C for 4 hours. Essentially zero dioxins were measured in the residual samples and exhaust gases. It is hoped that this method can be applied to cleaning contaminated soil in large quantities without extracting dioxins and thus be less costly.

TAKAOKA has made a detailed analysis of the behavior of dioxins in the wet scrubbing systems (WS) of two stoker MSWI in Japan. The PCDD/Fs were measured in the inlet and outlet of the WS, the filtrate of the scrubbing water, the suspended solids (SS), the fly ash and the sludge.

Although the outlet dioxin concentration increased by 20 times over that of the inlet concentration for WS #A, the increase was only 1.5 times greater for those concentrations in WS #B. It was found that O8CDD was adsorbed strongly to the SS particles according to the particular profile found. It was concluded that the increase at the outlet was caused not by releasing SS particles into the flue gas but by desorbing PCDD/Fs from the surface of walls or packing materials in the WS.