Successful Treatment of Dioxin Using Thermal Conduction Heating: Results and Lessons Learned from a First of Its Kind Project

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Background/Objectives. Large volumes of agent orange, a defoliant containing dioxin primarily as the 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) congener, were used during the U.S.-Vietnam War. The former U.S. military base at Danang, now a Vietnamese military airbase and civilian airport, was a Government of Vietnam (GVN) priority area for remediation to eliminate the risk of human exposure to 2,3,7,8-TCDD. The U.S. Agency for International Development (USAID) is the lead U.S. agency implementing the remediation project in Danang. The 2010 Environmental Assessment (EA) developed by USAID selected In-Pile Thermal Desorption® (IPTD®), an aboveground form of thermal conduction heating (TCH), for dioxin treatment based on effectiveness, implementability, environmental impact, and cost. Starting concentrations up to 157,000 ng/kg (equivalent to 157,000 pg/g or parts per trillion [ppt]), measured as 2,3,7,8 TCDD toxicity equivalents (dioxin TEQ) were detected in the pre-treatment sampling program. The GVN established cleanup standards for the project of 150 ng/kg (150 ppt) dioxin TEQ.

Approach/Activities. An engineered, insulated and covered pile structure measuring 70m wide x 105m long x 6m high was constructed to treat the contaminated soil and sediment. Excavation of dioxin-contaminated material was carried out over an area of about 17 hectares (41 acres). Excavated materials were placed in secure, covered stockpiles prior to loading in the aboveground thermal treatment structure. Thermal conduction heating to a target temperature of 335°C (635°F) at a residence time of 21 days had been shown in treatability studies and in previous field projects as being capable of achieving the stringent GVN remediation goal of 150 ppt. Thermal treatment was performed in two phases, with contaminated soil/sediment maintained under vacuum during treatment. In total, over 87,000 m^3 of soil and sediment were treated using the IPTD form of the TCH technology.

Results/Lessons Learned. A rigorous post-treatment sampling program was conducted to verify achievement of the 150 ppt GVN clean-up standard in each treatment phase. Post-treatment samples collected over the entire area and depth of the treated pile concluded that the 95% UCL post-treatment dioxin concentration was 2.6 pg/g in Phase 1 and 0.24 pg/g in Phase 2, resulting in a combined destruction / removal efficiency (DRE) for dioxin of 90% to 97% for Phase 1 and >99.99% for Phase 2. Details of the sampling program and results will be presented. Findings and lessons learned from this pioneering project will be discussed in the context of the implications for future successful thermal treatment of soils and sediments contaminated with dioxins, furans and other persistent organic pollutants (POPs).