

The Potential Inhalation Hazard Posed by Dioxin Contaminated Soil

Dennis J. Paustenbach, Tibor T. Sarlos, Virginia Lau, Brent L. Finley, David A. Jeffrey, and Michael J. Ungs

ChemRisk
Alameda, California

Mathematical models and field data were used to estimate the airborne concentrations of 2,3,7,8 tetrachlorodibenzo-p-dioxin (TCDD) vapor and particulates which could originate from soil containing 100 ppb TCDD. The model of Jury et al. (1983) and the box approach were used to predict the concentration of TCDD vapor from soil. The daily soil temperature was assumed to vary between 20° C and 40° C for six months of the year to account for diurnal warming and cooling of the soil. The depth of contamination was 50 mm. The model predicted average vapor flux rate for TCDD from soil for this temperature profile was 1.5×10^{-14} mg/sec-cm². The upper-bound estimates of the TCDD vapor concentration on-site at 40° C and 20° C were 2.5 pg/m³ and 1.8 pg/m³, respectively. Using a recently proposed unit risk value (URV) of 2.9×10^{-6} (pg/m³)⁻¹ [slope factor = 1.0×10^{-14} (mg/kg-day)⁻¹], the maximum plausible cancer risk is about 1×10^{-5} . If one accepts the EPA URV of 3.3×10^{-5} (pg/m³)⁻¹ (slope factor = 1.2×10^{-13} (mg/kg-day)⁻¹), then the risk is no greater than 1×10^{-4} . A maximum TCDD vapor concentration of 0.21 pg/m³ was predicted 100 meters downwind (for summer days). The on-site concentration of TCDD in suspended particulate was estimated to be 1.4 pg/m³ (based on a TSP level of 0.07 mg/m³ from site soil). For persons exposed to vapors and particulates about 100 meters off-site, the exposure was about 10-fold less. The model-predicted concentrations of TCDD vapor were compared with the results of field and laboratory studies conducted by Yanders et al. (1988). Our estimate of the maximum possible

TCDD vapor flux rate for their study was 4.6×10^{-17} mg/sec-cm². These results indicate that the concentrations predicted by the Jury et al. model are about 1000 fold greater than which actually occur. The inability of the Jury model to accurately estimate the rate of volatilization of TCDD from soil is probably because the TCDD was applied to the soil in a formulated state where it could easily migrate below the surface. A recent modification of the Jury model (1990) suggests that a 5-50 mm layer of clean soil will significantly retard (or eliminate) the vapor hazard posed by TCDD contaminated soil. The risks due to fugitive dust will always be greater than the vapor hazard, but for soil concentrations of 100 ppb the cancer risk should be less than 10^{-6} . Since few sites have average soil concentrations as high as 100 ppb, this nearly worst case analysis indicates that inhalation will rarely, if ever, be a significant route of exposure to TCDD-contaminated soil.