Society For Risk Analysis Annual Meeting 2010

Risk Analysis in Action

T4-E: Tuesday, December 7, 2010

Applications of Exposure Modeling

T4-E.2 15:50 Review of Exposure Models Assessing Outdoor Use of Volatile Consumer and Industrial Products . *Unice K.M.*, Scott P.K., Paustenbach D.J.; ChemRisk LLC* kunice@chemrisk.com

Abstract: Reliable methodologies for modeling airborne exposure to volatile organic solvents in consumer and industrial products are readily available. However, models for assessing outdoor exposure to volatile chemicals in the near field are less well studied and model evaluations of outdoor approaches have infrequently been conducted. Critical differences in air speed, turbulence and temperature between the indoor and outdoor environment affect both the rate of evaporation and dispersion of these chemicals in the breathing zone. Three approaches for modeling contaminant air dispersion in the breathing zone including a simple box model with mixing factor, multi-zone box models, and a near-field Gaussian plume model were identified and reviewed. Various approaches to evaporation rate estimation were also reviewed with emphasis on factors affecting chemical mass transfer including wind speed, surface area, temperature, vapor pressure and characteristics of the boundary layer. The sensitivity of predicted exposure concentration to each model input parameter was evaluated using Monte Carlo techniques. Temperature, exposed surface area of solvent and the orientation of the exposed individual to the direction of wind were found to be the key determinants of exposure. Wind speed was a key determinant of exposure for scenarios where the vapor generation rate was not mass transfer limited, such drum filling where saturated head space vapor emanates during splash loading. For scenarios where wind speed affects the evaporation rate and concurrently the magnitude of near-field vapor dispersion such as tool washing with an open bucket, the importance of wind speed was less than expected. Comparison of predicted airborne concentrations for various combinations of evaporation rate and air dispersion methods showed agreement within a factor of 3 when reasonable parameter assumptions were selected for solvents including acetone, benzene, ethylbenzene, toluene, xylene and limonene.