Cross Foundation Differential Pressure and Temperature Impacts on Vapor Intrusion at Two Buildings

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Background/Objectives. Intrusion of volatile organic compound (VOC) vapors into building air breathing zones can pose a significant health risk to building occupants. Predicting the potential for vapor intrusion (VI) and its impact on indoor air concentrations is complex. The presence of many target VOCs in indoor air from non-VI sources (carpets, glues, manufacturing) makes direct measurement of in indoor air an ineffective tool. Many regulatory agencies utilize simplistic models to predict VI potential. These models often utilize direct measurement of VOC concentrations in the soil gas beneath/near a building and an "attenuation factor" to predict likely VOC concentrations in the building airspace. The attenuation factors are determined by a qualitative evaluation of foundation condition. These models assume that contaminated soil gas is flowing into the building through openings in the foundation at all times. This assumption will not be true if the differential air pressure between the soil gas and the building interior is insufficient. VI will not occur if the relative soil gas pressure is less than the building air pressure. Differential pressure and temperature variances were continuously measured in two buildings to evaluate their impacts on soil gas and indoor air VOC concentrations and VI potential.

Approach/Activities. VI analysis was performed at two facilities located in the Connecticut River Valley of Vermont with confirmed VI impacts. Both buildings were sampled using EPA-TO14 for the first 7 days of the study. Building 1 sampling continued for an additional 7 days. Indoor air samples were collected from two locations within and one location outside of each building. Barometric pressure data loggers were placed at each sampling location to collect data every 15 minutes throughout the sampling period. One subslab soil gas monitoring point was installed at each building to allow for subslab pressure measurements. Subslab soil gas pressures were measured at each Site every 15 minutes during the study. The data are used to determine differential pressures between the sampling locations. Detailed weather conditions were logged by dedicated meteorological stations placed at each Site.

Results/Lessons Learned. Differential pressures between the subslab soil gas, building and outside fluctuated diurnally. These differential pressure fluctuations resulted in either decreased VI potential (Building 1 Area 1, Building 2) or reversed the pressure field resulting in potential indoor air penetrating in to the subslab soil gas (Building 1 Area 2). The diurnal differential pressure changes appear to be directly related to the relative temperature difference between the outside air and inside air. VOC concentrations measured on a daily basis fluctuated in direct proportion to the average daily differential pressure changes between the subslab and building air. At Building 1, increased differential pressures resulted in increased indoor VOC concentrations. At Building 2 the same relationship was seen in the basement portion of the building. However, the exact opposite was true for the 1st Floor.

Evaluation of VI potential must be determined for each individual building at risk. Pressure and temperature differentials significantly impact VI potential and should be measured as part of any VI assessment.