Vapor Transport through Sewer Systems: Mechanisms and Variables

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Background/Objectives. For decades vapor intrusion (VI) has been studied based on the concept of volatile organic compounds (VOCs) vapor migration through subsurface soil and infiltration into the building through foundation's cracks. However, results of field studies were not always expected by classical VI models. Empirical evidence has confirmed other routes of VOCs migration into indoor areas--with sewer lines being important preferential pathways. To date, this pathway has not been well characterized; and consequently, standard procedures for assessing the pathway have not yet been developed. There is not enough information about the occurrence of VOCs inside the sewer systems and their temporal variations. Greater insight about which parameters govern VOC transport within the sewer system is needed. This study investigates VOC fate and transfer mechanisms inside the sewer system, and evaluates the effects of different parameters on sewer gas VOC concentration.

Approach/Activities. A numerical model was developed to assess fate and transport of VOCs inside a sewer system. The sewer system serves as a source for contaminant vapors that can enter indoor spaces. By conducting a sensitivity analysis, this research assesses the effect of different parameters on spatial and temporal variations of VOC concentrations in sewer headspace. Combining results of the numerical model with field data, this study evaluates conditions that increase the potential for inhalation exposure risks via vapor intrusion thorough sewer systems into indoor spaces.

Results/Lessons Learned. The model is used to evaluate a range of scenarios. Liquid-gas mass transfer is the main mass transfer mechanism for VOC in sewer headspace. Results of the numerical model also indicates significant effect of the sewer headspace velocity on the sewer gas VOC concentration while other parameters such as sewer liquid depth in the pipe relative to the pipe diameter, temperature and pipe slope are also shown as important factors. Conceptual model scenarios developed based on field data and the numerical model verify application of the model to provide an improved understanding vapor transport within sewer systems.