Sewers as a Preferential VI Pathway: Dynamic Measurements and Quantitative Risk Assessments

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Background/Objectives. Since a study published by Riis et al. in 2010, vapor intrusion through sewers have received increased attention. In Denmark, it is estimated that, at approximately 20% of vapor intrusion sites, sewer lines are either the primary pathway or a significant contributing pathway for VOC transport to buildings. Recent Danish field studies have illustrated that the potential for vapor intrusion through sewers varies in an extremely dynamic manner; since both concentrations in the sewer and differential pressure between the sewer and indoor air can vary significantly on a time scale of minutes to hours. This highly dynamic behavior poses a challenge for the site investigator and the question remains: How do we account for this dynamic behavior when designing our measurement plan, and how do we best incorporate such results in our risk assessments.

The objective of the present study is to address the highly dynamic nature of VI through sewers by developing and field testing a measurement package, based on the following elements: A PID sensor in the sewer, a ppb-level sensor in the indoor air (bathroom), two differential pressure sensors (sewer–indoor air and soil gas-indoor air), a barometric pressure sensor, and valves and a pump for collecting samples for lab analysis; all through a programmable Arduino microprocessor platform.

Approach/Activities. The measurement package is developed for and tested at the “Forensic Test Site” of the Region of Southern Denmark, where previous site investigations have identified the sewer as a significant VI pathway.

Based on an initial analysis phase, a combination of worst-case parameters is identified and, and a “mouse trap” is sprung when the desired combination of parameters occurs, night or day (high PID and high differential pressure between sewer and indoor air). Upon mouse trap activation, valves are opened and a pump is started, collecting samples of sewer air and indoor air on Dräger carbon tubes – for lab analysis. The logged data series of PID measurements and differential pressure are used to document that the samples have been collected as worst-case samples. Normal, representative samples can be collected in the same manner. In addition to a natural state scenario, a controlled depressurization (of bathroom) scenario is planned, in addition to a scenario with a controlled drilled hole and mass flux estimation through this hole.

Results/Lessons Learned. The equipment package is being constructed, and field tests are conducted in October-November, 2017. Based on results from the “Forensic Test Site”, recommendations for future test program at other sites is proposed: When and what to measure + how to interpret results in a quantitative manner.