Measuring Indoor Air Concentrations for Multi-Week Periods to Provide a More Accurate and Definitive VI Risk Assessment

Harry O'Neill (Harry.ONeill@Beacon-usa.com) and Steven Thornley (Beacon Environmental Services, Inc., Forest Hill, MD, USA)

Background/Objectives. When determining potential health risks from the vapor intrusion of organic compounds into buildings over contaminated groundwater, indoor air samples are typically collected over 24-hour periods or less; however, research completed by Dr. Paul Johnson, President of the Colorado School of Mines, as well as others, have determined that the temporal variability of indoor air contaminant concentrations from vapor intrusion can vary by orders of magnitude over time and that short duration samples collected over 24 hours are likely to produce results that are not representative of actual health risks. However, using sorbent samplers to passively sample air over days or weeks will provide long-duration average concentrations that overcome the temporal variability and episodic occurrences of vapor intrusion. Passive samplers are low-profile and as part of a community-wide monitoring program were found to be better received by building occupants and easier to manage by field technicians than the prior sampling method of using evacuated canisters.

Approach/Activities. A community sampling program involved the collection of indoor air samples at over 600 homes during three (3) winter seasons and employed passive sorbent samplers that collected samples over 26-day periods. The passive samplers used have uptake rates that were verified to be linear out to 26 days by a robust study completed by an independent third party. This sampling approach replaced the prior sampling program that used inert stainless steel evacuated canisters to collect only discrete, 24-hour point-in-time measurements. The ability to collect an air sample over 26 days provided a time-weighted average concentration that represents with one sample more than 25% of the entire winter season, when vapor intrusion is more likely to occur at this site. By collecting long-duration samples, greater confidence was achieved that the health risks were properly assessed given the known temporal variability of indoor air concentrations. Collected samples were submitted to the accredited laboratory for analysis following EPA Method TO-17 to target a range of chlorinated compounds, as well as BTEX compounds. Results were provided within five (5) business days for each of the sampling events. Blind duplicates were submitted in each winter season and a correlation coefficient (r2) of 0.9936 was found between the sample pairs collected over three (3) seasons.

Results/Lessons Learned. The temporal variability of indoor air contaminant concentrations from vapor intrusion can differ by orders of magnitude over time. Short duration samples collected over 24 hours are likely to produce results that are not truly representative of health risks and do not provide sufficient data to properly assess whether building occupants are being exposed to unacceptable contaminant concentrations. The prior decade of sampling in support of this indoor air monitoring program using evacuated canisters did not alleviate the concerns that VI may be occurring even though homes consistently reported non-detects over 24-hour sampling periods. However, after three (3) seasons of employing passive samplers to collect samples over 26-day periods, the regulators are confident that homes with non-detects do not pose an unacceptable risk of vapor intrusion and are being removed from the ongoing community wide sampling program. This level of confidence in the data that are generated from long duration, time-integrated measurements will allow funds to be better appropriated to focus on buildings that do present vapor intrusion risks to occupants and to fund the installation of mitigation systems where needed.