Automated Continuous Real-Time Vapor Intrusion Monitoring and Response: Acute Exposure Prevention and More

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Background/Objectives. Indoor concentrations of acute toxins such as TCE can be dynamic. For this and other reasons, conventional vapor intrusion indoor risk characterizations continue to result in inaccurate risk conclusions, ambiguities and unacceptable exposures. For instance, vapor intrusion risks are typically characterized using individual point-in-time and time-integrated sampling methods that have been demonstrated to yield false negative and false positive results due to the lack of spatiotemporal resolution. In addition, these methods typically require more time to derive results than acute exposure durations of concern. There is a need to employ high resolution methods capable of accurate and rapid assessment and response to acute toxin exposures. Using automated high-frequency geospatial monitoring techniques, practitioners can rapidly distinguish between indoor sources and vapor intrusion, and when vapor intrusion is confirmed, vapor entry locations are quickly identified. Most importantly, continuous monitoring and response allows for exposure prevention through automated alerting and engagement of ventilation controls. This presentation will include examples where automated continuous monitoring systems were deployed to confidently evaluate potential vapor intrusion risks, identify indoor sources, identify vapor entry locations and preferential pathways, evaluate cause and effect due to building manipulations and dynamic climatic events, optimize mitigation systems, and quickly respond to risks and thereby prevent acute toxic exposures and financial liabilities.

Approach/Activities. A customized laboratory-grade gas chromatograph automatically collects and analyzes vapor samples from up to 16 site locations per instrument up to 300 m from the staging area. These systems have been integrated with telemetry and geospatial mapping algorithms for automatically generating time-stamped graphics, risk exceedance alerts and engagement of controllers through a web-based visualization and response platform. The system has been customized to automatically track the distribution of dynamic TCE, PCE, vinyl chloride and other VOCs of concern.

Results/Lessons Learned. High frequency continuous data collection, processing and automated visualization have resulted in data patterns that yield unequivocal conclusions regarding potential vapor intrusion risks and overall risk management. More specifically, continuous monitoring has resulted in intuitive understanding of spatial and temporal patterns, worst case acute exposure concentration and duration, mean concentration estimates for chronic risk calculations, determination of whether risks are minimal or non-existent, identification of vapor entry locations, confirmation of mitigation system performance, and enabled occupant protection via automated response before an exposure duration of concern transpired. Continuous monitoring over multiple barometric cycles has been used to close sites by demonstrating no risk during upward advective flux situations. For sites where risks exist, continuous monitoring has provided information appropriate for triggering interim and urgent responses and for confirming resolution.