Effective Characterization of Building Susceptibility to Vapor Intrusion with Building Pressure Cycling

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Background/Objectives. Vapor intrusion (VI) risks are challenging to assess using conventional discrete indoor air sampling because of spatial and temporal variability in volatile organic compound (VOC) concentrations. Building pressure cycling (BPC) offers a means of quickly characterizing building susceptibility to VI and estimating the potential VI risks. BPC tests can be conducted in one to two days for most buildings, and provide data that characterize the range of potential impacts that may arise from VI and background sources under the typical operating (baseline) conditions of the building. This paper describes protocols for conducting the BPC tests and the results of BPC tests conducted over several seasons in two commercial buildings studied as part of an ongoing ESTCP SERDP research project (ER 201503).

Approach/Activities. BPC tests were conducted at two commercial buildings: a small health center (Building 200) at the former Raritan Arsenal, Edison, New Jersey, and a mid-sized former dry-cleaning facility (Building 11193 at Vandenberg Air Force Base, California. The buildings were depressurized (which promotes VI) and pressurized (which hinders VI) to various levels using a blower door, while concurrently measuring or recording:

- Cross building pressure differentials and the corresponding ventilation rates to develop building leakage curves and estimate air exchange rates for a range of pressure conditions;
- Indoor air concentrations under depressurized building conditions to determine the potential mass loading due to VI combined with emissions from background sources in the building;
- Indoor air concentrations under pressurized building conditions to determine the mass loading emissions from background sources, which is subtracted from the total loadings derived under depressurized conditions to characterize the incremental mass loading due to VI; and
- Cross slab pressure differentials during BPC as well as baseline conditions to develop cross slab – cross building pressure relationships, which are used to assess the bulk gas permeability of the building foundation relative to the building envelope and, combined with the building leakage curve, to estimate air exchange rates under baseline conditions.

Results/Lessons Learned. The BPC tests conducted at both buildings provided consistent results over several days and in different seasons, indicating this technology is not sensitive to the timing of testing. The cross-slab pressure differentials at the Vandenberg building were much smaller than the cross-building pressure differentials, indicating a relatively high bulk gas permeability for the floor, whereas the opposite was true for the Raritan building. During depressurized conditions, stable indoor air concentrations were obtained after three to four air exchanges following a change in building pressure conditions, provided fans were used to mix the air within the building. During pressurized conditions in the Vandenberg building, stable indoor air concentrations were obtained using a roving (spatially integrating) sampling approach, which indicated the presence of background PCE emissions. VI mass loadings derived from the BPC test data were divided by the building volume and estimated baseline air exchange rates to calculate expected indoor air concentrations, which compared favorably to the indoor air concentrations measured under baseline conditions.