Exhaust Fans and Soil Gas Pollutants

A fascinating study of soil gas pollutants shows that when a basement is depressurized with an exhaust fan there can be a strong and immediate depressurization of the soil up to 40 feet around the house. This causes suction of soil gas and pollutants into the basement.

Jenn Air in the kitchen puts Weed-Kill in the basement?

Soil gas entry into houses has been both a severe problem (the Love Canal incident in New York) and a widespread public concern (radon). It has also been identified as a significant source of moisture in houses. But little or no attention has been paid to common chemicals that are deposited into the soil around a house by homeowners, either through surface application (pesticides, herbicides, fertilizers) or through subsurface sewage leach fields (cleaning solvents, drain cleaners, etc.) The strong pressure coupling between basement and soil demonstrated in this study raises questions as to whether the negative pressure created by combustion chimneys, imbalanced air distribution systems, ventilation systems, etc. might draw some of those common but potentially hazardous chemicals into the house.

Soil responds in seconds to basement pressures

The study site was an unoccupied single-family house in central California. The basement was constructed with concrete blocks that were filled with cement and sealed on the exterior surface with an asphalt waterproofing compound. Figure 1 shows a plan view of the house and surrounding site.

To measure the effect of house air pressure on the surrounding soil, the basement was depressurized to 25 Pa relative to the outdoor air. Soil gas pressure was monitored using probes sunk about four feet into the ground at various locations around the house.

The percent pressure couplings seen at each probe location are noted in Figure 1. A listed pressure coupling of 30% indicates that the level of soil depressurization at that location was 30% of the depressurization in the basement. For example, with 25 Pa house depressurization, a 30% coupling means that the soil pressure was 7.5 Pa (30% x 25) relative to outdoor air.

Pressure coupling was typically 30% to 40% at a distance of 1.5 feet from the house. Even at 10 feet the pressure coupling was as high as 14% to 18% in several places. One probe at 39 feet from the house showed 16% coupling. The response of the soil pressure was remarkably fast. Each time the exhaust fan in the basement was turned on or off, the pressure in the soil responded within a few seconds.

Bad news and good news

The bad news is that if potentially hazardous chemicals are commonly contained in soil gas (still a big

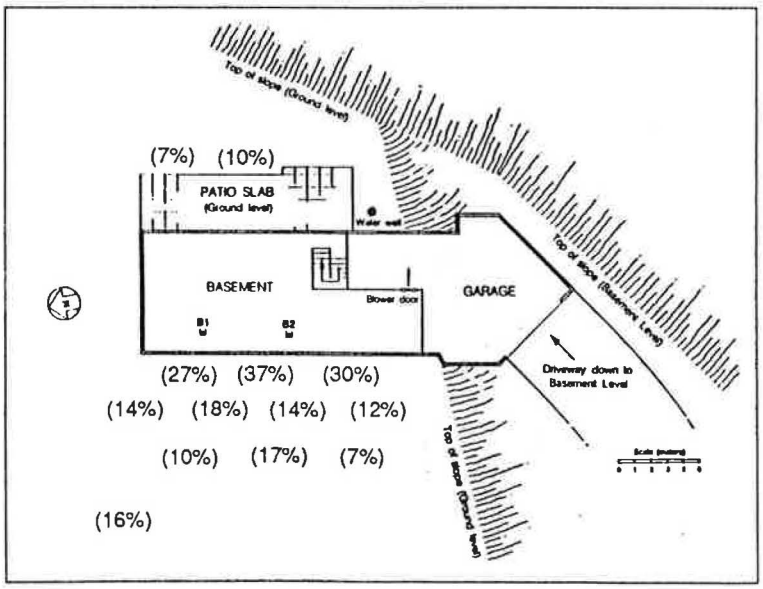

Figure 1 - Site plan of soil depressurization study. Numbers in parentheses indicate percent coupling of soil pressure with basement pressure at the indicated location.
Source: Lawrence Berkeley Laboratory.

if), then basement depressurization due to natural stack effect and exhaust appliances may draw those fumes into the house. The good news is that the mitigation practices used to limit radon entry will also work to limit entry of other soil gases. If "radon resistant" building techniques become standard, then indoor air pollution by other soil gas constituents is not likely to be a problem.

For more information

The report on this study, titled "Experiments and Modeling of the Soil-Gas Transport of Volatile Organic Compounds into a Residential Basement," was written by K. Garbesi and is available from Lawrence Berkeley Laboratory (Report # LBL-25519 Rev), Indoor Environment Program, Applied Science Division, 1 Cyclotron Road, Berkeley, CA 94720.

PRODUCTS

Incredible Beadboard

A new EPS foam sheathing product has a claimed R-value of R-4.4 for a ½-inch thickness, laboratory tests to back those claims up and, judging from the number of inquiries we've received at EDU, an aggressive and successful marketing strategy to spread the word.

Perma "R" Plus, manufactured by Perma "R" Products Inc. of Grenada, Mississippi, is a foil-faced molded bead expanded polystyrene foam board which comes in ½-inch, ¾-inch and 1-inch thicknesses. Both sides have foil facing, but one side is blackened. It looks like ordinary beadboard and despite the seemingly high R-value, we think that's all it is. If we are right, then Perma "R" should be changing the R-value on its label. If we're wrong, then Dow, Amoco, and the other extruded polystyrene makers better start worrying.

According to Tim LeClair at Perma "R" Products, Perma "R" Plus is made by a proprietary manufacturing process that creates the higher R-value without using CFC blowing agents (CFCs are used in the manufacture of extruded polystyrene [Styrofoam, Amofoam, etc.] and isocyanurate foam sheathing [Celotex, Energyshield, etc.] and are responsible for the high R-value of those products.)

Funny R-values

The listed R-value for Perma "R" Plus is R-4.4 for ½-inch, R-5.9 for ¾-inch and R-6.7 for 1-inch thicknesses.

One very curious aspect of those R-value claims is that the measured R-value does not increase linearly with thickness. Normally with any foam board, with or without foil-facings, the R-value for one inch is double the R-value for ½ inch. Not so with Perma "R" Plus. The R-value of 1-inch board (R-6.7) is much less than double the R-value of ½-inch product (R-4.4). We asked a spokesperson at Perma "R" Products whether sandwiching two of the ½-inch R-4.4 boards together would give R-8.8? He said he didn't know.

Of course the most impressive aspect about these R-values is that they are not only higher than any other beadboard product, but also substantially higher than the extruded polystyrene products as well! (Dow Styrofoam ½-inch board has an R-value of R-2.5.)

EPS R-value varies with density, but according to the Society of the Plastics Industry (SPI), at no density will the R-value be as high as the Perma "R" claims. SPI literature lists the following R-values for EPS products:

Density (lb/ft^3)	1.0	1.25	1.5	2.0
R-value per inch @75°F	3.85	3.92	4.17	4.35