Toxic gases can penetrate concrete blocks

For years, experts have advised people whose homes harbor worrisome radon levels to seal basement cracks as a first line of defense against further entry of the gas from soil. Now a study suggests that for homeowners whose basement walls are constructed of hollow-core concrete blocks — as most in the northern and eastern United States are — cracks may represent only a small part of the gas infiltration problem. Even uncracked block walls can let in radon and other toxic gases, transmitting up to 10 times more pollution from soil than do major cracks, the new study shows.

These "astounding" findings suggest the conventional focus on cracks "is in error," says John S. Ruppersberger, a radon-mitigation engineer at the Environmental Protection Agency in Research Triangle Park, N.C. If verified, the findings could reorient priorities for treating residential radon problems, he says.

Karina Garbesi and Richard G. Sextro of the Lawrence Berkeley (Calif.) Laboratory decided to investigate the transmission of gaseous soil pollutants through hollow-core concrete blocks after another study by their lab showed that sealing cracks in such a foundation didn't cure indoor radon problems. Indeed, Sextro notes, that study showed that sealing cracks achieved only a 10 to 20 percent reduction in this radioactive carcinogen.

Soil gases tend to enter structures only when driven by higher air pressures in the soil. On a calm, warm spring day, a home's air pressure generally matches the soil's. But a number of factors can depressurize a home, including wind blowing against the side of a house, use of large air-moving appliances (such as attic fans and clothes driers) and a large difference between indoor and outdoor temperatures.

Sextro's team studied an uninhabited house in central California, depressurizing its apparently crack-free basement with a large indoor fan. After flushing toxic gases from the indoor air, they monitored the levels of two tracers — Freon-12, apparently from a landfill 300 feet away, and sulfur hexafluoride injected into the home's yard — as these pollutants passed through the soil and into the basement.

The indoor depressurization exerted a pulling influence on soil gases to a depth of at least 9 feet below the surface, through an area skirting out from the house by as much as 42 feet, they report in the December ENVIRONMENTAL SCIENCE AND TECHNOLOGY. A computer model they adapted to analyze the data indicates that a natural, highly compacted, 18-inch-thick soil layer more than 6 feet underground helped extend the perimeter of the gas-pulling influence by reducing the home's ability to draw in diluting, near-surface air through the lower parts of its foundation.

The new data highlight the role basement walls can play in transmitting a host of dangerous compounds, including pesticides, says chemist Philip Hopke of Clarkson University in Potsdam, N.Y. In fact, he says, this underappreciated portal may explain how toxic levels of chemicals — such as the chlordane formerly used in termite control — pollute indoor environments even when applied correctly around a home's exterior.

The solution? Hopke suggests builders may need to look to other foundation materials such as solid concrete blocks or poured-concrete walls. But according to Ruppersberger, that may not be necessary. He has found that the gas permeability of hollow concrete blocks can vary by as much as a factor of 10 depending on how they were made.

Unfortunately, he says, the blocks favored by builders today are those that are more gas permeable, not less. Ruppersberger adds, however, that his research suggests homeowners can cut gas transmission through even the most permeable of these blocks by as much as 99 percent by liberally coating the indoor surface with latex paint or a paintable concrete topcoat. *— J. Raloff*

Neptune marvels emerge from data deluge

Four months after Voyager 2's flight past Neptune, researchers have published in the Dec. 15 SCIENCE their first summary of results from that encounter. But the gap between submission and publication gave them time to glean some newer findings, which they reported last week at the American Geophysical Union meeting in San Francisco.

For example, project scientists now think the solar system's fastest winds may whip through Neptune's atmosphere. Voyager 2 had discovered several large features, such as the Great Dark Spot, a counterclockwise storm about the size of Earth. But at last week's meeting, Andrew P. Ingersoll of the California Institute of Technology in Pasadena said the craft's photos also reveal a series of much smaller cloud features that appeared only during a single rotation of the planet. By comparing the cloud movement as captured on film to the length of a 16-hour, 11-minute Neptunian day, Ingersoll and his co-workers conclude that the little clouds may have scudded along at about 600 meters per second (m/s), or about 1,340 miles per hour.

Neptune's mostly hydrogen atmosphere includes a little helium, about 1 percent methane and a trace of ammonia, Voyager found. In a hydrogen atmosphere at a temperature like Neptune's 60 kelvins, Ingersoll says 600 m/s is "mach 1" — the speed of sound. In other words, the clouds appear supersonic. In comparison, he says, the fastest winds Voyager detected at Saturn moved about 500 m/s, while those of Jupiter and Uranus were clocked via film at 150 to 200 m/s.

Neptune's supersonic winds are not a certainty, Ingersoll cautions. The altitudes of the different cloud features, for example, are difficult to confirm, making it hard to compute the clouds' speeds. Moreover, he says, it is difficult to tell from the photos whether the movements represent actual fluid motion of atmospheric mass or merely a wave moving through the atmosphere.

One of Voyager 2's most striking discoveries was a pair of huge plumes towering about 8 kilometers above the surface of Neptune's big moon Triton, apparently representing geyser-like eruptions of nitrogen gas that were blown sideways by the winds (SN: 10/14/89, p.247). Since then, Torrence V. Johnson of the Jet Propulsion Laboratory in Pasadena told SCIENCE NEWS, researchers studying the photos by various methods have identified "several other puffs of stuff at the same altitude" in the area of one plume, though the vertical portions of those puffs do not show in Voyager's photos.

Other Voyager scientists led by Robert M. Nelson of Jet Propulsion Lab report that the albedo, or reflectivity, of Triton appears to indicate it has been resurfaced by material laid down atop the original terrain. "The very high albedo of Triton is consistent with a surface that has been recently renewed, such as [Jupiter's moon] Europa, or a surface that may still be undergoing regeneration, such as [Jupiter's] Io," the group writes in SCIENCE. "These data are consistent with a tectonically active Triton."

The new surface could have been smoothed by the heat of radioactive elements at the satellite's interior. But even without them, the finding would be consistent with the plumes, which provide their own evidence that Triton is geologically active.

In addition, the Voyager team has more accurately sized Neptune's eight known satellites, six of them discovered by Voyager 2. In SCIENCE, a team led by Bradford A. Smith of the University of Arizona in Tucson reports Triton's diameter is 2,700 km, while another study suggests Triton harbors a rocky, silicate core about 2,000 km across. The other moons and their diameters are Nereid, 340 km; 1989N1, 400 km; 1989N2, 190 km; 1989N3, 150 km; 1989N4, 180 km; 1989N5, 80 km; and 1989N6, 54 km. *— J. Eberhart*

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