ScienceNews
MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC
http://www.sciencenews.org/view/generic/id/49897

CASE OF THE TOXIC GINGERBREAD MAN

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Web edition : Saturday, November 21st, 2009

Enlarge

Run, run...

This polyresin ornament was offgassing dramatic amounts of a toxic additive.

W. Doucette

NEW ORLEANS Why did researchers take a knife to a cute little plastic gingerbread man? To make him give up the source of his toxic fumes.

Or so explained Bill Doucette, this morning, in a particularly entertaining session at the Society for Toxicology and Environmental Chemistry's annual meeting. But the underlying message that this Utah State University scientist brought home to his audience was anything but funny. He graphically illustrated that hidden dangers may lurk in surprising places.

Doucette's team stumbled upon the polluting Christmas ornament while puzzling out the source of some indoor-air anomalies detected by Hill Air Force Base, an aircraft-maintenance facility north of Salt Lake City.

Toxic chlorinated solvents released by the base led to contamination of a shallow groundwater reservoir. A pollutant plume containing 1,2-dichloroethane, or DCA, and trichloroethylene, or TCE, migrated out from under the base.

Vapors from these highly volatile chemicals can seep into homes as the pollutants flow beneath them. Fortunately, there are techniques to keep most of those fugitive vapors out (techniques similar to those used for keeping radon gas from entering homes). And Hill AFB installed such systems in homes where these chemicals polluted groundwater and indoor air.

"We got involved," Doucette explains, "only after [Hill AFB] had installed vapor removal systems and found some were not reducing the concentrations of this particular compound [DCA]." A second hint that something was hinky: Hill found that DCA and TCE concentrations in the air of these homes

didn't match the ratio present in groundwater

And that's where the gingerbread man comes in. He pointed Doucette's group, which includes an engineer who works at Hill AFB, to something other than vapors from groundwater pollutants as a source of substantial indoor air contamination.

The data would indicate that a lone ornament – that gingerbread man – could elevate DCA concentrations in an entire house above the level that Hill considers safe, notes toxicologist Christina McNaughton of the Utah Department of Health in Salt Lake City. Especially disturbing, she notes, is that many homes don't have just one such ornament, but a whole host of them or other goods molded from the same type of "polyresin" material.

Enlarge

Oh no, Mr. Bill!

Doucette and his team scratched the surface (and amputated the legs) of this ornament to find the source of its toxic emissions.

W. Doucette

In nearly all cases, products found to be emitting DCA were labeled as "made in China." That country-of-origin labeling is not insignificant, McNaughton adds. Although DCA can harden inexpensive plastics, she says that "its use is not allowed in the United States" – at least not in the manufacturing of consumer goods.

At today's meeting, she confirmed that the problem uncovered by Doucette's group not only appears to pose a genuine health threat, but also points to possible explanations for indoor-air anomalies showing up in other states, notably Florida.

Sniffing around

When Doucette and his group initially began checking out Utah homes with substantially elevated DCA readings, they suspected household cleaners or other consumer products might be responsible. So they began sampling the air, room by room, for DCA and TCE, looking for a hot spot.

And indeed, one home's basement storage room emerged as a zinger. Not sure what was the source of its contamination – air intrusion, the carpeting or the room's eclectic contents – the scientists transferred all of the goods into the garage. Within a few days, the room's DCA levels dropped from 82 micrograms per cubic meter down to 0.37. Meanwhile, pollution in the ventilated garage spiked from nondetectable values to 10 $\mu g/m^3$. When the researchers returned the goods to the room, the room's pollutant concentrations skyrocketed to 103 $\mu g/m^3$.

It looked like they had found the smoking gun. And, of all places, in a plastic bin of Christmas decorations. The researchers took the ornaments back to the lab, popped them into a sort of pressure cooker and assayed any fumes they could suck out of each. Sure enough, a gingerbread man and several other ornaments proved to be hot potatoes.

After testing some paint chips from the ornaments and finding little DCA, the researchers decided to probe deeper. So they amputated the cute little gingerbread guy's legs and sampled his interior. Bullseye. Each gram of this polyresin contained 2.3 milligrams of DCA. If the emission rate the Utah scientists measured from this ornament – 0.3 µg per minute – remains constant, the decoration should continue to emit toxic fumes for 345 days, the researchers report in a paper due to be published soon in *Ground Water Monitoring & Remediation*.

A few of the other local homes that had registered anomalous DCA levels also had such products. Doucette and his colleagues went to a store and bought seven new ornaments. And pollutant offgassing by some of these proved almost as high as that from the initial sentinel gingerbread guy.

But ornaments are hardly the only products made from this material. Doucette says his team turned up plaques and objects up to two-feet tall made from this DCA-laced plastic. And the bigger it is, the more DCA it can shed into air.

The pollutant's concentration in some Utah homes "certainly fell within the Air Force Base's action level," Doucette notes.

Which is? According to his team's new paper, DCA values in homes exceeding 0.94 $\mu g/m^3$ should trigger installation of vapor barriers or pollutant-removal technologies. Citing draft EPA guidelines, the new paper suggests that to keep DCA-based lifetime cancer incidence below a one-in-one-million level, the pollutant's concentrations in air should not exceed 0.094 $\mu g/m^3$. All it would take is one 65-gram gingerbread guy like the one they studied to exceed that value,

Kyle Gorder of Hill AFB works through the calculations for this estimate in the new paper.

Doucette's team forwarded its findings, last December, to the Utah Department of Health.

"We then started to do some quick calculations to determine whether [such DCA pollution] is a health concern," McNaughton says. At about the same time, she notified the Agency for Toxic Substances and Disease Registry, which funds her department to investigate risks associated with such emerging contaminants. And right away, she learned from this federal agency that other areas of the country were also reporting anomalous levels of this pollutant. Utah's problem "suddenly became nationally relevant," she says.

Earlier this year, McNaughton developed a "health consultation" letter about DCA which is now on her agency's website. It describes the pollutant's health risks, she says, "and the fact that both the estimated and measured indoor concentrations that have been found exceed the cancer-risk evaluation guide." Her letter has since been circulated to environmental-health directors in all 50 states.

A related brochure for consumers synthesizes this information.

It's important to keep in mind, McNaughton notes, that many decorative products are made from the same material that's in those ornaments, "so it's not just a holiday phenomenon." Her agency is now

looking for funding to begin testing a range of other objects in homes that may pose a similar risk. “This is something that’s definitely going to affect a lot of people,” she predicts.

Is the federal Consumer Product Safety Commission aware of DCA-emitting goods? “Definitely,” McNaughton says. “They have assigned a case investigator to it.” And that’s a good thing. “I’ve received a fair amount of calls from other states,” she notes. Like from Colorado, where indoor-air surveys have turned up rising numbers of homes with detectable DCA since 1997 – and increasing concentrations of the contaminant within affected homes.