

The problem with tallying 'dioxin'

Dioxins and furans are chlorinated pollutants that can form during any of several combustion and industrial activities. Together with polychlorinated biphenyls (PCBs), these related families of chemicals possess a similar ability to bind with a protein in the body — the ah receptor — and then enter cells to turn genes on or off inappropriately.

However, not all family members exhibit this toxic activity. For convenience, authors of EPA's new three-volume tome *Estimating Exposure to Dioxin-Like Compounds* (SN: 9/17/94, p.181) have tended to broadly term as "dioxin" all those compounds that do: 7 of the 75 dioxins, 10 of 135 furans, and 11 of 209 PCBs. To account for their respective potencies, each was assigned a toxic equivalency (TEQ), which relates its potential for harm to 2,3,7,8-TCDD, the most toxic of the dioxins.

Though data are very limited, the report notes, what is known suggests that annual dioxin deposition rates of about 1 nanogram TEQ per square meter of land are typical for remote regions of the United States. Rates two to six times that are common in urban areas. High-concentration "hot spots" may occur near industrial emitters of these compounds.

Overall, EPA officials estimate that incineration generates about 90 percent of the dioxin in air. Among these sources, hospital-waste incinerators may be the largest polluters. The reason, EPA suspects, is that there are so many of them (more than 6,000 nationally), they use fairly unsophisticated pollution controls, and they burn chlorine-rich wastes.

Though municipal-waste incinerators are the next biggest culprit, EPA says that new, mandated controls "should substantially reduce [their] emissions in the near future." Other sources include incinerator ash, diesel vehicles, manufacturing of chlorinated chemicals, wood burning, and papermaking.

However, notes William Farland, director of EPA's office of health and environmental assessment in Washington, D.C., researchers can today account for the source of only 10 to 50 percent of all dioxinlike compounds. He says this suggests that other major, unidentified sources may exist — or that there may be a major overcounting of dioxins if and when they become resuspended in air and fall out again as they recycle through the environment.

The Chlorine Chemistry Council in Washington, D.C., has hired a team of 18 experts (most from universities and state health departments) to investigate the soundness of the "source" numbers and the methodology EPA used to compute its risk estimates for dioxinlike compounds. John A. Moore, president of the D.C.-based Institute for Evaluating Health Risks, is cochairing the panel. Moore, a former head of EPA's pesticides programs, notes that some 90 percent of the TEQs that EPA estimates are in the environment come from chemicals other than TCDD. He expects his panel may challenge some TEQs for these chemicals and how this metric has been applied.

For instance, Moore observes, "there is a suspicion that [EPA] may not have used the receptor theory as it should. . . if you've got a [less potent dioxin] sitting in that receptor, it makes it not available to TCDD," the very potent one. So assigning risk, he maintains, "is not as simple as asking how much stuff is out there and assuming receptors will be available for all." Moreover, he notes, there are data to suggest that some chemicals may neutralize the activity of TCDD.

Lynn Goldman, EPA's assistant administrator for toxic substances, agrees that "there are significant data gaps that are critical to our understanding and effective management of dioxin." As such, she said last week, "we are calling on all parties to voluntarily submit any data that can help us better understand dioxin exposure" — from information on releases into the environment to data on dioxin concentrations in air, water, soil, food, animal feed, and human tissues.

Aiming for superheavy elements

When a light atomic nucleus smashes into a much heavier one, the two particles occasionally stick together to create a new element. Using such a strategy, researchers have synthesized more than two dozen elements having higher atomic numbers than that of uranium, which has 92 protons in its nucleus. Typically, these new elements survive for just fractions of a second before they radioactively decay or fission into isotopes of other elements.

Now, a team of physicists has discovered two new isotopes of element 106, seaborgium (SN: 3/19/94, p.180). One isotope has an atomic mass of 265 (having 159 neutrons in its nucleus), and the other has an atomic mass of 266 (having 160 neutrons in its nucleus). The isotopes take longer to decay than expected, suggesting that these particular combinations of protons and neutrons in a nucleus have an enhanced stability.

Yuri A. Lazarev of the Joint Institute for Nuclear Research in Dubna, Russia, Ronald W. Lougheed of the Lawrence Livermore National Laboratory in Livermore, Calif., and their collaborators report the discovery in the Aug. 1 *PHYSICAL REVIEW LETTERS*.

The researchers created these rare isotopes by hurling neon-22 nuclei into curium-248. One product, seaborgium-265, has a half-life (the time it takes for half of a sample to decay) between 2 and 30 seconds; seaborgium-266 has a half-life between 10 and 30 seconds. These half-lives are at least 10 times longer than those previously observed for a seaborgium isotope.

Theorists attribute the enhanced stability of these isotopes to a slight deformation of the nuclei from a spherical to an oval shape. They predict a stronger deformation and even greater stability for a nucleus with atomic number 108 and mass number 270.

"The remarkable influence seen here of small shape changes on nuclear properties will undoubtedly stimulate modeling of new nuclear shapes," Arthur N. James of the University of Liverpool in England comments in the Sept. 8 *NATURE*.

Meanwhile, Lazarev and his coworkers are bombarding uranium with sulfur nuclei to create what they hope will be new, longer-lived isotopes of element 108, hassium.

X-ray scans for trace elements

Locating trace elements within minerals and other materials plays an important role in studies of the origin of rocks, the transport of contaminants in groundwater, and other environmental and industrial processes. Obtaining such data more precisely may now be possible with the use of X-ray standing waves generated inside a crystal. Researchers from the Argonne National Laboratory in Argonne, Ill., and Northwestern University in Evanston, Ill., describe the technique in the Sept. 9 *SCIENCE*.

Michael J. Bedzyk and his coworkers aim a powerful X-ray beam at a tilted crystal surface. This beam interacts with the X rays diffracted by the crystal's rows of atoms to create a standing wave. By manipulating the beam and the crystal, the researchers obtain data they can use to pinpoint the locations of trace elements within the crystal and on its surface.

In one test of the scheme, the researchers located manganese atoms within a calcite crystal and lead atoms that had adhered to its surface after the crystal was dipped in a dilute solution containing lead. In another test, reported in the Sept. 12 *PHYSICAL REVIEW LETTERS*, Bedzyk and his colleagues used the technique to make the first quantitative, high-resolution measurements of the bond length, orientation, and location of pairs of gallium atoms adhering to a silicon surface.