Health and Safety

The Los Angeles Times published “Study Links Plastics to Embryo Ills,” by Marla Cone, in the April 1st edition. No April Fools joke, the article describes new evidence that bisphenol A (BPA) is a doozy of an estrogen mimic. Bisphenol A is used in the manufacture of polycarbonate and is also a common ingredient in epoxies.

Studies with mice showed that small amounts of BPA disrupt the way chromosomes align in the production of eggs. The error causes aneuploidy. The well known example in humans is Down’s syndrome.

The most disturbing aspect of estrogen mimics is that the effects are observed at very low levels of contamination. While the article doesn’t give numbers, it does say that the effects are being observed at levels close to or below what is generally considered safe.

A brief review: xenoestrogens or estrogen mimics are chemicals that trigger the receptors for the hormone estrogen in the human body in both males and females. Hotly disputed by the plastics industry, there is considerable circumstantial evidence that this interfering with the endocrine system is happening and is not good.

As is often the case with xenoestrogens, the discovery of BPA’s interference with chromosome alignment was accidental. In 1998, researchers in three different labs at Case Western Reserve University found a sudden increase in chromosomal abnormalities in the mouse eggs they were studying.

Initially, they suspected a genetic mutation was the cause. Instead, they found that a worker had cleaned the mouse cages and water bottles with a too-harsh detergent. The alkaline detergent caused sufficient quantities of BPA to leach out of the plastic to cause eight times the aneuploidy and 20 times the errors in chromosomal alignment in the mouse eggs.

Long time readers will remember that xenoestrogens have been a favorite topic in this column. Please see: *WAAC Newsletters* 20/3 (September 1998); 18/3 (September 1996); 18/2 (May 1996); 18/1 (January 1996); 17/1 (January 1995); 16/2 (May 1994); and as far back as 13/3 (September 1991) when the terms estrogen mimic and xenoestrogen were not yet in common use. But it has been a while since the topic was discussed here.

A few weeks ago, a WAAC member sent an email asking what I knew about Triton X-100 being toxic. So, let me review what I said in September of 1998:

First off, Triton X-100 is not toxic. Its degradation products, however, are potential estrogen mimics. According to Dr. Ana Soto (one of the researchers I mentioned in the January 95 column), Triton X-100 (octylphenol polyethoxylate) is itself not a xenoestrogen. Rats, however break it down into octylphenol, which is a strongly estrogenic.

It is likely, and as yet there is no evidence to the contrary, that humans metabolize Triton X-100 similarly. Studies by Richard Wolbers have also show that under artificial aging, the polyethoxylate chain is slowly lost and only the octylphenol remains.

Throughout the European Union, the discharge of octylphenol and nonylphenol ethoxolates which includes the popular Synperonic N (the European equivalent of Triton X-100) has been banned, largely on the basis of their effects on fish at very low levels in sewage effluent.

I think, as a profession, we should avoid Triton X-100 and other octylphenol and nonylphenol based surfactants if other detergents work as well. Years ago, I suggested Triton XL-80N as a replacement. XL-80N was formulated by Union Carbide as a fish-friendly replacement for X-100. (Fish respond to estrogen mimics much more obviously than mammals, and waste water contaminated at very low levels has been found to disrupt breeding and develpment of many species.)

For those situations where XL-80N doesn’t perform as well as X-100, Triton X-100 can certainly be used. However, I would do so with caution. Avoid exposure. In particular, wear gloves. Latex gloves should be changed frequently while working. And, if you work with other conservators, you have a responsibility to protect them from exposure, too.

Is Triton X-100 toxic? Most definitely not. Can it affect you or your unborn child? Possibly.

Should you refuse to work with it? That is, of course, your choice. Consider that you are probably surrounded by similar chemicals in everyday detergents and plastics. Do you practice safe sex? Well, you are likely exposed to Nonoxynol-9, polyethoxylated nonylphenol, the spermatocide. And what about BPA? Do you work with epoxy resin? (Definitely wear gloves and other personal protective equipment when working with epoxy. But you do that anyway, right?)

I think every studio/lab that has Triton X-100 should also have a bottle of Triton XL-80N (or equivalent) available. On the other hand, Triton X-100 is not the anti-Christ, nor even in the same category as benzene, methyl alcohol, lead, or mercury salts.

Last month’s column “Mercury, the Other Heavy Metal” generated more than the usual buzz. Ok, I don’t know if “buzz” really applies to a hand full of emails and comments, but they were wonderfully gratifying to receive.

In case you didn’t read last month’s column (and even if you did, I’m just so darned proud of it that I’m going to mention it again), here is an explanation for mercury contamination. The short version: Mercuric chloride, the material historically used as an insecticide on collection items, is photosensitive to UV. It can be sensitized by humic material and iron oxide (and many other materials, I’m sure) to absorb visible light. When it absorbs light, analogous to latent image formation in silver halide, a mercuric site in the crystal is reduced to metallic mercury. Once reduced, the metallic mercury can volatilize and contaminate the object's environment indefinitely.

This implies that objects treated with mercuric chloride will contaminate their surroundings (air, storage cabinets, other objects) by releasing mercury vapor. Exposure to light will increase this behavior, but dark storage will not make it go away, at least in the short run, once some degree of photoreduction has taken place. Good housekeeping, therefore, is not sufficient to prevent cross-contamination and exposure of collection personnel to mercury vapor. (The level of mercury exposure will have to be measured by air sampling to determine if it is occurring at hazardous, i.e. actionable, levels, but I would strive for a zero exposure environment.)

Also of note, the mineral cinnabar (or the pigment vermilion), mercuric sulfide, is photosensitive to visible light without the aid of a sensitizer. Upon exposure to light it releases mercury vapor. I wonder if that explains the light-catalyzed transition from the red, hexagonal form of mercuric sulfide, to the black, cubic structured metacinnabar. I posit that as metallic mercury volatilizes from the less stable hexagonal structure, it leaves holes in the crystalline lattice. At some point, the structure is sufficiently disrupted that the crystal can spontaneously reorganize into the lower density configuration of black metacinnabar.

Tania Collas at the Los Angeles County Museum of Natural History (see her article elsewhere in this issue) did some quick tests which lend credence to my speculation about mercury contamination in collections. She was able to show that mercuric chloride does release mercury vapor upon light exposure when placed with iron oxide pigment (watercolor in her case). She confirmed that cinnabar mineral specimens are indeed releasing mercury.

And, she found that old collection cabinets that no longer contain mercury treated objects still give positive test results for mercury vapor. (I think what has happened in this case, no pun intended, is that the mercury vapor has adsorbed onto and diffused into the inner surfaces of the cabinets and is now being slowly released back into the air.)

So, what to do? My recommendation is to co-opt an idea that came out of the Getty Conservation Institute some years ago for the control of volatile organic acids in display cases. Attach a small fan to a mercury absorbing respirator cartridge and circulate the air within contaminated storage cabinets. A swatch of the mercury vapor indicator material could be incorporated into the outlet stream and allow the filter effectiveness to be monitored. This proposed contraption hasn't been experimentally demonstrated to work, but it should. Note that it also contains the contamination; the only hazardous material to dispose of is the spent cartridge.

Preparing this column, I had to leaf though my old columns looking for previous references to estrogen mimics. I realized that I've been remiss. For years, in every May issue of this *Newsletter*, I would exhort whatever audience made it to the end of the column to remember to change the batteries in their smoke alarms at home and in their studios. It seems it's been a while since offering this advise, so consider yourselves exhorted. And since I try to do everything that I write about, I checked my own smoke detector batteries. While still alive, they were five years old. Oops!

So you are probably wondering, how did Chris know that the batteries were five years old? When I install batteries in a critical device, I mark them with a piece of tape and write the installation date on the tape. A tad anal retentive, I'll grant you, but I would have sworn that none of the batteries were older than two years if not for the date on the tape.

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