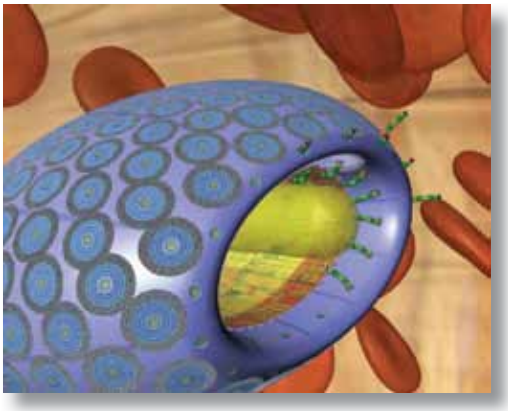
by Guy Crittenden

"Just as we're starting to think about small litter items, the problem is about to truly get microscopic."

Nano! Nano!

No, I'm not quoting the Robin Williams character from *Mork and Mindy*. Instead, I mean nanotechnology and the very small high-tech things that are presently going to invade our homes and economy in a wide range of products, including food and agriculture, cosmetics, coatings, ceramics, pharmaceutical and medical devices. Nano robots — tiny "molecular machines" — will one day travel through our arteries for diagnosing or treating ailments. Nano fibres will allow for the manufacture of environmentally adaptable clothing. The list of sci-fi sounding applications is almost endless.

As exciting as it sounds, some people are already starting to think about the implications for human health and the environment. Inevitably, some of these materials will end up as waste. It's time to think small. Very small! Concern already exists about "micro garbage," which usually refers to ubiquitous litter items like cigarette butts, coffee cups and lids, and chewing gum wrappers. Small plastic items may exist in the natural environment for decades, even centuries, and be ingested by birds and animals to their detriment. Just as we're starting to think about that challenge, the problem is about to truly get microscopic. And, unfortunately, nano particles can be toxic.



Tiny "molecular machines" will travel through our arteries and diagnose or treat ailments.

The term "nanotechnology" is not the particles themselves but rather an enabling technology that allows us to measure, see, manipulate and manufacture things usually between one and 100 nanometers. A nanometer is one billionth of a metre — a human hair is roughly 100,000 nanometers wide. According to Austin, Texas-based Nanotech Inc., in 2007 the global market for nanotechnology-based products totaled $147 billion, and research suggests that figure will grow to $3.1 trillion by 2015.

Nanotechnology will transform polymers, electronics, paints, batteries, sensors, fuel cells, coatings, and computers, and potentially improve healthcare through development of better medical devices, medications and treatments. More than 600 nanotechnology-enabled consumer products are on the market today.

However, nanotechnology is new and concerns include their safe manufacture and use. How can we measure exposure to nanomaterials? Weight and volume are used for conventional materials; with nanomaterials, surface area may be a better predictor of exposure and risk.

Of course, nanoparticles' small size could allow them to get into places where we don't want them. The same smallness that might allow diagnostic machines to travel through arteries also means that particles could go deep within the lungs when inhaled, then pass into the bloodstream and affect various organs. Frighteningly, particles could become air- or waterborne pollutants, spreading and accumulating in places where "normal" pollutants couldn't go. Nanoparticles in some products could be released into the air and inhaled or end up in food. No one knows how this might happen or what the unintended consequences might be.

Further research will separate speculative risks from real ones. (*See* **www.nanotechproject.org**) One would hope that nanotechnology won't become the next "asbestos scare" in both the sense of real risks and harm, or the excessive removal of asbestos and lawsuits that in some instances cost a fortune with little real benefit (except to lawyers and demolition companies). Key to enjoying the benefits of nanotechnology, keeping people and the environment safe, and avoiding hype and scares will be detailed assessment and strategic actions to manage, reduce or eliminate risks in the development stage.

Governments around the world are beginning to react. In 2008 in the United States, H.R. 5940, the *National Nanotechnology Initiative Amendments Act of 2008* would have reauthorized and refined the National Nanotechnology Initiative (NNI), strengthening the commitment to environmental and safety research. The bill passed the US House of Representatives but was not addressed by the Senate. This will likely be re-introduced. In July 2008, the Cambridge, Massachusetts Public Health Department recommended to the city manager that Cambridge (home to a lot of nanotechnology research) take steps to better understand the nanotechnology-related activities underway within the city.

In February 2008, the European Commission recommended that adoption of an EU code of conduct to govern responsible research in the nanosciences and nanotechnologies field. Late last year the California Environmental Protection Agency began collecting information from manufacturers on the transportation and fate of nanotubes once they enter the environment, as well as test methods for assessing the materials' physical and chemical properties to better understand their biological impacts. Under Assembly Bill 289, nanotube manufacturers statewide will have to provide the information to the state, and deadlines are being established. (A nanotube can be thought of as a sheet of graphite — a hexagonal lattice of carbon — rolled into a cylinder.) In 2006, Berkeley, California passed the first local ordinance in the USA by requiring handlers of nanomaterials to submit toxicology reports on the materials to the city government.

Good science policy and appropriate regulation is crucial to ensuring public safety and assurance for nanoproduct companies, insurance providers, investment firms, the legal community and governments worldwide. The environmental services and waste management industries need to pay close attention, as well. Soon, thousands of products made from or containing nanoparticles could enter the waste stream, potentially causing problems. This is a business opportunity for those who pay attention, and a possible risk for those who don't.

For more information, visit **www.nanotox.com**

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