

Sweating the Small Stuff

Nanotechnology Needs Research and Regulation

Nanotechnology is the process of manipulating matter at the molecular level – or nanoscale. Nanomaterials have at least one dimension that is 100 nanometers or less. A nanometer is one billionth of a meter – approximately 1/100,000 of a human hair.

This new technology has been touted as the next revolution in many industries, with more than 300 nanoproducts already on the market and sales of over \$30 billion in 2005. This includes everything from sunscreen and stain resistant clothing to food, food packaging and dietary supplements. Investments in the global nanofood market alone are expected to reach \$20 billion in 2010, with the world's biggest companies, including Altria, Nestle, Kraft, Heinz and Unilever, involved in nanotechnology research and development.¹

However, in the rush to incorporate nanoparticles into products already being marketed to the public, comparatively little money has been devoted to researching the health and environmental consequences of nanotechnology.

Smaller is Different

Nanoscale materials are very different than their larger counterparts, with distinct electronic, magnetic, chemical and mechanical properties. Nanoparticles have an increased surface area, which offers more space for interaction with other substances. This increased interaction with their surroundings means that substances at the nanoscale are more reactive and have higher toxicity than they do at their normal size. Picture a coffee maker. If you fill it with whole coffee beans, you get a very weak cup of coffee. But if you grind the beans first, you will increase the surface



area of the coffee beans and get a dark, strong cup of coffee.²

Adding to the concern of increased toxicity, substances that are stable in larger forms (such as aluminum) can also become reactive or explosive in nanoparticle form, creating the potential for health effects that are not seen when the substance is in its larger form.

Because they are tiny, nanoparticles have the potential to bypass the blood-brain barrier, (the membrane that controls the passage of substances from the blood into the central nervous system). They also have the potential to pass the placental barrier. One 2004 study found that nanoparticles can easily travel from nasal passageways to

the brain, and another found that gold nanoparticles can move across the placenta from mother to fetus.³ Once in the bloodstream, nanomaterials can circulate throughout the body and be taken up by organs and tissues. Given the higher toxicity of these particles, it is disturbing that the length of time they remain in the organs and what dose may cause harmful effects are unknown.⁴

Size and structural differences allow nanomaterials to migrate to different tissues and organs than their larger counterparts. There is also evidence that nanoparticles can be more completely absorbed by the body, increasing the substance's "bioavailability"⁵ (the amount of a sub-

stance that enters the bloodstream and is available to have an active effect). Nanoengineered materials also have the potential to increase the bioavailability of other chemicals, such as known toxins. One study found that micronized titanium dioxide in sunscreens increases the skin's absorption of several pesticides.⁶

The degree of these impacts can vary greatly between individuals depending on physiological differences, such as thickness and condition of hair and skin, physical activity and duration of exposure.⁷

Regulatory Oversight

Yet, despite these uncertainties and possible dangers, nanotechnology goes unregulated.

The Food and Drug Administration, which is the agency responsible for regulating food additives and new chemical substances in food, states that "the existing battery of pharmacotoxicity tests is probably adequate for most nanotechnology products that we will regulate. Particle size is not the issue." (emphasis added)⁸⁸ Experts agree, however, that particle size is indeed the issue.

The European Commission Scientific Committee on Emerging and Newly Identified Health Risks reported that "experts are of the unanimous opinion that the adverse effects of nanoparticles cannot be predicted (or derived) from the known toxicity of material of macroscopic size, which obeys the laws of classical physics."⁹⁹

Even industries that stand to benefit most from the development of nanotech materials recognize that particle size is the issue. DuPont's director of materials science and engineering has said "it would be unwise to claim that just because there are tiny amounts, it's harmless."¹⁰¹⁰

Due to the potential impact of nanotechnology on the environment, in 2006 the Environmental Protection Agency began to regulate a class of consumer items made with odor-destroying nanoparticles of silver. The agency got involved after concern grew that nanosilver being washed down drains may be killing beneficial bacteria and aquatic organisms and may also pose risks to human health.¹¹¹¹ This was the first move by the federal government to regulate nanotechnology. But most materials will not fall under EPA oversight.¹²¹² Most materials won't be regulated at all, despite the fact that store shelves will be increasingly flooded with products made with this emerging technology.

Conclusion

Chemicals like PCBs and pesticides like DDT and dieldrin, which were once thought to be safe, were not truly understood until long after human health and environmental damage already occurred. To avoid similar disasters in the future, nanotechnology's effects should be adequately

studied before they are allowed onto the market. An adequate level of study would at least match the amount of testing and safety data the federal government requires for new food additives.

Recommendations

- The scientific community has clearly established that the safety of nanomaterials cannot be assumed by studying their larger counterparts. The FDA should regulate nanotech products as the new chemical substances that they are, and require at least the same level of testing required for new food additives.
- If they are approved, nanoproducts should be clearly labeled so consumers are aware that the products they are using contain these controversial ingredients.
- Federal agencies such as the Food and Drug Administration should also be required to track any incidents, including adverse or allergic reactions, once nanotech products are on the market.

Endnotes

¹ Kuzma, Jennifer and Peter VerHage. Nanotechnology in Agriculture and Food Production: Anticipated Applications. Woodrow Wilson International Center for Scholars. Project on Emerging Nanotechnologies, September 2006, p.9-10.

² "Fine particles—Part 5: Incineration worsens landfill hazards."

Rachel's Hazardous Waste News. Environmental Research Foundation (Annapolis, MD), January 3, 1990.

³ Gibbs, Larry and Mary Tang. "Nanotechnology: Safety review and risk management overview." NNIN Nanotechnology Safety Workshop, December 2, 2004.

⁴ The Center for Food Safety. "Nanotechnology: It's a small (and unregulated) world after all." Food Safety Now! Autumn 2006.

⁵ Consumers Union. Written Testimony to the FDA on Nanoengineered Ingredients in Food, October 6, 2006. <http://www.consumersunion.org/pdf/foodtest1006.pdf>

⁶ Brand, Rhonda and James Pike, et al. "Sunscreens containing physical UV blockers can increase transdermal absorption of pesticides." Toxicology and Industrial Health, 19(1): 9-16, 2003.

⁷ Consumers Union, op. cit.

⁸ Ibid.

⁹ Appropriateness of Existing Methodologies to Assess the Potential Risks Associated with Engineered and Adventitious Products of Nanotechnologies. European Commission Health and Consumer Protection Directorate-General, Scientific Committee on Emerging and Newly Identified Risks, March 10, 2006. http://ec.europa.eu/health/ph_risk/committees/04_scenihp/docs/scenihp_o_003b.pdf

¹⁰ Consumers Union, op. cit.

¹¹ Weiss, Rick. "EPA to regulate nanoproducts sold as germ-killing." The Washington Post, November 23, 2006.

¹² The Associated Press. "Berkeley to regulate nanotechnology." AP Online, December 12, 2006.

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