Nanoparticles or Nanomaterials

TIER 1
POSSIBLE CONCERN

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Quick Summary

Nanomaterials are ultrasmall materials, 100 nanometers or less in size on at least one dimension. One nanometer is one millionth of a millimeter. Because of their size, nanomaterials have a range of unique physical, chemical, and electronic properties that can be used in a wide spectrum of applications. Some nanomaterials may also have unique toxic properties that have not been fully investigated.

What Are They?

- Nanomaterials are defined by size rather than composition and include both inorganic and organic materials.
- While we now synthesize a variety of unique, engineered nanomaterials for use in industry or in products, others occur naturally.

What Are They Used For?

- Nanomaterials are used in electronics; batteries; fuel cells; coatings for ceramic, glass, and plastic items; textile treatments; personal care products like sunscreens; and a host of other products.
- Some nanomaterials, including single-walled carbon nanotubes, can provide unique methods of drug delivery designed to target specific cells.
- Single-walled carbon nanotubes may also be used in electronics and energy applications, as well as in production of composite plastic polymers with enhanced strength or electrical or thermal properties.
- The high surface area to volume ratio and high reactivity of nanomaterials is useful commercially; one example is their use as metal catalysts that speed chemical reaction rates.
- Antibacterial consumer products containing silver nanoparticles are now common.

How Are They Getting Into the Bay?

- Given the wide range of applications and types of nanomaterials, these substances may be introduced to the environment via multiple pathways including municipal wastewater and urban runoff.
- In 2007, Silicon Valley was one of the top three nanotech development centers in the country.
- Inputs to municipal wastewater may occur as a result of normal transport and manufacturing operations, consumer use of nanomaterial-containing products, or by accidental release.
- Bench-scale studies have shown good removal of silver nanoparticles by conventional wastewater treatment. Wastewater treatment processes may also alter the chemical properties of engineered nanoparticles.

What Happens to Them in the Bay?

- Single-walled carbon nanotubes were not detected in Bay sediment collected in 2007 and 2010 (Schierz et al. 2012).
- No other nanomaterials have been analyzed in Bay samples.
- Significant gaps exist in the scientific understanding of transport, fate, and toxicity of nanomaterials.
- Analytical methods for nanomaterials in the environment are generally lacking.

Is There a Risk of Harm in the Bay?

- The highly reactive nature of nanoparticles is cause for concern for their potential toxicity.
- Some nanomaterials have been shown to increase the creation of reactive oxygen species, which can result in toxicity in aquatic organisms.
- The small size of some nanomaterials can allow them to compromise cells or cross cell membranes.

Management Timeline

- Launched in 2000, the National Nanotechnology Initiative encompasses 27 federal agencies overseeing a range of research and regulatory activities. The Initiative's Environmental, Health, and Safety Research Strategy, updated in 2011, provides guidance to federal agencies in developing research priorities.
- California's Department of Toxic Substances Control has issued two information requests to manufacturers and importers regarding analytical methods, fate and transport, and other information on carbon nanotubes (2010) and quantum dots, and nano forms of silver, iron, cesium oxide, titanium dioxide, and zinc oxide (2011).
- A 2011 report by the US Environmental Protection Agency (USEPA) Office of the Inspector General found that "USEPA has the statutory authority to regulate nanomaterials but currently lacks the environmental and human health exposure and toxicological data to do so effectively."
- USEPA, the National Science Foundation, and other federal agencies are beginning to address this data gap by funding research on the environmental implications of nanomaterials.
- Controlling nanomaterials in manufacturing settings where high dose exposure is more likely is a priority.