



Focus On: Nanotechnology

Nanotechnology is embedded in the products or processes of nearly every major industry and has become a mainstay of product enhancement. It also has potential risks that insurers cannot easily avoid even though they are just beginning to be understood.

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Since 2006, the list of nano-altered consumer products has exploded, soaring to over 1,300 products or product lines—an increase of 521% over the five-year period ending in 2011. An inventory of nano-based consumer products compiled by the Project on Emerging Nanotechnologies (PEN) shows nanotechnology is frequently used in products such as cosmetics, clothing, personal care and sporting goods among others. The health and fitness industry tops the list, with nano-enhancements incorporated into nearly 740 products.

A wide variety of applications

The list of applications, however, does not stop there. The National Nanotechnology Initiative (NNI), a presidential research and development initiative formed in 2000, indicates that nanoscale additives or processes have been used commercially in:

- Polymer composite materials, making them lighter but more resilient
- Surface treatments of fabrics, making them more resistant to wrinkles, stains or bacterial growth
- Thin films for eyeglasses, computer and camera displays, windows, and other surfaces, making them water-repellent, anti-reflective, or electrically conductive, among other attributes

- Food containers, reducing spoilage
- Automotive products such as high-power rechargeable battery systems, lower-rolling-resistance tires, thin-film smart solar panels, and fuel additives
- Household products such as degreasers, stain removers, antibacterial cleansers, specialized paints and sealing products
- Ceramic coatings to improve their toughness
- Catalysis applications to boost chemical reactions, which reduce the quantity of catalytic materials necessary to produce desired results
- Computing, communications, and other electronics applications, providing faster, smaller, and more portable systems.

In addition, scientists are exploring ways to develop clean, affordable and renewable energy such as paintable solar panels, windmill blades with carbon nanotube-based wires that make the blades stronger and more efficient, and converting cellulose into ethanol for fuel, among other applications.

US leads industry growth

The laundry list of products reflects impressive increases in the use of nanotechnology, whose market has grown between 16% and 33% each year for the last ten years in the US (NNI). Lux Research, a research firm specializing in emerging technologies, forecasts the global market will reach US\$ 2.5 trillion by 2015.

Global growth will be driven by increased applications in electronics, cosmetics and defense, according to a 2012 report by RNCOS Industry Research Solutions, which expects the compound annual growth rate to be approximately 19% between 2011 and 2014. Despite initiatives in developing economies like China, Korea, India and Brazil, the US is expected to remain the dominant market for years to come.

The National Institute for Occupational Safety and Health predicts that by 2015, US workers will account for approximately 800,000 of the 2 million expected to be employed globally in the nanotech industry.

Nanotechnology defined

NNI describes nanotechnology as the manipulation and restructuring of matter on a nanoscale for the purpose of creating materials, devices or systems that have fundamentally new properties or functions. How large is one nanometer? One-billionth of a meter, or about 1/100,000, the thickness of a sheet of paper.

Nanoparticles are not new. However, our ability to create, manipulate, and modify material at the nanoscale is the result of relatively recent advancements in scientific microscopy.

Manipulating material at the nanoscale causes it to behave differently. Decreasing the size of a nanoparticle increases its reactivity and changes its chemical properties. For example, stable materials like

aluminum may turn combustible, and insulators like silicon can become conductors. The shape of materials also influences their chemical and physical interactions with their environment. It is the behavior of manipulated nanomaterials that is at the heart of nanotechnology risk.

Four generations of risk

The International Risk Governance Council describes the progress of nanotechnology in four overlapping generations of development, beginning in 2000 with passive structures like those used in cosmetics and pharmaceuticals today. At this stage, nanotech structures are inert and relatively stable.

Subsequent generations are characterized by increasingly active nanostructures whose properties are designed to change during operation. Second and third generation products include targeted drugs and pesticides and applications in biotechnology, information technology and cognitive sciences. The fourth generation, expected to begin around 2015, should involve supra molecular nanosystems with applications in nanoscale genetic therapies.

Each successive generation carries new applications and risks which continue and are, therefore, compounded with the advent of the next generation. Because active nanostructures and nanosystems are more complex and their behavior is more uncertain, the potential for unintended consequences may occur in any generation.

Risks not fully understood

Notwithstanding its many benefits in developing new materials, nanotechnology has prompted concerns among regulators and other parties because its environment, health and safety impact is not fully understood.

Some are concerned that nanoparticles used in spray products such as disinfectants or paints could, theoretically, accumulate in lung tissue and enter the blood stream, for example. Carbon nanotubes may harm human lungs; nano-altered silver in antibacterial products could damage human cells; buckyballs, carbon molecules with a spherical, hollow construction, might accumulate in the environment and cause brain damage. Nanoparticles in drinking water, food additives, nutritional supplements, food packaging, or toothpaste could accumulate in the digestive tract or pass into the blood stream.

It is important to note that these concerns have not yet been unequivocally substantiated, as scientific studies have been inclusive with regard to the accumulation of nanoparticles in humans. At the same time, there has been no conclusive credible evidence reported affirming their safety either.

Growth outpacing regulation

Officials in the US and the European Union are examining ways to regulate nanomaterials. Most efforts have focused on modifying existing regulations for hazardous chemicals to regulate nanomaterials.

In the US a number of federal agencies have jurisdiction over the regulation of nanomaterials. Most prominent is the EPA, which claims regulatory authority under several acts including, among others, the Toxic Substance Control Act (TSCA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) for potential cleanup of nanomaterials. Under TSCA, the Environmental Protection Agency (EPA) can require manufacturers to test chemicals for their effects on human health or the environment. If there are potential hazards different from the bulk version of that chemical, the company is required to report it to the EPA.

Other federal agencies that may be involved in the regulation of nanotechnology include the Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH) and the National Toxicology Program (NTP).

At the state level, regulatory efforts have focused on collecting information as a way to better understand the risk that nanotechnology poses to human health and the environment. For example, California issued a “call for information,” asking in-state nanotechnology companies to share analytical techniques they use to evaluate potential health and environmental exposures, and toxicity, with the California Department of Toxic Substances.

In Europe, regulators have singled out nanomaterials for regulation under the existing Cosmetics Directive. Nano-specific changes to regulation of hazardous substances, chemicals and food safety that are overseen by agencies that function much like the US (EPA) and US Food & Drug Administration (FDA) are also in development.

In general, effective regulation has been challenging to achieve to date and continued attention and efforts seem to be needed.

Insurer considerations

The enormous projected growth of nanotechnology presents insurers with tremendous opportunities. As an enabler, insurance can help move the technology forward while ensuring its substantial economic and social benefits are realized safely. And from a loss perspective, nano-altered products could reduce insurers’ exposures in several areas such as making cars safer (lighter and stronger), buildings more flexible and less prone to weather-related damage, polluted sites easier to clean, and medicine less expensive and more effective.

But the technology also poses significant challenges.

CRO Forum, an international organization of risk management professionals, points out that assessing nanotechnology exposures is difficult. Technical studies, CRO says, have not yielded benchmarks that are relevant to insurance underwriting. Despite this, insurers may unwittingly assume nanotech risks every day, committing capital in the form of policy limits, defense, and other obligations.

The International Risk Management Institute (IRMI) suggests insurers collect data about nanoparticles used by insureds as well as their sources, known and potential hazards, and the state of science regarding the nanoparticles used. Documenting and verifying the hazardous or benign nature of nanoparticles involved in their operations may protect businesses and their insurers against incorrect assignment of responsibility for exposure.

Perhaps recognizing the importance of data collection, the Insurance Services Office (ISO) has added to its GL classification table a class for Nanomaterial Distributors, which applies to risks that sell nanomaterials, and for Nanomaterial Manufacturing, which applies to risks that manufacture or engineer nanomaterials.

Workplace safety

Even though officials have not established occupational safety and health standards for handling nanomaterials, businesses involved in the manufacture, import, or processing of these materials are still required to provide employees a workplace free from recognized hazards under OSHA.

Guidance, however, is lacking. NIOSH recommends taking common sense steps when employees are exposed to engineered nanoparticles. In practice, these precautions have typically included assessing possible risk throughout the production life

cycle, instituting worker safety engineering controls and procedures, and collecting health and environmental data.

Coverage and Claims

At present, few losses or claims have been reported, but the lack of claims provides no guarantee that the situation will not change. Nanomaterials have already been shown to penetrate the blood-brain barrier, and some have speculated that nanotubes, which have many of the same characteristics as asbestos, could have equally serious health consequences.

If nanotechnology were shown to cause illness, claims would likely emerge across insured classes and product lines including general liability, products liability, environmental liability, commercial umbrella, products recall, directors and officers, errors and omissions, and workers’ compensation.

Determining liability—including the who, what, where and when aspects of claims—will likely be difficult because claims, if they occur, will probably emerge over a long period of time. As nanotechnology develops, CRO says, courts may see “previously untested loss scenarios, prompting claimants to advance novel legal theories and interpretations of policy language.”

Exclusions

A source of contention could be the insurer’s pollution exclusion. ISO language is broad and does not specifically reference nanoparticles, leaving the question of whether or not it applies to nanoparticles.

ISO has introduced a broad Nanotubes and Nanotechnology exclusion that applies to all “ ‘bodily injury’, ‘property damage’, or ‘personal and advertising injury’ related to the actual, alleged, or threatened presence of or exposure to ‘nanotubes’ or ‘nanotechnology’ in any form, or to harmful substances emanating from ‘nanotubes’ or ‘nanotechnology’.”

This exclusion would seem to clarify that there is no intent to cover pollution or any other nanotechnology type of claim. However, to date insurers have been slow to adopt it because of concerns over market acceptance. This discrepancy could lead to litigation if nano-related environmental claims should occur.

Disregarding the potentially long-tail nature of these claims, determining liability also could be difficult because culpability could arise at any point in the product's life cycle, making an underwriter's job of isolating the risk especially problematic.

Moreover, many firms with nanotechnology risk exposures may be purchasing insurance coverage written on standard occurrence-based policy forms such as a Business Owners' Policy (BOP) or Commercial Package Policy (CPP), on which minimal underwriting of potential nanomaterial exposure is performed. Premiums may not adequately reflect the potentially high exposure.

Exposure Checklist

The following are examples of some information that underwriters should explore, particularly with respect to manufacturing or processing operations:

- What nanotechnologies does the insured use, including those supplied and created?
- Specifically, how is nanotechnology used in the insured's operations or products?
- What are the known hazards of the nanotechnologies being used?
- Have the nanotechnologies been studied for toxic effects?
- Have the nanotechnologies been studied for their environmental effects?
- Does the company follow any guiding principles at board level for managing nanotechnology risks?
- Have the operational managers and executives informed the risk management department about the nature and extent of the company's nanotechnology initiative?
- As part of their risk management have they performed an analysis of their product's entire lifecycle and, if so, are there any exposed hazards?
- Does the company follow any risk frameworks for managing the potential hazards to their employees?
- Does the insured company monitor the workplace for nanoparticles, and what safeguards are taken to protect employees?
- Are fume hoods used correctly?
- Do employees wear paper masks or full respirators with correct filters?
- When maintenance/cleaning is performed on machinery, are these employees equipped with proper protection?
- Does the company inform its customers about the nanotechnologies it uses or sells?