Modeling Approaches for Nanomanufacturing Risk Assessment

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Presentation

Short Description: **Given the significant uncertainty about environmental, health, and safety risks of nanomaterials, modeling their relative risks versus benefits is especially important. Several risk assessment methods exist in a variety of industries to investigate similar issues, depending on the nature of the problem and specific research needs. Using occupational exposure in carbon nanotube manufacturing processes as an example, we discuss and illustrate possible modeling approaches that might be useful for nanomanufacturing risk assessment, including Monte Carlo, multi-criteria, stochastic programming, and desirability function models.**

Keywords: Carbon nanotubes, SWNT, occupational health, uncertainty

Abstract: Although nanotechnology holds enormous promise in energy, technology, medicine, electronics, consumer products, and other applications, significant uncertainty exists regarding associated occupational, consumer, and environmental health and safety (EHS) risks. Of the few toxicity studies to date, several suggest engineered nanomaterials may pose potential risks to human health, due to their small size and large surface area, allowing them to penetrate dermal barriers, cross cell membranes, breach gas exchange regions in lungs, travel throughout the body, and interact at the molecular level [1]. For example, critical reviews of single wall carbon nanotubes (SWNTs) toxicity found damage to mice lung tissue [2], although further research is necessary to understand risks to humans. In response, several authors and regulatory bodies have advocated more research on nanotechnology EHS [3], including the U.S Environmental Protection Agency and National Institute for Occupational Safety and Health [4], [5].

Until proposed studies develop a sufficient risk understanding to inform safe handling of engineered nanomaterials, nanomaterial researchers, policy makers, and businesses have little guidance for safe operating practices. Several risk assessment methods, however, exist in a variety of other industries that also should be useful in nanomanufacturing, including Monte Carlo, multi-criteria, stochastic programming, and desirability function models. These methods differ in the manner by which they handle uncertainty, multiple criteria, and risk-benefits trade-offs. Each approach is illustrated, using occupational health risks associated with carbon nanotube manufacturing processes as an example. As more becomes known about nanomaterial exposure risks, these models can be updated to reflect the current knowledge base, suggesting optimal decisions likely will change over time.

References

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