Nanotechnology Risk Assessment: Literature Review

Abstract

Nanotechnology has the potential to revolutionize our world. Nanotechnology has fueled the imagination of scientists and science fiction writers and instilled panic in the hearts of modern-day Luddites (Borm, et.al, www.particleandfibretoxicology.com). The current level of technological advancement in the field of nanoscience and nanotechnology is providing society with nanocomposite materials (General Motors uses nanocomposite plastics, which allow production of scratch-resistant, light-weight, rust-proof parts to increase strength and reduce weight), nanoparticles (skin care manufacturers use nanoparticles in sunscreens that are easy to spread, provide better coverage and are extremely effective at absorbing ultraviolet light), and nanotubes (carbon nanotubes are lightweight and very strong, and have the potential for a variety of uses), to name a few. The future promises everything from unlimited, inexpensive energy and clean water, to biblical life spans and microscopic supercomputers. It also carries with it the danger of unthinkable military uses or even the cessation of life as we know it as a result of self-replicating synthetic life forms gone wild, referred to as "Grey Goo (Krimsky, 57-244)."

Data Base

The criteria of selection for the literature were relevance to the research topic and the year of publication. Both public and private libraries as well as online libraries were visited to access the data. Some of the online databases that were accessed are ebsco, questia, emerald, phoenix and so on.

Key words

The key words are risks, risk assessment, engineered, nanoparticles nanotubes, nano materials, nanotechnology, nanoscience and etc.

Literature Review

Introdction

With the promise of so much prosperity, and the threat of so much doom, questions regarding the safety ofnanotechnology have become a central element of the evolution of the nanoscience andnanotechnology industry. Within the industry, there are some who dismiss any notion of adverse societal or environmental effects, while in the public sector there are some who argue that all work in the field ofnanotechnology should cease unless and until it can be proven safe. While these represent the two extremes of thought, the natural middle ground consists of a group optimistic about the future of nanotechnology, but concerned about the health and safety issues

possible when dealing with unknown technologies (Farre, et.al, 81-95).

Risk Assessment

Wardak., et al. (435-450) says that the cycles that bring about the devastations of the use of nanotechnology. The topics presented by Gorman, Swami and Deshpande are the identification of the products that pose the greatest risks; where the risks occur in the life cycle of the product; and the importance of these environmental risks on the society. The result of this article is that through the expert elicitation process, it is possible to ascertain the severity of risk triggers, to identify the use and disposal scenarios where the risks occur, so as to thwart the devastations of nanotechnology.

The goal of the article by Wardak., et al. is to illustrate that it is possible to use nanotechnology while evading successfully, the dangers of nanotechnology, fort instance by using expert elicitation process. The article is reliable as it is free of any bias: the absence of biasness is seen in the presentation and illustration of how nanotechnology brings about the devastating environmental effects and how through the use of expert elicitation process, the threats of nanotechnology can be thwarted.

In the field of nanotechnology, risk assessment is difficult, due to the fact that there is no clear definition of nanotechnology. It is still unclear which research and development activities produce new

technological phenomena that are related to unknown impacts, and therefore deserves a carefully performed risk assessment. At present there is a certain consensus that there is demand for a riskassessment of engineered nanomaterials, especially synthetic nanoparticles. In this respect, the exposure rate of a person or the environment is an important aspect in assessing risks related to nanoparticles (Farre, et.al, 81-95).

Risk Identification

Risk denotes a concept that combines a specific adverse or harmful outcome of an action with the possibility of occurrence of this outcome. Risk identification starts with an analysis of main communal actors (government, companies, the scientific community, NGOs, and the general public). There are two main obstacles in identifying possible hazards. The first is connected to the limitation of knowledge. In many cases the possible impacts (for instance, of new technologies) are simply not known. Experience from the past can be used to construct scenarios that illustrate potential hazards related to the application of the new technology. But it is not possible to anticipate all potential scenarios (Wardak, Gorman, & Deshpande, 435-450).

Borm, P. J et. al. explored the potential risks that engineered nanoparticles can expose to the society. They noted that the engineered nanoparticles are capable of causing respiratory and inhalation problems, inflammatory reactions, tumors were also likely

to results but these have only been evident in research with rats. They noted that there was an increase in production of nonmaterial particles through engineering process and their use. The authors noted that engineered nanoparticles use will continue to rise and therefore the necessity for research on their effects on humans and the environment.

Risk Evaluation

Risks are characterized by the extent of damage, the probability of its occurrence, and the extent of its uncertainty. In case of release of chemical agents or nanoparticles, the exposure rate and reversibility are other additional important aspects. Stakeholders play an important role in this process (Allhoff and Patrick, 55-144)

Related to nanotechnology, risk assessment is confronted with additional problems. Due to the broad definition of nanotechnology, it is unclear which technical developments should be the object of a riskassessment. It is obvious that a risk assessment of nanotechnology in general does not make sense.

Borm and et al (2006) explored the use and application of engineered nanoparticles their sources and their potential markets. They noted that these materials were becoming increasingly useful in the modern world and their demand and use will continue to rise. They also explored their potential harmful effects on the society ad explored the ways in which they can be absorbed into the bodies. They examined

how they can affect the health of an individual who is exposed to these nonmaterial engineered particles. The authors also examined the standards that are required for the nanoparticles together with the terminologies that are used in nanoscience. The authors also defined the terms that are used in the technology and noted their differences. They also explored their production both deliberate and accidental. They examined the available data on the harmful potential of the technology and recommended that more research be done to fully examine their potential harmful effects. Since the authors have through, examined the nanoparticles technology from its production, application to the potential harmful effects their article, therefore, is unbiased. In other words the authors did not just address the potential risks that the technology can expose society to, but they examined its application and usefulness while noting the qualities that the technology has as well as its advantages. Their article is therefore reliable since it is not only detailed but they have cited other research conducted on the technology.

Borm and et al (2006) also related to such works by Lee, Seung, W. et. al. since they address issues relating to nanotechnology it uses and application and the potential harms that can result from particles engineered through nanoscience.There is little disagreement that additional knowledge on engineered, synthetic nanoparticles is needed. Analytical methods for characterization of nanoparticles—size distribution, shape, surface characteristics, and state (free, agglomeration, accumulation, dispersed, stability [persistence])—are insufficient. Knowledge about toxicity, ecotoxicity,

and bioacculmulation, as well as exposure rates of nanoparticles is very limited. There is little known about the fate of nanoparticles once they are released into the environment. At present, there are no methods to detect and monitor nanoparticles in the air, water, or soil, nor to detect them in animals and/or the human body (Krimsky, 57-244).

Risk Management, and Communication

Currently, there is no evidence of actual harm to health or environment from nanomaterials. Not enough is currently known about nanomaterials to conclude that no harms exist beyond the risks inherent in the bulk form of the materials since in their nanoscale form materials have significant fundamental property differences. As a result, the assessment of the various risk possibilities currently cannot be performed and the infancy of the field makes guesswork out of the likely societal benefit to be realized fromnanotechnology. In response to these uncertainties and unknowns, one current trend is to implement the precautionary principle when advancing the nanosciences (Kenneth and Thompson, 36-325).

Farre, M., et. al. article is about the dangers that are realized as a result of adopting nanotechnology, with these dangers being known to be pervasive enough to bring about detrimental effects to both the environment and the human health. The topics or elements that Farre, Gadja-Schrantz, Kantiani and Barcelo exploit are: the manner in which the nanomaterials residues detrimentally affect the environment and

in the long run, human and animal health; and the properties of nanomaterials that make them different from the parent compounds. The results of this exploration/research is that the surface properties of and minute sizes of NPs together with nanotubes usually provide large surfaces which bind together and transport the toxic chemical pollutants while generating reactive radicals.

Ethics

Hu, et al. (2009) examined the applications of nanotechnology in the synthesis of anodized titanium its application the process of its manufacture and its harmful potentials to the society and environment. They examined the engineering process its qualities and how it affects the body.

Hu, M. Z.,et. al. (2009) explored the characteristics of the nonmaterial examining the reasons for its usefulness and the qualities that makes its potentially harmful in so doing they were unbiased since they included both its advantages and disadvantages. They also examined the existing literature on these materials.

There work is comparable to that of the other authors discussed in the paper since it the other authors also examined the uses of nanotechnology and the negative effects on the society and the environment noting in details the qualities of the elements that make the useful and harmful at the same time.

In the article by Jorio et, al. the authors examined the uses and structure of carbon nanotubes. They noted the characteristics of the carbon nanotubes and what made them potentially harmful to the society as well as very useful. They examined the existing literature on the carbon nanotubes and noted that there was a need for further research on the area of their potential harm.

Jorio et, al in their article were unbiased since they consider in detailed characteristics of the Carbon Nanotubes it uses and applications as well as their potential to be harmful and explained in details the process that make them potentially harmful. They also examined the existing literature on the Carbon Nanotubes technology this therefore makes their work was unbiased since they holistically examined the technology.

Response

According to The main goal of the article by Lee, et. al. is to illustrate how nanotechnology is used in making high energy storage devices for many applications including the renewable energy and the hybrid vehicles. The topic most dominantly presented is how to increase the power output of lithium batteries through the reduction of lithium-ion diffusion distances. The result of the article is that the use of nanotechnology is the best mode of battery power storage.

The goal of the Lee, et. al. is to show the best technology to use in battery making as a form of energy storage, which is nanotechnology.

The article can be said to be somewhat biased, given that it mentions only the technical pros of nanotechnology while evading the cons of environmental and health degradation associated with nanotechnology. The article remains reliable, as far as the knowhow in the use of nanotechnology in battery making goes. The article by Lee et. al. is different from others since it only delves into the knowhow necessary for the use of nanotechnology. It has similarity with other articles by the virtue of discussing battery technology, while it's specializing in only the technicalities of using nanotechnology, irrespective of its hazards distinguish it from other articles.

Current Status

Farre, et. al. says about the dangers that are realized as a result of adopting nanotechnology, with these dangers being known to be pervasive enough to bring about detrimental effects to both the environment and the human health. The topics or elements that Farre, Gadja-Schrantz, Kantiani and Barcelo exploit are: the manner in which the nanomaterials residues detrimentally affect the environment and in the long run, human and animal health; and the properties of nanomaterials that make them different from the parent compounds. The results of this exploration/research is that the surface properties of and minute sizes of NPs together with nanotubes usually provide large surfaces which bind together and transport the toxic chemical pollutants while generating reactive radicals.