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Environmental Aspects of Nanomaterials: A Review

R. D. Kale[1]
[1]Department of Physics, Tuljaram Chaturchand College, Baramati, Dist- Pune (413 102), India

***Abstract**: As the production and use of nanomaterials (NMs) is increasing day by day, they cause concern for health and safety. The impact of nanomaterials on he environment and humans is not studied much. Naturally occurring NMs and man-made or engineered NMs that are known to have a wide variety of effects on the environment and health once taken up into a body. Natural and engineered nanoparticles (NPs) present in the environment are influenced by a large number of physico-chemical processes and show different behaviour in organisms, soil, and water. The accumulation of engineered NPs (ENPs) has been shown in various organisms and environmental compartments. It is crucial to ascertain the fate of NMs in the environment so that their availability for environmental exposure can be assessed. Environmental fate and load assessment of NMs must be undertaken. The alternative approaches to predict environmental effects should be developed [1-4].*
Keywords: Environment, nanomaterials, hazards, health, soil, water

I. INTRODUCTION

Nanotechnology is the recent term used for very small objects. The product of nanotechnology is Nanomaterials (NMs). They contain nanoparticles (NPs), smaller than 100 nanometres in at least one dimension. NMs are finding their use in healthcare, electronics, cosmetics and other areas. The physical and chemical properties of NMs often differ from those of bulk materials. A specialized risk assessment and management methods are needed while handling NMs. This needs to cover health risks to workers and consumers, and more importantly the potential risks to the environment. The risk assessment methods need to be kept up to date as the use of NMs expands, especially as they find their way into consumer products. The properties of NMs are not always well-characterized, and they call for risk assessment of possible exposures arising during their manufacture and use. Risk assessment requires a detailed examination of properties which include particle size, surface area, stability, surface properties, solubility, chemical reactivity, molecular structure, composition, purity, and known impurities or additives etc.

II. POTENTIAL EFFECTS OF NANOMATERIALS

A. Health

There is a range of possible interactions with biological systems and health effects of NPs. They can affect the formation of the fibrous proteins which are similar to those seen in some diseases, including brain diseases. Airborne particles can cause effects not only in the lungs but also on the heart and blood circulation. The NPs might lead to genetic damage, either directly or by causing inflammation. All these effects depend on nanoparticle's destiny in the body. Only a minimal amount of NPs doses escape the lungs or intestine, but long-term exposure results them to be accumulated in the liver or the spleen. Some NPs reach to all tissues and organs. They can enter into the brain via the membranes inside the nose. Nanotubes or rods with similar characteristics to asbestos fibres can cause the mesothelioma (a form of cancer).

B. Environment

Wider use of NMs will lead to increase in environmental exposure. We have very less knowledge about how they behave in air, water or soil. The NMs may be concentrated in certain areas, either by attaching together with minerals or by interaction with organic matter. They may pass from organism to organism, and perhaps move up food chains as other pollutants. Because of their diversity, NMs may have a wide range of effects. Some kill bacteria or viruses. Experiments so far have also shown possible harmful effects on invertebrates and fish, e.g. effects on behavior, reproduction and development. Unfortunately, the issues related to soil systems and terrestrial species are not much discussed, and it is not clear whether laboratory results can directly be applied to what may happen in the real world. Existing risk assessment methods e.g estimating exposure and identifying hazards, are generally applicable to NMs but specific aspects related to NMs need more development. Free, insoluble NPs either dispersed in a liquid or as dust poses the highest potential risks. The reference materials and methods for measuring manufactured NMs against natural background occurrence are need urgently. For environmental assessment, methods to measure free NMs after dispersal should be developed [5].

There are relatively few studies on Eco toxicological testing in soil and sedimentary systems [6]. In the available literature the methodology and practical approaches are also overlooked. Similar problems are raised due to suspensions of NMs in aquatic media and also due to mixing or spraying nano materials on sediments or soils. NMscan also get mixed directly to soils and sediments. It is clear that similar issues of standardization also apply to these systems. Therefore, practical changeability associated with the current studies, assessing the hazard of NMs in environmental models is necessary. The standardized methodology should be developed and implemented to test appropriately the particular nanomaterial as well as the particular organism. The variability should be kept to a minimum so that the results can be widely accepted and replicated.

Th manufacture, use and disposal will lead to releases of NMs to the environment e.g. wastewater treatment plants, landfill and combustion of products having NMs. Also, some NMs are used in environmental protection applications in the primary form. In the environment NMs are mainly associated with water and soils. The study of free dispersed form of NMs is of particular importance. Estimation of the possible free NPsin water and soil is very important. Unfortunately, the suitable information available on this topic is not available. The humans and other air-breathing species are exposed to NMs via the environment through inhalation, and aquatic organisms uptake it from water or sediments. The studies of exposure concentrations of dispersed NMs require detailed insight into the processes that act on these materials in the environment. As the currently available data of these processes is not enough, it is difficult to have the accurate quantitative predictions of the environmental effects of NMs. The intrinsic properties and characteristics of the materials and surface modification will also influence their destiny and behaviour. Some surface modifications processes like coatings will lead to increased dispensability, increased water column stability and lower settling rate of NMs especially when they combine with natural organic matter. The estimation of concentrations of NMs in water is essential to assess environmental risk. Because of the interactions of NMs with various components of the environmental system, generally near-zero concentrations of the NMs in its original form is expected. To dispose off NMs, we should have the understanding of the environmental conditions for the formation of stable colloidal suspensions of dispersed NMs. However, due to insufficient knowledge of the behaviour of NMs in natural waters, the full assessment of environmental exposure concentrations of dispersed NMs cannot be carried out. In wastewater treatment plants, formation of NMs into the solid biomass could be an important process for the hydrophobic materials which may end up in the sewage stream. The NMs will tend to aggregate and finally settle onto the substrate if they are not degraded or dissolved. These materials are expected to get stick on to solids within soil and sediments. However, solubility of NMs in water and the rate of dissolution of NPs in water are important to study the toxic effects of NMs in water. The resistance of NMs to conversion and degradation depends on its chemical composition. Although, the most of the NMs will remain in their original particulate form, it is not a general process for all kind of NMs. The organic coatings of NMs are readily changed or degraded and the process of dissolution makes NMs disappear. Regardless of the above causes, the increased use, and therefore, more availability in the eco system, of NMs with different levels of solubility will increase the potential levels of soluble substances. This can result in undesirable environmental effects. Depending on various factors like the material, receiving environment and species, these effects may be increased by a combination of particulate and soluble NMs. For NMs that do not dissolve readily, it should be checked whether NMs will form stable dispersions in air or stable suspensions in aqueous media. It is important to optimize the approach and design for the future studies and few important issues need to be isolated. The effects due to NMs and their equivalent, larger material should be comparing for environmental hazard of NMs in order to focus on the size effect.

IV. CONCLUSION

Determination of the presence of Nanomaterials in the environment is very crucial so that their environmental exposure can also measured. We must undertake the study of environmental aspects of nanomaterials. The use of the appropriate approach to the assessment of nanomaterials in the environment is very useful to assess the risk associated with nanomaterials. The alternative approaches may also be developed. Also, the accurate predictive model should be developed for the nonmaterial's effect on the environment.

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