Chapter 65
Risks and Preventive Measures of Nanotechnology

Waqas Anwar
Mirpur University of Science and Technology, Pakistan

Anwar Khitab
Mirpur University of Science and Technology, Pakistan

ABSTRACT

Application of Nanotechnology in Civil Engineering is a rapidly growing field. It has brought improvements in construction materials as well as practices. Moreover, further developments are foreseeable in this field based on the positive outcomes of the current research works. Utilization of nanoparticles in Civil Engineering has been proved advantageous from several aspects of strength, durability and sustainability. Unfortunately, there are not only benefits associated with the application of nanotechnology. According to various studies, nanoparticles are supposed to damage human organs through physical contact and inhalation. Considering the environmental impacts, atmospheric transport, as well as transport in saturated and unsaturated regions in the subsurface are possible. Nowadays, nanoparticles are progressively produced and they could easily be released in air, water, and eventually contaminate the soil which is harmful for the environment and its habitats. The following chapter would address these issues as well as preventive measures in order to improve benefit-risk ratio.

INTRODUCTION

Whether Nanotechnology is good or bad for the environment is totally based on the nature of its use and considerations made during its application. Several projects which involve the use of nanotechnology for betterment of the environment have been successfully established. However, the use of nanotechnology in any field requires great care and any sort of negligence is likely to bring negative effects for the environment and its habitats. For example, nano particles have the potential for the treatment of water and waste water to a great degree. CNTs, nano sized magnetite, CeO_2 and TiO_2 have been considered as prime nanoparticles to remove pollutants from water (Deliyanni et al., 2003; Mayo et al., 2007; Nawrocki

DOI: 10.4018/978-1-5225-1798-6.ch065

et al., 2010). However, any negligence may leave undesirable quantities of these nano-particles in water; thus instead of doing well, it may cause harmful effects on the environment and health of consumers.

EXPOSURE TO ENVIRONMENT AND HABITATS

Generally, nanomaterials become threat for the environment and its habitats when they are discharged in undesirable quantities into the wrong destinations. Nanomaterials may be released from point or non-point sources. Point sources include industries, storage units etc. and non-point sources include storm water runoff or wet deposition from the atmosphere. Exposure to nanomaterials may occur unintentionally in the environment or through the use of nanotechnology based products in our daily lives. Human exposure to these nanoparticles is more likely to happen during the manufacturing process. However, inhalation of nanomaterials released to the atmosphere and use of drinking water or food having accumulated nano particles is also possible. Moreover, absorption by soil and then transportation in saturated and unsaturated regions in the subsurface is also possible. This is very likely to affect the ground water table which then needs proper treatment before it is used for drinking and irrigation purposes (Wiesner et al., 2006). Furthermore from soil, nanoparticles may easily become the element of the vegetations; thus becoming a serious health threat for all consumers including the tiny insects.

Risks of Nanotechnology

As size of nano-particles is very small, they can easily stay in atmosphere and can cause air born diseases and several harmful environmental effects (Maynard et al, 2011; Oberdörster et al., 2005). Size of nano-particles can be as small as biological molecules such as proteins. They can easily be absorbed and may reach the inner bio molecules in the body (European Comission). Availability of limited knowledge about this technology and its impacts on the habitats is a major reason to consider risks seriously. It is an emerging field at the moment and not all nanomaterials have been studied in detail regarding their harmful effects. So, there is need to adopt wide precautions and consider all available research findings very critically during the whole life cycle of the nano-based products. Basically, for any material its exposure and effects throughout the life cycle are important to be considered. Figure 1 integrates the life cycle stages of nano particles with their pathways, transportation, exposure and effects in a simplified way.

Types of Risks

Risks can be divided into two main categories; known risks and potential risks.

- **Known Risks:** When the relation between the cause and its impact is established, the risks are ‘known risks’. In case of known risks, the significance of danger is well known and prevention is easy to make.
- **Potential Risks:** When a relation between the cause and the impact is not established, the risks are categorized as ‘potential risks’. In potential risks, the significance and the certainty of dangers is not known.