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Nanotechnology in water and air remediation

Iswerya AD

Our environment is contaminated by the pollutants emitted from industrial and human activities. Contaminants are usually in the air, water and soil. There is a need for a process to monitor and control the amounts of contaminants in the water, air and soil. Different technologies are being employed for this monitoring and control purposes, one among such is nanotechnology. Nanotechnology helps in creating materials or in engineering the existing materials at the nanoscale, which exhibit different properties when compared to the bulk materials. The surface-area-to-volume ratio is very high for nanomaterials which helps in the detection of very sensitive pollutants.

Only 30% of the world’s water is not trapped as glaciers, out of which only 0.08% is available as clean water. Hence, remediation is a process that is required to remove, neutralise or minimise the pollutants and contaminants in the water. Broadly, there are three different technologies used for remediation, namely physicochemical, thermal and biological. The old methods in use are less effective when compared to the use of nanotechnology in remediation.

Zero-valent iron nanoparticles have been used for remediation as they have been identified to have high reactivity towards many pollutants including cupric (Cu2+) and nitrate (NO3-) ions, chlorinated hydrocarbons, etc. The nano-iron can also be substituted with other metals like zinc, tin, silver, palladium, etc. Polymer nanoparticles can also be used for this purpose. At the same time, nanofibres provide better-quality of filtration membranes for the filtration of water. Additionally, air pollution is one of the biggest concerns worldwide. Nanotechnology can also be employed for air pollution remediation.

 Single-walled and multi-walled carbon nanotubes and gold particle absorption can be used in cleaning toxic gases. Both these materials have been identified as good adsorbents of various organic and inorganic gases or pollutants in the air. Further, nano-sensors and nano biosensors can be taken into account for monitoring. Although nanotechnology provides a variety of solutions for remediating pollutants, it has several potential health hazards, both to humans and the environment. For example, the inhalation of nanoparticles leads to lung problems, etc. Therefore, further research with special consideration of the challenges of nanotechnology and the appropriate design of nanoparticles will open the prospects of the use of nanotechnology in bioremediation.

Keywords: Water pollution, Air pollution, Nanotechnology, Remediation, Zero-valent iron nanoparticles, Carbon nanotubes

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