Innovations of Nanotechnology in Water Treatment

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Commentary

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DESCRIPTION

The long- term development of the global water situation is closely connected to the growth of the world population and global climate change. Constant growth of the world's population, which is read to be nearly doubled from 3.4 billion in 2009 to 6.3 billion people in 2050, is attended by a predicted challenged growth of farming production of 70%, by 2050. So, the demand for fresh water is growing dramatically, in particular for food production, since 70% of the world's freshwater withdrawals are already set down by agricultural irrigation.

After so much of advancement in science and technology, the pity is 78 Crores of people around the world don't have access to clean drinking water yet. In other words, one in every nine people in the earth suffering from limited availability of safe drinking water. Also, around 0.25 Crores of the people in the world don't have enough access to sanitation due to limitations in clean water supply.

The following are the most common water contaminants:

- Biodegradable plant debris and animal wastes
- Soil, dirt
- Chemicals like as oils, biopesticides, solvents, gasoline
- Nitrates and phosphates
- Heavy metals such as Arsenic, Lead and Mercury
- Bacteria and viruses

However, drinking water may not be fully free from these impurities but the concentration of these substances can be minimised so that they wouldn't result in health challenges and future problems.

The fields of nano-biotechnology and nanotechnology are under active research for the application in wastewater treatment. Nanoparticles consist of multiple strategies like ultrafiltration membrane, osmosis, absorption, nano-filtration degradation, advanced oxidation process and water remediation as well as disinfection through nanomaterials.

Most popular water purification methods by nanotechnology are as follows:

1. Adsorption into nanomaterials
2. Photocatalytic water treatment
3. Disinfection of water with nanomaterials
4. Nanomembrane filtration
5. Nanoparticles of Zero valent iron

Nanomaterials used for water filtration and their uses:

1. Nanoadsorbents
    - Pros- High specific surface, high adsorption rate
    - Cons- economically high production
    - Contaminants Removed- Heavy metals, organic materials and bacteria
2. Nanometals and Nanometal Oxides

   e.g., nanosilver, nano titaniumdioxide (TiO_2), magnetic nanoparticles, etc
    - Pros-Abrasion-resistant, Supramagnetic-facilitates separation, short intraparticle verboseness distance compressible, photocatalytic and low cost
    - Cons-Not as reusable as compared to other nanomaterials
    - Contaminants Removed-Heavy metals, radionuclides, media filters, powders and pellets
3. Membranes and Membrane Processes

   e.g., nanofiltration, nanocomposite, self-assembling, aquaporin-based and nanofiber membranes
    - Pros-Furnish a physical barrier for substances depending on their pore and molecule size, Reliable and Automated
    - Cons- Requires a high quantity of energy
    - Contaminants Removed-Can be incorporated into any type of water and/ or wastewater treatment systems

Limitations

Nanotechnology is a considerably effective alternative way for removing a wide range of pollutants from any type of water supply. Despite their high specificity in removing certain pollutants, nanomaterials have certain limitations, especially when considering the possible uptake of these components into wildlife.

Multiple studies including toxicity tests, life cycle analysis, technology assessment, and pathways and scattering of nanoparticles in water bodies have been carried out in order to evaluate the health troubles of nanomaterials. Nanoparticles such as CNTs, TiO_2, and silver nanoparticles in aqueous systems can have particularly adverse effects including bacteria, algae, invertebrates, fish and plants.

Fate and removal of nanomaterials in water: Wastewater treatment technologies include, besides biological treatment, multiple well established processes such as flocculation, sedimentation, and filtration processes that are partially administered in municipal wastewater treatment plants. In general, the removal of nanoparticles takes place *via* biological treatment through commerce with the microbiological community that might degrade or incorporate nanoparticles and sedimentation.