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Nanotech for clean water: an alternative approaches to control water pollution

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Abstract
Wastewater is any water that has been adversely contaminated by organic pollutants, bacteria and microorganisms, industrial effluent or any compound that deteriorated its initial quality. The recent advances and application of nanotechnology for waste water treatment is dealt briefly in this review. During treatment of municipal waste water it has to consider all aspect related to contamination and has to ensure that water is free from all harmful substances. Nanotechnology has new procedures for the treatment of waste water. These techniques are fabrication of membrane from nanomaterials and use of catalyst for decomposition of noxious compound in water.

Keywords: Nanotechnology; nanomaterials, waste water treatment

INTRODUCTION

Nanotechnology and nanoengineering produces significant advances in fields of waste water treatment. It can be defined as science and engineering in design, synthesis, characterizations and application of materials and devices that's at least one dimension ranges in nanometers. It is called 'platform' technology as it can modify endorse or clarify any existing scientific concept, when merge with other technology (Schmidt, 2007). In future nanotechnology has numerous applications like attenuate environmental pollution, decrease production costs by reducing energy consumption, increase production efficiencies in developed countries. The waste water treatment by nanotechnology may help in solving social problems in developing countries and treatment of epidemic diseases (Fleischer and Grunwald, 2008).

Future nanotechnology might bring answer to many existing scientific questions, however many of its benefits are already identified like in water sector, environmental, medicine and industrial sectors (Theron *et al.,* 2008). It can also address many issues such as health, energy and water (Binks, 2007). Major environmental benefits of nanotechnology were reported by draft nanomaterials strategies (Savage *et al.,* 2008). It includes:-

- Remediation and prior environmental treatment.
- Monitoring devices with high accuracy, sensitivity and smaller size.
- Nanomaterials that is higher and stronger.

Renewable energy can be used in cost effective manner, it require low energy and low waste generation devices, used in pollution control, preventive treatment based on early disease detection.

Nanotechnology in Water and Wastewater Treatment

- **Wastewater Treatment**

Waste water is divided in to:-

a) Municipalwaste water (commercial and domestic wastewater)
b) Industrial wastewater (industrial and agricultural activity waste water)

Factor effecting the composition of waste water are: land uses, groundwater levels and degree of separation between storm water and different sanitary waste. Municipal waste water is more variable in waste water contamination; comparatively industrial waste water has heavy discharge of effluent waste water from industry. Depending on the consumption of waste water the treatment process is applied. Generally this include following stages (Shon *et al.,* 2007).

1. Preliminary treatment: Removing of coarse and readily settleable inorganic solids with size range more than 0.01mm.
2. Primary treatment: Removing of bulk of suspended solids containing both organic and inorganic matter (0.1mm- 35µm).
3. Secondary biological treatment: Degrading the biodegradable binded organic matter and nutrient.
4. Tertiary treatment: filtration to remove organic and inorganic solids and pathogenic microorganisms. This is followed by chemical disinfection.

Improving these listed above treatment can be done through nanomaterials to fabricate separation and reactive media which is high quality in terms of reactivity and performance (Bellona and Drewes 2007). Nanoparticles are gaining popularity to bioremediate and disinfect wastewater (Mohan and Pittman, 2007). For example TiO_2 was promising nano-catalyst used for antimicrobial activity and fullerenes (C60) are pollution tracers, that provide contaminant-fate information to assist in developing water remediation strategies; magnetic nanoparticles are adsorbing metals and organic compounds; and nanocatalysts reduce the pollution by oxidizing contaminants (Hillie *et al*., 2006). Metal processing involves hexavalent chromium species Cr (VI), it is toxic to biological system (Dupont and Guillon, 2003). Hence metal industries should the chromium amount in effluent to 0.1mg/L before dicgharging it to sewer system (Ayuso *et al*., 2003). Maghemite nanoparticles were found potential. Hu *et al*. (2005) developed a new method which combined the adsorption ability of nanoparticles and the magnetic separation technique. The method was space-saving, cost-effective, simple, environmental-friendly and additionally, chromium was successfully removed from the wastewater and the original maghemite nanoparticles were retained by six adsorption – desorption cycles. The use of nanotech to remove contaminants is so widespread and more advances are yet to be discovered. The new advances include nanofiltration of biologically treated effluents from pulp and paper industry (Manttari *et al*., 2006); the degradation of organic dyes was done using manganese–doped ZnO nanoparticles (Ullah and Dutta, 2008)

Water Treatment

This nanofiltration through adsorption and catalytic degradation was made possible by advances in quantum world. The need for waste water treatment is increasing due to population increase, contamination sources increase. WHO (2004) reported 1 billion people do not have portable water and 2.6 billion does not have clean water, 40 years ago (1960) the establishment of three membrane separation processes: reverse osmosis (RO), ultrafiltration (UF) and microfiltration made clean water available (Sutherland 2008).

Nanotechnology in this field will be move pronounced in near future because scarcity of clean water in society is advancing in many countries around the world. Nanoparticles can be exploited to make water recycling, sea water desalination and water remediation more efficient and cost effective. Recent water filtration membranes produced by nanoparticles are

I. Nanostructured membranes from nanomaterials such as carbon nanotubes, nanoparticles and dendrimeres,

II. Nanoreactive membranes from metal nanoparticles and other nanomaterial (Theron *et al*., 2008).

Water contaminants removal can be efficiently and effectively done by adsorption (Jiuhui, 2008). Some scientific studies showed that protocatalyst can be effectively used to disinfect water i.e. under UV light using TiO_2 mediated catalyst (Kumar *et al.,* 2008)

CONCLUSION

This review was intended to give an overview of the various aspects of nanotechnology and the environment, mainly looking at it from the side of applications rather than from the risk side. The multidisciplinary field of nanotechnology's application for discovering new molecules and manipulating those available naturally could be dazzling in its potential to improve waste water treatment. The spin-offs of nanobiotechnology could be utilized across all the countries of the world. It should have become clear that nanotechnology in general and nanoparticles in particular will have important impacts on various fields of environmental technology.

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