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NANOTECHNOLOGY FOR WATER PURIFICATION-A GENERALISED REVIEW

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ABSTRACT

Water is the most important concern of today's life .The generalized scenario of the world is that most of the people are dying due to drinking of unsafe water. Industrial expansion,rising population & impact of change in climate are responsible for increasing impurities in drinking water. Sustaining and managing access to purified water is a challenge both for urban and for rural areas in India. In this review methods of Nanotechnology for water purification and water research where various membrane processes like nanofiltration, ultrafiltration, reverse osmosis, and nanoreactive membranes are used & the impact of using nanotechnology for water purification on human health & environment. Also discuss the technological advance in the context of the society's interest & need.

Keywords- Nanotechnology, Water Purification Methods, Future Scope

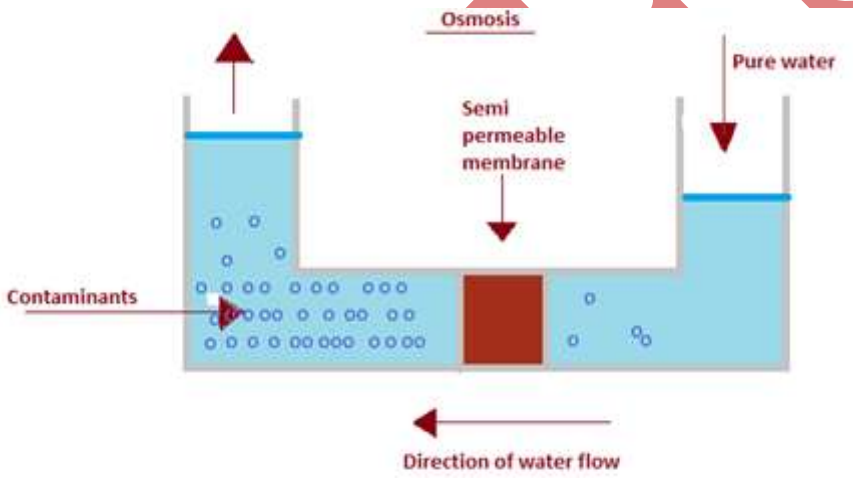
I. INTRODUCTION

Nanotechnology, the engineering and art of manipulating matter at the nanoscale (1-100 nm), offers the potential of novel nano materials for the treatment of water contaminated by toxic metal ions, organic and inorganic solutes and microorganisms. Due to their unique activity toward recalcitrant contaminants and application flexibility, many nano materials are under active research and development. To make purify our drinking water, we need to remove the impurities including those that are much too small to see (tiny microbes and chemicals). While large- scale water treatment plants work well, The objective of nanotechnology is to develop materials, devices, and systems with fundamentally different properties by exploiting the unique properties of molecular and supramolecular systems at the nanoscale. In recent years, research in the field of nanotechnology has grown exponentially as scientists and engineers continue to develop nano materials with unique properties. Now a days in every field of sciences is affected by the tools and ideas of nanotechnology, and breakthroughs have been made in computing, medicine, sensing, energy production, and environmental protection Applications of nanotechnology have been suggested for meeting the needs of poor people aimed at more effectively removing contaminants from water could potentially solve problems that have proven challenging to solve with conventional technologies..[1]

II. WATER PURIFICATION METHODS

2.1 Reverse Osmosis

In this filters have a pore size around0.0001 micron. After water passes through a reverse osmosis filter, it is essentially pure water. In addition to removing all organic molecules and viruses, reverse osmosis also removes most minerals that are present in the water. Reverse osmosis removes monovalent ions, which means that it desalinates the water. To understand how reverse osmosis works; it is helpful to understand osmosis occurs when a semi-permeable membrane separates two salt solutions of different concentrations. The water will migrate from the weaker solution to the stronger solution, until the two solutions are of the same concentration, because the semi-permeable membrane allows the water to pass through, but not the salt. In the following diagram, (a) procedure is shown. In reverse osmosis, the two solutions are still separated by a semi-permeable membrane, but pressure is applied to reverse the natural flow of the water. This forces the water to move from the more concentrated solution to the weaker. Thus, the contaminants end up on one side of the semi-permeable membrane and the pure water is on the other side. [2]



2.2 Nanofiltration for Water and Waste Water Treatment

Nanofiltration (NF) is a new type of pressure driven membrane process and used between reverse osmosis and ultra filtration membranes. The most different specialty of NF membranes is the higher rejection of multivalent ions than monovalent ions. NF membranes are used in softening water, brackish water treatment, industrial waste water treatment and reuse, product separation in the industry, salt recovery and recently desalination as two pass NF system. In this chapter, a general overview of nano filtration membranes, membrane materials and manufacturing techniques, principles such as performance and modeling, module types, membrane characterization and applications on water and waste water treatment were given. The salt separating mechanism of NF membrane are similar to nonporous RO membrane where solute & solvent fluxes are uncoupled contrast to convective solute transport in porous UF membrane The molecular weight cut off value of NF is in the range of 150-300 Da with unique property of higher rejection of multivalent ions than monovalent ions The high quality of RO permeate is perfect however it requires high feed press., RO permeate is some times mix with feed water to balance the ions & make stable drinkable water. NF membranes have taken away all these disadvantages of RO membranes which was a further development of RO membrane [3]

2.3 Nano Particles for Water Purification

Catalytic treatment of polluted water could be specifically targeted to degradation of chemicals for which existing technologies are inefficient or cost prohibitive. A catalyst is a substance that promotes the chemical reaction of other materials without becoming permanently involved in the reaction. Researchers are exploring how nano catalysts such as titanium dioxide (TiO2) and iron nanoparticles can be used to degrade organic pollutants and remove salts and heavy metals from liquids. People expect that nano electro catalysts will enable the use of heavily polluted and heavily salinated water for Sustainability of Water Purification Based on Nanotechnology drinking, sanitation, and irrigation. [4]A method using nanoscale zero-valent iron as a catalyst to remove arsenic from groundwater is tested. [5] Another example of promising research is exploring the use of nano catalysts to reduce pollution of oxidized contaminants (e.g., nitrates). Nitrate in drinking water is either not removed or it is removed using ion exchange resins. The former presents health risks, and the latter is expensive because waste streams must still be treated when the resins are regenerated. Nitrate is a stable and highly soluble ion with a low potential for co-precipitation or adsorption so that removal of nitrates using conventional water treatment is difficult. This research focuses on identifying the most promising catalysts (e.g., bimetallic metal catalysts such as Pd-Cu) to use for the reduction of nitrate and other oxidized compounds and to gain fundamental understanding of the reactivity and selectivity of these new catalytic materials. [6] Nano catalysts to remove tri-cholorethylene and organic aromatic contaminants, mainly pesticides, from groundwater have been explored. [7]

III. BENEFITS OF USING NANOTECHNOLOGY IN VIEW OF WATER PURIFICATION

Nanotechnology offers a number of benefits to the water sector, 1.enabling more effective removal of contaminants at lower concentrations 2. It reduces Co2 & waste.3.Air and water filtration, 4. Waste and water treatment, 5.hazourdous materials disposal,.6.in-building environmental systems.7. Remediation

IV. CONCLUSION

Due to the increasing globalization and human needs, nanotechnology for water & waste water purification treatment is the first priority for the research. Nanotechnology is the best method to purify the water & waste water. This review paper describes various methods for potable water as well as waste water such as Nanotechnology applications for, reverse osmosis. Nanofiltration for Water and Waste water Treatment and Nanoparticles for water purification. The incorporation of nano materials present into existing water purification is a challenge also. Membrane processes such as RO, NF are becoming the standardized water purification techniques for public utilities and industry Thus nanotechnology holds a lot of promise in the remediation of groundwater and for this there is further scope in research and development

.V. FUTURE SCOPE

In India Nanotechnology is a at a laboratory stage, some are at development stage & some of the technologies are reached at market. Silver nano particles for purification are the most popular in India due to its anti-bacterial properties. But again there are some barriers in providing safe & drinking water to the people. The reasons may be technology, market, financial & product challenges India Nanotechnology Market Leaders -Eureka Forbes Limited, TATA Chemicals, HUL Nanotechnology R&D- DST, ARCI, Agharkar Research Institute, IIT- Bombay, Stanford University, Aberdeen University

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[3] 3.Nanotechnology in Water Treatment Applications | Book Publisher: Caister Academic Press Editor: T. Eugene Cloete[1], Michele de Kwaadsteniet[1], Marelize Botes[1] and J. Manuel López-Romero[2] [1]*Faculty of Science, Stellenbosch University, South Africa;* [2]*Faculty of Science, University of Malaga, Spain* Pages: viii + 196 ISBN: 978-1-904455-66-

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