IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

NANOTECHNOLOGY IN WASTEWATER TREATMENT: A LUCID EXPOSITION

[1]Aruna C, [2]Asha B

[1]Research Scholar, [2]Associate Professor
[1]Civil Engineering,
[1]Annamalai University, Chidambaram, India

Abstract: Presently, water pollution has become one of the most significant complications by diverse toxic contaminants worldwide. Copious plans have been adopted by industries to treat wastewater prior to its release to the ecosystem, and some assorted new notions and technologies are speedy restoring the traditional methods. In recent decades, nanotechnology has attained broad attention and various nanomaterials have been instigated for the water remediation. Refinement of shape, nature, and size is regularly provides unique physicochemical and surface properties that accord themselves to novel utilization which makes them suitable for applications in wastewater treatment and for water purification. This article shortly reviews the latter application of nanotechnology for wastewater treatment.

Index Terms **- Biological treatment, Contaminants, Nanomaterials, Nanotechnology, Wastewater.**

I. INTRODUCTION

Water engulfs nearly two-thirds of Earth's surface. Still, deficiency of clean water has been a universal problem to humanity for many years. Nature has its own potential to recycle water and furnish an adequate quantity of clean water to us. However, unconstrained human population growth and unintended industrialization have deranged the natural purification processes, key to a dearth of potable water. Virtually, 90% of every disease in most of the developing countries is engendered due to the utilization of impure water. A considerable portion of the drinking water sources across the board are found to be contaminated with numerous toxins and pathogenic microbes, primarily due to the discharge of untreated man-made wastes or wastewater to these sources. Therefore, the suitable treatment of wastewater is very extensively prior to its release for safeguarding our ecosystem.

Industries over the world have arrogated sundry schemes to manage the wastewater before releasing it to the environment. Present wastewater treatment technologies require high capital investment, operation and maintenance (O&M) cost, high energy requirements, and large plant areas. Accordingly, industries from developing countries are detecting it very hard to afford such exorbitant technologies due to their low profit margins, and thus the deference to environmental legislation and standards in these industries are relatively low. It implicit that majority of the wastewater enters into natural bodies of water without any initial treatment. So as to deal with these issues it is the provocation for research, development, and technology institutions to transpire with cost-effective alternative wastewater treatment technologies with minimal area requirements. Nanotechnology proffers the ability for the evolution of substitute technologies for wastewater treatment.

It is the leading revolutionary technologies in the world. The term nanotechnology evokes a scope of technologies executed on a nanometres scale with extensive applications as a revamping technology in various industries. Nanotechnology encloses the production and application of physical, chemical, and biological systems at scales ranging from solitary atoms or molecules to around 100 nanometers, as well as the incorporation of the resulting nanostructures into larger systems. The predominant way that nanotechnologies might assist palliate water problems is by interpreting the technical troubles that eliminating water contaminants consisting bacteria, viruses, toxic metals, pesticides and salts. Many scientists affirms that nanotechnologies proffer more affordable, effective, permit manufacturer to produce less toxic particles employing classical methods. A frequent issue in developing countries is that drinking water is fouled with bacteria and viruses, which are the major reasons for water-borne disease. Due to alterations in climatic condition, and increasing pollution, water will become more exiguous, chiefly in developing countries. Moreover, in these countries, accessible water is often dangerous to consume. This article mainly inspect some modern advances and applications of nanotechnology in wastewater treatment, spotlighting the prospective utilization of these techniques to convey some specific challenges faced by the current wastewater treatment technologies. Many techniques initiated by nanotechnology, such as the applications of nanocatalyst and nanomembrane filtration for wastewater treatment are explored. Research advances on different nanomaterials like carbon compounds, metal oxides, metal nanoparticles, and zeolite used in these techniques are also considered.

II. Nanomaterials for Wastewater Treatment

Contemporary approaches indicates that assorted obstacles relating water quality could be resolved or considerable rise in the usage of nanomaterials and correlated stuff which created the growth of nanotechnology. Unique paths in the evolution of modern nanomaterials to treat wastewater are among the most exciting and brilliant technologies. Various research teams in the world are utilizing specific nanomaterials and operating the whole system effective, economical and rapid for the reuse of wastewater. On the other side, treatment of industrial wastewater with freshly synthesized nanomaterials is further probable useful application. Many of the restoration technologies at hand now are effective, very often are costly and long running, especially pumping and treating methods. The capacity to remove pollutants from surface and sub-surface and other environments are very laborious to ingress in situ, and performing so swiftly, efficiently and within feasible costs is the ideal intention. On that account, nanotechnology based wastewater treatment productively obliterates the toxins and aids in the recycling process to attain purified water, which tends to reduce in labour, time and dissipation to industry and clarifies the numerous environmental cases. Nanomaterials are chiefly grouped into various class hinge on their physical and surface properties. A nanomaterial embraces carbon nano-adsorbents (CNTs), metal nano-adsorbents (Al2O3 NPs, ZNO NPs, TiO2 NPs and CeO2 NPs), metallic nanoparticles (Au & Ag NPs), mixed oxide nanoparticle (Fe-Ti NPs), polymer nano-adsorbents, nanofibers, nanoclays. Moreover, it also employs the existence of nanoscopic pores in zeolite filtration membranes, and also nanocatalysts. Metallic/metal oxide nanoparticles as Titanium oxide nanoparticles and palladium nanoparticles are used as nanosensors for the study of organic and inorganic contaminants in the water systems.

Wastewater treatment methods are planned to acquire refinements in the standard of the wastewater. The several treatment methods may lessen the suspended solids, biodegradable organics, pathogenic bacteria, nitrates and phosphates. Wastewater treatment is divided into three types as primary, secondary, and tertiary treatments. Based on the sort of treatment and phase of purification, nanomaterials are sorted out for the effectual deletion of pollutants from the water systems. Nanotechnology can also be adopted for the removal of sediments, chemical effluents and charged particles. Nanofiltration is a new kind of pressure driven membrane process and employed in the middle of reverse osmosis and ultrafiltration membranes. The most distinct speciality of nanofiltration membranes is the premier dismissal of multivalent ions than monovalent ions.

Nanofiltration membranes are worked in softening water, brackish water treatment, industrial wastewater treatment and reuse, product separation in the industry, salt recovery and desalination as nanofiltration systems. Carbon nanotubes are special nanomaterials which can seperates wide range of pollutants comprising organic, inorganic, oil, turbidity, bacteria and viruses. Eventhough their pores are notably compact, carbon nanotubes have an equal or a rapid flow rate as compared to larger pores, perhaps of the satiny interior of the nanotubes. Nanofibrous alumina filters and other nanofiber materials also discard negatively charged pollutants such as viruses, bacteria, and organic and inorganic colloids at a quick rate than conventional filters. Singlewalled carbon nanotubes (SWCNTs) are differentiated from multiwalled carbon nanotubes (MWCNTs) by their number of layers, and few researchers are attracted due to its unique structure, magnificent properties and variety of potential applications.

Nanotechnology has propelled attempts to design and to create nanoscale components for merging into devices. Magnetic nanoparticles are an vital section of functional materials, operating unique magnetic properties because of their reduced size (below 100 nm) with potential for use in devices with declined dimensions. Polymer adsorbents are attracting more contemplation in sample pre-treatment procedure. Organic polymers are the technique into which inorganic nanosized particles can be inserted to magnify their physical, chemical, mechanical and sorption properties. Nanopolymer sphere, like Dendrimers are tailored adsorbents that are able to reject the organic and inorganic species. The interior walls of dendrimers are hydrophobic in nature and helps to sorption the organic compounds whereas the exterior branches can be tailored (e.g., hydroxyl- oramine-terminated) for adsorption of heavy metals. Nanoclays are the naturally transpiring particles with nanometer scale, and accounted as a nanomaterials of geological origin. Nanoclays exhibits different structures which subsists tetrahedral silicates and octahedral aluminium layers, and the type of the clays acts upon the arrangement and composition of these layers.

III. Conclusion

Fresh technologies can progress the cleanliness and quality of water, whether for individual consumption or for farming or manufacturing applications, are in high demand. As previously mentioned, many promising commercial nanotechnology applications are currently improved and bring to market. However, previous to these innovations can move from the lab to the group market, they must first overcome societal approval and fiscal viability hurdles. Lot of these applications are at a halt in their early stages of development and may need additional testing to demonstrate their consistency. Furthermore, these innovations would involve existing water treatment centres to spend additional capital to update equipment and train staff in order to introduce them. Despite the fact that advocates of nanotechnology are having a hard time persuading classified and public institutions to pay the high upfront costs of implementing new water cleansing technologies. Nanotechnology clasp the guarantee of long-standing benefits in the type of lower prices for purify the world's irrigate sources and the tremendous investments that will come with safe entrée to potable water throughout the world where there is presently a shortage of sufficient consumption of water and necessary sanitation facilities.

IV. References

[1] Chen,Y., L. Wang, S. Jiang and H.J. Yu, 2003. Study on original antibacterial polymer materials research of zeolite antibacterial agents and antibacterial polymer composite and their antibacterial properties. J. Polymer. Mater. 20: 279-284.

[2] Chohan, Z.H., C.T. Suparna and A. Scozzafava, 2004. Metalloantibiotics: Synthesis and antibacterial activity of nickel (II), cobalt (II), and zinc (II) complex of kefzol. J. Enz. Inh. Med. Chem., 19: 79-84.

[3] Colvin, V.L., 2003. The latent environmental impact of engineered nanomaterials. Nature Biotech., 10: 1166-1170.

[4] David Grenshaw(2009). Nanotechnology for clean water treatment: details and information. 6-May-2009. URL:www.SciDirect.net.

[5] Dendrimers. URL: en.wikipedia.org/wiki/Dendrimers.

[6] Diallo, M.S., S. Christie, P. Swaminathan, J.H. Johnson and W.A. Goddard, 2005. Dendrimer improved ultra-filtration recovery of Cu (II) from aqueous solutions by Gx-NH2-PAMAM dendrimers with ethylene diamine core. Environ. Sci. Technol., 39: 1366-1377.

[7] Droste, R.L., 1997. Theory with practice of water and wastewater treatment. New York: Wiley (Book).

[8] Fullerene. URL: en.wikipedia.org/wiki/Fullerene.

[9] Ichinose, N., Y. Ozaki and S. Kashu, 1992. Superfine particle technology. Springer, London, (Book).

[10] Islam, M.S., H.M. Motahar, Banu, L. Arjuman, C. Sultana and M.A. Quadir, 2003. Antibacterial and antifungal activity of mixed ligand complexes of oxovanadium (IV), titanium (III) and cadmium (II) metal ions. Oriental J. Chem., 19: 547-554.