A REVIEW PAPER ON NANOMATERIALS AND WATER TREATEMENT

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ABSTRACT

Nanoadsorbents are broadly divided in several groups according to their participation in the adsorption process. It comprises of nano-metal, nanostructured oxides, magnetic NPs and metal oxide NPs. In addition, in the field of carbon nano-materials, carbon nano-particles and carbon nanosheets recently evolved (CNMs). Other forms of silicon nano-substances such as silicone nano-tubes, nano-substances of silicon and silicone nanosheets are also used as nano-adsorbents. Nano-clays, polymers, aerogels and nano-fibers are also nano-materials used for heavy metadata and for waste water adsorption.

KEYWORDS: Nanomaterials, Fibre, Membrane

INTRODUCTION

Inorganic nano-particles based on oxides are usually formed of non-metals and metals. These nano-particles are commonly used to remove harmful pollutants from wastewater. Titanium oxides are included [1], titanium oxide/composite dendrimers [2], Zinc oxides [3], Sium oxides are included [4]. Oxide-based nano-particles have a high BET surface, negligible environmental influence, reduced solutionability and secondary pollutants [5]. The inherent presence and cost-effective iron manufacturing process make ferrous oxide a cheap substrate for adsorption of dangerous metals. It is an environmentally-friendly material which may be used in a polluted area where secondary contamination is less probable [6]. pH, temperature, adsorbent dose and incubation period of the parameters affecting Fe_2O_3 nanoparticles' adsorption of different heavy metals [7]. Various researchers have worked on enhancing Fe_2O_3 surface modification adsorption capacity [8]. [9] reported Fe_2O_3 nanoparticles, with surface modifications of 3-aminopropyltrimethoxysilane. [10] claim that these nano-adsorbents have been modified to show a good affinity for numerous pollutants, including Cr_3^+, CO_2+, Ni_2+, Cu_2+, Cd_2+, Pb_2+ and As_3+, for removing from waste water. Manganese oxide nano-particles (MnO). The high BET surface and polymorphic structure of a mangrove oxide (MnO) NP have excellent adsorption properties [11]. It was often used to remove numerous heavy elements from waste water, such as arsenic [12]. Mangane oxide and hydrous manganese oxide (HMO) nanoporous/nanotunnel are the modified MnOs used most often [13]. Zaman et al. (2009) have developed the NaClO HMO solution by adding $MnSO_4$ H_2O. Modified HMO has a surface area of roughly 100,5 m^2 — 1 BET. The process of ion exchange generation inside the sphere largely leads to adsorption of HMOs of various heavy metals such as Pb (II), Cd(II) and Zn (II) [14]. However, divalent metal adsorption was performed on the HMO surface in two phases. First metal ions adsorb the external surface of the HMOs, then diffusion intraparticle [15]. Zinc oxide nano-particles (ZnO). Zinc oxide (ZnO) has a porous micro / nanostructure with a high surface adsorption BET. The nanoassembly systems, nano-plate, nano-blade and hierarchical ZnO nano-rodes are widely used as a nano-adsorber for removing heavy metals from waste water [16]. In compared with commercial ZnO, the modificated ZnO nanoadsorbent forms described above showed outstanding efficacy in heavy metal removal. [17] employed ZnO nanoplates and porous nanoplates to remove Cu (II) from waste water. These modified nanoadsorbents from ZnO show better deletion effectiveness in Cu due to their unique micro/nano structure compared to commercial ZnO (II). In addition to these nano-assemblies, several kinds of heavy metals, including Cr_3^+, CO_2+, Ni_2+, Cu_2+, Cd_2+, Pb_2+ , Hg_2 and As_3+, have been removed [18]. Because of their electropositive nature, microposite orous nanoassemblies are particularly refined for Pb_2+, Hg_2+ and As_3+ adsorbing. The use of mesoporous hierarchical nano-rods of Pb (II) and Cd (II) from waste water revealed a high effectiveness of removal.

CARBON NANOTUBES (CNTS)

Carbon nanotubes (CNTs) are a studied material which may be removed from wastewater via adsorption by heavy metals and a number of organic contaminants [19]. There are, however, few issues about poor dispersion, difficult separation and small particle sizes Use of CNT adsorbent. Researchers have transformed conventional CNTs into modified CNTs (MWCNTs), for example, to address these issues [20]. Modified magnetic CNTs have a high dispersion capacity and may be collected or used by waste water magnet [21]. Several studies have showed that MWCNTs [22], Cu(II), including Pb(II) and Mn(II) were removed from heavy metals [23]. [24] have examined CNT-supported alumina adsorption for the treatment of aqueous lead solutions. The covered CNT has been removed better than the uncoated CNT.

Surface modification of CNT improves total CNT adsorption activity. Various sorts of surface modification processes are discussed by different studies, including surface acid [25], metal impregnation and functional molecules/group grafting [26]. The aforesaid tactics change the CNT surface characteristics such as BET surface area, surface loading, spreading and hydrophobicity. CNTs were treated with acids including HNO3, $KMnO_4$, H_2O_2, H_2SO_4 and HCl (Ren et al., 2011; Fu and Wang, 2011). Acid treatment reduces impudences on the surface of the CNT. It also creates new functional groups on the CNT surface, which boost their capacity to adsorb waste water [27]. In addition, microwave generated plasma surface waves may also be introduced to a group containing oxygen [28].

Another method for improving the surface properties of CNTs is the use of functional molecules/groups. It may be performed in a number of techniques including plasma, chemical modification and a microwave [29-32]. However, plasma technology is one of the best options due to decreased power usage and ecologically friendly operations. [30]showed the removal of heavy metals from wastewater by the use of modified CNTs grafted in various functional groups. Additional results for the removal of heavy metals from the water include modified CNTs, including MnO2.

GRAPHENE-BASED NANOADSORBENTS

Graphene is a carbon allotropy with certain features which make it particularly useful for several environmental cations. Graphene oxide (CO) is a two-dimensional nano-material carbon structure that is produced via chemical graphite oxidation. Hummers is the most common procedure for GO synthesis [31]. Hydrophilic groups generated by GO need a special oxidation method [32]. The presence of hydroxyl and carboxyl groups in GO as functional groups supports heavy metal adsorption [32]. GO adsorbs the removal of heavy metals more and more because of its wide surface area, mechanical strength, light weight, flexibility and chemical stability 2015 [33]. The functional group's existence also impacts the adsorption process on the GO surface. GO has two major characteristics compared to other nano- materials such as CNTs. First, there are two baseline planes on a single GO sheet, which may maximise heavy metal adsorption. Secondly, it has a simple synthesis process which may be performed by chemical graphite exfoliation without a metal catalyst or specialised equipment. Moreover, GO needs no acid treatment to enhance its adsorption capacity since it already has a hydrophilic functional group. Nano-based graphene was used by many teams to adsorb heavy metals from waste water.

CONCLUSION

There is no question about the efficiency of utilisation of nano-materials in wastewater treatment. However, this technology does have severe drawbacks, which have to be managed as nano-particles during preparation and treatment operations may be discharged into the environment and may pile up for a long time and create major dangers. Future research is essential to avoid the toxicity of such catalysts to the environment from decreasing in order to reduce the health risk. More research is required to reevaluate the potential ecotoxicity of any new catalyst and current material changes. In addition, a study of the nano-material life cycle is required to address their overall benefits and dangers. Mass approaches for nanotechnology are seldom employed. Since most nano-materials are still not cost competitive with conventional materials such as activated carbon, future applications will thus focus on efficient processes, where only small quantities of nano-material are required. In addition, considerable work is necessary to create cost-effective nano-material production methods and large-scale efficiency studies for successful field use.

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