A Brief Review on Usage of Nano Metal Oxide Adsorbents in Wastewater Treatment

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Abstract: **At present due to the shortage of water resources, effective treatment of wastewater is a foremost requirement and the treated water is using for gardening as well as agricultural purpose to avoid surface water utilization. In this aspect,the requirement is to develop and implement progressive wastewatertreatment technologies with high effectiveness and less investment. Through point and non-point sources, the discharged water is obtained after utilizing domestic and industrial purposes and including storm water runoff. This wastewater containing different types of pollutants including heavy metal ions. These heavy metal ions are considered as the serious environmental problem in society. Methods are available to remove the pollutants from wastewater and among adsorption is a widely used method for the removal of pollutants and particularly it plays an important role in wastewater treatment for the removal of heavy metals. At present in the water purification research under Nanotechnology, Nano materials are used as adsorbents for removal of pollutants from wastewater. A number of researches have evidenced that Nano materials (Nano carbon materials, Nano metal particles, and Polymer based Nano particles) are the good adsorbents for the removal of heavy metal ions from wastewater due to their unique structural properties. Due to simplicity, less cost, easy handling, and efficiency, the adsorption process is commonly popular for removal of heavy metals.In this paper concentrated on a brief review on the availability of Nano metal oxide based adsorbents for removal of water pollutants.**

I. INTRODUCTION

Water is nature's most common, abundant and widespread chemical compound of all living creatures and we all ways thought to be available in sufficiently and a free gift of nature. Clean, safe and adequate fresh water is vital to the survival of human beings. Assurance of drinking-water safety is a foundation for the prevention and control of waterborne diseases. Drinking water affects the health of human beings due to the presence of unwanted chemical impuritiesand bacterial constituents. Many diseases associated directly or indirectly depend on the quality of drinking water in human beings. Water may be contaminated by organic, inorganic, and biological contaminants and in which some of the contaminants are toxic and carcinogenic[1]Water is polluted in most areas due to increased population, human activities, industrialization, dumping of industrial waste and increased use of fertilizers and also pollution of freshwater resources due to wastewater disposal.

Some of the heavy metals are dangerous water pollutants due to their high toxicity,for example,Arsenic (As) is one of the harmful element. The other heavy metals such as Cadmium(Cd), Chromium(Cr), Mercury(Hg), Lead(Pb), Zinc(Zn), Nickel(Ni), Copper(Cu) and so on due to with high toxicity these are acting as water pollutants[2]. In addition to due to the high concentrations of Nitrates(together NO_2^- and NO_3^-), Sulfates(SO_4^{2-}), Phosphates(PO_4^{3-}), Fluorides(F^-), Chlorides(Cl^-) , Selenides, Chromates and Oxalates show hazardous effects,as well as these ions, change the taste of water. Organic pollutants, such as pesticides, fertilizers, hydrocarbons, phenols, plasticizers, biphenyls, detergents, oils, and greases are associated with toxicities [3]and emerging contaminants include pharmaceuticals and personal care products [4].

Water has been used for several operational purposes such as in the home appliances like cooking, washing, and bathing, in business, in agricultural, as a part of the industrial process in the different type of industries etc. After utilization, the discharged water from domestic, agriculture andindustries including storm water runoff iscalled as wastewater and finally which is obtained through a point or non-point sources. These wastewatersshould contain various/different types of pollutants and this wastewater is discharged without any treatment, it affects the quality of water. And also due to increasing water demand across the world, at now wastewater recycling is unavoidable. Many methods are availableare among whichadsorption is one of the best processes for effective removal of contaminants from water and wastewater.

Adsorption is a unit operation process which refers to the attachment of molecules on to the surface. It is useful for the removal of both organic and inorganic pollutants from water and wastewater and has an advantage over the other methods such as coagulation, filtration with coagulation, precipitation, ozonation, Ion exchange and reverse osmosis. It is a beneficial process because of simple design, high efficiency, easy handling and easy availability of different adsorbents and can involve low investment. Materials locally available such as natural materials, agricultural wastes, and industrial wastes can be utilized as low-cost adsorbents. In recent years, the search for low-cost adsorbents that have pollutant–binding capacities has intensified. Of the variety of adsorbents available for the removal of pollutants, activated carbon [5, 6]

has been the most popular and adsorption process depends on adsorption coefficient Kd and recitation partitioning of pollutant i.e. heavy metals or organic pollutants under equilibrium conditions [7].Importance of Nano Technology and Nano materials:

At present researchers are much more attention pay in the direction of application of Nanotechnology and Nano materials are in the water and wastewater treatment. Nanotechnology [8]has been many successful applications in different fields but recently its application for water and wastewater treatment has emerged as a fast-developing and attractive area of concern. Due to unique characteristics of Nano scale materials like their small size, large surface area and due to active sites [9] for interaction with different chemical species [10] to improve the adsorption capacity of the nanoparticles. In addition, these particles show distinctive characteristics, such as catalytic potential and high reactivity, which make them better adsorbing materials than usual materials. At present many researchers have been studied the potentiality for adsorption on Nano particle size materials [11]. In wastewater treatment application, a variety of efficient, eco-friendly and cost-effective Nano-materials have been developed [12] for water and wastewater treatment.Nano-materials have been developed [13] in a variety of forms such as nanowires, nanotubes, films, particles, quantum dots, and colloids.

Nanotechnology is an advanced process for wastewater treatment and this is widely used in the form of Nano adsorbents, Nano catalysts and Nano biofilms for water purification. In the following Table 1, capable role of a type of Nano materials is mentioned in water and wastewater treatment.

Table 1: Capable applications of nanomaterial's and nanotechnology in water/wastewater treatment

Type of Method	Some examples of Nano materials	Novel properties compared to other methods in purification
Adsorption	Carbon Nano Tubes/Nano metal oxides and Nano fibers	More specific surface area and computable selective adsorption sites, short intra particle diffusion distance, easy reuse, and so on. Used to remove organic and inorganic contaminants
Membranes	Nano silver/Titanium dioxide /Zeolites/Magnetite and CNTs	Strong antimicrobial activity, hydrophilicity, low toxicity to humans, high mechanical, chemical stability, high permeability and selectivity, photo catalytic activity, and so on. Highly reliable and mostly automated process. Applied in all fields of water and waste treatments
Photo catalysis	Nano-TiO_2 and Fullerene derivatives	Photo catalytic activity in UV and possibly visible light range, low human toxicity, high stability, and low cost Reaction selectivity Strong and wide-spectrum antimicrobial activity, low toxicity to humans, ease of use
Disinfection	Nano silver/titanium dioxide (Ag/TiO2) and CNTs	Strong antimicrobial activity, low toxicity and cost, high chemical stability and ease of use, and so forth.

Under Nano adsorption technology an effective research works published continuously with the object to the removal of pollutants from wastewater using different materials of Nanoadsorbents [14, 15].In this paper listed out various oxide based Nanoadsorbent materialsin the application of wastewatertreatment. These adsorbent particles are prepared by metals and non-metals and are widely used for the removal of harmful pollutants from wastewater.Titanium oxides [16, 17, 18], Zinc oxides [19, 20] Magnesium oxide [21, 22], Manganese oxide [23], Ferricoxides [24], Cadmium oxides [25], silver Nanoparticles [26], Copper oxides [27], Cerium oxides [28] and so on[29]. Due to moresurface area and precise attraction these metal oxides possess having a good adsorption property. In addition to metal oxides possess nominal environmental impact and low solubility and no matter of secondary pollution. Containing toxic with hazardous pollutants in wastewater to make it reusable by wastewater treatment and recycling is the major challenge for the environmental aspect in the present state. Adsorption with Nano materials has developed a technique to address this problem. Due to unique physical and chemical properties of Nano adsorbents are working capable to develop the technology for removal of pollutants from the wastewater treatment and it has advantageous over the conventional methods of water treatment. Continuous research is now ongoing to develop the Nano materials for finding the better adsorbents than available at present in wastewater treatment. Further, there is a huge possibility to explore the possibility of other materials such as activated carbon fibers, molecular sieves, micro porous glass, membranes, ceramic beads, polymeric materials, and carbon Nano scrolls etc. as adsorbents in wastewater treatment

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