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Treatment Of Waste Water by Nano Particles

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Abstract
Nanotechnology is a branch of study, which deals with the molecular level re-arrangement of atoms. This is becoming the active and advanced topic nowadays. Particles whose size lower than 100 nanometer are involved. Although the particles which have size lesser than 100 nm are considered as nanoparticles, nowadays, people use the word nano for tiny particles. The word nano is used in more areas In modern world, e.g., Tata nano car. Nanotechnology has its own applications in many branches of science and engineering such as medicine, biotechnology, food and beverages, aerospace, chemical, construction, environmental, consumer goods such as fabrics, textiles, sports, cosmetics, military, fire protection etc.

Keywords: water pollution, waste water pollution, nano particles.

Introduction
Nanotechnology holds great potential in advancing water and wastewater treatment to improve treatment efficiency as well as to augment water supply through safe use of unconventional water sources. There are many evidences to support the positive effects of nanotechnology in the area of waste water treatment. The particle used in nanotechnology is of very lesser size say lesser than l00nm. Nanoparticles has very high absorbing, interacting and reacting capabilities due to its small size with high proportion of atoms at surface. It can even be mixed with aqueous suspensions and thus can behave as colloid (Prachi, *etal.,*2010). The various methods of

synthesis, applications of nanoparticles mainly depend on the field at which it is used. Nowadays, a new term is coined in the modern era, which is nothing but green nanotechnology. Green nanotechnology is aimed at bringing the cleaner eco system since the cleaner and healthier environment is the need of the hour. The main objective of green nanotechnology is to;

(i) Minimize environmental risks

(ii) Minimize various health hazards

(iii)Replace existing hazardous particle with nanoparticles which are of minimal unwanted effects.

Types of Nanoparticles

Silver nanoparticles are known as excellent Antimicrobial agents, and therefore they could be used as an alternative disinfectant agent, silver nanoparticles are increasingly used as biocides in a wide range of products, The application of nanoparticles in silver form varies from household paints to artificial prosthetic device The extensive application of the silver nanoparticle results in their revitable release into the environment. On the other hand, released silver nanoparticles could pose a threat to naturally occurring microorganisms.

Nanosilver has become one of the most popular nanoparticles due to its many applications and relatively low manufacturing costs. It is currently being used in a wide variety of commercial products Including medical applications, water purification, Antimicrobial uses, paints, coatings, food packaging, impregnating other materials with silver Nanoparticles is a practical way to exploit the germ fighting properties of silver (Bogumila, *et al,* 2013).

Silver ions are also used into water purification systems in hospitals, community water systems, pools and spas. It is slowly replacing chlorine as the widespread element of choice for filtration. Silver also eradicates Legionnaires' disease, which is caused by buildup in pipes, connections and water tanks. Research has shown that the catalytic action of silver, in concert with oxygen, provides a powerful sanitizer that virtually eliminates the need for the use of corrosive chlorine.

Silver nanoparticle has adverse effect on sludge, that impact the aerobic and anaerobic microorganisms. Silver ions and silver nanoparticles concentrations as low as 0.4 mg/L inhibited the growth of nitrifying bacteria. In addition, anaerobic microbial activity in biomass (i.e., sewage sludge) was inhibited at silver nanoparticles concentrations of 19 mg/L (Parthasarathi, 2009).

One of the important nanoparticle whichacts as photocatalyst is Titanium di oxide nanoparticle. Generally titanium oxide is available in three different phases such as anatase, rutile and brookite. Each of them will be in different sizes. Nowadays Titanium dioxide is widely used for the preparation of nanomaterials such as nanotubes, nanowires. TiO_2 has the potential application for removing the toxic compound from waste water. The nanocrystalline titanium dioxide (NTO) is often used in photocatalytic water treatment. The poorly biodegradable water pollutants can be treated by photocatalytic degradation by the use of TiO_2 nanoparticle (Dhermendra, 2008).

Synthesis of Titanium dioxide nanoparticles can be achieved by

1. Hydolysis of Titanium (IV) isopropoxide or Titanium (IV) chloride
2. Flame hydrolysis method

The hydrogen production and water purification are the features associated with the use of titanium di oxide nanoparticle.

These methods of degradation of pollutants present in wastewater are done mainly by a series of hydroxylation reactions (OH). Electron whole pairs of NTA are produced in the nanocrystalline titanium di oxide semiconductor photocatalyst with the application of UV light illumination. These holes are positively charged ones. These holds charges when in contact with the water molecules thus form OH and H^+ ions. The electrons will act with dissolved oxygen to produce superoxide ions (O_2-). These, then combine with water molecules to form hydroxide ions (OH") and peroxide radicals (OOH) (Manoj, *et al,* 2012). The peroxide will then act with H+ ions to form OH and OH-. The holes thus oxidize OH- to OH. Thus finally the formation of OH is facilitated, and these radicals act and help in degradation of the pollutants in the solution.

Carbonaceous Nanoparticle

Carbon is a non-metallic element. It ranks the sixth in the list of most abundantly available elements. The major source of carbon is from coal deposits. It ranks the second most abundantly element in the human body, the first one is Oxygen.

Morphology of carbon nanoparticle is spherical and is available in the form of black powder. Density of carbon nanoparticle is 2.2670 $g/cm^3$and molar mass is 12.01 g/mol. The main characteristic feature of the carbonaceous nanoparticle is high capacity. These act as selective sorbents for organic solutes in the aqueous solutions. The history of carbonaceous nanoparticle dates back to the pre historic times. Fullerenes which are nanoparticle originated from the smoke and soot of the campfire. These smokes evolve out with some other combustion byproducts. These can be termed as crude nanoparticle. These crude nanoparticles are used in art. Fullerenes and carbon nanotubes have their own applications in a verity of fields. These are used in cosmetics, skin rejuvenation formulas. These can also be used in antibacterial functions. But this application of antibacterial aspects is under research and many more findings are being coming out. Investigations are being conducted worldwide for its application indrug delivery devices and machines.

Even though these nanoparticles are lighter, they have their own remarkable strength as their property. These are also used in bicycle components, golf clubs, skis and tennis rackets. Ultra-light and strong materials can be prepared with the use of carbon nanotubes. These materials are used in aircraft and cars which will be used for energy saving and energy usage purposes. These carbon nanotubes act as adsorbents in order to treat the wastewater. These adsorbents act on the impurities and toxic substances present in the wastewater. Carbon nanotubes are used for the removal lead, cadmium and organic pollutants from water, since CNTs have excellent adsorption property promising (Li, *et al,* 2007). The adsorption capabilities can be greatly governed by the morphologies of the CNTs. CNTs with poor crystallinity and morphology can be easily introduced with much more functional groups, interestingly leading to better adsorption capabilities. Treatment with oxidants will be able to promote the dispersibility of the CNTs.

Activated carbon nanoparticle is one important type of carbon nanoparticle. The material activated carbon nanoparticle makes it porous. This will be used in adsorption process or chemical reactions. Large surface area is the main characteristic feature of activated carbon nanoparticle (BabakKakavandi, *et al.,* 2013). Activated carbon nanoparticle is used in the process of cancer treatmentpnce/he adsorptive

Nanoiron Composites

Nanoparticles of iron (FE) have a greater scope of application in the modern world. These are widely used in the reduction technologies for groundwater remediation and wastewater treatment. These iron nanoparticle treatment in integration with other conventional methods of treatment will ensure an ecofriendly and energy saving approach of treatment because of naturally occurring iron oxides and their non-toxic and non-hazardous properties. All described properties of FeO nanoparticles can be even used for decomposition of pollutants contained in the waste water, mainly for treatment of industrial sewage. The usage of nanoiron paves the better way of approach to treat waste water. It can represent a significant qualitative step in the classical technologies of water treatment including drinking water. The extremely reactive iron nanoparticles thus offer a possibility to solve long-lasting problems with a high content of uranium and arsenic in a variety of localities. They can be also used for a reduction of the content of heavy metals, nitrates and phosphates in the drinking water. Just these inorganic pollutants, which are hardly or expensively removed by standard technologies, are effectively removed by FeO nanoparticles. The use of zero-valent iron is an advanced area, hence more and more researches are being carried out for proper and efficient utilization of this element (Pradeep and Anshup, 2009).

A lot of advancements are being expected in the upcoming years for the application of iron nanoparticles in the waste water treatment. Besides significant decontamination effect, their advantage relies on the formation of non-toxic product of oxidation of nanoparticles (very often Fe_3O_4), which is either deposited in the given locality and almost negligibly increases the natural occurrence of iron oxides or comes to filtration devices of cleaning units. In order to utilize these FeO nanoparticles in the treatment of waste water, nanoiron exhibits a large surface area along with an extraordinary reactivity in contact with pollutants.

Gold Nanoparticles

Gold has always been the one precious material people like best. Due to its intrinsic value, buying the yellow metal has been seen as a good way ofsecuring one's money. Big players on the market prefer it in the form of bullion, whereas small investors settle themselves with purchasing pieces of gold jewelry. In modern times though, has ceased to be merely a safe investn opportunity or exchange currency. As a result extensive research and continuous development has been discovered that gold can be successfully for scientific purposes as well.Gold Nanoparticles have been utilized for centuries to the vibrant colors produced by their interaction with visible light. Recently, these unique optical electronics properties have been researched utilized in high technology applications sue organic photovoltaics, sensory probes, therapeutic agents, drug delivery in biological and me applications, electronic conductors and catalysis (Huifeng, *et al,* 2013).

Gold nanoparticles are versatile materials used for a wide range of applications with characterized electronic and physical propertiesIn addition, their surface chemistry is easy to modify These features have made gold nanoparticles one of the most widely used nanomaterials for academic research and an integral component in point-o medical devices and industrial products world wide.

This nanoparticle has been used to reduuce pollutants in the form of heavy metals, fertilizers detergents, and pesticides. Gold meta intriguing potential to deal with the water pollution problem, as recent research on several fro advancing the concept of nanoscale gold as the for cost-effective nanotechnologybased treatment. Nano-gold has special properties, enhanced catalytic activity, visible surface pi; resonance color changes, and chemical stability that make it more useful than other materials.

Conclusion

The conventional methods of the have its own challenges such as environ: hazards, economic feasibility, time spent, consumption etc. To overcome these limitthere is a technology called Nanotechnology, which has its greater extent of application in water treatment area. Lot of researchers found the nanoparticle as a field with greater scope in a variety of fields. Nanoparticle based treatment ensure ecofriendly, environmental friendly, cost-effective, energy and time saving approaches when compared to the traditional and conventional methods of waste water treatment (Prachi, *et al,* 2010).

Few types of nanoparticles such as silver nanoparticle, titanium dioxide nanoparticle, iron nanoparticle, gold nanoparticle and carbonaceous nanoparticle are discussed so far. Apart from the above, there are other types of nanoparticles such as dendrimers, zeolites, copper nanoparticles etc. The choice of the type of the nanoparticle depends on the locality, availability, feasibility, economic conditions for the particular problem. The main advantages of using nanoparticleas are large surface area and hence often able to react very quickly, the best example for this type is silver nanoparticle. Nanoparticle has its own drawback such as its uncertainty about the facts revealed so far, since this topic of nanotechnology is still under research. One research in BBC reveals in a report from 2011-12, total market of emerging nanotechnology products used in water treatment which includes nanosorbents, will be around 80 million euro in 2015. Large scale of usage of nanoparticles such as nanosorbents will be expected only in another 10 years of research.

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