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# A Review On Nanoparticle Based Waste Water Treatment

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## Abstract

As the mother earth is confronting on natural emergency on account of an unnatural weather change, a disturbing circumstance emerge for water protection to spare our people in the future. Insufficient rainfall and high temperature records during summer prompts deficiency of fresh water. Lately, various governmental and non-governmental organizations are concentrating on logical examination to conserve fresh water for sometime later. Nanotechnology offers standout way to deal with waste water treatment by novel systems. Because of it's molecule size which is in the scope of 1-100 nm, the nanoparticles have unique physical, chemical, surface and biological properties when compared to bulk materials. Our studies based on different strategies on treatment methodology utilizing nanomaterials reveals that significant level of nanomaterials are used in squander water treatment. This review is an endeavor to represent the utilization of nanoparticles and its major roles as a capping agent, adsorbate and antimicrobial agent in waste water treatment.

**Keywords:**

Nanotechnology, Nanoparticles, waste water treatment.

## Introduction

Water is the most incredible substance in this world. About one-sixth of the world's population suffers from scarcity of clean drinking water. According to United Nations, by 2025 there will be an increase in the amount of extraction of fresh water resources by 50% in developing countries and 18% in developed countries. In other side due to the increased population and developed civilization the need of water is being obtained through the waste water treatment. It is estimated that in future the urban population will reach approximately 58% by 2025, this leads to increased waste water volumes and this pay the way for the urgent need of innovative and affordable waste water treatment.

Waste water treatment is the process of converting the polluted, disinfected water into drinking or reusable water causing nil or minimal environmental hazards by using chemical or natural agents according to the toxic nature of the water. Infinite number of techniques is being practiced for the treatment of waste water, like chemical agent such as chlorine, nitrate and their derivatives, Ultraviolet light, Water sediment filters, Activated carbon, Ion exchange water softener, Ozonisation, Activated alumina 'Altered' water etc.,, out of which chlorine (Cl) and bromine (Br) are widely used for antibacterial agents, but due to its toxicity and vapor pressure in pure form causes serious health hazards. The another important pollutant affecting the health is the ammonia which makes the drinking water unsuitable, its removal is important to prevent growth of algae, oxygen depletion etc., Even this type of ammonia contaminated water can be processed by Zeolite process by using Na+, K+ etc.,

Nanotechnology is another important field, and its significance is due to its particle size which is in the range of 1-100 nm have unique physicochemical, mechanical, electrical, optical, magnetic and surface properties contributes solutions for many global level issues includes medicine, water treatment, energy harvesting, agriculture etc.., There are many types of nanomaterial like carbon nanotubes, metal oxide nanoparticles, nanoparticles, composites, dendrimers, nanowires, nanofilms, fullerenes, Quantum dots etc., Out of which nanoparticles are significantly used for the waste water treatment due to their large surface area, unique adsorption properties due to their different surface sites and disordered region hence they react quickly because of this it is also used as a catalyst in many reactions.

Most of the waste water from the industrial effluents are mainly made up of toxic metal ions like Hg(II), Pb(II), Cr(III), Cr(VI), Ni(II), Cd(II), As(V), and As(III) causing environmental hazards and health problems. Nanostructured materials like carbon-iron nanoparticles, nanostructured iron zeolite, magnetic nanoparticles etc., are used in the treatment of waste water for the removal of pollutants or contaminants.

### DIFFERENT METHODS FOR SYNTHESIS OF IRON NANOPARTICLES:

Synthesis of Iron Nanoparticles are mainly classified into three main types:

1.Chemical methods

2.Physical methods

3.Biological methods

Chemical methods includes Sonochemical, Thermal decomposition, Co-precipitation, Electrochemical decomposition, Hydrothermal, Micro-emulsion methods. Physical methods includes Aerosal, Gas phase deposition, Electron beam lithography, Pulsed laser ablation, Laser induced pyrolysis, Power ball milling method. Biological method includes Plant mediated, Fungi mediated and Bacteria mediated. Out of which Chemical methods are the most widely used methos because of their tuning structural parameters leads to many other desired appications.

### CO-PRECIPITATION METHOD:

Co-precipitation is the most commonly used technique for obtaining high purity and better stoichiometric control nanoparticles. It can also produce wide variety of particle size ranging from submicron to tens of microns. There are three main mechanism (types) of Co-precipitation: Formation of mixed crystals, Occlusion, Surface adsorption. It is the simple method and a rapid preparation method. Composition and Size can be controlled and even the particle surface state and the homogeneity can be modified. The pH is recommended to be above 8 to obtain better end product as the particle size is dependent on the pH value.

### COMBUSTION METHOD:

Another method for the preparation of pure homogenous powder with nano-crystalline is Solution Combustion Synthesis. It uses salts like nitrates, carbonates, sulfates as supporting agents (as oxidants or reducing agents) and glycine, sucrose, urea and other carbohydrates. Once the reaction started with heating, an exothermic reaction occurs results in a fine powder. This process is considered as the quick and easy process, as saving time and energy. The parameters of combustion plays a vital role in producing a pure

and homogenous nano-powder like type of flame, temperature, generated gases, air-fuel-oxidant ratio and chemical composition.

**SOL-GEL AUTOCOMBUSTION METHOD:**

It is another important and attracted method for the better control of stoichiometry, nano-range crystalline size, ultra-fine hexaferrite powders. It makes use of oxidizing metal salts and combusting agent and its main significance is they are extremely facile, time & energy saving. This method uses a solution in its initial step of preparation leads to dispersion of reactants and resulting in a homogenous reaction mixture. It can considered as the thermally induced redox reaction and the released energy during this process plays vital role to form particles. It also pay the way for the multicomponent oxides with single phase and with high surface area.

**HYDROTHERMAL METHOD:**

A method suitable to produce the different chemical compounds using closed physical and chemical processes at the temperature of 100 deg celcius and pressure above 1 atm. The essential parameter needed for the fine result are the duration, temperature, pressure, initial pH. The main significance of this method is that it has the ability to synthesize particles which are unstable near the melting point and high quality large crystals. Most synthesized substances by this method is Zeolite.

**THERMAL DECOMPOSITION METHOD:**

It is one of the innovative technique for the synthesis of the stable mono-dispersed nanoparticles and attracts for its easiest preparation of controlled size and shape of nanoparticles economically. The main factors such as nature of metallic ion and the force of reaction with ligands in co-ordination compounds have significant effects on the temperature and pressure. The main highlight is that no stabilizing agents are required by this method.

**ROLE AND APPLICATION OF IRON IN WATER TREATMENT FOR NITROGEN REMOVAL: A Review**

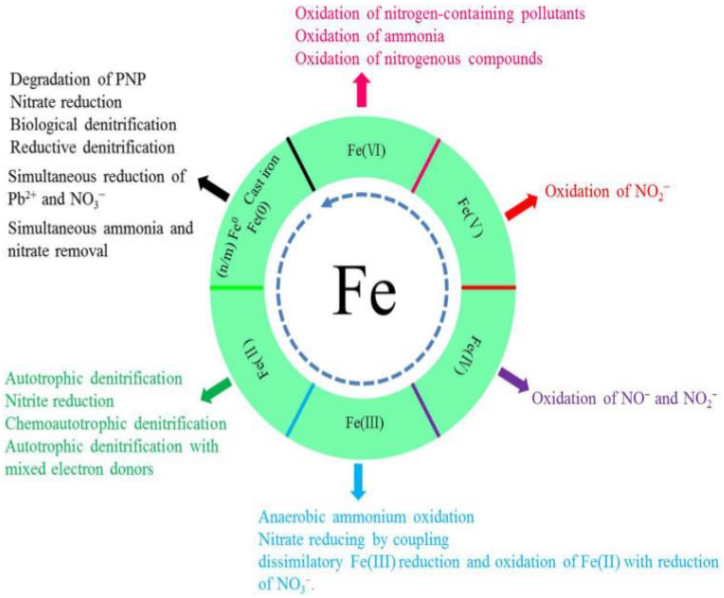
In which the material Iron was reviewed about its efficient role in nitrogen removal using various method and with different combination. Mostly Iron Nanoparticles were prepared by the modified Physical or Chemical methods, and mainly aimed to prevent passivation; to provide continuous activation of passive layers; to provide accessible surface area and to improve mass and electron transfer efficiency. Mostly, premagnetization were done to reduce the nitrate activity and selectivity by means of increasing mass transfer.

Macrophorous alginate substrate base Fe Nps prepared by chemical methods to prevent agglomeration. Mesophorous spheres of Cu on Iron/Aluminium oxide with iron content prepared for the applications of denitrification. Nitrate decline was successfully achieved faster using electrochemical and ultrasonic methods.

Size of the nanoparticles also plays an important role in efficiency of Iron Nps, nanosized particles showed more reactive than micron-scale powder, with high specific area, increasing the surface reactivity.

Different combinations were done out of which Cu-Pd/nFe showed Nitrogen Selectivity, Nitrate removal and acts as a bimetallic catalyst. Kaolinite-Fe/Ni were done showed simultaneous removal of Cu(II) and nitrate. Fe-Pd-Chelating resin showed selective reduction of nitrate to nitrogen.

For the removal of chemical nitrate, Electron transfer, Iron as catalyst, Pertinent chemical reactions were done . To remove the biologically coupled Nitrate, Electron transfer and Chemical reaction were used.




Though Iron nanoparticles achieved higher rate of removal of Nitrogen, there were some constraints like the experimental conditions, size of the particles, hindrances due to other products, and intermediates.

Water plays a significant role in our daily basis. The importance of water is an incredible substance in this world. Due to the increased population, improved civilization, developed industries and increased need, leads to the scarcity of water in and around the world. As a result the amount of waste water generated is another critical issue which further impure the fresh water or usable water as waste water. The need of properly degrading is highly needed.

Though there are many techniques to treat waste water, nanotechnology plays a vital role in the treatment of water. As nanoparticle has fine crystal size and large surface area, it acts as a very suitable material for the absorption of toxic substances which cannot be met by another techniques cleverly.

In this paper, the importance of water treatment and various chemical methods have been discussed. Various techniques to treat the industrial effluents with the help of nanoparticles like copper, cobalt, and ferrite combination played a capping agent, absorbate, antimicrobial or antibacterial role which removed the pollutants or toxic substances completely. Another important use of this nanoparticles are they are highly having recovery rate, which acts as cost efficient and economical.