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A Review

Role of nanomaterials in catalytic reduction of organic pollutants

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Developing innovative technologies for the effective treatment of wastewater containing organic pollutants is of extreme importance across the globe. The organic pollutants such as dyes and nitrophenols are the common hazardous pollutants known for their adverse effects on humans and aquatic organisms. Various methods have been used for the removal of organic pollutants from wastewater but they suffer limitations such as high cost, time consuming removal process and production of sludge or toxic by-products. In recent years, chemical reduction method is becoming popular for removal of organic pollutants using various nanomaterials as catalysts. Nanomaterials show great potential for removal of organic pollutants due to large surface area which provides high catalytic activity. In the present review, current studies on catalytic reduction of organic pollutants (dyes and nitrophenols) using four different types of nanomaterials specifically carbon nanotubes, silica, metal oxide and chitosan polymer based have been explored. The factors affecting the catalytic process and mechanism of catalysis is explained in detail.In addition, a critical discussion about the pros and cons of each nano-catalyst have also been included for developing better understanding of the choice of catalyst.

Keywords: Catalysis,Catalytic reduction, Nanomaterials, Organic pollutants, Wastewater treatment

Introduction

Water is such an important element in our lives that needs no explanation to prove its significance. It is part of our day-to-day activities and its most vital need is in quenching our thirst which makes its purity equally important, as polluted water can cause water borne diseases which can be even more deadly. The current situation of the water bodies is considerably poor. The main reason of this condition is the increasing industrialisation. To overcome this situation, we need to find a solution to reduce the pollution caused by release of toxic and non-biodegradable waste materials into the water bodies. Pollution is rising at an alarming rate has caused harm to the lives of human beings and aquatic species too. The most important topic of research for the researchers is to reduce this pollution level as fast as we can and as soon as possible. These pollutants include agricultural wastes, pesticides and sewage effluents, but the major contributor to this water pollution is industrial wastes like dyes, organic and inorganic compounds, chemicals and their improper treatment before releasing them in the aquatic systems. The damage is already done, so it is high time to tighten our belts and find an excellent technique for the environmental remediation. Besides heavy metals, the most concerning contaminants are the organic pollutants as they are non-biodegradable and are therefore persistent in the environment. Organic pollutants include pharmaceuticals, organic dyes, chemicals, pesticides, nitro containing compounds *etc*. which are deteriorating the quality of surface water, ground water as well as drinking water. So, remediation of water pollution is an urgent need. Toxicity of organic pollutants is highly dangerous as they can be carcinogenic, skin allergic and can even cause respiratory disorders[1,2]. Nitroaromatic compounds are mainly used in various industries for synthesis of pharmaceuticals, dyes, pigments, explosives *etc*. Nitrophenols have many negative impacts on human body as they cause irritation in nose, throat or lungs. They can penetrate our skin and can even cause problem in breathing. They can damage kidney, liver and central nervous system of human beings. Due to their environmental stability and non-biodegradability, their removal from water is difficult by the traditional water treatment methods. After knowing the toxic effects of nitrophenols the Environmental Protection Agency (EPA) has classified it as the primary pollutant and set its maximum permissible limit in natural water upto 10 ppb[3]. Dyes are another major water pollutant. They are mainly used to impart color to the fabrics, cosmetics, food, pharmaceuticals *etc*. They are highly hazardous and

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