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Recent Progress in Nanomaterials for Adsorptive Removal of Organic Contaminants from Wastewater

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Water being most vital component of life is getting contaminated due to inhuman disposal of toxicants in water bodies. Organic compounds such as dyes, pharmaceuticals/drugs, pesticides etc. are used for various purposes and become life threatening when dumped in water bodies without pre-treatment. Removal of these toxicants from environment is complicated but highly essential for sustainable development. Various methods have been used for this purpose among which adsorption is the most simple, fast, effective and inexpensive method for the removal of such contaminants. Nanomaterial proved to be one of the best adsorbent due to its unique structural properties which provides large surface area and high adsorption capacity. The factors affecting adsorption along with adsorption mechanism is discussed in detail. Detection of the pollutants is also quite tedious work as pollutants are present in trace quantity. UV-Visible spectrophotometry is widely used detection technique which is easy to operate, produce accurate results and cheap. The review emphasizes the use of nanomaterial as adsorbents for the removal of various organic pollutants from wastewater using UV-Visible spectrophotometry.

1. Introduction

Water is the most essential component of life and no one can survive without water. There is very less fresh water present on earth's crust, which is getting contaminated due to inappropriate dumping of waste in the rivers. The rapid growth in technology and industrialization is the major cause of addition of contaminants in water. Drinking the contaminated water causes many deadly diseases due to which lots of people dies every year. The contaminated water is not only harmful for human beings but also affects the entire ecosystem. The marine life is highly disturbed due to dumping of waste in sea. The wastewater contains mainly two types of contaminants inorganic and organic. Inorganic contaminants include toxic heavy metal ions, while organic contaminants include dyes, pesticides, pharmaceutical drugs, volatile organic compounds, and aromatic hydrocarbons etc. All pollutants either inorganic or organic, affects the environment. The presence of toxic metal ions even in low concentration can lead to many diseases which are harmful for living beings. Organic pollutants such as dyes which are used in many industries as colouring material are highly toxic and carcinogenic. Other organic pollutants as pesticides used in agricultural field to increase the quality as well as quantity of food also exhibit considerable toxic effects on living organisms. Since the presence of contaminants in water has bad effect on all organisms as well as on environment their removal is highly important.[1]

There are various techniques such as filtration, precipitation, sedimentation, coagulation, adsorption, oxidation, distillation, osmosis etc. have been used for the treatment of waste water. These techniques have certain limitation as they are individually not sufficient for all types of contaminants and some of them are even not effective in removal of toxic microbes which lead to diseases like cholera, typhoid, etc. So, the need of simple, fast and efficient method to remove contaminants from water is still going on. *Adsorption* is the most widely used technique for removal of toxicants from water. In this technique a porous material is used as adsorbent, on the surface of which the adsorbate (pollutant) get adsorbed and hence, removed from water. The adsorption has many advantages such as simple operational conditions, availability of variety of adsorbents, low cost and applicability on large scale. Many adsorbents including activated carbon, zeolites, polymers clays etc. are used for this purpose. These adsorbents are inert, easily available and can remove most of pollutants from water, but still are not that effective for the pollutants present in minute concentration. Other limitations include high cost and less reusability of these adsorbents. So, there is large scope to synthesize new adsorbents with effective adsorption capacity.[2]

Nowadays, Nanotechnology has emerged as the advanced technology which gives tool in the hands of scientists to prepare such sorbents which are quite effective in removal of contaminants from water. Nano means reducing the size of any material at nanoscale and by doing so, the properties of that material change tremendously. As the size of any material decreases, its surface area increases and large surface provide more adsorption sites which ultimately enhance the adsorption capacity.

The other advantage of nanomaterial is its regeneration ability and reusability for several cycles. Many nano-adsorbents

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