Review on natural method for wastewater treatment

Revisão sobre método natural para tratamento de águas residuais

Revisión sobre método natural para el tratamiento de aguas residuales

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ABSTRACT
In the present era of scarcity of water resources, effective treatment of wastewater is major prerequisite for growing economy. It is critical to develop and implement advanced wastewater treatment technologies with high efficiency and low capital requirement. Among various treatments, recent advanced processes in nano-material sciences have been attracting the attention of scientists. However, limited collective knowledge is available in this context. The present manuscript reviews the potential developments in nanotechnology with respect to wastewater treatment. The article reviewed and discussed utilization of various classes of nano-materials for wastewater treatment processes.

Keywords: water treatment, natural resource, nanotechnology, nano absorbent, nano coagulant.
RESUMO
Na atual era de escassez de recursos hídrios, o tratamento eficaz de águas residuais é um pré-requisito importante para a economia em crescimento. É crucial desenvolver e implementar tecnologias avançadas de tratamento de águas residuais com alta eficiência e baixo requerimento de capital. Entre os diversos tratamentos, os processos avançados recentes nas ciências de nano-materiais têm atraído a atenção dos cientistas. No entanto, há um conhecimento coletivo limitado disponível neste contexto. O presente manuscrito revisa os desenvolvimentos potenciais em nanotecnologia com relação ao tratamento de águas residuais. O artigo revisou e discutiu a utilização de diversas classes de nano-materiais para processos de tratamento de águas residuais.

Palavras-chave: tratamento de água, recurso natural, nanotecnologia, nanoabsorvente, nanocoagulante.

RESUMEN
En la presente era de escasez de recursos hídricos, el tratamiento efectivo de aguas residuales es un requisito importante para la economía en crecimiento. Es crucial desarrollar e implementar tecnologías avanzadas de tratamiento de aguas residuales con alta eficiencia y bajo requerimiento de capital. Entre los diversos tratamientos, los procesos avanzados recientes en las ciencias de nano-materiales han estado atrayendo la atención de los científicos. Sin embargo, hay un conocimiento colectivo limitado disponible en este contexto. El presente manuscrito revisa los desarrollos potenciales en nanotecnología con respecto al tratamiento de aguas residuales. El artículo revisó y discutió la utilización de diversas clases de nano-materiales para procesos de tratamiento de aguas residuales.

Palabras clave: tratamiento de agua, recurso natural, nanotecnología, nanoabsorbente, nanocoagulante.

1 INTRODUCTION

With the rapid development of urbanization and industrialization, numerous contaminants were discharged from industrial production and households into aquatic environment. These contaminants include nutrients, toxic substances such as heavy metals, organic compounds, dyes, parasites and many other complex compounds, which have caused severe influence both on the health of ecological environment and human beings. Consequently, removal of toxic pollutants from wastewater is needed. For this purpose, a number of conventional methods like precipitation, coagulation and other physicochemical technologies have been commonly employed. However, these approaches have been restricted by many factors, such as the increasing stringent water quality standards, the appearance of emerging contaminants, lower removal efficiency, complicated operating conditions, and expensive costs. For instance, chlorination could...
generate various disinfection by-products (DBPs) with a high mutagenic and carcinogenic risk as well as undesirable odors and tastes during the treatment process. Ion exchange, require complex condition actions and exhibit poor universality, which cannot meet the demands of rigorous water quality standards[1]. The advantage of nanoscience and nanotechnology have suggested that many environmental concerns involving wastewater decontamination could be solved or greatly diminished through the utilization of several promising nanomaterials. A variety of nanomaterials with unique functionalities such as nano adsorbents, nano catalysts, nano structured membranes, have been considered as efficient, economical, and environmental-friendly substitutes to the current wastewater treatment agents.

To the best of our knowledge, no detailed investigation has been carried on the study of natural root to removal of impurities in wastewater treatment. Comparative studies were shown in table1

2 CLASSIFICATION OF NATURAL COAGULANT

<table>
<thead>
<tr>
<th>Plant-based coagulants</th>
<th>Non-plant-based coagulants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moringaoleifera seeds</td>
<td>Chitosan</td>
</tr>
<tr>
<td>google images</td>
<td>google images</td>
</tr>
<tr>
<td>Water Melon Seeds</td>
<td>google images</td>
</tr>
<tr>
<td>Nirmali seeds</td>
<td>ShrimpShell</td>
</tr>
<tr>
<td>google images</td>
<td></td>
</tr>
</tbody>
</table>
3 APPLICATIONS OF NATURAL COAGULANTS TO TREAT WASTEWATER

The natural coagulants are used in wastewater treatments include microbial polysaccharides, starches, gelatingalactomannans, cellulose derivatives, chitosan, glues, and alginate. Coagulants which carry natural characteristics supposed to be harmless for human health, whereas existence of aluminium zest may provoke neurology & pathology diseases [1].

3.1 NAOMATERIAL/NANOCOMPOSITE

Nanomaterials have effectively contributed to the development of more efficient and cost-effective water filtration processes since membrane technology was considered as one of the advanced water/wastewater treatment processes. Nanoparticles have been frequently used in the manufacturing of membranes, allowing permeability control and fouling-resistance in various structures and relevant functionalities. [2] Some of the Examples of potential applications of nanotechnology in water/wastewater treatment were given in the table 2.
Table2: Method of removal and significant applications

<table>
<thead>
<tr>
<th>Applications</th>
<th>Examples of nanomaterials</th>
<th>Some of novel properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adsorption</td>
<td>CNTs/nanoscale metal oxide and nanofibers</td>
<td>High specific surface area and assessable adsorption sites, selective and more adsorption sites, short intra particle diffusion distance, tunable surface chemistry, easy reuse, and so forth.</td>
</tr>
<tr>
<td>Disinfection</td>
<td>Nanosilver/titanium dioxide (Ag/TiO$_2$) and CNTs</td>
<td>Strong antimicrobial activity, low toxicity and cost, high chemical stability ease of use, and so forth.</td>
</tr>
<tr>
<td>Photocatalysis</td>
<td>Nano-TiO$_2$ and Fullerene derivatives</td>
<td>Photocatalytic activity in solar spectrum, low human toxicity, high stability and selectivity, low cost, and so forth.</td>
</tr>
<tr>
<td>Membranes</td>
<td>NanoAg/TiO$_2$/Zeolites/Magnetite and CNTs</td>
<td>Strong antimicrobial activity, hydrophilicity low toxicity to humans, high mechanical and chemical stability, high permeability and selectivity, photocatalytic activity, and so forth.</td>
</tr>
</tbody>
</table>

Sources: By the author

3.2 NANO-ADSORBENTS

Nano-adsorbents are broadly classified into various groups based on their role in adsorption process. It includes metallic nano-particles, nano structured mixed oxides, magnetic NPs and metallic oxide NPs. Besides that, a recent development on carbonaceous nano-materials (CNMs) included carbon nanotubes, carbon nano-particles and carbon nano sheets. Moreover, various types of silicon nano-material are also used as nano-adsorbents such as silicon nanotubes, silicon nanoparticles and silicon nanosheets [3].

3.3 NANO DISINFECTION

Disinfection is an effective method to remove organic contaminants and biological pollutants such as pathogens from wastewater sources. While conventional technologies (e.g., chlorination, ozonation, could form hazardous DBPs in the decontamination process and pose a threat to human health. Advance in nanotechnology provide a new perspective to overcome weakness of these old methods. Carbonaceous nanomaterials exhibit strong antibacterial activity and lower oxidation ability could effectively inactivate pathogens under visible-light irradiation or direct contact, have low tendency to form DBPs. Graphene-based a nano composites were widely investigated as disinfectants. The
magnetic graphene developed by [4]Some nanoparticles were used as disinfection material, such as Ag, TiO$_2$, ZnO.

3.4 NANO-PHOTOCATALYSIS

Nanoparticle photocatalytic reactions are based on interaction of light energy with metallic nano-particles were great interest due to their broad and high photocatalytic activities for various pollutants [5]. Photocatalysts were comprised of semiconductor metals that can degrade variety of persistent organic pollutants in wastewater such as dyes, detergents, pesticides and volatile organic compound [6]. The simple mechanism of the working of photocatalysis is based on the photoexcitation of electron in the catalyst. The irradiation with light (UV in case of TiO$_2$) generates holes (h$^+$) and exited electrons (e-) in the conduction band. In an aqueous media, the holes (h$^+$) are trapped by water molecules (H$_2$O) and generate hydroxyl radicals (·OH) [7].

3.5 EVALUATION OF NANO-PARTICLES IN WASTEWATER TREATMENT

The application of nanotechnology for water remediation reported the following water filtration membranes produced from nanomaterials: i) nanostructured membranes from nanomaterials such as carbon nanotubes, nanoparticles and dendrimers, and ii) nanoreactive membranes from metal nanoparticles and other nanomaterial. Effective adsorbents include: i) activated carbon, ii) clay minerals and silicas, iii) zeolites, iv) metal oxides, and v) modified composites. The decomposition of organic compounds in water as well as the disinfection of water under UV light using TiO$_2$ mediated photocatalyst is gaining popularity as the effectiveness of the photocatalyst has been demonstrated by many scientific studies. Nanotechnology for water remediation will play a crucial role in water security and consequently the food security of the world. The applications of nanotechnology in the cleanup of contaminated water could be summarized with various parameter shown in Table 3.
Table 3: Result of removal efficiency with various parameters

<table>
<thead>
<tr>
<th>Natural Coagulant</th>
<th>Turbidity (NTU)</th>
<th>TDS (mg/L)</th>
<th>pH</th>
<th>Removal efficiency (PU %)</th>
<th>Ref no</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moringaoleifera seeds</td>
<td>4.25</td>
<td>305</td>
<td>9</td>
<td>64</td>
<td>[8]</td>
</tr>
<tr>
<td>Water Melon Seeds</td>
<td>0.95</td>
<td>437</td>
<td>7.26</td>
<td>89</td>
<td>[9]</td>
</tr>
<tr>
<td>Chitosan</td>
<td>0.65</td>
<td>-</td>
<td>9</td>
<td>86</td>
<td>[10]</td>
</tr>
<tr>
<td>ShrimpShell</td>
<td>0.72</td>
<td>-</td>
<td>7</td>
<td>96</td>
<td>[11]</td>
</tr>
</tbody>
</table>

Sources: By the author

4 CONCLUSION

In this review highlighted that natural resource material combined with nanoparticle should give effective waste water removal. Function of coagulants in wastewater treatment is to remove various parameters. Coagulants are present in two form, first is plant based coagulants and second is non-plant based coagulants. The treatment through bio coagulants signifies to a vital development in viable environment for better worth of eco-system particularly for less urbanised area. An attempt is using eco-friendly coagulant as a natural coagulant for the process of coagulation to treat wastewater. For the future studies were carried out for the processing technique such as composite polymerization and impregnation method can be incorporated in producing coagulants with enhanced capability.
REFERENCES


