



A review of pre- and post-surface-modified neem (*Azadirachta indica*) biomass adsorbent: Surface functionalization mechanism and application

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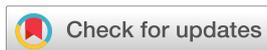
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Highlights

- Neem-derived biomass adsorbents are promising in pollutant removal.
- Surface modifications of neem-derived adsorbent increase their adsorption capacity.

- H_3PO_4 -impregnation is effective in the preparation of neem-derived adsorbents.
- Neem-derived adsorbents have so far not been used against nitrate ions and caffeine molecules.

Abstract

In contemporary wastewater treatment industry, advanced oxidation techniques, membrane filtration, ion exchange, and reverse osmosis are used to treat chemically loaded wastewater. All these methods required highly toxic oxidizing chemicals, high capital investment in membrane/filter materials, and the installation of sophisticated equipment. Wastewater treatment through an adsorption process using biomass-based adsorbent is economical, user-friendly, and sustainable. Neem tree waste has been explored as an adsorbent for wastewater treatment. The chemical components in the neem biomass include carbohydrates, fat, fiber, cellulose, hemicellulose, and lignin, which support the functionalization of neem biomass. Moreover, adsorbent preparation from renewable resources is not only cost-effective and environmentally friendly but also helps in waste management for sustainable growth. Contemporary researchers explored the pre- and post-surface-modified neem biomass adsorbents in scavenging the pollutants from contaminated water. This review extensively explores the activation process of neem biomass, physical and chemical methods of surface modification mechanism, and the factors affecting surface modification. The pollutant removal through pre and post-surface-modified neem biomass adsorbents was also summarized. Furthermore, it also provides a comprehensive summary of the factors that affect the adsorption performance of the neem biomass-derived adsorbents against dyes, metal ions, and other emerging pollutants. Understanding the surface-modification mechanisms and the adsorption efficiency factor of adsorbents will help in harnessing their potential for more efficiently combatting environmental pollution and making strides toward a greener and more sustainable future.

Graphical abstract



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