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Health risks associated with high level of nitrate in water and its removal by adsorption on organic-inorganic hybrid bio-composites

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Anthropologic activities including industrialization and agricultural practices contributed immeasurably to the imbalances in the nitrogen cycle and resulted in alarmingly increased levels of nitrate in drinking water sources and other water bodies, imposing a serious threat to human health and contributing to eutrophication. High nitrate concentrations in drinking water sources can lead to a potential risk to public health causing methaemoglobinaemia and cancer. Among the unit operations in water treatment, adsorption occupies an important position since it is an efficient and economically feasible process for nitrate removal from water. Chitosan is the promising adsorbent material due to low cost, biocompatibility, biodegradability and non-toxicity. In this study, chitosan based organic-inorganic hybrid bio-composites, such as chitosan/bentonite, chitosan/titanium oxide and chitosan/alumina (ChBT, ChTi and ChAl, respectively) were prepared and characterized. Stability of bio-composites significantly increased with crosslinker and inorganic dosage. Adsorption capacities considerably decreased at higher crosslinker dosage. The rate of adsorption rates were higher at the initial stages and decreased in the later stages due to the decrease in concentration gradient with time and equilibrium adsorption was established beyond 120 min. The adsorption capacity increased drastically with the increase in initial nitrate concentration. Higher equilibrium adsorption capacities were obtained in the pH range of 4-8. At optimum operating conditions, the actual adsorption capacities of ChBT, ChTi and ChAl were 35.68 and 43.62, and 45.38 mg/g as nitrate, respectively. Adsorption capacities increased with the increased temperature in the range 283 K to 313 K and decreased above 313 K. Regeneration study shows ChBT, ChTi and ChAl reusable adsorbent to nitrate removal from water. Among the three adsorbents, ChAl has shown highest stability and performance in all operating conditions.

Biography

Wondalem Misganaw Golie has completed his PhD in Chemical Engineering from Indian Institute of Technology Delhi, New Delhi, India in October 2017. His research interest includes separation and purification technology, reaction engineering, environmental engineering, environmental chemistry, environmental biotechnology, pollution control, water and wastewater treatment, adsorption and bio-sorption, applications of biopolymers, biocomposites and smart materials in environmental engineering.

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