Chapter 11
Innovative Approaches to Water Purification Harnessing Bio-Chemical Adsorbents for Multistage Potable Water Filtration

Manjappa Kiran Kumar
https://orcid.org/0000-0001-5397-8254
Sir M. Visvesvaraya Institute of Technology, India

Krishnappa Madhu Kumar
https://orcid.org/0000-0002-7174-9110
Sir M. Visvesvaraya Institute of Technology, India

Nagaraj Sasi Kumar
https://orcid.org/0000-0003-3988-4782
Sir M. Visvesvaraya Institute of Technology, India

ABSTRACT

Lifestyle choices significantly shape the intricate chemical makeup of the human body, impacting health and lifespan. The use of bio-chemical adsorbents in multi-stage potable water filtration represents a major breakthrough in addressing global water quality challenges. The fundamentals of bio-chemical adsorbents are discussed, distinguishing between bio-based and chemical materials and highlighting various types such as activated carbon, biochar, and graphene oxide. The concept

DOI: 10.4018/979-8-3373-0669-8.ch011

of multistage filtration systems is introduced by major advantages over single-stage systems and key design considerations. The chapter then delves into the applications of bio-chemical adsorbents in water purification, presenting case studies and comparative analyses with traditional methods to demonstrate their efficacy and performance metrics. Strategies to enhance adsorption efficiency through surface modifications, hybrid systems, and composite materials are explored in detail with targets on environmental impact, sustainability, regulatory standards, and future trends on bio-chemical adsorbents.

1. INTRODUCTION TO BIO-CHEMICAL ADSORBENTS

1.1 Importance of Water Purification

Ensuring the purity of water is crucial for human life. The impartment objective because water purification is necessary. Water original sources usually have bacteria, viruses, parasites, chemicals, and other impurities that can be harmful to human health. Water purification methods remove these impurities, making the water safe for consumption. Without water purification, people could contract water-borne diseases like hepatitis, typhoid, dysentery, and cholera A. These are fatal, can spread quickly, especially in places with poor sanitation (Nwadike et al., 2024). Water purification methods like filtration and activated carbon treatment can improve the taste and Odor of water by removing substances like chlorine, heavy metals, and organic compounds. This makes the water more palatable and encourages people to drink more (Abu Hasan et al., 2020). Water purification can protect from contaminating the natural water sources, thus protecting the environment. Polluted water can harm aquatic life, contaminate soil and damage crops. Purification methods can remove these pollutants, ensuring a clean water supply for all. Water purification guarantees that everyone has access to clean drinking water, supports health, and safeguards the environment. It is necessary for human life (Nagar & Pradeep, 2020).

1.2 Challenges in Current Methods of Water Treatment

Several challenges in current water treatment methods, including, with a growing population and urbanization, the demand for water is increasing. This puts a strain on water treatment plants, which must treat more water to meet the demand (E. Li et al., 2015). Many water treatment plants and distribution systems in the United States were built in the early to mid-20th century and are now in need of replacement or repair. This can lead to issues such as leaks, which may compromise water quality (Reams, 2021). New contaminants are being discovered in water sources,

Hydrogen Peroxide (H2O2) Decomposition as Green Propellant: Overview of Synthesized Catalysts

Hajar Jabri, Abdelaziz Sahibeddineand Rachid Amrousse (2025). *Innovative Materials for Environmental and Aerospace Applications (pp. 247-278).*
www.irma-international.org/chapter/hydrogen-peroxide-h2o2-decomposition-as-green-propellant/364275