

# Chapter 4

# Approach of Microbial Consortia in the Field of Industrial and Pharmaceutical Wastewater Remediation

**Prakash Baburao Rathod**

*School of Chemical Sciences, Kavayitri Bahinabai Choudhari North Maharashtra University, Jalgaon, India*

**Mahendra P. Singh**

*Shri Sadguru Saibaba Science and Commerce College, Ashti, India*

**Uddhav S. Markad**

 <https://orcid.org/0000-0003-3543-0898>

*University of Notre Dame, USA*

## **ABSTRACT**

*The increasing prevalence of industrial and pharmaceutical waste in water bodies poses a significant environmental threat, challenging traditional wastewater treatment methods. This has necessitated the exploration of innovative, sustainable approaches for effective remediation. Among these, the use of microbial consortia has emerged as a promising solution, harnessing the synergistic interactions of diverse microorganisms to degrade complex pollutants more efficiently than single-species cultures. Microbial consortia are composed of multiple microbial species, each with distinct metabolic capabilities, that work together to break down various contaminants found in industrial and pharmaceutical wastewater. The use of mi-*

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*icrobial consortia enhances biodegradation through cooperative interactions, where one species' metabolic byproducts can serve as substrates for another, leading to complete mineralization of pollutants. This chapter discusses the mechanism by which microbial consortia function in wastewater remediation. Additionally, it explores the application of microbial consortia*

## **INTRODUCTION**

Most of the world's population faces water crises because of global warming and pollution. Water pollution is a prime issue nowadays and a critical environmental issue that has significant implications for ecosystems, public health, and international water resources. Industries such as manufacturing, mining, and chemical production generate large volumes of wastewater that accommodate a collection of pollutants containing heavy metals (e.g., mercury, lead, Chromium(VI), and cadmium) (Rathod et al., 2018) organic compounds and toxic chemicals. These substances, when discharged untreated or inadequately treated into water bodies (Rathod et al., 2023). These metals accumulate in the environment and can poison aquatic life, disrupting reproduction, growth, and survival rates. For example, mercury can bioaccumulate in the food chain, leading to high concentrations in fish consumed by humans and posing significant health risks, such as neurological damage (Yakkala et al., 2021). Contaminants in industrial wastewater can enter drinking water supplies, posing direct risks to human health. For instance, exposure to primary levels of heavy metals can lead to significant health issues, including cancer, kidney damage, and developmental disorders in children (Rathod et al., 2019). Additionally, industrial pollutants can degrade the quality of water sources used for agriculture, contaminating crops and further exacerbating food safety issues (Rathod et al., 2024; Taware et al., 2024). It is crucial to address these problems with comprehensive scientific solutions. Various conventional techniques are known for water remediation, including physical processes such as sedimentation, filtration, and aeration, as well as chemical processes like catalytic remediation, coagulation, flocculation, disinfection, and precipitation. Biological activities, like constructed wetlands, trickling filters, and the activated sludge process, are also commonly used, along with advanced oxidation processes, ion exchange, fiber filtration (Lee et al., 2008), membrane filtration (Chappa et al., 2018; Yakkala et al., 2021), adsorption, and thermal processes. Each of these processes has specific applications in water treatment, contingent on the kind of contaminants and the scale of treatment required. However, many of these processes have disadvantages, such as the need for additional chemicals and physical interventions, which can negatively impact users. Activated carbon has shown promise as an adsorbent for removing industrial pollutants, but the cost of activated carbon

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