



Use of Natural and Modified Zeolites for the Treatment of Brewery Wastewater: Efficiency, Regenerability, and Environmental Applications

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The industrial production of beer has a significant environmental impact, particularly related to the generation of wastewater with high organic and inorganic load. For every liter of beer produced, up to ten liters of water are required, used in cleaning, cooling, and rinsing processes (Simate et al., 2011). These wastewater contain biodegradable organic compounds, nitrogenous compounds and phosphates, chemical additives, and detergents, which contribute to high chemical oxygen demand (COD), pH variability, and the presence of suspended solids. If not properly treated, these effluents can compromise aquatic ecosystems and promote eutrophication (Simate et al., 2011; B. Sawadogo et al., 2018). Recent studies (Irma et al., 2025, Bahmanzadegan & Ghaemi, 2025) have highlighted the adsorption capacity of zeolites, either natural or modified microporous minerals, in removing ammonia, phosphates, heavy metals, and dyes. This capacity is attributed to their high surface area and crystalline structure, which enhance the efficiency of the contaminant removal process. However, the effectiveness of zeolites is strongly dependent on environmental parameters and the regenerability of the material. The project aims to investigate the use of natural and modified zeolites in the removal of pollutants from brewery wastewater, evaluating their efficiency under real operational conditions and the potential for recovery and reuse of the materials used.

REFERENCES

- Simate, G. S., Cluett, J., Iyuke, S. E., Musapatika, E. T., Ndlovu, S., Walubita, L. F., & Alvarez, A. E. (2011). The treatment of brewery wastewater for reuse: State of the art. *Desalination*, 273(2-3), 235–247. <https://doi.org/10.1016/j.desal.2011.02.035>
- B. Sawadogo, Y. Konaté, Lesage, G., H. Mounboue Djanni, F. Zaviska, Heran, M., & H. Karambiri. (2018). Beer and soft drinks industry wastewater treatment using an anoxic-aerobic membrane bioreactor (MBR) coupling with



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nanofiltration in Sahelian context. Desalination and Water Treatment, 126, 32–39.

<https://doi.org/10.5004/dwt.2018.22801>

Bahmanzadegan, F., & Ghaemi, A. (2025). A comprehensive review on novel zeolite-based adsorbents for environmental pollutant. Journal of Hazardous Materials Advances, 17, 100617.

<https://doi.org/10.1016/j.hazadv.2025.100617>

Irma, M., Foo, K. Y., Susilawati, S., Md Yusof, E. N., Nishiyama, N., & Sabar, S. (2025). Advancements in zeolite and zeolite-based sorbents: Modification strategies in mitigating nitrogen-containing pollutants from water and wastewater. Inorganic Chemistry Communications, 172, 113715.

<https://doi.org/10.1016/j.inoche.2024.113715>Pap

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