Biostimulation: Green Solution for Treatment of Wastewater with High Organic Load

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INTRODUCTION

The quality of life on Earth is directly related to the general state of the environment as a complex whole consisting of several ecosystems. The constant progress of science and the improvement of technology and industry have led to the pollution of air, water, and soil. One of the biggest problems is the increase of potentially hazardous pollutants in water, which can endanger human health and harm other living organisms. Significant amounts of pollutants are released into the environment through the waste leachates. These types of wastewater carry a high level of organic matter and require physical, chemical, or biological treatment before discharge into the environment. Greener approaches to wastewater treatment strategies aim to promote sustainable and environmentally friendly wastewater treatment methods while reducing the environmental impact of traditional wastewater treatment processes [1].

Bioremediation technology is becoming increasingly important in overcoming these challenges, as it offers a sustainable and highly effective solution for the elimination of various types of pollution. Pollutants are converted into non-toxic products and by-products through processes of biodegradation or biotransformation by the enzymatic catabolic potential of microorganisms. To improve the effectiveness of bioremediation, additional tools are introduced, such as the optimisation of process factors through biostimulation and the use of indigenous or exogenous cultures as inoculants in bioaugmentation.

METHODS

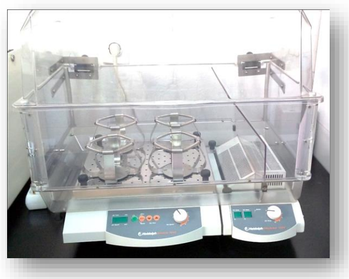
- In this work, the effectiveness of organic pollution removal by ***biostimulation*** with ***autochthonous microbial cultures*** in leachates with high organic load was investigated.

Biowaste

Organic fraction of municipal waste (OFMW)

- The leachates were obtained from biowaste and the organic fraction of municipal solid waste (OFMW) using a standard method [2].

- The experiments were carried out under submerged conditions in a batch process. The homogeneity of the system was achieved using a rotary shaker (160 rpm, 25±2 °C).



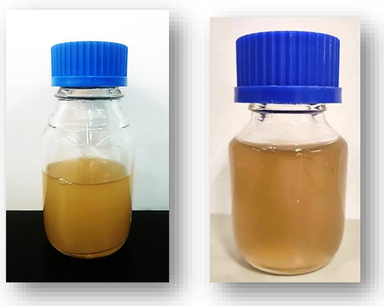
- The physico-chemical properties were measured for 8 days, with the concentration of organic matter expressed as chemical oxygen demand (COD).

- Microscopic analysis was performed to obtain a quick insight into the formation of the biomass of the leachate ecosystem

RESULTS

Table 1. Initial physico-chemical properties of obtained leachates from biowaste and OFMW.

	Biowaste	OFMW
COD, mg/L	11065	11968
TSS, g/L	0.86	1.34
pH, -	5.74	4.77
DO, mg/L	0.1	2.8
κ, mS/cm	2.99	6.96
color (λ=455 nm)	1508	396
OD (λ=600 nm)	0.73	0.93



Biowaste leachate OFMW leachate

- COD value indicates high organic content in obtained leachates.

RESULTS AND DISCUSSION

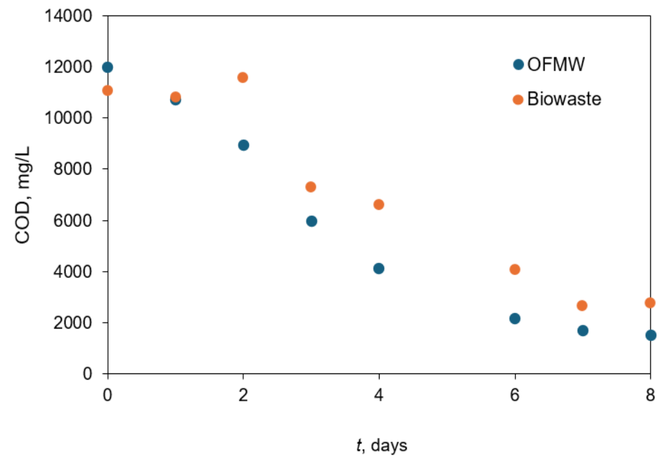


Figure 1. Change in chemical oxygen demand in the leachate bioremediation experiment over 8 days.

- The results obtained showed that the autochthonous microbial community is able to remove organic matter from wastewater with high organic load when biostimulated.

- The maximum removal efficiency of organic matter was 87% for the leachate from the organic fraction of municipal solid waste (OFMW).

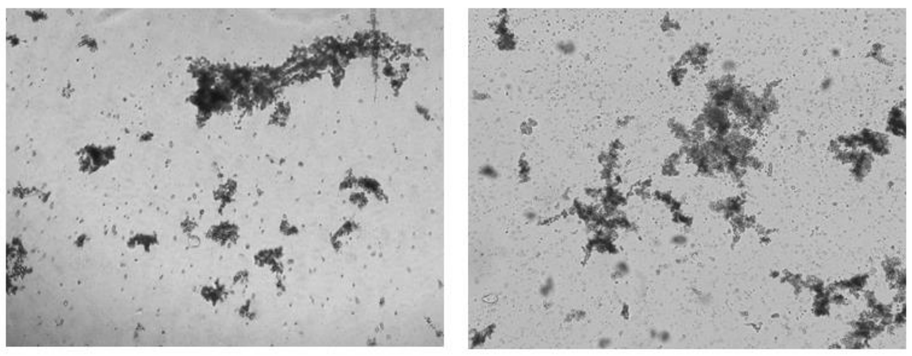


Figure 2. Microphotographs of activated sludge flocs in 6th day of biostimulation experiment for leachate from biowaste (left) and leachate from organic fraction of municipal waste (right); M=100×.

- Microscopic analysis showed the development of activated sludge flocs in both types of leachate.

CONCLUSIONS

- Leachates from generated waste represent a specific type of wastewater, due to its high organic load which can significantly impact the environment.
- Microscopic analysis is a quick and simple way of monitoring the formation process of activated sludge flocs.
- Bioremediation technology has the potential to utilise the metabolism of autochthonous microorganisms to treat wastewater with a high organic load.
- Biostimulation represents a simple but effective green solution to wastewater treatment challenges.

References:

[1] Mathew, J.T., Inobeme, A., Musah, M., Azeh, Y., AbdullahI, A., Shaba, E.Y., Salihu, A.M., Muhammad, E.B., Josiah, J.G., Jibrin, N.A., Ismail, H., Muhammad, A.I., Maurice, J., Mamman, A., Ndamitso, M.M. 2024 A Critical Review of Green Approach on Wastewater Treatment Strategies. J. Appl. Sci. Environ. Manage. 28, 363–391.

[2]EN 12457-4:2002, Characterization of waste – Leaching; Compliance test for leaching of granular waste materials and sludges – Part 4: One-stage batch test at a liquid to solids ratio of 10 l/kg for materials with particle size below 10 (without or with size reduction), European Committee for Standardization.