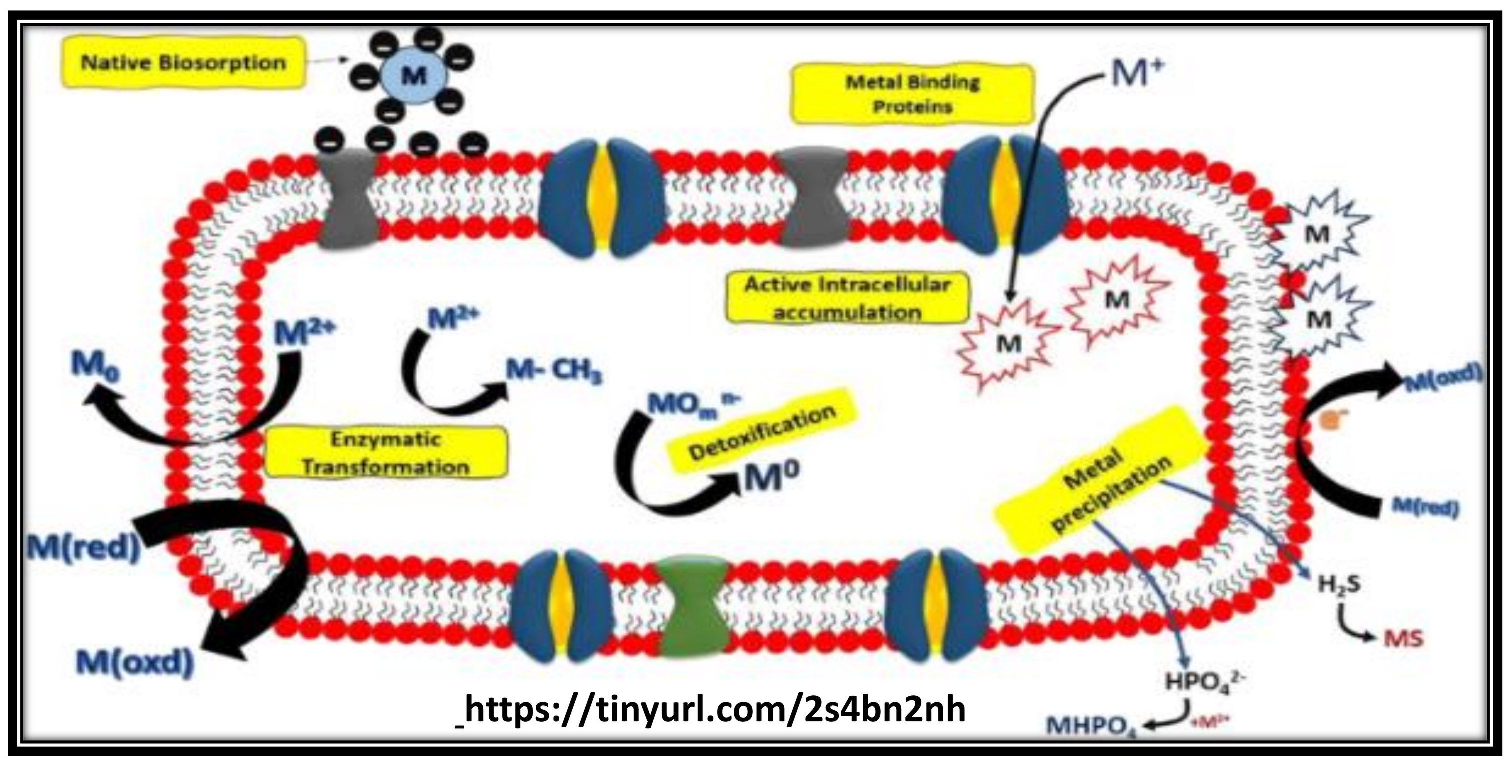
Comparing the efficiency of the biofiltration system with humic substances and resin in heavy metals removal in wastewater

Shozeb Javed, Prof. Dr M. R. Ghomi and Prof. Dr Ulrike Gayh.

INTRODUCTION

Environmental pollution due to anthropogenic activities and natural resources is increasing daily because of industrialization. It is becoming difficult for scientists to find ways to tackle the contaminants degrading environmental health [1]. Heavy metals in water and wastewater are an emerging issue these years due to the growing population, climate change and urbanization, leading to water scarcity throughout the world. The main source of toxic metals in streams is effluents from industries, such as electroplating, paints, plastics and batteries. For this concern, environmental awareness is growing among consumers and industrialists and legal constraints on the discharge of effluents, necessitate a need for cost-effective alternate technologies [2]. There are a variety of ways used to clean the metals from industrial wastewater – chemical precipitation, ion – exchange, leaching, electrolytes, hydrolysis, reverse osmosis, landfilling, excavation and chemical extraction, activated sludge, membrane filtration and oxidation ditches, and a few others. These methodologies are not always helpful in removing very low concentrations of heavy metals [3].

To tackle this problem, biosorption can be used to remove organic pollutants from wastewater and water. The process includes the use of different types of biomasses including algae, fungi, bacteria and plants. The bacteria involves various ways to remove metals from the wastewater – Biosorption, enzymatic Transformation, Intracellular accumulation, detoxification binding with proteins and precipitation.

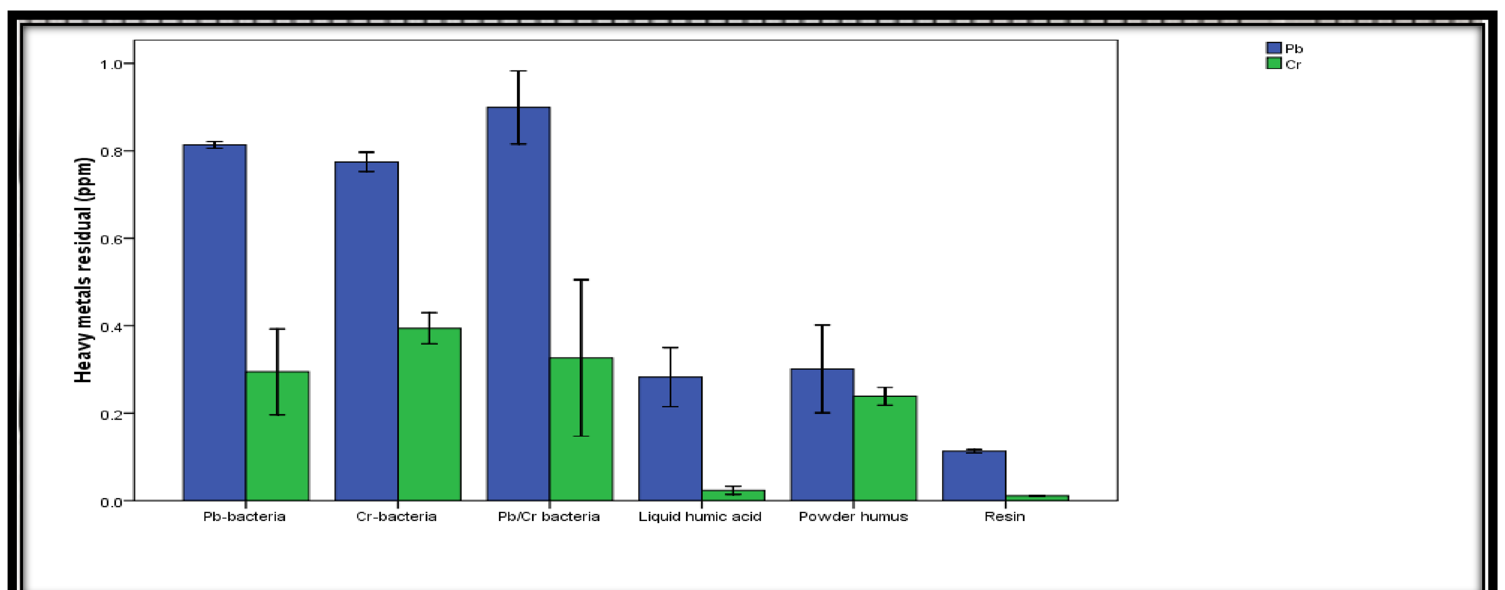


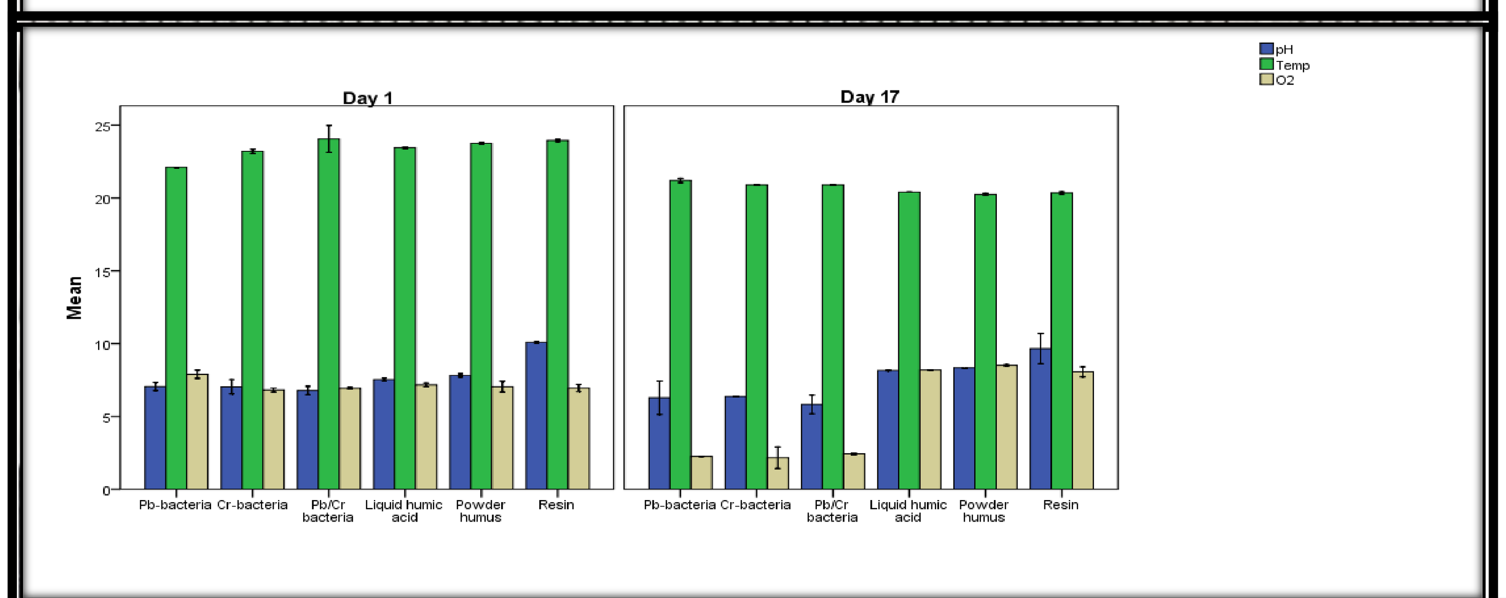
METHODOLOGY

Artificial wastewater was created in the water lab of SRH with various concentrations of two heavy metals (Cr and Pb) in distilled water. Bacteria were isolated from the Neckar river for bioremediation as a biofilter using nutrient broth, for initial screening of the culture and then finally in nutrient agar by pour plate method for the final screening. Acclimation was done for 16 days in biofilters as a batch process. Rohm and Hass Amber Lite MB 20 mixed-bed exchanger resin supplied from Amazon and Powder humus and Humic Acid (0.1%), supplied by HUMIN Tech, Germany was used to comparing the efficacy of the two metals removal with the biofilter created. The highest concentration of the metals obtained after the final screening in dilution of 10^6 was administered with 10 L volume in the biofilter set-up. On the 17th day (for biofilters) and after 2 hrs in the case of resin and humic substances, the concentration of two heavy metals was determined using kits - LCK 306 and 313 and instrument DR 3900 and physical parameters – pH, DO and temperature using probes in Multimeter.

RESULT

The resin had the highest reduction of lead (0.11 ppm residual), followed by humic acid (0.28) and powdered humus (0.3), and finally by three bacterial biofiltration systems. The chromium, resin and liquid humic acid have shown the greatest amount of mitigation and their results are significantly different ($P< 0.05$) from powder humus and three biofiltration treatments. The pH in our experiment was tending to be acidic in biofilter groups and significantly became different ($P < 0.05$) from humic and resin. The temperature had no significant difference among all groups during our experiment. Finally, dissolved oxygen (DO) showed a huge reduction in biofilter treatments and it shows that the bacterial metabolic activities got the oxygen from the solution containing bacteria rather than resin and humic groups





CONCLUSION

In conclusion, however, the biofilter had less efficacy to mitigate both Cr and Pb than those of resin and humic groups, but overall showed a good amount of mitigation more than 90% of the initial concentration.

REFERENCES

1) Ahemad, M., Khan, M.S., Zaidi, A. and Wani, P.A. (2009). Remediation of Herbicides contaminated soil using microbes. In: *Microbes in sustainable agriculture*. Khan, M.S., Zaidi, A., Musarrat, J., (eds.) Nova Science Publishers, New York, 261–284.
2) Rao, K.R., Rashmi. K., Latha, J.N. L and Mohan, P.M (2005). Bioremediation of toxic metal ion using biomass of Aspergillus fumigatus from fermentative waste: *Indian Journal of Biotechnology*.**4**: 139.
3) Carreño-Sayago, U.F. (2021). Development of microspheres using water hyacinth (*Eichhornia crassipes*) for the treatment of contaminated water with Cr (VI). *Environ. Dev. Sustain*. **23**, 4735–4746.

WWW.DEMOCRATIA-AQUA.ORG

Funded by the DAAD from funds of the Federal Foreign Office:
DAAD Deutscher Akademischer Austauschdienst German Academic Exchange Service
Federal Foreign Office