

Haute Ecole Spécialisée de Suisse occidentale

Fachhochschule Westschweiz

University of Applied Sciences and Arts Western Switzerland

Master of Science HES-SO in Life Sciences

Keratin Based Biosorbent for Chemical Waste Treatment

Pauline Daul

CHEMICAL DEVELOPMENT & PRODUCTION

HEIA-FR

Advisor: Dr. Véronique Breguet Mercier

DESCRIPTION & OBJECTIFS

This master's thesis focuses on the treatment of wastewater through biosorption using keratin-based products. The main objective is to valorize keratin-rich waste, such as feathers, hair, and wool, to capture heavy metals in aqueous environments. These non-biodegradable and toxic metals pose a major threat to both the environment and human health. Keratin is a protein found in nature in the form of α -keratin and β -keratin and composed of several functional groups capable of bonding to metals.



The sustainability objectives include selecting a green treatment and optimizing the process to minimize waste production. Additionally, the implementation of a flow system suitable for scale-up is optimized. Adsorption tests are conducted on copper and samples analyzed by AAS.



Wang, B.; Yang, W.; McKittrick, J.; Meyers, M. A. Keratin: Structure Occurrence in Biological Organisms, and Efforts at Bioinspiration. Prog. Mater. Sci. 2

RESULTS

Keratin based biosorbent development

Selection of adsorbent









β-Keratin

Duck feathers

60% of Cu²⁺ adsorbed

Selection of treatment



→ Best treatment is 2M NaOH

Saturation



→ Best adsorbent is wool treated with 2M NaOH

Optimization of treatment



The 1M NaOH solution appears to be a promising treatment for copper recovery in aqueous media. It offers several improvements that contribute to a reduction in waste production. A potential perspective would be to test the reuse of NaOH until the treatment loses its effectiveness. The flow system presents issues related to flow distribution and a decrease in the maximum adsorption capacity of the treated wool. Additional tests could be conducted using a larger column, which would eliminate the need for grinding and sieving the treated wool. If flow issues persist, an optimization of the batch method should be considered.

