

# Renewable keratin wastes for use in mining

## A. Main topics

- Exploration and RM resource assessment
- Recycling and Substitution

## B. Targeted audience

14-19 years old students

## C. Key concepts

### 1. Keratin

Keratin is the most abundant non-food protein being the major component of wool, hair, horns, nails and feather. Keratin sources as poor quality raw wool not fit for spinning, hair and feather from butchery and wool fibre wastes from the textile industry, account for more than 5 million tons per year. For these reasons, keratin-based wastes represent an important **raw matter** which should be better exploited. The disposal of this biomasses is a great problem, since its burning for fuel is inefficient and polluting because of its high sulphur content (3–4% wt).

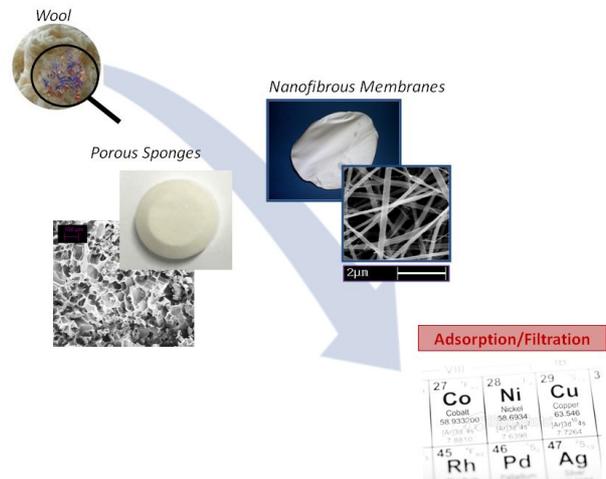
In recent years, there has been a growing interest in developing bio-based materials to produce economic and environmentally sustainable commodities for large-scale uses in several sectors (biomedical, automotive, packaging technical textiles, etc.). Biopolymers from sustainable resources are being considered as alternatives to commodity synthetic polymers because they are biodegradable and/or environmentally friendly. In this context, keratin extracted from keratin-based wastes can be used to prepare biodegradable new products for biomedical fields (scaffolds and drug delivery systems) and filtration systems for water deputation and air cleaning.

- Lectures
- Discussion and tests

### 2. Keratin for mining

Keratin is a good metal ion adsorbent because of the presence of numerous polar and ionisable groups, both on the backbone and on the side chain, which can remove charged metal ions (copper, chromium, lead, nickel, etc.) from water. The keratin extracted from wool can be processed into highly porous materials as sponges or nanofibrous membranes with increased adsorption capacities towards heavy metals.

- Lectures
- Discussion and tests



## D. Experimental activity

### a) Educational hands on RM toolkits

The proposed experiment is useful to learn about proteins starting from wool

The experiment consists in:

- the extraction of keratin of wool using a suitable extraction solution;
- keratin flocculation using a protein denaturing agent;
- recover of keratin powder by decantation or centrifugation.



### b) Recovery of heavy-metals from water

Adsorption experiments of copper ions by keratin-based materials will be carried out by immersing wool into copper sulphate solutions at different initial concentrations. An evaluation of the amount of copper ions adsorbed will be carried out by visual comparison of both final solutions and dyed wool (or by using a spectrophotometer if possible).

The experiment consists in:

- Preparation of  $\text{Cu}^{2+}$  solutions at different concentration;
- Adsorption procedure by immersing wool sliver samples in the copper solutions;
- Detection of  $\text{Cu}^{2+}$  concentration of the treated solutions.

## E. Toolkit material

- Wool and chemicals useful for the experiments
- Protocol with the description of the experiments
- Pedagogical dossier with explications, pictures, etc. that can be used by the teacher
- Multimedia tools (videos with processes that use the concepts seen during the experimentation)

## F. For information on the toolkit

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