TITLE: Bio-waste valorisation for heavy metal sorption

LAB & PEOPLE

- Name of the hosting lab: Environmental analytical chemistry (4.4.4.016, Department of Analytical Chemistry, Faculty of Sciences, University of Cadiz)

- General activities of the lab:
  - Innovation in preconcentration, separation and analysis methodologies for trace elements.
  - Study of the potential of bio-waste as metal biosorbents.
  - Design of sensing molecules and optical sensors for metal determination.
  - Evaluation of metal pollution in aquatic ecosystems: speciation, bioaccumulation, ecotoxicological effects and bioindicators of metal contamination.
  - Chemometric techniques in the development of analysis methodologies and their application in Analytical Chemistry.

- Website:
  https://rnm236.uca.es/
  https://produccioncientifica.uca.es/grupos/7849/detalle/

- Number of staff / PhD: 6/4

- Supervisor name and contact:
  María José Casanueva Marenco
  Department of Analytical Chemistry, Faculty of Sciences, University of Cadiz, Puerto Real, Spain, 11510. E-mail : mariajose.casanueva@uca.es

TOPIC OF THE INTERNSHIP

- Scientific context of the internship (max 20 lines)

Biosorption is an eco-friendly, economic and efficient technique applied for different purposes, which complies with the principles of green chemistry. It is defined as a metabolism-independent process (passive uptake) using biosorbents for the elimination or retention of different pollutants, such as heavy metals.

Biomass cost and its origin represent a vital criterion to be considered for the biosorbent selection. Non-living biomass has many advantages due to the absence of media and nutrients requirements, absence of toxicity limitations, possible reusability and easier mathematical and statistical modelling of pollutants uptake, among others. On the other hand, the use of bio-waste

leads to waste minimization, also obtaining low operating and manufacturing cost, flexibility, ease of operation and high efficiency.

Generally, the biosorption process is based on the physicochemical features of the biosorbent (solubility, molecular size, surface charge, chemical composition, reactivity and hydrophobicity). Also, factors like pH, temperature, reaction time, stirring, initial concentration of sorbate or sorbent dose often influence the biosorption process.

The aim of this research is to explore and study new non-living potential green bisorbents (agriculture and industrial by-products/waste or plant waste) in order to retain heavy metals from aqueous samples or enrich biomass in nutritional elements to be used as feed supplements and fertilizers.

Keywords: non-living biomass, heavy metals biosorption, waste valorisation

Bibliography:

- A.M. Elgarahy, K.Z. Elwakeel, S.H. Mohammad, G.A. Elshoubaky, A critical review of biosorption of dyes, heavy metals and metalloids from wastewater as an efficient and green process, Cleaner Engineering and Technology, 4, 2021, 100209. https://doi.org/10.1016/j.clet.2021.100209.
- A.A. Beni, A. Esmaeili, Biosorption, an efficient method for removing heavy metals from industrial effluents: A Review, Environmental Technology & Innovation, 17, 2020, 100503.
  https://doi.org/10.1016/j.eti.2019.100503.
- K. Chojnacka, M. Mikulewicz, Green analytical methods of metals determination in biosorption studies, TrAC Trends in Analytical Chemistry, 116, 2019, 254-265.
  https://doi.org/10.1016/j.trac.2019.02.013.
- L. Sánchez-Ponce, M.D. Granado-Castro, M.J. Casanueva-Marenco, M.D. Galindo-Riaño, M. Díaz-de-Alba, Sherry wine industry by-product as potential biosorbent for the removal of Cr(VI) from aqueous medium, Biomass Conversion and Biorefinery, 2021.
  http://dx.doi.org/10.1007/s13399-021-02053-0
- L. Sánchez-Ponce, M. Díaz-de Alba, M.J. Casanueva-Marenco, J. Gestoso-Rojas, M. Ortega-Iguña, M.D. Galindo Riaño, M.D. Granado-Castro, Potential Use of Low-Cost Agri-Food Waste as Biosorbents for the Removal of Cd(II), Co(II), Ni(II) and Pb(II) from Aqueous Solutions, Separations, 9, 2022, 309.
  https://doi.org/10.3390/separations9100309

- Tasks and duties entrusted to the student:

The student will collaborate in:

1. Research on new potential biomass to be used as biosorbent for heavy metal sorption.
2. Biosorbent pre-treatment/s

3. Physicochemical characterisation of the selected biosorbent/s.
4. Design and optimisation of a method for heavy metals biosorption.
5. Detection of metals using different instrumental techniques.
6. Study of the analytical features of the proposed method.
7. Application and validation of the biosorption method.
8. Tasks related to the application of statistical and chemometric techniques in chemical analysis.
9. Scientific search and writing.

- Skills to be acquired or developed:

1. Handling of common preparation, separation and preconcentration methods of samples for heavy metal analysis.
2. Knowledge of physicochemical characterisation of biomass-based biosorbents.
3. Management of diverse instrumentation, mainly molecular and atomic spectroscopy (ICP-OES, ICP-MS, AAS) for metal analysis.
4. Knowledge of optimisation of a method and its application in heavy metal analysis.
5. Application of data processing tools.
6. Ability to interpret and discuss the results obtained.

PROFILE OF THE DESIRED STUDENT

- Minimum level of study required: university graduate

- Field(s) of study: chemistry (analytical or environmental profile)

- Scientific skills: laboratory skills (handling of material and equipment, basic laboratory operations, etc.); scientific reading and writing; management of data processing software

- Language skills required: spoken and written English (medium or high level)

THE INTERNSHIP ASSIGNMENT:

Desired duration of the internship (in months): 3-6 months

Desired Starting date of the mission: *(please indicate the level of flexibility):* between 1st October 2023 – 31st July 2024

Indicative weekly schedule: *25 h / week*

These internships will receive Erasmus+ funding

Internship agreement: *an internship agreement will be signed.*

To SEA-EU students:

If you're interested please send your CV and letter of motivation to the scientist in charge, mariajose.casanueva@uca.es