

Sujet de thèse / PhD proposal

Préparation et utilisation de éco-adsorbants biosourcés à partir de résidus d'électronique imprimée pour l'élimination composés organiques dans les effluents papetiers

Epuration of effluents from the paper/pulp industry by eco-sorbents – Synthesis, characterization and efficiency

Dates	February 2023 to February 2026
Duration	3 years
Location	RAPSODEE, IMT Mines Albi / ISCR, ENSC Rennes
Required level and qualification	Master 2 / Engineer Chemistry, material, analysis, processes
Gross salary	≈ 2100 € /month

Description

The ANR program “REVeBIO” takes place in the context of the growth of printed electronic-devices production. New questions arise regarding the end-of-life of such products and in particular their recyclability and their impact on environment and health. To fulfill the targets of the European Green Deal and to include the development of these new electronic bio-based materials within a circular economy, one objective of the REVeBIO project aims at **valorizing and reusing the recovered rejects made of a mixture of cellulosic fines and minerals**. For that purpose, the partial thermo-conversion of the carbon-containing rejects, originating from the silver extraction, into an eco-sorbent suitable for the remediation of effluents derived from paper manufacturing, converting and printing processes.

The first stage of the project will be carried out in RAPSODEE (Albi, France). Biochar-based eco-sorbents will be produced by a partial thermo-conversion of the solid and liquid rejects of the process after silver recovery. The most suitable thermochemical conversion route will be selected according to the characteristics of the reject, namely its moisture content and composition. As a result, a biochar or a hydrochar will be produced, which can be used as an eco-sorbent for the effluent epuration process. The mixture of carbon-rich rejects, based on non-recoverable fibers, and metal-rich rejects, may allow tuning biochar properties to produce an eco-sorbent with catalytic properties in regard to targeted chemical compounds to be eliminated from effluents. A strong collaboration between the partners of the REVeBIO project in the tasks ‘eco-sorbents production’, ‘effluents characterization and treatment’, and ‘reject metallic composition’ will allow to link the targeted compounds in effluents epuration with the available metals in rejects for biochar production. The eco-sorbents produced will be fully characterized in terms of stability, composition, and structure (TGA-DSC, CHNS, ICP-OES, BET, microscopy, XRD, TPX, etc).

In the second stage, a depth analysis of the liquid effluent of paper industries will be carried out, for instance a screening to identify the compounds present in liquid effluents of the recycling process. They will be sorted into biodegradable and bioresistant compounds or family of compounds. The biorefractory compounds will be the main targets of the adsorption by eco-sorbents. This work will be conducted in the ISCR (Rennes).

After that, experiments will be carried out with the eco-sorbents produced by RAPSODEE, to evaluate their performances for the elimination of pollutants in the ISCR (Rennes). During this step, not only the targeted compounds, but also the by-products will be analyzed and monitored, in order to propose chemical and physical mechanisms, but also to optimize the process. Thus, batch assays will be carried out in order to determine adsorption isotherms and kinetics if only physical adsorption is responsible of the removal of the selected compounds. By-products analysis will allow to determine mechanisms, and then, to evaluate the catalytic potential of the biochars loaded in metal. On the other hand, the efficiency of the eco-sorbents produced will be determined on the removal of volatile organic compounds (VOC) for air treatment, since the gas emissions by the pulp and paper industry and the printing industry must be treated. Besides adsorption, catalytic oxidations are possible. Therefore, by-products should then be identified in order to understand potential chemical mechanisms during the operation (physical ones and/or catalytic ones).

Applicant qualifications

The candidate should have an engineer title or a master degree in chemistry, chemical engineering, environmental engineering, or materials from biomass. He(She) must have specific skills for a research project: curiosity, scientific precision, perseverance, perspective, teamwork. Oral and writing skills, both in French and English language, will also be required.

Application form

Candidates should submit a CV and a letter of motivation by email before **15/12/2022** to:
Annabelle COUVERT (annabelle.couvert@ensc-rennes.fr) and María GONZALEZ MARTINEZ (maria.gonzalez-martinez@mines-albi.fr)