جامعة السلطان مولاي سليمان
Université Sultan Moulay Slimane
كلية العلوم التطبيقية - بني ملال
Faculté des Sciences Appliquées - Beni Mellal

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Faculté des Sciences Appliquées
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Faculté des Sciences Appliquées de Béni Mellal
Centre d'Études Doctorales « Sciences Pluridisciplinaires »

Avis de soutenance d'une thèse de doctorat

Le Doyen par intérim de la Faculté des Sciences Appliquées de Béni-Mellal porte à la connaissance du public que **Mme Nezha BOUKONTAR** soutiendra une thèse de doctorat intitulée: **Development of hybrid materials based on biopolymers supported by layered double hydroxides for the water remediation: dyes and heavy metals adsorption.**

La soutenance publique aura lieu **le samedi 10 octobre 2026 à 10h00 à l'Amphi A,** devant le jury composé de :

Président	Prof. Hafid Abderrafia	PES	Université Sultan Moulay Slimane, Béni Mellal, Maroc
Rapporteur	Prof. Moujahid El Mostafa	PES	Université Chouaib Doukkali, El Jadida, Maroc
Rapporteur	Prof. Aboulkas Adil	PES	Université Sultan Moulay Slimane, Béni Mellal, Maroc
Rapporteur	Prof. Ouzzine Mohammed	MCH	Université Sultan Moulay Slimane, Béni Mellal, Maroc
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Fiche d'informations sur la thèse

- **Nom de la doctorante :** Nezha BOUKONTAR
  - Master en Chimie de formulation industrielle, Faculté Polydisciplinaire de Béni Mellal, Université Sultan Moulay Slimane.
  - Licence Fondamentale en Sciences de la Matière Chimie, option chimie de formulation, Faculté Polydisciplinaire de Béni Mellal, Université Sultan Moulay Slimane.
- **Directeur de Thèse** : Pr. Abdellatif ESSOUMHI, Sustainable Processes, Advanced Materials and Computational Chemistry Team, Université Sultan Moulay Slimane.
- **Lieu de réalisation du travail:**
  - Sustainable Processes, Advanced Materials and Computational Chemistry Team, Université Sultan Moulay Slimane, Beni Mellal, Maroc.
  - Multidisciplinary Research and Innovation Laboratory, Faculté Polydisciplinaire de Khouribga, Maroc.
- **Période de thèse :** 2020-2021 → 2025-2026.

Articles publiés

1. **Boukontar N**, El Khanchaoui A, Boussetta A, Mansori M, Essoumhi A. Enhanced dye adsorption in LDH-reinforced sugarcane bagasse hybrid composites: a comparative study. J Dispers Sci Technol. 24 avr 2026;1-15. doi:10.1080/01932691.2026.2661850

2. El Khanchaoui A, **Boukontar N**, Sajieddine M, Hnini K, Essoumhi A. Noticeable improvement in adsorption capacity of glycine-modified MgAl-LDH in the removal of Methyl Orange dye compared to urea standard method. Mater Res Innov. 16 avr 2023;27(3):152-62. doi:10.1080/14328917.2022.2101305

3. Adim S, Eddahmi M, Khanchaoui AE, **Boukontar N**, Mansori M, Essoumhi A, et al. Starch-ZnCr/LDH Composite and ZnCr-LDH: Synthesis, Characterization, and Adsorption Efficiency to Remove Congo Red from Aqueous Solution. Current Applied Materials 25 Jun (2024). DOI: 10.2174/0126667312332482241003051640

ABSTRACT

The increase in industrial activity has led to a significant rise in human exposure to dyes and heavy metals. These pollutants are classified as toxic and carcinogenic substances. The release of these substances into the environment can cause a number of harmful effects. Consequently, various techniques are used to remove these pollutants. However, adsorption remains the most suitable technology for this treatment due to its effectiveness and ease of application. Nevertheless, the choice of adsorbents plays a decisive role and adds significant value to the adsorption process.

The aim of this work is to develop bionanocomposites based on inexpensive and widely available biopolymers supported by layered double hydroxides. Then, to assess the adsorption capacity of these hybrid materials in removing dyes and heavy metals from aqueous solutions. To achieve this objective, methylene blue and Congo red have been selected as representative examples of cationic and anionic dyes, respectively. Due to its high toxicity, cadmium is chosen as a representative heavy metal.

The dyes adsorption was carried out using bionanocomposites based on sugarcane bagasse and layered double hydroxides. These bionanocomposites are synthesized using three simple, different methods in order to investigate the influence of the preparation protocol on the dye adsorption efficiency. Adsorption was studied by varying several parameters, such as the pH of the solution, the adsorbent dose, the contact time and the initial dye concentration. The results showed that the adsorption process is a rapid reaction. The pseudo-second-order kinetic model provides the best fit with the experimental data on dye adsorption onto bionanocomposites. The adsorption isotherm data for the dyes were well fitted to the Langmuir and Freundlich models.

The cadmium adsorption study was carried out through comparison of two bionanocomposites. One consists of sugarcane bagasse and layered double hydroxides, whilst the other is based on chitosan and layered double hydroxides. Various parameters were adjusted to control the operating conditions, such as the pH of the solution, the amount of adsorbent, the contact time and the temperature. The adsorption isotherm data are in good agreement with the Langmuir and Freundlich models. The calculated thermodynamic parameters indicated that the adsorption process is endothermic and spontaneous.

The obtained results in this study have shown that all these bionanocomposites are cost-effective and alternative adsorbents for removing toxic substances such as dyes and heavy metals from aqueous solutions.

Key words: Bionanocomposites, Sugarcane bagasse, Chitosan, Layered double hydroxides, Adsorption, Dyes, Heavy metals.