North-East Research Conclave

Sustainable Science and Technology **Extended Abstract** **May 20-22, 2022**

Track : SE

Experimental study on melanoidin adsorption using surface modified *Citrus limon* leaf powder (CLLP)

Rahul Verma[1], Lal Mohan Kundu[1,2], Lalit Mohan Pandey[1,3*]

[1]Centre for the Environment,

Indian Institute of Technology Guwahati, Guwahati, Assam, 781039, India

[2]Department of Chemistry,

Indian Institute of Technology Guwahati, Guwahati, Assam, 781039, India

[3]Bio-interface & Environmental Engineering Lab

Department of Biosciences and Bioengineering,

Indian Institute of Technology Guwahati, Guwahati, Assam, 781039, India

* Corresponding author: Tel. +91-361-258-3201; Fax +91-361-258-2249

Email addresses: rahul23@iitg.ac.in, lmkundu@iitg.ac.in, lalitpandey@iitg.ac.in

Abstract

Melanoidins are considered as high colorants and polluting biopolymers, produced in considerable quantities from molasses-based distillery effluent [1]. In the current study, adsorption of melanoidin was carried out on *Citrus limon* leaf powder (CLLP), as a low-cost natural adsorbent. The adsorption efficiency of *CLLP* was enhanced using amine treatment by forming self-assembled monolayers (SAMs). Experimental conditions such as concentration of adsorbent dosages (% w/v), solution pH and temperature (°C) were optimized by employing response surface methodology-central composite design (RSM-CCD) [2]. The surface modification significantly increased the adsorption capacity by 2.13 folds. The kinetics, thermodynamics and adsorption mechanism were also deciphered. At the optimized condition of temp. 27 °C, pH of 3.1 and adsorbent concentration of 2.0 % w/v, the maximum adsorption capacity of the melanoidin were calculated as 472 mg g^{-1} by the Pseudo-first-order kinetic studies. Higher correlation coefficient (R^2 = 0.99) of the Freundlich and D-R isotherm models, indicating the better fitting of experimental data followed by Langmuir and Temkin isotherm models. In addition, negative change in Gibbs free energy (ΔG) of -9.8 kJ mol^{-1} indicates spontaneous adsorption, whereas the negative change in enthalpy (ΔH) of -5.67 kJ mol^{-1} and positive change in entropy (ΔS) of 13.43 J mol^{-1} K^{-1} indicates exothermic adsorption.

The colour removal and chemical oxygen demand reduction efficiency were determined to be 93 ± 2 and 86 ± 2 %, respectively. FTIR, EDX, and Zeta potential were used to reveal the mechanism of melanoidin adsorption on modified CLLP. Reusability up to 4th consecutive adsorption/desorption cycles demonstrated modified adsorbent's high stability and potency. A similar adsorption study was performed with an industrial-grade spentwash sample to illustrate the usefulness of the present study and found to be 85 ± 1 % color reduction and 79 ± 1 % of COD reduction.

Keywords: Adsorption, Surface modification, Self-assembled monolayers, *Citrus limon*, Melanoidin.

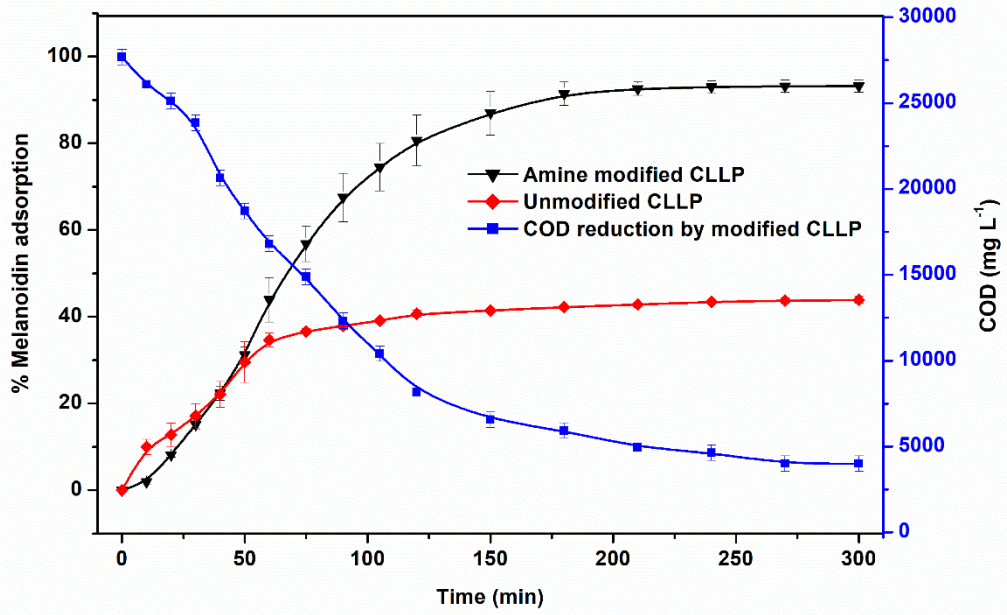

Figure 1: % melanoidin adsorption at optimized conditions by amine-modified/unmodified CLLP and simultaneously reduction of COD by amine-modified CLLP.

References

1. Ahmed, S., et al., *Experimental study and dynamic simulation of melanoidin adsorption from distillery effluent.* Environmental Science and Pollution Research, 2020. **27**(9): p. 9619-9636.
2. Verma, R., et al., *Experimental investigation of molasses as a sole nutrient for the production of an alternative metabolite biosurfactant.* Journal of Water Process Engineering, 2020. **38**: p. 101632.