

Accepted Manuscript

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PII: S0167-7322(17)35643-X

DOI: <https://doi.org/10.1016/j.molliq.2018.02.014>

Reference: MOLLIQ 8656

To appear in: *Journal of Molecular Liquids*

Received date: 22 November 2017

Revised date: 27 January 2018

Accepted date: 2 February 2018

Please cite this article as: Mohamed Mobarak, Ali Q. Selim, Essam A. Mohamed, Moaaz K. Seliem , A superior adsorbent of CTAB/H₂O₂ solution–modified organic carbon rich-clay for hexavalent chromium and methyl orange uptake from solutions. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Molliq(2017), <https://doi.org/10.1016/j.molliq.2018.02.014>

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**A superior adsorbent of CTAB/H₂O₂ solution–modified organic carbon rich-clay
for hexavalent chromium and methyl orange uptake from solutions**

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Abstract

Raw clay (RC) rich in organic matter (OM) was separately treated by hydrogen peroxide (H₂O₂), cetyltrimethylammonium bromide (CTAB) and a solution of CTAB/H₂O₂. The new strategy of RC modification using CTAB/H₂O₂–solution presented a swollen product (CTAB/H₂O₂–clay) with porous structure. Raw and modified clays were characterized by XRD, SEM, FTIR, zeta potential, S_{BET} surface area and tested as adsorbents for hexavalent chromium Cr(VI) and methyl orange (MO) from solutions. Adsorption experiments were conducted under experimental parameters including pH, shaking time, initial concentrations, adsorbent mass, temperature and ionic strength. CTAB/H₂O₂–clay gave the highest adsorption capacities for Cr(VI) and MO as compared to the other products at pH 2.0 and 3.0, respectively. Adsorption equilibrium of Cr(VI) and MO was evaluated using Langmuir, Freundlich, Temkin and Dubinin–Radushkevich models. Langmuir model fitted well the uptake results and the maximum uptake capacities (q_{max}) at room temperature (25 °C) were found to be 67.05 and 194.28 mg/g for Cr(VI) and MO, respectively. The values of mean free energy (E) were greater than 8.0 kJ/mol revealed the chemical nature of Cr(VI) and MO uptake. The pseudo-second-order model with $R^2 = 0.9999$ described well the kinetics data. Thermodynamic parameters (ΔH^0 , ΔG^0 and ΔS^0) indicated that the uptake of Cr(VI) and MO was spontaneous and endothermic.

Keywords: Raw clay; organic matter, hexavalent chromium, methyl orange; adsorption characteristics; thermodynamic studies

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