

How to Obtain Maximum Environmental Applicability from Natural Silicates

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Abstract: Unmodified natural silicates (bentonite, kaolin, clinoptilolite and diatomites) were tested as adsorbents for the organic pollutants in water tables using Methylene Blue (MB) as the model adsorbate. Among the selected materials, bentonite adsorbed as much as 237 mg/g, confirming its excellent suitability for pollutant removal. Spectral evidence confirmed successful MB immobilization at the bentonite surface. Furthermore, the thermal treatment of MB-saturated adsorbent in an inert atmosphere at 700 °C produced a carbon/silicate composite. EDX confirmed the formation of the nitrogen-doped carbon overlay on the silica scaffold and the obtained composite material was probed as an electrode material for oxygen reduction in an alkaline solution. Reduction proceeded via a two-electron mechanism with the main product being HO₂[•], a known nucleophile, which was subsequently used to degrade/demethylate MB. The composite showed a considerable 70% MB removal rate after an hour of electrochemical treatment. The synergy between the processes of adsorption of MB and the surface-generated HO₂[•] dictates the efficiency of the method and points to a possible route for spent adsorbent reuse in the form of a durable product for environmental protection.

Keywords: bentonite; methylene blue; oxygen reduction reaction; spent adsorbent

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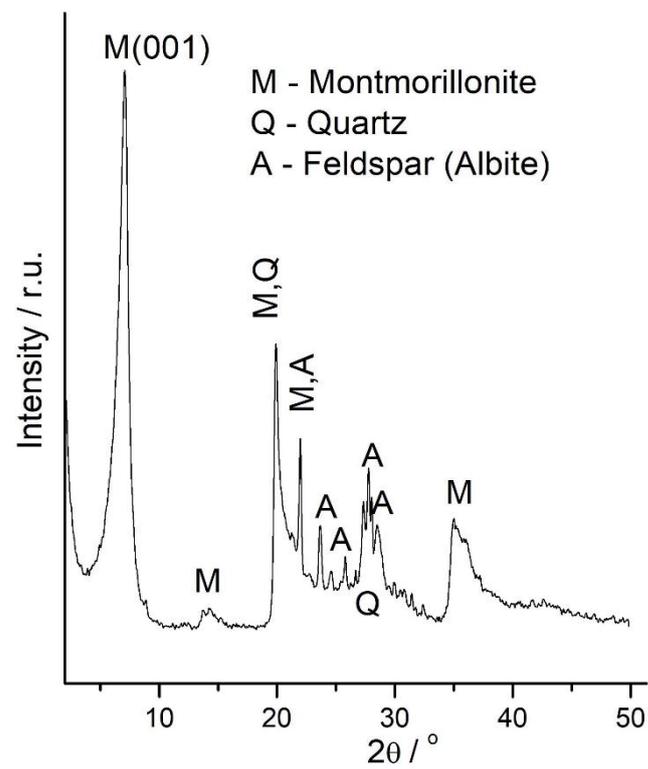


Figure S1. XRD pattern of bentonite sample.

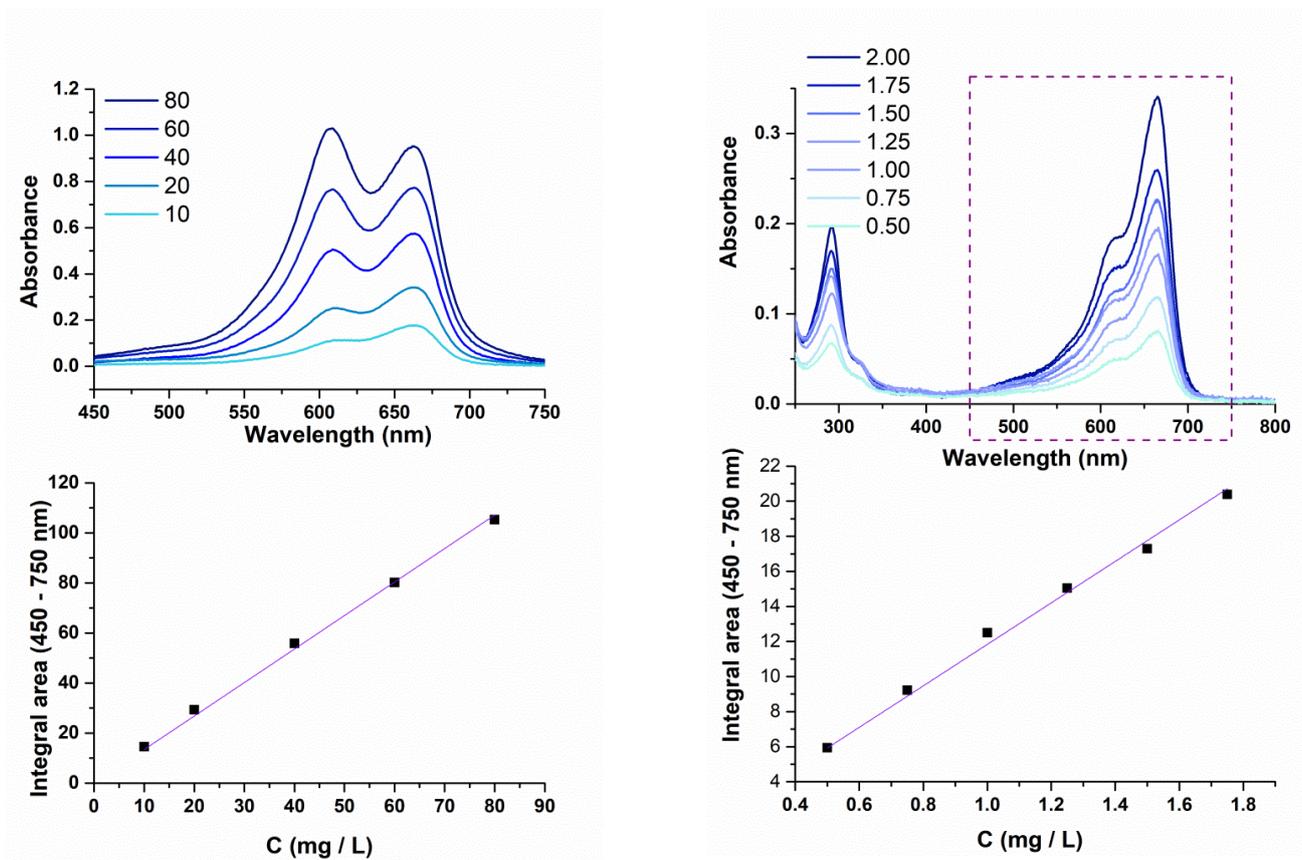


Figure S2. Calibration curve for Methylene Blue (right) aqueous solution and (left) in KOH, based on integral absorption band surface area. The fitted correlation coefficients are 0.999.

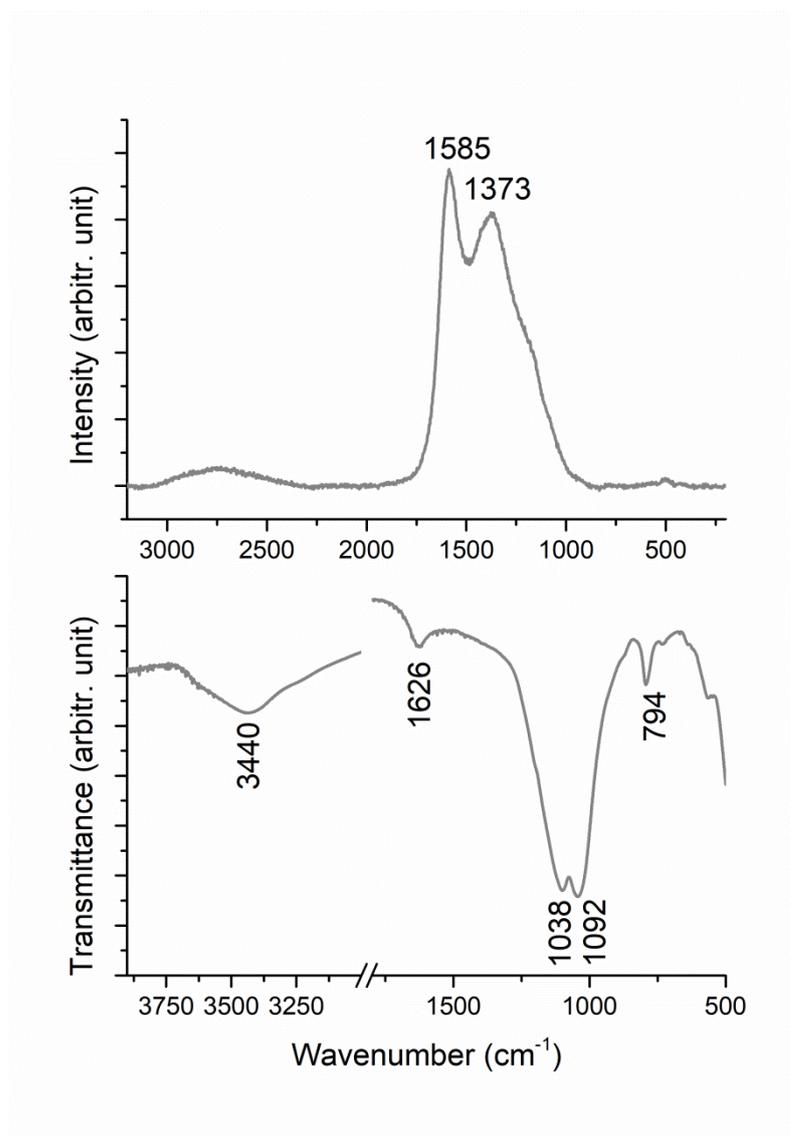


Figure S3. Raman and FTIR spectra of carbonized C-MB@BE sample.