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Characterization and evaluation of sugarcane bagasse ash as an adsorbent for the removal of Cd (II), Ni (II) and Zn (II) ions

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High volumes of cane bagasse ash are produced from cane bagasse combustion used in energy generation in sugar and alcohol production. The objectives of the present work are to evaluate the potential of the sugar cane bagasse ashes from Cuban (CBCC) and Brazilian (CBCB) sugar-alcohol industries, as new adsorbent material suitable for Cd(II), Ni(II) e Zn(II) remotion. A physical - chemical characterization of ashes, consisting in granulometric analysis, bulk and packed density determination, X-ray fluorescence analysis (XFR), thermal analysis (TGA and DTA), X-ray diffraction, Fourier transformed infrared spectroscopy (FTIR), scanning electronic microscopy (SEM) coupled to X-ray dispersive energy spectroscopy (DES) was carried out. This showed the high potential as adsorbent of both ashes. A kinetic study was carried out; equilibrium time of 40 min was reached for Ni(II) and 30 min for Cd(II). The data fixed to a pseudo-second order model. It was possible to identify that the main interaction mechanism in metallic species remotion process was of physical nature. Different models were applied for a better equilibrium data explanation; Langmuir and Toth models were those that best fixed. Kinetic equilibrium study data demonstrated the remotion power of CBCB and CBCC for ions under study with the following order: $Cd(II) \geq Zn(II) > Ni(II)$. Thermodynamic study in static and monocomponent systems allows demonstrating that the process is favorable and spontaneous. Moreover, form this thermodynamic study was verified that a temperature increasing favored the metallic species remotion power. The equilibrium study in static conditions in tricomponent system allows demonstrating that an initial concentration increasing of the species in the mixture caused a decreasing in the adsorption capacity in comparison with the monocomponent system. In dynamic conditions CBCB presented a low mass transfer resistance with better values in adsorption capacity than under static. This allows verifying that under these conditions the adsorbent material had the same selectivity order for metal species under study in comparison with the study under static conditions.

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