Waste coffee valorization for activated carbon production. Porosimetric study using the CPSM model. Application on Cr(VI) removal process from aqueous solution.

Hexavalent chromium (Cr(VI)) is a heavy metal that is highly soluble, and exhibits toxic effects on biological systems. Nevertheless, it is used in many industrial applications. The adsorption process of Cr(VI), using activated carbon (AC), is under investigation globally. On the other hand, around six million tons of spent coffee are sent to landfill annually. Under the spirit of the cyclic economy, this research investigated the production of AC from spent coffee for the removal of Cr(VI) from wastewater. The AC was produced via pyrolysis process under a nitrogen atmosphere. Chemical activation using KOH occurred simultaneously with the pyrolysis process. The produced AC was tested as an absorber of Cr(VI). The best fitted kinetic model was the diffusion-chemisorption model. A 24-hour adsorption experiment was carried out using a solution of pH=3 and initial Cr(VI) concentration 54.14 ppm. This resulted in an experimental maximum capacity of 109 mg/g while the theoretical prediction was 137 mg/g. It also resulted to an initial adsorption rate r_i=110 [mg/(g*h)]. The Brunauer-Emmet-Teller surface area was S_{gBET}=1372 m^2/g, the Langmuir was $S_{gLang.}$=1875 m^2/g, and the Corrugated-Pore-Structure-Model (CPSM) was S_{gCPSM}=1869 m^2/g. The micropore volume according to the CPSM model was 84.6 % exhibiting micropores at D_{micro1}=1.28 and D_{mico2}=1.6 nm. The tortuosity factor according to the CPSM model was τ=4.65.