PYROLYTIC TEMPERATURE EVALUATION OF MACAUBA BIOCHAR FOR URANIUM ADSORPTION FROM AQUEOUS SOLUTIONS

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Macauba (*Acrocomia aculeata*) is a palm tree native to the tropical regions of America. In Brazil, it is prevalent in the savannah, known as "cerrado". A valuable natural and renewable source of vegetable oil for food and cosmetic industries (nut oil) and for biodiesel (mesocarp oil), macauba has the potential to become the new "green gold" of Brazil, not only for its oil quality, but because it could solely be destined for commercial purposes, since it doesn't compete with food market industry such as soybean and sugar cane. The dark stiff part that protects the nut, called "endocarp", is generated as a residue in a considerable amount after the processing of the nut oil. The use of by-products and residues as precursors for the production of widely used adsorbents, such as activated carbons, may impart a value-added component to an already promising biomass. This study aims to demonstrate the potential of macauba endocarp as feedstock for the production of biochar suitable to be used as an adsorbent to remove uranium (VI) from aqueous solutions.

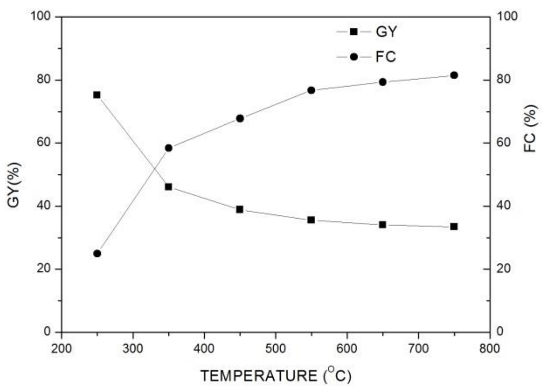

Figure 1 – Correlation between fixed carbon and gravimetric yield for macauba biochar obtained at six different pyrolytic temperatures.

Macauba biochar was produced under inert atmosphere (argon, Ar) at six different pyrolytic temperatures ranging from 250 ºC to 750 ºC, and evaluated for their adsorption capacities ("q") using an aqueous solution of 5 mg L^{-1} of uranium. The highest "qs" were obtained for the non-activated biochar produced at 250 ºC (BC250), followed by the one obtained at 350 ºC (BC350), with a removal percentage of 86% and 80%, respectively. This is most likely due to incomplete carbonization, which provides a material richer in superficial functional groups carrying the ability to bind uranium, as confirmed by characterization using infrared spectroscopy (FT-IR) technique.

In order to investigate and optimize the parameters that affect U(VI) adsorption, such as adsorbent particle size, dosage, contact time and pH of the solution, the working biochar was selected by the correlation between fixed carbon (FC) and gravimetric yield (GY). As shown in Figure 1, the best cost-benefit ratio was achieved when the endocarp was subjected to temperatures between 300 and 350°C, by which it is possible to obtain the largest amount of FC in detriment of the lowest gravimetric loss. This way, it is an advantage to use the BC350 instead the BC250, as corroborated by the gravimetric yield factor (GYF), shown in Figure 2. The GYF obtained for BC350 was 0.27%, whereas the one for BC250 was 0.19%. For temperatures higher than 350°C, the factor acquires a steady tendency, with no significant difference, indicating that any possible gravimetric gain won't justify the costs of working at higher temperatures. This way, the production of biochar at higher temperatures becomes unnecessary, reducing operational time and costs. The adsorption results for non-activated macauba biochar demonstrated its potential for uranium removal from aqueous solutions, achieving a removal as high as 80%. Further steps of surface enhancement may increase this material's adsorption capacity for U (VI), allowing its broader application.

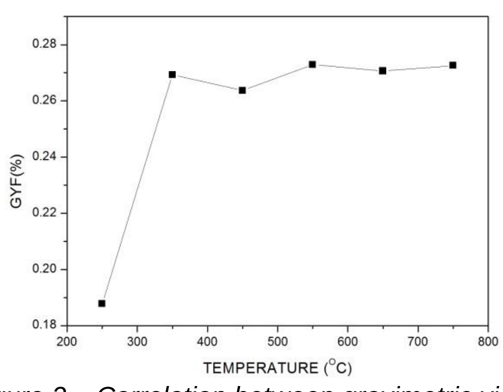

Figure 2 – Correlation between gravimetric yield factor and pyrolytic temperature.