POINT OF ZERO CHARGE DETERMINATION OF TEN STANDARD BIOCHARS FOR THE REMOVAL OF METHYLENE BLUE FROM AQUEOUS SOLUTIONS

Sabine Neusatz Guilhen, Instituto de Pesquisas Energéticas e Nucleares
snguilhen@ipen.br
Leonardo Betini Sebton, Instituto de Pesquisas Energéticas e Nucleares
Suzimara Rovani, Instituto de Pesquisas Energéticas e Nucleares
Nilce Ortiz, Instituto de Pesquisas Energéticas e Nucleares
Jorge Albero Soares Tenório, Universidade de São Paulo
Ondrej Masek, The University of Edinburgh

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This study describes the determination of the point of zero charge (PZC) of ten standard biochars (BC), supplied by the UK Biochar Research Centre (UKBRC), using the salt addition method, in order to select suitable biochar(s) for methylene blue removal from aqueous solutions. The initial pH (pH_i) was adjusted in a range of 3 to 13 using NaOH and HNO_3 solutions. The experiments employed a biochar dose of 10 g L^{-1}. The final pH values (pH_f) were recorded in the remaining suspensions after a 24-hour contact time at 120 rpm. The difference between pH_i and pH_f (ΔpH) was plotted against pH_i values and the pH at PZC (pH_{PZC}) corresponded to the point of intersection in the resulting curve. The results obtained in 0.1 mol L^{-1} $NaNO_3$ were the following: PZC at 7.24 and 8.53 for rice husk biochar (RH), the first obtained at 550 °C pyrolytic temperature and the latter at 700 °C (RH550 and RH700); PZC at 8.81 and 9.46 for oil seed rape straw pellets biochar obtained at 550 °C and 700 °C (OSR550 and OSR700), respectively; PZC at 9.24 and 9.84 for wheat straw pellets biochar (WS550 and WS700, respectively); PZC at 8.98 and 8.94 for *Miscanthus* straw pellets biochar (MSP550 and MSP700, respectively); and PZC at 6.73 and 7.15 for soft wood pellets biochar (SWP550 and SWP700, respectively).

Table 1 – PZC values of the tem biochars

BC550	PZC	BC700	PZC
RH550	7.24	RH700	8.53
OSR550	8.81	OSR700	9.46
WS550	9.24	WS700	9.84
MSP550	8.98	MSP700	8.94
SWP550	6.73	SWP700	7.15

The pyrolytic temperature didn't influence the pH values at PZC for MSP biochar. The biochars that presented the lower PZC values are compatible with cationic dyes, such as methylene blue, because the pH of the solution can be easily adjusted to be higher than the pH at the PZC. When the pH > pH_{PZC}, the biochar's surface is negatively charged, favoring the adsorption of cations. Therefore, the most suitable biochars for which it would be easier to adjust the solution pH above the PZC would be RH550 (PZC = 7.24), SWP550 (PZC = 6.73) and SWP700 (PZC = 7.15).

On the other hand, the other biochars that achieved higher PZC values can be applied to anionic dyes adsorption, since the biochars' surfaces would be positively charged when the solutions' pH values were adjusted to below each biochar's PZC values. A preliminary study was conducted in order to evaluate the adsorption efficiency of RH550, SWP550 and SWP700 as adsorbents for methylene blue. The experiments were conducted for a 50 mg L^{-1} methylene blue initial concentration, prepared as a solution at pH 8.

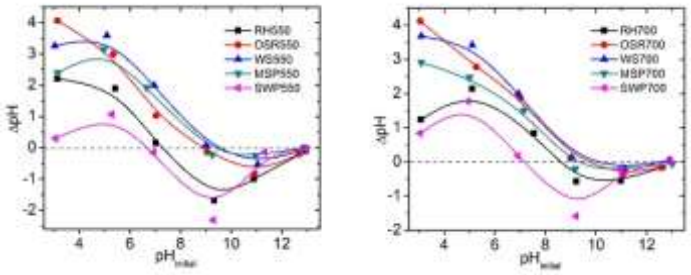

Figure 1 – PZC graphs for RH, OSR, WS, MSP and SWP.

This solution was placed in contact with each biochar in a dosage of 0.8 g L^{-1} and 120 rpm during 2 hours. After that, the remaining methylene blue in solution was measured by UV-Vis, with maximum absorption at 668 nm. The removal efficiency calculated for methylene blue was of 66% for RH550, 26% for SWP550 and 20% for SWP700. Under the given conditions, RH550 biochar performed better as an adsorbent for methylene blue. However, more studies will be conducted and the effect of the adsorption parameters will be evaluated.