

Palm kernel shell activated carbon for lead and methylene blue removal

ABSTRACT

Palm kernel shell activated carbon (PKSAC) is a porous material with high surface area used in adsorption application. The abundance of palm kernel shells from palm oil mills attracted researchers to use them as a precursor for activated carbon. This research investigates the ability of PKSAC for lead ion (Pb^{2+}) and methylene blue (MB) removal. Two size of PKSACs (0.4 mm and 1.4 mm) were prepared through chemical activation with 50w/w% potassium hydroxide, followed by activation in tube furnace at 800°C, and named as 0.4-50 PKSAC and 1.4-50 PKSAC, respectively. Morphology of PKS biochar and PKSACs were observed using field emission scanning electron microscope (FESEM) to observe the surface characteristics. The PKSACs were characterized for their ash and moisture content, iodine number, pH, and bulk density. Then, the response surface methodology (RSM) employing Box-Behnken design, with three independent variables were used to construct the experimental design for batch adsorption study, with percentage removal as the response. The independent variables were initial concentration (5 – 20 ppm for Pb^{2+} , 50 – 250 ppm for MB), pH (4.5 – 7 for Pb^{2+} , 4 – 10 for MB) and contact time (20 – 60 min for Pb^{2+} , 60 – 120 min for MB). The interactive effect of the independent variables on the percentage removal of Pb^{2+} and MB by 0.4-50 PKSAC and 1.4-50 PKSAC were investigated using 3D surface plots. The highest experimental Pb^{2+} percentage removal by 0.4-50 PKSAC and 1.4-50 PKSAC was 98.20% and 95.48%, respectively, at conditions of initial concentration of 20 ppm, contact time of 60 min and pH 7. While the highest experimental MB percentage removal by 0.4-50 PKSAC and 1.4-50 PKSAC was 99.97% and 98.71%, respectively, at initial concentration of 50 ppm, contact time of 90 min and pH 10. Overall, the present study concludes the ability of PKSACs in removing Pb^{2+} and MB, with reported percentage removal of >95%.