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FABRICATION OF MAGNETIC IRON ENRICHED BIOCHAR NANO-COMPOSITE: EFFECTIVE PHOSPHATE RECOVERY FROM ANAEROBIC DIGESTED SWINE SLURRY AND INFLUENCING FACTORS

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The fabrication of magnetic iron enriched biochar nano-composite and its further use as an adsorbent to recover phosphate from liquid fractions of anaerobic digestate were comparatively evaluated in this study. The raw biochars (Coconut Shell and Wheat) were magnetically modified through their dissolution in $FeCl_3.nH_2OFeSO_4$ and $Fe_2(SO_4)_3.nH2O$ (n=6 to 9). The comparative performance evaluation between pristine (Coconut shell biochar, CCB; Wheat biochar, WHB) and magnetically modified biochars (Coconut shell magnetic biochar, CCMB; Wheat magnetic biochar, WHMB) was investigated through a series of batch experiment. Magnetic Fe biochar surface modification showed a decrease of negative charge as well as surface area properties of CCMB and WHMB. Obtained results indicate that, magnetically modified biochars showed remarkable adsorption performance CCMB and WHMB (33.27 and 29.71 $mg.g^{-1}$) due to positive charge built up onto the surface of modified chars rather than CCB and WHB (17.57 and 15.21 $mg.g^{-1}$). The nature of PO_4^{3-} sorption for modified and unmodified chars confirmed to the Pseudo 2nd order (R^2 = 0.999, 0.999, 0.999, 0.998–0.998, 0.999, 0.998, 0.999). The isotherm data was better fitted to the Langmuir and Freundlich model (R^2= 0.967, 0.960, 0.987, 0.946)-(0.983, 0.983, 0.997, 0.997). The characterization results (XRD, SEM, and FTIR) showed that multiple sorption mechanism was involved during adsorption process. The dominant PO_4^{3-} sorption pathway to CCMB and WHMB was electrostatic attraction, surface precipitation rather than unmodified chars where electrostatic attraction was dominant. Thermodynamically, spontaneous and endothermic PO_4^{3-} adsorption mechanism in solution and liquid digestate was mainly associated with dipole dipole and hydrogen bonding force. Furthermore, the regenerated MBCs retained the substantial PO_4^{3-} adsorption capacity upto several time of regeneration cycles. Thus, obtained results herein suggest that these materials could be employed as a potential filter to recover nutrients from contaminated matrix.

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