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Copper removal from aqueous solution using chemical precipitation and adsorption by Himalayan Pine Forest Residue as Biochar

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ABSTRACT

This research deals with the use of pine residue biochar as an adsorbent for the removal of copper from aqueous solution which is a major component of printed circuit boards from E-waste. Biochar was produced from pine residue such as bark, cone and needle through pyrolysis, and the effect of temperature on biochar properties was assessed. The biochar yield of about 33% and maximum surface area of 368 m^2/g was obtained at pyrolysis temperature of 650°C. FTIR analysis revealed the existence of C-O, O-H and C = C functional groups on the surface of biochars. The point of zero charge of pine biochars were in the range 5.55 to 5.75. Batch adsorption studies revealed maximum copper adsorption capacity of 60–81 mg/g at near neutral pH. The batch adsorption data fitted well with Langmuir isotherm and followed the pseudo-second order kinetics. Adsorption of copper onto the biochar surface mainly followed physisorption which was reversible in nature. Desorption study revealed that pine biochar could be reused up to three cycles. Column adsorption data fitted well with Thomas model. These investigations revealed that the pine residue, which otherwise results in adverse environmental impacts, can be converted into useful resource like biochar as a heavy metal adsorbent.

Key words: biochar characterisation, Langmuir isotherm, Pine residue, pseudo-second-order kinetics, pyrolysis temperature, Thomas model

HIGHLIGHTS

- Use of chemical precipitation and adsorption to treat the wastewater simulating the PCB leachate.
- Use of Himalayan pine residue biochar to carry out the adsorption.
- To optimize the pyrolysis conditions for biochar production.
- Batch and continuous column adsorption experiments.
- Desorption experiments to check the regeneration and reusability of pine biochar.