Defence Seminar

| | |
|---|---|
| Seminar Title | : Defluoridation of Ground Water using Jackfruit Peel Activated Carbon |
| Speaker | : Pratima Minz ( Rollno : 519ch1006) |
| Supervisor | : Susmita Mishra |
| Venue | : Chemical Engg Department Library |
| Date and Time | : 08 May 2025 (10.30 am) |

Abstract

: Fluoride contamination is a globally acknowledged challenge, predominantly present in groundwater posing a considerable health risk. In order to meet the global demand to produce new adsorbates, the present work demonstrates the successful utilization of Jackfruit peel, a sustainable precursor for the synthesis of activated carbon. The response surface methodology (RSM) coupled with Box-Behnken design (BBD) was conducted to optimize and study the interactions of various experimental conditions during the preparation of activated carbon using different activating agents ($H_3PO_4$, KOH, and $ZnCl_2$) on yield percentage as well as iodine adsorption value. The synthesis parameters involved in chemical activation included impregnation ratio of activators, carbonization temperature and activation time. The desirability approach in the multi-response technique was employed for the optimization of all the chemically activated carbons. For AC/PA (Phosphoric acid-activated carbon) maximum yield (40%) and iodine value (1335.4 mg/g) was suggested at IR (28.8%), carbonization temperature (518 °C) and activation time (88 min). Similarly, for AC/ZC (zinc chloride-activated carbon), yield percentage of (40%) and (1335.4 mg/g) iodine adsorption value was suggested at IR (0.74), carbonization temperature (603 °C) for activation time (89 min). For AC/PH (potassium hydroxide-activated carbon), yield (19%) and (1234.5 mg/g) was suggested at IR of (0.54), carbonization temperature (799 °C) and activation time (85 min) as optimal conditions. The physico-chemical properties of the optimized activated carbon such as nitrogen adsorption/desorption isotherms, FTIR, XRD, SEM, TEM analysis, Raman spectroscopy and $pH_{ZPC.}$ were analyzed. The BET specific surface area of AC/PA (1577.45 $m^2/g$) was observed to be higher than other synthesized activated carbons. Influence of operating parameters such as pH, adsorbent dosage, contact period, initial fluoride concentration and temperature on fluoride removal was extensively studied in a batch mode to optimize process conditions. Fluoride removal was reported as 65% using AC/PA. So, in order to enhance the fluoride removal efficiency, the AC/PA surface was modified using metal oxide (zirconium). The modified activated carbon (AC/PA/Zr) was harnessed as adsorbent for the removal of fluoride from aqueous solution. The fluoride removal efficacy of AC/PA/Zr was determined in batch mode by varying the parameters such as, pH, adsorbent dosage, contact time, initial concentration, and temperature. The outcomes of the adsorption study was well fitted by Freundlich isotherm and pseudo-second order kinetic model with coefficient of determination ($R^2$) value of 0.99. The maximum fluoride adsorption capacity by the AC/PA/Zr was estimated as 12 mg/g. The XPS analysis confirmed the presence of adsorbed fluoride ions by the peak at binding energy 685.5 eV on the surface of AC/PA/Zr and in FTIR spectra the shift of peaks around 600 $cm^{-1}$ depicts the bond formation of Zr-F. Further, sachet filters of AC/PA/Zr was prepared for providing a solution for immediate fluoride treatment that showed fluoride could be reduced to permissible limit using real water samples within 30 min. Fixed bed adsorption study was evaluated in a fabricated lab scale column setup for removal of fluoride ions from the aqueous solution, to study the effect of bed depth, flow rate, and initial concentration on breakthrough curve.