National Institute of Technology Rourkela

Synopsis Seminar

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| Seminar Title | : Synthesis of Pterospermum acerifolium fruit derived activated carbon for carbon dioxide capture |
| Speaker | : Arpita Sahoo ( Rollno : 519ch1005) |
| Supervisor | : Susmita Mishra |
| Venue | : Department Library (CH) |
| Date and Time | : 18 Jul 2025 (11.00 a.m.) |


Abstract

: Carbon dioxide ($CO_2$) is a major greenhouse gas contributing significantly to global warming and climate change, posing a serious threat to environmental and human systems worldwide. As anthropogenic emissions continue to rise, the development of efficient and sustainable $CO_2$ capture technologies has become a global priority. This study focuses on the synthesis of activated carbon from *Pterospermum acerifolium* fruits using three chemical activators&mdash$H_3PO_4$, KOH, and $K_2CO_3$&mdashfor $CO_2$ adsorption applications. The process parameters, including impregnation ratio, pyrolysis temperature, and activation time, were optimized using Response Surface Methodology (RSM) based on a Box-Behnken Design (BBD). The optimized conditions yielded iodine numbers of 1197.05 mg/g ($H_3PO_4$), 1124.12 mg/g (KOH), and 1252.10 mg/g ($K_2CO_3$), with respective yields of 35%, 11%, and 12.68%. Comprehensive characterization was performed using TGA, CHNS, FTIR, Raman, FESEM, TEM, and BET analyses. To improve handling properties, KOH-activated carbon was further converted into granules using potato starch and polyvinyl alcohol as binders. The maximum $CO_2$ uptake was recorded at 303 K: 18.53 mmol/g for KOH powder and 12.18 mmol/g for starch-based granules. Adsorption data best fit Freundlich, Sips, and Dubinin&ndashAstakhov isotherm models, indicating heterogeneous surface adsorption. Kinetic analysis followed a pseudo-first-order model, suggesting a physisorption mechanism, while thermodynamic studies confirmed an exothermic and spontaneous process. The adsorbents retained ~99% adsorption capacity over five cycles. An Artificial Neural Network (ANN) model effectively predicted $CO_2$ uptake under varying conditions, demonstrating high correlation with experimental results.



***Keywords**: Activated carbon $CO_2$ adsorption capacity Box-Behnken design Artificial Neural Network Isotherm models Kinetic models*