National Institute of Technology Rourkela

Synopsis Seminar

Seminar Title	: Effective Mitigation of Pesticides from Agricultural Wastewater using Indigenous Resources
Speaker	: Smruti Smita Sahoo (Rollno : 519ch1016)
Supervisor	: Pradip Chowdhury
Venue	: New Seminar Room (Department of Chemical Engineering)
Date and Time	: 03 Sep 2025 (04:30 PM)
Abstract	: The thesis work reports comprehensive findings on the removal of toxic pesticides, viz., Imidacloprid, Chlorpyrifos, and Atrazine, from the agricultural wastewater emanating from different parts of the state of Odisha (India) using low-grade Bituminous coal and its derivatives. The carbonaceous derivatives of the coal sample were Activated Carbon (AC), Biochar (BC), Magnetic Biochar (MBC), and Graphene Oxide (GO). The parent coal and all its derivatives were characterized in detail using SEM, TEM, AFM, EDX, PXRD, FT-IR, micro-Raman, BET, XPS, etc. analyses. Th concentrations of Imidacloprid, Atrazine, and Chlorpyrifos were found to be approximately 20 mg/L, 10 mg/L, and 16.5 mg/L, respectively, in the raw wastewater emanating from the farmlands. Batch studies on the removal of Imidacloprid were carried out on simulated solutions and agricultural wastewater. Maximum removal percentage of ca. 92% was noted for the model contaminant, whereas for the real agricultural sample, the removal percentage was ca. 88.9% within 60 min of the experimental runs. The adsorbent regeneration showed encouraging results with consistent repeatability in performance up to the 4th cycle. Batch adsorption results with real agricultural wastewater showed promising results, reporting 81.5% and 92.8% removal of Chlorpyrifos, respectively, using BC and MBC samples. The regeneration study was encouraging, where between the freshly used samples (batch 1) and the final 7th batch (spent adsorbent), for biochar, a drop of 31.35%, and for magnetic biochar, 32.2% in terms of removal percentage was observed. Experimental results showed the maximum adsorptive loading of Atrazine on GO to be approximately 28.29 mg/g under the conditions of pH 8.5, initial concentration of 0.7 mg/L, and an adsorbent dosage of 0.8 g when batch experiments were performed with the simulated solutions. With real agricultural wastewater, under the optimal conditions, GO achieved a removal of 78.8%. The column experiments were successfully performed using the coal sample in treating all three aforementioned effluents. Data analysis showed that a change in the bed height caused the maximum difference in break-point time. Since break-point time is indicative of column exhaustion and accordingly switching to bed regeneration, the results infer that increasing bed height would lead to longer adsorption cycles. For 2.5, 5, and 10 cm bed heights, the corresponding removal percentages were: Imidacloprid (48%, 69%, 97.6%) Atrazine (39.6%, 54.1%, 85.9%) and Chlorpyrifos (43%, 61.7%, 94%), respectively. The mass transfer zone (MTZ) also increased with an increase in bed height. Thomas' model best fits the breakthrough data, predicting higher q_o values for Imidacloprid, followed by Chlorpyrifos, and Atrazine. Furthermore, the spent adsorbents were used in concrete mixtures by partially reducing the cement percentages. Compressive strength and workability tests on resultant spent adsorbent-concrete mixtures (shaped as blocks) were performed, and the results indicated acceptable mechanical properties.