Sustainable Water Purification by Indigenous Fruit Waste Technology (SWIFT): Ingenious Solution to Reuse Food Waste to Reduce Environmental Pollution

Bhosale, Rohan (School: Carmel High School)

Clean water scarcity and food waste management are major environmental concerns worldwide. Food wastes are rich in bioactive compounds that are currently being disposed of in landfills, generating methane gas, therefore exacerbating global warming. In this project, I combined these two issues to design a sustainable solution by leveraging the molecules present in fruit waste as biosorbents. Fifty different fruit peel powders (FPPs) were prepared and screened for their adsorption properties using methylene blue dye tests. The top 25 FPPs were then divided into five major groups and tested in triplicates for their effectiveness in the removal of harmful waste like divalent metal ions, oil waste, microbes, microplastics, and agricultural runoffs from contaminated water using appropriate analytical methods. In each category, functional kinetics and dose dependency were studied using both monolayer (Langmuir) and multilayer (Freundlich) adsorption isotherms. The FPP-based column chromatography was further coupled with peel-electrocoagulation and the joint process parameters were optimized using statistical response surface methodology involving central composite design. The main variables, column temperature, electrolysis time, electrode's location, contaminant dose, and column contact time, were studied using 50 different combinations of experiments which were planned using low, high, and axial points to achieve the maximum removal efficiency (R%) of all proposed contaminants. ANOVA verified the model's suitability of response at a 95% confidence level and p-values of 0.05. These optimum conditions led to removing 91% of contaminants from water and thus enabled an innovative low-cost process. Three prototypes were then invented and studied in batch and sequential modes.

Awards Won:

Fourth Award of $500