# *Chapter II*

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The prime focus of the present work is aimed at trapping toxic anions from industrial discharges. Hazardous anion laden effluents generated from laundry units are discharged into the aquatic streams without proper treatment, therefore are categorized under red list, by CPCB authorities. Acute needs for effective treatment methods of these effluents has become inevitable. Amongst all the reported treatment techniques, adsorption is recognized as an assuring methodology due to its ease of operation, simplicity in designing, steep efficiency, proportionate low-cost application and reduction of secondary pollution. Identification and characterization of novel biomaterials, from agricultural/ industrial by-products/ animal wastes as origin are the focus of attention in this study. This point of convergence is due to the inexpensive nature, excess availability, environmental friendly, ease and protect ion in handling against commercial sorbents available in the market.

* Three plant-based materials (i); *Camellia sinensis* stem (CSS), (ii); *Elaeocarpus tectorius* seed (ETS), (iii); *Vicia faba* husk (VFH) and one that of animal litter, *Gallus gallus domesticus* beaks (GGDB) are chosen to explore their sorption characteristics

* Chemical modifications of these materials are made to expand their surface area in order to probe their sorption capacities for the uptake of $PO_4^{3-}$, $NO_3^-$ and $SO_4^{2-}$ ions from prepared sorbate solutions, thereby extended to laundry leachates, where they are commonly present

* Physio-chemical studies of the treated sorbents are conducted to examine various factors in support of toxicants' removal trend. Surface characteristic studies are carried out using BET/BJH, SEM, EDAX and FTIR analyses to assess the chelating nature of the materials

* The influence of varied operating factors viz., dimension sizes, dosages, initial anion concentrations, agitation time interval, pH, cations/co-ions and temperature are verified experimentally through Batch equilibration mode to fix the parametric values of the modified materials

* The relative significance of the studied values against the functional factors as indicated in the statistical tools (SPSS software 20) at 95% confidence level is calculated

* The experimental data are validated using Langmuir, Freundlich, Temkin, DKR isotherm models. Kinetic studies viz., Pseudo First order, Pseudo-Second order, Elovich and Intraparticle diffusion models are applied to examine the sorption rate of the systems. Thermodynamic parameters are calculated to assess the feasibility/spontaneity and endo/exothermicity of the sorption reactions

* A considerate comparison amongst the examined four eco-friendly materials in trapping the anions is done, followed by the assessment of preferred sorption order of the three selected ions

* Calcium alginate/Goethite/Magnetite doped sorbent beads of maximum efficiency are synthesized and subjected to characterization studies viz., VSM, XRD, TG-DTA, Particle size analyser and Zeta potential techniques

* Anion chelating capacities of modified eco-derived materials and synthesized beads are juxtaposed

* Steadfast bed column studies are conducted to predict the continued performances of the fixed sorbents quantitatively to chelate toxic anions as a follow up of batch setup and further extended to field samples collected from laundry industries

* Column results are validated using Thomas, Adams and Yoon – Nelson models

* Desorption and Regeneration experiments are delineated to emphasize the reusability and economic viability of the exhausted materials and their utilization as nutrients to breed microorganisms (PSB – Phosphate Solubilizing Bacteria) in the process of promoting hilly vegetation

* Upscaling the experimental setup to field levels is manifested towards the scope of the current research. Hence, prototype column device packed with material exhibiting excellent sorption nature is constructed and implemented at laundry sites to trap toxic anions through perpetual monitoring