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N.SHYAMALA DEVI

Abstract

ABSTRACT

Heavy metal contamination of water bodies is a serious environmental threat as that of global warming. Industries such as chemical, leather, dye, electroplating, battery services are the significant sources which discharge wastewaters, containing toxic metal ions and anions polluting the aqueous streams, while exceeding their standard permissible limits. This is found to increase alarmingly day by day due to the extensive use of these ions by the above mentioned industries. Based on the thorough analysis of industries in Coimbatore district, many electroplating battery, laundry units are reported to discharge into the water streams and soils, on a large scale. Most of these units are listed under red category by Tamil Nadu Pollution Control Board. Considering these fact, Pb(II), Ni(II) and phosphate ions which are extensively employed in these industries have been chosen for their remediation. Ecofriendly materials are identified in trapping the chosen toxic metal ions from aqueous solutions through adsorption process. One agricultural/ one animal litter wastes viz., *Pistachio vera* shells/Bivalve shells are identified, treated with suitable chemicals and categorized into various particle sizes. The modified materials of varied particle sizes are subjected to physico-chemical characteristic studies to determine the pH, conductivity, density, moisture content, ash content, specific gravity and porosity. Surface and functional groups characterizations are performed using Fourier Transform Infrared (FTIR), Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Analysis (EDAX), Brunauer-Emmet-Teller (BET) and Barrett-Joyner-Halenda (BJH) analyses.

Batch equilibration mode experiments are set up to assess the sorption capacity of the selected adsorbents under different operating factors: particle sizes/ doses of the sorbent materials upon a range of initial concentrations of metal ions at different pH environments, agitation time intervals between the sorbent and sorbate species and the temperatures of the six sorption systems. Exploratory desorption and regeneration experiments are carried out for the metal laden adsorbents, as the repeated reusability of the materials is essential. From the experimental procedures, the nature of the adsorption and kinetics are explained employing certain isothermal models. Outcome of batch studies reveal the potentiality of both the materials, were bivalve shells exhibited better sorption nature. Quantification through column studies to assess the adsorbents' efficiencies in the continuous column

running with the aqueous metal ion solutions, followed by testing the field samples collected from Lakshmi Electroplating Finishers and SIDCO Industrial Estate(Lead- acid battery unit). Column results exhibited almost 99% metal removal efficiency of the shell powders, thereby emphasizing the promising characteristics of the identified materials.

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LIST OF ABBREVIATIONS AND NOTATIONS

WHO - World Health Organization

USEPA - United States Environmental Protection Agency

APHA - American Public Health Association

TPVSP - Treated *Pistachio vera* Shell Powder

TBVSP - Treated Bivalve Shell Powder

SEM - Scanning Electron Microscope

BET - Bruner Emmett Teller

BJH - Barrett Joyner Halenda

FT-IR - Fourier Transform InfraRed spectrophotometer

EDAX - Energy Dispersive X-ray spectrometer

AAS - Atomic Absorption Spectrophotometer

Conc. - Concentration

λ_{max} - Wavelength(nm)

pH_{zpc} - pH at which the surface charge of the adsorbent is zero

C_i - Initial metal ion concentration (mg/L)

C_e - Equilibrium metal ion concentration in solution (mg/L)

R^2 - Correlation co- efficient

q_e - Amount of metal ions adsorbed per gram of adsorbent at equilibrium (mg/g)

q_t - Amount of metal ions adsorbed per gram of adsorbent at time 't' (mg/g)

q_m - Maximum monolayer adsorption capacity (mg/g)

b - Langmuir adsorption constant

K_F - Freundlich adsorption capacity (mg/g)

n	-	Freundlich isotherm constant
R	-	Gas constant (8.314 J/mol K)
β_{DR}	-	Mean free energy of sorption per mole of adsorbate (mol^2/J^2)
ε	-	Polanyi Potential
E	-	Mean free energy (kJ/mol)
$\Delta G°$	-	Gibb's free energy change of adsorption (kJ/mol)
$\Delta H°$	-	Enthalpy change of adsorption (kJ/mol)
$\Delta S°$	-	Entropy change of adsorption (J/mol K)

List of Instruments / Equipments Used for Various Studies

LIST OF INSTRUMENTS / EQUIPMENTS
USED FOR VARIOUS STUDIES

1. Atomic Absorption Spectrophotometer
2. BET Surface Analyser
3. CHNS Analyser
4. Digital Conductivity Bridge
5. Digital Electronic Balance
6. Digital pH Meter
7. Energy Dispersive X- ray Spectrometer
8. Fourier Transform Infrared Spectrophotometer
9. Hot Air Oven
10. Nikon Diaphot light Microscope
11. Orbital Mechanical Shaker
12. Scanning Electron Microscope
13. Thermostat controlled Mechanical Shaker
14. UV-Visible Spectrophotometer