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<AT>Development of inexpensive biosorbents from de-oiled mustard cake for effective removal of As(V) and Pb(II) ions from their aqueous solutions

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<ABS-Head><ABS-HEAD>Graphical abstract
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<ABS-HEAD>Highlights► Inexpensive biosorbents (Si-PAMC and C-PAMC) were prepared from mustard cake (an agriculture waste material) for effective biosorption of As(V) and Pb(II) ions from their aqueous solutions. ► The pore size distribution of synthesized biosorbents fall on meso-porous domain with specific surface area S_{BET} =24.58 and 14.31m^2g^{-1} for Si-PAMC and C-PAMC, respectively. ► Langmuir model gave better description of As(V) and Pb(II) ions biosorption. ► Pseudo-second order kinetic modeling well describes the monolayer adsorption in both cases. ► Intra-particle diffusion implies that the thickness of the boundary layer effect is more in the case of Si-PAMC than C-PAMC. ► Florescence emission spectra reveal the hydrophobic interactions of ions onto biosorbents. ► The thermodynamic parameters were strongly dependent on derivation of the applied constants (K_c and K_L). ► Si-PAMC seems to be a novel substrate in comparison to C-PAMC for effective removal of As(V) and Pb(II) ions from its aqueous solutions.

<ABS-HEAD>ABSTRACT

<ABS-P>This study aimed to develop inexpensive biosorbents from an agriculture waste material (mustard cake) for the effective removal of As(V) and Pb(II) ions from their aqueous solutions. The derived biosorbents were characterized by SEM, FT-IR, pXRD, zeta potential, surface area, pore size distribution and florescence emission spectroscopy (FES).The impact of the dose, adsorbate concentration, pH, time and temperature variation onto the biosorption were performed in batch type study. Various models were modeled; however, Langmuir model was found best representative in both the cases. Adsorption process of both As(V) and Pb(II) follows pseudo-second order kinetics with (R^2 = 0.99). Intra-particle diffusion study implies that the thickness of the boundary layer effect is more in the case of Si-PAMC than C-PAMC. The biosorption mechanism is governed by complex interplay of inter ionic forces and complex formation ability of the metal ions in aqueous solution at a particular pH value. The FES study reveals the hydrophobic interactions. The desorption study revealed that the peak desorption from Si-PAMC was found as 53.73% for As(V) in 0.1 M HCl and 62.52% for Pb(II) in 0.05 M HCl solution whereas for C-PAMC it is found as 75.37% for As(V) and 80.35% for Pb(II) in 0.1 M HCl solution of each metal ions, respectively. The comparative biosorption reveals that Si-PAMC has better biosorption than C-PAMC which is primarily attributed to the presence of mesoporous silica. The present study concludes that the mustard cake seems to have potential for effective removal of metal ions from industrial waste streams.