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## Study of heavy metal adsorption capacities of clays and development of recovery methods to effectively remove & to convert the adsorbed metals into reusable forms

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During the research project; heavy metal adsorption capacities of Dediyawala ball clay and Boralesgamuwa kaolinite clay were studied in detail regarding Pb, Cd and Cr. Purified ball clay samples and purified kaolinite samples were collected from the Geological Department-Dehiwala during the period 02/10/2008-10/10/2008 and 15/01/2009-23/01/2009 respectively. Adsorption capacities (g $kg^{-1}$ of clay) along with the time period needed by each metal to reach the adsorption capacity and variations with varying pH, temperature, agitation and with interfering species (Na, K, Mg & Ca) were studied. In the second phase, ion exchange methods using ammonium acetate solution and diluted sulfuric acid were used to remove adsorbed metals from the two clay types and electrodeposition technique was carried out using a graphite anode, copper cathode and a saturated calomel electrode as the reference electrode, in order to electrodeposit each heavy metal.

Pb showed the highest adsorption capacity (71.401±0.010 g $kg^{-1}$) in the Dediyawala ball clay, followed by Cr (39.462±0.004 g $kg^{-1}$) and Cd (12.831±0.015 g $kg^{-1}$). Time taken to reach the adsorption capacities were 03, 07 and 04 days respectively. Regarding the results of Boralesgamuwa kaolinite; again the adsorption capacity of Pb (82.583±0.002 g $kg^{-1}$) was achieved as the highest followed by Cr (61.841±0.001 g $kg^{-1}$) and Cd (36.264±0.012 g $kg^{-1}$) with time periods of 20 hrs, 25 hrs and 23 hrs respectively.

Adsorption capacities were increased with pH and temperature to a limit but decreased with increasing pH when Pb was used with kaolinite. Upon agitation, the adsorption capacities increased with agitation time and decreased with increasing concentrations of Na, K, Mg and Ca. The decrements were larger with Na & K than with Mg and Ca. Acid treatment was more efficient than ammonium acetate treatment to remove adsorbed metals from clay surfaces except when Pb was used with kaolinite. Electro deposition efficiency was maximal with Pb followed by Cd & Cr. Positively charged metal ions interact electrostatically with negatively charged aluminosilicate surface sites of clays and get adsorbed. Since there are limited numbers of such sites there is an adsorption capacity with regard to a particular metal. Increase of $H^+$ ions interfere with metal ions and get adsorbed replacing the metal, consequently adsorption capacities decrease with decreasing pH in most cases and the acid treatment becomes a successful ion exchange method for the removal of adsorbed metals. This adsorption process is endothermic, so adsorption capacities increase with temperature. Agitation enhances effective collisions between a metal and clay surface sites thus promoting adsorption capacity.