Adsorption of selected chlorinated phenols from water on halloysite adsorbent modified by hexadecyltrimethylammonium bromide

In this PhD thesis adsorptive properties of halloysite mineral modified by hexadecyltrimethylammonium bromide (H-HDTMA adsorbent) were examined for the adsorption of phenol, 2-chlorophenol, 3-chlorophenol, 4-chlorophenol, 2,4-dichlophenol, and 2,4,6-trichlorophenol from an aqueous solution. The characterization of physicochemical properties of the H-HDTMA adsorbent was performed as well, i.e. the measurement of scanning and energy dispersion microscopy, infrared spectroscopy, specific surface area by adsorption of cold vapour of nitrogen, differential thermal analysis and total organic carbon.

The measurement of the adsorption kinetics of phenol and its chloroderivates on H-HDTMA adsorbent showed that the adsorption proceeds in accordance with pseudo-second order kinetic equation and an activation energy increases in the direction as follows: phenol < 4-chlorophenol < 2-chlorophenol < 2,4,6-trichlorophenol < 2,4-dichlophenol < 3-chlorophenol.

The results of measurements of adsorption of phenol and its chloroderivates on H-HDTMA adsorbent showed that the adsorption of phenol and 2-chlorophenol proceeds in accordance with the Freundlich equation and the equation Langmuir for the adsorption of 3-chlorophenol, 4-chlorophenol, 2,4-dichlophenol and 2,4,6-trichlorophenol.

The dividing method peak of inverse liquid chromatography was used, which allowed the refinement of the form of the adsorption equation. Using this method it was shown that the adsorption of these compounds occurs at the n active centers without dissociation on H-HDTMA adsorbent.

The equation of adsorption corresponding to this model has the multinominal form with exponential factors, and thus an intermediate form between multinominal Langmuir equation and power Freundlich equation.

The values of enthalpy of adsorption on H-HDTMA adsorbent are following: phenol –11,6 $kJ \cdot mol^{-1}$; 2-chlorophenol –23,3 $kJ \cdot mol^{-1}$; 3-chlorophenol –26,3 $kJ \cdot mol^{-1}$;. 4-chlorophenol –22,9 $kJ \cdot mol^{-1}$; 2,4-dichlophenol –26,1 $kJ \cdot mol^{-1}$; 2,4,6-trichlorophenol –18,4 $kJ \cdot mol^{-1}$. The calculated values of enthalpy adsorption have a physical sense; satisfy the entropy Boudart's rules.

The method of adsorption volume of inverse liquid chromatography allows to carry out measurements in the range of concentrations corresponding to the static adsorption measurements. It has been shown that both methods provide close results by comparing the values of the adsorption enthalpy determined by using the method adsorption volume of inverse liquid chromatography with values of isosteric adsorption heat determined by static method.