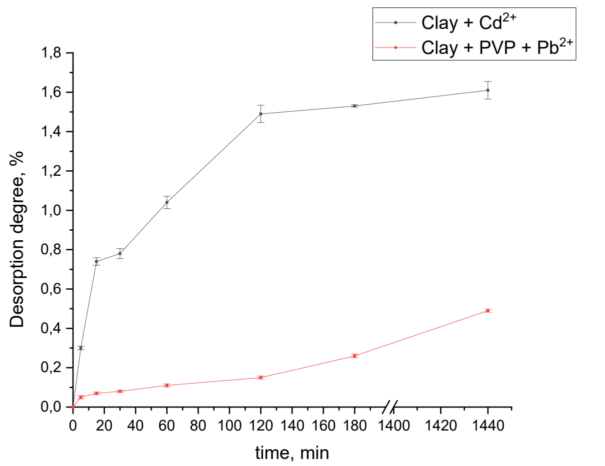

Figure 4 – Plot of the degree of desorption (%) of Pb^{2+} and Cd^{2+} ions by the original and modified clay over time

As can be seen from Figure 4, the desorption of metals is very slow and does not exceed 2%. Consequently, metal ions are tightly bound to sorbents, which makes it possible to use such sorbents for a long time.

Adsorption isotherms. The experimental adsorption isotherm of Cd^{2+} ions adsorption on clay and Pb^{2+} ions adsorption on modified clay are shown on Figure 5.

Adsorption capacity of clay minerals towards Pb^{2+} varies between 0.45 and 239 mg/g and between 3.87 and 981 mg/g for Cd^{2+} [22]. The maximum adsorption capacity of clay was found to be 11.2 mg/g for Cd^{2+}, and in the case of modified clay 7.6 mg/g for Pb^{2+}, which are average results for natural clays.

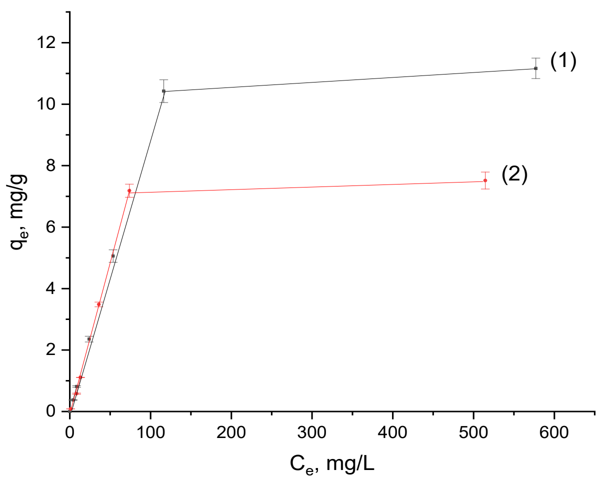

Figure 5 – Adsorption isotherm of (1) Cd^{2+} ions on clay; (2) Pb^{2+} ions on clay + 0.1% PVP

The equilibrium experimental results of Pb^{2+} and Cd^{2+} ions have been fitted by linear equations of the Langmuir [23] and Freundlich [24] adsorption models.

A linear form of Langmuir equation (4) can be written as:

$$\frac{C_e}{q_e} = \frac{1}{K_L \cdot q_m} + \frac{1}{q_m} C_e \qquad (4)$$

where q_e is the amount adsorbed on solid at equilibrium (mg/kg), C_e is the equilibrium liquid concentration (mg/L), q_m is the adsorption capacity or maximum adsorption (mg/g), K_L is the adsorption intensity or Langmuir coefficient (L/mg).

Freundlich isotherm is the earliest known experimental equation describing the sorption of material onto animal charcoal. This isotherm could be applied to non-ideal sorption on heterogeneous surfaces as well as multi-layer sorption. It is expressed by the following equation (5):

$$lnC_s = lnK_F + \frac{1}{n_f} lnC_e \qquad (5)$$

where C_s is the solute adsorbed (mg/g), C_e is the solute concentration at equilibrium (mg/L); K_F is the Freundlich constant, n_f is the equilibrium constant.

The Brunauer, Emmett and Teller (BET) model [25] is based on the concept of the polymolecular theory of adsorption. As applied to adsorption from solutions, the linear BET equation (6) is written as follows:

$$\frac{C_e}{q_e \cdot (C_s - C_e)} = \frac{1}{q_m \cdot K_{BET}} + \frac{(K_{BET} - 1) \cdot C_e}{q_m \cdot K_{BET} \cdot C_s} \qquad (6)$$

where K_{BET} is a constant of the BET equation; C_s is the limiting concentration of an ion in a solution (the solubility of salt at a given temperature).

The BET model provides for a multilayer filling of the surface with an adsorbate, and the active centres have the same energy values. Polylayers can be formed in different parts of the surface, both before and after filling the monolayer. The equilibrium constant K_{BET} characterizes the energy of interaction of the adsorbate with the surface of the adsorbent. Its sign (positive or negative) indicates the applicability or inapplicability of this model for describing adsorption in this system.

Comparing the approximation coefficients (R^2) of the Langmuir, Freundlich and BET models, we can conclude that the Langmuir model is more reliable ($R^2 > 0.99$). The Freundlich model makes it possible