The data show that the particles of the studied clay have a predominantly aluminosilicate chemical composition. Along with this, an insignificant content of Mg, Ca, Fe, Na, and K atoms is noted, which can serve as a confirmation of the presence of an exchange layer of these cations in the composition of the clay.

The study of morphological and microstructural features with a scanning electron microscope (Figure 3), showed that the particles of the studied clay are characterized by an anisometric shape. At the same time, clay is an association of particles with size of (15.51 ± 10.61) μm.

Results on equilibrium adsorption. The sorption capacity of the selected sorbents was tested concerning Pb^{2+} and Cd^{2+} ions. The results of Pb^{2+} and Cd^{2+} ions adsorption onto original and modified clay from 10 mg/L solutions are presented in Table 2. The equilibrium was reached in 30 minutes, which indicates that the adsorption is fast.

It was observed that the degree of extraction of Cd^{2+} ions by the original clay reaches 98-99%, while about 70% for Pb^{2+} ions. This suggests that the original clay can be used for the sorption of Cd^{2+} ions without any treatment, and it requires modification for Pb^{2+} ions extraction. Apparently, the surface of the initial clay has reaction centers that are more selective to Cd^{2+} ions.

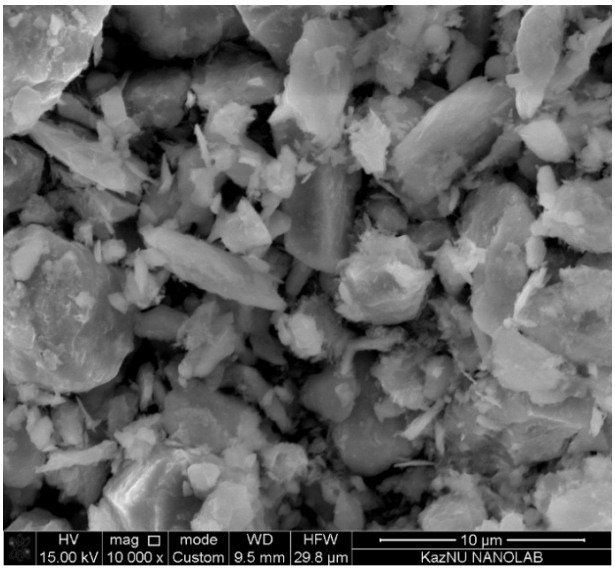

Figure 3 – SEM image of the original natural clay

Table 2 – The degree of extraction (E, %) and adsorption capacity (q_e) of Pb^{2+} and Cd^{2+} ions by the original and modified clay (T = 298 K, pH = 6, C_0 = 10 mg/L, contact time = 24 h)

Sorbent	E, %		q_e, mg/g	
	Pb^{2+}	Cd^{2+}	Pb^{2+}	Cd^{2+}
clay	70.01±1.77	97.40±1,99	0.49±0.01	0.78±0.02
clay + 0,1% PVP	98.08±0.99	-	0.67±0.01	-
clay + 0,5% PVP	98.11±1.64	-	0.67±0.01	-
clay + 1% PVP	98.03±1.13	-	0.67±0.01	-

As can be seen from the Table 2, the extraction degree of lead ions increased from 70% to 99% after modification with 1% PVP solution.

The larger values of Cd^{2+} ions adsorption by the initial clay are probably related to the difference in the ions sizes and hydration shells. The radius of the cadmium ion is 0.95 Å, and the radius of lead is 1.20 Å. The configuration of both hydrated metal ions in an aqueous solution is an octahedron [21], i.e. cadmium ions are smaller than lead, so they are better retained in the pores of the clay due to the physisorption. Therefore, further modification of clay with PVP increases the lead ions adsorption due to the contribution of chemical sorption.

The effect of the concentration of PVP in the obtained composite materials was investigated, the results of which are also presented in Table 2. Based on the data obtained, it can be concluded that the change in the concentration of PVP does not particularly affect its sorption properties. Therefore, because of economic feasibility, the most suitable concentration of the modifier is the lowest, that is, 0.1% PVP.

To assess the applicability of the adsorbent for a long time, the ability of metal ions to desorption is of great importance. The degree of desorption of the said metal ions over time is presented on Figure 4.