MODIFICATION OF ZEOLITE SURFACE CHARGE FOR WASTEWATER TREATMENT

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Nitrogen and phosphorus compounds from agriculture or municipal and industrial wastewaters are one of the major hazardous pollutants of the aquatic environments. Presence of these ions increases eutrophication of water races and reservoirs, as well as reduces effectiveness of some water treatment processes such as chlorination or filtration.

Nitrogen and phosphorus removal from wastewater based on physicochemical and biological processes gives frequently not satisfactory results. Anion exchanging sorbents are rarely used for nitrates and phosphates removal due to their high price. Application of natural sorbents is useless because they are mostly cation exchangers[5]. Natural zeolites have extremely high negatively charged surface areas, which enables their use as relatively no expensive sorbents of many various contaminants. However, their possible use as nitrates or phosphates sorbents requests recharging their surface from negative to positive.

In the present studies we tried to recharge the surface of a zeolitic tuff by iron polycations and hydroxides sorption. Natural clinoptilolite from Socirnica mine (Ukraine) and its sodium homoionic form were used for this purpose (Fig. 1). The sodium form of zeolite was obtained by triple equilibration of a natural zeolite with 0.5 M NaCl, washing with distilled water and air-drying. Sodium zeolite was next treated by 24h with 0.1 M $FeCl_3$, adjusted to different pH values ranging from 3 to 10, and separated by centrifuging. Zeta potential distribution was determined for the resulting materials suspended in water. Only zeolite treated at pH 3 had a positive zeta potential value (Tab. 1). This suggests that it could be used as a sorbent for nitrates and phosphates from wastewaters at low pH values. However, the negative mean values of zeta potential do not exclude the existence of positively charged areas on zeolites modified at other pH's. It was confirmed by high dispersion of zeta potential distributions which were partly located at positive values of zeta potential. These reflects the heterogeneity of analyzed samples in terms of the surface electric charge. Positively charged parts of zeolite surface will be occupied by anions during adsorption from wastewater. This will be more precisely studied in the next step of our investigations.

Fig. 1. Picture of zeolite samples during preparation of sodium form.

Table 1. Values of electrokinetic potential of zeolite modified at different pH:

pH	Zeta potential (mV)
3	6.2 ± 1.8
4	-7.8 ± 1.1
5	-20.2 ± 1.9
6	-30.5 ± 2.0
7	-44.7 ± 1.6
8	-46.3 ± 1.9
9	-49.1 ± 1.0
10	-49.6 ± 1.5

The effectiveness of the zeolite modification at pH 3 is also reflected by the colour of the material, which, among other materials, changed most intensively from green to red. This demonstrates the presence of Fe^{3+} ions on the surface of the mineral.

The studies should be extended to carry out further modifications of zeolite surface to obtain materials exhibiting point of zero charge at neutral or alkaline pH's, which allow to sorb anions from wastewater at high pH values.

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INFLUENCE OF SOLAR RADIATION ON HEAT TRANSFER PROCESS IN SOLAR COLLECTORS

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In solar collectors the heat is extracted by the heat transfer fluid, which flowing through the tubes. In this paper the heat flow from the absorber to fluid through the tube wall has been analyzed. Usually the conductance of the absorber and tube wall material has good thermal conductivity, but it has to be taken to account in an appropriate model. Accordingly it has to be taken into account that how the optical attribution of the materials influenced the efficiency of a flat plate collector. The amount of the absorbed solar radiation by the absorber plate has been determined, included multiple reflection, cover transmittance and absorptance of the absorber plate. Developed models were carried out for specially vacuum tube and flat plate solar collectors. Based on simulated results the conclusions have been performed.