

Data in Fig. a show that sodium citrate provides maximal plasticizing effect in the range of concentrations from 1 to 6 % with respect to the cement mass. At the same time, the least time of the solidification beginning and finishing (10 and 20 min, respectively) is observed in the sodium citrate concentration range from 4 to 10 % (Fig. b). It can be assumed that the accelerating effect of sodium citrate is due to the elimination of Ca^{2+} ions from the liquid phase of the hydrated cement by binding them to poorly soluble citrates. It is obvious that the concentration of citrate equal to 6 % with respect to the cement mass is the most optimal for obtaining a mortar mixture with maximal plasticity and minimal time of the solidification start.

Optimal concentrations of mineral additives to a dry mixture of aluminous cement, clay and chamotte in the ratio of 1 : 1 : 1 were found to be 5 % metakaolin, 5 % RSAM, 3.2 % basalt fiber, 1.7 % sodium citrate and 0.5 % “Ufapore” foaming agent. Using this composition of a dry mixture at a water-hard ratio (water/dry mix) equal to 0.45–0.7, it is possible to obtain a heat-resistant foam concrete without shrinkage cracks with a density of 300–650 kg/m^3 and a compressive strength of 0.2–2.5 MPa at natural curing and 0.3–3.2 MPa after heating at 1000 °C. This foam concrete, in contrast to foam concrete based on Portland cement and alumina cement, does not reduce its strength when heated, but, on the contrary, it increases after heating.

References

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Infrared spectroscopic studies of Mg-substituted zeolite Nakhchivan

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In recent years the use of high-silica zeolites as catalysts, filters in the oil refining, petrochemical, gas industry, in medicine, in the production of building materials, for the purification of sewage and industrial water, for the preparation of ceramic matrices became very promising [1]. It should be noted, that various

methods of modifying zeolites are widely used to improve the physicochemical properties, for example, the introduction of metal cations at the stage of hydrothermal processing [2]. In the present work, the structure of Nakhchivan zeolite modified with magnesium ions was studied by IR spectroscopy. IR spectroscopy can provide useful information about the structure and other properties of zeolites, and also shows how they change during various treatments. In addition, this method makes it possible to identify active sites on which adsorption or a catalytic process take place, to study the nature of these centers and the mechanism of catalytic reactions. The identification of the zeolite phase was carried out by IR spectroscopic analysis. This method was used to study the structure of the natural zeolite and Mg-substituted zeolite obtained by its modification.

IR spectroscopic studies were carried out using the “Nicolette IS-10” infrared spectrometer in the 400–4000 cm^{-1} frequency range. Samples of the investigated zeolites were prepared by tableting with KBr in air at a ratio of 1 mg zeolite/400 mg KBr using a hand press «Spectroscopic Creativity Pike Technologies». The resulting powder was compressed into a 1 mm thick tablet. The tablet was pressed with two ramps and put in place of the measuring cuvette. The second cuvette (comparison) remained free, i. e. the reference was air. The shooting was conducted in automatic mode.

Based on the data [3], it can be concluded that the absorption bands in the frequency range of 250–1400 cm^{-1} correspond to the basic vibrations of the aluminum silicic tetrahedrons of the framework structure of zeolites. The observed absorption bands are attributed to two types of oscillations: (1) – oscillations characterizing the primary structural TO_4 units, where T – Si^{4+} , Al^{3+} cations; (2) – oscillations of TO_4 -tetrahedra by external bonds. The second type of oscillation depends on the character of the articulation of tetrahedra in secondary structural units and the features of the cavities of zeolites. Zeolites have an absorption band in the area of 550–560 cm^{-1} related to oscillations in the external bond of tetrahedral $[\text{SiO}_4]$ and $[\text{AlO}_4]$ framework, due to the presence of doubly four-, five- and six-membered rings and determining the structure of the zeolite. The absorption band 797.53 cm^{-1} is associated with the valence oscillation of the Al–O bond, and 463.23 cm^{-1} – with the deformation oscillation of Al– O_4 . The presence of zeolite water is associated with absorption bands in the range of 3100–3700 cm^{-1} , and 1638.55 cm^{-1} is the band of deformation oscillations of water molecules. A growth of these oscillations intensity indicates an increase in the zeolite content in the rock. The absorption bands in the range of 2100–2500 cm^{-1} are explained by the presence of calcium and sodium carbonates. The absence of an absorption band at 960 cm^{-1} indicates a high crystallinity and the absence of amorphous phase impurities in all zeolites. The absence of an absorption band at 3720–3740 cm^{-1} , corresponding

to amorphous SiO₂, also indicates a high crystallinity and phase purity of all samples.

It should be borne in mind that the exact value of the frequency where the group absorbs depends on the environment of this group and its physical state. The first type of oscillation characterizing the primary structural units (Al and Si tetrahedra) refers to the bands in areas of 950–1250 cm⁻¹ and 400–500 cm⁻¹. A strong absorption band at 950–1250 cm⁻¹ is due to valence oscillations inside tetrahedra (1058.13 and 1067.58 cm⁻¹). Oscillations at 450–650 cm⁻¹ are characteristic for bonds Al–O–Si. This determines the topology of the secondary structural units and the structure of the zeolite. It is known that the valence oscillations of Si–O and Al–O in tetrahedra correspond to absorption bands in the range of 650–820 cm⁻¹. The position of these bands depends on the Si/Al ratio in the zeolite framework. The shift of the bands to the low-frequency areas occurs with an increase in the content of tetrahedrally coordinated aluminum cations. According to experiments the ion exchange of the initial cations with magnesium cations does not affect the thermal stability of the Nakhchivan zeolite. As it is known in our studies, the structure of Nakhchivan zeolite is stable up to 960 °C. Ion exchange with magnesium cations does not affect the thermal stability, it means that the natural sample after ion exchange is also stable up to 960 °C.

We found that the ion exchange of the initial cations with magnesium cations affected the pore volume of the natural sample (silicate module), which can have a serious effect on its adsorption and catalytic properties. As a result of the cation exchange the modified magnesium-substituted zeolite represents a high-silica zeolite with a high value of the silicate module.

References

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Direct surface-relief gratings recording using Se layers

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