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Synthesis Of High Silicon Zeolites From Kaolin And Bentonite

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ABSTRACT

In this paper problems of chemical and physical activation of local raw materials caoline and bentonite, and textural characteristics of high silicon zeolites and surface morphology were studied. The effect of the activation method of caoline and bentonite on the colloidal and sorption capacity was also studied. During the studies, the heat of wetting, adsorption linked water content and effective relative surface area were determined. Calculated distribution of pores by cycles (loops) of isothermal hysteresis $r \approx 8.5$ nm. The volume of porosity of the sorbent when the capillaries were filled with water was determined as $V_n = 0.135$ cm^3/g.

KEYWORDS

Caoline, bentonite, surface area, sorption capacity, adsorption linked water, porosity, the heat of wetting. adsorption isotherm, aromatization, high silicon zeolite(HSZ), mesoporous, montmorillonite.

INTRODUCTION

This work aims to study the effect of the addition of various d-elements on the catalytic properties of zeolite derived from bentonite and to study them in the process of catalytic aromatization of hydrocarbons. Zeolites and their derivatives are produced in large quantities by the industry in increasing volumes from year to year. The development of a scientific basis for the preparation and use of zeolites has become an independent area of fundamental research [1,4].

In practice, the most common zeolites are NaA and KA zeolites used to dry liquids and gases. The latter is also used to dry bioethanol. Interestingly, the more hydrophobic the adsorbate, the deeper the purification. At a temperature of 200 C and compressed air humidity of 10%, the equilibrium adsorption of water in zeolites reaches a zeolite value of about 10 mmol/g for NaA and NaX. NaX is also used to separate hydrocarbons, purify methane from hydrogen, and enrich the air with 95% oxygen. CaX and CaY are used to separate stereoisomers,e.g., glucose /fructose, while NaX and CaX zeolites are used to separate olefins from paraffin [5.9].

The selectivity and acidity of hydrophobic microporous molecular sieves are widely used in heterogeneous catalytic processes. For example, microporous molecular sieves are active catalysts for isomerization that occur in the presence of hydrogen at high pressure [10-12] This process requires the development of highly active bifunctional catalysts, the main component of which is HSZ, which has high dehydrogenation properties [13]. The catalytic properties of HSZ catalysts are explained by the presence of acid centres of various natures. The catalytic activity of the zeolite depends on the strength of the acid centres formed during decantation and firing. In addition to promoterization, zeolite catalysts are machined to control their properties [14-18].

MATERIALS AND METHODS

In the laboratory, the synthesis of zeolites was carried out in vessels with a volume of 250 cm3. The chemical composition of zeolites is as follows: the mass fraction of sodium oxide was determined on a flame photometer PAJ-2 flame emission photometry. The molar relations of SiO_2/Al_2O_3 were on formula $M=SiO_2Al_2O_3$.

An important characteristic of zeolites is their statistical capacity, which was determined by the values of the complete saturation of the zeolite with steam and heptane. Before analysis, the zeolite sample was heated at 500-550 0C for 3 hours. To determine the chemical and physicochemical characteristics of natural zeolites, samples of pellets weighing 100 g were placed in a glass flask with a volume of 250 cm3 and poured with 150 cm^3 of distilled water. The flask was stirred on an АВУ-6 device at 120 rpm for 24 hours. After drying, the adsorbent was passed through a 0.5 and 0.25 mm sieve and the remaining samples through a 0.25 mm sieve were passed through a 0.5 mm sieve chemical characteristics were studied.

Before acid treatment, the soil was ground to 0.08 mm. To 10 g of ground, the soil was added 40 g of heated H_2SO_4 and heated by stirring in a water bath.

After treatment, the soil was filtered through a paper filter in a Buchner funnel and washed with distilled water at pH=5,4-5,7. The soil was then dried in an oven at 120 °C for 5 hours with filter paper. Synthesis of high-silicon zeolites (HSZ) is based on the "Sol-gel" method of alkaline aluminium-silicon gels. To decant the resulting zeolite with a high silicon content, 100 g of 25% ammonium chloride was added to 10 g of zeolite. The solution was kept in a water bath at 90-1000 °C for 2 hours under constant stirring, then the precipitate $(NH_4{}^{+}/zeolit)$ was filtered, washed with distilled water, dried and calcined at 550-6000 °C for 8 hours. The decanted zeolite powder was then compressed into tablets and cut into granules. The catalytic methane aromatization reaction was carried out under the following conditions.

ANALYSIS AND RESULTS

The distribution of pores by specific surface area and size was detected on the automatic absorptiometer "ASAB 2010" by low-temperature nitrogen desorption. Sedimentation analysis was carried out by the Oden method in water and an aqueous glycerol mixture in various dispersion media. Physicochemical and textural characteristics of natural bentonite imported from Navbahor district (Uzbekistan), which was originally used for the production of high-silicon zeolite, were studied. The results are shown in Figures 1

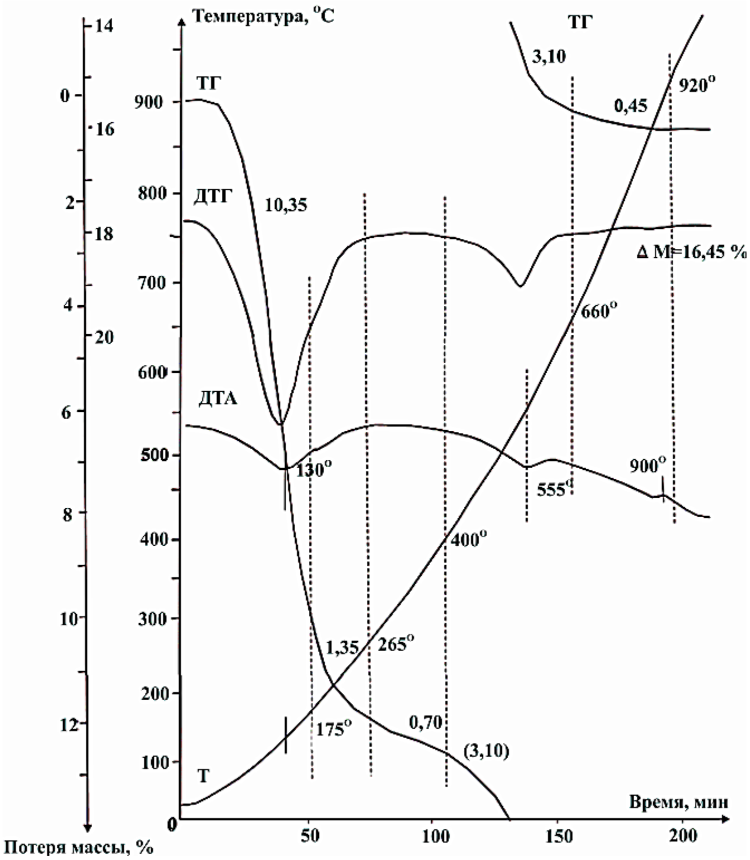
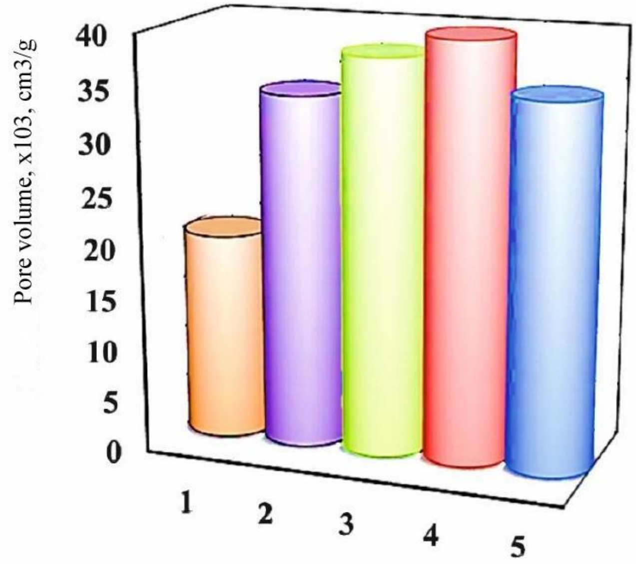


Figure 1. Derivatogram of bentonite sample.



1-primary bentonite; 2-20 minutes; 3-30 minutes; 4-40 minutes; Bentonite treated for 5 to 50 minutes.

Figure 2. The duration of acidic activation of bentonite depends on the size of the pores.

The adsorption isotherm (Fig.1a) has a characteristic shape of microporous adsorbents.

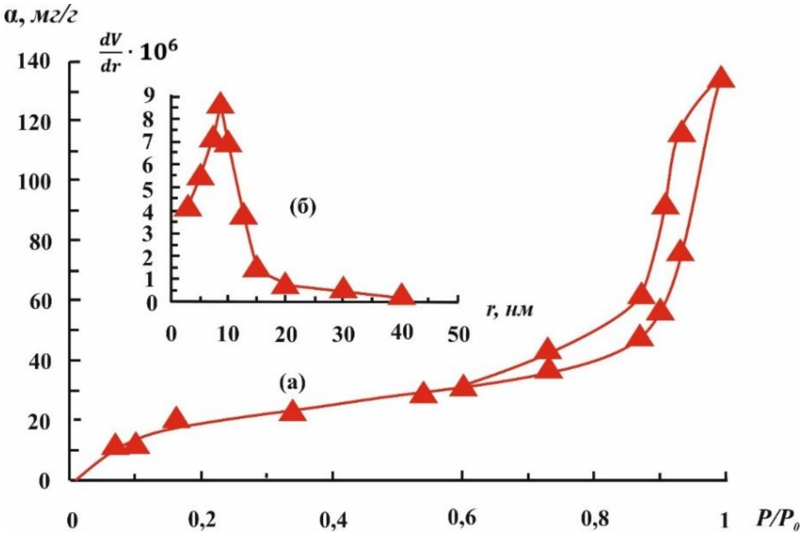


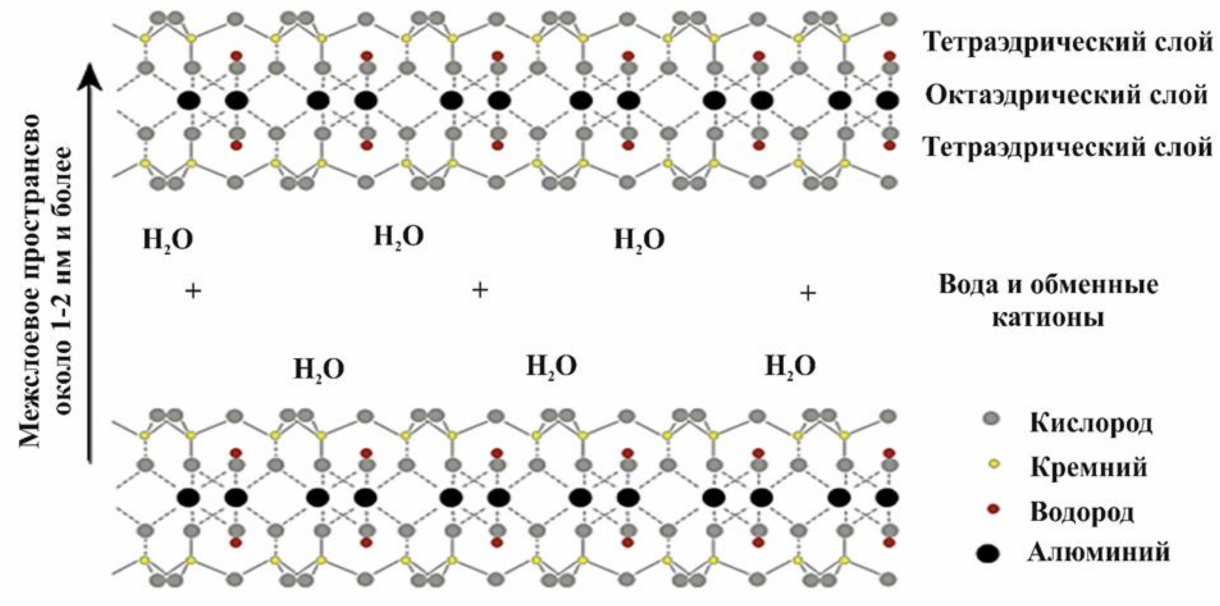
Figure 3. Water vapour adsorption isotherm in N-shaped bentonites (a) and porous size distribution (b).

The capacity of a monolayer of adsorbed water Gm = 0.78 mmol/g. Specific surface area calculated using the BET formula.

$$S_{sol} = \Gamma_{\text{м}} \cdot N_A \cdot \omega$$

NA-Avogadro number; ω-0.1 nm^2 water molecules are a sedentary surface and area 47 m^2/g. Calculated pore distribution over cycles (loops) of isothermal hysteresis r ≈ 8.5 nm. The pore volume of the sorbent was determined by filling the capillaries with water Vn=0.135 cm^3/g.

The main component of bentonite is montmorillonite. The structure of Montmorillonite can be thought of as follows: a single layer of silicate consists of two layers of tetrahedrons joined together by their edges. Since the bonds between them are weakly high molecular distance is large, different particles enter the intermolecular space: ions, molecules, nanoparticles can enter. This explains why bentonite soils have high sorption, swelling and ion exchange properties. The elemental cell of bentonite contains 3 plates, which form packets, with $[AlSiO_4]$ –tetrahedrons. The three-layer package will be negatively charged:



Conversion of methane (purity 99.9 %) without oxidizers Current Electron-microscopic studies have shown that the shape and size of crystals formed by sorbents obtained from different structure-forming agents vary.

CONCLUSIONS

Thus, the physicochemical and texture characteristics of natural bentonite in Navbahor district (Uzbekistan), methods of their enrichment and activation, as well as the possibility of using high-silica zeolite in the catalytic aromatization of petroleum gases and natural gas were studied. The calculated size distribution of the pores along the isothermal hysteresis cycles (loops) was r ≈ 8.5 nm. The volume of sorbent porosity by capillary filling with water was determined as Vn=0.135 sm3 /g. It has been proved that the shape and size of the crystals formed by the sorbents vary depending on the nature of the structure-forming ones.

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