Nickel catalysts prepared on the basis of various carriers have been widely investigated and are used to conduct a number of catalytic processes. The use of synthetic zeolites for the production of nickel catalysts is of special interest on account of their regular structure and their ability for cationic exchange. The physicochemical properties of zeolites of the X type, containing the Ni\(^{2+}\) ion and other metal ions, were studied recently in [1]. However, no data were cited on their catalytic activity.

In this work we investigated the structure and catalytic properties of nickel zeolite catalysts, prepared by ion exchange on the basis of high silica zeolites of type Y. The catalytic properties of reduced nickel catalysts have been studied in the reactions of isomerization of n-hexane and cyclohexane, as well as in the hydrogenation and hydroisomerization of benzene under flow conditions.

**EXPERIMENTAL**

The nickel catalysts were produced by ion exchange, by repeated contact of crystalline powders of the Na- and Ca-forms of type Y zeolite with a 5\% solution of Ni(NO\(_3\))\(_2\). After exchange, the catalysts were washed with water until the NO\(_3\) ions were entirely removed, then they were dried, pressed into tablets, and reduced with hydrogen at 450°. The nickel content in the catalysts was determined by resolving them in HCl and precipitation of the nickel with dimethylglyoxime. Data on the chemical composition, degree of exchange of Na\(^+\) or Ca\(^{2+}\) for Ni\(^{2+}\), and nickel content in the catalysts prepared are cited in Table 1.

Magnetic susceptibility (\(\chi\)) and its temperature dependence for unreduced zeolites were measured under vacuum by the Faraday method in the temperature interval from -196 to +340°. As can be seen from

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*Note: The diagram and table mentioned in the text are not included in this transcription.*
and cyclohexane, as well as in the reactions of hydrogenation and hydroisomerization of benzene. The experiments were conducted in a flow-type apparatus with a catalyst volume of 10 ml. The isomerization of hydrocarbons was conducted at a pressure of 30 atm, hydrogen:hydrocarbon mole ratio of 3.2, and volume velocity 1 h⁻¹. In the case of hydrogenation and hydroisomerization of benzene, those parameters were the following: pressure 30 atm, H₂/CH₅, and volume velocity 0.5 h⁻¹. The temperatures of the experiments were varied within a broad range (200-350 °C), but in such a way that the amount of hydrocaracking products did not exceed 5%, i.e., the selectivity of the catalysts was close to one. The experimental data obtained are cited in Figs. 2 and 3.

**DISCUSSION OF RESULTS**

An analysis of the x-ray diffraction data obtained for unreduced catalysts containing the Ni²⁺ ion indicated that: 1) the values of d do not exactly coincide with those for NiO (deviations ± 0.01-0.3 Å); 2) the increase in the intensity I of the lines expected for the individual phase NiO upon the introduction of Ni²⁺ into the zeolite is not observed; and 3) the ratio of I [6:10:6:2:2:2:2:2:2] of the corresponding lines on the x-ray diffraction patterns of the catalysts, characteristic of NiO, is not observed. Thus, the x-ray diffraction picture indicates the absence of a phase of crystalline NiO in the unreduced catalysts. An analogous analysis of the x-ray diffraction patterns of the reduced catalysts, with very few exceptions, indicated an increase in the intensities of all the lines corresponding to metallic nickel, which permitted us to conclude that this phase is present. However, it will require additional confirmation by an independent method, since it was based only on an analysis of the intensities.