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The Adsorption Character of Zeolites, Type 4a, Obtained By Natural Raw Trepel Bitola R. Macedonia

Blagica Cekova, Blagoj Pavlovski , Vesna Markoska, Arianit Reka

Abstract*— Zeolites as micro-pore adsorbents are characterized by a pore diameter of less than 1.5 nm. The basic characteristic of the micro-pore absorbers is the emergence of molecular sieves action which is expressed with absorption to specific molecules, whose diameter is less than the open micro-pore. This way, the zeolites appear to be typical micro-pore adsorbents. In order to describe this process, specific notions are used, such as effective, critical diameter of the shafts, and critical diameter of the molecules that are adsorpted. In our case, the adsorption properties of the zeolites of the 4A type are determined with a static gravimetric method. For determination of the specific surface, the LANGMUIR equation is applied. The designated specific areas of the zeolites that are synthesized for 2, 4 and 6 hours are: S = 163m^2/g, S = 197m^2/g, S = 239m^2/g. The results are shown graphically. The designated specific areas define the application of the zeolites as adsorbents, used on the natural raw material - trepel - Bitola for the synthesis of zeolites from the type 4A.

***Index Terms*— adsorption, LANGMUIR - equation, specific surface area, Trepel.**

I. INTRODUCTION

Adsorption feature of zeolite obtained is tested with statistic gravimetric method. The trepel represents a sedimentary rock (of biogenetic origin) with grayish to grayish-white color, very light and soft, fine to superfine grained structure, porous, shell-like break, tongue sticky. It is evident from the sedimentation of the PLANT products that are responsible for the creation of coal in the former lake basin from the Miocene and Pliocene period. The sediment complex consists of trepel and coal and it represents a biogenic – sedimentary formation. Usually trepel was identified as diatomite. Later on it was confirmed that the trepel differs from the diatomite mainly by its composition. Moreover, they have a granular and massive structure and often thin layered texture [1]. Observed under a microscope, the trepel exhibits a specific set of properties that further differs it from diatomite. From this set, the most specific property is the globular structure of the basic silicon mass of the trepel. Besides the globular opal the trepel it also contains organic substances, illyte, feldspar, quartz, chlorites, granular glauconite, colored iron hydroxides etc. Using X – ray diffraction, it has been confirmed that the trepel has a crystal structure constructed from low – temperature cristobalite [2]. Mineralogical and chemical composition of the trepel used in our experiments possesses a possibility to develop a complex inorganic technological procedure for production of zeolites, light bricks, cements etc. For this work, we used the trepel as a material for a synthesis of zeolites type 4A with a time of crystallization for 2, 4 and 6 hours [3] [4]. We employed low temperature synthesis, investigated and characterized the obtained product, zeolite type 4A, by using structural and thermal methods [6].

II. EXPERIMENTAL SECTION

The chemical composition of the trepel used in our experiments is given in Table 1.

Components	% (mass)
SiO_2	60,05
Al_2O_3	12,75
Na_2O	0,93
Fe_2O_3	6,57

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K_2O	1,60
MgO	2,16
CaO	2,60
SO_3	0,95
Loss of mass	12,19
Total	**99,80**

Adsorption is performed with various concentrations of sulfuric acid and applied statistical gravimetric method with water vapor. Adsorption isotherm of zeolite obtained within 2 hours period is shown in Fig. 1. Whereas Fig. 2 shows zeolite obtained within 4 hours, and Fig. 3.zeolite obtained within 6 hours period. Linear forms of the isotherms are given in Fig. 4, 5 and 6. For each obtained zeolite the specific surfaces were determined. The values are given in Table 2 [5].

Table 2. Values of the specific surface

Values of the specific surface	
Zeolite	**Specific surface a (m^2/g)**
2 hrs	163
4 hrs	197
6 hrs	239

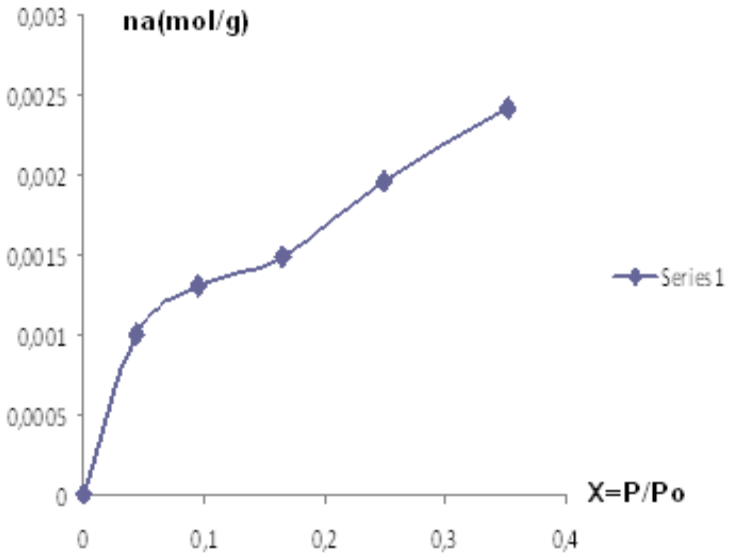

Fig. 1. Adsorption isotherm with steam – Langmuir isotherm of zeolite obtained within 2 hours

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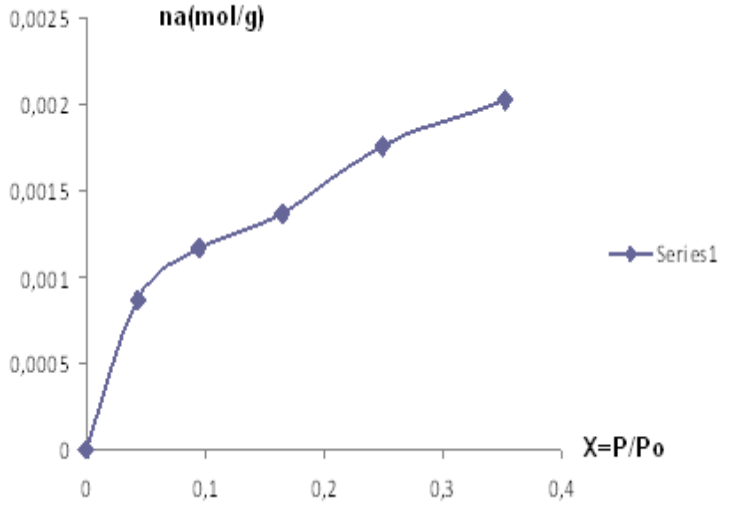

Fig. 2. Adsorption isotherm with steam – Langmuir isotherm of zeolite obtained within 4 hours

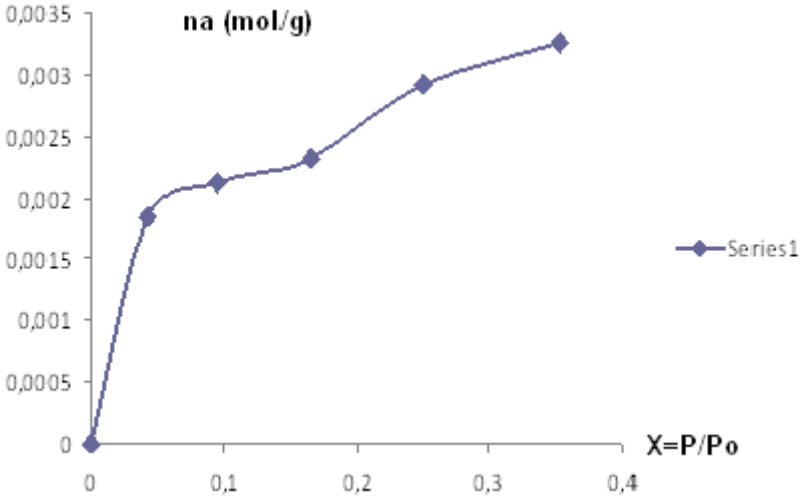

Fig. 3. Adsorption isotherm with steam – Langmuir isotherm of zeolite obtained within 6 hours

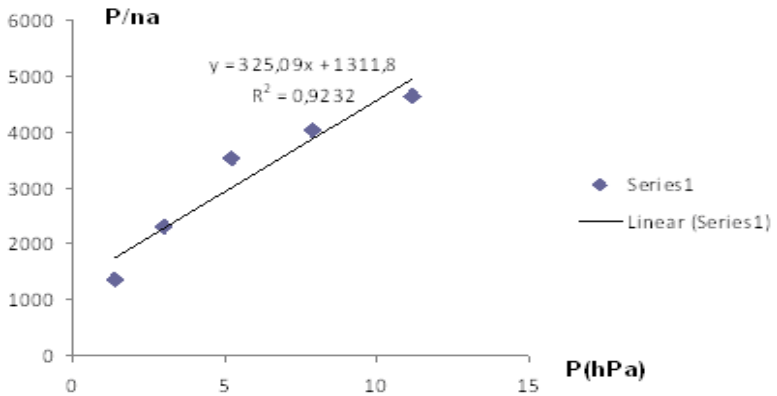

Fig. 4. Linear form of the isotherm of zeolite obtained within 2 hours

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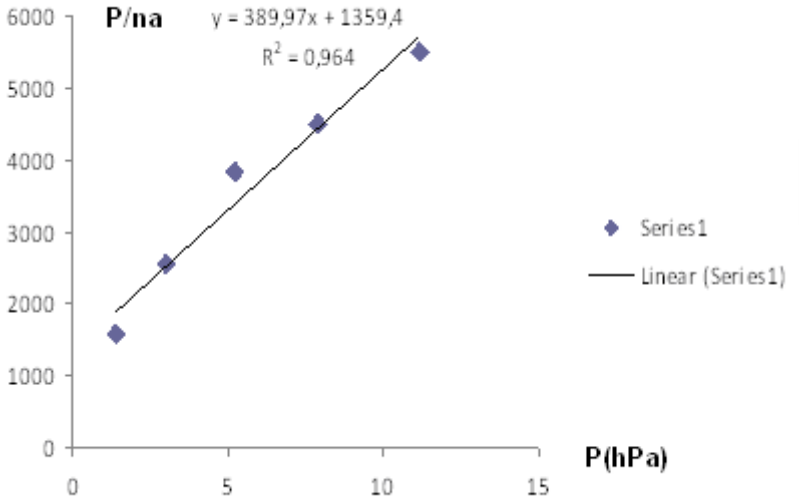

Fig 5. Linear form of the isotherm of zeolite obtained within 4 hours

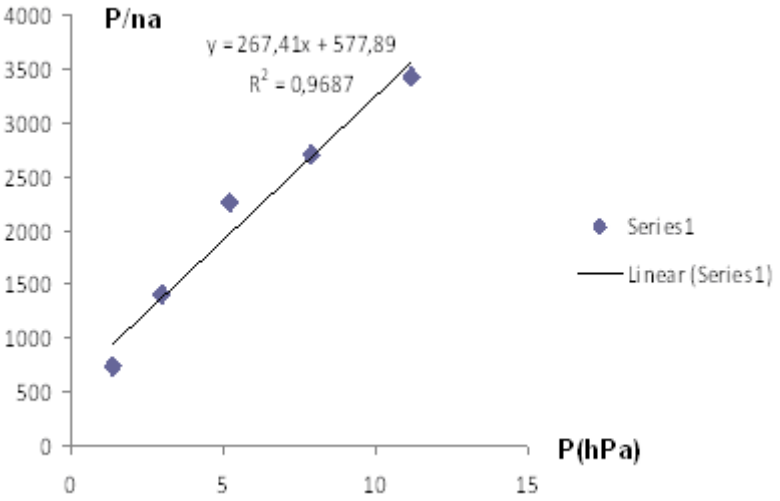

Fig. 6. Linear form of the isotherm of zeolite obtained within 6 hours

Of the results obtained from the specific surface we can conclude that highest adsorption ability has the zeolite which has been obtained during the synthesis process for a period of 6 hours. This zeolite also has a high grade of crystallinity [1].

III. EXPERIMENTAL SECTION

From the obtained results and experiments it can be concluded that trepel, which has high percentage of amorphous SiO_2, is suitable for synthesis of zeolites type 4A. The obtained products with their characteristics are compared with the commercial zeolites. Considering that it is raw material which contains a mixture of different components, especially organic substances, is possible application of trepel for a synthesis of zeolite type 4A. By improving the purity of trepel may increase the crystallization of zeolite type 4A. In the future the obtained zeolite from trepel will be tested as an absorbent.

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Blagica Cekova She graduated from the Department of Educational Chemistry at the Faculty of Natyral Science and Mathematics in Skopje, where she recived her Bsc.from the Department of Applied Chemistry in Skpoje 1978. Her master's thesis was on the Synthesis of Zeolite Type 4A from Solid – Liguid Extraction Remainders of Alunit from Alunitized Tuff in 1984. She received her PhD from St"Kiril and Methodius " Univerziti in Skopje in 1988.her doctorate was on the "Contribution to the Examination of Extraction Proceses of Kaolinite and Precipitate SiO_2 and Synthesis of Hydratised Na- Silicates from White Opalized Tyff". She currently employed at the MIT University, Faculty of management Ecological resources in Skopje.Her main scientific interest lies in the Synthesis of Zeolites and other Synthetic Silicate Products from Natural Mineral Raw Materials. She had puplished 46 and presented 142 scientific works in this field.

Blagoj Pavlovski, *PhD* - full professor, Inorganic Technology currently in pension, graduated in 1967 in the Faculty of Technology and Metallurgy in Skopje, while in the period 1973-1976 in Aachen, Germany got his PhD. Dr. Pavlovski has published over 120 professional and scientific publications (some papers published in the United States of America, Germany, Netherlands, Italy, and Hungary etc.) in the field of non-metals and it's a holder of 5 patents. Dr. Pavlovski during his career was in the various functions. He served as the Head of the Institute for Inorganic Technology at the Faculty of Technology and Metallurgy, President of the Faculty Union, President of the Executive Board of Union for education in the chemical industry, President of the Section for Nonmetals in the Union of Chemists and Technologists of Macedonia, Vice Dean and then Dean at the Faculty Technology and Metallurgy – University St. Cyril and Methodius. During this period Dr. Pavlovski was engaged in the educations process as well, mentoring undergraduate students as well as mentoring post-graduate (masters and PhD) students, at the same time holding lectures for the undergraduate students in the following subjects: Science of inorganic materials, the technology of refractory and special ceramics and Basic theory of Technology of nonmetallic mineral products, while for the postgraduate students Dr. Pavlovski held lectures for the following subjects: Kinetics and mechanisms of heterogeneous reactions, Structure and properties of ceramic materials, Refractory Materials and Special Ceramics. Dr. Pavlovski has greatly cooperated with the industry where he has completed 96 projects, whilst with the ministry of Science and Educations has completed 6 projects.

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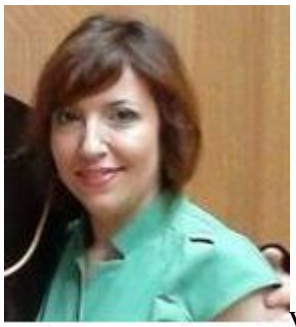

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