ANALYSIS OF PROCESSES OF ADSORPTION OF ORGANVERMICULITE TO BENZENE AND WATER VAPOR

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ABSTRACT

In this article, the modification of chitosan synthesized from the died honey bee Apis Millifera with the mineral vermiculite and the physicochemical properties of the obtained sorbent using the Mac-Ben device, its meso- and microporosity, as well as the degree of crystallinity according to the results of X-ray diffraction analysis, are studied.

Keywords: wastewater, chitin, chitosan, vermiculite, organvermiculite, sorbent, Mac-Ben device, X-ray diffraction analysis, sorption isotherm.

ORGANVERMIKULITNING BENZOL VA SUV BUG'IGA ADSORBSIYASI JARAYONLARINI TAHLIL QILISH

ANNOTATSIYA

Ushbu maqolada jonsiz asalari Apis Milliferadan sintez qilib olingan xitozanni vermikulit minerali bilan modifikatsiyalash va olingan sorbentni fizik-kimyoviy xossalarini Mak-Ben qurilmasi yordamida mezo- va mikrog’ovakligini hamda rentgen nurlari difraksion tahlili natijalari asosida kristallik darajasi o’rganidi.

Tayanch so’zlar: oqava suv, xitin, xitizan, vermikulit, organovermikulit, sorbent, Mak-Ben qurilmasi, rentgen nurlari difraksion tahlili, sorbsiya izotermasi.

INTRODUCTION

Due to the fact that both organic pollutants and heavy metals are not removed from wastewater to MPC values by traditional water treatment methods, at the final stage of the water treatment process, as a rule, an adsorption post-treatment stage is introduced. The adsorption method can remove pollution of various nature to the minimum residual concentration in the absence of secondary pollution. In recent years, for these purposes, natural mineral sorbents - silicates, which usually include materials with a regular

structure (diatomite, flask, vermiculite, hydromica, and others) are increasingly used. Natural silicates are activated chemically or thermally to increase and regulate their pore structure, changing the nature of the surface.

LITERATURE ANALYSIS AND METHODOLOGY

Hence, a promising and very relevant trend is the development of new forms natural modified sorbents intended for local post-treatment of water. Modification of layered silicates with mineral acids leads to an increase in their sorption capacity [1]. The most complete study of the surface modification of layered silicates is presented in the monograph by Yu.I. Tarasevich and F.D. Ovcharenko [2].

It is known [3] that a natural polysaccharide (chitin, chitosan) is used as a surface modifier of natural silicates. The use of polysaccharides for the modification of vermiculites makes it possible to obtain new sorbents with a higher adsorption capacity [4, 5].

Vermiculite was modified as follows: 100 g of vermiculite heated to constant weight at a temperature of 120–150°C with a grain size of 0.10–0.05 mm was stirred in 200 ml of 7 (12, 20, 36.5)% hydrochloric acid solution for two days. Then the suspension was filtered and washed with distilled water until neutral. The resulting vermiculite was dried to constant weight. The main elements were analyzed and its important physico-chemical properties were determined.

DISCUSSION

It is important to conduct fundamental research based on the study of the sorption properties of chitosan. Chitosan and its derivatives are used in a number of industries of interest. The sorbents obtained during the study were stored at a temperature of 20-25°C for 1-7 days. After separating the solid phase, it was washed with distilled water, and the washed water was checked for the presence of Cl^- ions. The dried samples were then stored in a desiccator. The study of the adsorption of benzene vapors on the samples was carried out on Mac Ben device and on the basis of the desiccator method. To determine the adsorption activity in solutions, spectral analyzes were performed in the presence of dye solutions (methylene blue (MB), indigo and congo red (CR)). The concentration of dye solutions varied from 0.1 to 1 mmol/l.

RESULTS

We used vermiculite-modified chitosan obtained according to the procedure [6–7]. The adsorption isotherm was determined by the volumetric method. The convenience of this method lies in

the fact that it allows one to further expand the theoretical knowledge of adsorption based on thermodynamic laws. This organ-vermiculite based on chitosan from benzene and water vapor molecules is characterized by interaction with physicochemical forces (Fig. 1, Table 1).

As shown in fig. 1, the duration of the heat of adsorption is determined by the interaction of benzene and water vapors with the amino and hydroxide groups of chitosan due to van der Waals forces. The heat of adsorption is continuous, since the processes proceed with the same bond. Since the molecules of benzene and water vapor are initially sorbed on the surface of the organo-vermiculite membrane, the sorption is very strong. During the last adsorption of benzene and water vapor molecules, the heat of adsorption equalizes on the line of thermal condensation of benzene and water vapor at a temperature of 293–298 K.

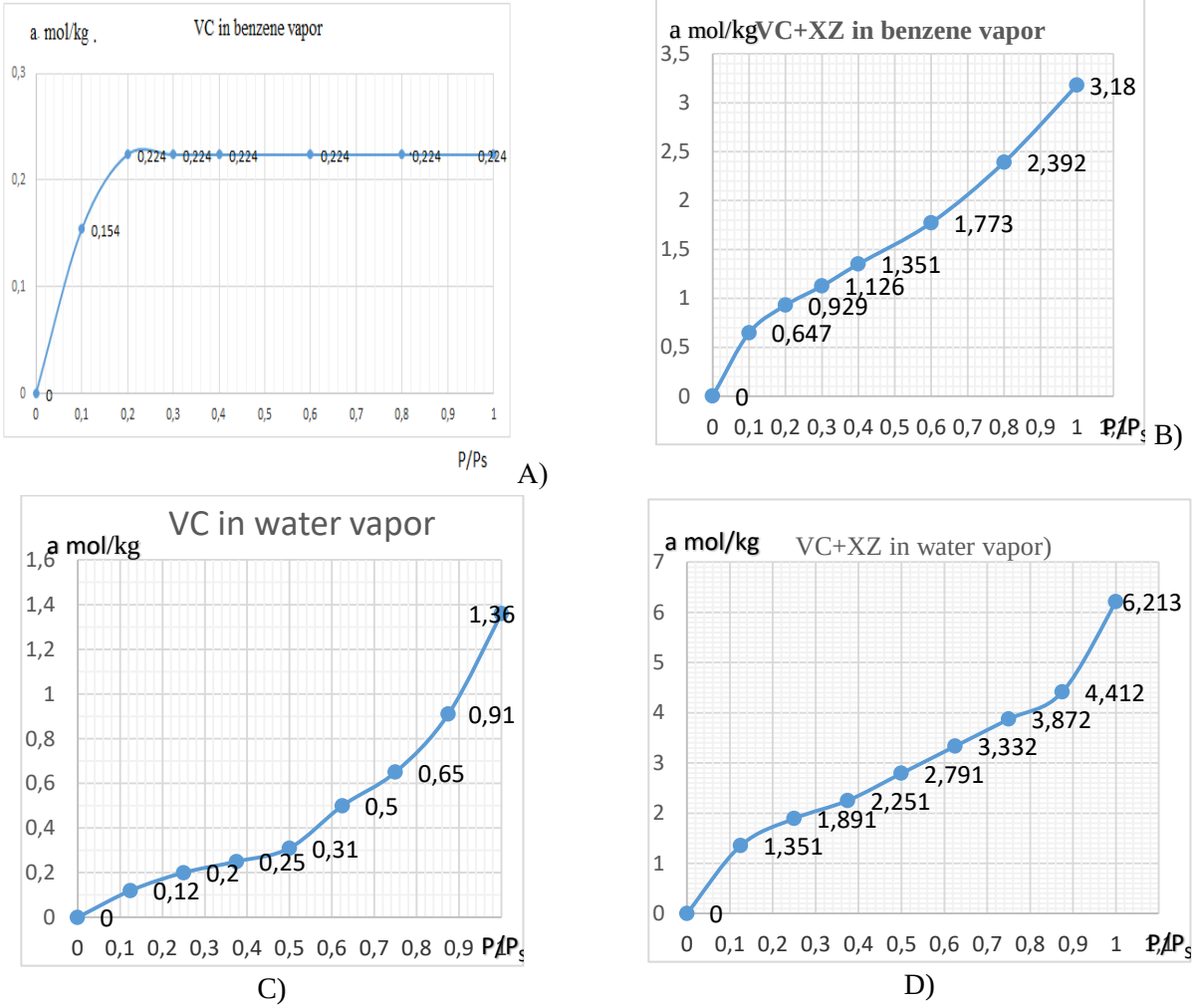

Figure 1. Sorption isotherms of benzene and water vapor by vermiculite (A,C) and modified vermiculite (B,D)

Table 1 shows the results of benzene and water vapor sorption isotherm of organvermiculite and the values of

monolayer capacity, specific surface area, saturation volume, mesopore and pore radii were calculated. Compared

Table 1

Benzene and water vapor sorption isotherm of organvermiculite

№	a_m(single floor capacity) mol/kg	S (comparative surface) m^2/g	Wo Micropore	Vs Saturation volume	W me, mesoporous	Pore radius Å, (nm)
In benzene vapor						
VC	0,146	35,14	0,0207402	0.0198545	0.00	11,3
VC+XZ	0,786	188,26	0,1865572	0,2818636	0,10	29,9
In water vapor						
VC	0,148	9,62	0,0744513	0,02448	-0.05	50,9
VC+XZ	1,383	89,84	0,0705948	0,111834	0,04	24,9

with vermiculite, chitosan-modified organvermiculite has higher single-layer capacity and specific surface area. This serves to further increase the adsorption properties of sorbents.

The main method for determining the crystal structure of organosorbents is X-ray diffraction analysis. X-ray diffraction lines for the original XZ, VK and synthesized XZ-VK show that the interplanar distance d0.01 of vermiculite layers is 9.8 in Chitosan, respectively; 19.6; 22.5; 24.5 Å in the mineral vermiculite, at 15.8; 18.2; 21; 24; at 30 Å and 9.6 in chitosan-modified vermiculite; 26.2; 31; increased to 34.9 Å (Fig. 2,3-4) [10-12].

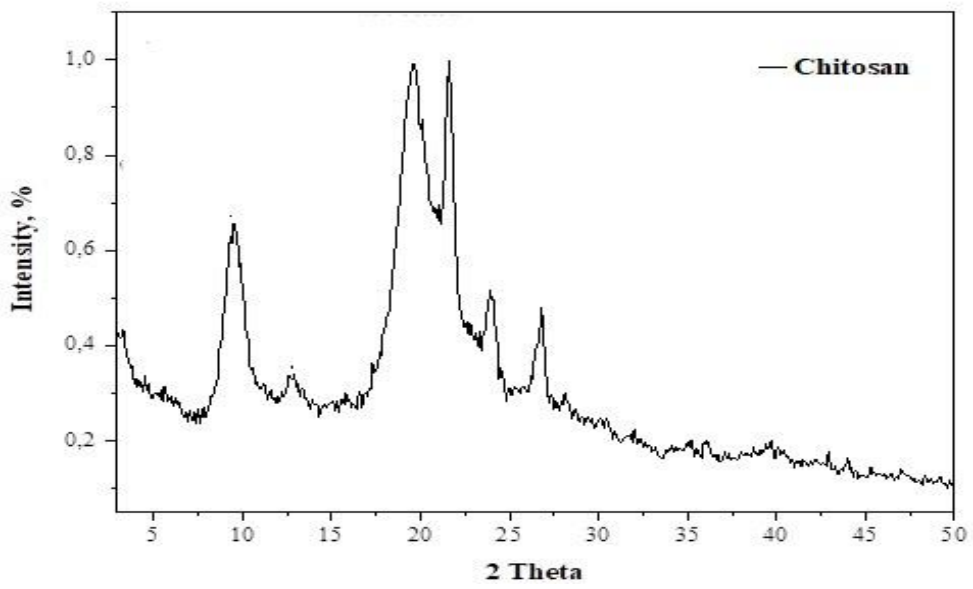

Figure 2. Results of X-ray diffraction analysis of chitosan.

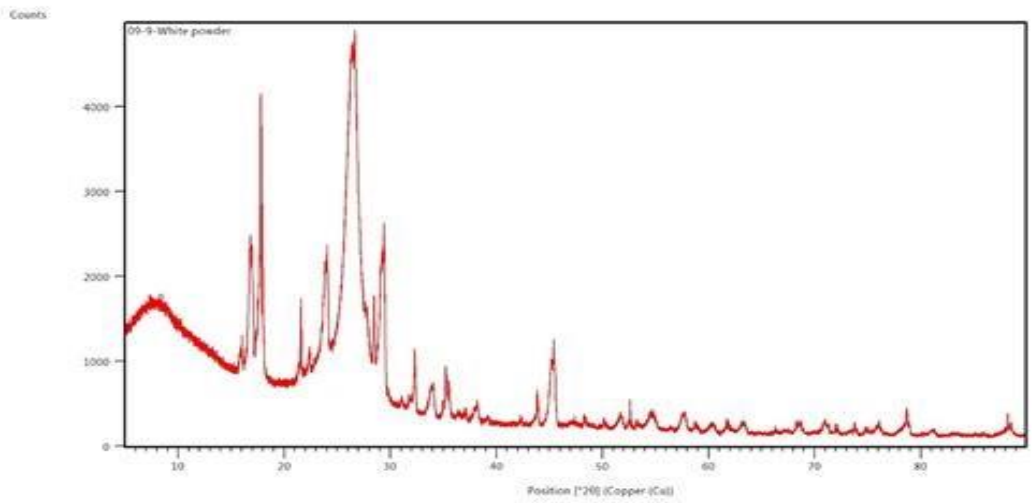

Figure 3. Results of X-ray diffraction analysis of vermiculite

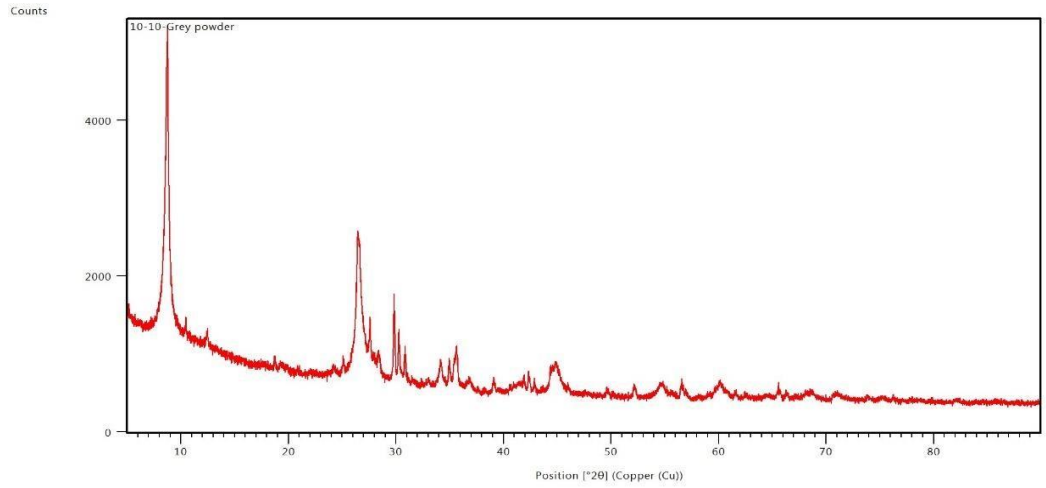

Figure 4. Results of X-Ray Diffraction Analysis of Chitosan + Vermiculite

CONCLUSION

According to the results of our research, the specific surface capacity, micro- and mesoporosity of the sorbent obtained by modifying vermiculite on the basis of chitosan was studied using modern physico-chemical methods using the Mc-Ben device, and the degree of crystallinity using the X-ray diffraction analysis method. Our studied sorbent allows us to use it as an import substitute sorbent for industrial wastewater treatment.

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