Section 5. Chemistry

https://doi.org/10.29013/AJT-22-9.10-36-40

Alieva Mukaddas Tuychievna,
Candidate of chemical sciences, associate professor,
Tashkent State Technical University, Uzbekistan
Ikhtiyarova Gulnora Akmalovna,
Doctor of Chemical Sciences, Professor,
Tashkent State Technical University, Uzbekistan
Kholturayeva Noroy Ruzmatovna,
Candidate of chemical sciences, associate professor,
Tashkent State Technical University, Uzbekistan

OBTAINING COMPOSITIONS BASED ON LOCAL RAW MATERIALS FOR TEXTILE INDUSTRIAL WASTEWATER TREATMENT

Abstract. In this article, the organosorbent was obtained by modifying the bentonites of Navbakhor, a deposit on the territory of the Republic of Uzbekistan, in the presence of chitosan. The physicochemical properties of organosorbents were studied using modern spectrophotometric methods: a UV-5100 spectrophotometer and an Eye One Pro reflectance spectrum minispectrophotometer. The methods of waste water treatment of textile industries from ions of various metals, dissolved salts and residues of pigment dyes were studied, the determination of macro- and microelements by inductively coupled plasma mass spectrometry (ICP-MS) was studied.

Keywords: Waste water, chitin, chitosan, bentonite, modification, macro- and microelements by inductively coupled plasma mass spectrometry (ICP-MS).

Introduction

In recent years, a large amount of waste water has accumulated in industrial enterprises around the world. Cleaning them and returning them to the system is one of the urgent problems. However, cleaning them is a multi-step process that takes a lot of time. Treatment of industrial wastewater should be carried out taking into account their composition. Waste treatment methods are divided into: mechanical, chemical, physico-chemical and biological types, but when they are used together, the method of wastewater treatment and disposal is called a combined method [1–5].

The main part

The use of this method is determined in each specific case by the nature of pollution and the harmful level of released compounds. One of the methods of chemical cleaning of waste, especially of the textile industry, is cleaning with the help of various adsorbents. In this work, the organosorbent obtained as a result of modification named of Navbahor bentonite of the Republic of Uzbekistan with chitosan was used. Industrial wastewater of textile enterprises was taken as an object. When their composition was studied, it was found that they consist of various metal ions, dissolved salts and pigment dye residues.

Chitosan is basically derivative form after the process of modification of chitin. It is a high molecular polymer glucosamine, it is soluble in a mixture of organic and inorganic acids. However, chitin is insoluble, while chitosan is soluble in acidic solutions. It can be used in various fields, agriculture and medicine. One of the obvious problems in the chitosan extraction process is the regeneration or sterilization of the highly effective alkaline solution in the wastewater. In most cases of the reaction process, the alkali concentration is reduced by 30–50% alkali solution. It is not allowed to place the reagent directly into the sewer. It is widely used for the dyeing of occasionally active and pigmented cotton materials, as well as for the dyeing of protein and cellulose mixed fabrics with acid-active dyes [6–7]. Compositions obtained on the basis of modification of bentonites with chitosan are used in agriculture, textile, medical and wastewater treatment, paper industry quality level, cosmetics, food production, veterinary and also. various industries for practical purposes.

Determination of macro- and microelements by inductively coupled plasma mass spectrometry (ICP-MS). This method was used to determine the elements of calcium, phosphorus, magnesium, iron and iodine in food products. for this, 0.0500–0.500 g of the test substance is measured on an analytical balance and placed in a Teflon container of an autoclave, then an appropriate amount of purified concentrated mineral acids (nitric acid and hydrogen peroxide) is added to it. The autoclave is closed and placed in a Berghof program controlled microwave digester (MWS-3+). Depending on the type of test substance, the appropriate program is determined. After decomposition of the substances placed in the autoclave, they are placed in volumetric flasks with a capacity of 50 or 100 ml and brought to the required mark with 0.5% nitric acid. Substances were detected using an ISPMS or a similar emission spectrometer with an inductively coupled argon plasma. The following equipment was used for the above analysis. ISPMS NEXION-2000 or similar mass spectrometer, microwave separators (Germany) or similar Teflon autoclave: flasks of various sizes. Reagents used: Multi-element standard #3 (29 elements for MS) Standards – mercury, nitric acid, hydrogen peroxide, bidistilled water and argon (gas purity 99.995%) [8].

How to use Eye One Pro. To carry out measurements, the Eye One Pro mini spectrophotometer was connected to the USB port of a computer, the Eye One Share program installed on the computer was launched in Windows, and the device was calibrated using a white substrate included in the standard set [30]. After that, the samples were measured, and the resulting data was exported to Excel as a series of reflection coefficients for different wavelengths. For each diffuse reflectance spectrum acquired with the Eye One Pro, the Kubelka-Munky F-function F was calculated and the diffuse reflectance intensity was observed to be related as follows:

$$F(R) = (1 - R)2/2R = 2.3c\varepsilon/S,$$

Here R – is the diffuse reflection coefficient; ε – molar absorption coefficient of the sorbate, M-1 cm^{-1}; c is its concentration, M; S – scattering coefficient, cm^{-1} [9–10].

Discussion of the results. Indigo dye solutions of different concentrations were prepared for this purpose. The absorbance level of indigo dye was determined on a UV-5100 spectrophotometer at a wavelength of 315 nm. The obtained results are presented in the following table 1 and (figure 1).

The results of the obtained analysis show that the amount of adsorption absorption of indigo dye in the prepared solution with a concentration of 1–30 mg/l decreases from 96.1% to 34.84%, that is, its absorption capacity can be seen to decrease as the concentration increases. The concentration of indigo dye in 20 and 30 mg/l solutions is almost close, indicating that it has reached its saturation point.

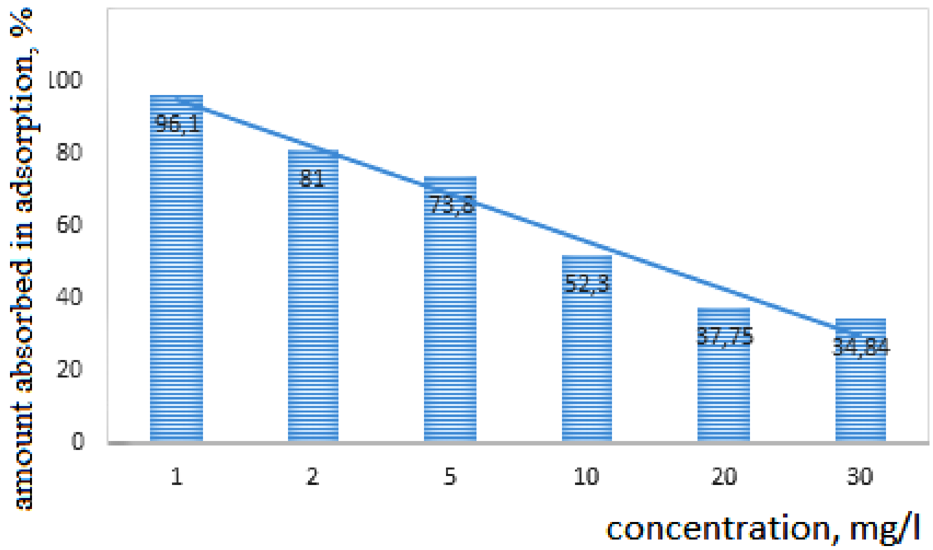

Figure 1. Dependence of indigo dye solution adsorption on solution concentration

Table 1. – Dependence of indigo dye adsorption on solution concentration

Indigo dye, concentration, mg/l	Amount absorbed in adsorption mg/l	Amount remaining in solution after adsorption, mg/l	The absorption concentration of the solution,%
1	0.961	0.039	96.1
2	1.62	0.38	81.0
5	3.69	1.31	73.8
10	5.23	4.77	52.3
20	7.55	12.45	37.75
30	10.45	19.55	34.84

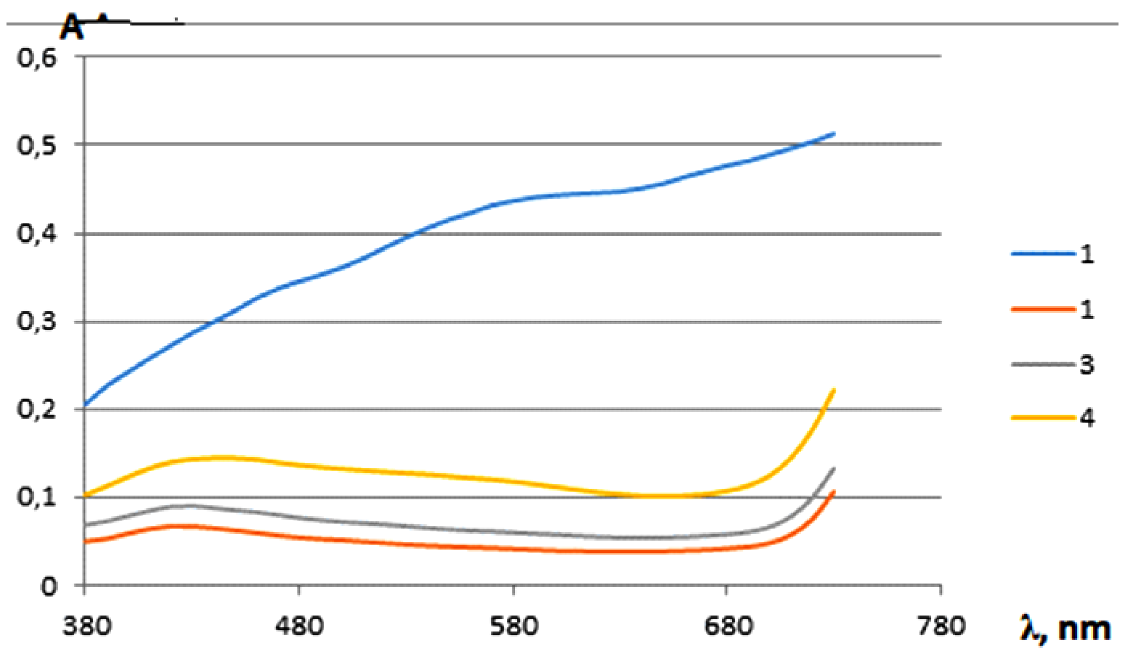

Figure 2. Navbakhor alkaline bentonite PBMB (1), Bentonite modified with chitosan (2), Water (3), Waste water (4) reflection spectrum

The reflection spectra of the obtained sorbents were studied.

As can be seen from (Figure 2), it is known in the absorption spectra of organosorbents that the maximum of the analytical signal is observed at 310 nm for textile wastewater, and after absorption on the organosorbent it is found that it has a maximum of the analytical signal at 540–550 nm.

As a result of the analysis of the absorption spectra of organosorbents, a bathochromic shift of the absorption maximum was observed, which can be explained by the absorption of various metal ions, dissolved salts, and pigment dye residues in wastewater. In addition, it undergoes various dissociation processes in various media.

In order to determine the degree of purification of wastewater from textile industries from various metal ions, dissolved salts and residues of pigment dyes, a study of macro- and microelements was carried out by inductively coupled plasma mass spectrometry (ICP-MS) [11–12].

Table 2. – Results of ICP-MS analysis of the amount of heavy elements

samples	Ti mg/l	V mg/l	Cr mg/l	Mn mg/l	Co mg/l	Zr mg/l	Mo mg/l	Ag mg/l	Ba mg/l	Pb mg/l
Waste water	0.080	0.066	0.208	0.204	0.007	0.016	0.029	0.008	0.263	0.019
Waste water treatment with modified bentonite	0.064	0.056	0.155	0.147	0.004	0.010	0.012	0.001	0.133	0.015

The analysis of heavy metals in wastewater samples brought from Delta Rumino Limited Liability Company located in the Republic of Uzbekistan and wastewater samples treated with bentonite modified with Apis mellifera chitosan was determined using plasma inductively coupled mass spectrometry (PIB-MS) (table 2).

As can be seen from the above table, we observed a decrease in the amount of heavy metals: titanium, vanadium chromium, manganese, cobalt, gallium, molybdenum, silver, barium, lead in the sample of wastewater brought from "Delta Rumino" LLC.

Conclusion and recommendations: In short, it indicates the possibility of using colored dyes from the composition of textile industrial wastewater in the sorption of our organosorbents. The results obtained are characterized by high selectivity, accuracy and expressiveness.

In conclusion, wastewater treatment of heavy metal ions by sorption method is one of the most suitable methods for industrial enterprises. At the same time, the water is softened, which makes it possible to use water in the circulating water supply.

References:

1. Марченко Л. А. Исследование возможности сорбционной очистки при ликвидации нефтяных загрязнений / Л. А. Марченко, Е. А. Белоголов, А. А. Марченко, О. Н. Бугаец, Т. Н. Боковикова // Научны й журнал Куб ГАУ. – №84 (10). 2012. – С. 23–32.
2. Хальченко И. Г., Шапкин Н. П., Свистунова И. В., Токарь Э. А. Химическая модификация вермикулита и исследование его физико-химических свойств "Международном научном форуме Бутлеровское наследие 2015". URL: http://foundation.butlerov.com/bh-2015
3. Ихтиярова Г. А., Умаров Б. Н., Исомитдинова Д. С. Туробджанов С. М. Очистка сточных вод текстильного предприятия композиций на основе вермикулита и модифицированного хитозана. Журнал Композиционные материалы. – №4. 2021. – С. 116–118.
4. Ikhtiyarova G. A., Umarov B. N., Turabdjanov S. M. Purification of textile wastewater by vermiculite modified with chitosan // International Journal of innovative research. – Vol. 9. – Issue 9. 2021. – С. 9780–9786.

5. Алиева М. Т., Ихтиярова Г. А., Умаров Б. Н. Модификация вермикулита и бентонитовой глины с хитозаном и исследование адсорбционных свойств органосорбентов для обезвреживания сточных вод. Международная научно-практическая конференция «Интеграция науки, образования и производства – залог прогресса и процветания». – Т. II. – г. Навои, РУз, 2022. – С. 24–26.
6. Ikhtiyarova G. A., Umarov B. N., Turabdjanov S. M., Mengliyev A. S., Usmanova G. A., Axmadjonov A. N., Haydarova Ch. Q. Physicochemical properties of chitin and chitosan from died honey bees Apis Mellifera of Uzbekistan. Journal of Critical Reviews. – Vol 7. – Issue 4. 2020. – P. 120–124.
7. Ixtiyarova G. A., Hazratova D. A., Umarov B. N., Seytnazarova O. M. Extraction of chitozan from died honey bee apismellifera // International scientific and technical journal Chemical technology control and management. – Vol. 2020. – ISSN. 2. – Article 3. – P. 15–20.
8. Саввин С. Б., Штыков С. Н., Михайлова В. В. Органические реагенты в спектрофотометрических методах анализа // Успехи химии. – Т. 75. – №4. 2006. – 380 с.
9. Jankiewicz B. Spectrophotometric Determination of Iron (II) in the Soil of Selected Allotment Gardensin Łódź / B. Jankiewicz, B. Ptaszyński, A. Turek // Polish Journal of Environmental Studies. – V. 11. – No. 6. 2002. – P. 745–749.
10. Иванов В. М., Фигуровская В. Н. Цветометрические характеристики тиоцианата железа (III) // Вестн. – Моск. ун-та. Сер. 2. Химия. – Т. 45. – № 5. 2004. – 315 с.
11. Akao M., Yamazaki A., Fukuda Y. Vermiculite board for novel building material. J. Mater Sci Lett – 22(21). 2003. – P. 1483–1485.
12. Karatas M., Benli A., & Toprak H. A. Effect of incorporation of raw vermiculite as partial sand replacement on the properties of selfcompacting mortars at elevated temperature. Construction and Building Materials, – 221. 2019. – P. 163–176.