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A. Asamatdinov

Nukus state pedagogical institute, Nukus, Uzbekistan
E-mail: asamatdinov@mail.ru

Study of properties of k-30 based on Nitron fiber waste

Abstract. *The purpose of the work is study the structure of polyelectrolytes for obtaining of hydrogels for water-retention in sandy soil of Aral region.To study the time of hydrolysis of nitron fiber waste and the IR spectra of the materials obtained. Thus, a method for producing hydrogels based on hydrolyzed OVN and polyvalent metal salts has been developed. The crosslink density of macromolecules is determined by the concentration of the polymer. There are shown dynamics of changes in the structural and mechanical characteristics in the process of gelation.*
Keywords: *nitron, fiber, wates hydrolysis, hydrogel, polyelectrolyte, polymer, IR-spectr.*

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Introduction

Crosslinked polyelectrolytes, capable of forming hydrogels with high degrees of swelling, attract great attention in connection with the emergence of new fields of their application. The use of super moisture absorbents as water-retaining agents allows a new solution to the problem of water conservation for agricultural needs in drylands and in desert development.

In this regard, studies in the field of producing hydrogels, establishing the structure and their operational and important properties are relevant. Polyelectrolytes of the K series produced at the Navoiazot Plant have great potential for synthesizing three-dimensionally cross-linked hydrogels. The carboxyl and amide active functional groups contained in them are convenient objects for polymer-analogous reactions [1, 2].

Such a conclusion was also confirmed by data from the method of determining the wilting point by vegetative thumbnails. In the entering process using a dose of 0.1% of the swelling polymeric hydrogel in the sand with a culture of barley the difference between the wilting point in comparison with the control was negligible. This indicates that the moisture which was contained in the hydrogel is involved in moisture availability for plant growth, to the same extent as that in the capillaries [3].

Materials and methods

Hydrolysis of Nitron Fiber

Obtaining the K-30 preparation under laboratory conditions boils down to the following [4]: in a two-liter, three-necked round-bottom flask equipped with a reflux condenser, stirrer, and thermometer, 100 g of Nitron Fiber wastes (NFW) were placed, previously it was crushed to a fiber length of 10 to 20 mm and filled with 1000 ml 5, 0% aqueous sodium hydroxide solution. The mixture was heated with stirring in a water bath for 40-50 minutes to a temperature of 333-343 K. At the same time, the swollen alkaline pulp turns weak orange, then gradually over a period of 25-30 minutes the temperature of the reaction medium in the flask was raised to 368-371 K, in this case, the pulp, painted in bright orange color, begins to undergo saponification.

Table 1

Saponification kinetics of NFW in a 5% (K1-30) and 6% (K2-30) NaOH aqueous solution at a temperature of 368-371 K

№	Saponification time, h	The nitrogen content in the substance,%		The amount of saponified nitrogen,%		The degree of saponification,%		Condition and color of the saponification product	Solubility of products
		K_1-30	K_2-30	K_1-30	K_2-30	K_1-30	K_2-30		
1	0,5	20,50	20,41	3,70	3,79	15,30	15,66	Weakly swollen fibers	Insoluble
2	1,0	15,20	15,10	9,00	9,10	37,20	37,60	Creamy, swollen fibers	Insoluble
3	1,5	12,20	12,10	10,00	12,10	51,5	50,00	Weak orange	Swells
4	2,0	11,30	11,15	12,90	13,05	53,30	53,92	Dark orange	Not fully
5	2,5	10,10	9,65	14,10	14,55	59,00	60,12	Red orange	soluble
6	3,0	8,24	8,01	15,76	15,69	66,00	66,90	Creamy Orange	Soluble
7	4,0	7,30	7,02	16,90	17,18	70,00	70,99	Cream	Soluble
8	6,0	7,10	6,85	17,1	17,35	70,70	71,69	Yellow	Soluble
9	8,0	6,60	6,55	17,60	17,65	72,70	72,93	Yellow	Soluble
10	10,0	6,20	6,03	18,00	18,17	74,40	75,08	Yellow	Soluble
11	12,0	5,80	5,61	18,40	18,59	76,00	76,81	Yellow	Soluble
12	14,0	4,20	4,01	20,00	20,19	82,60	83,42	Paleyellow	Soluble

IR spectroscopic studies

To confirm the chemical composition of the products of the **NFW** hydrolysis and establish the nature of the functional groups, infrared absorption spectra of the K-30 polyelectrolyte and hydrogels were recorded on a Spekord-75 UR spectrophotometer in the wavelength range of 400-4000 cm-1, for which the powdered substances with bromide potassium were tableted. There were examined Gel-like substances in a cuvette. The assignment of the characteristics of the absorption bands to the corresponding groups was carried out according to [5].

Results

Obtaining K-30 polyelectrolyte based on Nitron fiber waste

By hydrolysis of **NFW** under the influence of various reagents under mild conditions, various representatives of the K-series water-soluble polymer preparations were synthesized [6-8], which are artificial structure-forming agents for Central Asia unstructured soils, clay stabilizers, coagulators in wastewater treatment, etc. d. [6,9]. The successful use of these agents in various areas of the national economy depends on numerous factors, the main of which is the nature of the polyelectrolyte itself and the chemical composition of the property system of which is regulated.

By studying the kinetics of saponification of OVN in an alkaline medium under certain conditions, a water-soluble polymer was obtained, conditionally called K-30. The **NFW** is a copolymer of acrylonitrile, methylacrylate, and dicarboxylic acids. The molecular weight of the **NFW** is about 70-106 thousand, which was determined viscozimetrically. The OFWs were thoroughly washed in warm water and dried at 368–373 K to constant weight, then dissolved in freshly distilled dimethylformamide and its molecular weight was determined using the Flory formula [10].

In considered conditions of polymer-analogous conversion, nitrile groups are not completely saponified, but ends at a certain stage, therefore, **CN**-groups are partially preserved in the polymer, along with the formation of amide-imide and carboxyl groups.

Alkaline saponification products of **NFW** are complex block copolymers containing units of acrylonitrile, sodium, and ammonium salts of acrylic acid, acrylamide, and acrylimide [11].

IR - spectroscopic studies of K-30 polyelectrolyte

To study the structure of PE and hydrogels, we studied the IR spectra recorded in tablets with

KBr in the region of 400–4000 cm –1. To study the absorption of infrared radiation, there was carried out saponification with 5% sodium hydroxide, with a polymer to alkali ratio of 1.0:0.5.

Table 2

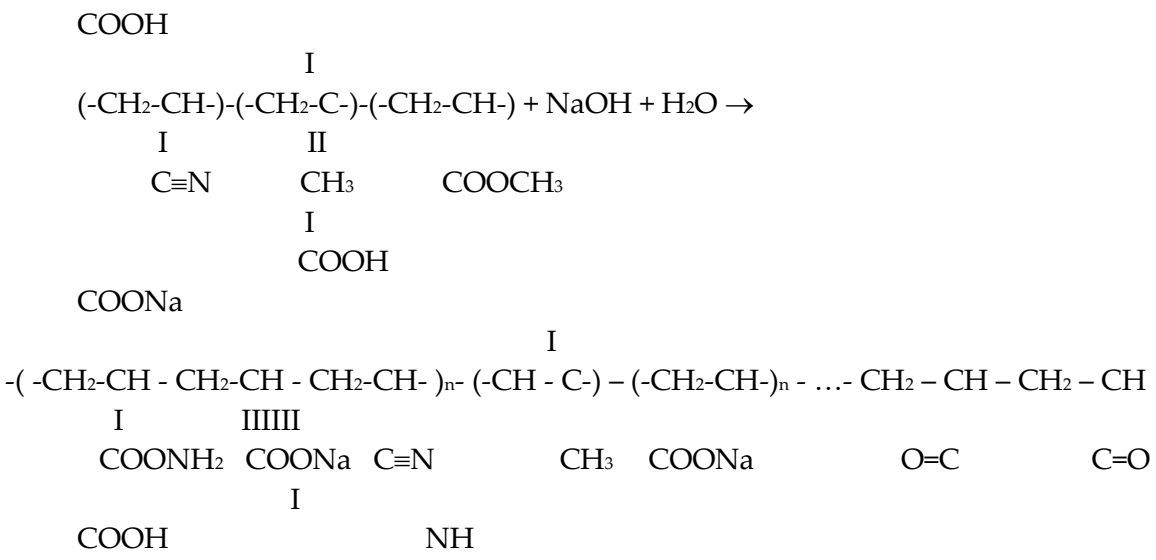
10-IR - spectra of the absorption band of HEPP and hydrogels

The frequency of the absorption bands, cm-1	The intensity of the absorption bands and assignment
3000, 2930 - 2970	Symmetric and asymmetric stretching vibrations NH_3
1720-1735, 1700-1150	C=0 stretching vibrations in carboxyl groups
3330-3400	Stretchingvibrations N—H
1600	High intensity aromatic core vibrations
1580 - 2000	Deformationvibrations —NH_2
1400 - 1410	Symmetric and asymmetric stretching vibrations COO-
1460	Deformation vibrations —CH— methylene groups
1310 - 1300	Low-intensity bands corresponding to fan, torsional and pendulum vibrations of the group —CH_2 —
900, 950, 990	Unflattering deformation vibrations —COOH, deformation vibrations N—H groups
1680	Groupstretchingvibration – CO
1590	asymmetric stretching group wave of COO^-
2246	stretching group wave of –CN
3700-3200 см–1	wave of hydrogen bonded groups – OH
1657 и 1555	characteristic for carbonyl and amide groups

It is well-known from the literature [12–14], the infrared absorption spectra of the high-frequency transitions make it possible to draw a conclusion about the structure and reveal changes that occur in the chain of PE macromolecules.

Discussion

Based on the foregoing, it can be concluded that the macromolecules of the K-30 preparation, which are the products of 12-hour hydrolysis of **NFW** with sodium hydroxide, have a complex structure with a reagent ratio of 1: 0.50: 0.50. The estimated elementary element of PE based on spectral analysis can be represented as follows:



The dependence of the complexing ability of macromolecules on the distribution of ligand groups was previously shown for copolymers [15] and polyampholytes [16]. In our case, the gel is formed when polyvalent metal salts (Al^{3+}, Cr^{3+}, etc.) are added to the K-30 aqueous solution, which enters as crosslinking agents, interacting with the carboxyl groups of K-30 molecules. Since Al^{3+}, Cr^{3+}, and other ions cause the association of carboxyl groups from different chains, which causes the solution to transition into a gel state. There were used chemical, physicochemical, and colloid-chemical methods of analysis to study them as well as to conduct various studies.

Conclusions

This shows that the macromolecules of the K-30 preparation contain amide, cyclic imide, carboxyl, and carboxylate functional groups and can be attributed to polyampholytic PE. Moreover, the amide and imide groups are intermediate products of saponification of **NFW** by alkali, which tend to undergo further hydrolysis during prolonged storage of the drug.

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А. Асаматдинов
Нүкіс мемлекеттік педагогикалық институты, Нүкіс, Өзбекстан

Нитрон талшығы қалдықтарының негізінде к-30 қасиеттерін зерттеу

Аңдатпа. Мақаланың мақсаты Арал өңірінің құмды топырағында су ұстау, гидрогельдер алу үшін полиэлектролиттер құрылымын зерттеу болып табылады. Сондай-ақ, осы зерттеу аясында автор нитрон талшығының қалдықтары мен алынған материалдардың ИҚ спектрлерін гидролиздеу уақытын зерттеді. Зерттеу аясында гидролизденген ОВН және поливалентті металдардың тұздары негізінде гидрогельдерді алу әдісі жасалды. Макромолекулаларды тігу тығыздығы полимердің концентрациясымен анықталады. Мақалада гель түзілу процесінде құрылымдық-механикалық сипаттамалардың өзгеру динамикасы көрсетілген.

Түйін сөздер: нитрон, талшық, Уэйтс бойынша гидролиз, гидрогель, полиэлектролит, полимер, ИҚ-спектр.

А. Асаматдинов
Нукусский государственный педагогический институт, Нукус, Узбекистан

Исследование свойств к-30 на основе отходов нитронового волокна

Аннотация. Целью данной работы является изучение структуры полиэлектролитов для получения гидрогелей для водоудержания в песчаной почве Приаралья. Также в рамках данного исследования автор изучил время гидролиза отходов нитронового волокна и ИК спектры полученных материалов. Таким образом, в рамках исследования был разработан метод получения гидрогелей на основе гидролизованного ОВН и солей поливалентных металлов. Плотность сшивки макромолекул определяется концентрацией полимера. В статье показана динамика изменения структурно-механических характеристик в процессе гелеобразования.

Ключевые слова: нитрон, волокно, гидролиз по Уэйтсу, гидрогель, полиэлектролит, полимер, ИК-спектр.

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Information about author:

Асаматдинов А. - химия ғылымдарының кандидаты, жаратылыстану факультеті, Нүкіс мемлекеттік педагогикалық институты, Нұрмұхамедов көшесі, 1, Нүкіс қаласы, Өзбекстан.

Asamatdinov A. - Candidate of Chemical Sciences, Faculty of Natural Sciences, Nukus State Pedagogical Institute, 1 Nurmukhamedov str., Nukus, Uzbekistan.