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DETERMINATION OF THE SORPTION INDEX OF POLYACRYLONITRILE FIBERS

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Abstract:
Considerable work has been done in the literature on the modification of polyacrylonitrile fiber by various methods to obtain different types of fibers with different properties, such as dye, ion exchange, biologically active, electron exchange, bactericidal and so on.

Keywords: Polyacrylonitrile Fibers, dye, ion exchange, biologically active, electron exchange, bactericidal

INTRODUCTION

Considerable work has been done in the literature on the modification of polyacrylonitrile fiber by various methods to obtain different types of fibers with different properties, such as dye, ion exchange, biologically active, electron exchange, bactericidal and so on.

Methods of physical modification include modification of forming conditions, elongation of fibers, drying or heat treatment, chemical modification - copolymerization, welding of copolymers to chain end radicals, adsorption of various substances on fiber by treatment in fiber elongation solution. Modification of polyacrylonitrile PAN fibers by physical means involves the production of fibers that differ in their properties: strength, elongation, modulus of elasticity and other parameters. Methods of chemical modification of PAN fiber are not limited in practice. This is due to the light copolymerization of acrylonitrile with vinyl series monomers, the high reactivity of the nitrile group, and its conversion to other groups.

PRACTICAL SIGNIFICANCE OF THE STUDY

The inclusion of the Somonomer link in the PAN fiber composition is well stained with cationic dyes due to the presence of acid SOON, NSO_3 or other acid groups in the macromolecule with the main characteristic (NN_2 or pyridine ring) dyes. The increase in the cation or anion exchange properties of PAN fiber depends on the acidic or basic group behavior of the monomer used as the copolymer. The inclusion of such groups in the PAN fiber increases the cation or anion exchange property of the fiber several times. The storage of quinides or other oxidizing-reducing groups in the production of electron-exchange fibers based on PAN fibers is widely covered in the literature.

Acrylonitrile or acrylic acid has been used as a starting product in the production of polyacrylonitrile fibers on an industrial scale. However, to date, extensive work has been done on a number of studies to obtain copolymers of polyacrylonitrile fibers with acrylonitrile and vinyl series compounds. Copolymers of acrylonitrile with two, three and four different substances were obtained. Copolymers expand their range of applications by modifying several properties of fibers. Depending on the properties of copolymers can be divided into three types: neutral, acidic and basic copolymers. Neutral copolymers - methylacrylate, methyl methacrylate, vinyl acetate, acidic copolymers - styrene sulfonate, amyl sulfonate, metal sulfonate, itaconic acid and acrylic acids, basic copolymers include vinylpyrrolidone, 2-vinylpyridine and 2-methyl-5-vinyl. Vinyl acetate from neutral salmonomers is a widely used salmonomer with acrylonitrile obtained in liquid or gaseous medium in the presence of an industrial acetylene and acetic acid catalyst (mercury, zinc, cadmium acetate). To date, cationic and anion exchange fibers based on polyacrylonitrile fibers have been obtained and are also used as sorbents in industrial wastewater treatment. This is based on the exchange of nitrile groups in the PAN fiber for cation or anion exchange groups. The treatment of polyacrylonitrile fibers with antibacterial agents, the use of biologically active fibers for medical use, as well as the production of special bandages with analgesics have been introduced. Complex physico-chemical modification of PAN fiber is based on the fact that the physico-mechanical and sorption performance of copolymers modified mainly by chemical modification of the ammonium salt N, N-dimethylaminoethylmethacrylate and monohydric acetate [2] is high compared to industrially produced nitron fiber. The monomers included in the polymer increase the hydrophilic and simultaneous dyeing properties of the fibers because they contain carboxyl, hydroxyl or amino groups. In the work of other researchers [2], the nitrile group in polyacrylonitrile fibers is treated with an alkali or acid solution, in which a small amount of hydrolysis also occurs simultaneously. The nitrile group is converted to the carboxyl group and a yellow color is formed in the fiber during the decomposition of ammonia.

In another method, as described above, the nitrile group in the polyacrylonitrile fiber is treated with a solution of hydrogen peroxide under alkaline conditions. The staining of the fiber with cationic dyes after treatment in a hydrogen peroxide bath has been reported in the literature [3]. Addition of active groups to the fiber macromolecule. Qualitative second (third) monomers: vinylsulfonic acid, allylsulfonic acid, styrene sulfonic acid, itaconic acid, methacrylic and other unsaturated carbonic acids and vinyl pyridine-like monomers are distinguished by good absorption of cationic dyes. In the study, when carried out at temperatures of 60, 80, 950S and the calculation of the diffusion coefficient on the basis of the Melnikov formula [2] of the sorption curves, it is 2, 2, respectively; 2.7; 4.4; 10-4cm2 / des. It has been stated that the fibers dye well when the amount of dye is 3 g / l, and that a 20 g / l solution of sodium chloride as an electrolyte to these dyes results in maximum absorption of the dye. With increasing the concentration of the dye in the solution to a certain amount, the color intensity also increases, the resistance of the color to the physicochemical effects decreases.

SCIENTIFIC AND PRACTICAL SIGNIFICANCE OF RESEARCH RESULTS.

Determination of structural-adsorption parameters and dye absorption parameters of the obtained fiber by obtaining a bicomponent copolymer in the presence of nitron fiber povinilacetate. To achieve the goal it is necessary to perform the following tasks:

- preparation of dimethylformamide solution of polyacrylonitrile.
- to find optimal conditions for obtaining bicomponent polymer by adding polyvinyl acetate polymer in different proportions to the polymer solution.
- formation of fibers by formation from the obtained copolymers.
- determination of adsorption-structural parameters of fibers.
- determination of dye absorption index of fibers.
- for the first time, the adsorption performance of nitron fibers was achieved by the absorption of dyes by mixing different ratios of polyacrylonitrile and polyvinyl acetate polymers several times.

For this purpose, in this work, fibers were obtained from bicomponent systems based on PAN and polyvinyl acetate polymers, which are the raw materials of nitron fiber, and their properties were studied in comparison with nitron fiber. We know that there are modifiers that completely change the properties of PAN fiber, even when the percentage content of the modifying polymer is small. We used polyvinyl acetate polymer as a modifier and studied its effect on nitron fiber. Water vapor sorption was measured at 293 K and their sorption isotherms were obtained. The sorption isotherms of the modified fibers are S-shaped and the isotherms can be divided into 3 parts.

1. The interaction of water vapor with the active centers of the fibers, the formation of monolayers, the relative pressure ranges from R / Rs = 0 - 0.35.

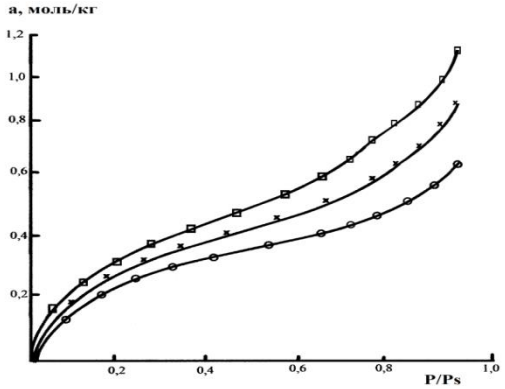
2. Polymolecular adsorption ranges from relative pressure R Rs=0.35 to 0.65.

3. Capillary condensation ranges from relative pressure R / Rs> 0.65, relative humidity 100%. It can be seen from the sorption isotherms of the modified fibers that the water vapor at all relative pressures was associated with an increase in sorption due to the amount of polyvinyl acetate in the PAN fiber.

The specific gravity of the fibers was calculated based on the BET equation.

$S = w \cdot Na \cdot am$

The sorption results of the modified fibers relative to water vapor were lower at low relative pressures (R / Rs) and increased as they approached high R / Rs = 1.0. It was found that the sorption depends on the percentage composition of the second polymer component. Sorption-structural parameters were calculated according to water vapor sorption of PANVA-3, PANVA-5, PANVA-7 fibers.



PANVA - 3 (1) PANVA - 5 (2) PANVA - 7 (3) water vapor sorption isotherms of fibers (measured at 293K)

Table1.1.
Sorption-structural properties of modified fibers

Fibers	Monoquat capacity $a_{т,}$ mol / kg	Relative surface S. $m^2/г$	High adsorption capacity $см^3/г$
Nitron fiber	0.086	54.55	-
PANVA – 3	0.088	56.18	0.0145
PANVA – 5	0.09	57.27	0.0152
PANVA – 7	0.092	58.36	0.0154

The above figures are compared with nitron fiber: the specific gravity increased by 1.03 times in PANVA-3, 1.05 times in PANVA-5, 1.07 times in PANVA-7, due to the high sobitation volume and monolayer capacity in PANVA-3 2.34%, in PANVA-5. 4.65%, and increased to 6.97% in PANVA-7. In conclusion, it can be said that the polyvinyl acetate copolymer affects the good sorption ability of nitron fiber in water in increasing order. The effect of the conditions of obtaining fibers on the basis of physical bicomponent polymers PAN and increasing the sorption and absorption capacity of the obtained fibers, the dependence of the structure of the polymer on the concentration was studied.

During the study, the PAN powder was dissolved in a dimethylformamide solvent until a homogeneous medium was formed. The dyeing kinetics of the original and modified fibers were studied and the diffusion coefficient of the dyeing process was calculated. The increase in the diffusion coefficient of the dyeing process is associated with an increase in the structural-sorption properties of the fiber. This process has been proven by the results of isothermal sorption of water vapor.

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