International Journal of Research
ISSN: 2348-6848 Vol-6, Special Issue-5
3rd EduINDEX International Multidisciplinary Conference held on 6-7th April 2019 at **Edupedia Publications Pvt Ltd**, New Delhi

Makhmatkulova Z, H., *Scientific Director , Ph.D., assosiate professor.*
Tashkent State Pedagogical University named after Nizami (Tashkent, Uzbekistan).
E-mail: zuhro_m@mail.ru

DIRECT COLORING OF NATURAL AND SYNTHETIC FIBERS BY APPLYING A 'NITRITE-ACID-METAL CATION' SYSTEM

Abstract. *In this science project presented the development of low cost technology of coloring natural and synthetic fibers with diazotization method by applying a 'nitrite-acid-metal cation' system. Presented researches of synthesis of coloring components on natural and synthetic fibres, physico-chemical properties of the as-colored fibers were determined.*

Keywords:*dyeing, coloring of fibers, nitrite-acid-metal cation' system, low cost technology of fibers coloring.*

Uzbekistan is one of the main world manufacturers of cotton fibers. Besides that, production of natural silk, wool, acrylic and polyamide fibers is currently developing. However, only a small part of fibers is processed in finished goods, and the main part is exported in the form of semi-finished product. One of the main reasons for this is the absence of processing of chemical materials in the country, including dyes. In particular, aniline-coloring industry does not exist in Uzbekistan. As is known, coloring of textile materials can be done by two methods: sorption of coloring compounds on the fibers from the solution and synthesis of a dyeing component directly on a fiber.

The first way is dyeing fibers by active, acid, disperse and other classes of synthetic dyes. The coloring of fibrous materials by synthesis of dyes directly on a fiber has represented great interest. Because one step coloring of fibers is economically perspective due to excluding complex technological processes, namely, allocation of dye from reactionary mix, filtration, washing, drying, and grinding. On the other hand, use of chromogenic components having simple structure promotes an increase in penetration speed of chromogenic compounds on a fiber.

Nowadays, oxyazo, black aniline and phthalocyanines are widely applied in dyeing of textile materials. However, the presence of azo group in molecules of such compounds does not fully solve the problem of obtaining strong color, which is resistant against physical, chemical and mechanical impacts. Therefore, the aim of the present work is coloring of natural (cotton, wool, natural silk) and synthetic (polyamide and acrylic) fibers without use of synthetic dyes. That is, 'nitrite-acid-metal cation' system will be applied to direct coloring of natural and synthetic fibers.

Objective: The primary objective of the present project is to develop new, low cost technology of coloring natural and synthetic fibers with diazotization method by

applying a 'nitrite-acid-metal cation' system. The main objectives of the planned research are as follows:

- Synthesis of coloring components on natural (cotton, silk and wool) fibers by applying a 'nitrite-acid-cation' system;
- Synthesis of coloring components on synthetic (polyamide and acrylic) fibers by applying a 'nitrite-acid-cation' system;
- Investigation of the influence of synthesis parameters (temperature, time, pH, and coloring modulus) on color formation;
- Exploration of the influence of 'nitrite:acid:metal cation' ratio on structure of fibers by various physico-chemical methods;
- Determination of physico-chemical properties of the as-colored fibers (strength, wrinkle resistance, elongation, and nitrogen content)
- Study of color formation in fibers by optical method;
- Definition of color characteristics (color coordinate and chromaticity, saturation, and whiteness) of the as-colored fibers;
- Investigation of color formation mechanisms.

Experimental:

Preparation: According 'nitrite-acid-metal cation' system, the following starting materials are selected: 1) sodium and potassium nitrites as nitrite; 2) hydrochloric, sulfuric, oxalic, and acetic acids as acid; and 3) sulphates of iron, cobalt, copper, and nickel as metal cation. The fibers will be first washed with the solution containing 4 g/L nonionic detergent and 2 g/L soda ash at 80°C for 30 min and then dried at RT. After that, fibers will be impregnated in the 'nitrite-acid-metal cation' – based solution with pH=3-4 at 95°C for 10 min. The unreacted or remained compounds on the fiber surface will be removed by washing with nonionic detergent at 60°C for 5 min, hot and cold water, respectively, and then dried at RT.

Characterization: The as-colored fibers will be characterized by X-ray diffraction (XRD), differential thermal analysis/thermal gravimetry (DTA/TG), scanning electron microscopy (SEM), transmission electron microscopy (TEM), dynamometer, etc.

Expected results: On the basis of the experimental results, the effective way of coloring natural and synthetic fibers will be recommended. After time-, temperature-, and pH-dependent experiments, formation mechanism of coloring components in the natural and synthetic fibers will be presented. The colored natural and synthetic fibers with the improved physico-chemical properties will be obtained. In addition, the developed coloring compositions will allow solving coloring problems partially in textile industry of Uzbekistan. The results of the present research will be published as co-authored papers with the colleagues in China.

Methodology:

Sampling. For realisation of formation of colour on fibre preliminary researches with reaction use diazotization with use of salts of metals of variable valency and mineral or organic acid are carried out.

Preparation. Natural fiber has been kept in the processing solution at 80ºC during 30 minutes, which contained natrium salts, mineral or organic asid and kathions of polyvalent metall. For colouring a material load into a bath containing coloring compounds, rise temperature to 80-90ºC, stop heating, the sample take out and wash out in a soap or water solution of any urface-active substance, then in warm and cold water and dry.

Analysis. The formation or the colour is proved by measuring the colour coordinate and chromaticity, and other colorimeterical characteristics with the help of spectrophotometer «Raduga – 2B». The formation or the new chemical bonds between protein fibre, particularly in natural silk and coloring composition is proved by IR-spectroscopy, DTA, DTGA, X-ray structure analysis and chromatograthy methods. The analysis of the painted samples have been executed in laboratory of physical and chemical tests at Institute of physics and chemistry of polymers at Republic Uzbekistan Academy of sciences. However, apparatuses and equipments in chemical laboratories of the Uzbekistan are outdated. Sensitivity and accuracy of those apparatuses and equipments do not meet modern requirements of the analysis of structure of polymers. Besides, we have no possibility of definition of physical-mechanical indicators as we have no possibility to carry out research on corresponding equipments. Therefore the analysis of structure of polymer processed by painting compositions is desirable for spending in laboratories of a world class. On the basis of the received results delivery of recommendations about approbation under production conditions is planned.

REFERENCES

1. Helmut Bruggemann; Uve Gunter; Helmut Climmek. A polymeric composition and a way of its reception. Patent of the Russian Federation. №2126023. 1999 y.
2. Kuvayev E.Ю, Odintsov O.I, Melnikov B.N. , Andreev K.L. (Ivanovo state himiko-technological university) Use of new peahens for hardening of colourings of fabrics, coloured direct dyes. News of high schools. Technology of the textile industry. 2005, №1, pp. 54-57.
3. Krotova M. N, Kuvayev E. Ю, Odintsov O. I, Melnikov B.N. Application new TVV in processes of printing of textile materials by active dyes. News of high schools. Technology of the textile industry. 2005, №3, pp. 55-57.
4. Odintsov O. I. Use cathionic preparations for hardening of colourings of textile materials/ Odintsov O.I, Melnikov B.N., Krotova M.N. // Journal of applied chemistry, Sankt–Petersburg. – 2009. – vol. 82. – № 3. – p.467 – 471.

5. Starikovich E.E. Metallized dyes and their application in the textile and knitted industry. M: "Light industry", 1973.
6. Dolgova S.N. Fastening of the basic dyes on silk with the help covalent bonds. //Theses of reports Republican conference. «Chemical technology of textile materials», Tashkent, 1992. p. 28.
7. Preliminary patent RUz №3825. МПК D06 P 1/00. 1996y.
8. Lifentsev O. M, Melnikov B.N. Dyeing and printing of fabrics by synthesis of pigments on a fibre. M.:«Light industry», 1973. 168p.
9. Mironov G.S. and others. Synthesis of aromatic amins-semiproducts for organic dyes and colour cinemas - photographic materials. // News of high schools. Chemistry and chemical technology. – 2003. – v.46, № 3. –pp. 30-32.
10. Chan P.M., Yuen C.W.M., Yeung K.W. Text Asia, 1998, v. 29. (May), p. 59-61.
11. Ramakrishna K. Colourage, 1999, v. 46(July), p. 29-31.
12. Kalinnikov J.A., Vashurina I.Ju. Natural dyes and auxiliary substances in chemikal-textile technologies - a real way of increase ecological cleanliness and production efficiency of textile materials. Dews.Chemical. (Journal of Russian Chemical society of D.I.Mendeleyev), 2002, vol. XLVI, № 1. pp.77-87.
13. Hwang, E.K.; Lee, Y.H.; Kim, H.D. Dyeing, Fastness, and Deodorizing Properties of Cotton, Silk, and Wool Fabrics Dyed with Gardenia, Coffee sludge, Cassia tora. L., and Pomegranate Extracts. Fiber. Polym. 2008, 9, 334-340.
14. Makhmatkulova Z., Miroshnichenko I., Fyodorova N., Tashpulatov Y. Influence of some parameters on color formation in dying process of natural silk in the absence of traditional dyes. Uzbekistan Journal of Chemistry, 2000, №4, c.34-37.
15. Miroshnichenko I., Makhmatkulova Z., Tashpulatov Y., Fyodorova N. Composition for dyeing natural and synthetic fibers. Uzbekistan Patent. No. IAP 03259, January 31, 2007.
16. Makhmatkulova Z., Fyodorova N., Tashpulatov Y. Prospective methods for coloring natural and synthetic fiber-forming polymers. Uzbekistan Journal of Chemistry, 1 (2008) 42-46.
17. Makhmatkulova Z. Development of effective technology of chemical modification of natural silk. IV International Conference on Modern Problems of Advanced Science (Chemistry and Chemical Engineering Section), 17-25 Desember, 2008, Belgorod, Russia, pp.20-22.