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TECHNOLOGY OF PRINTING PATTERNS ON FABRIC BASED ON WATER-SOLUBLE POLYMERS

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Аннотация. Водорастворимые полимеры играют важную роль в современных технологиях текстильной печати благодаря своим экологически чистым свойствам и высокой функциональной эффективности. Эти полимеры широко используются в качестве загустителей, связующих и пленкообразующих компонентов в пастах для текстильной печати. Среди них особое значение имеют поливиниловый спирт, карбоксиметилцеллюлоза и полиэтиленгликоль из-за их высокой растворимости в воде, контроля вязкости и совместимости с красителями. Применение водорастворимых полимеров в текстильной печати позволяет равномерно распределять красители по поверхности ткани, повышает стойкость цвета и четкость рисунка. Кроме того, эти полимеры облегчают удаление во время стирки, не вызывая загрязнения окружающей среды. Научные исследования показывают, что использование водорастворимых полимеров повышает эффективность печати, снижает расход воды и улучшает показатели качества текстиля. В статье анализируются технологические принципы печати на тканях водорастворимыми полимерами, их физико-химические характеристики и эффективность в технологиях обработки текстиля. Исследование основано на существующей научной литературе и экспериментальных результатах в области химии полимеров и текстильной инженерии.

Ключевые слова: водорастворимые полимеры, текстильная печать, поливиниловый спирт, карбоксиметилцеллюлоза, текстильная технология, печатная паста, химия полимеров.

Annatatsiya. Suvda eriydigan polimerlar ekologik toza xususiyatlari va yuqori funktsional samaradorligi tufayli zamonaviy to'qimachilik bosib chiqarish texnologiyalarida muhim rol o'ynaydi. Ushbu polimerlar to'qimachilik bosib chiqarish pastalarida quyuqlashtiruvchi moddalar, bog'lovchi moddalar va plyonka hosil qiluvchi komponentlar sifatida keng qo'llaniladi. Ular orasida polivinil spirt, karboksimetil tsellyuloza va polietilen glikol suvda yuqori eruvchanligi,

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yopishqoqlikni nazorat qilish va bo'yoqlar bilan mosligi tufayli ayniqsa muhimdir. To'qimachilik bosib chiqarishda suvda eriydigan polimerlarni qo'llash bo'yoqlarning mato yuzalarida bir tekis taqsimlanishini ta'minlaydi va ranglarning mustahkamligi va naqshlarning ravshanligini oshiradi. Bundan tashqari, bu polimerlar atrof-muhitni ifloslantirmasdan yuvish jarayonlarida oson olib tashlashni osonlashtiradi. Ilmiy tadqiqotlar shuni ko'rsatadiki, suvda eriydigan polimerlardan foydalanish bosib chiqarish samaradorligini oshiradi, suv sarfini kamaytiradi va to'qimachilik sifat ko'rsatkichlarini yaxshilaydi. Ushbu maqolada suvda eriydigan polimerlardan foydalangan holda mato bosib chiqarishning texnologik tamoyillari, ularning fizik-kimyoviy xususiyatlari va to'qimachilikni qayta ishlash texnologiyalaridagi samaradorligi tahlil qilinadi. Tadqiqot polimer kimyosi va to'qimachilik muhandisligidagi mavjud ilmiy adabiyotlar va eksperimental topilmalarga asoslangan.

Kalit so'zlar: Suvda eriydigan polimerlar, to'qimachilik bosmaxonasi, polivinil spirti, karboksimetil tsellyuloza, to'qimachilik texnologiyasi, bosma pastasi, polimer kimyosi

Abstract. Water-soluble polymers play an important role in modern textile printing technologies due to their environmentally friendly properties and high functional efficiency. These polymers are widely used as thickening agents, binders, and film-forming components in textile printing pastes. Among them, polyvinyl alcohol, carboxymethyl cellulose, and polyethylene glycol are particularly important due to their high solubility in water, viscosity control, and compatibility with dyes. The application of water-soluble polymers in textile printing allows uniform distribution of dyes on fabric surfaces and improves color fastness and pattern clarity. In addition, these polymers facilitate easy removal during washing processes without causing environmental contamination. Scientific research shows that the use of water-soluble polymers enhances printing efficiency, reduces water consumption, and improves textile quality indicators. This article analyzes the technological principles of fabric printing using water-soluble polymers, their physicochemical characteristics, and their effectiveness in textile processing technologies. The study is based on existing scientific literature and experimental findings in polymer chemistry and textile engineering.

Keywords: Water-Soluble polymers, textile printing, polyvinyl alcohol, carboxymethyl cellulose, textile technology, printing paste, polymer chemistry

INTRODUCTION

Textile printing is one of the most important technological processes in the textile industry, aimed at transferring decorative patterns onto fabric surfaces using dyes and auxiliary chemicals. Modern textile production increasingly relies on

ISSN 3030-3907

environmentally friendly and efficient materials to improve product quality and reduce environmental impact. Water-soluble polymers have become essential components in textile printing processes because of their functional properties and compatibility with dyes and pigments [1].

Water-soluble polymers are macromolecular compounds capable of dissolving in water and forming stable solutions or gels. These polymers are widely used as thickeners, binders, stabilizers, and film-forming agents in textile printing pastes. Their main function is to regulate the viscosity of printing compositions and ensure uniform distribution of dyes on textile surfaces [2].

Among the most widely used water-soluble polymers in textile printing are polyvinyl alcohol (PVA), carboxymethyl cellulose (CMC), sodium alginate, and polyethylene glycol. These polymers possess high viscosity, excellent film-forming properties, and compatibility with reactive, disperse, and pigment dyes [3].

According to scientific studies in textile chemistry, the use of water-soluble polymers significantly improves the fixation of dyes and enhances the clarity of printed patterns. Furthermore, these polymers can be easily removed from the fabric during washing processes without leaving harmful residues [4].

The purpose of this study is to analyze the technological principles and effectiveness of fabric printing using water-soluble polymers based on scientific literature and research findings in polymer science and textile engineering.

METHODOLOGY

The methodology of this research is based on the analysis of scientific literature related to polymer chemistry, textile technology, and printing processes. A comparative analysis method was used to evaluate different types of water-soluble polymers applied in textile printing technologies.

Scientific sources such as textbooks, peer-reviewed articles, and research reports were examined to identify the physicochemical properties of water-soluble polymers and their functional roles in textile printing systems. Particular attention was given to studies analyzing polyvinyl alcohol, carboxymethyl cellulose, and sodium alginate due to their widespread industrial use [5].

In textile printing technology, water-soluble polymers are commonly used in the preparation of printing pastes. The paste typically contains dyes, water-soluble polymers, dispersing agents, and other additives. The viscosity of the paste must be carefully controlled to ensure precise application of dyes onto the fabric surface [6].

Laboratory and industrial studies indicate that polymers such as sodium alginate are particularly suitable for reactive dye printing because they do not react

ISSN 3030-3907

with dyes during fixation processes. Polyvinyl alcohol is widely used due to its excellent film-forming ability and stability in aqueous systems [7].

The analysis also included technological processes such as preparation of printing paste, application of dye using printing machines, drying, fixation, and washing stages. Each of these stages plays a critical role in determining the quality of the final printed textile product [8].

RESULTS

The analysis of scientific literature shows that water-soluble polymers significantly influence the quality and efficiency of textile printing processes.

First, these polymers control the rheological properties of printing pastes. Proper viscosity ensures that dyes remain localized during printing and prevents spreading of patterns on fabric surfaces [2].

Second, water-soluble polymers contribute to uniform dye distribution and improved pattern definition. Studies indicate that printing pastes containing sodium alginate or carboxymethyl cellulose produce sharper and more uniform designs compared to pastes without polymer thickeners [9].

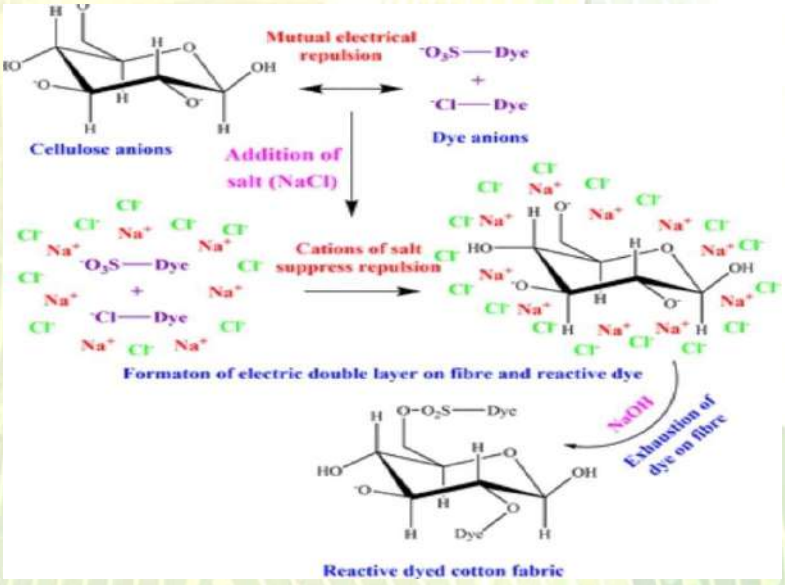


Figure 1. Schematic illustration of the hierarchical control of ink droplet penetration and reactive dye fixation on fabric surfaces treated with water-soluble polymers.

The fabric is first treated with hydroxypropyl methylcellulose (HPMC) or sodium alginate (SA), which form a thin polymer layer on the fiber surface. During inkjet printing, the polymer coating regulates the penetration of dye droplets and prevents excessive spreading. This controlled penetration improves pattern sharpness and uniform dye distribution. During the steaming process, reactive dye molecules form covalent bonds with hydroxyl groups of the cellulose fibers, resulting in stable dye fixation and enhanced color fastness.

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Third, these polymers improve dye fixation and color fastness properties. During fixation processes such as steaming or heating, polymer matrices help maintain dye molecules in close contact with fiber surfaces, enhancing bonding between dye and fiber [10].

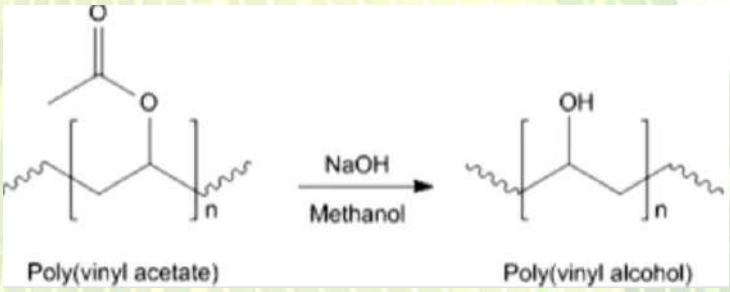
Another important result is the environmental advantage of water-soluble polymers. Many traditional textile printing thickeners contain synthetic chemicals that are difficult to remove from wastewater. In contrast, polymers such as sodium alginate and CMC are biodegradable and easily washable, reducing environmental pollution [11].

Furthermore, the use of water-soluble polymers contributes to improved productivity in textile manufacturing. Their ability to stabilize printing pastes and maintain consistent viscosity allows more efficient operation of modern textile printing machines [12].

ANALYSIS AND DISCUSSION

The role of water-soluble polymers in textile printing technology is closely related to their molecular structure and physicochemical properties. These polymers consist of long chains of repeating monomer units that interact with water molecules through hydrogen bonding, forming stable aqueous solutions.

Polyvinyl alcohol is one of the most widely studied water-soluble polymers in textile processing. It is produced by the hydrolysis of polyvinyl acetate and is known for its excellent film-forming ability and chemical stability. Research indicates that PVA solutions exhibit high viscosity and strong adhesion properties, making them suitable for use as binders in textile printing systems [3].



2-Figure.Conversion of poly(vinyl acetate) to poly(vinyl alcohol) by alkaline hydrolysis using NaOH in methanol, where acetate groups are replaced by hydroxyl (–OH) groups.

Carboxymethyl cellulose is another important polymer widely used in textile printing. It is derived from cellulose through chemical modification, where hydroxyl groups in cellulose are replaced with carboxymethyl groups. This modification increases the solubility of cellulose in water and enhances its thickening properties. Studies show that CMC solutions provide excellent viscosity control and compatibility with various dye systems [4].

ISSN 3030-3907

Sodium alginate, extracted from brown seaweed, is particularly valuable in reactive dye printing. Unlike some synthetic polymers, sodium alginate does not react with reactive dyes during fixation processes. This property prevents dye hydrolysis and ensures higher color yield and pattern clarity [5].

From a technological perspective, the effectiveness of water-soluble polymers depends on several factors including molecular weight, concentration, and interaction with other components of the printing paste. High molecular weight polymers generally produce higher viscosity solutions, which are necessary for precise pattern formation during printing processes.

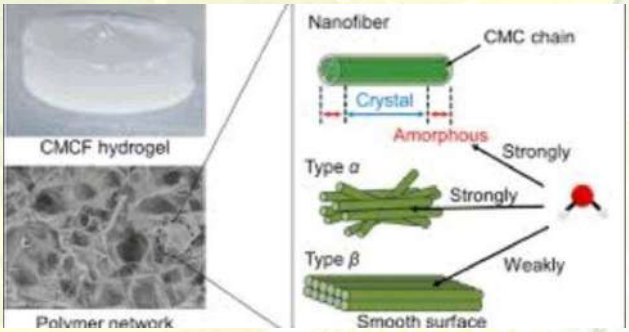


Figure 3..Structure of a carboxymethyl cellulose fiber (CMCF) hydrogel showing the polymer network and nanofiber structure. The CMC chains contain crystalline and amorphous regions that influence molecular interactions and the formation of the hydrogel network.

Environmental considerations have also increased the importance of water-soluble polymers in textile technology. Textile printing processes generate large amounts of wastewater containing dyes and chemical additives. The use of biodegradable polymers such as sodium alginate and CMC reduces the environmental impact of textile production [11].

Modern research in textile engineering also focuses on developing new polymer systems with improved performance characteristics. For example, modified cellulose derivatives and biodegradable synthetic polymers are being investigated as potential alternatives to traditional thickeners in textile printing [12].

Overall, the scientific literature demonstrates that water-soluble polymers play a critical role in improving printing quality, enhancing process efficiency, and reducing environmental impact in textile manufacturing.

CONCLUSION

Water-soluble polymers are essential components of modern textile printing technology. Their ability to regulate viscosity, stabilize printing pastes, and improve dye distribution significantly enhances the quality of printed fabrics.

ISSN 3030-3907

Scientific studies confirm that polymers such as polyvinyl alcohol, carboxymethyl cellulose, and sodium alginate provide important functional advantages in textile printing processes. These polymers improve pattern clarity, increase dye fixation efficiency, and contribute to better color fastness properties.

In addition to technological benefits, water-soluble polymers also offer environmental advantages due to their biodegradability and ease of removal during washing processes. Their use supports the development of sustainable and environmentally friendly textile production technologies.

Therefore, the application of water-soluble polymers in textile printing represents an important direction for improving efficiency, quality, and environmental sustainability in the textile industry.

REFERENCES

1. Shore J. Colorants and Auxiliaries: Organic Chemistry and Application Properties. Society of Dyers and Colourists, 2002, pp. 112–118.
2. Clark M. Handbook of Textile and Industrial Dyeing. Woodhead Publishing, 2011, pp. 256–263.
3. Finch C. Polyvinyl Alcohol: Properties and Applications. John Wiley & Sons, 1992, pp. 45–52.
4. Heinze T., Liebert T. Cellulose Derivatives and Their Applications. Springer, 2001, pp. 134–140.
5. Christie R. Colour Chemistry. Royal Society of Chemistry, 2015, pp. 210–216.
6. Holme I. Printing Technology for Textiles. Woodhead Publishing, 2001, pp. 88–94.
7. Broadbent A. Basic Principles of Textile Coloration. Society of Dyers and Colourists, 2001, pp. 321–329.
8. Gulrajani M. Textile Printing Technology. IIT Delhi Publications, 2010, pp. 150–159.
9. Shenai V. Technology of Textile Processing. Sevak Publications, 2002, pp. 201–208.
10. Aspland J. Textile Dyeing and Coloration. AATCC Press, 1997, pp. 175–183.
11. Lewis D. Environmental Aspects of Textile Dyeing. Woodhead Publishing, 2007, pp. 97–104.
12. Karmakar S. Chemical Technology in the Textile Industry. Elsevier, 1999, pp. 242–249.

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