

**ANALYSIS OF THE EFFECT OF ADHESIVES ON PAPERS CONTAINING
POLYESTER (LAVSAN) FIBRE WASTE**

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Abstract

In the article, high-strength paper samples are analysed during the production process of paper containing polyester (lavsan) fibre waste, including the introduction of adhesives into the paper cellulose together with synthetic waste fibres, the influence of selected adhesives on the physical-mechanical and printing properties of paper.

Keywords: cotton cellulose, polyester (lavsan), modified cationic starch (MCS), carboxyl methyl cellulose (CMC) glue, acrylic emulsion (AE).

Introduction

The pulp and paper industry is an industry related to wood processing. Currently, the world paper industry produces more than 800 types of paper and cardboard with different, completely opposite properties, the main raw material for the production of paper and cardboard in the world (more than 90%) is wood cellulose [1]. Taking into account the shortage of wood raw materials for Uzbekistan, the wide use of non-wood alternative raw materials from various herbaceous plants, one-year plant waste, chemical and textile industries, and household waste for the production of paper products is promising [2].

Cotton pulp is the main and most expensive raw material for paper production. The technology of paper production from cotton cellulose on an industrial scale does not have economic efficiency, but adding waste from the textile and chemical industry to paper pulp solves the problem of efficient and rational use of raw materials and saves valuable cotton cellulose. In the production of printing paper, the use of valuable cotton cellulose partially from industrial waste with polyester (lavsan) fibre serves to increase the assortment of paper in the production of paper products at local enterprises and also serves to reduce industrial waste ecologically, and at the same time allows you to determine the appropriateness of the use of secondary fibres.

The purpose of the study

It consists in researching the physical-mechanical and printing-technical properties of paper containing polyester (lavsan) fibre waste for printing products in the printing industry.

Research object

Paper masses made of different ratios of cotton cellulose and polyester (lavsan) fibres, paper samples obtained from these paper masses, and multi-colour printed copies printed on the surface of these papers were obtained.

Technological part

Taking paper samples and evaluating their quality was carried out in the test centre of the paper factory of "Global Komsco Daewoo" JV following the approved technological regulation. Samples containing cotton cellulose fibres and polyester (lavsan) fibre waste were taken in different proportions. Grinding of fibrous materials was carried out in Massroll-22.5 (Moscow). The degree of crushing of cellulose fibres was determined as 50-55° Shopper-Ringler. Samples were made on the sheet melding machine of the company "Rapid" (Germany). To obtain a paper containing a certain part of cotton cellulose with polyester (lavsan) fibre waste, weighing ≈ 80 gr/m², cotton cellulose is ground to 50-55 °C, and then cleaned and cut into 2-5mm lengths of polyester (lavsan) fibre to prepare printing paper. mixed with waste.

Additional fillers and adhesives were added to the composition of the paper pulp. The composition of the pulp The consumption of materials based on 1t of paper was as follows: Cotton pulp 0 - 100%; polyester (lavsan) fibre waste 2 - 50%; kaolin ($Al_2O_3 \cdot 2SiO_3 \cdot 2H_2O$) - 145 kg/t; rosin glue (A mixture of tar acids containing $S_{20}N_{30}O_2$).-25.7 kg/t and consists of aluminium sulphate $Al_2(SO_4)_3 \cdot 18H_2O$ and rosin glues were used as adhesives.

Results and discussion

Polyester (lavsan) contained in cotton cellulose is waste fibres with an increase in the amount, the bond strength between the fibres gradually decreases, the number of intermolecular hydrogen bonds in the paper sheet decreases, and finally, the general properties of the paper deteriorate [3].

The main purpose of this scientific work is used in the paper production process to increase and stabilize the hydrogen bonding forces between the primary and secondary fibres in the pulp-modified cationic starch (MCS), Carboxyl methyl cellulose (CMC) and acrylic emulsion (AE)using adhesives, paper samples by adding from 0.5 to 2.5 per cent to the composition of the paper mass and the effect of these glues on the physical-mechanical and printing properties of paper (Table 1) was studied.

In the first stage, the technological and economic feasibility of using modified cationic starch (MCS) was evaluated and their effect on paper strength parameters was studied. MCS is considered a high-quality component for printed materials, forming a thin film on the surface of the paper, improving the strength and resistance properties of the printed material, and is often used as a film-forming agent [4]. The effect of MCS on the mechanical properties of paper was studied.

The obtained results show that in the process of obtaining MCS printing paper, a 5% increase in the strength of the paper was observed. This can be explained by the interaction of the adhesive with cellulose fibres, and the formation of hydrogen bonds with the cationic starch fibres due to the presence of anionic groups in fillers due to the mechanism of adhesion of small fibres to each other. It can be explained that the ash level of the experimental papers increased by 3 times, the filler, adhesive and synthetic fibres in the paper mass increased in volume, and the whiteness level of the paper increased, and the whiteness level increased due to the better retention of kaolin and cellulose fine fibres by MCS glue.

In the second step, CMC sodium salt carboxyl methyl cellulose glue was used. Carboxyl methyl cellulose (CMC) is an acidic ester of cellulose and glycolic acid $\text{OH-CH}_2\text{-COOH}$. This ether is obtained in the form of sodium salt and is economically advantageous due to its low cost and easy availability. CMC was used as an adhesive in the paper composition in this scientific work.

The obtained results helped to increase the strength properties of the paper due to its unique physicochemical properties, which are presented in the literature as a component of CMC paper pulp. It was observed that the strength properties increased up to 8% when the CMC content of the paper increased by 2.5%. When taking CMC paper samples, it was observed that the strength properties increased by 10% despite the addition of 20% of polyester (lavsan) fibre waste. CMC is more promising and effective due to its hydrophobicity, while significantly increasing the strength properties of the paper.

In the third stage, paper samples were obtained by adding acrylic emulsion polymer adhesive compounds. Acrylic (polymethylacrylate) emulsion is an inconspicuous white liquid with a pH of 6.0-8.5, a relative viscosity of at least 1.75, and a monomer mass fraction of no more than 0.35%. A 15% improvement in breaking length was observed when comparing paper samples containing acrylic emulsion to paper pulp and paper samples containing MCS and CMC glue. The expediency of using a new acrylic emulsion polymer glue instead of the traditionally used MCS and CMC glue was based on the experimental method. Acrylic emulsion not only improves the mechanical performance of the paper, the optical properties of the paper and the whiteness of the paper have been increased by 12%. (See Figure 1).

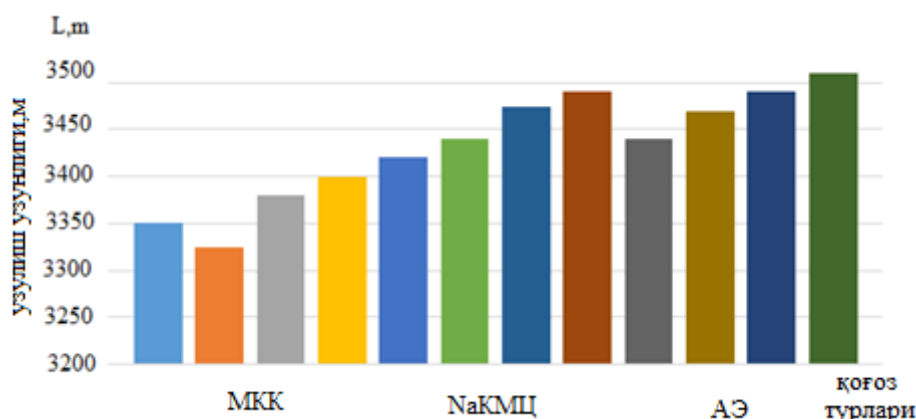


Figure 1. Diagram of the effect of adhesives on the breaking length of experimental papers

The obtained results revealed that the quality indicators of the paper samples were improved by 15%. It was found that the properties of polymer glue samples containing synthetic compounds correspond to the established standards and are as follows: polymer adhesives have the necessary adhesion to ensure a strong bond with the paper mass, give elasticity to paper samples, and increase the breaking length. Thus, it was determined that it is appropriate to use MCS, CMC and acrylic emulsion as adhesives in improving the strength indicators of paper samples. At the same time, in improving the quality of paper and cardboard samples (breaking length by 15 per cent, optical indicators by 12 per cent), MCS,

In this scientific work, paper samples with high strength are obtained during the process of paper production, including the introduction of adhesives into paper pulp together with synthetic waste fibres.

An analysis of the results is presented in Table 1.

Table 1. The effect of adhesives on the physical and mechanical properties of experimental papers

Indicators	Adhesives											
	MKK				Neither the KMTs				AE			
	1	2	3	4	5	6	7	8	9	10	11	12
Options												
The amount of adhesive in the paper mass, %	0.5	1.5	2.0	2.5	0.5	1.5	2.0	2.5	0.5	1.5	2.0	2.5
Cotton cellulose, %	100	80	80	80	100	80	80	80	100	80	80	80
Polyester (lavan) fibre waste, %	-	20	20	20	-	20	20	20	-	20	20	20
Break length, m	3380	3375	3386	3395	3394	3398	3405	3408	3398	3404	3408	3412
Degree of whiteness, %	86	87	86	88	87	91	90	91	85	87	90	89
Interruption voltage, N	31.0	31.5	32.8	33.0	32.6	32.8	33.4	34.2	32.6	33.3	34.7	34.9
Bending, i.b.s.	44	54	65	86	46	52	81	96	45	60	78	97
Kullik, g	1.2	5.5	4.6	4.9	1.0	2.6	3.1	3.5	1.7	2.6	3.7	4.9

Conclusion

A paper production method is proposed, consisting of (80%) cotton cellulose and (20%) polyester (lavsan) fibrous waste and chemically active (2-2.5%) adhesives, in which dispersions of cellulose-chemically active adhesives are cotton cellulose and the possibility of obtaining high-quality, high-quality paper with high strength by forming a high-strength bond between waste fibres was shown.

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