ISSN 2181-8622

Manufacturing technology problems

Scientific and Technical Journal Namangan Institute of Engineering and Technology

INDEX COPERNICUS INTERNATIONAL

Volume 9
Issue 3
2024

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Crossref doi
SLIB.UZ Scientific library of Uzbekistan

STUDY OF THE EFFECT OF ADHESIVE SUBSTANCES ON PAPER STRENGTH PROPERTIES

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Abstract: In the article, modified cationic starch (MCS) containing 80 percent of cotton cellulose, 20 percent of polyester (lavsan) fiber waste, carboxyl methyl cellulose (NaCMS) glue in the second stage, and acrylic emulsion (AE) in the third stage are 0.5 to 2 percent of the paper pulp. Paper samples were taken by adding up to .5% and the obtained paper samples were comparatively analyzed. The results showed that the quality indicators of the paper samples improved by 15%.

Keywords: cellulose, paper, fibrous waste, polyester (lavsan) synthetic fiber, breaking length, ashiness, bending resistance, adhesive, polymer, emulsion.

Introduction. Papers are fiber materials, mainly different types of fibers are crushed, and fillers and adhesives are added to the composition. The properties of paper are explained as elastic-plastic, capillary-porous colloidal material. The origin of the term "Paper" is still unclear. However, in European countries, this concept is associated with the word papyrus. In fact, paper is the rarer in English, das Rariyer in German, le rariyer in French [1]. The most popular and widely used raw material for paper production is cellulose. Cellulose ($S_6N_{10}O_5$) is a complex organic compound of carbon, hydrogen and oxygen. Cellulose is a polymer composed of long chains of linear molecules. All parts of the molecules are connected with each other using glucose anhydride units 1→4- β glucoside [2].

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%) wood is cellulose [3].

Wood pulp is used to obtain high-quality and high-strength paper from wood pulp [4]. The advantages of these raw materials are reflected in the high level of flexibility, whiteness, smoothness and number of folds in the paper [5].

In recent decades, the production and consumption of wood has increased significantly in most countries of the world. Currently, 15,000 types of wood products are known, and this number can increase indefinitely. Forest specialists call this fact a technical revolution in the use of wood. On average, it takes 25-30 years to grow a new tree [6]. Currently, the issue of rational use of forest resources has become an urgent problem. Alternative raw materials for paper production are the main source, especially in many Asian countries that do not have forests and have limited wood resources. Currently, non-wood fibers are mainly used in the world for the production of special

types of paper. Cotton, linen, hemp fibers are used to obtain high-quality types of paper. In this regard, the use of wood waste, wood biomass and alternative secondary raw materials is one of the solutions to this problem.

There are not enough wood reserves in Uzbekistan. Therefore, obtaining cellulose using alternative and secondary raw materials available in the Republic is an urgent task today. Uzbekistan was the first among the CIS countries to conduct large-scale technological experiments in the field of cellulose production using alternative fibers. In the past few years, he has taken a number of successful and useful steps in this direction.

Uzbekistan is rich in annual plant waste, which is a raw material for the production of cellulose. Currently, only 6-7% of the total reserves of non-wood alternative plant materials are used. Processing only 10% of annual agricultural and plant waste allows to obtain more than 250,000 tons of semi-finished products for the production of paper and cardboard per year. Paper and cardboard products made from non-wood alternative plant materials, in particular, annual plants and agricultural waste, are promising in the production of packaging and corrugated cardboard products [7].

Today, in our Republic, cellulose obtained from annual plants is the main raw material for paper production. Cotton is one of the most common types of such fibers. This is the largest amount of unconventional raw materials. Paper made from cotton and fiber waste has high whiteness and is often used in the production of special types of paper (banknotes, state declarations, etc.).

The printing properties of paper are determined by the properties of fibrous materials in the paper pulp, primarily by the properties of cellulose and additional fiber suspension. In paper production, mechanical parameters are important parameters affecting printing properties. When adding adhesives to paper, along with the hydrophobicity of the paper, the level of strength increases and the ability to absorb moisture decreases, and the smoothness of the paper increases, and at the same time, the formation of additional hydrogen bonds between the fibers in the mass. helps to be.

The main goal of this scientific article is to use innovations in pulp and paper production, to obtain products with new properties and to achieve environmental standards due to the use of waste. The work is aimed at the improvement of a new technology that allows to obtain paper using secondary waste fibers, reduce the amount of waste, increase the range of paper and save electricity in the pulp and paper industry.

The purpose of this experiment is to obtain paper samples using different types of adhesives used in the paper production process in order to increase and stabilize the hydrogen bonding forces between the primary and secondary fibers in the paper pulp, and to determine the physico-mechanical properties of these adhesives. and consists of studying the effect on printing properties (Table 1).

Research work was carried out in three stages. In the first stage, modified cationic starch (MCS) containing 80% of cotton cellulose and 20% of polyester (lavsan) fiber waste, in the second stage, carboxyl methyl cellulose (NaCMS) glue and in the third stage, acrylic emulsion (AE) in the composition of paper pulp from 0.5% Paper samples were

taken by adding up to 2.5% and the obtained paper samples were analyzed comparatively.

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 a high-quality component for printed materials, it forms a thin film on the surface of the paper, improves the durability and resistance to external effects of the printed material, and is often used as a film-forming agent. The effect of MCS on the mechanical properties of paper was studied [8].

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

Table 2. Effect of adhesives on physical and mechanical properties of experimental papers

Indicators	Adhesives											
	MCS				Na CMS				AE			
Options	1	2	3	4	5	6	7	8	9	10	11	12
Amount of adhesive in paper sellulose, %	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 sellulose, %	100	80	80	80	100	80	80	80	100	80	80	80
Polyester (lavsan) fiber 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
Whiteness level, %	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
Grayness, 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

At the second stage, NaCMS sodium salt carboxymethylcellulose glue was used. Carboxymethylcellulose (CMS) is an acidic ester of cellulose and glycolic acid ON-SN_2-SOON. This ether is obtained in the form of the sodium salt, while being economically viable due to its low cost and easy availability. NaCMS was used as an adhesive in paper in this scientific work.

The obtained results helped to increase the strength properties of the paper due to its unique physico-chemical properties, which are presented in the literature as a component of NaCMS paper pulp. When the amount of NaCMS in the paper increased by 2.5%, it was observed that the strength properties increased up to 8%. When taking samples of NaCMS paper, despite the addition of 20% of polyester (lavsan) fiber waste, it was observed that the strength properties increased by 10%. NaCMS significantly increases the strength properties of the paper and is more promising and effective due to its hydrophobicity.

At the third stage, paper samples were taken 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%. Compared with the paper samples with acrylic emulsion added to the paper pulp and the paper samples containing MCS and NaCMS glue, it was observed that the breaking length was improved by 15%. The expediency of using a new acrylic emulsion polymer glue instead of the traditionally used MCS and NaCMS glue was based on the experimental method. Acrylic emulsion not only improves the mechanical performance of the paper, but also increases the optical properties and whiteness of the paper by 12%.

The results showed that the quality indicators of the paper samples improved by 15%. The properties of the polymer adhesive samples containing synthetic compounds were found to be in accordance with the established standards and the following were found: polymer adhesives have the necessary adhesion to ensure a strong bond with the paper mass, elasticity to the paper samples gives, increases the break length. Thus, the expediency of using MCS, NaCMS and acrylic emulsion as adhesives in improving the strength indicators of paper samples was determined. At the same time, the expediency of using a synthetic binder containing MCS, NaCMS and acrylic emulsion in improving the quality of paper and cardboard samples (breaking length by 20%, optical indicators by 12%) was analyzed based on experiments.

In this scientific work, it was possible to obtain paper samples with high strength by introducing adhesives together with synthetic waste fibers in the paper production process [9].

Summing up, it can be said that the paper pulp consists of (80%) cotton cellulose and (20%) polyester (lavsan) fibrous waste and chemically active (2-2.5%) adhesives. in this case, it was demonstrated that dispersions of cellulose-chemically active adhesives create a high-strength bond between cotton cellulose and waste fibers, and it is possible to obtain high-quality, high-quality paper that meets the requirements of the printing process.

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