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ALTERNATIVE RAW MATERIALS FOR PULP AND PAPER PRODUCTION

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According to the World Economic Forum, the consumption of sanitary and hygiene paper, including toilet paper, paper towels, napkins in the USA, Europe, Australia, Japan, and New Zealand, has been significantly increased due to the COVID-19 pandemic [1]. In particular, in Ukraine, over the last month, the demand for these products has increased 1.5 times. The productivity of the respective production capacities has increased on average by 25 % [2]. This trend shows that alternative types of fibrous semi-finished products are finding their place to meet the needs for sanitary and hygienic products.

Despite paper documents and periodicals, which are considered an indicator of the development of the pulp and paper industry, are being actively displaced by digitization, this industry has produced significant changes in the product range in recent years, as well as growth prospects. Over the last decade, there has been a decline in the production of some types of printing paper, for drawing, and newsprint. However, the need for cellulosic packaging materials is increasing worldwide, along with the need for natural raw materials for hygiene products. The pulp and paper industry is transforming and developing, seeking to become the nucleus of the bioeconomy in the future. We can say that the industry has undergone the most significant transformation in many decades. A broad search for new ways of processing plant raw materials and their components, new sources of cellulose fibers is taking place in many laboratories and research centers [3, 4].

The growing scarcity of wood raw materials causes the use of non-wood nature processing products to obtain cellulosic materials. This is due to the annual recoverability and low cost of raw materials such as agricultural waste, as well as the development of new environmentally friendly ways to obtain cellulosic semi-finished products.

In the structure of paper and cardboard production in Ukraine at the beginning of 2020, the production of tare cardboard and fluting dominated at about 68 %, boxed cardboard at about

11%, sanitary and hygienic paper 20 %, and other types accounted for only 1 % [2]. The raw material for the enterprises of the industry is waste paper, which refers to the secondary raw materials with low mechanical properties. To achieve the required quality indicators of cardboard and paper products, enterprises import a large number of chemical auxiliaries and cellulose. This leads to a higher cost of production and reduced competitiveness of enterprises. One of the ways of solving the raw material base for the enterprises of the branch can be the organization of the own production of semi-finished products from the waste of non-wood raw materials.

In Ukraine, the production of hemp, mainly technical, is sufficiently developed. This crop is grown in an area of approximately 3000 ha [5].

A significant advantage of growing hemp is that it is compatible with all other crops. The advantages of hemp include the fact that, depending on the type, variety, and growing conditions, its height reaches 0.6-5 m, and thickness – from 3 to 30 cm, which provides reserves of raw materials [6].

A characteristic feature of the anatomical structure of hemp is the presence of bast fibers and wood layers The first layer is 30-40 % of the entire stem and the second – 60-70 %. The bast layer contains the most valuable cellulose fibers, the content of which is about 60-70 %. The length of the bast fibers ranges from 5.0-55.0 mm, and the length of the perch fibers is 0.60-0.75 mm. The shive of hemp is a waste product and is of limited use in the textile and other industries [7].

The purpose of the work is to determine the chemical composition of the shive of hemp and to study the possibilities of using it to obtain fibrous semi-finished products.

Studies of the chemical composition of the shive, namely moisture, ash content, hot water solubility, 1 % alkali solubility, alcohol-benzene mixture solubility, lignin, cellulose, and hemicellulose were carried out by the standard methods (Tappi Test Methods).

Holocellulose was determined by treating an extractive free raw material with an H_2O_2 + CH_3COOH solution for 30 and 50 min to track the behavior of the raw material [8].

From the 30th minute of treatment, the color of the holocellulose changes from yellow to white, confirming the practical absence of lignin in the holocellulose. As you know, the color of the material indicates the presence of chromophore groups (carbonyl, carboxyl, aromatic rings), which are also part of lignin [8].

It should note that our colleagues have previously practiced the standard methodology for the determination of holocellulose in non-wood plant raw materials. It shows that further treatment of non-wood plant material does not significantly reduce the content of residual lignin in plant material, but reduces the content of holocellulose, respectively. The reduction of holocellulose content after 30 minutes of treatment of non-wood plant material with a peracetic acid solution is associated with the partial continuation of the removal of lignin from the plant material. Hydrolysis of polysaccharides under the action of the peracetic acid is predominant in this case [8].

Cellulose is a major component of the cell walls of all plant species and. Therefore, any plant raw material can be considered as a potential raw material for pulp and paper products. However, from processing efficiency, plant raw materials must appropriate certain basic requirements. In particular, they include the constancy of the anatomical and morphological structure and chemical composition.

As can be seen from the data in the table, the shive of hemp in its composition contains about 67-70 % of holocellulose. What characterizes it as a high carbohydrate feedstock. The carbohydrate complex includes cellulose and hemicelluloses – pentosans, hexosans, and related uronic acids. However, the shive is suitable for processing into fibrous semi-finished products and can be considered a complete replacement of wood. About the content of lignin, its amount

is at the level of hardwood. The mineral content of the shive is slightly higher than that of wood but is 2-2.5 times lower than that of wheat straw.

Table 1

Chemical composition of hemp waste and other materials

Composition	Value (%)				
	Stalks of hemp	Stalks and fibers of hemp	Softwood [9]	Hardwood [9]	Stalks of wheat straw [10]
Moisture	9.7	8.9	-	-	-
Ash	1.6	2.2	0.7-1.0	0.14-0.5	6.6
Hot H_2O Extractive	4.0	6.3	2.1-2.5	1.8-2.4	10.1
1 % NaOH Extractive	23.5	26.1	11.0-11.6	10.9-11.3	37.2
Ethanol-benzene Extractive	2.2	1.9	0.9-7.5	0.4-3.0	5.2
Lignin	24.5	19.3	28-30	18-25	16.5
Cellulose	46.8	52.3	40-50	31-49	45.6
Pentosan	-	-	10-12	23-29	26.7
Hemicellulose	17.9	18.7	23-25	26-35	-
Holocellulose (30 min)	66.6	70.5	-	-	71.8
Holocellulose (50 min)	64.3	67.5			

It should note that the ash, which mainly contains silicic acid, hurts the mechanical strength of the obtained fibrous semi-finished products. It partially remains in the semi-finished products, which leads to a decrease in indicators, as well as goes into the waste liquor, which hinders its further regeneration. Compared to wood, the shive contains a high content of water-extractable substances, which are not part of the cell wall and mainly concentrated in the cell cavities and the intercellular space. During the extraction of the shive with a dilute alkali solution, a significant yield of soluble substances observed. This is due to the dissolution of not only the extractives but also the low molecular weight fractions of hemicelluloses and cellulose. Such regularity is confirmed by information on the peculiarities of the chemical composition of non-wood raw materials.

Based on the data obtained, it can predict that technological modes of processing the shive may be close to the processing of hardwood. We can conclude that the chemical composition of hemp waste is a valuable material for processing into fibrous semi-finished products. Annual non-woody plants in one growing season, unlike wood, quickly become industrially mature. One of the main advantages of such raw material is its annual renewability and the possibility of processing both traditional and non-traditional methods of delignification, with the production of primary fibrous semi-finished products to meet the needs of the industry.

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ВИЗНАЧЕННЯ РОЗЧИННОСТІ ОСАДІВ ПІД ДІЄЮ КИСЛОТ ДЛЯ ЗАХИСТУ ОБЛАДНАННЯ СИСТЕМ ВОДОСПОЖИВАННЯ

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На багатьох підприємствах використовуються оборотні системи водоспоживання. Для захисту металевих конструкцій у воді та водних середовищах від корозії та накипу застосовують інгібітори корозії і стабілізатори накипоутворення. В разі оптимального підбору типу та дози інгібіторів і антискалантів можливий перехід до замкнутих систем водоспоживання. Результатом такого переходу буде зменшення кількості забору свіжої води, зменшення об'ємів стічних вод та подовження терміну експлуатації трубопроводів та обладнання.

Крім підбору ефективних реагентів для стабілізаційної обробки води, існує проблема застарілого обладнання, поверхня якого вкрита шаром продуктів корозії та карбонатно-сульфатним осадом [1]. Ефективність використання інгібіторів корозії та стабілізаторів накипоутворення в трубопроводах, що вкриті продуктами корозії та накипом, мінімальна. В даному випадку необхідно або збільшувати витрату реагентів,