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THE ROLE OF THE DECORTICATION PROCESS IN THE PRIMARY PROCESSING OF STRAW OF TECHNICAL HEMP

РОЛЬ ДЕКОРТИКАЦИОННОГО ПРОЦЕССА В ПЕРВИЧНОЙ ОБРАБОТКЕ СОЛОМЫ ТЕХНИЧЕСКОЙ КОНОПЛИ

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This paper discusses the prospects for effective use hemp culture in various industries and the role of the decortication process in the processing of bast fibers. The factors affecting the spinning ability of bast fibers, including the purity of the fibers, a property that determines the efficiency of the decortication process, are analyzed, and the main factors affecting the decortication process are also determined.

В работе рассматриваются перспективы эффективного исполь-зования конопляной культуры в различных отраслях промышленности и роль процесса декортикации в обработке лубяных волокон. Анализируются факторы, влияющие на прядильную способность лубяных волокон, включая чистоту волокон, свойство, которое определяет эффективность процесса декортикации, также определяются основные факторы, влияющие на процесс декортикации.

Keywords: natural fibers, bast fibers, hemp, technical fibers, elementary fibers, decortication, shives, lignin.

Ключевые слова: натуральные волокна, лубяные волокна, конопля, технические волокна, элементарные волокна, декортикация, шивер, лигнин.

Hemp (Cannabis sativa), that is, hemp seed, also called Indian is a cultivated plant that has many uses. Hemp fibers are one of the strongest and most durable among plant fibers. Hemp is a coarse bast fiber obtained from hemp stems. The bast layer of the hemp stalk contains on average about 20...25% fiber in male plants and about 12...20% in female. For a number of industrial varieties of hemp sowing, this indicator reaches 35...40%. The fiber length is on average about 1.8 m, sometimes up to 2.5 m. This type of bast culture is a raw material for a number of industries, such as: food, paper, textile and others. The range of application of hemp is almost unlimited and this is its uniqueness. It is known that hemp can produce more than 25,000 kinds of products: from paper to plastic. Hemp fabric today has become a new elite material for modern designers and allowed to create a new trend in fashion. In Europe, the USA and Canada, hemp fiber clothing is considered fashionable.

Hemp and flax growing are the most important branches of agriculture. Cannabis processing is an industry that is currently experiencing a rebirth in many countries around the world. Technical hemp is a bast culture whose structure is considered identical to flax. The advantages of growing hemp include the absence of pesticides and chemicals for pest control, which allows to obtain environmentally friendly and non-toxic materials and products [3]. Technical hemp is actively used in the industrial manufacture of fiber [1]. Technical hemp fibers have earned worldwide recognition due to their wear resistance, resistance to loss of useful properties in salt water and at extremely low temperatures, which made hemp fiber products indispensable in the marine industry [3].

Bast production is waste-free. Since all the components of this plant are used in various industries. For instance:

- long fibers are used in the manufacture of environmentally friendly fabrics [2]. Hemp fibers are particularly durable and resistant to salt water, as a result of which they have found application in the marine industry. Hemp ropes and ropes are still used, since they practically do not wear out due to contact with sea salt

- short fibers - raw materials for the textile and cellulose industry [2].

- waste (tow) resulting from scuffing and scratching, is used mainly for the production of technical materials (packaging materials, etc.).

- shives is used in the manufacture of building materials

- seeds for the production of oils, protein concentrate [3], cosmetics, medicines, and squeezed seeds as cake for feed.

In many countries of the world there are industries that are based on hemp raw materials. For example, Belgium, Canada, USA, China, Russia and others. Today in the world there is a stable and high demand for natural seed and fiber products. Over the past few years, China has been the world leader in the production of textile hemp raw materials. Here the technology of fiber processing is constantly being improved. Interest in the production of hemp abroad, taking into account its unique properties, is constantly growing.

In the Republic of Kazakhstan, state bodies and other organizations are implementing measures to create favorable conditions for the development of domestic production of bast crops. The interest of the national economy of Kazakhstan for fiber obtained from drug-free hemp is increasing annually. One of the most important recent stages in the development of domestic production is the growth of bast fibers, namely drug-free hemp and oil flax in the south and north of our homeland. This is evidenced by official data on the sown area of drug-free hemp, which in 2017 sowed area was 600 hectares, and in 2018 the sown area increased by 4000 hectares [3].

In the spring of 2016, several experimental crops were made in different regions of Ka-

zakhstan to determine the most optimal conditions for growing hemp. The experiment was held in the South Kazakhstan, Almaty, North Kazakhstan, Karaganda and Pavlodar regions. In 2017, in the Kerbulak district of the rural district of Sarybastau, Kyzylshoky LLP in the Almaty region, 600 hectares of technical hemp were sown. In the Kerbulak region, she lived best. To do this, as an experiment had to plant it in five regions of the Republic.

The hemp yield per hectare is very high. Technical hemp contains less than 0.1% THC (tetrahydrocannabinol), one of the main cannabinoids. So in narcotic hemp contains from 1-20% THC. However, it should be noted that hemp production in Kazakhstan is less than oilseed flax. The most famous and largest producer of hemp in Kazakhstan is KazHemp LLP.

KazHemp is engaged in the cultivation and processing of technical hemp is engaged in KazHemp. According to the domestic company KazHemp, in 2019, it was sown with 1000 hectares of industrial hemp, while most of the products are exported [2].

The company produces long hemp fiber, shives, short fiber and technical hemp seeds.

In 2017, our industrial hemp was exported by industrial experience, in Japan they have already received cellulose, it is very high quality. There is a big economy, if the tree grows 20...25 years, then hemp in 100 days.

Today, industrial hemp is cultivated in small quantities in Kazakhstan - the sowing area barely reaches 1000 hectares, while most of the products are exported [3].

The main limitations of the large-scale development of hemp-based products are the lack of technology to produce high-quality fibers with high yields. In this regard, it can be concluded that there is an urgent need to develop an integrated technology for processing the stem mass of bast crops in Kazakhstan, which will also contribute to the transition to a sustainable production of hemp fibers and products from them.

Thanks to their superior quality, hemp fibers are increasingly being used for a large number of traditional and innovative industrial applications.

The quality of the final product - yarn, primarily depends on the properties of the raw materials used. An objective assessment of the quality of raw materials allows manufacturers to most accurately choose the scope of its effective use. An objective assessment of the fibers is a knowledge of all the properties of the fibers, the morphological structure. But these indicators can undergo changes during technological processes.

An analysis of literary sources has revealed many factors affecting the spinning ability of bast fibers. The most significant indicators are:

- fiber purity - lack of taperedness;
- release of technical coarse fibers into elementary fibers;
- high mechanical properties - strength, flexibility, coefficient of friction;
- geometric properties - average length, linear density;
- a reduced content of adhesives of elementary fibers (lignin, hemicellulose, polysaccharides) on the fiber [4], since non-cellulose substances prevent the dispersion of technical fibers [5].

The purity of the fibers means the absence of defects and impurities in them. Purity ensures the stability of the spinning of the fibers, the quality of the yarn obtained and the textile products made from it [6].

In bast fibers, the following defects are distinguished:

- cones - compacted lumps of tangled, short fibers;
- shives - small pieces of wood of the stem, not associated with fiber;
- flaws - a fiber on which entirely or in small gaps at a length of at least 5 cm there is wood tightly bonded to it.

The purity of the fibers is estimated by the percentage of weed impurities and defects on them per unit length and mass. Bast fiber purity is achieved with a decortication process. The preparation of fibers for spinning consists of several stages. Important of which are the processes of decortication, the elementization of technical fibers. Technological processes occurring during preparation should not impair the quality of the fibers.

Decortication (from Latin decorticatio - peeling of bark) is a mechanical way of separating the bast of spinning plants (kendyr, ke-

naf, rope, hemp) from the fire without a preliminary lobe, the process plays a central role in the entire chain of production of natural fibers [7].

The main factors affecting the separation of sheavess from fibers are:

- maturity of the stem of bast crops;
- the effective operation of equipment designed for the primary processing of bast fibers, which includes a set of machines for producing products, insufficiency of the pressure of organs in the process of mashing occurring between grooved rollers;
- methods of harvesting and cultivating the bast (methods for processing stems to break the bonds between the bast and wood);

The interconnection of factors affect the technological parameters of the product and the efficiency of the decortication of bast fibers. The purity of the fibers ensures the efficiency of cleaning the feedstock after the main stages of fiber processing. After the main processing stages, we subtract the fiber clogging and determine the efficiency of removing wood weed impurities from the fibers.

A test was carried out to determine the purity of hemp fibers. The objects of the study are short fibers of technical hemp grown in the Almaty region, the harvest of 2019. Samples of 100 grams were taken after processing the main stages: crushing, scutching and carding. The tests were carried out in accordance with GOST R 53484-2009 "Flax trepany. Technical conditions".

The mass fraction of fires, defects and weedy impurities is determined according to GOST R 53484-2009 “Scutched flax fibre. Specifications".

Determination of the content of shives and fibers is carried out according to GOST R 53484-2009 "Scutched flax fibre. Specifications". From each sample 100 g of the sample was taken to determine the content of shives and fibers. Manual separation of fibers and sheavess. After obtaining the mass of the separated shives and fibers, for the accuracy of the results, the fractions were dried in an oven at a temperature of (105 ± 3) ° C to constant mass, then the fractions were weighed. Weighing error not more than 0.01 g. Mass fraction of shives and weedy impurities (S) according to GOST R 53484-2009 "Scutched flax fibre. Specifications" calculated by the formula,%:

$$S=m_1/m\cdot 100,$$

where m – is the initial mass of the sample, g; m_1– mass of shives and weedy impurities, g.

Determination of the mass fraction of the flaws. Flaws are called fiber, on which entirely or in small gaps at a length of at least 5 cm there is wood tightly bonded with it.

To determine the mass fraction of the flaws, handfuls of fiber selected for the mass fraction of the shives are used. From the middle of each handful, two point samples of fiber are taken in the form of whole strands along the length of a handful weighing 6-7 g each and laid out separately on paper, forming two samples weighing about 100 g each. Both fiber samples are weighed and a flaw is selected from each separately. To do this, the strands of fiber are spread in a thin layer on the table and carefully select the twisted fibers with tweezers. The weighing error should be no more than 0.01 g.

The mass fraction of the flaws (Fl) is calculated by the formula:

$$Fl=m_3/m_2\cdot 100,$$

where m_2 is the initial mass of the sample, g; m_3 – mass of defect, g.

The mass fraction of fibers (F) is calculated by the formula:

$$F=m_4/m_5\cdot 100,$$

where m_4 – is the mass of fiber, g; m_5 – initial sample weight, g.

The arithmetic mean of the results of two determinations is taken as the test result. The calculation is carried out to the first decimal place and rounded to the nearest whole number.

Table 1

Sample after process	Indicators	
	Mass of shives	Mass of fiber
Crushing	6% (of which 1,5% are flaws)	94%
Scutcing	5% (of which 3% are flaws)	95%
Carding	0%	100%

Table 1 shows the results of the study, which show the effectiveness of the decortication process at the main stages of the processing of bast fibers, as well as a decrease in the mass fraction of the fire and undercuts to the complete absence of wood on the fiber. This indicates the purity of the fibers, which is achieved by the efficient operation of equipment designed for the primary processing of bast fibers, which consists of a complex of machines for crushing, scutching and carding. On the sample after the crushing machine, the shives mass was 6%, in the next stage of shives scutching it decreased to 5%, after the carding stage of the sheaves it was completely removed by the carding machine. As a result, the obtained fibers without defects – shives, flaws that during the spinning process will not create difficulties, which emphasizes the most important role of the decortication process in the processing of bast fibers.

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