

**TECHNICAL AND TECHNOLOGICAL SOLUTIONS FOR PRODUCING FIBRE
FROM BAST CROPS**

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**ТЕХНІКО-ТЕХНОЛОГІЧНІ РІШЕННЯ ПРОЦЕСУ ОДЕРЖАННЯ ВОЛОКНА З
ЛУБ'ЯНИХ КУЛЬТУР**Berezovsky Yu.¹, Kuzmina T.¹, Lialina N.,² Yedynovych M.¹, Lobov O.,¹¹ Kherson National Technical University, Kherson / Ukraine;² Kyiv National University of Construction and Architecture, Kyiv / Ukraine;

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DOI: <https://doi.org/10.35633/inmateh-60-16>**Keywords:** flax; bast raw material; cleaning; processing; method, processing device; production.**ABSTRACT**

The paper is devoted to solving problems related to developing scientific bases for resource-saving technologies in bast crops complex processing. The work contains theoretical and experimental research in processing flax and hemp raw materials.

The work objective is to find ways to improve the production conditions for processing bast fibre plants and to solve the problems of ameliorating the qualitative and quantitative bast fibre characteristics by improving the technological features of stem material processing and structural design application to the joint connections of the devices for processing bast-fibre raw materials. The paper also analyses current trends in the flax and hemp processing industry development, investigates the technical and technological features of processing bast-fibre crop stems and assesses the directions for increasing their processing efficiency.

РЕЗЮМЕ

Статтю присвячено вирішенню проблем розвитку наукових основ ресурсозберігаючих технологій комплексної переробки луб'яних культур. Стаття містить теоретичні та експериментальні дослідження в галузі переробки лляної і конопляної сировини.

Завданням роботи є пошук шляхів покращення виробничих умов переробки лубоволокнистих рослин та розв'язання питань підвищення якісних і кількісних характеристик луб'яних волокон за рахунок поліпшення технологічних особливостей обробки стеблового матеріалу і застосування конструкційних розробок вузлових з'єднань пристроїв з обробки лубоволокнистої сировини. У статті також проаналізовано сучасні тенденції розвитку переробної галузі льонарства та коноплярства, досліджено технічні і технологічні особливості процесу обробки стеблової частини лубоволокнистих культур та надано оцінку напрямкам підвищення ефективності їх переробки.

INTRODUCTION

The issue of the domestic agrarian market's modern development and functioning, which comprises both flax and hemp products market, now needs urgent consideration. Its importance is due to the significant destructive changes in the current light industry condition in Ukraine. Common flax, which in the second half of the nineteenth century was a strategic agricultural crop and the only natural fibre source in Ukraine, is now a technical plant that is little used in production. Rapid decrease in acreage from 169.4 thousand hectares in 1990 to 1.3 thousand hectares in 2018 (Ukraine's State Statistics Service), decline in flax products yield and quality, lack of effective market infrastructure, losing economic connections between different industries, as well as sales channels, significant dependence on energy resources was caused by the correspondent processes in the specified field, which resulted in losing Ukrainian raw materials base for light and textile industry with flax and hemp producers unable to provide the domestic market with the raw materials and high-quality fabrics and other necessary products from bast plants, and with leading positions in foreign markets lost (Prymachuk T.Yu. *at. al.*, 2017; Chekhova I.V. *at. al.*, 2017). The decline in domestic flax and hemp production industries came to Ukraine immediately after the decrease in textile production.

Among all agricultural crops, bast plants are most difficult to process, with seeds and straw or retted straw obtained after harvesting, further formed into bales or rolls.

The fibre production efficiency under modern conditions cannot be ensured without using machines with low metal and energy consumption (*Rudyk R.I. et al., 2015*). At the same time, the lack of specialized machines, produced in Ukraine, required for harvesting and post-harvest operations, equipment for the primary bast plant processing and the foreign equipment's high cost do not contribute to the industry's re-equipment to the latest technologies. The low processing enterprises efficiency now allows obtaining only 20-30% of scutched flax fibre from the total flax amount produced (*Prymachuk T.Yu. et al., 2017*), and lacking flax factories for processing raw materials into commodity products forced the flax producers to seek raw material consumers abroad.

The flax and hemp production industry still has sufficient potential and opportunities for stabilization and further development, first of all, due to favourable soil and climatic conditions, availability of, albeit outdated, material and technical processing base in possible bast crops growing areas, relevant local population's professional skills in bast production. Under certain investment attraction conditions and introducing innovative technologies the industry will acquire considerable potential, which will help to increase the domestic raw materials competitiveness, leading to flax and hemp production revival, stable Ukrainian economy development and the rural population's well-being.

Therefore, it should be noted that an important relevant issue for today is the revival and stabilization of domestic flax and hemp production, which can be achieved by introducing latest high-efficiency and energy-saving technologies, using modern scientific developments and design inventions, increasing the yield capacity, improving the quality which will ensure economic efficiency of domestic fibre-containing plants production and processing, developing with appropriate subsidies the undeveloped agricultural regions, improving economic relations between market agents.

MATERIALS AND METHODS

Theory and practice of enterprises' technical re-equipment, technological machinery modernization, applying modern effective equipment for processing bast raw materials, which are considered in scientific sources (*Helyazetdinov R.N., 2009; Tikhosova H.A., 2011*) give reason to state that nowadays, in order to overcome crisis phenomena in the Ukrainian light industry and to obtain positive results in processing flax and hemp stem material, it is necessary to use innovative solutions to the processing-related problems taking into account these industrial crops' specific physical and mechanical properties, changing consumer market demand for environmentally friendly and safe products, modern high-tech innovations, new mechanisms design specificity for processing bast raw materials.

Based on the conducted theoretical and experimental research, the inefficiency in using traditional processing technology for domestic bast crops with the use of heavy, metal-intensive and energy-consuming equipment, as well as the inappropriate use of existing technological machinery has been determined. The analysis of technical and technological directions for development, considered in scientific works (*Helyazetdinov R.N., 2009; Berezovsky Yu.V., 2014*), indicates that equipment of various functional purpose should be used to obtain high quality fibre mass.

Currently, relevant discussions are underway and scientific bases are being established to develop advanced technologies for processing stem bast material, to design high-performance technological equipment or its nodal components, and to work on the prospects for their industrial implementation, which in general can have a positive effect on improving the qualitative and quantitative values of performance indicators. So far, developing and implementing advanced bast processing technologies with the use of effective components and nodes of the breaking and scutching unit parts, which, due to innovations, can significantly improve separating and clearing the fibre from processed material non-fibrous part.

In the countries of the Eurasian continent there is a growing demand for bast plants constituents, which are increasingly demanded in various industries due to the development of advanced processing technologies for the respective industrial crops. Currently, EU plant producers are making extensive use of plant biological resources in the high-tech automotive, aviation and construction industries that serve as a driving power for other industries. Due to the increasing needs for flax and hemp plant components, the cultivation area is increasing, which creates the necessary prerequisites for preserving the environment and expanding the society greening by creating a clean safe product with a high natural component content. Therefore, the efficient and rational use of natural resources in the context of limited financial capacity and lacking wide raw material range is currently unsolved and urgent.

Previously, many specialists were involved in bast crop manufacturing and using their valuable properties, but so far, universal methods for obtaining natural fibre have not been invented, and equipment used at industrial enterprises requires modernization, as it is energy and metal-intensive and includes numerous components, which reduces its effectiveness and the flax and hemp production profitability (Helyazetdinov R.N., 2009; Berezovsky Yu.V., 2016).

In recent years, there are 3 areas in Ukraine where common flax cultivation continues in small areas – Zhytomyr, Sumy, and Chernihiv regions, whose farming enterprises harvest it at an average yield of 6.3 c/ha. The cultivation structure shows that common flax was cultivated in the forest-steppe zone and Polissia from 2012 to 2014, and oilseed flax was cultivated in all zones, with the Steppe zone prevailing (Rudyk R.I. at. al., 2015; Prymachuk T. Yu. at. al., 2017) (Fig. 1).

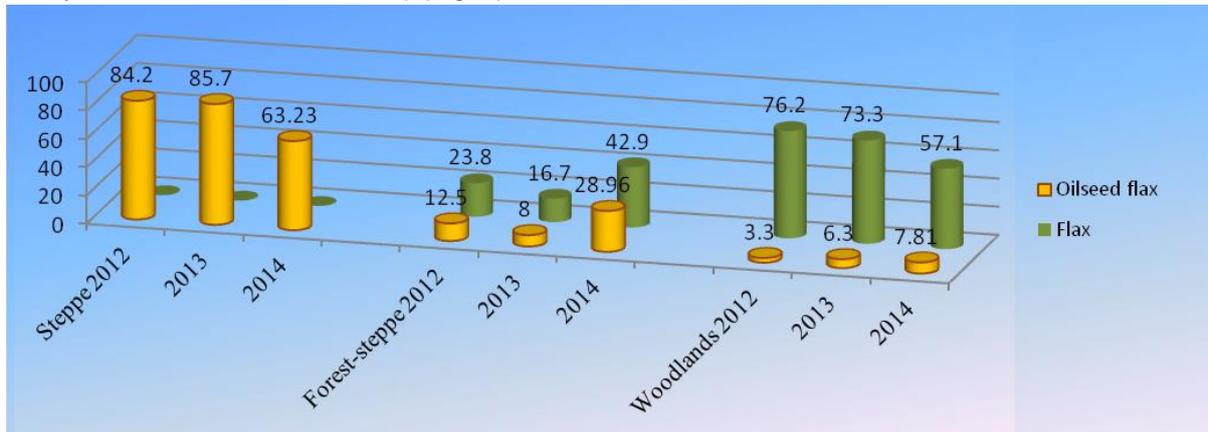


Fig. 1 – Flax cultivation structure within Ukrainian natural and climatic zones for the period 2012 - 2014 (constructed according to the Ukrainian State Statistics Service)

Over the last decade in Ukraine, areas under common flax have been gradually converted to the oilseed flax cultivation, the seeds containing 45-55% oil (Agronews.Ua, 2017). Comparing the oilseed flax production in Ukraine and in the world, the opposite trends can be noticed: the decline in Ukraine, the growth in the world. Flax production is not intensive, Ukraine's share in the world flax seeds production is only 2% with the amount of 40-60 thousand tons annually (Ilkiv L.A., 2018; Bakertilly.Ua, 2017; RosFlaxHemp.RU, 2017), and its share in the flax fibre production is negligible. As a consequence, flax is not an attractive crop for farmers and is sown inconsistently (Fig. 2).



Fig. 2 – Oilseed flax production in Ukraine, 2011-2019

Obviously, to increase the flax production profitability, it is necessary to use flax straw to produce at least fuel briquettes or pellets. The next step should be the fibre production from stem material, which requires larger long-term investments.

In the meantime, existing flax processing enterprises are idle due to the lack of raw materials while flax straw in the southern regions is either plowed or burned in the fields. World flax seed production is between 1.6 and 2 million tons annually.

Kazakhstan has become the world's leading oilseed flax producer in 2018, planting 1103 thousand hectares, Russia – 744 thousand hectares, and Canada – 358 thousand hectares, accounting for about 34% of the world's gross harvest (*AgroPortal.Ua., 2018*). The largest flax seed importers are the USA, China, Germany and the Netherlands.

In the import structure, the United States and China occupy 70% of the world market. Due to the globalization and economic growth in South and Southeast Asia countries, flax seed consumption in these regions is forecasted to increase significantly in the coming years.

In such a situation, the state's indifference towards the domestic fibre production and the absence of a realistic plan for the flax and hemp production development leads to further decline in the bast fibre crop primary processing, which increases the likelihood for this industry disappearance and increases the costs of light industry producers for the procurement of natural fibre raw materials.

As oilseed flax differs from common flax by anatomic and physico-technological properties, processing oilseed flax stem material by the technology used for common flax is not possible (*Holovenko T.M., 2013*), although its processing can use similar processing techniques – breaking, scutching, shaking with various features of the technological equipment structural design and its application procedure.

Due to this, oilseed flax processing is carried out by the technology for obtaining monotypic fibre. Various methods and devices are used for the monotypic fibre production, the characteristic feature being their designation for shives processing and not being adapted for retted straw direct processing. During the breaking process, the wood destruction is carried out, the connection between fibres and wood is broken, and shives are partially separated (*Valko P.M., 2011*). This operation is the preparation for the further fibre clearing from shives in the production line scutching part to obtain monotypic fibre.

In traditional production conditions, monotypic fibre is obtained by a method that includes drying retted straw to reach a 12% moisture content, forming a dried retted straw layer, its breaking and shaking on a shaking machine, re-breaking and batting a thinned layer of raw material, drying to a 6-8% moisture content and finishing on a tow preparing machine (*Tikhosova HA, 2011*). In this way, monotypic fibre is obtained, similar to the common short type, separated from shives. The disadvantage behind this method is the large number of operations performed and not sufficient line productivity; it also implies high equipment metal and energy-consumption. In some developed technological lines, disintegrator and advanced flax processing machines are used for the processing of oriented and entangled straw and retted straw stems of common flax and oilseed flax with different maturation degrees, crossed hemp stems, shives, short flax fibres, hemp, flax and hemp tow of high and low linear density. However, these innovations require the complete equipment replacement at existing plants, the line performance is quite low with limited differentiation of the impact on the fibre, which affects the finished product quality. In addition, the breaking and shive removing mechanism on the flax processing machine is not disclosed, so the problem related to choosing the equipment that can be used for machining bast raw materials remains unsolved.

At present, scanty raw materials volumes available at the bast crop primary processing plants, outdated equipment and stem material processing technologies, which no longer meet the modern production requirements, are still used. Domestic manufacturers are simply unable to buy high-performance overseas processing lines for bast fibre material. With the increase in demand for organic products for processing various domestic bast raw materials, new measures and technological equipment for its processing are to be developed (*Berezovsky Yu.V., 2013*). Under these conditions, the development of the flax and hemp production industry potential through introducing innovative technologies in agricultural, processing and industrial production should become a priority. The broad innovation involvement in this field should provide a comprehensive approach to solving industry problems. More efficient bast crop stem processing requires improved breaking and scutching processes.

In previous decades, the industrial capacity of domestic primary processing enterprises was mainly focused on processing common flax retted straw to produce a significant long fibre percentage. Nowadays, with the cottonization technology spreading, the production priorities in flax and hemp industry have changed significantly towards stem material processing in order to obtain monotypic fibre, which could be used to receive mixtures with fibres of different origin - natural, artificial, and synthetic. Monotypic fibre can be used not only for textile production by traditional technologies, but also for producing cellulose, cotton wool and the

like. The technological process for obtaining monotypic fibre made it possible to accelerate flax retted straw processing, to avoid the need for fibre distribution processes, which reduced production costs.

According to the results obtained due to the scientific, technical and patent sources analysis, experimental and theoretical studies at Kherson National Technical University, a method for obtaining monotypic fibre and a device for its implementation were developed (Berezovsky Yu.V., 2016), which allows to obtain flax and hemp fibre with low content of shives and non-fibrous impurities, improve processing equipment performance.

The results of experimental and theoretical studies of production processes for obtaining processing products show that the studied mechanical methods for processing bast raw materials are based on using different approaches to the fibre production. The most common foreign fibre producers' approaches are applying basic mechanical effects on the processed bast raw material to the processed material by the low-destructive action of breaking stem material and the maximum scutching process efficiency. The concept and practice of domestic bast fibre plant processing is to perform another significant mechanical impact on the processing material. The devices used cannot effectively break the connections between the wood and the fibre of bast raw materials, do not provide sufficient separation of the stem wood part from the fibrous one, will not allow to efficiently clean the fibre from wood and other non-fibrous impurities, which in general has a negative impact on the entire unit efficiency for processing bast crop stems.

In order to achieve higher productivity and effective separation of shives and other impurities from the fibre, researchers have often tried to apply techniques such as shaking, vibration, drawing, scraping and layer thinning (Helyazetdinov R.N., 2009; Valko P.M., 2011). Developments based on the technologies proposed to improve the conditions for the cleaning and separation of flax fibre and other bast crops have not been able to sufficiently ensure that the retted straw treatment is improved and that its versatility is guaranteed. The positive aspects in different approaches to the bast raw material processing should be fundamental in developing new construction elements, methods and processing technologies that can ensure the innovative products manufacturing.

Therefore, the basis for the new development was the task of creating a method for obtaining a monotypic fibre from domestic bast crops, in which due to technological features it would be possible to obtain a fibre with a high degree of cleaning from shives and other non-fibrous impurities.

The set task is solved in a way that involves unwinding rolls on unwinding machine, breaking with rollers with simultaneous drawing, scutching, and final cleaning the fibre from shives on tow shaker. During the breaking with rollers the raw flax is arranged, simultaneously carrying out the scraping, thinning of the raw material layer by the stripping rollers of bar, disk, comb type in complex interaction with the shaking-vibration device, which is placed between the breaking and scutching processes, carried out by simultaneous action of beater bars and scutching drum blades. Implementing complex interaction of the stripping rollers of bar, disk, and comb type within breaking process with shaking-vibration device of the shaking process, which is placed between the breaking and scutching processes after arrangement, breaking bast raw material layer allows for preliminary cleaning from shives and other non-fibrous impurities, which helps to remove free shives formed during the material passage through the breaking machine (Berezovsky Yu.V., 2016).

The essence of the presented development is explained in Fig. 3, which shows a flow diagram of a process for obtaining monotypic fibre from bast-fibre crops. The technological scheme uses the following equipment: an unwinding machine 1, if necessary, a drying machine 2, a spiked mechanism 3, a breaking machine 5 with a pair of rollers of enlarged diameter 4 and a set of rollers of various types, a shaker 6 for primary cleaning with a vibration device, scutching units 7 and shakers 8 equipped with a vibration device (Berezovsky Yu.V., 2016; Berezovsky Yu.V., 2017).

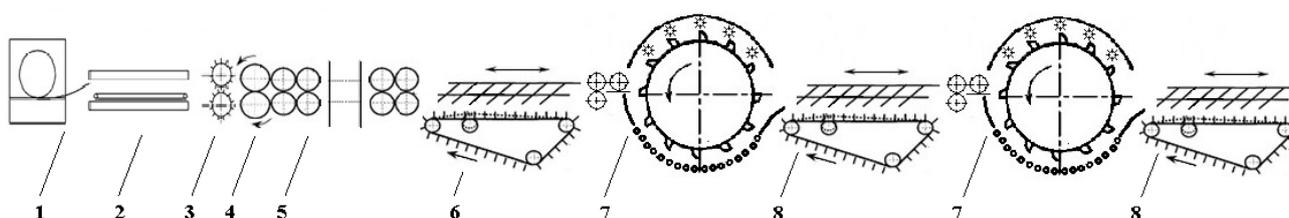


Fig. 3 – Process flow diagram for obtaining monotypic fibre from bast-fibre crops

1 – unwinding machine; 2 – drying machine; 3 – spiked mechanism; 4 – pair of rollers of enlarged diameter; 5 – breaking machine; 6 – shaker for primary cleaning with a vibration device; 7 – scutching units; 8 – shakers equipped with a vibration device

The process of producing monotypic fibre from bast-fibre crops is carried out as follows. Bast-fibre raw material after unwinding rolls on unwinding machine 1 is passed, if necessary, to a drying machine 2, then by means of a spiked mechanism 3 is fed to the first pair of rollers of enlarged diameter 4 of breaking machine 5, which provides efficient drawing of stems with different physical and mechanical properties and passes the raw material to the breaking machine 5 rollers of various types, where parallelization takes place, arranging raw flax stems, intensive breaking with simultaneous drawing, scraping, and thinning of the raw material layer which is sent to the shaker 6 for primary cleaning from shives and other non-fibrous impurities equipped with a vibration device. The raw material, beaten and partially cleaned from shives is fed to the scutching unit 7, where an intensive process of separating bulk containing shives and other non-fibrous impurities takes place. Depending on the bast raw material type, its condition and quality, it is possible to adjust the gaps between the beater bars and scutching blades and between the grid and the scutching drum at unit 7. For the final cleaning from shive residues and other non-fibrous impurities, the fibre mass from the scutching unit 7 goes to the vibration machine 8 equipped with a vibration device for the final cleaning of the fibre from shives and impurities.

RESULTS

The developed method for obtaining monotypic fibre from bast-fibre crops and the device for its implementation allows to provide versatility of bast crop stem processing through processing different types of domestic bast-fibre raw materials and to increase the processing equipment productivity. Using the above method for obtaining monotypic fibre from bast-fibre crops and the device for its implementation allows increasing the efficiency of destructing residual bonds between wood and beaten bast raw material fibre, separating fibre from shives and other non-fibrous impurities, increasing the productivity of processing bast raw materials.

The developed device's breaking part includes a number of breaking rollers of various designs (*Berezovsky Yu.V., 2014; Berezovsky Yu.V., 2016; Berezovsky Yu.V., 2017*), which, due to their structural features, provide improvement of conditions for separating shives from fibre mass and bast-fibre raw material contraction by 3-5% in comparison with traditional technological equipment used at domestic processing enterprises:

- flattening rollers, presenting a hollow cylinder, along the entire length of which, in a circle with constant pitch, one-sided set profile depressions are made, the lateral sides having a convex rather steep surface;
- corrugated breaking rollers of slope riffling with a larger curvature radius of the ruffle edge relative to the curvature radius of the ruffle edge of the steep riffling corrugated breaking rollers;
- rollers, presenting a shaft with fixed disks mounted on it, installed at an equal distance between them, with unilateral bends at the edges made in a circle with a constant pitch, and bushings placed between the disks, with unilateral bends across the entire bends' height having unilateral protrusions in the form of corrugations of a slope or steep set riffling profile with a constant pitch in a circle;
- stripping rollers of bar or rotor with rifles type, which are made with an increase in their diameters by 3-10% relative to the diameters of the breaking rollers between which they are located and are rotatable with angular velocity equal to other rollers, given by their kinematics;
- rollers, presenting a hollow cylinder, with generatrices lines having ruffles of slope and steep profile, while along the tops of the roller ruffles micro-ruffles of steep corrugation are placed, with tight brushes being placed above and below the pair formed by them;
- rollers of steep riffling having ridge profile contour of the ruffles and a relatively small ruffle height in comparison with their pitch;
- rollers of a bar type with a speed difference between them, the first pair of rollers having an enlarged diameter, providing a uniform gap between the roller profiles.

The design features specific for these breaking rollers allow to ensure the parallelization, retted straw stems ordering between themselves within the raw material layer being drawn, to improve the efficiency of the conditions of destruction and weakening the connection between the fibrous part of the stem and the wood due to the transverse compression processes in those stem parts that were not subjected to the effect of transverse compression when passing through the first pair of breaking part's flattening rollers.

These rollers make it possible to create conditions for numerous areas of shear force or shear stress, which facilitates the processes of bending-breaking and fibre separation from wood due to the occurrence of fracture to the lengths less than critical, increasing the roller surface adhesion coefficient with the bast crop stems. During their action, the fibre breaking and separation from the wood is improved due to simultaneous transverse compression processes, stem wood bending-breaking, sliding bending and shives shifting in relation to fibre, drawing, scraping and thinning of the material layer. Breaking process in the developed breaking unit is carried out more softly and effectively without considerable damage to fibre while providing the necessary load on the stem material.

To implement the developed method for obtaining monotypic fibre from the bast-fibre crops a scutching unit is used (Fig. 4), comprising a scutching drum, having beater bars on it, and scutching blades above them, and a grid, located under the scutching drum, the beater bars having wavy profile in cross-section, and their working edge made by cutting at a blunt angle in relation to the movement direction of the bars, with the profile of each bar offset relative to the profile of the adjacent bars by halfway of a wave, and on the top, on the surface of scutching blades a protrusion is made in the form of a ridge, while inside the scutching unit above the scutching drum, bar rollers, rotatable on axes, are mounted. The grid is designed to move in relation to the scutching drum to adjust the gap between the grid and the scutching drum, which breaks the residual bonds between the wood and the fibre, separating fibre from shives, allows providing more effective conditions for breaking the residual bonds between the wood and beaten bast raw material fibre, cleaning fibre from shives and other non-fibrous impurities. The presented scutching unit model allows improving the efficiency of the scutching process with the possibility for obtaining cleaner fibrous mass by 4-5% compared with the technological equipment currently used in domestic light industry.

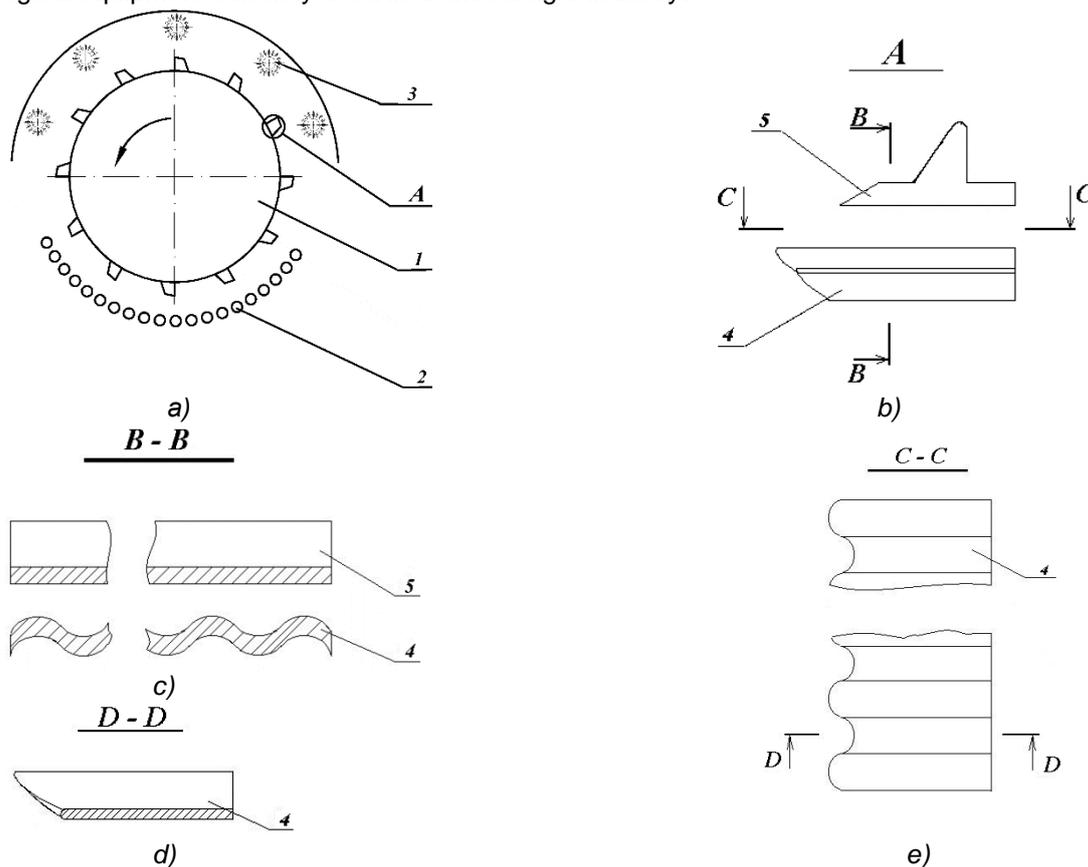


Fig. 4 – Scutching unit design

a – top view, b – section view of the beater bars and scutching blades; c – cross section of the beater bar and the scutching knife; d – beater bar top view; e – beater bar cross section; 1 – scutching drum; 2 – grid; 3 – bar roller; 4 – beater bar; 5 – scutching blade

The application after scutching beaten and pre-cleaned material on the shaking machine equipped with a vibration device allows additional shaking and cleaning of the fibre mass from shives and other non-fibrous impurities. Due to the oscillations of the needle feeder vibrating under the influence of the vibrating device, an intensive separation of the residual shives occurs, which significantly improves fibre purification.

The process of bast raw material double treatment with a scutching unit and shakers equipped with a vibrating device, provides the most effective cleaning of fibre mass from shives and other non-fibrous impurities.

The presented technical and technological solutions allow improving the efficiency of shives removal, obtaining high quality fibre with low content of non-fibrous impurities, which at the end of the manufacturing process gives the opportunity to obtain better fibre and in larger amount, and therefore the possibility for expanding its further application scope. This was confirmed by the conducted research on common flax and oilseed flax processing at the Starosambirskyi Flax Plant, and the research on hemp was carried out within the study samples. The developed device due to the structural features of its parts provides effective conditions for breaking the connections between wood and fibre of bast raw materials, sufficient separation of the stem wood part from the fibrous one and increase in the degree of fibre cleaning from foreign impurities, which in general has a positive effect on the efficiency of all technological equipment for processing bast crops stems. Using this device should provide greater processing capabilities for different types of domestic bast-fibre raw materials, which increases the versatility and productivity of processing equipment in general.

Taking into account the conditions of rapid increase in the cost of energy and other material resources, according to the above method for processing bast crop stems, fibre was produced not by increasing energy and material costs, but by improving and optimizing technological processes that would ensure high product quality. Under these conditions, production and procurement costs are significantly reduced, the costs associated with the fibre distribution in the production process, which have a positive effect on the economic component of processing bast material. This allows to significantly simplify the technological processes of harvesting flax retted straw by reducing the number of harvesting equipment and to increase its productivity in further primary processing, to comprehensively mechanize both harvesting and primary processing processes, as well as to increase the equipment productivity by 40÷50%, to reduce the shives content in fibre to 3-5%, reduce the equipment's metal consumption to 20%, energy consumption – up to 30%, improve working conditions and general production culture. These figures may vary depending on raw material type and its initial condition.

In order to ensure stable qualitative indicators of processing bast fibre raw materials, it is further necessary to investigate the change of the fibre's physical and mechanical properties in processing stem material, to determine the impact on it of equipment structural modifications to develop an adequate production process model for obtaining fibre products with forecasting its optimal parameters, which will provide appropriate recommendations for industrial applications.

The fibre obtained as a result of using the proposed innovative technical and technological solutions, allows to implement in-depth processing of domestic bast-fibre plants, to expand the product range based on them, to use it in various fields of application, to stimulate farmers to cultivate flax and hemp and to carry out their primary processing, to enhance their role as leading technical crops. All of the above can lead to improved living conditions in rural areas and a reduction in the dependence of the national economy on raw material import, which can save the country's foreign exchange reserves for relevant purposes. Prospects for using the presented technical and technological developments can contribute to the modernization of the light industry processing sector, its further development, and Ukrainian market expansion, increasing job opportunities and attracting highly qualified specialists to the correspondent sphere, improving the competitiveness of domestic products in the world market.

CONCLUSIONS

In order to increase the efficiency of fibrous material treatment processes, a method for processing oilseed flax has been developed, which allows to expand the product range from processing oilseed flax retted straw and to create waste-free technology. Also, a method for obtaining monotypic fibre from bast-fibre crops has been developed, which makes it possible to process all types of domestic bast crops, providing its versatility, reducing the equipment's metal and energy intensity. The device for its implementation allows to effectively separate fibre from wood and other non-fibrous impurities, and increases the processing equipment productivity.

The indicated developments are able to increase the flax and hemp product competitiveness by improving its quality and reducing production costs. The innovative component of the proposed technical and technological solutions for flax and hemp processing gives the opportunity to manufacture products with new consumer and functional properties, extending the application scope, increasing its attractiveness and

competitiveness due to decreasing the shives content in fibre to 3-5%, reducing equipment energy intensity to 30% and increasing its productivity by 40÷50%.

The presented methods for raw material processing and structural design of elements and units of the technological process for obtaining monotypic fibre from bast-fibre crops provide an opportunity to solve the problem of different domestic bast-fibre raw materials industrial processing, which increases the versatility of the technological processing scheme by improving the efficiency of the purification of bast raw materials due to improving the conditions of residual connections destruction between wood and fibre, cleaning fibre from shives and other non-fibrous impurities. Within industrial use, it can have a positive impact on the production and economic performance of flax and hemp processing enterprises by producing high quality natural fibre in larger amounts.

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