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REVIEW OF RESEARCH ISSUES OF DETERMINATION OF MECHANICAL PARAMETERS OF COMPOUND LOADING STRUCTURES AND WORKING BODIES

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Abstract: There is a big use as carrying elements in technology and worker organ's component design of technology. In article is organized review of the questions of the using and determinations mechanical parameters of component design, applicable as worker organ cotton picking machine and cotton bud picking machine, unripe cotton bell cleaner.

Keywords: The Component designs, power factor, carrying element, worker organ, cotton picking machine, cotton bud picking machine, unripe cotton bell cleaner, mechanical parameters, parameters to acerbity.

Introduction. The use of composite structures in technology. Composite structures used in various sectors of the national economy are divided into two groups: composite structures used as load-bearing elements and composite structures used as working bodies.

Composite structures of both groups can also be divided into two types according to the mode of operation: composite structures without using force factors for structural purposes and composite structures using force factors for structural purposes.

Force factors in composite structures can be used to increase the bearing capacity by elastic strengthening, the formation of a rigid spatial structure using interference fits and the formation of a package of numerous elements capable of working not only in compression, but also in bending and torsion using axial compressive force , as well as for the accumulation of potential energy needed to perform a certain job [1]. For these purposes, use longitudinal, transverse, incl. radial and moment force factors.

Review of studies of mechanical parameters of composite structures used as load-bearing elements.

It should be noted that in most of the load-bearing composite structures, functional forces are not used.

In cases where the calculated cross-sectional dimensions are larger than the largest cross-section of rolled bars, composite beams of various cross-sectional shapes from a homogeneous or dissimilar material are used. The issues of calculation and design of such structures are well developed and are presented in educational, reference and special literature.

Note that when calculating the bending of composite beams, the theory of pure bending is used, from which it follows that the change in deformations over the section will occur according to a linear law, regardless of the shape, size and materials of the composite elements.

It is very convenient to use the reduced cross section method. The method consists in converting the cross-section of a composite beam, the various parts of which are made of different materials, into an equivalent cross-section of the beam, consisting of a homogeneous material called a "reduced cross-section". In this case, the position of the neutral axis must remain unchanged. Further calculation and research are carried out according to the usual method.

However, such a simplified approach is often not justified, and then one has to resort to using the results of special studies. Fundamental research of Academician VS Vlasov and a number of other specialists is devoted to the issues of calculation and determination of the main mechanical characteristics of load-bearing structures in such cases.

Sometimes a load-bearing composite structure can be viewed as a thin-walled composite bar. Such constructions have been investigated in a number of works.

When calculating and designing two - and multilayer composite structures, the nature of the bonds between the layers is taken into account. Distinguish between shear links, which prevent the mutual shift of one layer relative to another, and transverse links, which prevent the layers from displacing relative to each other in a plane perpendicular to the structure axis.

Force factors in load-bearing composite structures can be used in order to increase the rigidity of the structure or their elastic strengthening.

To increase the bending stiffness of high-rise composite structures assembled from disk-shaped elements using a powerful cable fixed along the longitudinal geometric axis of the structure, a large compression force is reported, which increases the resistance of the disk-shaped elements to their rotation in the plane of bending experienced by the entire structure.

There are various methods of elastic hardening of load-bearing composite structures, the essence of which is reduced to subjecting the elastic deformations of their elements to the opposite deformations that occur during working loading [2]. For elastic strengthening of hollow structures in the form of bodies of revolution, for example, cylindrical pipes, exposed to high internal pressure, composite pipes are used, assembled by press or shrink fit from two or more cylinders. As a result of the addition of the stresses that have arisen during assembly with the working stresses, the stresses along the section are leveled and the strength of the structure increases.

In the functioning of composite bearing structures, the issues of the influence of friction forces and structural damping, which consists in the ability of rigid connections of their elements to dissipate mechanical energy during cyclic deformations, acquire a certain importance. The analysis assumes that the friction forces are constant and follow the dry friction law, and the materials of all structural elements follow Hooke's law.

Investigations of the mechanical parameters of the working bodies of cotton and poultry harvesting machines, heap cleaners.

The main component working bodies of modern cotton pickers are spindle drums and cotton strippers. The spindle drum is formed by vertical tubular spindles and upper and lower discs, and in recent years, one-piece spindles have been replaced by composite ones.

The use of compound spindles ensures the stability of cotton picking and increases the productivity of cotton pickers by 15-20%. Strippers are used to remove cotton from the spindle drum spindles and are integral drum-type structures.

Studies to determine the mechanical parameters of spindle drums and cotton strippers were carried out by Urazbayev M.T., Usmanhodzhaev Kh.K., Turanov Kh., Sablikov M.V, Dzhabarov D.S., Kozhevnikov G.A., Fayziev M.Kh., Landsman M.I., Maksumov, Glushenko A.D., Inamagamozym Kh.M., Vakhrameev A.A., Shoumarov, Izzatoza Z.Kh, etc.

In the works of the listed scientists, the issues of strength and reliability of the main parts of the pullers were investigated with the determination of the acting force factors, and the determination of the mechanical parameters of the main parts of the pullers and the determination of the force factors acting in them in the context of ensuring sufficient strength and reliability were carried out.

Peeling, various sawing, removable and brush drums, loosening toothed drums, paddle drums and peeling drums are integral among the main working bodies of the heap harvesters and heap cleaners.

Peeling and toothed loosening drums are designed for loosening raw cotton from chickens, peeling unopened chickens, as well as for transporting and separating small tenacious litter.

Sawing, removable and peeling drums are designed, respectively, for extracting clean cotton from boxes by stringing it onto saw bands, removing raw cotton from them, cleaning and final cleaning of raw cotton from fine tenacious litter. Structurally, these working bodies have much in common.

In work [3], some results of experimental studies are given to determine the acting force factors and mechanical parameters of all the composite working bodies of poultry harvesting machines.

In the works of the above scientists, polls were also resolved to determine and rationalize the main mechanical parameters, reduce mass, moments of inertia of masses, loads acting on certain elements, etc., of the composite working bodies of the heap cleaners in the form of drums of various designs.

In the overwhelming majority of working bodies of the considered category, force factors are not used for design purposes, and the exception is the saw rollers of cleaners for raw cotton ginning machines [4], the design of which is similar to genie saw cylinders.

They are smaller, aluminum spacers are replaced with plastic ones. There is no information in the literature on mechanical studies of these rolls.

Research of mechanical parameters of the composite working bodies of textile machines.

As examples, we can name the screed and paddle drums of feeder-mixers, drums of various feeders and cleaners, in scraper machines, input shafts, feed and removable cylinders, pegs, paddle drums, three-bar slat and needle scraper, spike shafts, in carding machines - rolling rollers, cylinders and rollers of feed hoppers, loosening drums, receiving, main and removable drums, work rollers, in dyeing and finishing machines most of the working bodies of roller and drum type[5].

The mechanics of composite working bodies without the use of force factors for design purposes is generally well developed. The issues of their calculation and design with the determination of the main mechanical parameters are covered, in addition to the special one, in the educational literature.

The issues of calculation and design and determination of the main mechanical parameters of leveling and paddle drums of feeder-mixers, head feeders and carbon monoxide feeders are covered in [2]. The issues of determining the mechanical parameters of composite working bodies such as peg drums are covered in the works [4, 5].

As in the case of calculating the organs of cotton ginning machines of similar designs, strength calculations are often performed for the individual most loaded elements, for example, the strips of peg drums. If the dimensions and mass of the pegs are significant, then the shear stress strength of the welded joint of the peg with the drum shell is additionally calculated, and the centrifugal force of the peg mass is considered the main force acting on the pegs. Planks of plank and needle ruffles are calculated as multi-support continuous beams that undergo bending under the action of distributed centrifugal forces.

Composite cylinders and shafts of loosening and scutching machines are calculated as beams lying on an elastic foundation, and the value of the load distributed along the length of the working body from the elastic resistance of the compressible layer of fibrous material is determined by empirical formulas.

Special mention should be made of the features of the calculation of crimping rolls. Under the influence of large forces acting in them, the crimping rolls bend, which disturbs the uniformity of the clamping of the fibrous layer along the length of the rolls. To ensure uniformity of the load across the width of the tight winding mechanism, a line of the axes of the shafts is calculated by calculation and the diameters of the shafts are increased in each section by twice the deflection in this section [1].

The next large group of composite working bodies without constructive use of the power factors of textile machines is the majority of working bodies of cards and carding machines.

The issues of calculation, design and research of rolling rollers, cylinders and rollers of feed hoppers with canvasless feeding are solved in principle similar to the cases of feed rollers of cotton ginning machines. Such an analogy can also be seen between the loosening toothed drums of the corn harvesting machines and the loosening drums of the feeding hoppers of the canvasless feeding cards.

Another large important group of integral working bodies of carding machines and apparatus are drums for various purposes - main receiving, removable, transmitting combing and rollers - working, combing, removable of various designs, distillation, silt-stripper, six-field, cleaning, runner, runner and runner.

This group is characterized by the presence of a thin-walled shell covered with a serrated or needle-like set and fastened to the shaft with two crosses. These working bodies perform the most important technological functions and hence the high requirements for the accuracy of manufacturing dimensions and shapes, the roughness of working surfaces and dimensional stability. They are also subject to high requirements for strength and rigidity, which are used for structural calculations.

The main external force factors acting on the drums are considered to be the tension of the headset and centrifugal mass forces. The calculation of the radial deformation can be carried out taking into account the influence of the crosses and the weakening of the section of the drum by holes for wooden plugs to secure the cardo tape.

The overwhelming majority of shafts and cylinders for various purposes of dyeing and finishing equipment are also integral. In some of them, for example, in the composite low-deflection shaft of the NIEKMI structure, the power factors of a structural purpose are not used [2]. The mechanics of compound shafts in finishing machines are well developed and there is an extensive literature on them.

The most elaborated and studied in detail are the questions of the theory of functioning, interaction with the processed product and the mechanical parameters of working bodies. The questions of the interaction of these working bodies with each other and the definition of the resulting force factors, stresses and force analysis are investigated.

Discussion. Functional force factors can be used in the composite working bodies of textile machines. Most often, radial force factors are used in joints with interference of roller-type composite working bodies.

The issues of calculation and design with the determination of the values of stresses, deformations and other mechanical parameters are well studied and are given in the educational, reference and special literature [6, 7]. In the calculations, it is assumed that the moment of inertia of the cross-sectional area of the composite shaft is equal to the sum of the moments of inertia of the cross-sectional areas of the composite elements.

In addition, since the composite shaft works as a whole, the curvatures of the axes of the composite elements and the angles of twist should be considered the same . The next important point is the definition of the various forces acting on the composite shaft, well described in [2,3,4]. Preliminary and verification calculations are performed.

Conclusions. The main working bodies of sawing and roller gins, various fiber cleaners, linters and delinters, knife drums of scutching machines, rotors of condensers of units for the production of canvas, woolen, non-woven materials CHN -180, shafts of fabric forming mechanisms of weaving machines of the TMM type, typesetting shafts of various machines for dyeing and finishing production.

The calculation and design of such working bodies, incl. saw shafts, cylinders and drums of cotton machines are far from being completely solved and at a level that does not meet modern requirements. The subject matter, volume and level of scientific research on the mechanical parameters of composite working bodies also do not meet modern requirements.

It is required to solve the following main problems:

Study of the issues of determining the bending stiffness of the main component working bodies of cotton machines, the most important of which are sawing working bodies.

The importance of the problem for the practice of designing fiber separators is undeniable. For example, the maximum permissible deflection of the saw cylinder of a genie is 0.3-0.4 mm. An increase in the diameter of the saw cylinder shaft from 61.8 mm to 100 mm in order to increase the bending stiffness led to a sharp increase in mass and the actual deflection under the influence of gravity and technological load was already 1.6 mm.

It seems to us that it is unreasonable to neglect the bending stiffness created by a package of working and spacer elements and to equate its value with the calculated stiffness of a monolithic body made of similar materials and having the same dimensions [5,6].

It also seems insufficiently correct to equate the influence of the axial tightening force of a package of saws and gaskets on the bending stiffness of the saw gin to the influence of the Euler shaft stretching force of the same or doubled value. In general, the empirical method [7], which is not bad for practice, is not theoretically justified, and the given justification of the calculation-empirical method [8] does not agree well with the basic principles of mechanics, since the elastic modulus is a characteristic of the material, but not the structure.

The most promising method for determining the flexural stiffness of composite working bodies, based on the analysis of the equilibrium conditions of individual disk elements of a package of the same thickness, is presented in [9, 10].

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CONTENTS

PRIMARY PROCESSING OF COTTON, TEXTILE AND LIGHT INDUSTRY

GROWING, STORAGE, PROCESSING AND AGRICULTURAL PRODUCTS AND FOOD TECHNOLOGIES

MECHANICS AND ENGINEERING