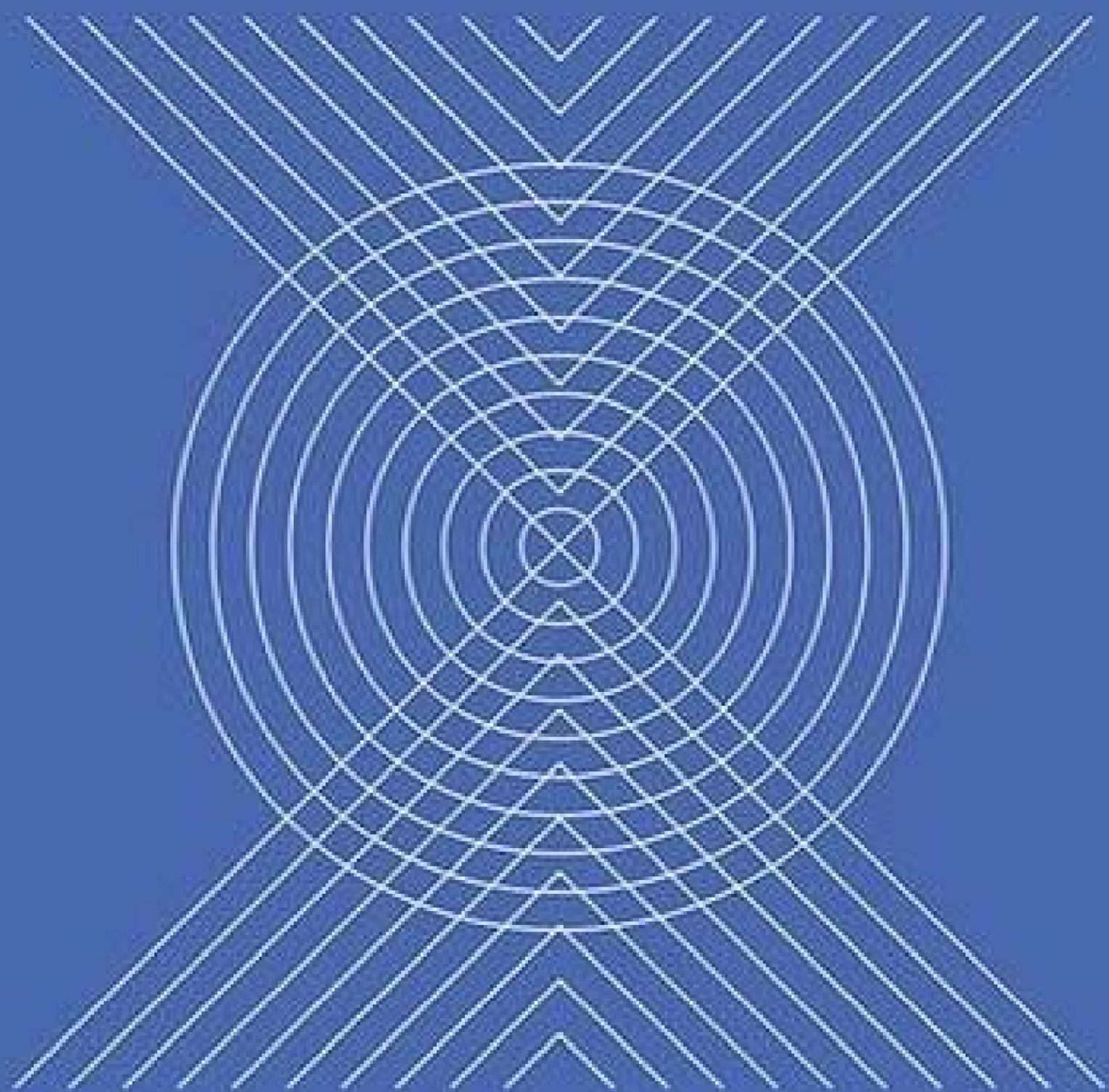


Advanced Materials and Structural Engineering

Editor: Jong Wan Hu



PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON ADVANCED MATERIALS AND
ENGINEERING STRUCTURAL TECHNOLOGY AMSEE2016 26-27 June CHIANG MAI.
THAILAND.

Advanced Materials and Structural Engineering



CRC Press

Taylor & Francis Group

Boca Raton London New York Leiden

CRC Press is an imprint of the
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A BALKEMA BOOK

Details from Composite Polymeric Materials for Working Bodies of Cotton Cars and Mechanisms

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Abstract— The designs of machine-building details from constructional polymeric materials for working bodies cotton of machines and mechanisms having curved –linear a surface on perimeter and spherical rounding curve in the head, facilitating minimal resistance to introduction them in stoutness of weight of a clap –cotton are developed.

It is shown that application them in the caustically working bodies of cars increases their productivity, reduces power consumption, reduces damageability of fibers and split up and prevents a possibility of fire of cotton raw.

Keywords-component; composite polymeric material, cotton raw, is caustic, a tilt angle, damage, split up, productivity, power consumption, cotton fiber.

Introduction

Now for performance of loading and unloading and scheduled maintenance with cotton raw on procuring points and the cotton of numerals plants various cars and mechanisms, such as the proem-giving PLA brand mechanisms, mobile loading cranes of cotton of the HPP brand, cars for digging of tunnels and an clarifications of revolts of the OBT brand and developer of revolts of cotton of the RBD brand are used. These cars mechanisms, despite distinction in principle of action, configuration and a design, have working bodies with the identical scooping elements executed in the form of the details of various design made of steel. The majority of details have the cylindrical form passing to a cone with an insignificant oval at the end [1].

However these mechanisms have also characteristic specific shortcomings [2]. One of them is damage of fiber and seeds of cotton, formation of free fiber as a result of interaction of metal details of working bodies with cotton raw.

Other specific lack of details of the working bodies made of steel is the possibility of ignition of cotton raw at their impact with the solid and heavy impurity which are available in cotton. All these impurity both when warehousing cotton in revolts, and at his subsequent giving in production, interact with details of working bodies of cars and mechanisms.

The third specific lack of details of working bodies is that the existing design of the details having the spear-shaped form doesn't provide sufficient capture of a portion of cotton raw when working, connected with transportation and dismantling of cotton raw that leads to formation of a scattering of cotton

and leads to decline in production and efficiency of cars and mechanisms.

Besides, rigid connection of details of working bodies complicates to carry out timely replacement of caustic at their wear and breakages.

Therefore elimination or reduction to a minimum of the specified shortcomings is rather actual problem and it is possible to solve it in the different ways. For example, to improve and improve a design of working bodies, to raise a technological level of products and to introduce more progressive manufacturing techniques of details of these cars and mechanisms. But, perhaps, it is more effective to apply new composite polymeric materials and coverings on the basis of complex studying of their contact interaction with cotton raw.

Development of Shock-resistant and Wear proof Composite Materials

Shock-resistant polystyrene composite materials (SRPCM) and shock-resistant polyamide composite materials (SRPCM) and wear proof polyamide composite materials (WPCM) (table 1) are developed for production of details of the rubbing couples (caustic) of working bodies of cotton cars and mechanisms.

Apparently from table 1, the developed shock-resistant and wear proof composite materials on the basis of shock-resistant polystyrene and polyamide have rather high rates of properties, to the meeting requirements imposed to materials of caustic of working bodies of the cotton cars and mechanisms working in the conditions of blow and wear.

3. Designing of Details from Composite Materials for Working Bodies of Cotton Cars and Mechanisms.

One of perspective ways of increase of a technological level and overall performance of cotton cars and mechanisms is production of details (caustic) of the rubbing couples of working bodies from new, most effective constructional materials, including from the composite polymeric materials (CPM) on the basis of polyolefin's: the polyethylene of the high density (PEVP) and polypropylene (software) possessing the high strength, ant frictional, vibration-absorbing, damping properties and wear resistance [4 - 5], meeting the formulated requirements imposed to materials for caustic of working bodies from which main thing is technological effectiveness and profitability of the used material, decrease in

damageability of cotton fiber and seeds, an exception of accumulation of static electricity, education having reeled up

fibers on surfaces of caustic and a spark at impact with the solid bodies which are in cotton raw.

TABLE 1. Properties of shock-resistant and wear proof composite materials on the basis of shock-resistant polystyrene and polyamide

| Composite material | Indicators of properties of composite materials | | | | |
|--------------------|---|--|-----------------------------|------------------------|------------------------|
| | Strength at a bend, MPa | Specific viscosity, kJ/sq.m ³ | Hardness on To Brinell, MPa | Module elasticity, GPA | Coefficient friction * |
| SRPCM -1 | 56,9 | 25,3 | 145,0 | 3,0 | 0,36 |
| SRPCM -2 | 62,3 | 27,5 | 135,0 | 2,9 | 0,345 |
| SRPCM -3 | 65,8 | 30,8 | 145,0 | 2,8 | 0,34 |
| SRPCM-1 | 108,0 | 137,6 | 84,0 | 2,1 | 0,35 |
| SRPCM -2 | 110,3 | 139,0 | 85,7 | 1,95 | 0,33 |
| SRPCM-3 | 112,2 | 140,7 | 86,3 | 2,0 | 0,31 |
| WPCM -1 | 99,7 | 130,8 | 87,2 | 1,85 | 0,32 |
| WPCM -2 | 100,3 | 132,3 | 87,2 | 1,90 | 0,31 |
| WPCM -3 | 101,8 | 135,5 | 89,5 | 2,05 | 0,33 |

* Coefficient of friction defined at interaction with cotton raw of humidity of W = 8,2%, speeds of sliding of V=1,5 m / c and specific pressure of P=0,02 MPa

In connection with rather brief experience of production of such products from ant frictional and ant frictional – wear proof composite polymeric materials special calculation procedures them on durability are absent, and calculation of such products is made, as a rule, by the techniques accepted for the corresponding metal products now. However when designing products from composite polymeric materials it is impossible to apply mechanically the old designs accepted for metals. It is necessary to consider such features of binding – polymers as anisotropy of physic mechanical properties, fragility, lower elastic properties, rather low fatigue durability, also change of physic mechanical and occasional office technical properties of polymers at introduction of mineral, fibrous and carbon and graphite fillers.

When designing products from composite polymeric materials it is necessary to avoid sharp changes in thickness, neplavnost of interfaces as at the same time the sharp excesses and breaks of glass-fiber fillers which are inevitably connected with considerable loss of durability are observed. For obtaining equivalent margins of safety and a ravnzhestkost of metal and plastic products of their section sometimes it is necessary to thicken. Thickening size in each separate case is defined by a ratio of strength and the module of elasticity of composite materials and metal. When profiling sections it must be kept in mind that thin sharp edges from shock-resistant and wear proof composite materials have insufficient durability, the smallest admissible radius of a curve of edges is equal to 0,75 - 1,5 mm depending on the size of products.

Besides, when designing products it is necessary to consider the technological capability of performance connected with the limited sizes of thermo layers (the equipment for molding under pressure) and difficulties of production of equipment.

In this regard, proceeding from the analysis of operation of details of working bodies of cotton cars and mechanisms, we have formulated requirements imposed to a form and

profile (design) is caustic from AIKPM. The main requirements are:

- 1) the forward edge a splitting has to provide the minimum resistance to introduction it in the mass of cotton raw;
- 2) the form a splitting has to provide the minimum losses of cotton raw as bulk cargo at him the maximum capture of cotton. to transportation;
- 3) the tilt angle a splitting has to provide introduction it in thickness of cotton raw for the purpose of ensuring the maximum capture of cotton. The tilt angle a splitting is one of the key parameters determining reliability and overall performance of caustic by capture and movement of cotton raw. It is recommended to take a corner between the direction of the forming detail and a horizontal for the required size of a tilt angle;
- 4) the weight and length a splitting has to sufficient for intensive introduction be caustic in thickness of cotton raw.

Taking into account the above-stated requirements, we have developed the most rational form a splitting for working bodies of the cars and mechanisms [6] working in the conditions of frictional interaction with cotton raw.

We will most in detail consider designing of details from shock-resistant and wear proof composite polymeric materials of working bodies of cotton cars and mechanisms.

4. Designing of Details from Composite Polymeric Materials for Working Bodies of the Mobile Loading crane of Cotton

The detail of working body of a mobile loading crane of cotton represents a fascinating element (fig. 1) executed in the form of a core with a spherical curve in head part and with a trapezoidal profile in cross section and is placed on the basis. At the same time his fascinating surface is located at an angle to the basis, and in the basis between stiffening ribs of a profile the opening under bolted connection and dredging with a radius of 40 mm is executed.

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The spherical curve in head part of a detail R1 radius = 10 mm facilitates his introduction in thickness of mass of cotton raw. Radius of curvature (R) of a dental makes 270-272 mm, a tilt angle (φ_K) of a detail (is caustic) to a surface of a tape of working body 65-70o, and a corner between side sides (α_K) is caustic 20-25o. The specified parameters provide introduction of a detail in thickness of mass of cotton raw, improving her fascinating ability, reliability and overall performance.

Placement of a dental on the basis with an opening under bolted connection and dredging by R2 radius = 40 mm allows to attach a detail to a tape of working body of a mobile loading crane of cotton and facilitates assembly of working body. At the same time the line operations on operational development and a privarivaniye of a detail to a metal level which are present at assembly of metal details are excluded.

Assembly of details in working body is made as follows. Details from composite polymeric materials 1 are fixed on a plastic or metal longitudinal level, then on a rubberized tape 2 workers of body by means of bolted connections (a bolt 3, a nut 4, a washer 5). Depending on number of the details fixed on a longitudinal level of a tape, the step between longitudinal levels is chosen equal 450-500 mm. Longitudinal levels with splitting on a surface of working body settle down in chessboard order for providing a uniform conclusion of fibrous material (cotton raw).

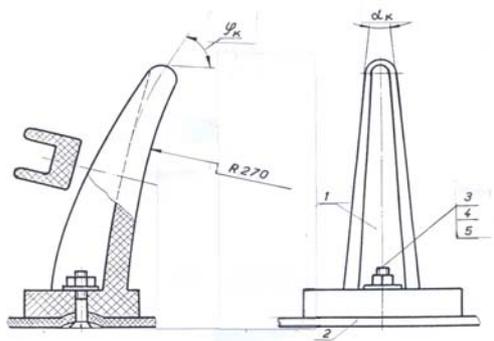


Figure 1. The design is caustic from composite polymeric materials of working body of a mobile loading crane of cotton: 1 – it is caustic, 2 – a rubberized tape of working body, 3 – M8 nut, 4 – a bolt of M8 x 20, 5 - a washer 8

Performance of a detail with a trapezoidal profile in cross section with side edges allows to increase rigidity and stability of his design, without increasing the sizes of head part of a detail that would have an adverse effect on her ability to take root into thickness of mass of cotton raw. Detail sections from shock-resistant, ant frictional , wear proof and antifriktsionno

– wear proof composite materials are thickened for 40-50% in comparison with metal, in addition the size of admissible tension also decreases by 25-30%. As at the uniform section of a detail it is impossible to receive appropriate durability, the detail inevitably is exposed to the bend and blow leading to sharp decrease in local durability and breaks.

The best, from the point of view of the maximum use of durability of a composite, is the wedge-shaped design of fastening, a so-called larkspur in which the basis the splitting is natural continuation of a feather with very little change of thickness. Wedge-shaped fastening is reliable, the splitting demands for performance of the smallest sizes of the basis. The basis the splitting at such fastening has a shaft in the form of the truncated wedge with a small corner at top. On a longitudinal level the wedge-shaped groove of the corresponding sizes into which it is inserted splittings and it is rigidly fixed is carried out.

5. Designing of Details from Composite Polymeric Materials for Working Bodies Developera Buntov of Cotton

Detail of working body of revolt of a developer of cotton (fig. 2) it is executed in the form of the core having the form of the truncated cone, bent on curvature radius in the direction of rotation of working body of milling type.

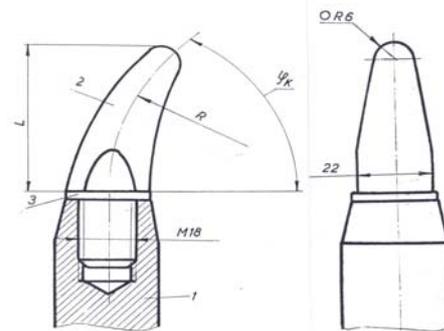


Figure 2. It is caustic from composite polymeric material of a rabochegoorgan of a developer of revolts of RBD cotton: 1 - working body of milling type; 2 - it is caustic from composite polymeric material; 3- washer

Radius of curvature makes 70-75 mm. Assembly of caustic in working body is made as follows. The splittings having M18 carving screw on to a pipe of a mill of working body. When replacing caustic it is enough to unscrew of them and splittings are exempted from a mill pipe.

6. Designing of Details from Composite Polymeric Materials for Working Bodies of the Tunneleroyny car.

The Tunnedeolyny car for digging and an clarifications of edges of revolt of cotton consists of an arrow with chain kolkovym working body on which chain levels with splitting (fig. 3) are fixed. The lower part of a detail has the bifurcate form with two openings for fastening to a level by means of bolted connection. It facilitates assembly of details and

liquidates operations on operational development and a privarivaniye of details to a longitudinal metal level.

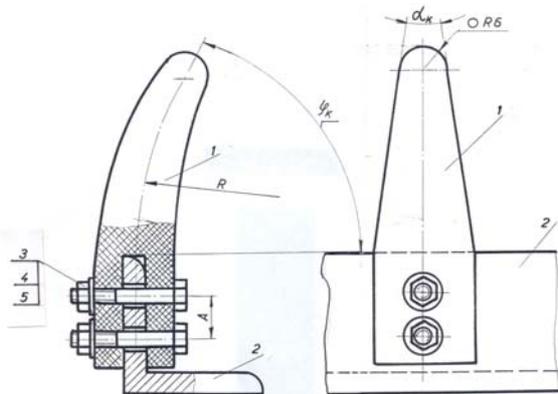


Figura 3. Detail of working body of the tunneleroyny car of OBT: 1 detail from composite polymeric material; 2-metal square; 3 bolt; 4 nut; 5 washer

Installation of details in working body of the tunneleroyny car is made as follows. Details are fixed previously on longitudinal levels by means of bolted connections and then, in turn, longitudinal levels with details - on a chain of working body. At the same time the step between longitudinal levels makes 350-400 mm. When replacing details it is enough to unscrew nuts and details are exempted from a level.

This design of details of working body of a mobile loading crane of cotton, developer of revolts of cotton and the tunneleroyny car allows to simplify, and also to reduce labor input of installation and replacement of details, simplifies manufacturing techniques and assemblies of working body.

7. Tests of Details from Composite Polymeric Materials

For test of prototypes - details from composite polymeric materials serial and experimental mobile loading cranes of cotton of the HPP brand, developer of revolts of RBD cotton and tunneleroyny cars of OBT have been under production conditions used).

Tests were carried out on cotton raw of a version S-6524 of the 1st grade, humidity of 8,2% and a contamination of 6,7% at various volume density.

In the course of tests productivity of cars was defined by a cut-off method. Time of a cut-off is chosen equal 3 pages. Productivity was defined by the relation of the mass of cotton raw given kolkovy working body of the mechanism by the time of his work on the following formula:

$$Q = \frac{P}{t}, \quad (1)$$

where Q – the technical productivity of the car, t/h;

P - the mass of cotton raw given working body of the car, t;

t - car operating time, h.

Measurement of the power consumed by the electric motor was carried out by means of two wattmeters according to the famous scheme.

The power consumed by the electric motor is equal to the sum of indications of two wattmeters. $N = N_{w1} + N_{w2}$, (2)

where N_{w1} and N_{w2} – indications of wattmeters of $W1$ and $W2$.

Considering that preservation of natural properties of cotton raw is one of the main conditions during creation of working bodies from composite polymeric materials for their use at works with cotton raw, we have conducted researches on studying of influence of details from composite polymeric materials on degree of mechanical damage of seeds and cotton fiber.

The Droblennost of seeds was studied according to the existing technique by cotton raw stripping by sulfuric acid.

The actual droblennost of seeds working body equaled to a difference between the droblennost received before influence of the worker body for a formula $\Delta D = D_2 - D_1, \%$, (3)

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D_2 - a droblennost of seeds after influence of working body, %;

D_1 - an initial droblennost of seeds working body, %.

Researches of mechanical damage of cotton fibers details of working bodies of cars were conducted by a microscopic method.

The amount of the damaged cotton fibers determined by working body of a mobile loading crane of cotton as a difference between amount of cotton fibers with mechanical damage after influence of working body and the initial, expressed as a percentage to total fibers to the shtapel

$$\Delta P = P_2 - P_1, \%, \quad (4)$$

where ΔP - amount of the fibers damaged by working body, %;

P_2 - amount of fibers with mechanical damage to cotton after influence of working body, %;

P_1 - amount of fibers with mechanical damage to initial cotton, %.

Results of tests of serial and experimental details from metal and composite polymeric materials of working bodies of a mobile loading crane of cotton, a developer of revolts of cotton and the tunneleroyny car are given in table 2.

TABLE 2. Comparative indicators of tests serial and experimental kolkovkxh of working bodies hlopkopererabatyvayushchikh of cars

| Volume density of cotton raw, kN/m ³ | Productivity, t/h | | Consumed power, kW | | Droblennost seeds, % | | Damage fibers, % | |
|---|-------------------|--------------|--------------------|--------------|----------------------|--------------|------------------|--------------|
| | serial number | experimental | serial number | experimental | serial number | experimental | serial number | experimental |
| mobile loading crane of cotton of brand xmm | | | | | | | | |
| 1,0 | 7,5 | 9,0 | 0,45 | 0,35 | 0,16 | 0,10 | 0,56 | 0,16 |
| 1,5 | 10,0 | 11,5 | 0,65 | 0,50 | 0,22 | 0,12 | 0,63 | 0,18 |
| 2,0 | 11,0 | 14,0 | 0,75 | 0,62 | 0,25 | 0,11 | 0,78 | 0,22 |
| 2,5 | 15,5 | 18,0 | 1,05 | 0,80 | 0,30 | 0,16 | 1,08 | 0,30 |
| Developer of cotton revolts РБД | | | | | | | | |
| 1,0 | 5,5 | 6,5 | 2,4 | 2,15 | 1,35 | 1,1 | 0,76 | 0,35 |
| 1,5 | 7,1 | 8,2 | 2,7 | 2,3 | 1,52 | 1,4 | 0,92 | 0,43 |
| 2,0 | 8,0 | 10,1 | 2,9 | 2,6 | 1,93 | 1,67 | 1,12 | 0,53 |
| 2,5 | 10,3 | 12,2 | 3,2 | 2,75 | 2,51 | 1,98 | 1,29 | 0,65 |
| 3,0 | 13,2 | 15,0 | 3,45 | 2,95 | 2,75 | 2,2 | 1,52 | 0,95 |
| Tunneleroyny car | | | | | | | | |
| 1,0 | 1,2 | 1,8 | 2,5 | 2,3 | 1,92 | 1,5 | 0,31 | 0,12 |
| 1,5 | 1,5 | 2,1 | 2,85 | 2,5 | 2,24 | 1,79 | 0,49 | 0,15 |
| 2,0 | 2,1 | 2,6 | 3,0 | 2,7 | 2,40 | 2,05 | 0,58 | 0,20 |
| 2,5 | 2,9 | 3,8 | 3,4 | 2,95 | 2,87 | 2,13 | 0,70 | 0,28 |
| 3,0 | 3,1 | 4,6 | 3,7 | 3,2 | 3,4 | 2,5 | 0,10 | 0,57 |

These tables 2 show that on the absolute velikchena productivity of cotton cars with details from composite materials is slightly higher, and the power consumption, damage of fiber and seeds is lower in comparison with serial working body. It means that uvelikcheny productivities of cars, decrease in power consumption and damage of fibers and seeds it is connected with ant frictional properties of material of a detail, snikzhayushchy cotton interaction forces - a raw about her surface and, besides, it is caused by a configuration of the detail which is the most rational and providing effective capture of a portion of cotton raw.

The analysis of data of table 2 shows that primenekny composite polymeric materials as materials for a razrabotanny new design of details of working bodies of cotton cars and mechanisms, the raboktayushchikh in the conditions of frictional the vzaimodeystkviya with cotton - a raw leads to increase of productivity of cars for 7-14% and a snikzheniya of power consumption for 5-8%, mechanical damageability of fibers for 0,12-0,28% and a droblennost of seeds for 0,16-0,32%, and also liquidates possible fire of cotton raw and education having reeled up fibers on detail surfaces, saves scarce and expensive constructional materials

Conclusions. Thus, the carried-out tests under production conditions of details from shock-resistant and wear proof composite materials have shown that, their application in details working bodies of mobile loading cranes of cotton, developer of revolts of cotton and the tunneleroynykh of the cars having an optimum design, high technological effectiveness and efficiency will allow to increase considerably their reliability and working capacity, to reduce damageability of seeds and cotton fibers, to reduce formation of free fiber in the course of acceptance and transportation of

cotton raw, and also at preventive operations with cotton raw, to liquidate a possibility of sparking and fire of cotton owing to decrease in coefficient of friction of cotton raw at interaction with a working surface of a detail from composite polymeric material, to improve quality of the produced fiber.

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