569. Work technological researches of wood nemalining of defibrator elements

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Abstract. Attrition of segments knifes of slip milling defibrator and with attrition is related changes of work characteristics that have influence on productivity and quality of producible production are researched in this article. Principled construction of defibrator is given, principle of its action is described. Segments are described too and possible constructive variants of segments are given.

Segments of slip milling are one of the main elements of slip milling process. Subjections of production and quality of producible production of segments attrition and work characteristics of defibrator are determinate. Comparison of two constructions of segments attrition is accomplished. Getting results are given in graphs. Generalizing conclusions are given in the end of work.

Keywords: defibrator**,** technological, segment, milling

Introduction

The first defibrators were with stone discs or with round stones, which were milled wood giving with chain speed. It was great mechanism of few highs, which is milled wood. Fraying stone a lot of abrasive materials are hited to mass and were troubled production [1, 2].

Modernizing production were constructed mills with metallic discs, which were secured better productivity and better quality of mass milling [3, 4, 5].

Modern machines of milling are knifing-disking machines. Ultimate result is gotten during two or three levels of milling [6, 7].

Defibrators that produced various companies are comparable and identical construction, vertical or horizontal position of rolls only and with one or two movable discs, theirs clearances, construction of using segments, quality of making production and content of milling [8, 9, 10, 11].

Mills with one movable disc is worked with 1500-1800 rev/min., rotation frequency of two moving discs is 2400-3000 rev/min. Every disc is rotated locomotive with separate motor. Mill has isolation of sound to 80 dB, as these mills have powerful 1.5 Mw motors [5, 12].

Transducer is introduced in the construction of mill, that is regulated opening between discs with 0,01 mm accuracy constantly. Using transducer, segments are saved from direct metallic contact. Hydraulic system of pressing is regulated opening between discs of milling [5, 13, 14, 15].

The theory of MPP panel structure is originated of Elis and Bas on 1950 years, its through connections of splint between molecular one with other are interacted for hydroxide connections of hydrogen group, this theory is not changed to date [13]. The cause of theory is structured that the character of between nemaline contacts in the plate is analogous to between

molecule lateral chain contacts of panel that are interacted through bridges of hydrogen. Contacts of hydrogen are started when distance between atoms $2.55*10^{-10} - 2.77*10^{-10} m$.

Panel of wood cutting are used successfully in the works of civil individual and of flats and buildings of commercial purpose wildly and fixing buildings partly. Work quality and commercial success belong from panel [16, 17, 18].

Milling shingles it is trying that technologic process could shorten, could be good quality of production, that nemalination could happen by less temperature and by less expenditure of steam and so on. Attrition of segments and intensity of attrition have influence for that, so that working of segments not only are deteriorate but and productivity of all system and quality of production [19, 20].

Determinating reasons of segments attrition and its consistent, it could avoid big breakdowns, to choose optimal work conditions, that could make certain most optimum work of all system, that could get maximum relation of productivity and of work quality and of economy [21].

Defibrator and its working principle

Milling of nemaline materials is very pervious process of work power. So economy of using energy relied on workability of mechanism and on workability of work process.

Shingle is milled with defibrators (with disc mill) on two or three stages of milling. The process is gone between two discs on them with screws are fixed segments, that are rotated on opposite directions, one disc is standing, is fixed by corps of milling chamber and other, pulling on roller of motor, rotating with motor. Process is analogous to working principle of stator and rotor.

Searching mill of horizontal working, its construction is presented on fig. 1.

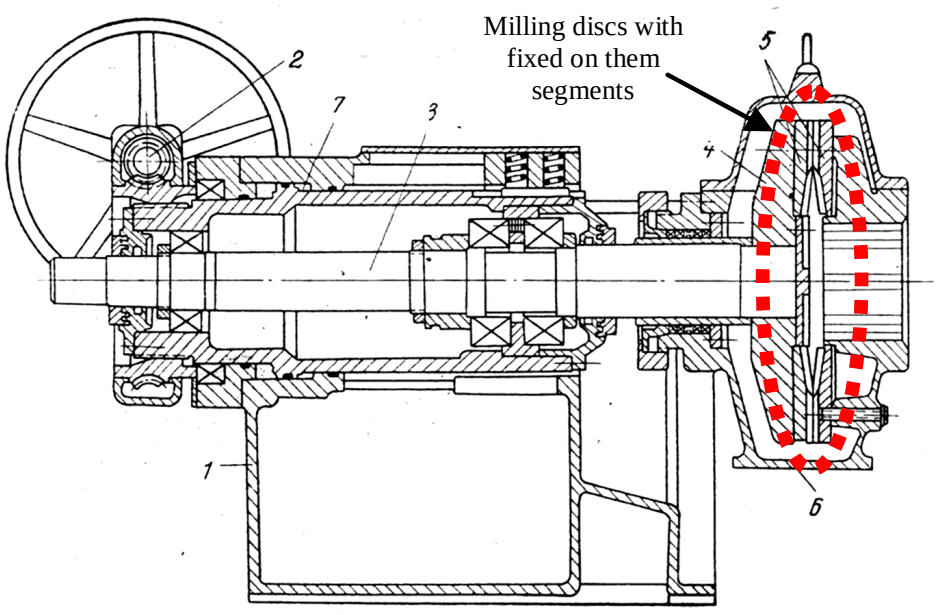

Fig. 1. Longitudinal layer of defibrator: 1 – the base of fastening, 2 – mechanism of gap regulation, 3 – roller, 4 – disc, 5 – segments, 6 – chamber of milling, 7 - hydraulic system of pressing

Principal kinematical scheme of defibrator is given on fig. 2.

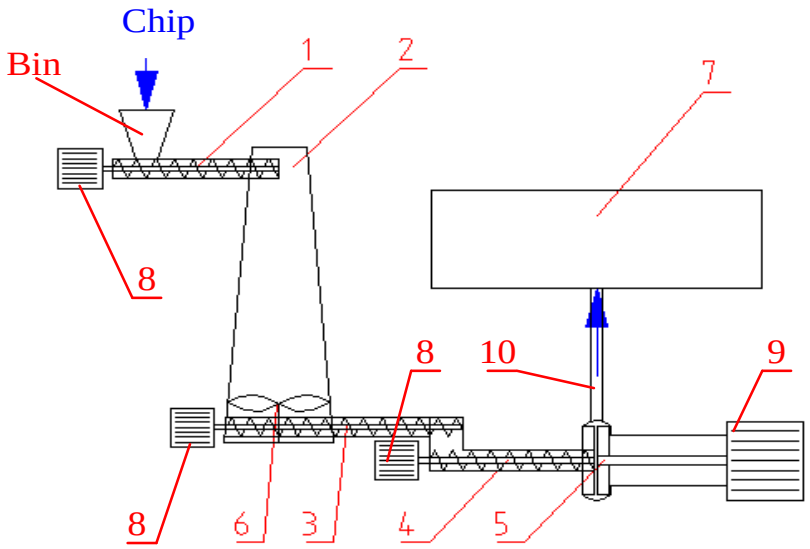

Fig. 2. Principal kinematical scheme of defibrator: 1 – screw of supply of steaming camera, 2 – steaming camera, 3 – the first screw of supply, 4 - the second screw of supply grinding camera, 5 – camera with two discs, 6 – stirrer, 7 – reservoir of defibratoring mass, 8 – electromotor, 9 - electromotor, 10 – tube of exhaust

Prepared chip is kept in bin. From bin through opening 1 is poured over upper supply screw of defibrator 2, that is rotated 60 kW of electromotor, is moved through corpus of screw to chamber of steaming 3. In chamber of steaming chip is damped of steams of high pressure, that pressure is 9-10 bars. Temperature in chamber of steaming supported 150-165^0 C of heat. In chamber of steaming chip is damped, mixing in dolly. Damping with stem is very important and from it is depended degree of milling mass, and damping is depended on temperature of steam in chamber of steaming and expenditure of steam. From first lower screws of chamber of steaming 3 is withdrawn chip and is transmitted for second lower screw 4, that pushed chip to chamber of milling 5. Chip to chamber of milling with screw is pushed through opening of still disc, so chip is plumped between segmental discs is grinded id is eliminated with turning movement from milling chamber through very little opening between discs. Disc of milling chamber is rotated with one powerful 600 kW electromotor 9 only, that moment of turning to roll is transmitted through muff. Electromotor fixed to concrete base. Speed of segments rotation is 1100-1460 rev/min. Diameter of discs is 960 mm. It is very important pressing of segments and distance between it for process of control that is controlled hydraulic mechanisms of pressing. From chamber of milling is eliminated through tailpipe 10 to reservoir of mass 7. Defibrator is controlled with computer-based desk of control that is indicated separate working characteristics of defibrator and state of defibrator generally.

Producible product of investigative object is milled shingle of wood, from it is produced MMP panel (Fig. 3).

Structural panel MPP is produced from milling shingle. Using of MPP panel is very wide. These panels could be produced of different thickness and overall dimensions.

Fig. 3. MPP panel

Work elements of defibrator

One of the main elements in the researching mechanism are discs of milling with segments that are fixing on them (Fig. 4), that have knives for milling of chip. Principal construction of segment is given in fig. 4. Table of segment is divided into several pieces, which lightened process of chip milling.

Construction of segment has three zones of milling (Fig. 4a):

I - zone of defibrating (primary zone of milling);

II - medium or rough milling zone (conical zone);

III - outside or thin zone of milling (refinement zone).

Wood passing into chamber of milling is graining with rotary motion, then is passed into zone of defibrating, where with knives is segmented into compound splints of wood.

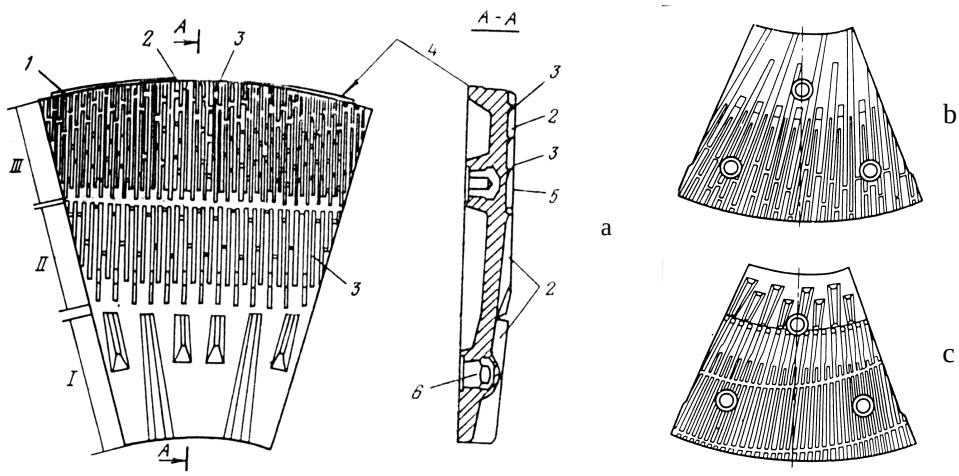

Fig. 4. Constructions of segments: a – milling zones of I, II, III segment; 1 – channels, 2,5 – knives, 3- partitions, 4 – radial surface, 6 – screw-nut, b;– with large amount of partitions; c – with little amount of partitions

Splint of wood in the medium zone is oriented towards tangential way and is processed with rough mechanical milling.

Splint of wood in the outside zone of milling is processed by rule the worst, and quality of production is depended on it. Splints are pushed to periphery of discs along partitions of segment.

Obliquity of segments profile has influence to work stability of disc grinding-mill, for attrition of segments profile and for quality of producible production. Obliquity of segments has influence to length of splint and to vapour, that is distinguished during work expulsion too. Obliquity of segments profile is depended on bore of discs, on spread of milling zone, on profile of knives, on degree of milling. Profiles of segments could be several forms (Fig. 6).

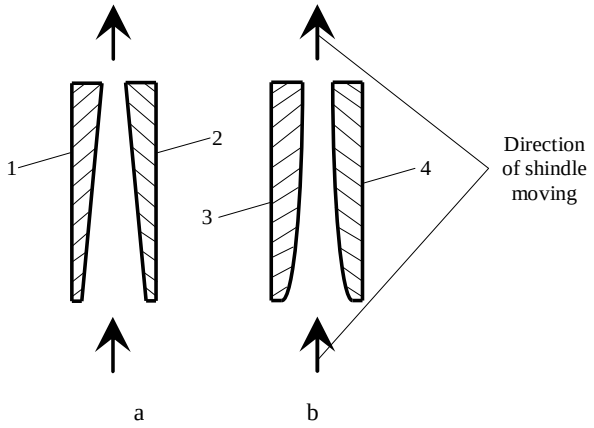

Fig. 5. Constructions of segment knife profile: a – straight comicality, b – convex comicality

Durability of segments profile is depended on sort of wood and on its quality, on milling degree, on segments configuration and on gap between sizes of segments. Deformations of segments profile could be for deformation of cutting part, when:

- enlarged channel on the top of knife, for uneven feed of shingle or false mounting of preservative mechanism;
- channel well-stocked with burning mass and pitch – for big concentration of fat and of pitch in the wood;
- channel is filled with hard mass for rounding of cutting margin edge;
- channel is filled with hard mass for filling of channels with silicate of natrium being in the wood or for indissoluble particles in the water and for sand;
- fool frying cutting part for selected material badly or when in the composition of wood there are hard indissoluble particles;
- cutting part is deformed partly and it is springed up channels for being different outside objects in the milling chamber;
- for uneven contact with moving disc that have cutting surface it is up started marks in the standing disc;
- little channels of cutting part is faded for cavitations;
- cutting part is glistened for material of segments that is chosen wrongly or for large number of indissoluble particles in the mass.

Interval between segments has influence to stability of work, to productivity, to removability of vapour, to attrition of segments. A little throw is aggravated of vapour removability, the major throw is speeded up attrition of segments, is decreased productivity of

defibrator and stability of exploitation. Through zone of channel feed is removed to 40% vapours that are formed during channel milling. That to give production of appropriate quality it needs to increases obliquity of segments in the medium zone of milling and width of zone of smooth milling.

There are partitions between knives in segments (Fig. 4 b, c) that are necessary for that vapour and not milling mass is no passed between knives longitudinally. The height of partitions is square to height of knives or they could be slightly lower.

Amount of partitions and its position in the segment has a big influence to process of milling and to quality of producible production. Wherewith thickest profile of knife and wherewith narrowest partitions, the less there are partitions. Discs of milling with different segments are researched experimentally. Segments with little and large amount of partitions view used (Fig. 6 a, b). Special screws are used for push of partitions to cameras of milling and of vaporization (Fig. 7a, b).

a b

Fig. 6. Segments are fixed to disc: a – segments with large amount of partitions; b – segments with little amount of partitions

a b

Fig. 7. Screws of channel push: a – screw of milling chamber, b – screw of vaporization chamber

Decreasing pressure of vapours between knives it is decreased and clearance between discs too, that is perfected milling of splint. Regulating amount of removable vapour it could be influence to factious composition of mass. Functioning dynamic and axial loads, regulation and backing of clearance in some diapasons – it is very complicated task.

Friction in the working zone

Friction is termed expressions complex of two one of other vis-à-vis moving solids, that are come in the contact zone, when in the result of that springed up power of contact or power of friction.

Friction is springed up, when two bodies is moved one of other vis-a-vis (kinematical or movement friction) or when it is tried to move frames, that are in the state of chill-out (static or quiet friction).

Outside friction is termed, when two one of other vis-à-vis moving solids is touched with surfaces and inside – when one of other vis-a-vis is moved elements of solid structure (atoms, molecules).

Inside power of friction is consisted of mechanic part tangibly (to win and to deform to resistance of surfaces inequalities) and molecular part (to win anatomic and molecular adhesive connections that are composed between surfaces and to win electric interface):

$$F = fP \tag{1}$$

where: f – coefficient of sliding friction, P – normal load.

Received, that conditions of lubrication in the moving pairs are indicated the best through number of Gumbel and trough diagram of Stribeck. It shows differences of friction and of lubrication conditions by connection between coefficient of friction f:

$$f = \frac{P}{F} \tag{2}$$

where: P – normal power, F – power of friction.

Loads of defibrator motor is decreased for resistance of screw to rotation and to rotation of milling discs resistance. These powers of resistance are started pushing shingle to chamber of vaporization and milling it.

When screw is rotated with backlash resistance powers are for touching screw with corps, in that it is rotated, but these resistance powers for friction are vary small. Knobs of shingle plumping between screw and corps, for friction, are made resistance powers that are decreased loads of motor. But these powers are small and are not disturbed for more of mechanism us. Problems turned up when to mechanism us are gotten outside objects (large shingles, knobs of stone and of iron and so on), then load of motor is decreased hard. If decreasing loads greatly motor not cute out automatically, then elements of mechanism us are damaged (belt rotating motor is broken, screws and segments are fried and are nicked and so on).

The basic source of defibrator work problems is friction that on one case is better, on other case – lesser. It is understand, that the biggest friction in this mechanism is up started milling shingle; it could underrate other aforesaid cases of friction that are very little.

These cases of friction could be normally:

1. dry friction;
2. half dry friction;
3. liquid friction.

The worse case, when friction is dry completely. Dry friction is termed friction, when surfaces of friction diagnosed directly, them is not separated any oil material. In the case of dry friction coefficient of friction could be big particularly, great significance have powers of adhesion for it.

Resort of any oil-material is decreased coefficient of friction considerably. Efficiency of most pores of friction is quality by where which lesser coefficient of friction, so it is importantly to explore all variants of pores of friction of work with oil-material. Half dry friction is happened milling shingle in searching case, it warranted vapors that are in the milling chamber.

Research results and its analysis

Work parameters of defibrator were researches, subject to screws, segments attrition, and term of defibrator work and so on.

Parameters of work defibrator using segments with big number of partitions are presented on fig. 6a.

Work of segments is from 200 to 300 hours. It can see, that working characteristics is begin degenerate lengthening work time. Characteristic of the main motor is changed, working with full load, indication is increased 92-105%, is increased scatter of loads. Rotation speed of screws is decreased 75-64%. Loads of motors are increased at this production of making speeds: motor load of the firs lower screw is 22-26%, motor load of the second lower screw is 20-23%. It means that segments are frayed a bit and loads of the basic motor increased for state of segments namely. Such working characteristics of defibrator are normal. Segments are managed to mill shingle yet, as loads is begun to increase. It is not recommended to decrease expenditure of vapour.

Work of segments is from 300 to 400 hours. Working characteristics are worsened more. Scatter of loads of the basic motor is increased 90-107%. Speed of rotation screws is decreased 70-58%. To these speeds of mass production, their load of motors is increased: load of the firs lower screw is 24-28%, load of the second lower screw is 23-28%. Segments are fried more, but decreasing speed of shingle feed these work is normal and them could exploit. Uneven ion of loads of the basic motor is ascertained for razed segments. It needs to decrease speed of shingle feed, it means, that to decrease making of mass 10-15% and to increase expenditure of vapour.

Work of segments is from 400 to 500 hours. The basic motor is worked hardly, its loads are 84-110%. Rotation speed of screws is decreased 65-52%, load of the firs lower screw is 26-30%, load of the second lower screw is 25-34%. It means that motors of screws are worked very task; its loads are uneven and are varied often. Segments are very beat-up and them needs to change. Wanting to decrease work that is laden of equipment, it needs to decrease expenditure of vapour from 2.0 to 2.5, 3.0 t/h, to increase screw feed to 55% and to change segments.

Work of segments is 500-550 hours. Load of the basic motor is 78-112%, it is worked very hardly, and loads are varied constantly. Speeds of screws feed are varied constantly too 55-43%, load of the firs lower screw is 27-32%, load of the second lower screw is 30-45%, the second lower screw is weighted particularly. Defibrator is worked very laden and its work is not sure, because segments are frayed and they are not cached to mill shingle. Work of segments above 500 hors is shown, that with these segments must not to work, because loads were increased inadmissibly (Fig. 8a, 10).

Working surface of segments is frayed very much and height of knives is decreased from 8 to 3,5 mm. Ledges of knives edges are round down, and surface of cutting is frayed, it is up started a lot of dents and patch's of roll. With these segments must not to work, these segments could change with news necessarily.

Recommended work time of segments is 350-400 hours. Working segments from 400 to 500 hours could mechanism to exploit 80-90% from it full power. Recommended expenditure of vapour is 2.0 t/h.

Work parameters of defibrator using segments with a little amount of partitions are presented on fig. 6b.

Work of segments from 200 to 300 hours. Load of the basic motor is increased 94-104%. Rotation speed of screws is decreased 80-72%. Loads of others motors is decreased; load of the firs lower screw is 20-23%, load of the second lower screw is 19-21%. Results are shown, that segments are frayed a little, but these characteristics of defibrator are normal.

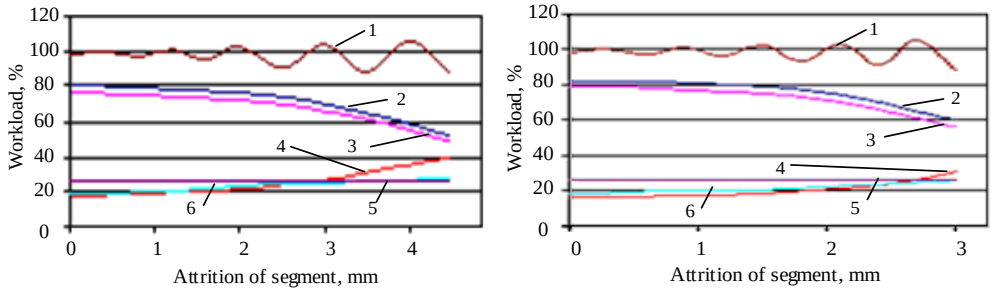

Fig. 8. Dependence of work parameters of defibrator from attrition of segments: a – segments with large amount of partitions; b – segments with little amount partitions; 1 – load of the basic motor, 2 – speed of the first lower screw motor, 3 – speed of the second lower screw, 4 – load of the first lower screw motor, 5 – load of the second lower screw motor

Work of segments from 300 to 400 hours. Load of the basic motor is increased 92-106%. Speed of screws is decreased 75-65%, its loads of motors is decreased: load of the firs lower screw is 23-26%, load of the second lower screw is 22-26%. Segments are frayed a little, but theirs working state is normal and them could exploit further. It is recommended to increase expenditure of vapour from 2.0 to 2.3 t/h.

Work of segments from 400 to 500 hours. The basic motor is worked hardly, loads is varied 88-108%. Speed of screws is decreased 70-60%, load of the firs lower screw is 26-28%, load of the second lower screw is 25-28%. These shows of motors loads means, that motors of screws are worked very weight, theirs loads are not equal and are changed often. Segments are frayed very much and it needs to change them. Defibrator for attrition of segments is very laden and it is increased productivity of production. Wanting to decrease loads of mechanism it needs to increase expenditure of vapour from 2.2 to 2.5 t/h (Fig. 8b, 10).

Working surface of segments is frayed and height of knives is decreased from 8.0 to 5.0 mm.

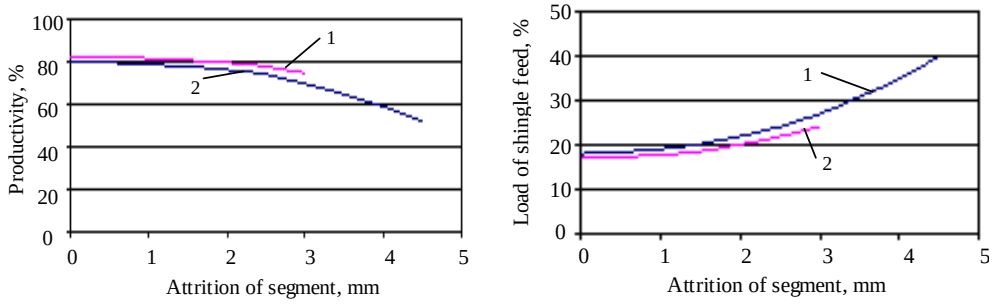

Fig. 9. Segments attrition influence on: a – productivity of defibrator work, b – load of shingle feed screw, 1 – segments with high amount of partitions, 2 - segments with little amount of partitions

Work parameters of defibrator using segments with large amount of partitions.

When segments are frayed to 1.0 mm, work parameters of defibrator are good. The basic motor was worked with 96-102% load, motor load of the firs lower screw is 20-22%, load of the second lower screw is 18-20%, speeds of screws are 82-72%. Loads of motors are not large. Good productivity of work and good quality of production.

Working characteristics are worsened when knives of segments are frayed over 1.0 mm and frying to 2 mm forward. Loads of the basic motor is increased 92-105%. Speed of screws is decreased 75-64%, load of the firs lower motor screw is 22-26%, load of the second lower motor screw is 20-23%. General work characteristics of defiblator are good. Segments are managed to mill screw yet, so loads is begun to increase already.

Frying segments from 2.0 to 3.0 mm it can see increase of defibrator loads and deterioration of work characteristics. Loads of the basic motor is increased 90-107%. Speed of screws is decreased 70-58%. Load of the firs lower motor screw is 24-28%, load of the second lower motor screw is 23-28%. It can see, that motors are frayed and theirs loads are varied often. Loads of the basic motor are skipped because segments is not kept a out to mill screw, because theirs surface is faded.

Frying segments 3.0-4.0 mm it can see enlarged loads. The basic motor is worked hardly, loads are skipped 84-110%. Speed of screws is decreased 65-52%, load of the firs lower motor screw is 26-30%, load of the second lower motor screw 25-34%. These shows of loads motors means that motors of screws are worked very weight and theirs loads are not equal. Segments are frayed very much sufficiently yet and it needs to change them with news (Fig. 9a).

Work parameters of defibrator using segments with little amount of partitions.

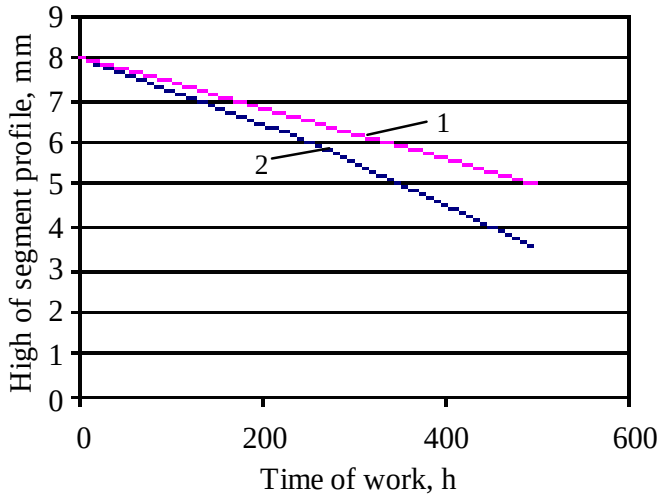

Fig. 10. Dependence on work time of segments with large and little amount of partitions: 1 – segments with large amount of partitions, 2 – segments with little amount of partitions

Frying segments from 1.0 to 2.0 mm working characteristics are worsened. Loads of the basic motor is increased 92-105%. Speed of screws is decreased 77-64%. Loads of motors are increased: load of the firs lower motor screw is 21-24%, load of the second lower motor screw is 19-22%. General work characteristics are good.

Frying segments from 2.0 to 3.0 m it can see decrease of defibrator loads and deterioration of work characteristics. Loads of the basic motor is increased 88-108%. Speed of screws is

decreased 70-60%, load of the firs lower motor screw is 26-28%, load of the second lower motor screw is 25-28%. These motors loads characteristics means that motor of screws are worked very laden, theirs loads are not equal and is varied often. Segments are very raze but could work yet (Fig. 9b).

Comparing segments with little and with large amount of partitions it is determined, that knives of segments with large amount of partitions are frayed 4.5 mm, when knives of segments with little amount of partitions are frayed 3.0 mm only. Ledges of edges knives segments with large amount of partitions are rounded more, theirs surface of cutting is faulted more and there are more dents in comparison with segments with little amount of partitions. Work characteristics of defibrator using segments with large amount of partitions are worse than using segments with little amount of partitions for these reasons.

Conclusions

When different stranger elements are plumped to zone of milling (large shingles, bits of stone and iron and similarly) surfaces of segments are frayed not gradually and we could see roll paths on surfaces, nicks and other breakdowns of surface, that are decreased efficiency of segments and of all mechanism us work.

Attrition of segments has substantial influence on indexes of work parameters of defibrator. Work parameters of defibrator are worsened frying segments. Frying segments 1.5-2.0 mm characteristics of work are worsened, but not apace how reaching 2.0-2.5 mm attrition. Working characteristics are very bad, reaching 4.5 mm attrition, so it needs segments to change straight.

Comparing segments with large and little amount of partitions knives are frayed, that knives of segments with large amount of partitions are frayed 4.5 mm, when knives of segments with little amount of walls are frayed 3.0 mm only. Ledges of edges knives of segments with large amount of partitions are rounded off more, theirs surface of cutting is faulty more and there are sockets more comparing with segments with little amount of partitions. Characteristics of defibrator using segments with large amount of partitions are worse than using segments with little amount of partitions for these reasons.

Summing working characteristics of segments with little and large amount of partitions it is determinate, that segments with less amount of partitions are better, because they are worked with same conditions, are frayed less, it needs less vapour milling shingle, and quality of production is better also.

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