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DETERMINATION OF THE VALUE OF SELECTED OSCILLATION FREQUENCY MEASUREMENT POINT ANALYZED PARTS OE SPINNING - ON THE BOX SPINNING

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Abstract

The experimental analysis carried out included the character of appearance of influence of mechanical oscillations of the analyzed circuits OE - spinning machine. These are the most common causes resulting increase in the level of mechanical oscillations. Were ranked according to their impact of failure which lead to this phenomenon. Based on these data flow is executed action of mechanical oscillations of the analyzed circuits OE - spinning machine. He also explained the nature of the mechanical oscillations of the control measuring points on the analyzed drives. Based on the experimental analysis a band of oscillation for each integral component of the analyzed components (this dependence are shown in a plane system). The obtained diagrams are determined by the size of extreme values amlituda and frequency. Thus obtained values were used depending on the determination of the circular velocity dependence of the oscillation frequency amlituda. The obtained curves have been entered into a universal model and the optimal frequency determined by the safety of the analyzed components OE - spinning machine.

Key words: OE – spinning, oscillatory processes, analysis.

1. INTRODUCTION - BASIC PRINCIPLE OE - spinning

Basic Principles of the rotor - bezvretenskog spinning procedure consists in the formation of individual fibers, yarns, which were previously isolated from the output tape (tape carded). Display labels R1 OE spinning machines whose circuits are analyzed in this dissertation was carried out on **picture 1**.

Picture 1. Showing OE - spinning label R1 (Rieter)

Phases of this type of spinning (spinning classic bezvretenski way) consists of the following operations:

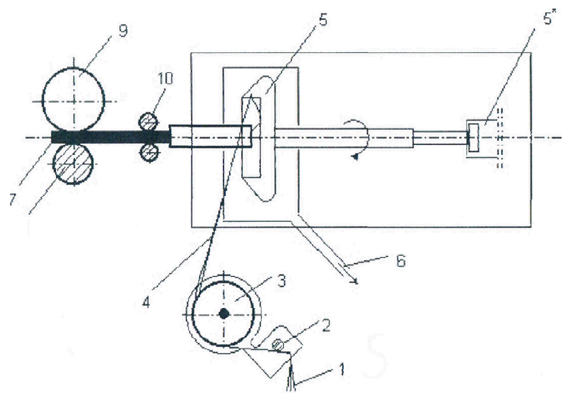
- bed (I and II), the operation of discretization of fibers (separation of individual fibers) from the output carded strip,
- transport of individual fibers with the air stream,
- stacking of individual fibers (group) at the entrance to the report,
- spinning fibers in the report and
- finished winding the yarn at the exit of the rotor.

One of the main advantages without spindles spinning procedure for the processing of cotton and chemical fibers, cotton is a type in the number of phases. In the classical process of spinning the ring spinning machine, spinning process occurs in seven stages of work, while in modern without spindles spinning process occurs in two stages of spinning, which are shown in Table 1.

Table 1. Comparison of phase spinning

CLASSIC without spindles PROCEDURE	**CURRENT PROCEDURE without spindles**
First CLEANING **Second carding** **Third bed and** **Stretch II** without spindles **SPINNING**	**First Automatic line Interrelated:** **• OPENING** **• Mixing** **• CLEANING** **• carding** **• REGULATORY** **2. Stretch Second** without spindles **SPINNING**

According without spindles spinning process, the material in the form of strips (1) with the other passages stretch over the opening roller (2) into the zone of action devices bed (3). Bed roller whose speed of 7000-8000 rpm (r / min) was coated with special serrated set so that the pull tapes from a single fiber (4), which is followed by electricity in the air transport for the spinning rotor (5). Individual fibers extracted with the help of air flow entering tangentially to the wall of the rotor. The high-speed rotor (rotor with a diameter ϕ 32 and the rotor 115 000 (o / min)) fibers are packed into the groove of the rotor in the form of wedge-beam parallel. Rotating rotor due to the effects of centrifugal force and effect Koriolisovog acceleration ie. force, formed by some form of the yarn balloon. Yarn spun from the rotor through the outlet rollers (10) wound on the spool (9). Cross drainage Speed ranges from 25-220 (m / min), the capacity of the coil to 5 (kg) with yarn wound on it (usually a coil capacity up to 2 (kg) with a wound yarn). Scheme without spindles ways of spinning the OE spinning type R1, manufacturer of Swiss company Rieterr is shown in **picture 2**.



1.First Ribbon fiber, 2. The opening roller, 3. Roller bed fiber, 4. Oriented fibers, 5. Rotor, 5 '. Aerobed, 6. Dust extraction nozzle out of the box, 7. Yarn, 8. Guide or, 9 Coil. , 1.0 Rollers for tensioning the yarn before winding the bobbin

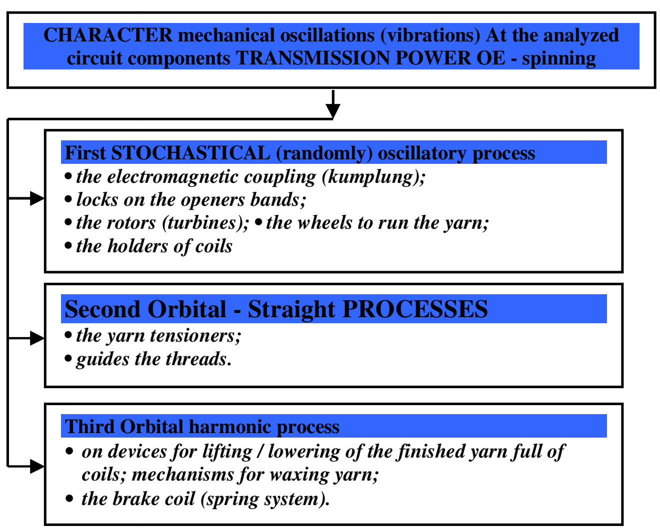
Picture 2. A simplified view of how to obtain yarn spinning method without spindles

2. CHARACTER mechanical oscillations (vibrations) in the analyzed OE - spinning

The analysis of mechanical oscillations, given the importance of character formation that these phenomena. types of events that cause failures of component parts and components analyzed OE - spinning machine.

The character (s) of the mechanical oscillations of the control points on the power transmission assemblies for spinning boxes and assembly of the finished yarn winding coils appear in three forms, namely as (**picture 3.**).

1. First Stochastic (random) oscillatory processes;
2. Second Oscillation of the oscillatory processes - pan;
3. Third Oscillation of the oscillatory processes - harmonic motion.



Picture 3. Diagram of classification character of mechanical oscillations of the analyzed components, fluid power components OE – spinning

3. GENERAL APPEARANCE ON MECHANICAL OSCILLATIONS OF COMPONENTS ANALYSED OE – spinning

The mechanical oscillations of the component parts of the analyzed components OE - spinning machine, created by force and due to the action of dynamic forces within the system to change its direction and intensity (size).

The identification of their origin is based on deterministic dynamical origin of the concept of force.

When analyzed OE - spinning each source generates mechanical oscillations. The most common reasons that cause mechanical oscillations (vibrations) in the structural parts and components analyzed OE - spinning machine are:

1th Unbalance rotating parts (rotating parts);
2th Lack of dynamic stiffness of the housing and its supports (light foundation);
3th Disorders of joints and bearings of rotating parts;
4th Poor driving and tangential belts for power transmission systems (wear belts);
5th The invalidity of rolling bearings;
6th Wear of the component parts and components due to friction phenomena (turbo - mechanical processes);
7th Turbulent flow and accumulation of impurities in the processing of yarn (the appearance of wear due to friction in the intake box);
8th Wear of the teeth (furniture razvlakivanje) rotating elements and components;
9th The effect of electromagnetic forces that affect the proper operation of electrical and electronic parts;
10th The cancellation of elastic (spring) components due to the appearance of their elongation;
11th Looseness in the joints.

Based on the above mentioned reasons that cause mechanical oscillations (vibrations) of the analyzed elements and components of OE - spinning the division made its impact on the boxing and spinning to the finished yarn winding coils (picture 4.).

INFLUENCE OF MECHANICAL OSCILLATIONS Dependability analyzed elements and components BOX ASSEMBLY PLANT FOR spinning and coil winding ALMOST IN OE yarn - spinning

1. **Unbalance current (rotating) parts assembly OE – spinning** (The roller to bed; kumplung the pocket; The rotor, the aero bed; the wheels to run the yarn; the holders of coils;)
2. **Lack of dynamic stiffness of the housing system and its technical supports (light foundation) -** This effect causes a mechanical oscillation (vibration) to all elements and components of OE - spinning
3. **Disorders of the rotary coupling parts of the technical system** (The rotors (turbines); he electromagnetic coupling;)
4. **Poor driving and tangential belts for power transmission systems (wear belts)** (On your belt rollers for opener; The rotor (turbine);
5. **The invalidity of rolling bearings** (Locks on an arm of the opener; The branch of the wheel to run the yarn; The bearing holder coils;)
6. **Wear of components and component systems for the appearance of friction (turbo - mechanical processes);** (of the drum to bed; kumplung the pocket; the rotor (turbine); the wheels to run the yarn; at the nozzle (Dekleva) - cover of the rotor; on conductors or.)
7. **Turbulent flow and accumulation of impurities in the processing of yarn (the appearance of wear due to friction in the intake box);** (Insert the opening of channels; The intake box; For aero bed; The drain pipe; Or on the conductor;
8. **Wear of the teeth (furniture couch) rotating element assemblies and components;** (Locks the openers bands;
9. **The effect of electromagnetic forces that affect the proper operation of electrical and electronic parts;** (The electromagnetic coupling; The reader;)
10. **The cancellation of elastic (spring) components due to their elongation;** (The yarn tensioners; A mechanism for waxing yarn; The pretensioner / tappets coils;)
11. **Looseness in the joints;** (The holders of coils;)

Picture 4. The course of action of mechanical oscillations in circuits anlizirane - OE spinning

4. GENERAL ON EXPERIMENTAL ANALYSIS OF OBTAINING ANY belt vibrations for a component of the analyzed CIRCUITS

Experimental analysis is presented through three stages of studying the basics of mechanical vibrations at selected measurement locations, and included:

1. Global knowledge of the process of oscillation;
2. An experiment measuring the level of mechanical oscillations;
3. Identification of a result obtained (analysis).

1. Global knowledge of the oscillation process (selection of sampling locations at which the measurement was carried levels of mechanical oscillations)

Measurements of mechanical oscillations are included seven selected measuring points whose position is shown graphically in section 3 and are located in these locations and to:

I test point: located just below the opening of channels;

II test point: there is next to the lever to open the lid of the rotor (dekle);

III test point: it is pitched at the top of the rotor lid (as close as space allows access akcelometra);

IV test point: there is a branch of the wheel to run the yarn;

V test point: located in the middle of the cover (housing) mechanism for waxing yarn;

The choice of measurement position is elected for the following reasons:

- The measuring point was selected so that they can more accurately determine the parameters of mechanical vibrations that result from feeding strips carded in the process of processing - spinning;
- Measuring point II, was chosen as it is in this position can determine the parameters of the mechanical oscillations that occur in the work of the electromagnetic coupling and open the locks of the drum carded strips;
- Measuring point III, were selected on the slanted part of the rotor lid (dekle) in such a way that would be approached as close to the rotor and aeroležaju. Rotor (turbine) and aeroležaj are enclosed in a separate enclosure so that it is not possible to measure in their area of work, but it must be done through the lid of the rotor.
- Measuring point IV, was chosen on the opposite side of the wheel to run the yarn, and to the holder sleeve or casing in which the wheel rests. - Measuring point V, was chosen as the center of the cover that. the housing mechanism for waxing yarn. This position of the measurement will be performed the measurements caused by mechanical passage through paraffin filling yarns and resilient system that causes suppression of paraffin.

2. An experiment measuring the level of mechanical oscillations

The experiment consisted of the following combinations of measuring the level of mechanical vibration on the structural components built into the circuit box assembly for spinning and winding coils the finished yarn. These combinations are pursued to obtain more precise results of measurements of mechanical oscillations (vibrations). The order of measurements in which involved a combination of these integral components in circuits are:

Measurement I: Includes measuring the level of mechanical oscillations in circuits when installed all new components;

Measurement II. Includes measuring the level of mechanical oscillations in circuits when they built the correct components and are in operation.

Measurement III. Includes measuring the level of mechanical oscillations when the built-in circuits worn components (except beds and cartridge holder grafts that are taken as new otherwise it would not be able to perform the measurement, because it is the final place where the process ends, and could not be made to the coil winding of yarn as the final stage of spinning).

Measurement IV. Includes control (again) measurements, measurements III (repeated in the more sophisticated level of oscillation, ie. Amplitude and frequency bands).

3. The characterization of these investigative findings (analysis)

By measuring the control of mechanical vibrations, ie. measuring parameters of random variables (stochastic random function) to the selected control points were done in Physical Review *OXYZ* system, with the *OX – axis*, shows the value function of the amplitude frequency *(A(f)),* on *OY - axis* during the oscillation *(t)* while the *OZ - axis* shows the amplitude of oscillation. These values in the spatial system are shown for each signal and the measurement point to the sequence of measurements. This display mode for the sequence of measurements is useful because it gives a true picture of the level of the oscillation spectrum and on the basis of their values determine the value of the belt depending on the amplitude of **the oscillation frequency of oscillation.**

As the dependence of the amplitude of oscillation as a function of time (t), ie the size of non-periodic. it is random (stochastic) values, which is concluded from the above oscillation spectra, it is necessary to carry out their analysis of this spectrum decomposition (random functions *A(t))* the sum of harmonic components, of which is determined by the oscillation frequency spectra (views in Figures 5 to 9), who demonstrated an example of the measurements of amplitude - frequency characteristics of the measuring points of the analyzed components.

Based on the graphical view (chart) oscillation of random (stochastic) function can be determined by the value of the level oscillations (amplitude and frequency) for each integral component of the analyzed components. These values are shown a result obtained by measuring the oscillation part of the band (band cover of max. And min. In the amplitude and frequency) for the sequenced measurements, while their mean values determined by spectral analysis of random functions and on the basis of stochastic parameters that describe the random functions (this part of the analysis is carried out in part terorijskom value analysis of mechanical vibrations).

5. FREQUENCY SPECTRUM MEASUREMENT SIZE oscillating integral components of the analyzed circuit MEASUREMENTS PERFORMED sequenced on a particular example

The frequency of oscillation spectra are chosen so that each band represents a calming of assembly component ie. response, and are shown in the diagrams of oscillation A = f (f), the measurements performed and for each test point (and the example of the measurements of amplitude - frequency characteristics of the measuring points of the analyzed components).

The obtained diagrams arising from the measurement data processing, are determined by the size of extreme values (max. and min.) The amplitude and frequency. Impressions were made to the diagrams and sequenced with each diagram of oscillation. Experimentally obtained values will be used in the analysis and correlation, depending on connection parameters, the reliability of components and assembly of mechanical oscillations influence on their work. Also, these values will be used in determining the stability (of the analysis allowed the risk) of each measuring point, ie. each structural component of the analyzed components.

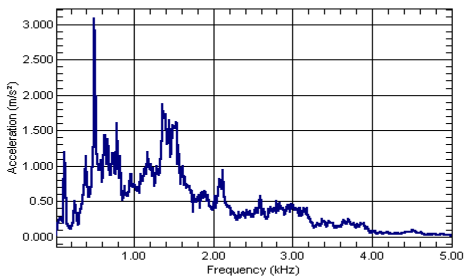
In the following, will be shown an example of the measurements of amplitude - frequency characteristics of the measuring points of the analyzed components. On the basis of extreme values are determined according (A_i, f_i, ω_i) that will be used to determine the circular velocity dependence of the amplitude of oscillation frequency.

Based on the above measurement procedures can be experimentally determined coefficients depending on the level of amplitude and frequency, whose value will be later incorporated into a universal model around determining the optimal frequency of security of the analyzed components, such important parameters in analyzing the security operation.

Based on the obtained experimental data, determine the amplitude and correlation coefficients for each frekevencija integral component of the analyzed components.

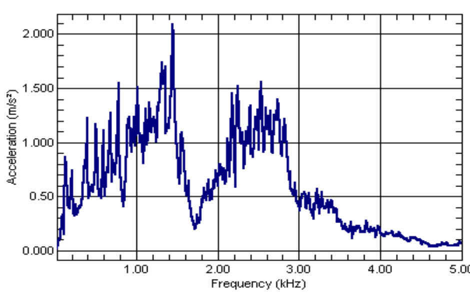
The procedure for collecting the experimental data is shown in the diagrams and to the physical system and a plane for example, the measurements at specific time intervals (the pictures show 5 to 11).

Area: Spinning mill **Unit:** Spinning
Machine: Section 1 **Point:** Measuring point 1



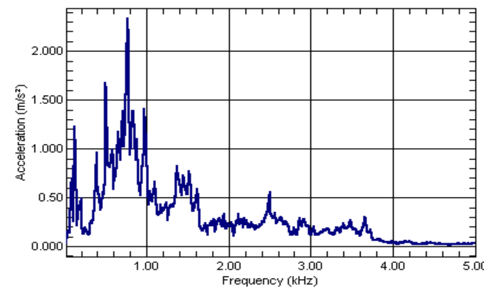
Picture 5. Plane view of oscillation for measuring point 1

Area: Spinning mill **Unit:** Spinning
Machine: Section 1 **Point:** Measuring point 2



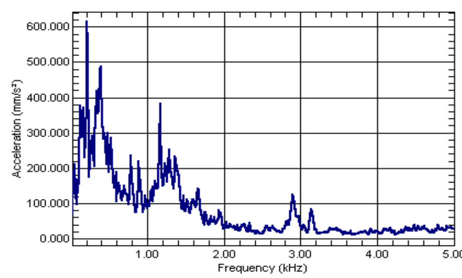
Picture 6. Plane view of oscillation for measuring point 2

Area: Spinning mill **Unit:** Spinning
Machine: Section 1 **Point:** Measuring point 3



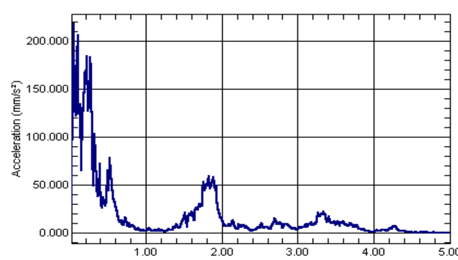
Picture 7. Plane view of oscillation for measuring point 3

Area: Spinning mill **Unit:** Spinning
Machine: Section 1 **Point:** Measuring point 4



Picture 8. Plane view of oscillation for measuring point 4

Area: Spinning mill **Unit:** Spinning
Machine: Section 1 **Point:** Measuring point 5



Picture 9. Plane view of oscillation for measuring point 5

6. DETERMINATION OF THE VALUE OF THE INDICATED oscillation frequency (reference) EXAMPLE OF amplitude - frequency characteristics to Selected Measuring points analyzed CIRCUITS

Determination of dependence (correlation) function of the frequency of oscillation amplitude of the oscillation $f_i = A_i(f_i)$, determined from the recorded spectra of stochastic (random) oscillatory signals. The values of these signals are displayed numerically (iterative) values, obtained by the extreme values (signal peaks) oscillatory stochastic processes. The observed spectra to include a range of soothing and stochastic signals are defined as arithmetic mean of the extreme values of stochastic signals.

Analysis to determine the correlation dependence of oscillation frequency as a function of oscillation amplitude $f_i = A_i(f_i)$, started from their values obtained in a software package for data processing SENTINEL. This software package has been provided all the numerical values of all points of the measured values presented stochastic signals in the selected reference example. The presented example of the measured signal is the reference because it is the same measurement was created after the completion of the overhaul OE - spinning machine (zone II - a safe zone of the analyzed components). Also, it is important because the measurement was conducted on the spinning box no. 1 which is located immediately after the powertrain OE - spinning, so that the most burdened in terms of the impact of mechanical vibrations on his work.

Circular frequency depending on the frequency of oscillation of the analyzed components measuring points $\omega_i = f(f_i)$, can be expressed with the standard form:

$$\omega_i = 2 \cdot \pi \cdot f_i ,$$

where the coefficient in the plane angle $2 \cdot \pi = const.$, and their linear dependence, ie. value of the circular frequency is increased by the product of a constant coefficient $2 \cdot \pi$.

To determine the circular frequency of the selected measuring points $(\omega_1, \omega_2, \omega_3, \omega_4, \omega_5)$ will go to the numerical values depending amlitudno - frequency characteristics. The analysis of the model will take two distinct values, ie. extreme values of circular frequency $(\omega_{i\,\max,}, \omega_{i\,\min.})$ that depending on the extreme values of the oscillation amlituda $(A_{i\,\max.}, A_{i\,\min.})$. Display these characteristic values are found in Table 2.

Table 2. The extreme values (A_i, f_i, ω_i) typical examples of the analyzed

Mark measuring point		1	2	3	4	5
The extreme values of the amplitude of oscillation $A_i\left[\frac{m}{s^2}\right]$	Max.	1,86919	1,86919	1,86919	1,86919	1,86919
	Min.	0,24401	0,24401	0,24401	0,24401	0,24401
The extreme values of the frequency of oscillation $f_i[kHz]$	Max.	1,3625	1,3625	1,3625	1,3625	1,3625
	Min.	2,2875	2,2875	2,2875	2,2875	2,2875
Calculated extreme values of circular frequency of oscillation $\omega_i\left[\frac{rad}{s}\right]$	Max.	8560,84	8560,84	8560,84	8560,84	8560,84
	Min.	14372,78	14372,78	14372,78	14372,78	14372,78

Based on the extreme numerical values depending on the amplitude and circular frequency of oscillation can be determined by the correlation coefficients of the form:

$$\lambda_i(\max,\min) = \frac{A_i(\max.,\min)}{\omega_i(\max.,\min)}\left[\frac{m}{rad\cdot s}\right],$$

we will contact them with circular **velocities in the plane of oscillation amplitude dependence of frequency,**

where: i - the number of reported measurement results of the oscillation $i = 1,2,3,4,5$.

The values of correlation coefficients obtained are presented in tables (Table 3).

Table 3. The values of correlation coefficients

Mark measuring point		**1**	**2**	**3**	**4**	**5**
The correlation coefficients	$\lambda_{\min.}$	$2{,}183\cdot10^{-4}$	$2{,}183\cdot10^{-4}$	$2{,}183\cdot10^{-4}$	$2{,}183\cdot10^{-4}$	$2{,}183\cdot10^{-4}$
	$\lambda_{\max.}$	$1{,}697\cdot10^{-5}$	$1{,}697\cdot10^{-5}$	$1{,}697\cdot10^{-5}$	$1{,}697\cdot10^{-5}$	$1{,}697\cdot10^{-5}$

7. FINAL REMARKS

The procedure for collecting the experimental data is shown in the reference example. On it are the specific values of oscillation frequencies. Based on the obtained experimental values of the mechanical oscillations at selected measuring points of the analyzed components is determined by the correlation coefficient depending on the amplitude of the circular frequency, which is called the circular velocity in the plane depending on the amplitude of the oscillation frequency. Its numerical values are shown in this section. This was necessary because no values of correlation coefficients is not possible to determine the safety of the frequency curve of the analyzed components.

Picture 10. shows the curves of the frequency of security exploitation time of constituent components of the box spinning model for optimal security. The optimal security model includes components with values of allowable risk. On the graphic clearly evident band is absolutely safe and work the clutch system is located on the curve depending on the values shown $M_{\xi}(t)_{BP} = f(t)$. Obtained from the diagram clearly concluded that the risk safety belt assembly operation of spinning boxes at his work of 13 300 (h). Therefore it is necessary to pay particular attention to the exploitation period, ie. over this period provide continual testing in the amplitude of mechanical oscillations at selected measuring points. Also shown in the diagram are indicated periods of time and replace all necessary parts and components assembly to obtain the maximum value of the security operation.

It must be noted that the optimal functioning of the security model of spinning boxes set up in areas of the constituent components of the allowable risk because the risk of illegally entering the risky field of assembly and the right to intervene in the work to replace worn parts and components assembly or repair.

h	$M_{\xi}(t)_{BP}\cdot 10^{10} \Rightarrow \lambda_{max}$	$M_{\xi}(t)_{BP}\cdot 10^{6} \Rightarrow \lambda_{min}$
13000	8.274	5.517
13023	11.37	7.59
13068	7.145	5.69
13080	11.3	7.537
13300	3.184	2.123
13600	11.7	7.803
15000	19.524	13.015
15040	19.836	13.222
15060	20.062	13.491
15080	20.15	13.437
15190	21.053	14.033
15400	22.863	15.243

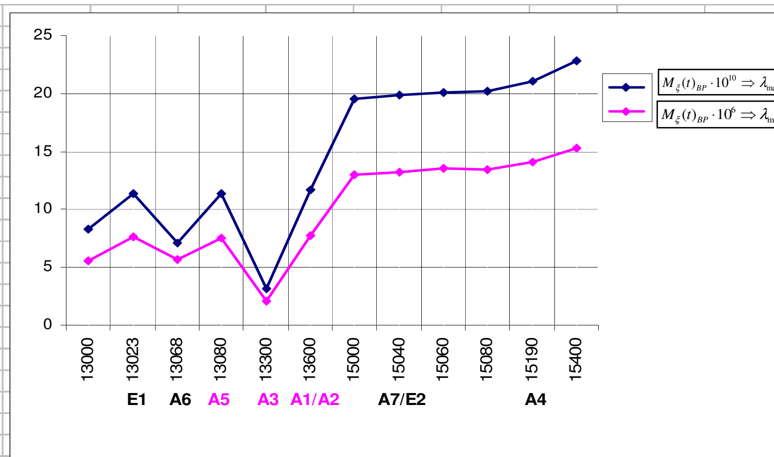


Figure 10. Diagram of the frequency of security depending on the time of exploitation of the constituent components of the assembly of the box spinning on which technologies are not implemented procedures for preventive maintenance - the optimal model

In **Picture 11.** shows the curves of frequency of security depending on the time of exploitation of the constituent components of the box spinning model for optimal security. The optimal security model includes components with values of allowable risk. On the graphic clearly evident band is absolutely safe and work the clutch system is located on the curve depending on the values shown $M_{\xi}(t)_{BP} = f(t)$. Obtained from the diagram clearly concluded that the risk safety belt assembly operation of spinning boxes at his work of 14 250 (h). Therefore it is necessary to pay attention to the exploitation period, ie. over this period provide continual testing in the amplitude of mechanical oscillations at selected measuring points. Also shown in the diagram are indicated the time periods required to replace all the constituent components of the box spinning in order to obtain the greatest value of their security operation.

It must be noted that the optimal functioning of the security model of spinning boxes set up in areas of the constituent components of the allowable risk because the risk of illegally entering the risky field of assembly and the right to intervene in the work to replace worn parts and components assembly or repair.

h	$M_{\xi}(t)_{BP}\cdot 10^{12} \Rightarrow \lambda_{max.}$	$M_{\xi}(t)_{BP}\cdot 10^{8} \Rightarrow \lambda_{min.}$
13983	4.89	5.05
14001	4.9	4.95
14100	4.69	4.842
14128	4.7466	4.9
14151	5.938	6.124
14200	5.048	5.211
14250	4.0571	4.153
14251	9.818	10.138
14300	15.09	15.57
14301	6.399	6.6
14450	6.81	7.023
14600	8.7	8.97
14962	13.442	13.86
15000	7.519	7.837
15630	9.624	10.031
15730	13.777	14.36
15805	19.224	20.037
15905	10.673	11.15
15995	11.04	11.53
16000	11.06	11.55
16150	14.983	15.648
16300	20.658	21.577
17000	15.295	14.97

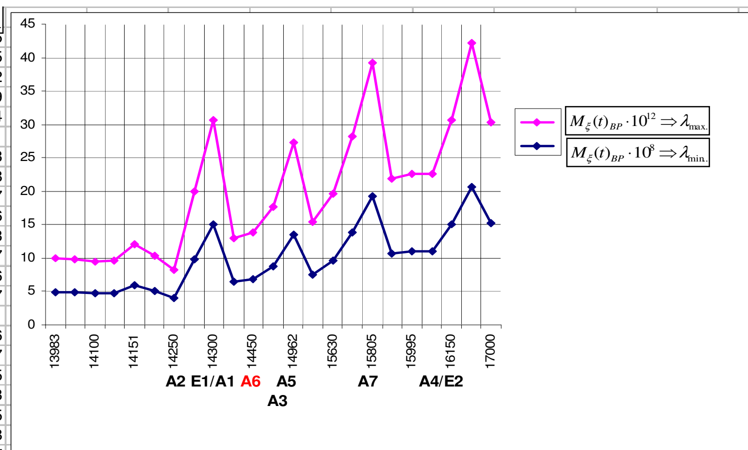


Figure 11. Diagram of the frequency of security depending on the time of exploitation of the constituent components of the assembly spinning box where the technology implemented procedures for preventive maintenance - the optimal model

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