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Experimental Research of the Noise Spectrums of a Gear Pump with Helical Toothing

The objective of the work is the experimental testing of the noise level by the lines of spectrum of the experimental gear pump with helical toothing and the comparison with the noise level of a serial pump.

The article presents the results of tests of noise characteristics of the experimental gear pump with helical toothing. The levels of noise, noise spectrums of the experimental gear pump with helical toothing and a serial pump of the analogical size with straight toothing were investigated using different operating modes. The comparative analysis of noise characteristics of the pumps under different load was carried out in order to estimate the efficiency of using helical toothing in gear pumps from the point of view of noise reduction.

Experiments of the noise level of a gear pump with helical toothing showed that with the increase of pressure of hydraulic fluid the level of noise slowly increases from 1,5 to 6 dB depending on speed mode. The highest noise level of a pump with helical toothing (91,5 dB дБА) is noticed under the pressure of 16,0 MPa and rotation frequency n=2400 revolutions per minute.

The comparative analysis of the experimental pump and a serial pump enables to state that the noise level of the experimental pump is lower in all operating modes compared to the serial pump.

During tests it was marked that the noise level of the stand which is a barrier is quite high and under some operating modes it is close to the noise level of the experimental pump on the stand.
toothing, gear pump, noise

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Selection of a processing medium for the finishing antifriction nonabrasive treatment

The article includes the systematized information on processing mediums used for FANT. The role of processing medium components for producing antifriction coatings with the complex of tribotechnical properties has been shown. On the basis of well-known compositions, conditions for coating formation as well as the functional and technological requirements for FANT processing mediums, the procedure has been proposed for developing and choosing the composition of processing medium for laying the coatings by applying FANT method.
finishing antifriction nonabrasive treatment, processing medium, composition, coating

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Выбор состава технологической среды для ФАБО

В статье систематизированы имеющиеся сведения о технологических средах, используемых при ФАБО. Показана роль компонентов технологических сред для получения антифрикционных покрытий с комплексом триботехнических свойств. На основе анализа известных составов, условий формирования покрытий, а также функциональных и технологических требований, предъявляемых к технологическим средам для ФАБО, предложен порядок разработки и выбора состава технологической среды для нанесения покрытий методом ФАБО.

финишная антифрикционная безабразивная обработка, технологическая среда, состав, покрытие

Problem description. One of the methods for laying the copper-bearing antifriction coatings on friction surfaces of workpieces is the finishing antifriction nonabrasive **treatment** (FANT) carried out by laying the friction coating of plastic metals. The condition required for carrying out FANT successfully is the introduction of special technological liquid into the contact area -processing medium that moistens the surface being machined, loosens the oxide layer, plasticizes the surface and creates the conditions for fastening the metals together. The processing medium mainly defines the quality of surface obtained and the efficiency of FANT process. However, the widespread use of FANT is slowed down because of lack of efficient processing mediums for the friction coating. The improvement of FANT methods and development of new technological devices for performance of the said methods will become possible only in case of systematizing the approaches to the creation of processing mediums [1].

Today there is no theory for creating the processing mediums, and the majority of their compositions is worked out on the basis of component selection as a result of tests. Despite the availability of various processing mediums for FANM, there is no single composition that would enable the machining of a wide spectrum of metals. It is apparently connected with the complex technical, physical and chemical requirements for the processing medium compositions.

In this connection, there has risen the necessity in systematizing the available information on processing mediums as well as recommendations for choosing their composition. It will allow choosing the most effective components from the whole variety of compositions and, therefore, obtain the high quality coatings and increase FANT efficiency.

Objective of the task. The objective of this task is the development of algorithm for choosing the composition components for FANT processing mediums.

Results of research. The structural and technological peculiarities of the workpiece being machined, as a rule, define the method of FANT performance [2] as well as the selection of a processing medium composition (Table 1).

Taking into account that while carrying out FANT through frictional and mechanical method, the coatings are laid without significant changes in composition and structure of the laid coating (the material of a tool is transferred to the steel or iron surface of a workpiece), the role of processing mediums is in cleaning the workpiece surface from oxides.

While using the frictional and chemical method, the structure of coating mainly depends on processing medium compositions such as metal plaque processing mediums (MPM), including the film-forming material as one of the components (copper salts are recommended), and also the components ensuring the removal of oxides (acids, glycerine, etc) from the workpiece surface, the transfer and adhesion of ions of film-forming material while mechanical activation of the tool surface. Physical, mechanical and antifriction properties of these coatings are defined by the ingridients included into the composition of MPM.

Table 1 — Peculiarities of methods for FANT coating

Method of FANT coating	**Main area of application**	**Method of coating**	**Mechanism of coating formation**	**Requirements for processing medium composition**
Frictional and mechanical	The revolution surfaces of simple forms such as cylinders, tores (cylindrical rings), bodies (cases), etc.	Machining the rotating workpieces by a rotating tool in the processing medium	Laying the coating by using the friction of a metal tool against the workpiece in the processing medium	The ability to get softened and dissolve the oxide films, and not to interact with deposited metal; not to change its composition while machining, and very good wettability
Frictional and chemical	Not large parts of irregular shapes such as balls, bearing assemblies, etc. Polysurfaces of large parts such as sliding guides, sheet materials, etc.	Placing in the processing medium; treatment with a brush, etc.	Laying the coating by using the friction of a non-metal tool against the workpiece in the processing medium	The availability of polar groups in molecules affecting the surface activity of compositions
Chemical	The revolution surfaces of simple and irregular shapes	The treatment of rotating parts (workpieces) with a felted cloth, rubber in the processing medium	Self-formation (without external power) of metal coating on the surface of a workpiece and placed into the processing medium	The content of ions of metal coated

The experience of carrying out FANT in MPM, containing inorganic copper compounds and superficially active substances, allow obtaining the antifriction coatings of copper, stannic, bismuth and other materials with the controlled thickness 1...25 microns [3]. As MPM, the authors of works [4, 5 and others] use the metal plaque additives.

The processing medium composition is worked out on the basis of component selection according to the results of tests which are performed in two stages [6]:

- technological tests for the selection of component composition;
- tear and wear tests for defining the technical efficiency of processing mediums.

It should be noted that the majority of processing mediums used for FANT includes glycerine which is applied as a model processing medium and which performs the function of selective transfer while pair bronze-steel friction much easier than others.

However, the use of pure glycerine as the processing medium has the following shortcomings such as:

- low efficiency of the process as a result of necessary significant efforts for pressing against the rubbing tool [1];
- low quality of coating laid [7];
- the composition of material transferred from the rubbing tool does not differ from the reference one;
- insufficient extreme pressure and antiwear properties.

So, as a result of experimental researches, for increasing the coating quality the various components are additionally put into the processing medium composition.

Thus, depending on FANT method and the device for its performance, the authors of work [8J have recommended the processing medium compositions to be used for laying the copper-bearing coatings.

The quantitative content of glycerine ensures the optimal viscosity and required concentration of superficially active substances as a result of tribodestruction of glycerine while friction.

In case the content of metal salts is lower than 1,5%, the formation of thickness uniform coating can'b be ensured, while the extreme pressure and antiwear properties of the machined workpiece are getting lower. In case the content of metal salts is over 1,5%, the intensive corrosion of the machined surface and coating can be observed.

The hydrochloric acid ensures the rapid destruction of oxide films on the surface being machined.

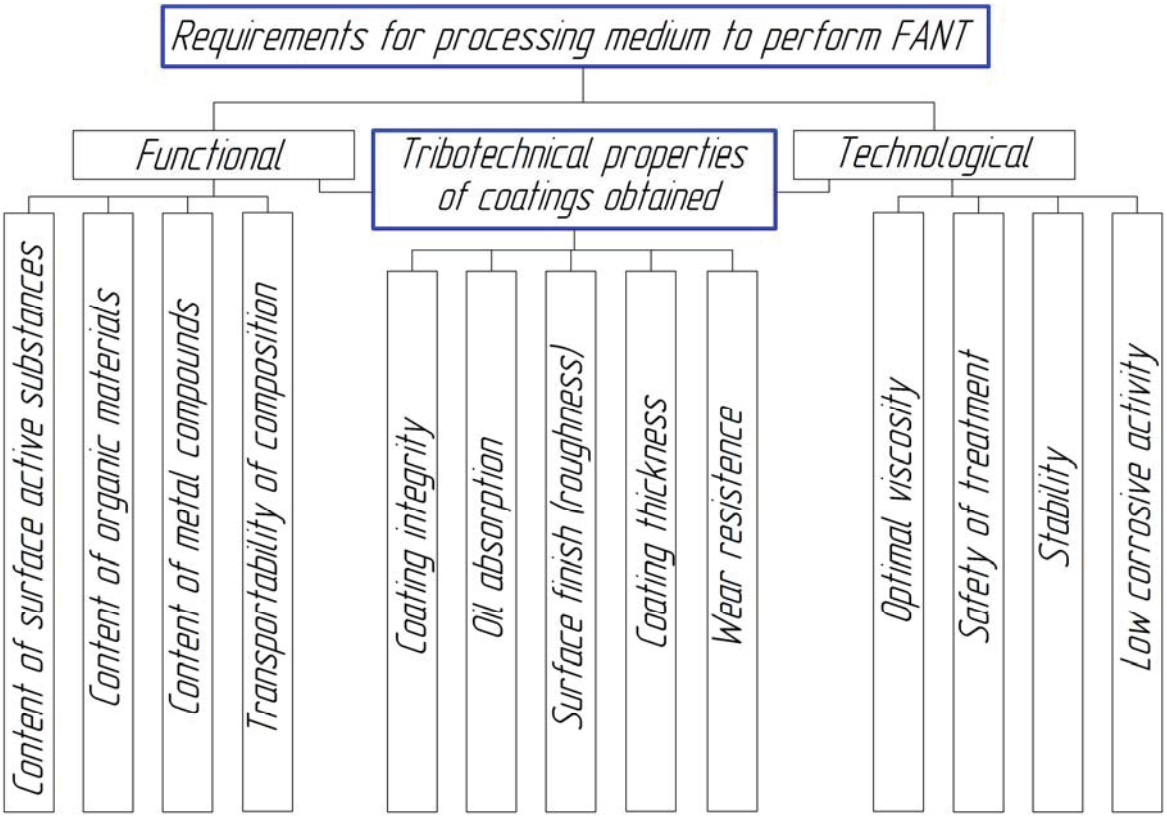
The water produces the cooling effect and has a very good dissolving power in relation to the other components of composition, and allows controlling the composition viscosity.

Introducing the other components into the processing medium composition for FANT is intended for increasing the efficiency (Trilon B) [9], coating thickness (oleinic acid, isopropyl alcohol) [10], quality of machining the alloy steel (ortho-phosphoric acid) [7], for removing the oxide films from the surface being treated (oxide of silicon) [11], and other properties.

The processing medium composition for FANT, as a rule, is laid with the brush or sponge on previously cleaned and defatted surface of the workpiece fixed in the chuck. The high viscosity of the composition requires the development of special devices for its feeding to the surface being machined as a result of high viscosity. Therefore, the processing medium composition for FANT should be performed as water solution that does not include active deoxidants. It will allow feeding it to the working zone through the standard cooling system of the machine tool (lathe).

The work [1] covers the main functional and technological requirements imposed on the processing medium regardless of the method of FANT and aimed at obtaining the complex of tribotechnical properties received as a result of its use (fig. 1).

The main criterion of processing medium quality is the complex of tribotechnical properties of coatings that should be assessed according to the following indices: coating integrity, oil absorption, surface finish (roughness), thickness of coating, wear resistence.



Figures 1 — Requirements for the processing mediums to carry out FANT

The final stage of processing medium development is carrying out the tests to define the technical efficiency of FANT technology with the processing medium proposed.

Conclusion. The analysis of compositions and requirements imposed on the processing mediums for FANT, and also the conditions for antifriction coating formation, has allowed considering the issue of creation and selection of the processing mediums consistently. The following procedure (algorithm) is proposed for working out (selection) of the processing medium composition for FANT:

1. The analysis of design and technological features of the workpiece (material, solidness, surface finish, working conditions).
2. Selection of FANT method (frictional and mechanical; frictional and chemical; chemical).
3. Development of FANT technology (selection of tool design and materials, coating, and method for inputting the processing medium).
4. The selection of component composition on the basis of functional and technological criteria alongside with obtaining the complex of tribotechnical properties (see Fig.l)
5. Approval of processing medium.

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Вибір складу технологічного середовища для ФАБО

Метою даної роботи є розробка алгоритму вибору компонентів складу технологічного середовища для ФАБО. Це дозволить із усього різноманіття вибрати найбільш ефективний склад технологічного середовища, тим самим одержати якісні покриття й підвищити продуктивність ФАБО.

Для цього в статті систематизовані відомості про технологічні середовища, що використовуються при ФАБО. Показана роль компонентів технологічних середовищ для одержання антифрикційних покриттів із комплексом триботехнічних властивостей. Проаналізовані основні функціональні й технологічні вимоги до технологічних середовищ, що застосовуються при ФАБО, спрямовані на досягнення комплексу триботехнічних властивостей.

На основі аналізу відомих складів, умов формування покриттів, а також функціональних і технологічних вимог, що висувають до технологічних середовищ, запропонований порядок розробки й вибору складу технологічного середовища для нанесення покриттів методом ФАБО.

фінішна антифрикційна безабразивна обробка, технологічне середовище, склад, покриття

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