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ENSURING RELIABILITY OF TECHNOLOGICAL PROCESSES IN HEAVY ENGINEERING

The issue of reliability of the technology for part machining in heavy engineering is becoming increasingly relevantr. While implementing designed technological processes on unique universal machines, machinists systematically monitor the process of ensuring the accuracy and quality of the machined surfaces of parts. When dimensional wear of tools, thermal, elastic deformations, or vibrations of the “machine – device – tool – part” (MDTP) system disrupt the normal course of technological operations, dimensional adjustment of the tool, its change, etc., occur.

When applying multi-purpose CNC machines, which are widely used at small equipment repair enterprises, the issue of ensuring reliability of technological operations is of particular importance. Not only possible manifestations of accelerated dimensional wear of cutting tools, chipping of cutting edges, and occurrence of vibrations in the MDTP system should be taken into account, but also conditions for reliable operations should be predicted when designing technological processes, especially when machining difficult-to-machine materials used in mining and metallurgical equipment.

Reliability of machines is carefully analyzed at enterprises, both during product operation (when analyzing statistics), at the stage of designing parts and mechanisms in the course of their modernization (when predicting their reliability), as well as while designing technological processes (equipment and tooling selection, optimal processing type selection, CAD/CAM-based programming, accuracy and quality ensuring, etc.).

The design of technological processes as an engineering method and the problem of accuracy and productivity of repairing as its theoretical basis go through the stages from the analysis of the latest national and foreign research concerning the evaluation of technological operations accuracy based on the study of statistical analysis data to the development of theories and methodology for optimizing machining processes.

Currently, predominance of repair technologies for machines and mechanisms in the mining and metallurgical industry causes a problem of collecting statistical data on the impact of the machining technology during surface restoration on the subsequent operational reliability of the machine. The Ukrainian state standards for equipment reliability include the basic provisions of the failure model, as well as the assessment and prediction of reliability based on the results of operation under conditions of insufficient failure statistics. However, the State Standard on predicting the reliability of technological operations at the design stage is still expected.

The analysis of factors ensuring reliability of technological preparation of production and the development of a methodology for parametric optimization of the technological process underlie the joint scientists and practitioners’ research in this field. This technological process is supported by its own technological system, which includes equipment, machine tooling, cutting tools, control means, and dedicated software. The task of optimizing the technological process, taking into account its reliability, is defined as the development of the process structure and parameters that will minimize the variable part of an enterprise’s reduced costs which depends on the technological process option.. Taking into account constraints on the quality of the part, equipment productivity, technological capabilities of the main production assets, and the costs of current assets, a mathematical model is developed that imputes the cutting modes, the period of cutting tool stability, the inter-operation allowance for the dimensional adjustments of the MDTP system to the controlling technological parameters. In addition, the model determines numerical values of technological parameters at which the target function – the variable part of the reduced costs – takes on the minimum value.

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ROUGHNESS PARAMETERS OF COMPOSITE ANTIFRICTION PARTS OF HIGH-SPEED PRINTING EQUIPMENT

The development of the printing industry requires the creation of such machines, which must provide high requirements for the parameters of their reliability and, above all, for high wear resistance, durability and maintainability.

The speeds of the working bodies are constantly increasing when the parts' rotational speeds of the friction pairs reach the level of 800−1000 rpm and above, and the load increases to 5.0 − 7.0 MPa. This leads to the appearance of friction temperatures from 300 to 500°C on the working surfaces, which creates extreme conditions for the printing machines operation [1, 2].

Such conditions require special approaches to ensure the reliability of printing equipment and increase its maintainability.

The parameters of antifriction parts' wear resistance for high-speed printing machines such as KBA Rapida−105, "Plamag Rondest RO 170", "Star Binder 1509", etc., are determined not only by the functional capabilities of the materials from which these parts are made, but also by the quality parameters of their surfaces. Such parameters are formed as a result of fine grinding processes.

Surface roughness depends on the type and properties of the material, method and processing modes. Requirements for friction parts' surfaces high quality are constantly increasing. These are due to the continuous increase in important operating parameters of printing equipment and, above all, lengthen of parts service life, mechanisms and machines in general.

Recently, new bearing composite materials have been synthesized based on grinding waste of alloyed tool steels 4H2V5MF, 5H3V3MFS, etc. with CaF_2 solid lubricant additives for a significant increase in the service life of friction units of rotary printing machines [1, 2].

Such composites' matrix are metal grinding wastes of machine-building and tool-making industries, which are taken to the dump because of their abrasive contamination and are not used in the repeated cycle of production.

After proper processing, these wastes can be used in the further production cycle in particular for the production of effective slide bearings, as initiated by the authors [1–3].

The authors [1−3] developed a technology for the synthesis of new composite bearings from recycled raw materials, which also included a comprehensive technology for this waste regeneration.

Studies have demonstrated the developed composite bearings based on steel grinding waste can be successfully operated at speeds up to 1000 rpm and specific pressures up to 5 MPa in the friction units of high-speed printing equipment [1, 2].

Whereas the friction processes analysis has shown the friction surfaces wear rate is determined by the working surfaces' initial quality parameters, such as, for example, the roughness parameter Ra.

However, the technological processes of finishing such new composite parts for printing machines are currently insufficiently studied.