

About the need of carrying out researches of wear resistance of groups of mating parts for ensuring anticipatory scheduling of repair influences

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Abstract. The article shows the role of scientifically substantiated system of planning as the function of management of technical maintenance and repair of the equipment on the basis of the analysis of the factors influencing durability of operation of processing equipment of the industrial enterprises. It is shown that the use of system of fixed-schedule maintenance allows: to prepare the controllable and predictable over a long time period repair program according to the types of repair, the types of equipment, the workshops and the whole enterprise; to predict material, financial and labor resources, necessary capital investments in development of production base of repair service; to carry out preliminary preparation of repair work, to carry out them in the minimum terms; it increases the quality of repair and, finally, increases the reliability of the equipment.

1 Introduction

The effectiveness and reliability of functioning of processing equipment of the industrial enterprises depends on its technical condition. The modern inventory has rather high settlement rates of reliability. However, in use under the influence of various factors, conditions and duties the reference state of an inventory continuously worsens, operational reliability decreases and the danger of emergence of refusals increases. Reliability of functioning of an inventory depends not only on quality of manufacture, but also on evidence-based operation, the correct maintenance and timely repair. Scheduling is the main function of management of maintenance and repair of an inventory at the industrial enterprise and the final stage of decision-making process which is the choice of this or that optional versions of development. Content of process of scheduling of repair work and

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services at the enterprise consists in development, justification, ensuring realization and organization of check of implementation of the scheduled plan of maintenance and repair of processing equipment. At the same time the plan fixes the definite chosen purposes, it contains obligatory tasks for realization with the indication of volumes, terms and stages of their execution and also forms of control of execution keeping. Eventually, scheduling on maintenance and repair of an inventory at industrial enterprises as Vlasov B.V. and Semyonov V.M. noted "it is necessary to consider as scientific anticipation of concrete paths on the fullest ensuring trouble-free and reliable operation of the processing equipment operated at the enterprise" [3].

Identification and use of reserves at maintenance and repair of an inventory at the industrial enterprises, increase in its profitability are substantially caused by perfecting of the system of scheduling making a basis of an economic mechanism and being primary and most difficult link in a control system of maintenance and repair of an inventory of the industrial enterprise. The significance of a system of scheduling as functions of management of maintenance and repair of an inventory of the industrial enterprise is proved by the fact that labor input of departments of chief mechanical engineers of machine-building enterprises, the bound to scheduling of repair work and services, make up to 60% [11, p. 7], and at the enterprise in many respects depends on functioning of the economic mechanism of service of maintenance and repair of an inventory technical condition and operability of an inventory.

2 Investigation

Now according to the requirements of the specifications and technical documentation at many enterprises the Uniform System of Turnaround (UST) [4] or the branch systems of maintenance and repair (BSMR) [8] are applied to maintaining of technical condition of an inventory as a set of the organizational and technical actions for leaving, supervision, an upkeep and repair of an inventory held preventively on in advance made plan (schedule) for the purpose of prevention of the progressing wear, prevention of accidents and maintaining of an inventory in constant operational readiness [10].

As the main technical and economic criterion of systems there is the minimum of equipment downtimes on the basis of a rigid regulation of repair cycles. According to this criterion frequency and amount of works are determined by maintenance and repair by common standards, pre-established for all types of an inventory. Such approach prevents the progressing wear of an inventory and reduces suddenness of an exit it out of operation. The UST systems and BSMR give the chance to prepare the repair program operated and predicted for the long period: by types of repairs, inventory types, shops and the enterprise in general. Constancy of repair cycles allows predicting the material, financial and human resources, necessary capital investments in development of production base of repair service. It simplifies scheduling of preventive actions, allows carrying out a pre-treatment of repair work, to carry out them in minimum terms, increases quality of repair and finally increases reliability of operation of the equipment.

However the existing systems were in a conflict with market mechanisms of production economic activity of the industrial enterprises and in new economic conditions don't provide, in many cases, acceptance of optimal solutions. It is explained by the following reasons and circumstances:

- first, the technique of scheduling of repair work and services is imperfect: as the content of process of scheduling of repair work and services at the enterprise consists in development, justification, ensuring realization and the organization of check of implementation of the scheduled plan of maintenance and repair of processing equipment, the plan fixes the definite chosen purposes, it contains obligatory, by each type of repair

influence on processing equipment, tasks with the indication of volumes, terms and stages of their execution and also forms of control of execution keeping. The schedule of maintenance and repair of processing equipment centralized on the enterprise in general and in details painted in each division of repair service follow-up is optimized and turns into even more detailed schedule of work of the mechanical-repair shop and shop repair bases. Under it all are built external and intercommunications (providing with materials, components, production readjustment, providing with the tool etc). The system of plans takes the finished form, becomes "reference", that is traditional scheduling of repair and maintenance of processing equipment is carried out by the principle of the pushing system;

-secondly, the planned volumes on structure and labor input are established on the basis of the visual forecast of technical condition of objects of repair and schedules of a system of maintenance and repair. The real volumes of repair work are specified in process of realization of repair and maintenance of an inventory and, as a rule, in the course of the general dismantling of objects of repair. Besides, in practice of scheduling the actual loading of an inventory isn't considered that leads to unreasonable increase in the material and human resources at realization of repair work and services;

- thirdly, scheduled plans of scheduled maintenance don't install a conclusion priority in repair of different types the equipment;

- fourthly, as purpose of scheduled maintenance is carried out according to regulations, often according to outdated standards, developed in the period of a command management system and, naturally, not considering a number of restrictions (technological, material, temporary, labor), their types don't depend on actual state of an inventory by the time of the beginning of the repair or maintenance caused by the actual operating time of an inventory at various high-speed modes.

The large volume of works on expeditious redistribution of resources and no uniformity of loading of repair crews is a consequence of such situation. As well as in any complete system, ways of self-defense from destruction are at the same time developed that does a system very conservative, morbidly reacting to any change. Experience shows that balance of reorganization of scheduling requires 10-15 days. Any change of the program of release demands huge work on reorganization of the balanced schedules of manufacture of separate spare details and clusters. In these conditions work of planned personnel of department of the chief mechanical engineer reminds "labour of Sisyphus". At first they develop and join all scheduled plans of maintenance and repair of processing equipment and will organize its realization, and then right there will disorganize it, changing these scheduled plans because of emergence of sudden equipment failures, transition to new sales markets at threat of loss of the large buyers demanding accounting of differences in parameters of products and the quality standards and, respectively, rapid change of production and "change-over" of fixed assets which coefficient of wear, for example, in metallurgical production and production of finished metal products exceeds 40% [11] that significantly complicates a problem of scheduling and leads to increase of a role of repair activity at the enterprise.

The practice shows that successful exercise of trial functions of scheduling on maintenance and repair of an inventory at the enterprises is bound to a number of the objective difficulties caused by specifics of production of repair work and services. One of these difficulties, according to us, is shown in the considerable imperfection of the existing information base of production of repair work and services at the enterprise: in due time JSC "Experimental scientific research institute of machine tools" [4] and industry laboratories [8] made enormous work on definition and establishment of frequency of repair cycles, overhaul lives and categories of maintenance during the operation of the equipment on the complete change in various types of production for a metal-cutting inventory (the universal equipment, automatic transfer lines, CNC machines processing the centers, robots), a forge and press, foundry, rolling inventory, automatic rotor transfer lines,

automatic rotor and conveyor transfer lines, lines of a chemical treatment, a hoisting-and-transport inventory, elevators and elevators of periodic action, the equipment for manufacture of optical details, a woodworking inventory was carried out. The volume of the carried-out research work impresses! However, according to us, the established frequency of repair cycles, overhaul lives and categories of maintenance during the operation of the equipment on the complete change for various types of production are after all the "average temperature on hospital" which isn't considering rather large number of factors that will affect durability of operation of processing equipment: operating conditions of an inventory; repair features of an inventory; quality of the performed repair work and maintenance; number of the clocks fulfilled by each item of equipment; skill level of repairmen and others.

Experience of machine-building enterprises demonstrates that in repair services where rather practiced engineers work, techniques and mechanics, when developing annual schedules of scheduled repair of an inventory are brought, the prompted by practice, corresponding amendments in repair cycles and overhaul lives. As a result at such machine-building enterprises the effectiveness of application of "The uniform system of the Party of Pensioners of Russia" and "The branch system of maintenance and repair of processing and hoisting-and-transport equipment" considerably increases. From here need of constant perfecting of the existing information base of production of repair work and services at the enterprise as it is initial base for definition of need for an inventory, renewals and materials, when calculating number of workers-repairmen, their wages fund, costs of maintenance and repair of an inventory etc, that is practically for calculation of all planned and estimated targets of work of service of maintenance and repair of an inventory and its divisions follows.

Use of digital technologies by the enterprises of traditional way using the modern technologies as the infrastructure [2] opens possibilities of elimination of imperfection of the existing information base of scheduling and production of repair work and services at the enterprise. But for this purpose it is necessary to conduct researches of wear resistance of groups of the interfaced details (a shaft plug, the screw nut, the rubbing planes) on types of processing equipment, on geometrical forms, design and running characteristics on the interfaced details (the sizes, accuracy of processing, a type of material, etc.) depending on features of operation (the actual time of operation, high-speed characteristics of operation) that it was possible to expect the gradual (wear) refusals resulting from gradual course of this or that process of the damage which is progressively worsening exit pupils of an object and in advance to provide and plan preventive and repair influences.

The task is very daunting, but the problem of carrying out researches has important economic value and will allow the enterprises to adapt successfully to the changing external and internal conditions and to provide increase in innovative activity.

For this purpose at first it is necessary to carry out grouping of the interfaced details (a shaft and a plug, a screw and a nut, the rubbing surfaces) on types of processing equipment, by sizes, accuracy of processing, by types of materials and to conduct researches of their wear resistance at various high-speed modes. After that it is necessary to carry out grouping of the interfaced details on frequency of maintenance and repair that is one of the conditions allowing to increase significantly validity of the made management decisions and effectiveness of implementation of scheduled plans of maintenance and repair of processing equipment. And in conclusion it is necessary to develop tools of model operation of processes of distribution of repair work and resources on the basis of the semantic and case analysis. That is, in general, creation of a system of strategic and operational planning of maintenance and repair of processing equipment at the enterprise [5] on the basis of digital technologies, capable to process and analyze data of total actual time of operation is necessary, at various high-speed modes and beforehand to be prepared

for carrying out repair influences "on the basis of the exact forecasts provided with new information technologies" [7].

As a result formation of tasks for performance of work on maintenance and repair of processing equipment, will differ in finding solutions on the basis of the semantic analysis of geometrical forms, design and running characteristics on the interfaced details and features of operation and will allow to realize anticipatory scheduling and exercise of repair influences for the purpose of prevention of contingency situations.

3 Conclusion

The implemented programs of modernization of the Russian economy as it is noted by many authors [1, 2, 6, 9, 12], are directed to inducing of innovative activity in hi-tech sectors of the enterprises, but at the same time processes of maintenance and repair of processing equipment in the enterprises remain unaddressed.

In our opinion, at realization of "the digital enterprise" turning on in its structure and activities for maintenance and repair of processing equipment in the enterprise as only at the comprehensive approach covering all types of activity at the enterprise on the basis of broad use of digital technologies receiving a synergism is possible and necessary.

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