

# **IMPROVING THE EFFICIENCY OF REPAIR-TECHNICAL SERVICE OF PRODUCTION BY USING THE CONCEPT OF TOTAL PRODUCTIVE MAINTENANCE**

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At present, the efficiency of the production system as a whole depends to a large extent on how well the repair and maintenance management system is organized. The emergence of equipment downtime due to repair and malfunction disrupts the production process, worsens all the economic and financial performance of its activities, and a decrease in the accuracy of the equipment adversely affects the quality of the products.

Since the second half of the twentieth century, the development of repair organization in the USSR and abroad has gone in many different ways. In the USSR, a system of preventive maintenance was developed. This system is a set of planned organizational and technical measures for the care, supervision, maintenance and repair of equipment. Among its main features can be identified planned nature and preventive (preventive) focus. Planned nature requires early identification of the composition, volume and frequency of

maintenance and repair work. Also, this system provides for carrying out medium and small repairs on a special schedule; overhaul maintenance, consisting of daily care and supervision of equipment, in the implementation of adjustments and minor repairs without stopping the production process; periodic inspections, flushing, testing for accuracy, which are carried out according to the plan after a certain number of hours of operation of the equipment. The system of preventive repair has significant drawbacks, among which one can note: inaccuracy of the standards for repair, overhaul cycles and significant deviations in the actual data of the equipment operation from planned, lack of consideration of the actual conditions (technological modes) of equipment operation, lack of accounting for the quality of materials and spare parts, reliable data on the technical condition of the equipment. But, despite this, in the Republic of Belarus, as well as in Russia and other CIS countries, this system has been used for many decades [1].

One of the main problems of domestic production is the use of obsolete and physically worn out equipment. It is in many cases that it is the cause of injuries and accidents. Such equipment requires large costs for its maintenance and repair, which leads to low productivity of enterprises and a high cost of their products. In addition, the quality of goods due to this is much lower than the quality of the goods of their foreign competitors possessing more sophisticated equipment.

This problem cannot be solved simply by replacing the old equipment with a new one. This confirms the fact that its depth is still not fully understood. Not every replacement of equipment will allow an enterprise to achieve its goals, in particular, to ensure the competitiveness of products. There are three ways to get new equipment: buy it from domestic manufacturers, buy abroad or make by yourself. For domestic enterprises at this stage, the latter option is irrelevant, although in the world it is practiced.

But, perhaps, one of the most important questions is how to replace the replaced equipment, start, maintain and operate. Modern equipment, which, as a rule, is always highly technological, requires not only an appropriate level of knowledge of personnel who are in touch with this equipment in one way or another, but also a new system of relations between these employees. Building a system of relations is a very difficult task that requires a long time. The solution of this problem can be substantially facilitated and accelerated due to the use of world experience in effective equipment management. To date, the most complete expression of this experience found in the model, denoted by the abbreviation TPM (Total Productive Maintenance).

At the turn of the 1940s and 1950s, an American system for the prevention of equipment was used in Japan, which presupposes a clear division of labor between the operators using the equipment and the specialists who carry out its maintenance. At the same time, Japan began to develop its own concept of quality assurance, according to which the rate should not be made on quality control from the outside, but on the creation of high quality directly in the process of work. One of the natural stages in the implementation of this approach was the emergence of quality circles, which did not ignore such an important factor of quality assurance as equipment [2].

The Japanese specialists studied the work of Ford's automobile companies in the US, and then, based on this experience, and their own developments, they created a production system called TPS (Toyota Production System). The above-mentioned general maintenance system for TRM equipment is one of the components of this production system. The TRM system was developed in Japan at the turn of the 1960s and 1970s at Nippon Denso, the supplier of electrical equipment for Toyota, as a technique for increasing the efficiency of equipment and its service life. This system includes a set of methods designed to ensure that

each machine is constantly in a working state, and production is never interrupted. In 1989, the expanded content of the TRM system was given [1].

The purpose of TRM is to create an enterprise that constantly strives to increase the efficiency of the production system. To achieve this, a mechanism is used that covers all workplaces, and involves the prevention of all types of losses («zero accidents», «zero breakdowns», «zero marriages») throughout the life cycle of the production system. In this system, all departments are involved: design, commercial, managerial, but, above all, production. In addition, all the personnel participate in the achievement of the goal – from the top manager to the employee of the «first line» [2].

TPM includes eight principles, among which are the following:

- 1) continuous improvement: practice-oriented prevention of production losses;
- 2) autonomous maintenance: the equipment operator must independently inspect, clean, lubricate, and minor maintenance work;
- 3) maintenance planning: ensuring 100 % availability of equipment, as well as carrying out kaizen activities in the field of maintenance;
- 4) training and education: staff should be trained in accordance with the requirements for improving skills for operation and maintenance of equipment;
- 5) launch control: realize a vertical curve of launching new products and equipment;
- 6) quality management: implementation of the goal of «zero defects in quality» in products and equipment;
- 7) TPM in the administrative zones: elimination of losses in indirect production units;
- 8) labor safety: transformation of accidents at the enterprise to zero [3].

The TRM system refers to the equipment maintenance systems according to its real state. Its essential difference from the system of preventive maintenance is that in the latter for determining the object, terms and amounts of maintenance work is the operating time of the equipment, in TRM, the determination of the terms and amounts of work is based on the actual condition of the equipment (with the exception of maintenance work).

After the TRM system gained fame outside of Japan, the world's leading corporations of various fields took up its implementation. Among them are the largest automakers such as General Motors, Ford, BMW, Renault, as well as Eastman Kodak, Procter & Gamble, Pirelli and DuPont [1].

Qualitative improvement of the state of the enterprise is achieved when using TPM due to the coordinated change of two factors. The first is the professional development of the individual: the employees of the enterprise should be able to independently perform daily maintenance, maintain the operability of high-tech equipment, design equipment that does not require maintenance and repair. The second one is the improvement of equipment: increasing the efficiency of using existing equipment due to its continuous improvement and designing new equipment taking into account the full life cycle, with the subsequent conclusion of it in the shortest possible time at full design capacity.

In the TRM concept, two types of breakdowns are considered to be the main obstacle to the use of equipment: stopping equipment and leading to a deviation from the normal course of work and, as a consequence, entailing marriage or other losses.

«Zero breakdowns» are achieved in the TPM through the phased, systematic and continuous implementation of five groups of activities:

- creation of basic conditions for the normal operation of equipment;
- observance of operating conditions of equipment;
- restoration of natural wear and tear;
- elimination of constructive (project-related) shortcomings of equipment;
- increase the skill of operators, repair and maintenance specialists, design engineers.

Having studied the advantages of this system, it is worth noting that it is very effective, as it implies avoidance of marriage, accidents and breakdowns absolutely at any stage of the life cycle of the equipment, which helps to keep it operational.

In Belarus, Russia and other CIS countries enterprises continue to use the outdated system of planned preventive maintenance practically unchanged, which leads to significant losses of time, productivity, money and causes considerable damage to their competitiveness. The use of the TRM system would make it possible to achieve the greatest efficiency in the field of maintenance and repair of equipment.

When deploying the TRM system at an enterprise, the question naturally arises – is it worth doing this before purchasing equipment or after. At the moment, the accuracy and quality of equipment in domestic enterprises are insufficient to produce high-quality products. In addition, repairs are carried out very rarely, and not always properly, which led to obsolescence of technology, as well as to a decrease in functional characteristics. Thus, the primary system is an efficient system for working with equipment. Only if there is such a system will enterprises be able to scoop up all the reserves of their equipment, and when buying a new one, avoid the miscalculations and losses that inevitably arise in the absence of such a system [2].

Despite the simplicity of the ideas, it takes a lot of effort and time to develop the TRM system (from 3 to 10 years), in view of the fact that the system offers both a radical change in the outlook and psychology of the individual employee and the entire set of relations between the employees of the enterprise. However, the successful experience of Japanese enterprises shows that such changes contribute to the success in the world market.

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