

ASPECTS OF ORGANIZING THE UPKEEP AND REPAIR ACTIVITIES PERFORMED IN INDUSTRIAL PLANTS

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Abstract: This paper presents the main types of maintenance and repair systems used in our country. The advantages and disadvantages of each type of repair system are also presented, together with some recommendations concerning the improvement of their efficiency.

1). INTRODUCTION

In the reference material on this subject, the maintenance activity has been given attention by the specialists for a long time, being approached in relation with the other activities taking place within the industrial plants, activities included in a system based on an excessively rigorous planning.

There are several opinions regarding the possible systems of repair and upkeep of the equipments.

In [1] the following systems are presented:

1. The system of repairs due to necessities
2. The system of repairs based on finding
3. The system of preventively-planned repairs

2). THE SYSTEM OF REPAIRS DUE TO NECESSITIES

In a first organizing stage, the repair of the equipment used to be done „due to necessity”, in the moment when it didn't work anymore, because it had gone out of order. Doing the repair of the equipment in the moment of its breaking down has a lot of disadvantages for the industrial plant, the most important of which we can mention:

- the drawing out of the equipment from production, for repairs, in an unpredicted way, which causes the dezorganization of the basic production process
- the increasing in leaps of the repairs' volume, without any possible preparation done before, which causes losses in the basic production and the increasing of the repair's costs as well
- the lack of data about the volume of repairs which are going to be done, which leads to the immobilization of some important circulating funds in the technical and material reserves
- the impossibility of preventing the planned system of technical and organizational measures meant to increase the period of using the equipment and keeping it in a normal functioning condition.

In spite of all these disadvantages, the system of repairs due to necessities can be used for the rarely used equipments or for some devices which, if unused, don't cause losses in the production and don't disorganize the normal progress of the production or they don't violate the work safety rules. This system of repairs is used also for the equipment of a great importance, when the breaking down produces accidentally and it couldn't be predicted or prevented by a forced replacing of some devices after a certain period of functioning, the propensity for breaking down being impossible to be detect by visual controls.

3). THE SYSTEM OF REPAIRS BASED ON FINDINGS:

According to this system, the planning of the upkeep and repair procedures is based on a previous overhauling of the equipment and on a findings report which establishes the technical condition of it. With this system, the planning of the repairs is based on the data about the condition of the equipment, obtained on the occasion of periodical technical overhauls, the judiciousness of the plans of repairs and the degree of compatibility with the real necessities depend on the preciseness of the evaluation of its condition. The main disadvantage of this system is that it is not based on scientifically founded standards, on the basis of which we could establish the volume of the repairs and of the material and financial needs in order to keep the equipment in a normal functioning condition. This system of planning and performing the repairs can be used especially for the machines and mechanisms from small assembling workshops, where the equipment works with interruptions, not having a constant loading; it can also be used for repair some heavy equipments, of high accuracy, unique, which need very complicated procedures.

4). THE SYSTEM OF PREVENTIVELY-PLANNED REPAIRS

This system represents an ensemble of measures of the equipments' upkeep, control and repair, which are performed periodically, to a certain distance in time, through which we aim the forestall of the excessive wear and damages, and the preservation of the exploiting qualities necessary for a normal functioning. The system of the preventively-planned repairs, by the whole ensemble of upkeep and control measures, has a prophylactic character, and by foreseeing the method and the stages of the repairs, it has a planned character.

By its content, this system has the following main advantages:

- the knowledge of the date when the equipment is going to be drawn out of function for repairs
- the decision in due time upon the kind of repairs which are needed to be done and upon the duration of the procedures
- the providing in best conditions of the working team and of the material and financial means necessary for repairs

This system can be applied in two ways:

a). The standard method. Using the system of preventively-planned repairs by the standard method consists of sending the equipment to be repaired after a certain number of hours of functioning, regardless its technical condition and replacing some parts, without taking into account their technical condition, after a certain number of hours of functioning. Based on this method, the repair is done following a technological procedure previously conceived, which contains in details all the procedures done on the occasion of the repair.

This method can be used with good results for the equipments which work in the same conditions, where, not replacing in due time some certain devices, can lead to damages that can disorganize the production process, such as the automatic lines of mechanical processing. This method can also be used for the equipments and mechanisms for which, not replacing in due time some certain parts can lead to damages or to the decreasing of the work safety of the staff.

b). The Method of Periodical Technical Overhauls. According to this method, the equipments get in planned repairs after a certain number of hours of functioning, periodically, in a certain order, according to a cycle of repairs, before each repair a

technical overhauling being done, in order to know the condition of the equipment. Each planned repair is done according to the needs for removing the damages found on the occasions of the periodical overhaulings, and to ensure the normal functioning of the equipment till the next repair which is established by the period between repairs. Between the periodical, planned repairs, the equipment is subjected to technical overhaulings, in order to establish if the equipment needs to be repaired at the planned moment, what devices will have to be replaced and to prepare in due time the new parts necessary for the upkeep and repair procedures.

The system of the preventively planned-repairs by the method of the technical overhaulings has got the greatest popularity, being applied in all enterprises that are engines/machines makers.

In order to design a very reliable system of preventively-planned repairs we should take into account a lot of basic principles.

The first principle which must be considered is the one that states that in order to establish the kind and the volume of the repair procedures we should consider the building and functional peculiarities of different equipments and installations.

Another principle which is important when speaking about the system of preventively planned repairs, states that in all cases when the functioning conditions of the equipment, the requirements for profitableness, for ensuring the quality of the upkeep and repairs and the level of production, don't change in time, the volume of repairs, of different kind of repairs, should stay the same.

Another principle that should be considered when conceiving the system of preventively planned repairs is the one which states that if the number of functioning hours increases over the limit which has been established between two repair sessions, the volume of repairs must be increased too, as a consequence of the increasing of the wear level of the machine parts.

It is of a great importance in establishing the structure of a repair cycle to establish the best number of functioning hours for the equipments, between two repair sessions, which must include the technical standards of the upkeep and repair, in the shape of functioning time between two kinds of repair sessions.

Another principle in establishing the system of preventively planned repairs is the one according to which the different repairs must be planned to be done on cycles of similar structures, repeated to precisely established periods, and being performed in a previously established order.

In other studies on this subject [3] it is presented the following classification:

- a). the system of corrective upkeep;
- b). the system of current functional upkeep
- c). the system of periodical functioning upkeep of a preventively-planned type
- d). the system of technical overhaulings and preventively-planned repairs
- e). the system of the upkeep and repairs of a palliative type

5). THE SYSTEM OF CORRECTIVE UPKEEP

The corrective upkeep is defined as an enssembly of measures taken by the suppliers and the beneficiaries of machines, equipments and intallations, which by applying, ensures:

- the building improvement, by re-designing some machine parts or devices which don't correspond to practical demandings (they get worn out too soon), they need a large number of spare machine parts, they are not easily drivable, they make much noise or strong vibrations etc.

- functional improvement, i.e. the designed equipment, for different reasons, works below the foreseen parameters (a difficult assembling of the parts, advances or limited runs, low output). This situation is usually solved by designing some extra accessories, of some tools having multiple functions (simultaneous drilling and boring out) or by processing more machine parts in the same time unit by: simultaneous drivings, multi-axle ends etc;
- eliminating some deficiencies regarding the reliability and maintenance of the equipment or installation. These deficiencies usually appear during the guarantee period, but also on the occasion of the maintenance and overhauls at the beneficiary. The corrective upkeep applies during the whole guarantee period stipulated by the builder of the equipment, and especially when starting functioning and then, periodically, according to the agreement and to the results.

6). THE SYSTEM OF CURRENT FUNCTIONAL UPKEEP :

The system is based on an ensemble of measures taken by the manager of the upkeep and repairs department, to perform, generally daily, a number of specific operations for a normal functioning of the technical endowment. These operations are:

- a. the cleaning and removing the impurities and the polluting elements from the equipments
- b. lubricating or greasing the existent equipments
- c. the daily monitorizing of the equipments, machines and installations' behaviour, while functioning

Performing these operations implies to schedule them: when, with what, by whom, how, establishing monthly budgets for expenses for each equipment and monitorizing them by the factors of decision, in order to include them in an amount.

7). THE SYSTEM OF THE PERIODICAL FUNCTIONAL UPKEEP OF A PREVENTILY- PLANNED TYPE

This system places the interventions "before" the break out of the equipments and focuses on the "prevention" more than on "repair" the deficiencies.

The prevention of deficiencies, with a certain probability, allows us to know the phenomenon before its appearance, and to decide which parts must be replaced, creating in this way the possibility of dimensioning, according to the economical calculations, the supply of spare machine parts, and the possibility of replacing before a deficiency appears or a damage is produced.

The prevention of the deficiencies is done by a rigorous upkeep periodically done (weekly, monthly etc), by processings and cheking procedures, by overhauls with replacing the worn out parts, by adjustment, reconditioning etc, so that the equipments or the technological lines would work again for a certain period of time.

The operations and procedures specific to this system are:

- the periodical checking of the equipments (Pc) – means watching, feeling, listening to or measuring the technical functioning parameters of the equipments, detecting the deficiencies in advance. The operation is done by specialist workers who take care of a certain number of equipments, which they are resposable for, from technical and functional point of view, their salary depending on the good functioning.
- the partial overhauling (Po) means to examine the functioning of the machine parts and to replace those which don't correspond anymore, to eliminate the abnormal noises and the deficiencies of any kind. The intervention is done according to a planning

but only upon the parts that require this. It requires a prior preparation and responsibility on persons and types of procedures, for the equipments that have been considered;

- the general overhauling [Go] aims to verify in detail the functioning systems, their safety in functioning and their accuracy. It is done for each equipment, according to the planning (weekly, monthly etc) and it includes all the components that require any intervention of a mechanical, hydraulic, electrical or electronic type etc. It is performed only by specialized staff, which prepare before the machine parts taken in custody from the supplies warehouse.

- the technical control of quality aims the quality of the periodical checkings, of the partial overhaulings or of the general ones, if they correspond to the accepted standards, and the quality of the products and the technical condition of the equipments as well. If they find technical or functional deficiencies, the controlling staff announce the intervention team in order to rectify the situation.

8). THE SYSTEM OF TECHNICAL OVERHAULINGS AND PREVENTIVELY-PLANNED REPAIRS

By a system of technical overhaulings and preventively-planned repairs we understand all the technical and organizational measures used by the industrial plant in order to preserve the working capacity of the machines, equipments and installation, in safe conditions during functioning.

The system of technical overhaulings and preventively-planned repairs is based on the following procedures and specific operations:

- repairs required by necessity (it is the case of accidentally break downs or damages) skip the planning and cancel the nearest one which was going to be done. This is valid only when the repair is one of substance and corresponds to the correspondent types (CR1 or CR2 or even KR);

- the repairs based on findings are done when the machine, the equipment or the installation are not adequate anymore from functional, technical or technological point of view, and the intervention is immediately needed, although there are no damages or accidental break downs. The operation is not planned but it is of a good quality and it overlaps the nearest procedure of CR1 or CR2 type;

- the repairs with a rigorous planning (standard) consist of interventions of substance and of superior quality on the date it was strictly planned, even if the machine, equipment or the installation correspond from technical, functional and technological point of view

- the overhaulings and the technical overhaulings and the preventively-planned repairs are based on operations and procedures specific to technical overhaulings (TO); the current repairs (CR) and cardinal repairs (KR)

In order to perform in good conditions the above operations there are many operations needed: a training of the intervention staff for each type of procedures; the providing and making of the spare machine parts; the planning in due time of the operations and the monitoring of the functioning after the next cycle; planning; planning the interventions; drawing up the technical and technological reference material; providing spare machine parts, materials and lubricants; initiating the orders; checking the equipments; performing the procedures; reconditioning and re-using the worn out parts; drawing up the delivering-receiving documents; reserves.

9). THE SYSTEM OF THE UPKEEP AND REPAIRS OF PALLIATIVE TYPE

The system of the upkeep and repairs of palliative type applies to machines and equipments that are repaired but still kept in functioning, due to either a good function or to the impossibility to buy a new equipment.

The system temporarily improves a state of facts without eliminating the cause of it. In other words it brings a temporary solution.

The equipments and the machines which are in this situation are intensively and extensively used, and the interventions are done only in case of breaking down or we plan interventions of CR1 and CR2 type, required by necessities or based on findings, which bring the equipments to the normal limit of functioning for a while, after which the same type of interventions will be done again.

5). CONCLUSIONS

After reading the reference material and the studies made as part of a co-operation contract with some important enterprises, such as S.C. Înfrățirea S.A. and S.C. Metalica S.A. Oradea, we have concluded the following:

- The enterprise represents a production system extremely complex in which the increase of the economical efficiency is crucially influenced both by the size of the equipments and the using of them at the foreseen technical-economical standards, which can be obtained by a good upkeep and repair.

- Although they contain some common elements regarding the procedures that are done, common elements of planning and preventing, they are separately presented (e.g. the system of periodical functional upkeep of preventively-planned type and the system of technical overhauls and preventively-planned repairs)

- The multitude of the types of upkeep and repairs systems may produce confusion regarding their specific content, the conditions of application, their advantages and disadvantages etc

- We consider that all the shortcomings presented in the case of each maintenance and repair system cannot be eliminated but by re-organizing this activity, through a new conception regarding its management, that is by adopting the industrial maintenance.

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