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RECONDITIONING THE DEGRADED PARTS OF THE AGRICULTURAL AND FOOD INDUSTRY TECHNICAL EQUIPMENTS – AN OUTDATED TECHNICAL CONCEPT?

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Abstract: *In the paper is demonstrated that giving up without discernment at the recondition of the degraded parts specific for agricultural and food industry technical equipments is established to be damaging and technical- economical unjustified. Abolition step by step of the material base for parts reconditioning and agricultural equipments repair can be considered one of the major causes of the Romanian agricultural decrease. From the reconditioning technologies are considered viable those which use hard material loading, deposition through welding with electric vibrator contact, plastic deformation etc., with the condition of technical requirements fulfillment specific to the considerate parts. Is signaled also the lack of a proper system for accounts of the damaged parts and their global directing to metallic waste collecting units.*
Keywords: *agricultural equipments, damaged parts, reconditioning.*

1. INTRODUCTION

The last 20 years had produced in Romanian agriculture and food industry profound structural and economic changes. The technical and technological progress is found in these base braches of the national economy through the appearance and the utilization of some very performance technical equipments under the work quality, work capacity and reliability aspects, but also very expensive and practice inaccessible for the small Romanian farmer. Romanian industry machine building for agriculture and food industry could not maintain the rhythm with the European evolution in this domain, so the new technical equipments are mostly of foreign provenience. In the same time there are still used in a significant proportion Romanian tractors and agricultural machines, physic and moral outdated, but irreplaceable in some situations [2].

The global neo-liberal politic, used in the last decades which considers the consumption as the economy engine, fact which was proven unrealistic and with serious consequences under the form of a severe economical crisis, especially in geographic areas where this politic was exacerbated (U.S.A, Europe). A consequence of this politic referee to giving almost completely to reconditioning of parts with certain types of wear and their replacing with new parts. The method is simplistic and with high quality results, but these parts are, sometimes, extremely expensive, in comparison with the same parts reconditioned to normal technical conditions.

This situation leads to high agricultural works cost and implicit to high agricultural products cost, which will not be able to compete on the European free market with similar products, obtained in more economic advanced countries.

On the other hand, the principle 20-20-20 (by the year 2020 to be reduced the energy consumption with 20% and 20% from this energy to come from renewable sources) is not encouraged through giving at some parts reconditioning, because in the respective parts were invested much energy, which can't be neglected through reforming without discernment this parts. On the other hand the reconditioning of any defection to any parts type is not technical and economical justified, in the condition in which the functioning cycle of the reconditioned parts is, normally, shorter than in new parts case.

Essentially for worn parts reconditioning is the existence of an adequate material base, which existed in Romania before 1990 in well organized form and adequate equipped for parts reconditioning and the technical equipments repairing with medium and even high level requirement. Unfortunately this material base disappeared in great proportion, so the maintaining activity of the tractors and the agricultural machineries is made by these equipments manufacture firms, at very high costs (the change parts and the related labor for equipments repair are very expensive for the financial possibility of the most Romanian farmers).

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2. MATERIAL AND METHOD

When reaching the wore limit, any part must be replaced, keeping it further could have negative consequences from different points of view. Maintaining the agricultural machines in functional conditions using to wore parts replacement only new parts, leads not only to a high cost of the maintenance works, but to a waste of reusable materials. A large part from the wore parts can be reconditioned through technological methods and procedures according to the nature and the functional role of the respective parts.
The application domain of the parts reconditioning is very wide, with the condition that to the recondition parts to give technical characteristics identical with those of the new parts assuring their functioning on intervals corresponding to repair cycle. On the other hand is necessary an economical calculus for establishing the reconditioned part cost, which normally is less than 50 % from the new part cost.
Results that the reconditioning problem is connected by the possibility of applying a corresponding technology which can satisfy both economical and technical conditions. Satisfying this condition is determined, in turn, by the production volume, which must be big enough.
For parts reconditioning it can be applied one of the next methods: processing to repairing dimensions (steps); initial dimension reestablishing; the use of intermediary parts (compensators); replacing a piece of the part. The last two methods assure in return, the parts initial dimensions or their intermediary dimensions. Also, to a part it can be applied, in different stages of it's wore, different reconditioning methods. So the levels spindles and levers of crankshafts can be reconditioned through the step repair method until depletion of the supplementary material layer provided from construction, after which it can be loaded through metallization and restoration, to an initial or an intermediary dimension.
The chosen recondition method must take into account the work part conditions and its assembly mode and its material, the applied thermal treatments at the part manufacture, by it's constructive design form etc.
For choosing the appropriate recondition method is recommended [3] the use of an economical indices of form:

$$I_{ec} = \frac{C_u \cdot t_u}{C_r \cdot t_r}, \tag{1}$$

in which: C_u represents the cost of a new part; C_r – the cost of a reconditioned part; t_u – the function time of a new part between two successive reparations; t_r - the function time of a reconditioned part between two successive reparations.
The condition of economy of applying the method is full field if the economic indices I_{ec} is higher than one and if the functioning time of the reconditioned part is equal or multiple of the new part functioning time.
The possibility of using a reconditioning method must be taken into account from designing and manufacturing of each part and of the technical equipments in on the whole. On the other hand, the modern exploiting of the equipments from agriculture and food industry imposes the continuous decrease of the costs for maintaining and repairing , which means that after a determined exploitation time period these parts to be maintained and repaired with minimal costs. Simultaneous with the equipment technical status change is modified the cost values for technical maintenances and repairs. Establishing the optimal maintenance regime, which to take into account the influence of the technical maintenances periodicity over the size of parts wore and of the reconditioning possibilities through a certain and accessible method and process can be done through a technical – economical method, in which is kept into account the materials and exploitation costs and the maintenance and repair labor costs. So, the increase of the oil consume for motors, the energy consumption increase and of harvest machinery losses, increasing the traction force of the agricultural machines etc., leads to increasing over certain limits of the parts wore, which influences the work quality of the considered equipments, but also the possibilities and the costs for parts reconditioning .
If are taken into account the partial costs which forms the total production costs of the equipments (fig. 1) is found that some parts have a constant evolution (C_u – normal exploitation costs) others increases (C_e – supplementary exploitation costs due to current reparations, crop loses etc.) and others decreases (C_a – amortization costs).

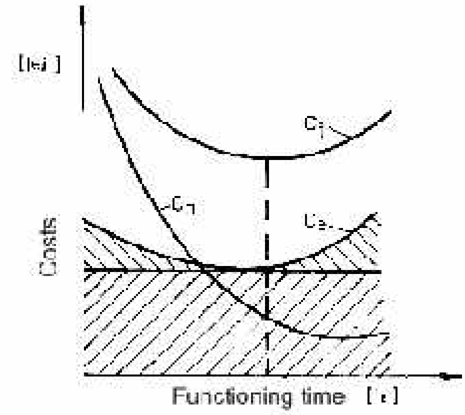

Figure1: Production costs variation depending on the functioning time [2]

Conform to this criteria (economy) the parts wore limit will be established immediately after the minim point from the total costs curve C_t, but not to late after this point. The economic criteria can be applied single or as completing the other criteria (technical, technological, safety in exploitation) to establishing the limits wore and in further of reconditioning methods and procedures.
Connected to the described method, the total specific cost for making the maintenance works can be calculated as:

$$C_m = C_i + C_r \text{ [lei/h]}, \quad \mathbf{(2)}$$

in which: C_m is the total specific cost, in lei/h; C_i – the specific cost of the technical maintenances, in lei/h; C_r – the reparation specific cost, in lei/h.
The specific costs are obtained so:

$$C_i = \frac{A}{t} \text{ and } C_r = \frac{B}{T}, \quad \mathbf{(3)}$$

in which : A is the total cost of the technical maintenance operations at a exploitation time t or to the respective periodicity; B – the total cost of reparations to a exploitation time T.
In general cases the functions $C_i = f(t)$ and $C_r = f(t)$ near a hyperbolic law or a linear law and the specific costs depending on the periodicity maintenance work reduce, decrease for C_i and increase for C_r . From summing these two costs results the total cost $C_m = \psi(t)$, which has an extreme point $C_{m\ min}$ and for which corresponds the optimal periodicity of maintenance and repair works, so the wore value of the parts which will lead to optimal reconditioning solutions or to reformation.
If is known the connection function between the technical maintenance periodicity and between two successive reparations $T = \psi'(t)$, the optimal periodicity can be determined with relation:

$$\frac{dC_t}{dt} = \frac{d}{dt}\left(\frac{A}{t} + \frac{B}{\Psi(t)}\right) = 0 . \quad \mathbf{(4)}$$

The possibilities of reducing the maintenance costs depends, mostly, by the constructive solutions used for designing the new equipment, but also of the manufacture technology from the upstream fabric. In this way for designing a new technical equipment for agriculture or food industry it must be taken into account of:
▪ the use of constructive solutions and manufacture technological processes which can assure the reparation possibility through reestablishing the spaces between parts using different methods and proceeds of reconditioning.
▪ the widest unification (specially to engines, tractors, agricultural machines and some equipments from food industry) of the main parts and analogs subassemblies from the point of view of destination and work conditions;
Regarding the first request is necessary to take into account the following aspects [4]:
o assuring the technological settlement basis for parts reconditioning possibility (centering hole, others settlement surfaces);
o the possibility to applying of a reparation method (dimensions steps, reestablishing the initial dimension etc.);
o the possibility of loading the wore part surface and of ulterior mechanical processing;
o assuring a sufficient wall thickness in the places where it will be applied the reconditioning;
o the possibility of strict observance of the surface qualities imposed by the technical conditions, taking into account the endowment with machines and installation of the reparation services;
o assuring the possibility of dismantling joints for replacing a part;
o assuring, in general, the simple part dismantling and mantling;
o assuring convenient access to lubrication points;
o the possibility of assuring the joints after their mantling;
o the provision of the smallest number of tools for maintenance operations and of tools and devices necessary for repairs;
Regarding the second request (unification) are imposed:
➢ assuring the parts interchangeability;
➢ reducing to minimum of the dimensions number of arbors which are mounted in bearings or plain bearings, which can be provided with bushings easy changeable after wore. Identically is put the problem in the case of transmission belts of different machines, of gaskets etc.

3. RESULTS AND DISCUSSIONS

Depending of the wore limits acceptable in parts functioning, of materials from which these are executed, of the finishing technologies used in manufacturing etc., to the parts of the agriculture and food industry machine can be applied different reconditioning methods and proceedings [1].
So, if is taken into account the reconditioning through galvanic coating by plating of a part, technology which assures a rough superficial layer which is very resistant at wore, must take into account that the maximum respectively layer thickness can not exceed 0.35 mm on radius. Because in this thickness is included and the addition of processing for

encircle in nominal dimensions, results that the limit wore which can be accepted to this parts will be smaller than 0.2 mm. If it will be applied successive coverage of iron- nickel- chrome, the thickness of the coverage layer can have 2…3 mm and the wore limit is modified corresponding. The dimensions of wore limits from this point of view will not exceed the values established based on technical or technological criteria [5].

Also, are machinery organs to which the wore intensity is maintained constant without appearing the damage wore and worsening the functional indices is produced in a so advanced wore stadium, that the work organ can't be reconditioned.

For example, the work organs from the MC – 5 hammer mills can be used with good results form a quality point of view for grinding a quantity of 150 t of corn. After grinding this quantity the hammers can't be reconditioned anymore, being necessary their replacement. If the work process is interrupted after grinding about 100 t of corn, when the hammers wore is of 10…12 mm , these can be loaded through welding with rough material and the functioning cycle is retaken, which can be even longer than in the case of new hammers.

If at work organs of the hammers mills the wore limit can be established regarding the reconditioning possibilities, to the plow blades the wore limit can be established depending on the reconditioning proceeding. So the plow blades which reached the wore limit, determined by worsening the quality work indices, were reconditioned only through replacing the wore portion with a piece cut from another plow blade (compensator), heavy and uneconomic process. In this case the plow blade wore is of 25…30 mm, after 120…150 plowing ha and after reconditioning there can be plowed another 50…60 ha. If at a wore of 18…20 mm is made a load with hard alloys (when are plowed only 90…110 ha) is assured the plow blade use for plowing another 250…300 ha, until the using limit.

This process is applied to some parts with pronounced wore on small surfaces even from manufacturing, assuring a substantial increase of the work time. Is the case of big electric spindles rotors, of plow cutter, of some cutters of mowing and harvesting apparatus etc.

4. CONCLUSIONS

- The parts reconditioning can be done only to a certain wore limit or unit modifying the mechanical properties of their materials and only when the parts, through construction and functional conditions are suitable for reconditioning operations. At reaching of respectively limits the wore parts must be reformed and replaced with new parts.
- The parts reforming is done in the following situations:
  - the part dimension reached its resistance limit;
  - the superficial hard layer is outworn and it can't be remade;
  - through successive reconditioning the constructive dimensions decreased so much that the contact pressures becomes very big and it can't be assured a normal lubrication ;
  - the parts suffered damages which can't permit their reconditioning, as example corrosions, breaks, cracks or deep tread pattern, structural modifications etc.;

when reforming a part it must be taken into account and the conjugate parts.

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