CONSIDERATIONS REGARDING TO TAMPING TOOLS LASTINGNESS

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ABSTRACT: The tamping are used to technological operation of realizing a support ballast under the inferior part of the sleeper, with the main purpose to assure a specific geometry and resistance of the railway. During the tamping process, they are subject to bending, compression-stress, impact stress, axial compression as well as some abrasive, fatigue and impact wear phenomena. From this consideration, results the role and importance of tamping tools lastingness concerning the performance and cost of tamping process as well as correct adoption of manufacturing process for tamping active part.

The experimental research of reinforcing technological process of the active part of tamping tool with metallic carbide as well as to select of material used for brazing represent one of the way to increasing of lastingness.

The paper presents theoretical and practical problems of tamping tools lastingness.

KEYWORDS: tamping operation, tamping tools, wear, lastingness, reliability.

1. FACTORS WHICH INFLUENCE THE TAMPING TOOLS LASTINGNESS

The investigations in specialized literature regarding at the actual stage of the researches, design, manufacture and exploitation of the tamping tools showed a low level of information and technical details regarding these types of tools. Increasing the lastingness of the tamping tools is a primordial factor in the efficient exploitation, technologically and economically, and is an important process for the tamping tools and for the tamping machines as well. During the tamping process, the tools are under influence of bending stress, compression stress, axial compression as well as abrasive, fatigue and impact wear phenomena.

Taking into consideration the mod of action, operating conditions and the stress influence, in figure 1 are presented the main factors which must to be take into account to obtain a optimum lastingness from point of view of performance and cost of tamping process.

a. Shape and dimensions of the tamping tool.

The lastingness of the tamping tools it is influenced by the surface and edges of active part of the tamping tool, which are defined by the angle made with the axis of a rectangular reference system (Fig.2).
Fig. 1. Cause-effect diagram for study of the tamping tool lastingness.
In the section (N-N), fig 3 a, the geometry is described by the next constructive angle; \( \delta \) - the main surface angle; \( \beta \) - the sharp angle of active part; \( \alpha \) - the secondary surface angle (the secondary surface can be made from two surfaces with different inclination angles \( \alpha \) and \( \alpha_1 \)); \( \delta \) - the cutting angle (\( \delta = \alpha_1 + \beta_1 \)); \( \lambda \) - the inclination angle of the constructive edge.

On the (x-x) direction, fig.3 b, the geometric shape of active part is described by the K angels of the lateral surfaces (\( K > 90^0 \)or \( K = 90^0 \))

Regarding the body of the tamping tools, this one can be made in different sections: circular, oval, rhombus etc, with the maximum dimensions at the fixing part and which grow less and less to the active part of the tool.
b. Characteristics of ballast and type of operation

Characteristics of ballast can be described by two component parts: characteristics of crushed stone (different forms, dimensions and granulometry, stipulated in standard) and colmation degree of the ballast prism.

Regarding the influence of compactness and colmation degree of the ballast prism, the different type of tamping operation (Bi – intermediary tamping; B I, II, III – technological tamping 1,2,3.; BG – general tamping; BÎ – maintenance tamping) which take place in the ballast prisms, it has been found that the compactness and colmation degree increase, in general, in enumerated order. The tamping tools lastingness decrease at the same time with increasing of compactness and colmation degree.

c. Materials used for the tamping tools.

In literature and technically practice are know the materials and technical processes to obtain a satisfactory wear for a different type of tool which works in a specific technical system. In the case of the tamping tools, could be mentioned some materials having in their composition in different percents Cr, Mn, Mo, W etc. Chemical and physic-mechanical properties of the materials used for manufacturing of tamping tools must to permit minimum 50000 cycles of tamping for resistance to wear active part of the tamping tools and 10000 cycles of tamping for the breaking strain of the tools.

In order to improving the mechanical characteristics of the tamping tool and to obtain a increasing of their lastingness we have established that the main factor which has the primordial influence is the wear of active part of the tamping tool. For to increase the resistance to wear, it is necessary to concentrate the study and research to identification, selection and utilization of some hard and extra hard materials for applying on the active part of the tamping tool.

Regarding to the hard and extra hard materials, having in view the specifically conditions of functioning of the tamping tools, in many case are used metallic carbide plates covering the active part of the tamping tools.

d. Type of wear.

The wearing of tamping tools has a result detachment of materials as well as modification of initial state a friction surfaces, especially in the active surfaces zone of the tools.

Concerning the wear development can be mention it is cumulative and increase, usually, with length of friction or duration of friction, acting load (tamping force), rate of doing work, hardness of material and microgeometry of the tamping tools.

Taking into account working conditions and environment as well as nature of tool-ballast materials, practical result have confirmed that it is exist two preponderant fundamental types of wear: abrasive and fatigue as well as impact wear as particularly form.

The abrasive resistance depend on numerous factors: shape, dimension and structure of the ballast, value of load (force intensity), sliding speed, hardness, modulus of elasticity etc. The influence of hardness of the tool surface Hₜ and the ballast Hₘ against to relatively resistance at abrasive wear depend on Hₜ / Hₘ ratio. So that, for Hₜ / Hₘ >0.6 ...0.8, the abrasive resistance increase quickly, and for Hₜ/Hₘ = 1 ...1.4, a great resistance of abrasive wear is obtained.

The fatigue wear of active surfaces of the tamping tool has in fact reason the repeated stress which are to continued by elastic deformation in superficial stratum and/or coming out of some fissures. The fatigue wear it is determined by elastic and plastic contacts, micro cutting processes and micro geometry of the contact surfaces.
Impact wear it is a specifically type of mechanical wear which take place owing to repeated shocks at tamping tool penetration into the ballast. As a result of impact process, the structure of the superficial stratum; appears a structure which is characteristic of fatigue phenomena, with micro cracks and detachment of material. The wear is more fast so as the impact force and the impacts frequency are more great.

e. Manufacturing of the tamping tool.
The main factors which are exercise and influence over elaboration of operating process are: shape and dimensions of the tool, execution project, production volume, type of semi finished material, operating precision, available equipments and degree of technical education of the operating personnel.
In the operating process, the lastingness of the tamping tool it is influenced by:
- the type of semi-finished material: preferable it is the forget material;
- the technology of covering of the active part: by arc welding, using different type of electrodes or by brazing with plates of metallic carbides;
- some nonconformity on account of: strain concentrator from semi-finished material elaboration (hammer or drop forging); in homogeneity or other materials defect, internal strain induced by semi-finished material elaboration or as a result of welding the active part to the body of the tool (when they are not monoblocks);
- deviations to the precision of the dimension, shape, position or the quality of the active part or body surfaces;
- selection of the best practical solution for to setting of tamping tool into tool holder.
The tamping tool lastingness is also influenced by the reconditioning method used to those three parts of the tool: active part, body and setting part of the tool into tool holder. The reconditioning of the active part depend on the solution selected for to increase of the active part lastingness (arc welding or brazing with plates of metallic carbide).

f. Mode of operation
Mechanized tamping consists in the vibration and squeeze of the ballast under the inferior part of the sleeper, by 35 Hz, amplitude of the oscillations is 3 …5 mm and the force is 10 kN. The vibrations associate with friction between the tamping tool and ballast, exercise an influence over lastingness of the tamping tools.
The value of force which acting on tamping tool, not more then 10 kN, depend on the following factors:
- the properties of ballast;
- the material and geometry parameters of the tool;
- operating parameters (velocity 0,5 …2 m/s, penetration stroke into ballast, compression force of the ballast, value of pressing-detachment stroke of the tool, compression-vibration time of the ballast etc).

The lastingness of the tamping tools it is also influenced by the their working conditions. In this context, must take into account: to abrade the impact between active part of the tamping tool with different hard pieces (which are in the ballast, iron rail etc) an a result of operator error, incorrect laying of the railroad sleeper; respecting of instruction for mounting, pressing and holding the tamping tool into the tool-holder.
2. LASTINGNESS – RELIABILITY CORRELATION OF THE TAMPING TOOLS.

The initial quality of the tamping tools and their operating reliability can be considered as a economical problem with important implication for the tamping machines. The operating reliability of the tamping tools can not be estimate or predict without to have a knowledge of lastingness of the tamping tools component parts which are under the influence of considerable wearing process.

Therefore, the lastingness can be considerate a essential characteristic of the reliability concept, it has to be conditioned by the interdependence between intrinsically strength properties and the real operating situation, while the reliability represents the quality in time of the product.

In conditions of tamping process development, as a result of the variation of factors which are exercise an directly influence of the tamping tools lastingness, a dispersion of the lastingness values takes place.

In is very important to determine of the adequately statistical model which is able to indicate the possibility ways to increase of the lastingness for a known reliability or increasing of the reliability for a impose lastingness. Reliability indicators which presents a very much importance are: mean time between failures (MTBF) and failures rate (λ).

3. CONCLUSIONS

In order to increase of lastingness of the tamping process and implicit to reduction of the unit costs (lei/mil.) afferent of this process, it is necessary to use tamping tools with high lastingness. The specialized literature showed summary information regarding at dimensions, geometrical shapes of the tamping tools, the quality of surfaces, the materials and technical process used to manufacture of the tamping tools. The information is even more summary or is missing regarding the lastingness of the tamping tools, the wear and evolution of this.

For to increase the lastingness, respectively the reliability of the tamping tools it is requisite identification the factors that influences the lastingness, also the solutions for increasing it. In the actual stage, from the determined factors, we have established that the factor which has the primordial influence is the wear of active part of the tamping tool.

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