COMPARATIVE STUDY REGARDING THE COSTS OF USING CATEGORIES OF THE TAMPING TOOLS

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Abstract: The objectives of modern construction, maintenance and repair technologies of railways demand among its important factors, a new solution for projecting, constructing and using of tamping tools. New types of tamping tools with increased durability which prove to be efficient during high productivity tamping processes should take the place of traditional tamping tools. It is needed by the new tamping tools, with adequate construction and geometry, adapted to the effective costs of the tamping operations, for the purpose to improve their durability and the efficacy.

Keywords: cost of tamping operation, cost of tamping tools, wear, lastingness, metallic carbides, tungsten carbides

1. INTRODUCTION

An important element in construction and maintenance of the railway cost analysis is the cost implied by the tamping operations. Increasing the productivity of the tamping operation leads to reduction of the unit costs (lei/ml) of these operations. For obtaining these improvements it is necessary to use the tamping tools with high durability, which is permitted to increase the productivity and the costs of research, design, construction and use of such tools being quickly amortized and the profit being guaranteed.

The tamping tools are needed to be adapted to tamping machines and to the specific case of tamping, depending on the type of work and the degree of automation of the tamping machine, also depending on the quality of tamping operation. In any case the tamping tools should contribute to the economic efficiency of the entire tamping machine.

The tamping tools and the tamping machine should be optimally exploited and the attention should be accorded to the geometry of the railway and to the quality of the tamping operation, also to the coefficient of effective utilization of the tamping machine. Efforts are necessary to be done in order to reduce the auxiliary time used not directly for the tamping operation. For this reason it is an objective, reducing the time-work affected to the change of tamping tools, reducing the time needed for disassemble the used tools, or for assemblage of new tamping tools, also for the renewal, transport and measuring-control operations of tamping tools. Productivity losses caused by de changing of tamping tools are always pointed out, when the tamping machine needs to be stopped for replacing the used or braked tools when adjustments for tools are needed for specified dimensions. The effect of reducing the time affected to the change of tools insures lower work cost unit (ml of tamping). Other advantage with positive influence for reducing exploitation, maintenance and repair costs in the case of using tamping tools with high durability is reducing the weariness and defects caused by wear or even the breaking of port-tools (port hammer-arms), expensive machine parts and very difficult to supply causing a long immobilisation and repair time. The high number of tamping tools replacements with low durability is the cause of port-tools defects, this being pointed out especially in the case of the high productivity tamping machines (e.g. Plasser&Theurer tip 09-32 CSM).

2. TECHNICAL CONSIDERATIONS

Mechanized tamping consists in the vibration (oscillation) and squeeze of the ballast under the inferior part of the sleeper, at frequencies by 35 Hz, amplitude of the oscillation is 3÷5 mm and the force is 1000 kf (10 KN). Most of the cases, the mechanized tamping is executed with pairs of tamping tools (Fig. 1), which are disposed symmetrically face to face, on both sides of the sleeper, doing opposite movements. The tamping tools [1] are mounted on the tamping mechanisms (Fig. 2). These pairs of tamping tools are placed on both sides of the track [2]. The tamping tool is working similarly as the cutting tools, with the difference that during the technologically tamping process doesn't results splinters, but is taking place the vibration (oscillation) and squeeze of the ballast under the sleeper.

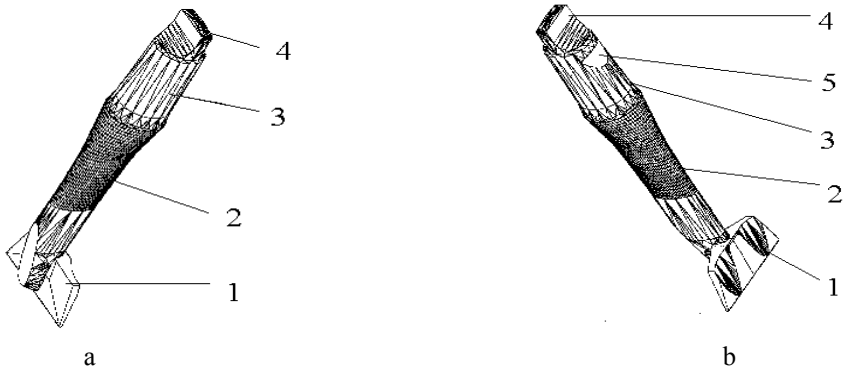

Fig.1 The tamping tool P&T 08-275 UM, for the mechanized tamping:
1-active part – tine (a- secondary surface; b- main surface); 2-body of the tool; 3-the part of the tamping tool which is attach to the port tool ; 4-part of the tamping tool which prevent the rotate of the tamping tool into the port tool ; 5- technological surface for fixing the tamping tool into the port tool

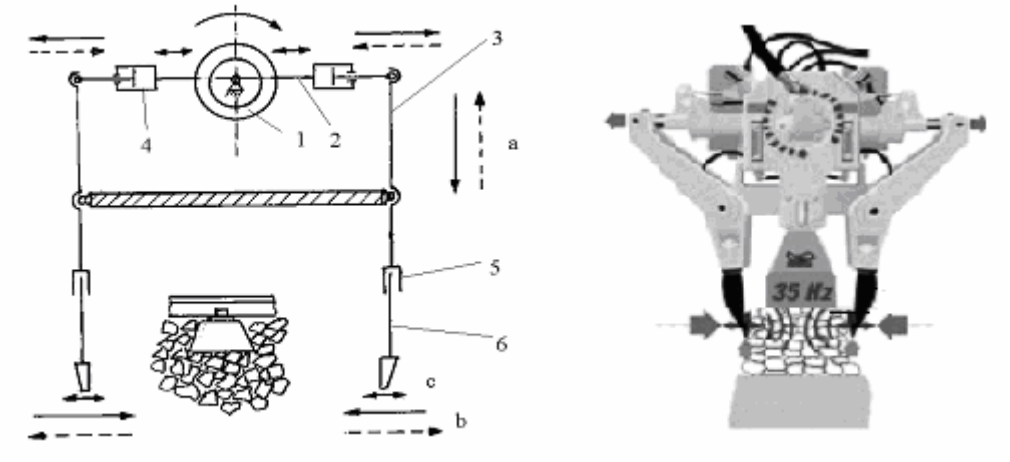

Fig.2 Tamping mechanism
1-axle with eccentric for oscillation movement (vibration)-c ; 2- connecting rod ; 3 - port tool arm ; 4-hydraulic cylinder for b movement – squeeze ; 5-port tool; 6-tamping tool; a –ascension and descend movement

In literature and technically practice are known materials and technical processes to obtain a satisfactory wear for a specific type of tool which works in a specific technical system (the work regimen, the work environment). In the case of the tamping tools, the using of some materials (alloys) having in their composition in different percents Cr, Mn, Mo, W and some adequate technical process, like forging in the matrices to maintain the

materials fibers and thermal or thermo chemical treatments, offers special mechanical properties (breakage resistance, shock resistance, wear resistance) – Fig. 3.

Fig. 3 The classic tamping tools type P & T 09 – 32 CSM – curved plated (armed) on the active part by manual and electrically welding with two types of metallic covered electrodes, which were recommended by the producers for the high abrasive and shock resistance

In the actual stage, from the determined factors, we have established [3] that the main factor which has the primordial influence is the wear of active part of the tamping tool. It is necessary to concentrate the study and the research to find some ways, materials and technical processes for using these, in the purpose of increasing the lastingness of active part of the tamping tools and the research of the behavior of these in exploitation.

It has achieved so, for the first time in Romania [3], the first tamping tools having the active part (tine) plated with plates of metallic carbide through brazing (Fig.4). By experimentally covering with plates from metallic carbide of the tamping tools type P & T 09 – 32 CSM, using hard paste process (brazing), the obtained lastingness is until 270 % higher than the lastingness obtained in the present.

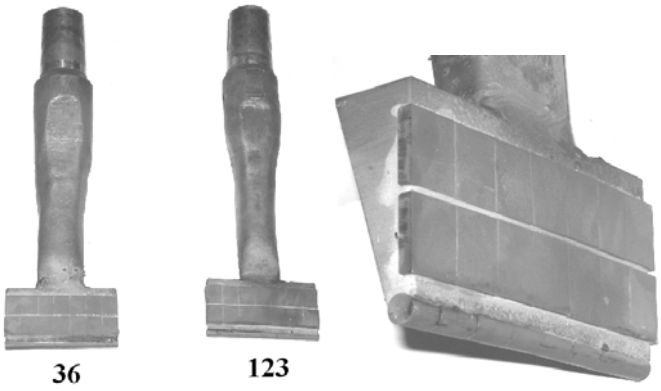

Fig. 4 The new tamping tools type P & T 09 – 32 CSM – curved nr. 36, 123 plated (armed) on the active part with plates with metallic carbides

3. THE COSTS EVALUATION

In the current stage, the tamping tools exploitation is done so that each tamping tool can be mounted on a single tamping machine type, the interchangeability degree being limited mainly due to the size and different

dimensions of the tamping tools grip, also due to the different way of grip, and fixing on the port tool. Even in the case of same manufacturer the tamping tools differ from one machine to another. Few are the cases when the interchangeability of tamping tools is allowed from one machine to another.

Tamping tools users are obliged to manage different types of tools, specific to each type of tamping tool machine used. A positive fact that simplifies the exploitation of tools is that the tamping tool remains the same no matter the type of tamping operation done with the same type of tamping machine. This fact eliminates auxiliary operations-referring to the replacement and calibration of tools depending on the operation being executed, the transport, manipulation, storage and reconditioning, auxiliary operations which generally reduce the productivity and the utilization coefficient associated to the tamping machine.

Managing (organizing the exploitation activity) different types of tamping tools, specific to each tamping machine, imply a lot of obstacles. Starting from the tamping tools exploitation cycle which includes: the supply and transportation of the tamping tools from the manufacturer or pre-made parts in order to be put together; the storage of new tools or pre-made parts as required; introducing in manufacturing cycle and manufacturing of new tamping tools; the transport of new tools to place where tamping machine operates; the replacement of used and defected tamping tools; the assemblage and replacement of new tools; the commissioning of new tamping tool on the machine; the exploitation of tamping tool under normal condition within the limits of admissible weariness; the disassembling of the defective tamping tools; the transportation of tamping tools from the work site to the reconditioning. During this period accidental defections occur, that require the dismantling of defective tamping tools and their transportation to specialized workshops for reconditioning; the application of reconditioning technologies depending on the available materials and the technological capabilities; the transportation of reconditioned tamping tools to tamping machines, the assemblage and calibration of tools on the machine for a new exploitation cycle. The cycle is repeated until a serious malfunction occurs, which leads to the impossibility to use the tamping tool. These serious malfunctions refer only to the tamping tool's body: to the grip part, the breakage of maximum strain zone; in body deforming zone - the breakage of the curves area; in other areas between the grip and the passage area from the body of the tool to its active part.

During the life of tamping tool these suffer a number (n) of reconditioning operations but only related to the active part, as presented above. The reconditioning of tamping tools is presently done depending on weariness or defects of the active part as follows:
-the reconstruction of dimensions, position and quality of the active part's surfaces thru welding operations using wear resistant materials and if needed mechanical finishing in order to correct dimensions, forms and finishing.
-in the case of wear over the admissible limits or when material loses or malfunctions occur new material will be added to the active part; later wear resistant materials will be applied and mechanically finished in order to correct form, dimension and finishing.
-the complete replacement of the active part, the assemblage with the body of the tamping tool being made using electric arc welding procedure with covered metallic electrode; later wear resistant materials will be applied and mechanically finished in order to correct form, dimension and finishing.

Another element that should be taken into account is the tamping tools cost including the exploitation and the (n) times reconditioning of these, assembling and disassembling operations, calibration, transportation, port tools and tamping mechanisms weariness, etc, compared to high durability tamping tools.

For an annual evaluation of tamping tools costs several elements will be taken into account:
-the amount of tamping work annually executed = 1.000 km = 1.000.000 ml of tamping
This amount of tamping operations is executed using more types of tamping machines and include all categories of mechanized tamping operations (Bi,BI,BII,BIII,BG,Bî etc.)
-500 km of tamping operations are executed annually using 10 type BNRI-85 tamping machines
-350 km of tamping operations are executed annually using the high productivity Plasser&Theurer 09-32 CSM tamping machine
-150 km of tamping operations are executed annually using the Plasser&Theurer 08-275 UM tamping machine

For annual tamping operations the following are being used:
-10 pcs. type BNRI-85 tamping machines each with 8 pcs. tamping tools
- 1 pcs. type Plasser&Theurer 09-32 CSM tamping machine with 32 pcs. P&T 09-32CSM tamping tools
- 1 pcs. type Plasser&Theurer 08-275 UM tamping machine with 8 pcs. P&T 08-275 UM tamping tools
-1 BNRI-85 type set = 8 pcs. With a medium durability of 6.000 ml tamping operations and can be reconditioned up to 5 times
-1 set type P&T 09-32 CSM tools = 32 pcs. With a medium durability of 7.000 ml tamping operations and can be reconditioned up to 10 times
-1 set type P&T 08-275 UM = 8 pcs. With a medium durability of 7.000 ml tamping operations and can be reconditioned up to 10 times

The evaluation of present costs with BNRI-85 tamping tools:
500 km/year : 6 km/set = 83, 3 sets / year
83, 3 sets /year : 5 reconditioning operations/set = 16, 7 sets / year
16,7 sets / year x 8 pcs/ set ≈ 134 pcs /year - new BNRI-85 tools annually
134 pcs/year x 106 € / pcs = 14.204 € / year - for new BNRI-85 tools
134 pcs/year x 5 reconditioning operations /year x 31 €/ pcs. reconditioning operations = 20.770 € / year - for reconditioning
TOTAL = 14.204 € / year + 20.770 € / year = 34.974 € / year

The evaluation of present costs with P&T 09-32 CSM tamping tools:
350 km / year : 7 km / set = 50 sets / year
50 sets / year : 10 reconditioning operations/set = 5 sets / year
5 sets / year x 32 pcs / set = 160 pcs / year - new P&T 09-32 CSM tamping tools
160 pcs / year x 100 € / pcs = 16.000 € / year - for new P&T 09-32 CSM tamping tools
160 pcs / year x 10 reconditioning operations /year x 30 €/ pcs. reconditioning operations = 48.000 € / year - for reconditioning
TOTAL = 16.000 € / year + 48.000 € / year = 64.000 € / year

The evaluation of present costs with P&T 08-275 UM tamping tools:
150km / year : 7 km / set = 21, 5 sets / year
21, 5 sets / year : 10 reconditioning operations/set = 2, 2 sets / year
2,2 sets / year x 8 pcs / set ≈ 18 pcs / year – with the new P&T 08-275 UM tamping tools
18 pcs / year x 106 € / pcs = 1.908 € / year - for the new P&T 08-275 UM tamping tools
18 pcs / year x 10 reconditioning operations /year x 31 €/ pcs reconditioning operations = 5.580 € / year - for reconditioning
TOTAL = 1.908 € / year + 5.580 € / year = 7.488 € / year

PRESENT GENERAL TOTAL = 34.974 €/year + 64.000 €/year + 7.488 €/year = 106.462 €/year

By increasing the durability of tamping tools, independent of the type of construction, for 18 km experimentally obtained with unit price increased for these, the costs are reduced to:

The evaluation of costs with high durability BNRI-85 tamping tools:
500 km/year : 18 km/set ≈ 27, 8 sets / year
27, 8 sets / year : 5 reconditioning operations/set = 5,6 sets / year
5,6 sets / year x 8 pcs/ set ≈ 45 pcs /year
45 pcs /year x 180 € / pcs = 8.100 € / year - high durability BNRI-85 tools
45 pcs / year x 5 reconditioning operations /year x 50 €/ pcs. reconditioning operations = 11.250 € / year - for reconditioning
TOTAL = 8.100 € / year + 11.250 € / year = 19.350 € / year

The evaluation of costs with high durability P&T 09-32 CSM tamping tools:
350 km / year : 18 km / set = 19, 5 sets / year

19, 5 sets / year : 10 reconditioning operations/set ≈ 2 sets / year
2 sets / year x 32 pcs / set = 64 pcs / year
64 pcs / year x 150 € / pcs = 9.600 € / year - for P&T 09-32 CSM high durability tamping tools
64 pcs / year x 10 reconditioning operations /year x 50 €/ pcs. reconditioning operations = 32.000 € / year - for reconditioning
TOTAL = 9.600 € / year + 32.000 € / year = 41.600 € / year

The evaluation of costs with high durability P&T 08-275 UM tamping tools:
150km / year : 18 km / set = 8, 3 sets / year
8, 3 sets / year : 10 reconditioning operations/set = 0, 84 sets / year
0,84 sets / year x 8 pcs / set ≈ 8 pcs / year
8 pcs / year x 150 € / pcs = 1.200 € / year - for P&T 08-275 UM high durability tamping tools
8 pcs / year x 10 reconditioning operations /year x 50 €/ pcs. reconditioning operations = 4.000 € / year - for reconditioning
TOTAL = 1.200 € / year + 4.000 € / year = 5.200 € / year

GENERAL TOTAL = 19.350 €/year + 41.600 €/year + 5.200 €/year = 66.150 €/year - using high durability tamping tools

Total costs reduction = 106.462 €/year - 66.150 €/year = 40.312 €/year

CONCLUSIONS

Using high durability tamping tools 40.312 € / year are being saved for each 1.000 km of tamping. This justifies from an economic point of view the necessity to study and achieve high durability tamping tools.

REFERENCES

[1]. Plasser&Theurer, *Stopfpickel service vorschrift, ein-u, Ausbau, Regenerierung, S19-01*, Plasser&Theurer, Linz, 1994.
[2]. Plasser&Theurer, *Tamping depth control SDA-03/2-23, Adjusting instruction*, Plasser&Theurer, Lenz, 1994.
[3]. Beşleagă Cr., *Contributions regarding to increase the lastingness of the tamping tools*, Doctorate thesis, Bucharest, 2006.