On the Issue of Technical Re-Equipment of Production Bases of Track Machine Stations of JSC "Russian Railways"

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Abstract. In the proposed work, based on the analysis of the existing technical equipment of the track machine stations production bases and the prospective volumes of laying and removing the rail-sleeper lattice during track repairs, to be offered ways to solve the required development of the production capacities of the link-assembly, link-disassembly, link-repair bases of the track machine stations

1. Introduction

On the Russian railways network, the link technology of overhaul of the track has been adopted, while the volume of overhaul and the volumes of assembly and disassembly of the links of the rail-sleeper lattice (RSL) are equal: what is assembled must be laid, what is removed must be disassembled. The link-assembly and disassembly production is a separate, but integral part of the technological chain of overhaul of the track, produced at the stationary production bases of the track machine stations (TMS) [1-5]. During the peak of the volume of overhaul of the railway track in 1979-1985 in accordance with the policy of the Ministry of Railways, serial production of both link-assembly and link-disassembly technological lines was carried out. During this period, most of the link-assembly and link-disassembly works were carried out at the mechanized production bases of the TMS, consisting of the actual technological line and the infrastructure serving it (gantry cranes, access roads, warehouses, etc.). The termination of the serial production of link-assembly and link-disassembly lines led to the fact that almost all lines in operation today have worked out the standard service life. According to the results of an expert survey, the seasonal productivity of the lines is on average 47.5% of the productivity of the newly installed line. Decrease in the volume of overhaul of the railway track in the period 1985–1994 led to the fact that at the beginning of 2007 the volume of overdue main tracks for overhaul amounted to 19195 km, i.e. 16% of their extended length.

At present, the lines for assembling, disassembling and repairing the RSL have served for 20 years or more and are not suitable for further operation due to significant wear. The operating link-assembly-disassembly-repair equipment is basically both physically and morally outdated, in working order is supported by the enthusiasm of the operators, is not adapted for assembling the RSL on new types of rail fasteners such as ARS, W-30 and requires replacement or, at least modernization. Work on the repair of links and the assembly of railroad switches on a reinforced concrete base is carried out not on specialized, but on adapted stands, using not specialized, but universal mechanized tools.

So, with the urgent need to increase the volume of overhaul of the track to eliminate the expiration of the main tracks for overhaul, the volume of mechanized link assembly and dismantling production,
while maintaining the existing trends, is almost halved. As a result, most of the link assembly and dismantling work will be carried out at primitive stands with a manual mechanized tool, which is unacceptable for a country that has a world priority in the design, manufacture and operation of highly mechanized link assembly and dismantling equipment. One of the main components of the track facilities - the link assembly and disassembly production, involved in the technological process of overhaul of the track, is currently in a phase of stagnation. After the termination of the serial production of link-assembly and link-disassembly technological lines - the main means of mechanization of the corresponding work - practically all lines in operation have worked out the standard service life, are worn out, partially decommissioned, their design is outdated. The consequence of this is a 1.5-fold decrease in the average level of mechanization for the railway network in the railway network - from 0.52 to 0.32. With the policy of JSC «Russian Railways» unchanged in this matter, in the projected volume of overhaul of the track, almost all link assembly and dismantling works will be carried out in a low-mechanized way (the average level of mechanization is 0.2) [6-20].

2. Discussion

The proposed recommendations for the reconstruction of the network of link-assembly and link-disassembly production bases TMS should provide not only a quantitative increase in the park of mechanization equipment, but also qualitative changes in the design and principle of operation of technological lines, in the methodology for determining their locations, in the methodology for managing production resources of the track facilities.

High-performance production facilities should be created on each railway: with workshops for the centralized assembly of a new RSL with reinforced concrete sleepers; workshops for centralized repair of an old-year lattice on reinforced concrete sleepers; lines for disassembling old-year lattice on wooden sleepers; workshops for assembling turnout blocks with reinforced concrete beams; with storage of ballast materials (crushed stone).

On each railway, the basic and auxiliary production bases of the ICP should be identified. To accommodate the equipment of the above industries, the areas and buildings freed up during the centralization of work should be maximally used. If it is impossible to re-equip the vacated premises, with appropriate justification, it is necessary to provide for the construction or reconstruction of sanitary and household and other structures.

The locations of the basic and auxiliary production bases of the TMS should be determined on the basis of a feasibility study by comparing several options. According to the chosen option, in the established order, a project should be developed for each object, while the regional principle of choosing an object is quite acceptable, taking into account the following technological requirements.

Workshops for the centralized assembly of a new rail and sleepers with reinforced concrete sleepers with automated high-performance lines should be as close as possible to the places of production of reinforced concrete sleepers, possibly even at the sleeper plant.

When designing a workshop, the following should be provided: a high level of loading of link assembly lines; an accelerated turnover of materials and a reduced technological reserve; a decrease in transport costs; rational placement of a RSL assembled in the winter period within the railway. Taking into account the seasonality of the repair track works, at the shop it is desirable to have sufficient storage areas for materials and assembled RSL, to have an additional (by calculation) number of rolling stock for transporting the assembled lattice to storage sites at auxiliary production bases and delivering it to the places of work. At the additional production bases of the TMS, only storage sites with cranes for the new and removed track grid should be retained. The rest of the equipment, track development, etc. is taken out of service, the existing premises, if necessary, will be re-profiled. Maintenance personnel are retrained to work in track columns due to the increase in the amount of repair work transferred from track distances to track machine stations.

Workshops for the centralized repair of old-year lattice on reinforced concrete sleepers should be equipped with appropriate lines that allow repairing the entire volume of the RSL removed during the season. In winter, the line should be able to assemble RSL from new materials. Depending on the
condition of the sleepers and fasteners, the repaired lattice can be laid in the path of the 1st and 2nd classes (only with new fasteners) or in the path of the 3-5th classes (in the corresponding a combination of old and new elements). At production bases with workshops for centralized repair of old-year RSL or near them, there should be complexes for the disposal and processing of unusable reinforced concrete sleepers into crushed stone with appropriate equipment, storage sites for receiving sleepers that are not suitable for further operation and materials generated in the process of their destruction.

Lines for disassembling old-year lattice on wooden sleepers are installed, as a rule, on the open area of the basic production base for processing the entire RSL removed during the season. The base should provide equipped storage areas, as a rule, for three types of sleepers, rails, fasteners with the possibility of prompt shipment. One or several basic bases with lines for dismantling old-year lattice on wooden sleepers should be equipped with complexes for the disposal and processing of unusable wooden sleepers with appropriate equipment, storage areas for receiving sleepers, their disposal and recycling. Assembly workshops with blocks of switches with reinforced concrete beams with automated assembly complexes should be located on a production base for this purpose for year-round operation and should be provided with the same conditions during design as when designing workshops for centralized assembly of a new RSL.

Warehouses of ballast materials (crushed stone) should be located within the railway with a capacity calculated in accordance with the annual storage volumes, equipped with sufficient loading and unloading capacities for this, sufficient track development and, if necessary, equipped with increased paths for unloading crushed stone from gondola cars.

Basic production bases for performing one or several types of work on it will allow the most rational use of track equipment for working with links and turnouts in order to maximize its load, rhythmic, including year-round, work of service personnel in industrial production conditions. In addition, the basic production bases will streamline the functioning of the storage facilities for track superstructure materials and products ready for track repair, rationally concentrate the optimal transportation of links and switch blocks to and from the places of their removal during track repair. Auxiliary production bases are intended to perform the functions of storage devices for finished products for maintenance during the repair season of the corresponding sections of the track. Basic bases, on which work is carried out to assemble track links with reinforced concrete sleepers, to repair links with reinforced concrete sleepers, to assemble switches with reinforced concrete beams, must be equipped with workshops to accommodate appropriate equipment. Basic bases, on which work is carried out to dismantle track links with wooden sleepers, can do without workshops for the corresponding equipment, since the lines can provide the TMS with a lattice during the repair season, especially since the old-year materials will immediately be used during dismantling.

For the further implementation of the specialization of production bases, it is necessary to switch to the regional principle of their location without regard to the boundaries of the railways. For example, it makes sense to create basic production base for the assembly and disassembly of RSL with wooden sleepers at the Tynda station of the Far Eastern Railway to service the adjacent repaired landfill of the Far Eastern Railway and Transbaikal Railway. At the same time, the production base of the Skovorodino station of the East Siberian Railway is being transferred to an auxiliary production base. To carry out this work, it is necessary to analyze the location of production bases on a regional basis. As the production bases are saturated with high-performance equipment, it is possible to reduce basic bases, transfer them to auxiliary ones, and liquidate auxiliary bases. At the same time, depending on the availability of warehouse space and the volume of warehouses, basic production bases for certain types of work can perform auxiliary functions.

To equip the basic production bases, instead of the existing physically and morally obsolete equipment for link assembly work and work with turnouts, it is necessary to supply new equipment. Prior to the delivery of new equipment, the existing one must be maintained in working order by organizing its repair [19-21].

New equipment must be of a modern level, must ensure the entire technological cycle of work per shift and must include:
lines for assembling links with reinforced concrete sleepers, reconfigurable for various types of fastenings, with a capacity of at least 100 running meters of lattice/hour;
complexes for the repair of links with reinforced concrete sleepers, reconfigurable for various types of fastenings, with the possibility of assembling links from new materials with various types of fasteners, with a repair capacity of at least 75 running meters of lattice/hour, and when assembled with new ones, at least 100 running meters of lattice/hour;
lines for disassembling links with wooden sleepers with mechanisms for removing anticreeper, dividing crutches by elements, sorting sleepers into three grades, with a capacity of at least 100 running meters of lattice/hour;
complexes for the assembly of switches with reinforced concrete beams, reconfigurable for different brands and types, with a capacity of two transfers per shift.

To provide railways with new equipment, it is necessary to organize its production. This requires:
determine the type and design samples of equipment, using the accumulated experience of design, operation of working samples, design developments;
to distribute the production of equipment by year, taking into account export supplies to the CIS countries and replacing the previously released one, while using feedback constantly updating its technical level;
organize corporate service of manufactured equipment, including its installation and repair;
organize training of service personnel.

To extend the service life of the equipment used on the roads, it is necessary to develop a maintenance and repair system (MRS), which should include organizational, information and technical support. The organizational basis for the implementation of MRS should consist of: a general "Regulation", which establishes uniform requirements for the organization of maintenance and repair for enterprises and organizations operating the existing lines; "Regulations" on the certification of enterprises entitled to carry out maintenance and repair work. MRS information support requires the development of indicators for assessing maintainability, the preparation of "Instructions" and "Manuals" for the maintenance and current repair of operated lines, the development of repair documentation for medium and capital repairs, including repair manuals; technical specifications for repairs; sets of repair drawings; consumption rates of materials and spare parts; regulations for technical equipment. The material support of MRS involves the provision of enterprises with spare parts, materials and means of maintenance and repair at the entire stage of the life of the equipment, which requires a program for the release of the required products and the acquisition of repair funds.

3. Conclusion
An analysis of the current state of the link-assembly and distribution-repair equipment at the production bases of the PMS and the forecast of its moral and physical deterioration shows that, while maintaining the current situation with the restoration of the resource of the existing and the release of new equipment in the near future, approximately 90% of the repair work will need to be carried out in a low-mechanized labour-intensive manual method.

The recommendations set out in this work optimize the costs of track repairs, lead to cost reduction, removal of excess capacity and staff by creating centralized specialized bases (workshops) for the year-round assembly and renovation of enlarged track superstructure elements (RSL links, railroad switches blocks), equipped with the latest automated lines.

4. References
[1] Shtarev S 2002 Link Assembly, Disassembly and Repair Equipment of Track Facilities Basics of Design (Moscow: ASV) p 200
[2] Kudryavtsev E M 1989 Complex Mechanization, Automation and Mechanical Equipment of Construction (Moscow: Stroyizdat) p 377
[3] Lysenko N N 2004 Resource-Saving Technologies and Means of Their Implementation for Transportation, Replacement and Laying of Continuous-welded Rail Strings on Non-backing Fasteners: Dis. Cand. Tech. Sciences (Moscow: MIIT) p 294

[4] Novakovitch V I 2005 Non-welded Track with Super-long Rail Lashes (Moscow: Route) p 142

[5] Белтыуков В П 2013 Path and Track Facilities 2 23

[6] Novakovitch V and Korpachevsky G 2020 Path and Track Facilities 7 20

[7] Певзер В О 2018 Scientific Foundations of the Track State Control System (М Moscow: РАС) p 54

[8] Поздеев В Н 1971 Design and Optimal Placement of Production Bases of Track Machine Stations (on the Example of the West Siberian Railway): Dis. Cand. Tech. Sciences (Novosibirsk) p 214

[9] Исаев К 1976 Proc. of the Central Research Inst. of the Ministry of Railways 532 102

[10] Михайловский Г И 1970 Research and Selection of the Main Parameters of Sets of Machines and Equipment for Track Production Bases; Dis. Cand. Tech. Sciences (Ленинград: ЛИИИИ) p 216

[11] Мироненко Е, Залавский В, Хадукаев Н, Журавлева Т и Коржахакова А 2020 Path and Track Facilities 11 27

[12] SP 119. 13330.2017 1520 mm Gauge Railways (Moscow: Standardinform)

[13] Дымкин Г и Етиген И 2015 Path and Track Facilities 4 17

[14] Novakovitch V and Karpachevsky G 2015 Path and Track Facilities 7 25

[15] Орлов Я А и Егиязарян А В 1986 Production Bases of Track Machine Stations (Moscow: Transport) p 151

[16] Ерадзе Д Г 1982 Calculation and Design of the PMS Production Base (Ростов-на-Дон: РИИЖТ) p 24

[17] Instructions for the Assembly, Laying and Operation of Tracks with Various Modifications of Rail Fastening of Reinforced Concrete Sleepers on Reinforced Concrete Sleepers 05.04.2018 approved by order of JSC "Russian Railways" 689

[18] Album of Track Designs for Various Operating Conditions 30.12.2016 approved by order of JSC "Russian Railways" № 2735

[19] Марголин А И, Кныш В Д, Скрипачев И Ф и Бунин А И 2009 Patent № 2374377 RF Е01 В29/02 Method of line assembly of turnouts Bul 33

[20] Марголин А И, Кныш В Д, Скрипачев И Ф и Бунин А И Line for the repair of railway track links with reinforced concrete sleepers 2009 Patent № 2361032 RF Е01 В29/24 Bul 19

[21] Абдурашидов А Я, Атаманюк А В, Бредюк В Б и др. 2019 Track Machines (Moscow: UMTs ZhDT) p 960