



REQUIREMENTS SUBSTANTIATION FOR RESPONSIBLE PURPOSE STEELS USED IN RAILWAY TRANSPORT

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Abstract

The growth of requirements for the properties of steel, as a rule, outstrips the development of technological techniques aimed at improving the purity of the metal. As a result, it is necessary to further search for effective ways of refining, alloying and modifying steel. In this regard, the development of new technological methods of smelting and out-of-furnace processing, allowing effectively refining and modifying steel, is an urgent task. Most machines, machines and parts are subjected to cyclic loads during operation. Therefore, the problem of endurance of materials is relevant for railway, automotive, aviation, shipbuilding, machine tool, energy and other industries.

Keywords: side frames, side frame break, steel production, casting properties, fluidity, mechanical properties, operational properties, modification, micro-alloying.

1. Introduction

Improving the operational and technological properties of industrial products, improving the technical level and quality of products is one of the main tasks of science, technology and modern engineering. The continuous tightening of





requirements for the reliability of structural elements makes it necessary to analyze in more detail the specific conditions of their work. Most machines, machines and parts are subjected to cyclic loads during operation. Therefore, the problem of endurance of materials is relevant for railway, automotive, aviation, shipbuilding, machine tool, energy and other industries.

The increase in freight traffic in the world places increased demands on steel used for the manufacture of railway parts and poses new challenges in the field of metallurgy, while reliability and durability are the most important of them. The fulfillment of these requirements determines the competitiveness of products in the relevant segment of the railway transport market. Currently, in the CIS, a model 18-100 trolley and its modifications are used as a trolley of a freight car (Figure 1).

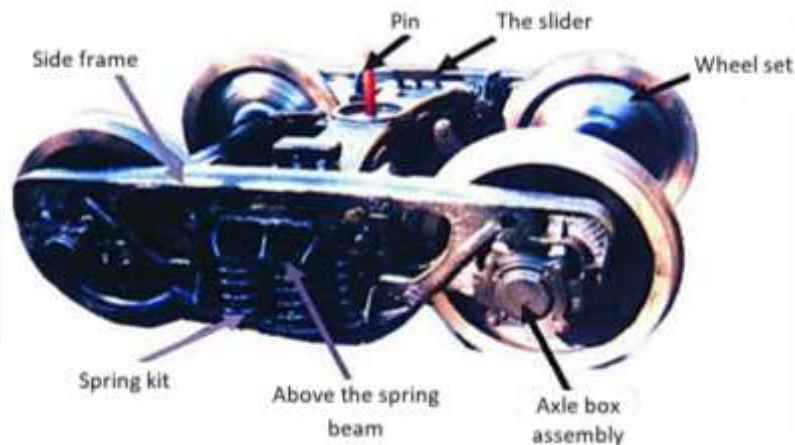


Figure 1 - General view of the trolley model 18-100

One of the main components of this design is the "side frame" (Figure 2), because it combines into a single system a spring beam, spring suspension, wheel pairs with axle assemblies and mounted braking equipment. The "side frame" is cast from 20GL steel according to GOST 32400-2013.



Figure 2 – General view of the part side frame of the trolley model 18-100:



1 - Technological opening, 2 – technological opening, 3 - middle opening (spring), 4 - friction strips, 5 - axle box opening, 6 - tide for the brake surface, 7 - support surface for the brake kit, 8 - axle guides (jaws)

2. Methods

According to statistics on railway transport, with the growth of freight traffic, the problems of cast parts of model 18-100 trolleys have increased dramatically and over the past 10 years, the fractures of the side frames have increased.

In operation, there are mainly two types of fractures - brittle and fatigue. The main factors contributing to these fractures are: reduced mechanical properties of steel; disadvantages of steel smelting and deoxidation technology and imperfection of casting technology and steel casting, leading to the formation of volumetric structural imperfections and an increased number of non-metallic inclusions in steel. The fracture leads to its decommissioning, respectively, to economic losses, and most importantly, if a defect is detected belatedly, it can lead to human casualties.

Despite changes in the design and manufacturing technology of the side frame in order to reduce the risk of accidents on railways, the number of problems associated with this defect does not decrease, and in some cases increases.

3. Results and Discussion

The Central factory laboratory of the Subsidiary "Foundry and Mechanical Plant" made decisions to study the causes of the fracture. Analysis of the fracture site of the side frames (Figure 3) showed that in most cases, the content of harmful impurities in the fracture area increased, which led to an increase in the fragility of the metal, in particular sulfides and phosphides. Therefore, the main prevention of fracture is the regulation of the content of harmful impurities in the metal.



Figure 3 – Side frame break



Traditional methods of out-of-furnace metal processing during the smelting of the initial intermediate product, both in arc and induction furnaces, have a number of restrictions on the degree of refining from impurities such as phosphorus, sulfur, oxygen, non-metallic inclusions and others, largely determining the quality of the finished metal products.

The growth of requirements for the properties of steel, as a rule, outstrips the development of technological techniques aimed at improving the purity of the metal. As a result, further search for effective ways of refining steel is necessary.

As is known, the chemical composition of steel is among the main parameters that determine the mechanical properties of the product, the optimal combination of which determines the operational durability and reliability of parts. The side frame of the trolley is cast from low-alloy steel 20GL, 20GFL or 20FTL. There are several modifications of steel for the side frame, but their compositions are close. Usually it is 20GL or 20GFL.

For parts undergoing operational wear, it is necessary to choose the optimal combination of all mechanical properties, including at low temperatures, since castings are operated, including in the regions of the far North. The mentioned tasks can be solved by choosing the optimal chemical composition of steel, its modification, micro-alloying and parameters of heat treatment of steel castings for railway transport, providing high mechanical and operational properties of castings taking into account the growing requirements.

4. Conclusion

The problem of the quality of the side frames of freight cars has recently become extremely relevant for everyone who has a fleet of freight cars. A potential threat to the safety of train traffic, in particular, is cases of breaking of the side frames of trucks of freight cars.

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