

Innovative Decisions at Steel Semifinished Items Metal Restructuring in Mechanical Engineering

*Ganiev Mahmut Mashutovich, Astashchenko Vladimir Ivanovich,
Shveyov Andrey Ivanovich and Shveyova Tatyana Vladimirovna*

Department of Energy and Information, Kazan Federal University,
Naberezhnye Chelny, Russian Federation

Abstract: Kinds of defects in cast steel and their influence on properties of an alloy are resulted. Stability of structural heterogeneity and liquating phenomenon at the stage of technological restructuring of steel is shown. Decisions are offered on liquation of line and isle structural heterogeneity, preservation of a fine-grained structure and localization of separate metallurgical defects in steel products.

Key words: Inovative • Steel • Technological • Fine-grained structure

INTRODUCTION

So far steel remains the basic constructional material and increase of its consumer properties is the problem causing technical progress of mechanical engineering. Undoubtedly, the basis of these properties is pawned in metallurgical manufacture and first of all, due to the chemical elements in steel content and its macro and microstructures. At technological restructuring of metal in a system «cast product - rolling - forging - detail», efforts of experts at each separately taken stage of process should be directed on preservation and strengthening of those content and structure parameters which favorably influence properties of a steel product and on reduction or full elimination of negative effect. Special attention should be paid to chemical compound of steel as this parameter is fully inherited by final products.

During machines and mechanisms designing details the basic purpose is pursued, that is a combination of minimally possible weight and costs of a product with its reliability and durability. One of decision of such problem is maximal use of properties resource in the given material.

The purpose of work is development of technological and technical decisions in mechanical engineering manufacture, directed on macro and microstructures in steel products favorable formation. The dominating attention in the decision of this problem is allocated to

liquidation questions of undesirable structural displays in steel and localization of defective zones inherited from metallurgical manufacture. Those features are the rests of cast structure, liquating strips and liquating square, porosity, line and isle structural heterogeneity, anisomorous structure, etc.

It is known, that presence of striation in a metal ware leads to deterioration processing steel by the edge tool, namely adverse chip forming is observed, surface cold working and surface processing cleanliness is decreased at cutting [1, 2]. Besides such heterogeneity serves as the reason of the hyper deformation and detail shape distortion at chemical and thermal processing [3-5].

It is necessary to eliminate striation at stages of thermal processing at forging manufacturing - stages of hot plastic deformation or at thermal processing. Pearlite strips are steady enough against heating. According to researches, the most comprehensible variant of this problem decision is annealing perfection, namely maintenance sufficient heating temperature for homogenization and creation of necessary cooling speed of products from austenitization temperature up to temperature of the minimal austenite stability in pearlite area. They are kept in steel if austenitization is carried out at temperature $Ac_3 + (100 \div 150^\circ C)$. For their liquidation in carburized alloyed steel the austenitization combination is sufficient at temperature $AC_3 + (100 \div 150^\circ C)$ and the

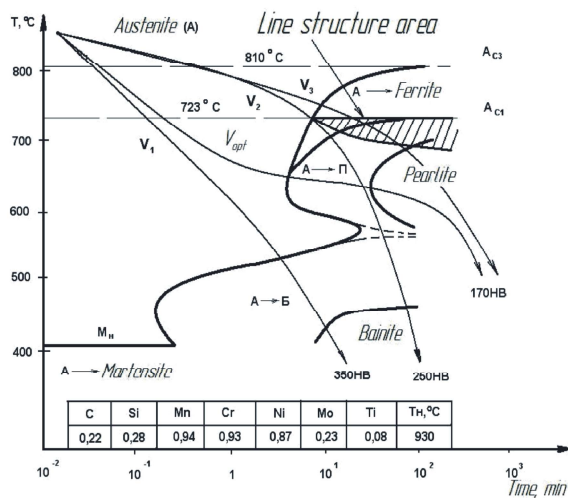


Fig. 1: The diagram of austenite isothermal transformation and a striation display zone in steel 20XrHMTA

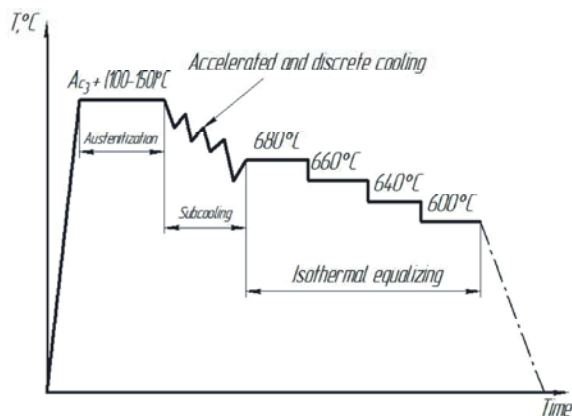


Fig. 2: The scheme of billet annealing from carbonized steel

subsequent cooling with the set speed. It is established that striation in steel is inherited from metal rolling in full if during annealing A speed of forging cooling after austenitization does not exceed 8°C/min. In case of cooling with a speed more than 23°C/min it is possible to eliminate this structural heterogeneity completely. Experimental results and a long production experience have allowed establishing striation display pattern in steel 20XrHMTA depending on temperature and time parameters of its thermal processing (Figure 1).

Chemical micro heterogeneity, also as well as structural striation, negatively influences on edge tool processing stock steel and, especially, on drawing operations, gear milling and deep drilling. (Chip forming, stability of the tool and surface cold working serves

cutting processing criteria). Adverse presence of these phenomena at metal rolling can be liquidated at a stage of thermal forging processing. For this purpose the unified annealing way is developed and introduced (Figure 2), including austenitization at temperature 950±10°C, accelerated and discrete cooling up to temperature 680±10°C and the subsequent endurance with step downturn of temperature under the scheme 680-660-640-600°C. Time of endurance at each temperature makes 120-150 minutes.

The long production experience has shown, that the given technology of forging heat treatment from steel 15XrHM2TA, 20XrHMTA and 18XTP eliminates striation, stably forms ferrite and pearlite structure with precisely expressed borders of grains and provides hardness within the limits of 156-207 HB. Thus, pearlite microhardness makes 196-320 HV and ferrite microhardness -143-210 HV. In case of a difference in microhardness between these structural components no more than 80 HV the best processing parameters are observed by forging cutting by edge tool on automatic machining transfer lines. It is also necessary to notice that these cast structure features in a greater degree define technological properties of steel, so necessary at its restructuring in mechanical engineering manufacture [6, 7].

From the point of view of reliability and durability of details in operation the key attention of experts should be given to the size of grain and such metallurgical features as porosity, liquation square and impurity by nonmetallic inclusions, liquation strips and other imperfections of cast structure.

CONCLUSION

- Thermal stability of steel grain structure is defined by an alloy chemical compound, namely by presence of refractory elements and (or) its micro alloying with special elements. For KAMAZ truck gearbox parts and axles steel 18XrHMTA is introduced micro alloyed by aluminum and nitrogen.
- Line and isle micro liquation are eliminated at steel thermal processing including high-temperature austenitization, the accelerated cooling up to temperature 680-600°C with the subsequent endurance at step downturn of temperature under the scheme 680-660-640-600°C. The technology is introduced in KAMAZ Inc. for low-carbon alloyed steel forgings.

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