BASIC CONCEPTS AND SCOPE OF APPLICATION

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ABSTRACT

Special steels are iron-based alloys that differ from ordinary steels in special properties due either to their chemical composition, or to a special method of production, or the way they are processed. The presence of one of these factors is sufficient for the steel to be called special. Most often, special steels are characterized by all three features. This also applies to alloyed steels with a high content of alloying elements [2].

Scientists and technologists have been studying the properties of steel for a long time. In 1851, for the first time by the Russian scientist metallurgist Anosov P.P. the law on the relationship between the structure and properties of metals was discovered, which gave a great leap forward for the origin of steels with special properties [2]. Comparing the macrostructure of the produced damask steel with their cutting properties, Anosov P.P. wrote: "If it is easy to cut a gas scarf in the air with a cranked and mesh damask steel, then I can do the same with my damask steel." In his work on damask steel, he wrote: “an admixture of manganese to steel in small quantities up to 1/200 of a fraction does not produce a visible change in it, and if its content is increased to 1/100 of a fraction, then the steel will become harder, more brittle and generally coarse. With an increase in the amount of manganese to 1/50 of a fraction, the steel becomes so brittle that upon impacts it pricks along the length, according to the direction of the layers of its components...","chromium and especially titanium, with the same amount, harm steel less than manganese "[1]. Anosov's research and conclusions about the influence of various elements on the properties and structure of steel remained valid for a century. The law on the interconnection of the structure and properties of metals was developed in the works of D.K. Chernov. He was the first to point out the existence of critical temperatures and their dependence on carbon concentration. Then the foundations of the theory of alloying steels were developed. Steel with new properties was obtained. I.N. Bogachev and his co-workers developed new cavitation-resistant steels with unstable austenite. Currently, the country produces over 1000 different grades of steels, and the share of special steels is steadily growing every year.

General trends in world development in the production of special steels show that at present, intensive research and development are underway in the field of casting and wrought alloys and steels with special properties, raw materials, initial components for their production and technologies for their processing into high-tech science-intensive products with a large share of innovative component. Moreover, the main directions of development of special electrometallurgy abroad are: 1) Improving the technology of smelting and remelting special metal, units, control and process control systems, to ensure the quality of the metal, increase the yield and reduce costs. 2) Creation of new, less costly technologies for the production of special metal "ground" (not the aerospace industry) application, for a significant reduction in the cost of metal. Currently, more and more attention is paid to the production of special steels and alloys by powder metallurgy. The prospects for the development of powder metallurgy are primarily associated with the creation of new, lightweight, durable composite materials and nanostructured coatings. Creation of hard-alloy materials with a nanostructure will improve the cutting properties and physical and mechanical characteristics of the material by at least 2–3 times, and the application of coatings using nanopowders can increase the service life of products by 5–6 times [4].

According to the Strategy for the Development of the Metallurgical Industry for the Period up to 2020, the focus of innovation policy should gradually shift from the tasks of securing enterprises in the world metal products market (the main priority of 1990-2006) to the tasks of mobilizing development potential (priority until 2015) and in further - to provide conditions for improving the technical level of the domestic metallurgical industry (priority 2010-2025). Moreover, based on the "Strategic directions for the development of materials and technologies until 2030", it is envisaged to develop technologies for obtaining ultrapure ultrafine powders with respect to impurities and ceramic inclusions based on a new generation of titanium, intermetallic, niobium and nickel alloys, including "extra" -powders for laser LMD surfacing (granulometric composition 40-80 microns), ceramic-like titanium alloys, working up to a temperature of 700 ° C, as well as the creation of a competence center (technology transfer) for powder materials and additive technologies [5].

Hundreds of steels and alloys are known in metallurgy with outstanding performance characteristics. At the moment, there is no unambiguous classification of them, due to the fact that in many cases steel is classified as a special one, even according to one of the three indicated characteristics: - by chemical composition; - by the method of production; - by the way of processing. In terms of chemical composition, special steels primarily include iron alloys alloyed with nickel, chromium, tungsten, molybdenum, vanadium, etc., for example, stainless steels with a content of more than 13% chromium and additives of nickel, molybdenum, and others [6]. In the production and heat treatment of such steels, the character of alloying is of great importance. Alloy steels are called iron alloys, to which certain amounts of alloying elements are added in order to obtain a number of special properties. Depending on the amount of alloying additives, steels are subdivided into: - low-alloyed (the amount of additives does not exceed 2.5%); - medium alloyed (additives from 2.5 to 10%); 9 - highly alloyed (additives over 10%). During the production of unalloyed steel, along with the charge (including scrap), various alloying elements, for example, nickel, copper, chromium, involuntarily enter. In total, their number is about 0.5%. These impurities, as a rule, have a negligible effect on the properties of steels and can therefore be neglected. Mistakenly, these began to be called doped. At the same time, sometimes an insignificant addition of an alloying element, even in an amount of 0.1% or less, introduced into a certain steel, allows this steel to be considered alloyed [6].

Which are subdivided, depending on the furnaces used, into: converter, open-hearth, crucible and electric arc furnace. The choice of a particular production method depends on the purpose of the steels (field of application). For example, steels with a content of 0.6–0.8% C and about 0.6–1% Mn for mass production, for example, for hardenable rails, are smelted by the converter method or in the main open-hearth furnaces of large capacity. Steels of approximately the same chemical composition, which are used for the manufacture of dies, cutting tools, etc., can be smelted either in open-hearth furnaces or in electric furnaces. Investigation of the effect of minimal amounts of impurities of such elements as nitrogen, oxygen, sulfur, hydrogen and phosphorus on the properties of iron alloys makes it possible to determine the features caused by the steel production process. The study of metallurgical laws shows that in most cases the characteristic properties of alloys, due to the chemical composition and, in particular, small amounts of impurities, can be achieved only as a result of using certain methods of producing these alloys. Thus, special steels by the method of production (taking into account the influence of insignificant amounts of impurities) can be considered simultaneously as special steels in terms of chemical composition.

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