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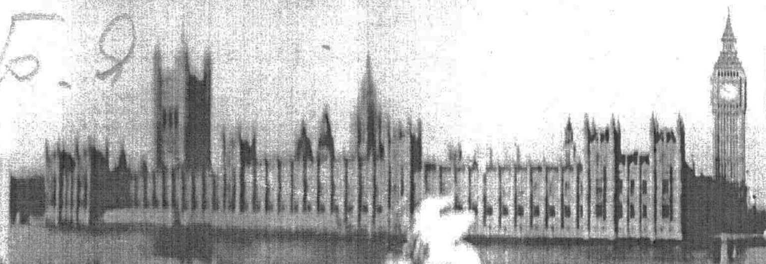

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THE TECHNOLOGY OF SYNTHESIS THERMITE ALLOYED STEEL

Introduction. Thermic reactions have been known for more than a century and are used to produce ferroalloys, to heat exothermic castings, to heat seal, to weld special coatings, etc. In the 1930s, for the first time, a method was proposed for obtaining liquid steel by burning a thermite mixture, and two decades later M.Z. Zolkover et al. [1] points to one of the first introduction into the industrial practice of foundry production of aluminothermic melting of steel and the production of shaped castings on its basis. Taking into account the data of the studies [2], the authors developed and carried out the production of various carbon steels as a result of the aluminothermic reduction of iron scale with addition of carbon and ferroalloys to termite.

Theoretical and experimental parts. Termite steels "20ГЛ"..."35ГЛ", "30ГЛ", "30ГСЛ", "32ХО6Л"..."40ХЛ", "20Х5МЛ" (with perlite-ferrite structure) and "20Х5ТЛ", "40Х9С2Л" (with a martensitic structure) have been obtained on the basis of special alloys of exothermic charges. The chemical composition and mechanical properties of these steels have been studied after standard thermal treatment - normalization. The practical data was found that the introduction of more than 20% of the additives in termite leads to the termination of the separation of the thermite metal and slag under conditions of laboratory termite micromelting at a weight of up to 300 g. The charge for exothermic burden of 10 to 50 kg the additive content in it can be increased to 25...30%, for mass of batch from 100 kg and above, up to 45% of additives can be introduced.

The stable chemical composition of thermite steel largely determines the stability of its mechanical properties. Therefore, the issues of controlling the content of oxygen, hydrogen, aluminium, sulphur and other elements in the thermite alloy are of particular importance. The change in their content in the thermite metal can be carried out in two technological ways: 1) after the sampling of the iron scale to determine its chemical composition and the FeO, Fe_2O_3 content, the necessary amount of aluminium and is calculated according to the stoichiometric ratio; 2) the strong divergence of the obtained required ratio of FeO and Fe_2O_3 in iron scale, additional oxidation (firing) at a temperature of 300-450°C is carried out.

The content of hydrogen and sulphur in the metal is kept within the permissible limits by calcination of iron scale, degreasing and drying of aluminium chips to remove moisture residues, cutting fluid, oils, etc. The reduce of effect on high-temperature thermite metal and to eliminate the associated high porosity and shrinkage in castings, inert admixtures-iron chips and ferroalloys-were introduced into the composition of the charge (provided that the combustion temperature of the charge remains above 2400 K – the melting point of aluminous slag). In order to increase the stability of combustion and improve the kinetic characteristics of the course of reactions, 1...2% (by weight of charge) of the fluorspar CaF_2 was introduced into the charge composition. It not only reduces the ignition temperature of the exothermic powder mixture, but also increases the yield of the metal from it. On the basis of the microfluids carried out, the dependence of the assimilation of carbon (in the form of silver graphite) and other elements on the termite metal was revealed; which was necessary to obtain the required chemical composition of the thermite steel when calculating exothermic charges.

The alloys for synthesizing can be used not only for the metallothermic method of obtaining castings, but also for termite high-temperature gradient technologies. The borne should be in mind that in the profit-making area, there is a mixing of the thermite steel and the steel poured into the mold.

The continuation of the research was aimed at determining the effect on the structure and properties of the casting of termite steel, depending on its quantity. The data of the analysis of mechanical properties and microstructure (table 1) allow us to conclude that the termite steel is not inferior to these parameters of the foundry, and the impact toughness it exceeds by 14-20%, which is associated with additional pre-oxidation and microalloying of the alloy with aluminum charge.

Table 2 -The mechanical properties of mixed steel[1]

Content of thermite steel in mixed,%	σ_m, MPa	σ_B, MPa	σ, %	ψ, %	KCU, J/cm^2	Ball grain
0	305	430	32	56,4	1100	1
1	305	440	34	60,6	1160	2
2,5	315	430	34,5	69,4	1300	4
5	355	450	36,0	70,0	1320	4

[1]Mixed steel is a steel consisting of ordinary steel smelted in an electric arc furnace and a thermic furnace.

The continuation of the research was aimed at determining the effect on the structure and properties of the casting of termite steel, depending on its quantity. The data of the analysis of mechanical properties and microstructure (table 1) allow us to conclude that the termite steel is not inferior to these parameters of the foundry, and by the impact toughness it exceeds by 14-20%. Addition of thermite steel to conventional sharply reduces the grain size in the cast state.

Conclusions. As a result of the study of thermally alloyed steels, it was possible to show that their mechanical properties differ from the properties of steels obtained by the traditional method. It should be noted that the impact strength of the first is 20-50 higher, which is explained by the finer-grained structure of the termite metal, well deoxidized and modified with aluminium. The possibility and expediency of using exothermic charges containing oxides of alloying elements in place of their ferroalloys is shown, which, in principle, allows any kind of steel or alloy to be smelted in this way.

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