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## EXPERIMENTAL RESEARCHES OF TECHNOLOGY OF SETAA

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A technological scheme is elaborated and the series of the research melting are conducted on the experimental setting which confirmed expediency of application of technology of the secondary electro-thermal alloying and affinage (SETAA). The optimal electric modes, and also conformities to law of influence of time of self-control, strengths of current and voltage, are set on chemical composition of metal and speed of processes, what be going on at SETAA. It is shown that application of SEAR for polishing steel with content of silicon to 0.75 % is economic justified.

Keywords: metal, slag, alloying, affinage, charge

At the analysis of distribution of sulphur between a metal and slag at the process of electro-slag remelt by a direct current repeatedly was a question about possibility of the use of settings a «stove-scoop» for the secondary alloying and affinage of steel. It was shown that coefficient of distribution for sulphur  $(S)/[S]$  changed more than in two times at the change of polarity for the voltage attached to the electrodes. But because of absence of adequate physical and chemical models for the multicomponent systems «metal-slag-gas» it is impossible it was effectively to manage this process, and remain only empiric possibilities for development of separate technological receptions, keeping indoors for the limits of this metallurgical aggregate, this technology of smelting, set brand steel and set composition of slag.

Electrochemical correction to activity of elements in a slag, entered first in works of prof. A. Ponomarenko, allowed substantially to improve predictive possibilities of physical and chemical models of the system «metal-slag» and to approach it's to the level of requirements, produced to the intellectual kernel of ASMTF of industrial metallurgical aggregates. Subsequent introduction in the model of the system «metal-slag-gas» of enthalpy thermal balance with the inalienable calculation of last temperature and new thermodynamics model of the condensed solutions opened practical possibilities for development of theoretical bases and technology of fundamentally new processes, such as a secondary electro-thermal alloying and affinage (SETAA) in the process of treatment of metal in a stove-scoop.

The fundamental element of theory of SETAA is a curve of electroneutrality (CE) on which position of points for separate elements in relation to abscise axis is reflected ability of slag in its conditions to take in or give an element. If a point of element with positive valency is below than this axis, then an element aims to pass to the slag. It not case this element aims to pass to the metal or gas. Elements with negative valency pass to the slag in case if a corresponding point is higher than abscise axis. Couple position of points for elements on CE is reflected the order of oxidiza-

tion or renewal for elements at the change of oxidized/reduced potential of the system.

If to reveal to the slag a positive charge, then an equilibrium in the system will be displaced toward the increase of degree of the deoxidation system, that will result in renewal of elements with positive valency from a slag. At the same time there will be desulphurizing, id est moving away of sulphur from a metal and absorption it by slag, as sulphur has negative valency. If an electrode, submerged in a slag, is a cathode, conditions are created for the dephosphorization of metallic fusion. The ordinates of elements on CE allow to estimate the size of voltage, necessary for creation of reduced or oxidizing conditions on the known geometrical configuration of slag layer and electro conductivity of slag.

For sustaining a theory SETAA was conducted series of the research melting on the experimental setting.

At realization of melting there are used the flux of ANF-28 next composition:  $CaF_2$  - 44 %,  $Al_2O_3$  - 5 %,  $CaO$  - 29 %,  $SiO_2$  - 22 %. Charge was placed in graphite crucibles by a diameter a 40 mm, high in a 60 mm with the conical restriction in the bottom part. Composition of charge: 75 g St 3 steel, 75 g ferrous powder, 50 g flux. Tamman stove preliminary was warmed up on power 50-60 % of nominal size, and then it is increased to 90 % for achievement of the set temperature 1550 °C in working space. Stove standed 20 min. to the complete melting of charge and bringing the system over to the equilibrium. Then it is connected to source of direct-current : «+» to the graphite electrode, submerged in slag fusion, and «-» - on conducting graphite crucible through a graphite electrode and brace. The source of direct-current was connected to the electrode-anode by means of steel wire. For decrease of hit of volatiles components of slag in air the stack of stove during realization of the research melting was covered by the folios of asbestoses.

Given voltage varied from 12 to 30 V, and strength of current from 1.5 to 5.0 A. The volt-ampere description was taken of the experimental setting with a molten metal and slag.

Fusion was maintained under a current from 20 to 35 min. A charge which passed through a «metal-slag» system made, thus, from 1800 to 10500 Coul at power from 18 to 150 W. After disconnecting of voltage from electrodes Tamman stove turned off, a graphite electrode is extracted, and after cooling and samples of metal and slag are take. The samples of metal cleaned out from the bottom part and sent to the chemical analysis.

There are analyzed the conduct of separate elements in the process of SETAA.

*Carbon.* At self-control of fusion during 20 min a metal is satiated by a carbon to the level of 2.2 % at co-operating with porous graphite crucible. At the key-in of current through a slag content of carbon in a metal notedly goes down due to a reverse process. It is explained by positive valency of carbon and positive polarity of electrode submerged in a slag.

*Manganese.* A manganese at self-control of metal without a current (20 min) partly oxidizes and passes to the slag as  $MnO$  oxide. At the feed of current the same manganese is restored. However due to small maintenance of oxide of manganese in a slag are changes small.

*Aluminium.* An aluminium begins to restore to the level about 0.02 % at the skipped charge more 3000 Coul. However in connection with that an aluminium on the curve electroneutrality is below than silicon, the quantity of the recovered aluminium is comparatively small.

*Sulphur.* Sulphur has negative valency in a slag, therefore at the key-in of current of positive polarity through a slag it aims to pass from a metal in a slag. As a result content of sulphur in a metal in experiments 4 and 5 decrease more than in two times. Thus, the process of renewal for elements with positive valency is accompanied by the accessory desulphurizing of metal.

*Phosphorus.* Change of content phosphorus in a metal is insignificantly, because, at first, on the curve of electroneutrality he is higher, than silicon both an aluminium and displacement of the crooked electroneutrality at the feed of positive voltage on an electrode does not almost influence on this element. Secondly, content of phosphorus in the flux of ANF-28 very small.

*Silicon.* With the increase of charge, according to Faraday law, quantity of the restored silicon is increased. However comparing of actual curve with theoretical curve, expected by Faraday law is shows the systematic exceeding of the restored quantity of silicon on 0.39 % as compared to Faraday law. It specifies on that the output of the restored silicon has two constituents: electrolysis (on Faraday) and equilibrium in accordance with the curve of electroneutrality.

The series of the experimental melting confirmed that application of the secondary electro-thermal alloying and affinage for polishing steel with content of silicon to 0.75 % is economic justified. More over, technology of SETAA and at higher content of silicon in a metal also can be economic advantageous, if to take into account the concomitant desulphurizing of metal. It is appears expedient to continue experimental researches of SETAA technology for more detailed study of conduct of other alloying elements and development of basic parameters for the industrial setting.