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THE ANALYSIS OF THE CARBON ATTENDANCE IN COPPER ALLOYS

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Preliminary Note – Prethodno priopćenje

In the work show, that opinions the leaning on it dissolubilities of carbon can be recognized (and only in approximation) only for copper about large purity. They do not concern it her mostly multiple alloys, at which the majority of alloy additions marks with possibility of creating carbides. Equally important the possibility of creating of carbides of accidental dirts is. The analyses DTA of slags be remain showed with part of carbon and carbides. Introduced and investigation own arguments authorize to conclusion that the technological process of fusion of copper alloys does not it be to characterize in relation with separate guilds to different alloys and should to be to hold on valid in steel - makes principles.

Key words: copper alloys, carbon refining, extraction slag, DTA, porosity

Analiza prisutnosti ugljika u bakrenim slitinama. U radu se prikazuje mišljenje koje se odnosi na topljivost ugljika te se mogu potvrditi (i to jedino aproksimativno) samo za bakar velike čistoće. Ne razmatraju se njegove većinom višestruke slitine kod kojih većinu legiranih dodataka označavaju kao moguće tvorce karbida. Jednako je važna mogućnost stvaranja karbida sa slučajnom nečistoćom. DTA analiza preostale troske pokazuje da je jedan dio s ugljikom a drugi s karbidima. Uvedeni i istraženi vlastiti argumenti vode k zaključku da tehnološki proces taljenja bakrenih slitina ne karakterizira vezu s pojedinim cehovima prema različitim slitinama već ga treba zadržati kao valjan za osnove proizvodnje čelika.

Ključne riječi: bakrena slitina, rafinacija ugljika, ekstrakcijaska troska, DTA, poroznost

INTRODUCTION

It proves that there is a big discrepancy in the opinions on the structure and the basic features of slag (S) as well as the essence of their interaction with refined metal (M) and the atmosphere (A) of melting (Figure 1). There are three methods of slag refining in the copper alloys melting conditions: the oxidising [1], the neutral and the alternative method of melting copper and its alloys in conditions of reduction with an activator (R) introduced into the slag [2-5].The active components of melting atmosphere influence the processes taking place while slag refining. An alternative for that methods is gas-slag refining [6-8] in where the concentration of impurities extracted by the slag is obtained. Most of the experiments have shown that in this way is possible to achieve optimum economic and technological results.

The problem of interfacial reaction between liquid slag and metal has been presented. On the basis of the analysis of the problem and the results of the author research [9,10] it is stated that the most promising are the reducing conditions of refining. In the previously works author [9] has been presented scheme of interaction of chemical reagents in the melting copper conduction as:

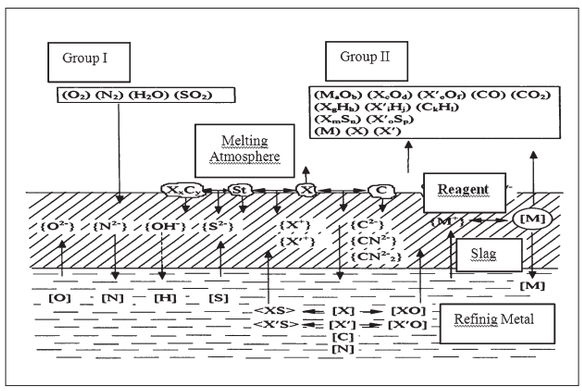

Figure 1 A proposed scheme of refining process (real conditions under the cover) of a liquid metal with a carbon-carbide-cyjanamide slag solution, where: ( ) – gas, X - reagent ,St – reaction stymulator, { } – ions in the slag, [ ] elements in the melting metal

carbide compound, metal, cyjanamide or carbon. The paper presents the analysis of the ion reaction in to the slag during refining process with calcium carbide, oxygen, nitrogen and carbon. It proves that there is a big discrepancy in the opinions on the calcium and carbon role in the slag and their interaction with refined metal and the atmosphere of melting. Author shows on the most

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important role of the carbon $\{C^{2+}\}$ and $\{C^{4+}\}$ ions on the effectiveness of carbide slag metal extraction process.

EXPERIMENTAL, RESULTS AND DISCUSSION

Basic reaction describing the carbide dissociation mechanism is:

$$\{X_m C_n\} \rightarrow \{X^{m+}\} + \{C^{n-}\} \quad (1)$$

To stand of carbon as of ion $\{C^-\}$ is impossible acceptable, because element this having construction $1s^2$ s^2p^2 can create following ions:

$$\{C^-\} \rightarrow \{C^{2+}\} + 3e \quad (2)$$

$$\text{or} \quad \rightarrow \{C^{4+}\} + 5e \quad (3)$$

$$\text{or} \quad \rightarrow \{C^{+}\} + 2e + 1e \quad (4)$$

$$\text{or} \quad \rightarrow \{C^{4-}\} - 3e \quad (5)$$

Described with equalizations 2-5 ionic reactions explain specificity of influence of carbon in carbide slags. Show, that his melting and strong influence reducing results from occurrences in slag mostly of ions $\{C^{2+}\}$ or $\{C^{4+}\}$. Released in this manner in slag electrons are main link in mechanism exchanges of ions on border of distribution of phases slag-metal. In consequence after carbon dissolution in including oxygen alloy is possible setting reaction :

$$[C] + [O] = (CO) \quad (6)$$

It taking into account reactions 2 and 3, the figure of oxygen ions was put in to the liquid metals how $[O^{4+}]$ as well as $[O^-]$. It the possibility of setting reaction was put additionally (6). Because carbon (how in reaction 6) in solution of copper alloys come from carbides of alloy additions (mainly M'C), it can the total figure of ion reactions of carbon monoxides formation have figure:

$$[M'C] + [O] = [M'] + (CO) + 2e \quad (7)$$

With introduced reactions (6) and (7) it is possible to bring in, that possible is forming gas blisters - (CO). They can be one of main causes of casts porosity. According as with theory of segregation during solidification in layer diffusive comes to crossing of value of dissolubilities. It has similarly how in steel - makes in ingot moulds, this to lead to dissolved reaction carbon and oxygen (how at 7).

The oxygen can also react with the carbon in solid state, coming from for example from facings of stove. It melting near absence of oxygen in atmosphere such reaction were it been possible to record:

$$[O] + < C > = (CO) \quad (8)$$

Over presented analyses' found affirmance in founders' opinions many times. It was affirmed the difficulties of procurance from alloys with the silicon, nickel, alluminium whether the iron the casts without gas blisters. Exchanged alloy additions create carbides. The increased content of carbon be moved also the porosity in melting of alloys with different additions (Table 1).

Table 1 **The Results of the chemical analysis and the mechanical properties of the B555, B101 alloys**

Alloy	Kind of crucible	[O] / ppm	Porosity %	[C] / ppm
B555 CuSn5Zn5Pb5	ceramic	12	1,1	0-10
	graphite	49	1,8	—
B101 CuSn10P	ceramic	10	0,7	0-10
	graphite	86	3,2	10-20

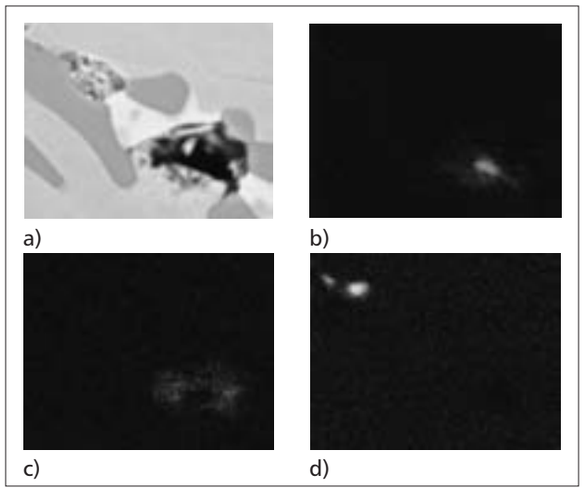

Figure 2 Microanalysis of chosen components of bronze (a) the be drowned in graphite crucible BK331: b) - carbon, c) - silicon, d) - iron

If more rathe desoxygenation such alloys did not accomplished deep, then reaction had to set (8). Numerous blisters were in cast effect. In the melting atmosphere the wide part of CO/CO_2 and the vapors of the component alloy (M') or their oxides (M'O) was observed. The author's test and industrial investigations shown the significant contents of carbon in some metallic phaze. The microanalyses' of silicon bronze confirmed clear contents of carbon, mainly near smelting in graphite crucibles (Figure 2).

On the basis of the thermo gravimetrical measurements an original methods, which modulates real conditions of reacting, was elaborated [1,9]. On the basis of this measurements system a method of interpretation the slag property was proposed. The method enables estimation of refining features of slag (S). In the experiments with derywatograph refined alloy is replaced with non-metallic inclusions (WN) in the melting pot. The inclusions are introduced into the slag in proportions which respond with the melting losses of the alloy. Al_2O_3 standard is proposed to be replaced with S+R (where R-reducer) refining sample. This made it possible to achieve thermal and mass effects concomitant with reduction reactions of WN which are is in the slag. The analysis of slag containing WN [4] allowed to establish the possible combinations of EW and r values to-

a) b)

Figure 3 Probe - the macro (0,5x) of the industrial BK331 ingot before (a) and after (b) carbon-carbide slag (with the carbon powder)

gether with a proposed explanation. On the basis of calculations it was also found that due to the differences in vaporisation or reaction with the atmosphere of compositions the simultaneous consideration of two values (r and EW) is necessary.

Proposed numerical indexes of EW and r are regarded as a measure of refining abilities of the whole system A-S-WN-R. It enabled optimisation of alternatives of WN interactions with carbides and carbide-originating metals in slag of various different chemical compounds.

It has been described the influences of same alloys compounds on the structure, properties and segregation effect of the ingot. The experiments on bronze melting with the slag refining proved that optimum is achieved. For example for silicon bronzes are selected refiner with calcium carbide, carbon and aluminium as the complex reagent (Figure 3). The reducers of this kind not only make it possible to keep a constant deficit of impurities in the slag layer but also let carbon in the melting atmosphere. The efficiency of eliminating oxygen out of the melting atmosphere is much bigger – 10^{-6} –10^{-9} hPa oxygen partial pressure. The author slag constitution with the carbon reagents has been applied in metallurgical and foundry conduction.

SUMMARY

The active components of melting atmosphere influence the processes taking place while slag refining An alternative for that methods is gas-slag refining in where the concentration of impurities extracted by the slag is obtained. Most of the experiments have shown that in this way is possible to achieve optimum economic and technological results.

On the basis of the analysis of the problem and the results of the author's research it is stated that the most promising are the reducing conditions of refining. In the previously works author has been presented scheme of interaction of chemical reagents in the melting copper conduction as: carbide compound, metal, cyjanamide or carbon. The paper presents the analysis of the ion reaction in to the slag during refining process with the metal carbide, oxygen, nitrogen and carbon. It proves that there is a big discrepancy in the opinions on the calcium and carbon role in the slag and their interaction with refined metal and the atmosphere of melting. Author shows on the most important role of the carbon $\{C^{2+}\}$ and $\{C^{4+}\}$ ions on the effectiveness of carbide slag metal extraction process.

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Note: The responsible translator for English language is professional lecturer from West Pomeranian University of Technology, Szczecin, Poland