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TIN BRONZE SMELTING PROCESS FROM BRIQUETTED BORINGS

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The paper refers to the smelting process of tin bronze, directly and only from borings collected and briquetted on grades in view of casting into parts for machine-tools, and also in bars used for bimetallic parts execution.

It is known the tin bronze smelting process, - (1) – where the load consists of primary alloys manufactured in specialized metallurgical companies, from own (recycled) waste, from pure metals and hardening alloys and from modifiers.

The disadvantage of this process is that, besides the own waste and primary alloys there are also prescribed pure metals and hardening alloys for smelting .

It is known the tin bronze smelting process, - (2) – where for smelting it is used pressed recycled material, broken material, casting networks, STAS composition blocks, primary metals (cathodic copper) and fusible components, tin, zinc, lead.

The disadvantage of this process is that, besides the broken material and recycled material, there are also used fusible components, STAS composition blocks and also cathodic copper in the process.

It is known the tin bronze smelting process, - (3) – where for smelting there are used primary metals, that is cathode copper in the form plates sized 1/3 of furnace diameter, preheated at 150 – 200^0 C, respectively from tin cut in pieces of max. 3 – 5 kg, and also preheated at 150 – 200^0 C.

The disadvantage of this process is that prescribes the tin bronze smelting from elements, which is an expensive process and needs a lot of preparatory prior operations.

It is known the tin bronze smelting process, - (3) – where are prescribed own production wastes for smelting, and also accompanied with a recasting for refining due to the large extent of waste impurities. For this purpose it is used nitrogen or argon, which are introduced in smelt under a controlled pressure in quantity equal to 2-3 metal volumes. In view of eliminating the impurities in the form of volatile compounds, the smelt is chlorinated, the quantity of chlorine is of 1-5 volumes with respect to the smelt subject to refining.

The disadvantage of this process is that it can not be largely applied in production because during chlorination appear very powerful toxics within the work space.

Also, it is known the tin bronze smelting process, - (6) – where is prescribed tin smelting from wastes, as well as scrapings together with blocks.

The disadvantage of this process is that besides the use of scrapings it also prescribes the use of STAS composition blocks for the bronze smelting .

Also, it is known the bronze borings using procedure , - (4) – in executing the bimetallic bushings following the recasting in steel supports through the high frequency currents or arc heating procedure.

The procedure has lots of disadvantages due to many prior operations of preparing the borings – magnetic separation, calcination, complete alkaline cleaning, washing, drying, weighting, pressing in supports.

The method corresponding to the proposed procedure eliminates the mentioned disadvantages by bronze smelting directly with tin and only from bronze borings briquetted on grades, without other prior operations or other charging materials.

After all the bronze marks were directed to only one workshop for mechanical processing, their remaking takes place in accordance with the operations schedule on grades, on cutting machines perfectly clean from oil or other impurities, isolated from one another with screening walls, in order to avoid combination of different grades of borings, therefore the borings are strictly collected based on grades.

The resulted borings, clean and without impurities, is briquetted on grades at 160 atm. pressure in briquettes having 140 x 40 .... 80 mm size and specific weight of 5.85 g/cm3.

Out of these briquettes are smelt the superior tin bronzes in flaming furnace with black-lead crucible, taking into consideration that in these furnaces very fast smelting can be obtained and bronze keeping at high temperature, especially local overheating, can be avoided because at the side and underneath heating cannot appear the local overheating due to thermal convection currents, which are formed inside the bath, the alloy having a higher temperature next to the walls goes up, and the colder alloy from crucible axis area goes down. Thus, the heating transmission through conductibility is replaced by convection transmission, with a higher efficiency, which also shortens the charge duration, according to fig. no. 1.

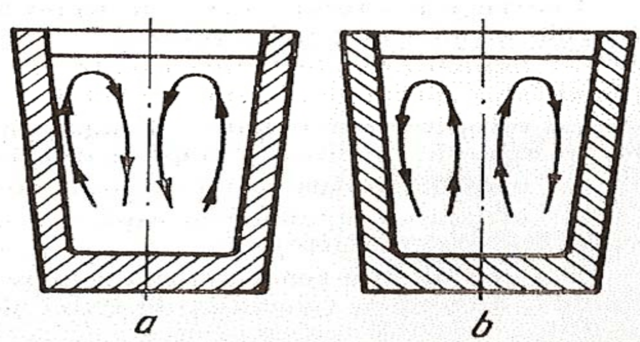

Fig. 10.9. Formarea curenţilor de convecţie în aliaje la elaborarea în creuzete:
a — la încălzire; b — la răcire.

Convection currents formation in alloys in the melting parts. a) heating b) cooling

The load is based on borings briquettes of pressed bronze with the following properties: Cu Sn 12 T, Cu Sn 10T, Cu Sn 10 Zn 2T, Cu Sn 9 Zn 5 T, Sn 6 Zn 4 Pb 4 T, as casting flux it is used: the CUPROM flux for deoxidation, ZGUREX for slag collection, and also potassium tetraftuoroborate KBF4 for modification.

Taking into account the burnings 5.5 ... 5.8% resulted from the experiments performed, the secondary alloying elements resulted from borings recasting, the quality of bronze made of the same borings quality shall be smelt only when the alloying elements values are the minimum of the average values indicated in STAS 197/2 – 76, because in these cases the respective burnings do not diminish these values under the lower limits of the values indicated in STAS.

In the case when the secondary alloying elements values are under the average values indicated by STAS 197/2 – 76, which shall be determined each time by the laboratory through 3-4 tests, taken from different parts of the borings provided for briquetting, the briquettes properties shall be combined for the smelting of a certain type of bronze, of superior quality with the chemical composition stipulated in STAS.

In annex I there are various combinations of loads of briquetted borings types, for the smelting of a certain type of superior bronze, the quantities and percents are given for charge quantities of 250 kg, taking into consideration the respective adherence, the alloying elements

Annex I

1. Cu Sn 6 Zn 4 Pb 4 Alloy smelting
(charge of 250 kg)

Variant I				Variant II				Variant III			
CuSn6Zn4Pb 4		CuSn9Zn5		CuSn6Zn4Pb 4		CuSn10 (CuSn10Zn 2)		CuSn6Zn4Pb 4		CuSn12	
kg briquette	%	kg briquette	%	kg briquette	%	kg briquette	%	kg briquette	%	kg briquette	%
220	88	30	12	230	92	20	8	235	94	15	6

2. Cu Sn 9 Zn 5 Alloy smelting
(charge of 250 kg)

Variant I				Variant II				Variant III			
CuSn9Zn5		CuSn10		CuSn9Zn5		CuSn12		CuSn6Zn4Pb 4		CuSn10	
kg briquette	%	kg briquette	%	kg briquette	%	kg briquette	%	kg briquette	%	kg briquette	%

120	48	130	52	205	82	45	18	30	14	220	86

Variant IV			
CuSn9Zn5		**CuSn6Zn4Pb4**	
kg briquette	%	kg briquette	%
102	41	148	59

3. Cu Sn 10 Zn 2 T Alloy smelting
(charge of 250 kg)

Variant I				**Variant II**				**Variant III**			
CuSn10Zn2		**CuSn12**		**CuSn9Zn5**		**CuSn12**		**CuSn6Zn4Pb4**		**CuSn12**	
kg briquette	%	kg briquette	%	kg briquette	%	kg briquette	%	kg briquette	%	kg briquette	%
175	70	75	30	112	45	138	55	58	23	192	77

4. Cu Sn 10 Alloy smelting
(charge of 250 kg)

Variant I				Variana II			
Cu Sn10		**Cu Sn12**		**Cu Sn10 Zn2**		**Cu Sn12**	
kg briquette	%	kg briquette	%	kg briquette	%	kg briquette	%
175	70	75	30	175	70	75	30

5. Cu Sn 12 Alloy smelting - Cu Sn 12 alloyshall be smelt from borings only when the average Sn content is of 12% in borings briquettes, taking into consideration that the STAS 197/2 – 76 stipulates a content of 13 – 11 %.

The method in accordance with the indicated procedure, provides the following sequence of operations for superior bronze smelting from briquetted borings:

- cleaning the black-lead crucible and read heating
- loading on the bottom of the CUPROM preheated crucible 1% of the charge

weight, 2.5 kg if the crucible is of 250 kg and read flux heating

- loading the borings briquettes until the crucible is filled up:
- quick melting 2.2 – 2.5 h and as the briquettes are melted and go down, other preheated briquettes should be added, keeping the crucible filled up;
- slag collecting with 0.5% ZGUREX after the melt alloy reached 1200^0 C temperature;
- gas removal with 0.5% TRIPEX slowly immersed in the bath, with a black-lead bell to the crucible bottom, the reaction will last 3 ...5 minutes.
- modification with potassium tetraftuoroborate KBF4 2.5% also slowly immersed in the bath, with a black-lead bell, the reaction will last 3 ...5 minutes.
- slag removal with 0.5% ZGUREX, afterwards the bath surface is bestrewn with ZGUREX;
- the alloy casting (after maximum 5 minutes of modification) into the ladle where the phosphorous copper CU-P9 is introduced 0.5% of alloy weight, its minimum temperature will be 1160^0 C ;
- ZGUREX is sprinkled on the preheated ladle bottom before pouring into it the alloy and also on the alloy's liquid surface, after pouring it into the ladle; the slag film formed because of zgurex, on the liquid alloy's surface in the ladle is active and continuously contributes to inclusions collection.

In executing these operations, the following rules shall be strictly observed:

- any type of humidity of the tools, crucibles, etc, shall be avoided;
- the flame shall be adjusted for slight air excess, the poorly oxidized atmosphere serves for diminishing the dissolved hydrogen content and produces the non-metallic impurities oxidation, that go into slag;
- the fasted melting shall be administered, maintenance of high temperature and especially the overheating shall be avoided;
- any useless movement at the bath surface shall be avoided;
- the falling hight of the metal jet shall be reduced to minimum during casting into ladle and also during casting into forms;
- the working tools used for melting shall be covered with paint, black-lead bell for gas removal, carefully dried-up;
- only completed dried up additions shall be used and only the stipulated grades.

After the casting of bronze pieces, smelted from bronze borings, shall be applied a thermal treatment of homogenization annealing at the temperature of 600^0 C, maintaining for 2 hours followed by slow cooling. This annealing' s purpose is to eliminate the dendroid segregations pf fragile phases, and also of the dendroid segregations of chemical inhomogeneities. In the case of bimetallic pieces, which were executed from bronze bars casted from bronze smelted from borings, it will be applied the thermal treatment of stress-relief anneal at the temperature of 200^0 C, maintaining for 1 hour followed by slow cooling, taking into consideration that after brazing (plating) they were cooled by water.

This method application provides the following advantages:

- integral reusing of tin bronze borings;
- minimum loss because of few prior operations;
- any superior bronze smelting strictly from the properties of briquetted borings;
- parts execution from bronze or bimetals with a removal coefficient over 90 %, if we take into consideration that the borings resulted from processing are reused;
- minimum burnings and short smelting because of the provided smelting

processing;
- bronze smelting without STAS composition blocks, without primary metals or hardening alloys;
- obtaining compact parts (pieces) with superior mechanical properties following the provided thermal treatment of annealing.

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