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USING THE REFRACTORY CAST IRONS AT CASTING PARTS FOR HEAT TREATMENT FURNACES

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ABSTRACT: The paper present the possibility of using refractory cast irons at the casting of parts for heat treatment furnaces. It presents the chemical composition and mechanical characteristics, as well as metal load used to elaborating this type iron in induction furnace. The paper also presents optimal molding-casting technology to obtain a casting part of this cast iron.
KEYWORDS: refractory cast iron, castings, induction furnaces, mould

INTRODUCTION

Refractory cast irons is alloyed irons generally used to work at 1100°C temperature regim. The main property of refractory cast irons is the resistance la increased volume and resistence to oxidation. More than that must have good creep resistance, thermal shock resistance and higher mechanical characteristics at high temperatures. Depending on main alloy element, refractory cast irons are classified in cast refractory alloy with: Cr, Si, Si şi Cr, Al [1].

For Roumania, the STAS 6706/79 to provide 11 grades of refractory cast irons. This standard establishes: domanins of use, chemical composition and mechanical characteristics of refractory cast iron [2].

Iron FrCr04 (table 1) has the following applications: parts working in air and gas at high temperatures. For examples: displacement system of hearth heat treatment furnaces, opening-closing system gas generators, grids, recovery pipes, furnece cooling frames, etc. [1,2]

Table 1. The chemical composition of pig iron Fr Cr 04.

C%	Si%	Mn%	P%	S%	Cr%
3,1-3,7	1,6-2,4	max. 0,9	max. 0,25	max. 0,12	0,25-0,60

Brinell hardness (HB) = max. 245; Breaking strenght (Rm) = min. 180 N/mm^2

Structure and form of graphite: ferrite, carbides and lamellar graphite.

MATERIALS USED FOR REFRACTORY CAST IRON ELABORATION

Elaboration of refractory iron used for casting parts is studied is done in induction furnace. The iron charges were produced in an induction furnace of DSN-3 type, with basic lining, with a nominal capacity of 1500 kg [1].

For syntethic iron to be elaborated the metallic charge contains 30% iron scrap and 70% steel scrap (table 2) [1,2,3]. The chemical composition of total slag is presented in the table 3.

The materials used to making an iron charge, i.e. metal charge and added materials are presented in the table 4. Iron scrap and steel scrap containing 0.3 – 0.5 % moisture and splinter scrap containing 1% water and oil [1,2,3].

Table 2. The material in charge

The material in charge	Chemical composition, %						Participation %
	C	Si	Mn	P	S	Cr	
Liquid iron	3.5	2.2	0.6	0.2	0.1	0.4	30
Scrap iron for re-use	3.5	2.2	0.6	0.2	0.1	0.4	20
Scrap iron	3.9	2.5	0.8	0.6	0.1	-	10
Steel scrap	0.49	0.35	0.73	0.04	0.05	0.3	40

Table 3. The chemical composition of total slag

Component	SiO_2	MnO	CaO	P_2O_5	FeO	Other
Value, %	60	14	6	0,08	7	12,92

Table 4. The materials used to making a iron charge.

Material	Quantity [Kg]	Grade	Chemical composition, [%]						
			C	Mn	Si	P	S	Cr	other
Liquid iron	410.68	FrCr04	3.5	0.6	2.2	0.2	0.01	0.4	-
Scrap iron for re-use	273.79	FrCr04	3.5	0.6	2.2	0.2	0.01	0.4	-
Scrap iron	136.89	-	3.9	0.8	2.5	0.6	0.01	-	-
Steel scrap	547.59	OL 70	0.49	0.73	0.35	0.04	0.05	0.3	-
Ferroalloys	4.62	FeCr	0.008	73.0	0.7	0.01	0.01	26.18	Al= 0.09
	1.58	FeSi	0.10	0.50	96.7	0.04	0.04	0.20	Al= 2.5
	8.40	FeMn	0.4	85.4	1.8	0.26	0.02	-	-
Materials for carburizing	41.72	Scraps electrod	92.8	-	-	-	-	-	7.2
Materials for desulphurisation	18.53	CaC_2							
TOTAL	1443.8	F_rCr04	3.5	0.6	2.2	0.2	0.01	0.4	-

PRESENTATION OF THE OBTAINING TECHNOLOGY A REFRACTORY CAST IRON CASTING

The casting "WEARING RING" studied (figure 1), is cast of the refractory cast iron, FrCr04 (STAS 6706-79). This piece is a subset of the displacement system of mobile hearth of the heat treatment furnaces.

After analyzing the finished piece design (figure 1) is established molding technology for parts analyzed [3,4,5]. Thus, choose of the piece separation plan, this surface is flat and casting position is horizontal (figure 2) [3,4,5].

After determining the size of additions contraction, constructive inclinations and core marks dimensions, is determined configuration and dimension of the pattern. The pattern is executed from wood and is presented in figure 3 [3,4,5].

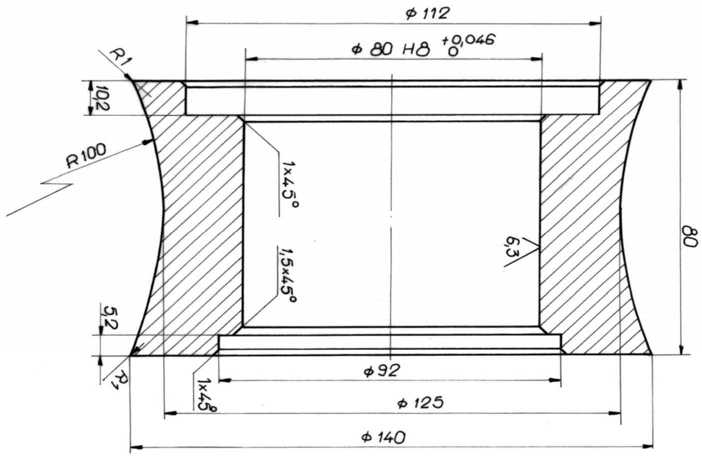

Figure 1. The finished piece design (Wearing ring)

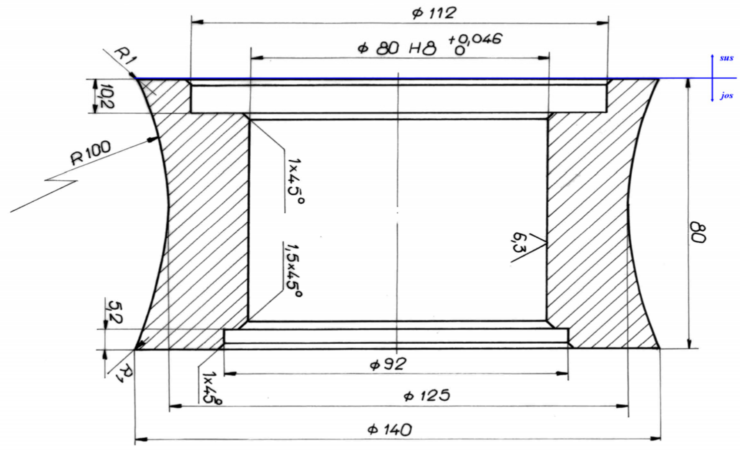

Figure 2. Choosing separation plan

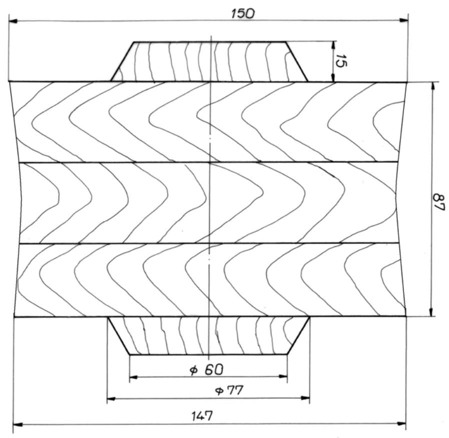

Figure 3. The pattern wood necessary to obtain cast part

THE PLAN OF OPERATIONS FOR MOULDING-CASTING PARTS

In order to molding is running the technological operations as follows [3,4,5,6]:

1. *Place the pattern on the mould board and placed the mould jacket (bottom) and then do powdering with insulation powder. Tamp down filling mixture in layers, using molder's mallet; the excess of molding material shall be removed with a wooden or metal rule. With a vent rod run vents then mould part returns to 180°.*
2. *By blowing clean the entire separation surfaces of pattern and a mould part with a brush then mounted the second part of the pattern which is provided, for this operation, two taps. The following is mounting upper mould part over the bottom, then venting patterns, made of wood. Powdered with insulation powder then tamp down filling mixture in layers, using molder's mallet and the excess of molding materials shall be removed. Run vents with steel rod.*

3. *Upper mould part rises and returned to 180^o, after which the patterns is extracted from the upper mould part and bottom mould part. Follow execution for any repairs of mould cavity.*
4. *Bottom mould part is placed to the ground, on a bed of mould mixtures and installs in this mould part the cores (cores were executed separately for core box). After the execution this operation upper mould part is mounted and assembled (closed mould) using screws.*

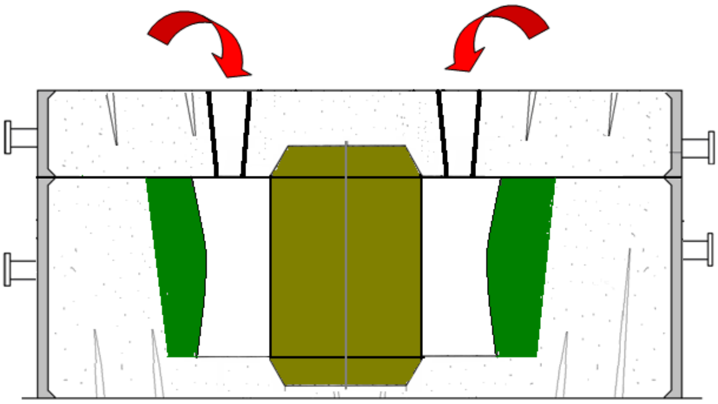

Figure 4. Assambled mould for casting

5. *The mould is consolidated by placing a weigh which rests upon well mould part and not on the molding mixture after which the liquid alloy is poured through the venthole (figure 4).*

6. After solidification of the alloy following the casting shake-out and then the casting is sent to processing workshop for final configuration by mechanical processing.

CRITICAL ANALYSIS OF MOULDING-CASTING TECHNOLOGY

If you make a critical analysis of current moulding tehnology of casting analyzed we find some deficiency:

- ☐ *Very high consumption of core mixture because side-core location. Order to remove this inconvenience can be established a new technology by which to eliminate this side-core, the provision of added processing the sides of the part. After casting part, by machining processing, as well as the addition processing can be removed, by making sure the configuration outside of the workpiece.*

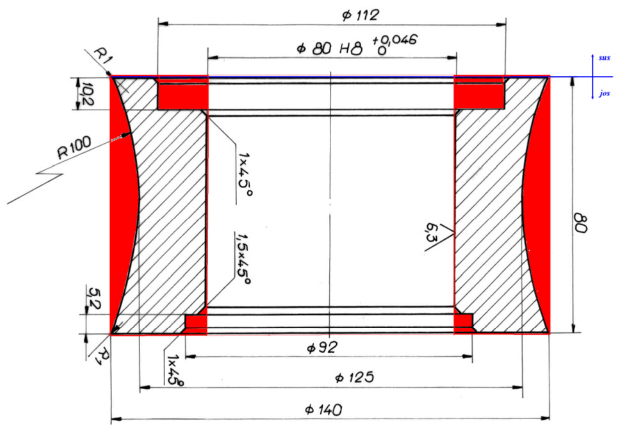

Figure 5. Presentation of added processing on technological design

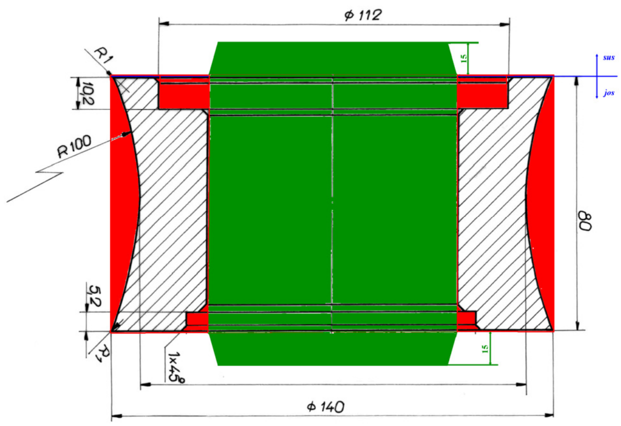

Figure 6. Vertical cylindrical core marks

- ☐ *Changing the configuration pattern, thanks to this technology changes*
- ☐ *Changing the configuration mould cavity, after eliminating side core.*

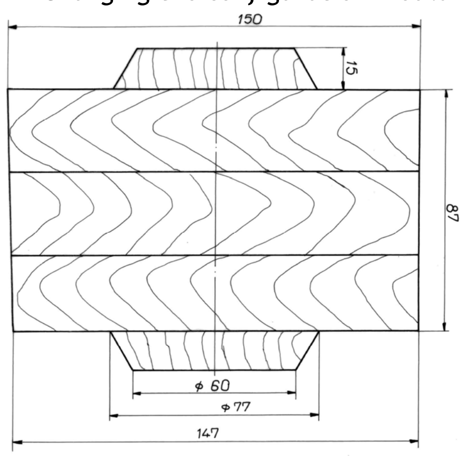

Figure 7. The patern of wood designed to obtain casting

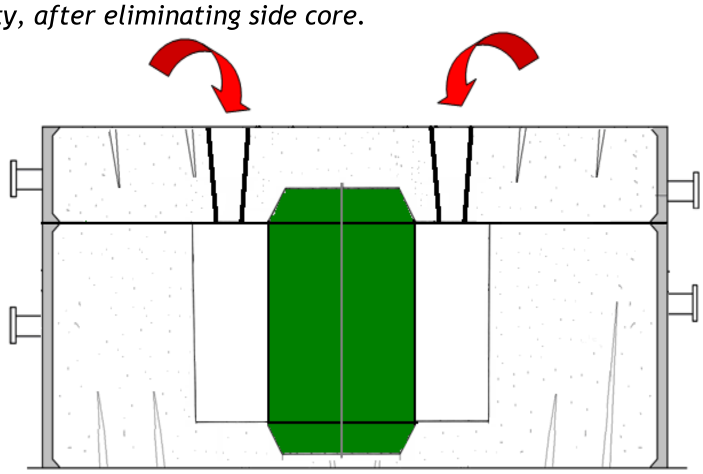

Figure 8. Assembled mould for casting

CONCLUSIONS

In general, the elaboration of refractory cast iron steel FrCr0,4, intended for casting the studied piece within a metallurgical enterprise does not raise particular problems, but there must be made a critical control of the process of elaboration of the alloy in view of obtaining quality castings.

The iron making in furnaces heated electric induction has some advantages from the point of view metallurgical:

- *Loss by burning lower (0,5 to 3,0 %) in comparison to those registered to other furnaces (which reach 8-10 %);*
- *Possibility to use a load that can recover waste small metal scrap (splinter);*
- *The iron making in induction furnaces have values of characteristics physico-mechanical higher by about 10-20% as compared to those obtained in other furnaces, at identical loads;*
- *Can be obtained iron with a low sulf;*
- *Decreases contents of non-metallic inclusions;*
- *Are possible advanced overheating (and controlled) of cast-iron;*
- *Decrease the level of air pollution in the atmosphere in and around the foundry.*

Changing technology moulding-casting of casting analyzed leads to:

- *Reducing the consumption of a mixture core*
- *Reducing the consumption of the mixture of filling of the mould*
- *Decrease of labor for the execution of the mould and the core*
- *Reduce the price of production of casting analyzed.*

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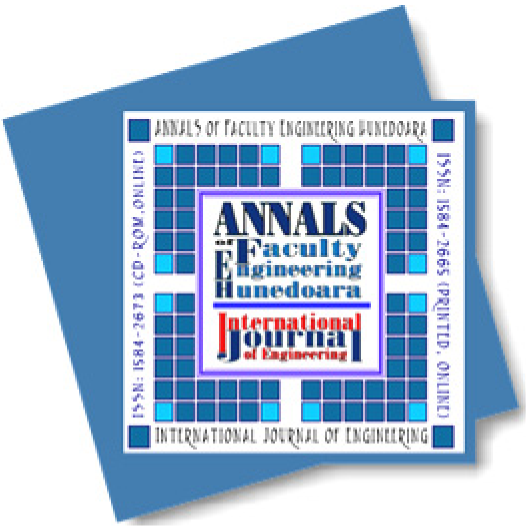

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