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MAKING CAST PIECE USING EXOTHERMIC HEAD

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ABSTRACT

In this paper presents a study about cost of part obtained with exothermal heads by replacement of classic heads. This method contributes to conduct solidification of cost pieces, because exothermal heads are forecast witch mixture cover witch at connection with liquid alloys gives off warmth, effect of exothermal reactions between these components.

KEYWORDS: exothermal head, yield index

1. Introduction

Casting alloys are one of the most important branches of metallurgy, casting by achieving the most pieces of ferrous and nonferrous alloys.

Pieces obtained by casting included in the composition machines, installations and appliances shall conduct of everyday life. In ferrous alloys, foundries growth yield index represents an essential objective to efficient economic growth, because they enable reduction of specific consumption of materials. |Through of method we can save a lot of energy, materials and labour. In the steel case, which is on alloy with a large volumic contraction, to obtain one ton of good parts, the consumption is 1,5…2 tons of liquid metal. This consumption means increase materials energies and other materials consumption and the cost of is growth up most production. The loss of metallic material is in heads and represents 40…80% from cast parts mass. If heads mass is diminish with 45%/tone metals economic of cost part, we can optined an energies of 150…300kW and 300…500kg.

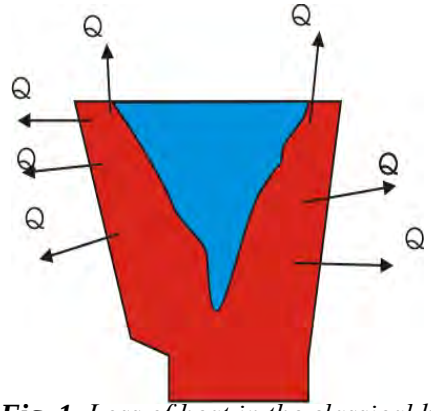

***Fig. 1**. Loss of heat in the classical heads*

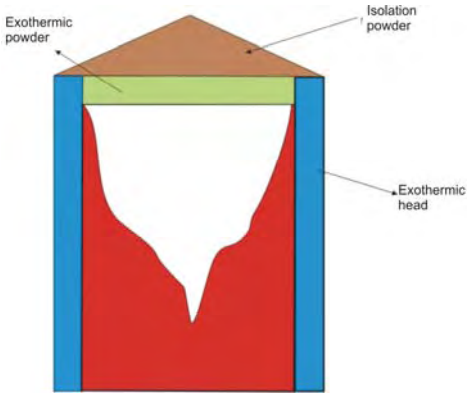

***Fig.2.** Loss of heat in the exothermic heads*

The yield index or efficiently to use of metal η_s represents the rate between of good cast parts quantity M_p and quantity liquid metal M_l.

$$\eta_s = \frac{M_p}{M_l}.100 = \frac{M_p}{M_p + M_{rt} + M_m + M'}100[\%] \quad (1)$$

where:

M_p – good parts cast mass,
M_{rt} – consumption metal in cast network,
M_m – consumption metal in heads,
M'- consuption metal in drops and rejects.

The first ways to diminish the metal consumption are:

- the reduction of metal looses because of rejects
- the reduction of metal looses throw drops
- the reduction of metal looses for header of parts.

For increase of yield index we can diminish the rate between M_m/M_p, that means the grow of head efficiently.

This efficiently is characterize by use index of metal in the head C_{um}[%] and yield index η_s[%] in function of used types of head.

Table 1 *The efficiently of exothermal and thermo isolate heads used*

Alloy	Reduction of head mass [%]	Increase of yield index
Steel	30-50	10-30
Iron	50-60	15-35
Cooper alloy	40-55	20-30
Aluminium alloy	30-40	25-35

We can appreciate the used of exothermal and thermo isolate heads, we can accomplish big reduced of metal consumption by comparing with others technological measures. The diminish of technological and processing addition a new and good chrematistic for casting equipment and improve the quality of forming mixtures.

2. Stages realization castings piece using heads exothermic

Studied piece is made from steel T55MoCN16 mark and is meant for grinding coal to central heating. The chemical composition of steel T55MoCN16 mark is show in table 2.

Table 2*.Chemical composition*

C	Mn	Si	P	S	Cr	Ni	Mo	Al
[%], min								
0.62	0.6	0.2	-	-	1.1	1.4	0.2	0.02

Steps to achieve benchmark are presented in the following photos:

Fig.3. *Casting benchmark*

Fig.4. *Casting technology by using exothermic heads*

***Fig.5**. Casting piece*

In the next table is shown the yield index for different types of heads.

Table 3

Head types	C_{um}	η_s
	[%]	
Open head	< 0.08	
Close head - with atmospheric pressure, - with gaze pressure	0.08 – 0.14 0.14-0.18	55-60 60-65
Thermo isolate head	0.18-0.25	65-70
Exothermal head	0.25-0.33	70-75

For obtained of good temperature gradient between head and casting part we can used of exothermal mixtures.

Exothermal head have a coating from mixtures who at touch with liquid alloy who give of warm. This warm is come from exothermal reaction between the metal components.

Exothermal heads is divided in two types:

- with a little gradient of temperature 50-100K,
- with a big gradient of temperature 400-500K.

The warm give of from exothermal mixtures is coming from reduced of oxidation reaction this reaction is divided in three categories:

- Goldschmith reaction (the burn of aluminium under the action of one oxide, iron oxide or iron mineral),
- burn reaction of aluminium under the action of air oxygen or because action of chemical combination who produced oxygen,
- burn reaction of organics materials (wood burn, milling wood),

Goldschmith reaction is produced with equations:

$$2Al+Fe_2O_3=2Fe+Al_2O_3+ Q$$
$$2Al+3FeO=3Fe+Al_2O_3+ Q$$

Some mixtures (Feedex types) is based on partially aluminium burn under oxygen action.

In this case thermal effect is bigger that the mixtures based on Goldschmith reactions. The reaction is instantaneous but less violent.

It is necessary an exactly doses of aluminium and the materials who have oxygen is very small. Than results from stoechiometrical calculus. This mixture burn immediately after the head feeling with metal and the cost is bigger than the materials like aluminium and iron oxide. That is happed because growth of contained in alcalines azotates. The necessary materials to produce the composition of exothermal head is divided in five groups :

- activities components who enter directly in oxidation reaction (aluminium powder) aluminium splinter and ferrousilicium powder),
- oxidations components who insurance necessary oxygen to exothermal reactions developed like ferrum oxide, manganous oxide, iron mineral, potassium azotates and sodium azotates,
- catalytics (specially andded for burn process dryving, fluoride of alkaline metals, criolite and furnace powder),
- inert components (who stopped the exothermal reaction and decrease the temperature,
- binding materials.

Exotermal mixture are choice on the alloy nature (iron steel and nonferrous alloys) by parts geometry and casting conditions.

The exothermal mixtures must accomplish other conditions like.

a) the exothermal coating must be enough resistant at the mechanical tension of metal liquid,

b) the mixtures must to be easy modeling modeler and to have a great stability to the ignition temperature .

Exothermal powders for covering hinder the warm waste throw these zone and also for help maintained the atmospheric pressure in superior zone of head. The commercial name is Ferrux HD powder.

The material used for covering the superior zone have next rates and proprieties:

Al=25-27%,
C=8-10%,
Na_2O_3/K_2O=3.5%,
H_2O < 3.5%.
Density 0.55- 0.60g/cm^3.
Warm loss 250 cal/cm^2 after one hour.
Speed worm loss=0.1 cal/cm^2 in one second.

This powder mix with isolated powders who can not enable the warm wasted by give of exothermal powders. The commercial name of isolated powders is Slax powder.

The composition of Slax powder is:

-SiO_2=82-86%,
-C=4.5-8.5%,
- Na_2O_3/K_2O < 2.3%,
- H_2O < 2.5%,
- CaO < 1%,
- Fe_2O_3< 1%,
Density 0.27g/cm^3 is after one hour.
Speed worm loss=0.17 cal/cm^2 in one second.

The solidification part with exothermal heads is present in following pictures.

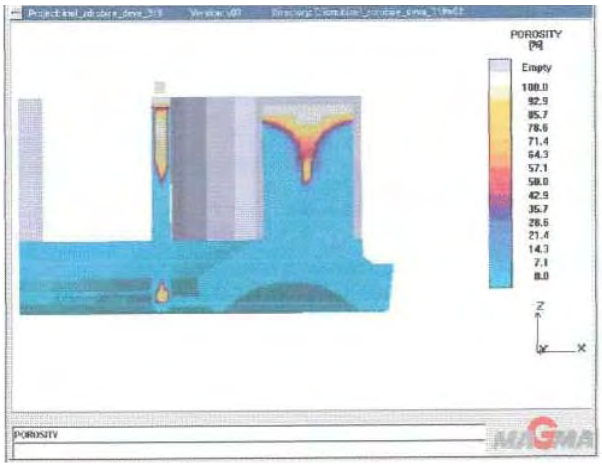

Fig.6. *Solidification mechanism of cast part with head influence area*

3. Conclusions

The part achievement with exothermal heads is a necessity in foundries, because the classical heads used, involved an unreasonable consumption by energy, materials and hand made.

By exothermal heads applications the yield index grows as 65%.Used modern materials in foundries driving to the cast part reduction.

References

[1]. J. Brown – *Foseco Ferrous Fondryman's Handbook*, Butterworth Heinemann, 2000

[2]. E.N. Budonov - *Experienţe privind modernizarea producţiei de piese turnate a firmei Fritz Winter*, Germania, în Liteinoe Proizvodstvo, 2005, nr. 5, pag.1-5

[3]. E.N. Budonov - *Noile tendinţe ale dezvoltării tehnologiilor de turnare în 2007* în Liteinoe Proizvodstvo, 2006, nr. 12, pag.1-7

[4]. J. Campbell – *Castings,* The new metallurgy of cast metals, Butterworth Heinemann, 2003.