

# Using special additions to preparation of the moulding mixture for casting steel parts of drive wheel type

A Josan<sup>1</sup> and C Pinca Bretotean<sup>1</sup>

<sup>1</sup> Politehnica University of Timisoara, Department of Engineering and Management, 5 Revolution Street, 331128 Hunedoara, Romania

E-mail: [ana.josan@fih.upt.ro](mailto:ana.josan@fih.upt.ro)

**Abstract.** The paper presents the possibility of using special additions to the execution of moulding mixtures for steel castings, drive wheel type. Critical analysis of moulding technology leads to the idea that most defects appear due to using improper moulding mixture. Using a improper moulding mixture leads to penetration of steel in moulding mixture, resulting in the formation of adherences, due to inadequate refractarity of the mould and core mixtures. Using only the unique mixture to the moulding leads to increasing consumption of new sand, respectively to the increase of price of piece. According to the dates registered in the industrial practice is necessary to use the special additions to obtain the moulding mixtures, carbonaceous materials respectively.

## 1. Introduction

In foundries, for achievement the moulds and the cores are used natural and synthetic moulding mixtures. In the first case are used the sands in their natural state, of quarry, with or without small special additions. In the second case are used the quartz sands (naturals or washed), to which are added necessary binders [1], [2], [3], [4].

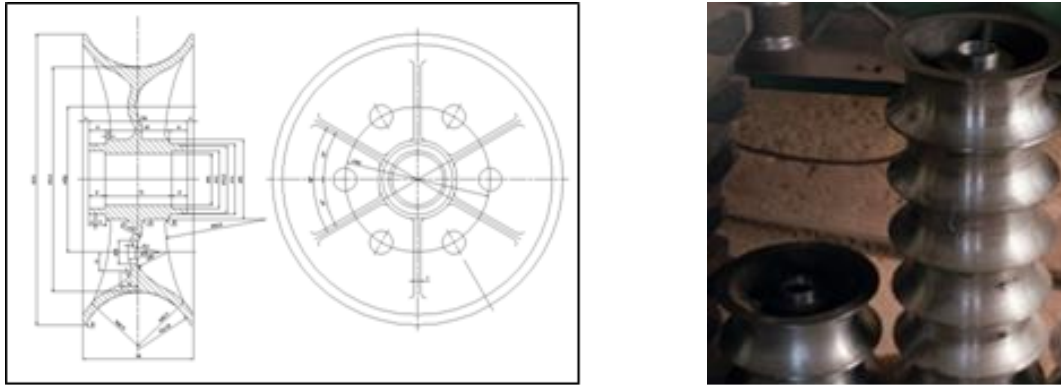
Because in nature can be found few materials that correspond to related thermophysical properties, productivity and economicity imposed by foundry, becomes necessary to make some recipes for moulding mixtures/core mixtures cheap and good quality, corresponding to final destination (the realization of moulds and cores).

Temporary moulds contain a granular material, with high refractory, as the base material, to which is added some binders and addition materials. The product obtained by dosing and homogenization of these materials in desired proportions, is called the moulding mixture [1], [2], [3], [4].

## 2. The recipes of moulding and core mixtures

For piece *Drive wheel* (Figure 1) cast of carbon steel 230-450W [5], [6] is used both pattern mixture and filling mixtures, as well core mixtures.





**Figure 1.** The casting – *Drive wheel*.

Thus, for execution the moulds, are used *green sands* (as a *pattern mixture*), 90...92% new sand and 6...8% bentonite. Mixtures characteristics are [1], [2], [3], [4]: humidity: 3,5...4,0%; permeability: 100UP; compressions strength: 0,6...0,8daN/cm<sup>2</sup>.

The *filling mixture* are the following recipe: reused mixture: 95%; new sand: 3,5%; bentonite: 1,5%; water: 3%; coal dust: 0,1%.

To making the core is used the core mixture, with the following composition: 98% new sand; 1,6% bentonite; 1...2,5% oil flaxen; 0,5...1,4% dextrin. The mixture characteristics are: permeability: 100UP; levigable component: 2%; humidity: 2...3%; compressions strength: 0,15...0,3daN/cm<sup>2</sup>.



**Figure 2.** The lateral core.

### 3. Using the special additions to preparation of the moulding and core mixtures

Critical analysis of the moulding technology leads to the idea that most defects appear due to use the improper moulding mixture. Thus, using a inadequate moulding mixture, leads to penetration of steel in moulding mixture, resulting in the formation of *adherences*, due to inadequate refractivity of the pattern and core mixtures [7], [8], [9], [10].

Using just one sort of mixture (unique mixture) to moulding leads to *increased consumption of new sand*, respectively to *increase in the price of the piece*.

To prevening the chemical penetrations to steel casting and correct execution of moulds, is recommended changing the recipe used for moulding mixtures. According to data registered in the industrial practice, is ideally suited to use special additions in composition of the moulding mixtures, respectively *coal materials*.

About these aspects, among additions of moulding mixtures an important role has the “*additions against of adherences*”. Their role is to produce a protective film (gas or solid) between the metal and the wall moulding, during casting and solidification of the alloy [7], [8], [9].

*Mineral coal* (pitcoal, brown coal or lignit) are used in grinding state to casting in green-sand mould. The protective action of coal is carried at 1000°C, to contact surface metal-mould [7], [8].

The coal used as an addition in moulding mixtures is characterized by the following:

- + Low ash content (max. 11%);
- + To sift in proportion of 80% through sieve of 0,063 mm and 95% through sieve of 0,16 mm;
- + Content of volatile substance, min. 35%;
- + Humidity, max. 10%.

Recipe the preparation of moulding mixture contains [1], [2], [3], [4], [10]:

a) *The composition of the starting mixture:*

+ Quartz sand Vălenii de Munte	84%
+ Bentonite from Valea Chioarului	12%
+ Grinding coal	4%
+ Ethyleneglycol	0,5%
+ Water, max.	3,2%

The mixing time – 6 min.

b) *The recipe of refresh* – the calculation of refresh recipe will be based on levigable component (LC) and mixture degradation, which will be determined by ratio mixture/metal.

For a content of 11% LC, refresh recipe is:

+ New sand	2%
+ Bentonite	10,5%
+ Grinding coal	0,3%
+ Glycol	0,1%
+ Water	depending on residual moisture in the mixture.

In the preparation of the unique mixture, based on refresh recipe, the order to introduce the materials in the mixer as follows:

- + Recirculated mixture (after reconditioning);
- + New sand;
- + Bentonite;
- + Grinding coal,

these are then mixed for one minute, then added:

- + Water;
- + Glycol,

and mixture was further mixed 1,5 minute; follows:

- + Passing through disintegrator (the aerator/mousseur);
- + The control of moulding mixture.

#### 4. Using refractory paints / powders to moulds and cores

To prevent the appearance of adherences and obtain smooth surfaces, with commercial aspect, is realized by used of *refractory paints*, which prevents penetration of molten alloy into the mould pores and does not react with these.

The refractory paints are applied on the surface of moulds and cores in order to produce a refractory layer to contact surface of mould with molten alloy; the refractory paint must be fluid and dense, to form a continuous layer, thin and uniform, on the surface of mould and core.

The refractory paint recommended is composed of:

- dusty component (zircon dust – is also called zircon flour  $\text{ZrSiO}_4$ ) – has high refractivity (melting temperature - 2500°C) and a low coefficient of thermal expansion;
- binder (synthetic resins with fast solidification);
- dispersion medium (organic solvent, isopropyl alcohol).

The refractory paint used to reduce defects is of type **FOUNDRYLAC ZIRCONIU**. This type of paint is characterized by high strength and optimum dyeing, with leveling effect, which conferring a very good degree the final finishing of the surface (figure 3).

#### ***The powders protection***

Prevention of adherences is realized using anti adhesive powders, which are used only for casting into the green-sand moulds, this forming a layer with high refractory on surface of the green-sand mould. This layer prevents direct contact between molten alloy and walls mould. Refractory powders most frequently used are: graphite powder, quartz powder; milled talc, Portland cement.



**Figure 3.** The mould parts (upper and lower) performed.

#### **4. Conclusions**

In the case of piece analyzed (*drive wheel*), the defects registered most frequently are *adherences*, due to the processes occurring in the moulds, during casting of molten steel. These types of defects are categorized as the surface defects of type D [7].

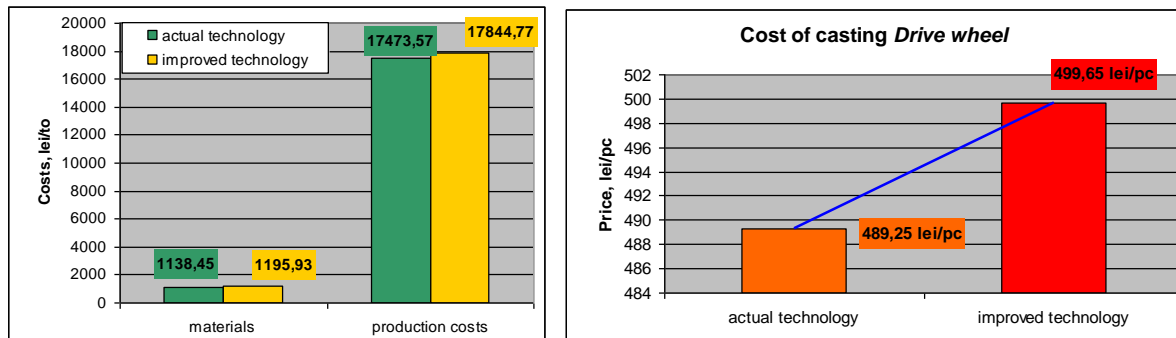
*Adherences* are defects characterized by a rough surface and is a defect is found to visual inspection, being the defect that causes the more rejects. This defect is the effect of metal penetration into the moulding mixture, and the causes of the appearance of adherences can be mentioned as follows:

- inadequate moulding mixture (high grain-size, low refractivity);
- inadequate mould stamping, especially at intersections of surfaces;
- using paints and powders of low refractory.

In order to improve the moulding-casting technology for analyzed casting, has making a series changes and following these changes the consumption of material will vary as follows:

- decreases the consumption of sand quartz (Valeni) and bentonite
- increase the consumption of refractory paint;
- is added the consumption of coal and ethylene glycol.

After the economic calculations, the total value of materials used in the moulding-casting, production price and price of the analyzed piece in the two technologies are presented in Figure 4.



**Figure 4.** Comparative analysis of the two moulding technologies.

After performing changes in moulding-casting technology for the casting study results:

- for the studied casting (*Drive wheel*) the price is 499,65 lei; in the case of changed moulding-casting technology result a price increase with 10,4 lei/pc, respectively 2,12%
- the same price increase is not significant, because the percentage of rejects registered due to defects decreases by approximately 3,2%.

## References

- [1] Josan A 2002 *Technology moulding and casting alloys*, Publishing Polytechnic, Timișoara, Romania
- [2] Josan A 2012 *Casting and moulding technologies of metal parts – the project guide-book*, Publishing Polytechnic, Timișoara, Romania
- [3] Socalici A, Ardelean E, Ardelean M, Heput T and Josan A 2007 *Casting and solidification of steel*, Publishing Cermi, Iași, Romania
- [4] Stefanescu C and Cosneanu C 1989 *Mixtures moulding systems for foundry*, Technical Publishing, Bucuresti, Romania
- [5] \*\*\*SR ISO 3755:1995. – *Non alloy cast steels for mechanical constructions of general use*
- [6] Chesa I 1984 *Choosing and using of steels* Technical Publishing, Bucuresti, Romania
- [7] \* \* \* 1977 *International Atlas of casting defects* Technical Publishing, București, Romania
- [8] Stefanescu D M, Piwonka T S, Giese S R, Barlow K O and Haynes K 2000 The penetration of the ferrous alloys in the moulding mixtures, *The Journal of Foundry* **3** 4-10
- [9] Josan A, Pinca Bretotean C, Ratiu S and Pauca A 2011 *Research on changing technology of molding casting of a part cast steel for reducing rejects registered in industrial practice*, Fourth International Conference on Advanced Materials and Structures AMS2011, Timișoara, Romania, October 27-28, pp 67
- [10] Josan A, Pinca Bretotean C and Pauca A 2012 *The Use of Regenerated Mold Mixtures in Manganese Steel Piece Casting* Proceedings of the 3-rd International Conference on Energy, Environment, Devices, Systems, Communications, Computers (INEEE '12): Mathematical Modelling and Simulation in Applied Sciences, Rovaniemi, Finland, April 18-20, pp 162-164