ANNALS OF THE FACULTY OF ENGINEERING HUNEDOARA
2003, Tome I, Fascicole 3

STATISTICAL RESEARCH UPON THE REJECT FORMS IN THE CAST IRON ROLLS PRODUCTION

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ABSTRACT

In our foundries, specialised in the cast iron rolls, in spite of trying the most accurate guidance of the iron melting processes, of the outside treatments melting aggregate, of the moulding and drying of moulds (the so-called casting process), of the cooling and the directional solidification of the castings in the moulds, as well as of the rapping, cleaning and the subsequent processing of the rolls, the performance factor remains relatively low.
The paper presents an industrial study upon reject forms, which appear in the production of cast iron rolls, in iron chill, and try to emphasize the cause of their occurrence in the product making process, and proposes technologycal measures for their prevent and, in this way, the diminution of the reject percentaje.
In the paper there is an analysis regarding the nature of this defects and an evaluation of the causes which lead to the rejection of rolls, and some measures of prevent are proposed. The industrial analysis included charges of rolls from different hardness classes (semihard, hard), with definite and indefinite crust, casted in simplex or duplex processes.

KEYWORDS

cast iron rolls, reject forms, statistical analyses,hardness classes, rolls' type

1. INTRODUCTION

This paper analyzes the main reject forms, which appear in the production of cast iron rolls, of different dimensional class or a hardness of crust. The study takes into account the clasycal casted rolls, in iron chill and moulding sand, through simplex and duplex processes.

2. SYNTHESIS OF THE ANALYSIS

In our foundries, specialised in the cast iron rolls, in spite of trying the most accurate guidance of the iron melting processes, of the outside treatments melting aggregate, of the moulding and drying of moulds, the so-called casting process, of the cooling and the directional solidification of

the castings in the moulds, as well as of the rapping, cleaning and the subsequent processing of the rolls, the performance factor remains relatively low. For the growth of this factor, it is necessary to carry out the following technologycal conditions:

- the correct supply in continuous running, with the adequate charging stocks, with new and adequate moulding materials, determined in the practical instructions, regarding the metallic charge, the formula of the moulding sands and of the refractory mould finish.
- the correct evidence of the castings, as well as the maintenance (the repairment, after case) of the casting equipment.
- the clear maintaining of the moulding and the casting pit, and the guarantee of their optimum dimensions, according to the dimensions of the cast rolls.
- the necessity to assure instructed and skilled workers, as well as the technical-engineering staff, which has to possess sufficient experience to carry out all conditions, that are included in the production technology.
- the existence and the usage of adequate control apparatus for all technologycal parameters and in all the stages of production.
- the adequate organization of the work, to assure the working task in all the stages of production.

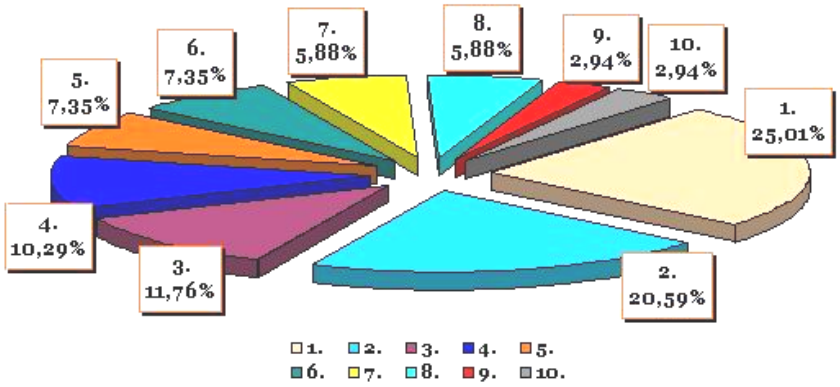

FIGURE 1. REJECT FORMS OF THE CAST IRON ROLLS

1. pockets;
2. cracks (longitudinal or transverse, at heat or at cold);
3. insufficient or extended depth of the roll's hard crust;
4. inadequated hardness at the necks and the body of roll;
5. inclusions and adherences;
6. skrinkages and porosities;
7. inadequated chemical composition;
8. texture defects;
9. inadequate base size,
10. other reject forms

The main defects, which lead to the rejection of cast iron rolls, can be classified, in the following way:

- pockets (pipes);
- cracks (longitudinal or transverse, at heat or at cold);
- insufficient or extended depth of the roll's hard crust;
- inadequated hardness at the necks and the body of roll;

- inclusions and adherences;
- skrinkages and porosities;
- inadequated chemical composition;
- texture defects;

inadequated base size, etc.

In the following paragraphs there is an analysis regarding the nature of this defects and an evaluation of the causes which lead to the rejection of rolls, and some measures of prevent are proposed. The industrial analysis included charges of rolls from different hardness classes (semihard, hard), with definite and indefinite crust, casted in simplex or duplex processes.

From the total quantity of rejects, more than 25% is caused by pockets in the mass of the castings. The main causes for the presence of the pockets are:

- the gases from the mould and from the atmosphere, during the casting;
- insufficiently dry moulds, or moulds which absorbed humidity by standing.
- clay on the necks and wabblers, resulted from the sealing of the assembling surfaces of the equipment;
- the quality of the refractory mould finish used in the process, which must not bring gases into the iron;
- the overthickness of the layer of refractory mould finish, which can release greater quantities of gases;
- the unheated chill, which leads to the changing of the cooling conditions;
- the nettings of scales or fissures on the chill;
- the low casting temperature;
- the contraction in the lower neck, in the upper one, respectively, owing to the rapid solidification of the metal in the entire volume of the crust.

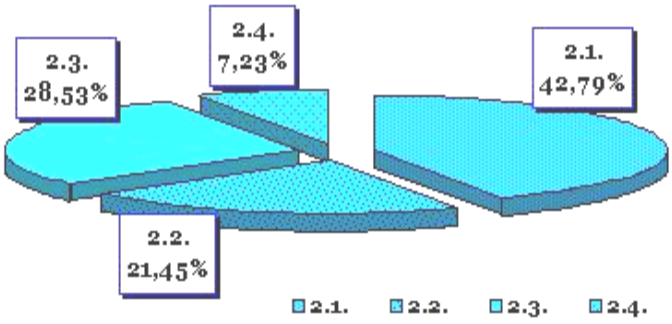

FIGURE 2. THE REPARTITION OF THE CRACKS

The cracks (longitudinal or transverse) represent almost 20% from the total mass of rejects. Avoiding the occurrence of cracks is an extremely complex task, which requires an adequate respect of the rolls production technologies, especially in the preparation of the chill for casting. Most of the cracks are formed at about 1000^0C, when the cast

iron mechanical strenght is very reduced. The cold cracks appear at temperatures below 550^0C, in the elastic deformation area, and, sometimes, even at ambient temperature. The causes of cracks (both longitudinal and transverse) are various, but can be separated according to whether they are formed at heat or at cold. Thus, the longitudinal cracks, formed at heat, may be caused by:

- □ hitting the chill, during casting and solidification processes of the metal in mould;
- □ premature solidification of the riser, knowing that the liquid metal, cast uphill, covering the entire mould may reach the riser being at a very low temperature;
- □ selective heating or/and cooling on the chill;
- □ scratches on the inner side of the chills, etc.

The longitudinal cracks, at cold, can be caused by the following factors:

- □ changes of volume in the metallic ground-mass;
- □ the rapped rolls storage near the hot ones.

The transverse cracks occur in the following situations:

- □ wrong assembly of the casting mould;
- □ wrong assembly of several chills, in the case of rolls with extended length;
- □ temperature difference between the chills, etc.

TABLE 1. THE ANALIZED CAST IRON ROLLS

No. Crt.	TYPE OF ROLLS	HARDNESS CLASS	NUMBER OF THE ANALIZED CAST IRON ROLLS		PROPORTION	
			[pieces]	[pieces]	[%]	[%]
1.	FNS	FNS 0	281	12	57.82	2.47
		FNS 1		62		12.74
		FNS 2		207		42.59
2.	FS	FS 2	27	27	5.55	5.55
3.	FD	FD 1	52	37	10.69	7.61
		FD 2		15		3.08
4.	FDI	FDI 1	103	34	21.38	6.99
		FDI 2		69		14.19
5.	FND	FND 1	23	23	4.73	4.73
TOTALS			486		100	

TABLE 2. THE REJECT FORMS OF THE CAST IRON ROLLS

No. Crt.	TYPE OF ROLLS	HARDNESS CLASS	THE ANALIZED CAST IRON ROLLS				THE REJECT FORMS			
			[pieces]		[%]		[pieces]		[%]	
1.	FNS	FNS 0	252	10	51.85	2.05	29	2	5.96	0.42
		FNS 1		54		11.11		8		1.63
		FNS 2		188		38.68		19		3.91
2.	FS	FS 2	23	23	4.75	4.75	4	4	0.82	0.82
3.	FD	FD 1	40	30	8.23	6.17	12	7	2.47	1.44
		FD 2		6		1.23		5		1.85
4.	FDI	FDI 1	87	29	17.9	5.96	16	5	3.29	1.03
		FDI 2		58		11.93		11		2.26
5.	FND	FND 1	16	16	3.29	3.29	7	7	1.44	1.44
TOTALS			486		86		68		14	

Another group of defects, which lead to rejection consists of inadequate depths of the hard crust of the rolls. These defects may consist of insufficient thickness of the crust, or of excessive thickness, instead of

the specified ones by their subsequent destination. The uneven thickness on the height of the crust, on the rolling face, leads to rejection, too.

Regarding other groups of defects, which appear in the case of cast iron rolls, analyzed in a more wide and extensive context, they will be discussed in a future article.

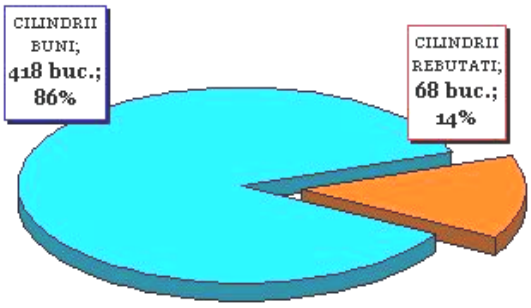

FIGURE 3. THE ANALIZED ROLLS STATISTICS
(THE NUMBER OF GOOD QUALITY's OF ROLLS AND THE REJECTED FORMS)

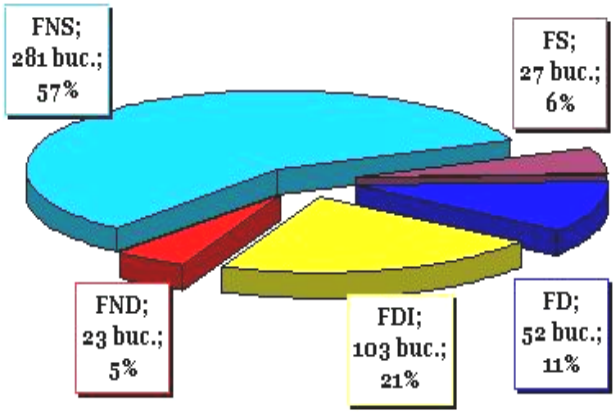

FIGURE 4. THE TYPE OF ROLLS INCLUDES IN ANALIZES

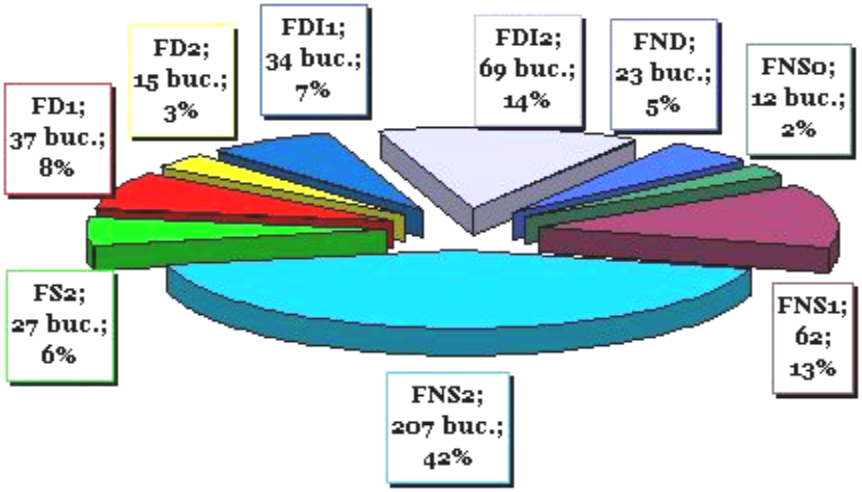

FIGURE 5. THE ANALIZED ROLLS STATISTICS
(INCLUDING THE HARDNESS CLASSES)

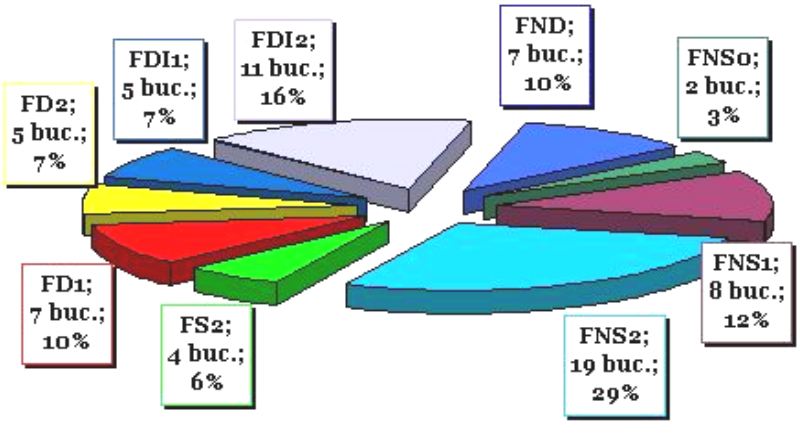

FIGURE 6. THE REJECT FORMS STATISTICS (INCLUDING THE HARDNESS CLASSES)

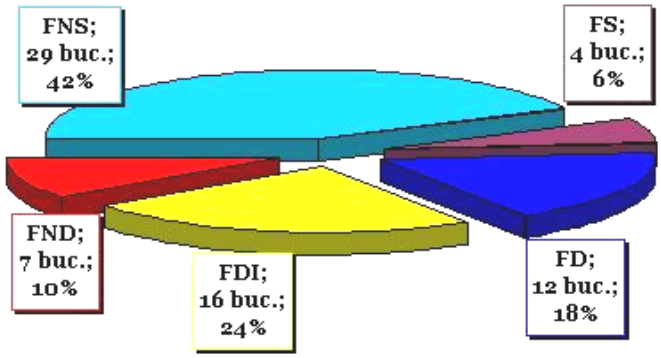

FIGURE 7. THE REJECT FORMS STATISTICS (ALL THE ROLLS SITUATION)

TABLE 3. SINTESIS OF THE NATURE REJECTS FORMS

No. Crt.	NATURE OF THE REJECTS FORMS		NUMBER OF REJECT FORMS, [pieces]		PROPORTION, [%]	
1.	pockets		17		25.00	
2.	cracks	longitudinal at hot	14	6	20.58	8.82
		longitudinal at cold		3		4.42
		transversal at hot at cold		4		5.88
		fine and dispersed cracks		1		1.49
3.	insufficient or extended depth of the roll's hard crust		8		11.76	
4.	inadequated hardness at the necks and the body of roll		7		10.29	
5.	inclusions and adherences		5		7.35	
6.	skrinkages and porosities		5		7.35	
7.	inadequated chemical composition		4		5.88	
8.	texture defects		4		5.88	
9.	inadequate base size		2		2.94	
10.	other reject forms		2		2.94	
TOTALS OF THE REJECTED CAST ROLLS			68		100	
TOTALS REJECTS PERCENTAJE			-		14	

3. CONCLUSIONS

For the achievement of performant castings (in this case, the cast iron rolls), adequate from dimensional, technical and functional points of view, with the view to application in industrial practice, an accurate and detailed knowledge of the production technology is recommended, and thus, a consideration for some preventing measures against the

occurrence of defects, which are the subject-matter of this study. These measures could be:

- an adequate drying of moulds and avoiding maintenance for long periods of time, after moulding and drying, not to absorb humidity;
- an adequate assembly of necks, of the chill (or the chills) and of the entire casting equipment;
- usage of mould finish with minimum volatile content (zyrconium mould finish) and mould coating in uniform layers.
- preliminary heating of the chills, up to temperatures of about 80^0C, a point at which they are considered to be sufficiently heated;
- achievement of the directional solidification and the proper operation of the riser;
- casting at optimum temperature prescribed by the production technology;
- avoiding accidental hitting, during the casting process, as well as during the process of solidification;
- application of adequate cooling rates;
- adequate dimensioning of the riser;
- the isolation of the riser with asbestos for maintaining the liquid metal in the riser;
- the storage of rolls in adjusted places, protected from unfavourable weather conditions and far from intense circulation.

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