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STUDIES AND RESEARCHES REGARDING THE ANALYZE OF CHEMICAL COMPOSITION AND THE REASONS FOR TAKING OUT OF OPERATION THE MILL ROLLS CAST AT S.C. SIDERMET S.A. CALAN

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Abstract: *The paper presents a critical analyze of the rolls cast out of nodular iron at S.C. Sidermet S.A.. Călan and inspected in operation at S.C. Siderurgica S.A. Hunedoara. The chemical compositions for 15 inspected rolls, the casting temperatures and the characteristics recorded when put into operation are shown. With these data, there were performed a series of correlation, the specific graphics, the equations and the regression coefficients were shown. The reasons for putting out of operation the inspected rolls were analyzed and the hardness and durability histograms were drawn.*

Keywords: *rolls, hardness, durability*

I. INTRODUCTION

The economical efficiency of the rolled products manufacturing highly depends on the quality of the roll, whose durability is determined both by the characteristics of the material the rolls are manufactured out of and by the operating conditions.

When selecting the material, the mill type, the sizes of the roll (diameter), the rolling speeds, the stands of the rolling mill train the rolls are manufactured for, the working temperature of the panel within the rolling process, the way of cooling during the operation and the pass sizes are to be taken into consideration.

Depending on these factors, not only the material, but also the roll manufacturing technology is different in order to ensure the characteristics imposed by the operating conditions.

Usually, the nodular iron rolls are designated for rolling the small sections with the diameter of 300÷600 mm on pre-finishing stands.

2. ANALYZE THE TECHNOLOGY FOR CASTING THE MILL ROLLS OUT OF NODULAR IRON

In order to analyze and to optimize the technology for casting the mill rolls al S.C. CILINDRUL S.A. Călan, there were taken into study 15 rolls cast out of nodular iron, FNS2. These rolls were also inspected during the operation at S.C. Siderurgica S.A. Hunedoara, within the 650 mm Rolling Mill.

Table 1 shows the chemical composition of these rolls and also the data recorded during operation.

Table 1. Chemical composition and the characteristics of the mill rolls cast out of nodular iron

Roll no.	Chemical composition, %								Cast. temp. °C	Casting time	Brinell hardness		Dura-bility t/mm
	C_{total}	Mn	Si	S	P	Cr	Ni	Mo			Panel	Neck	
1	2,98	0,64	1,87	0,06	0,165	0,29	1,15	0,75	1265	110"	366	280	29
2	2,9	0,79	1,7	0,09	0,29	0,33	1,51	0,24	1270	100"	419	288	28
3	3,1	0,6	1,74	0,09	0,162	0,33	1,92	0,31	1280	130"	450	273	68
4	3,03	0,63	1,88	0,021	0,181	0,37	1,75	0,37	1260	145"	340	300	55
5	3,14	0,62	1,74	0,09	0,249	0,3	1,36	0,26	1280	140"	375	303	58
6	3,09	0,68	1,94	0,044	0,248	0,31	1,47	0,28	1275	120"	385	275	41
7	3,08	0,61	1,73	0,018	0,187	0,28	1,31	0,26	1260	155"	381	252	40
8	3,17	0,6	1,74	0,09	0,162	0,33	1,92	0,31	1280	130"	388	276	61
9	3,06	0,69	0,68	0,01	0,163	0,4	1,69	0,41	1270	160"	412	287	42
10	3,2	0,63	1,75	0,02	0,164	0,3	1,45	0,25	1275	135"	390	280	10
11	3,08	0,68	1,94	0,044	0,248	0,31	1,51	0,42	1270	140"	386	275	71
12	2,72	0,79	1,7	0,06	0,116	0,33	1,51	0,24	1265	100"	380	262	72
13	3,2	0,63	1,75	0,02	0,164	0,3	1,35	0,25	1270	140"	381	264	67
14	2,98	0,64	1,87	0,06	0,165	0,29	1,28	0,34	1280	100"	352	260	26
15	3,15	0,6	1,74	0,09	0,162	0,33	1,92	0,31	1280	130"	387	276	27

Table 2. Chemical composition (STAS 9432-85)

Type rolls	Chemical composition, %									Brinell hardness
	C	Mn	Si	S_{max}	P_{max}	Cr_{max}	Ni	Mo	Mg	
FNS2	3,0-3,5	0,1-0,7	1,2-2,5	0,02	0,15	0,6	1,5-2,5	0,3-0,5	0,02-0,04	354-441

Regarding the 15 analyzed rolls, the followings were established:

- only one roll could be framed within the limits admitted by the reception Standard, regarding the chemical composition;
- the elements that have a negative influence on the quality of the rolls in what concerns the S and the P content can be presented as follows: at 5 rolls the S content is exceeded and at 3 rolls the P content is exceeded;
- the elements that have a positive influence on the quality of the rolls with Ni, Mn and Mo can be presented as follows: at some rolls, the content is below the admissible limit;
- the casting temperature at one roll was 1230°C instead of 1250°C, which is the minimum temperature required by the technological process;
- because of these deviations in what concerns the chemical composition and because of other elements within the manufacturing process, the hardness required by STAS: 354–441 HB could not be obtained for all the rolls.

By using the recorded data, a series of correlation was performed, and the equations and the regression coefficients were shown. Following this analyze, some deviations from the STAS 9432-85 requirements regarding the chemical composition were established (see fig. 1, 2, 3).

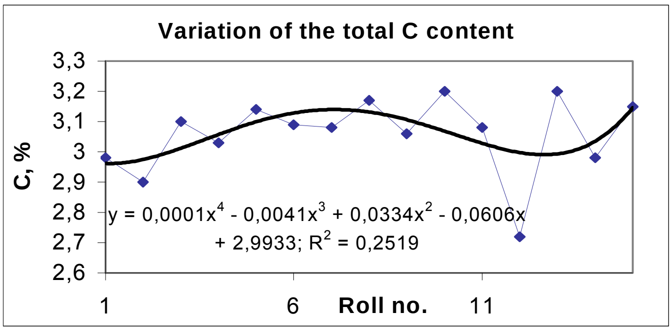
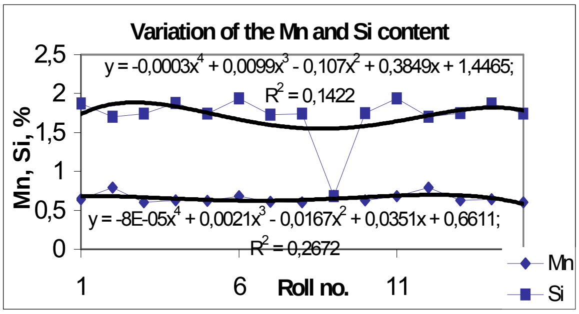


Fig.1. Variation of the C content.



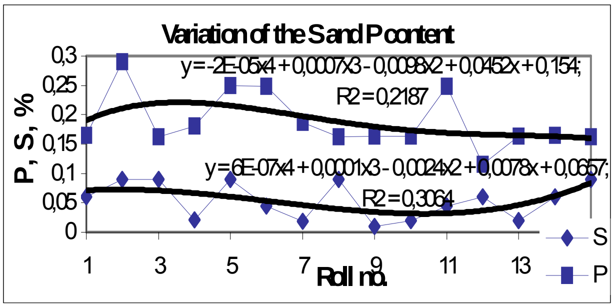
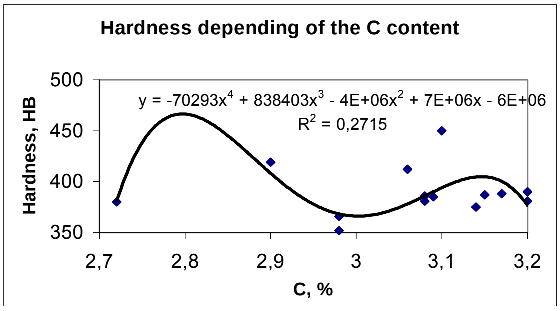


Fig.2. Variation of the Mn and Si conent.

Fig.3. Variation of the S and P content.

Figure 4 shows the hardness recorded depending on the carbon content, and figure 5 shows the hardness histogram. It can be noticed that in general, almost all the hardness values are located with in the STAS 9432-85 and STAS 4596-87 limits (excluding the rolls no. 4 and 14, that have a lower hardness than required by STAS, i.e. 354…441 HB).



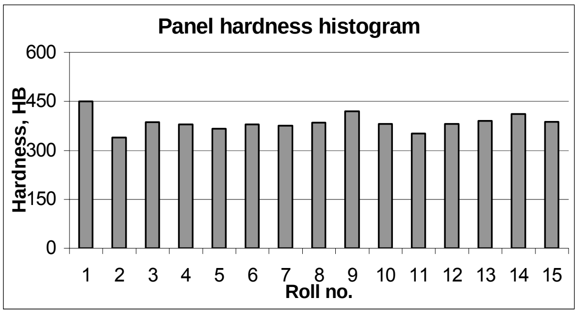
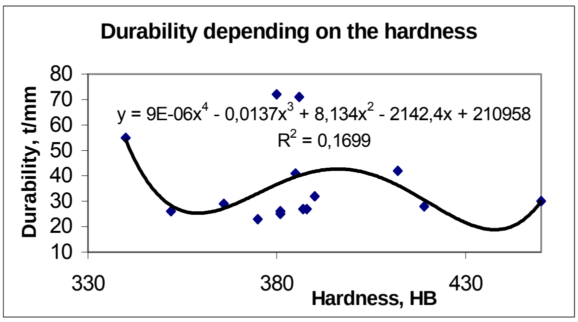


Fig.4. Variation of the hardness depending on the C content.

Fig.5. Panel hardness histogram

Figure 6 shows the deviation of the roll durability depending on the hardness, and figure 7 the durability histogram.



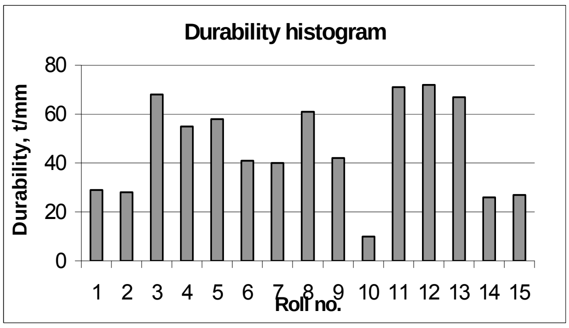


Fig.6. Variation of the durability depending on the hardness.

Fig.7. Durability histogram.

The reasons for taking out of operation the mill rolls are in generally the followings:

- occurring the cracks in the roll shell, because of the thermal fatigue;
- thermal wear that could be in principle explained by the different behavior of the components that form the basic metallic mass under temperature

deviations. The main components within the structure of the nodular irons used when manufacturing the mill rolls are: pearlite, cementite and nodular graphite. Cementite is the component with the highest volume variation depending on the temperature, it is strongly strained and cracks. During the rolling process, the more coarsely the cementite separations are, the more the cracks increase.

- the presence of the graphite separations leads to the increasing of the working area heat conductance, phenomenon that reduces somehow the stresses between the cold and warm areas, thus reducing the thermal wear;
- the mechanical-thermal wear, due to the passing of the warm rolled product through the roll in the austenitic field, is directly influenced by the fineness of the basic metallic mass structure and also by the form and the size of the graphite separations. In order to obtain a proper durability, a fine, homogenous structure with high pearlite dispersion degree is required.

3. CONCLUSIONS

By analyzing the 15 mill rolls cast out of nodular irons at S.C. Cilindrul S.A. Călan and tested in operation at S.C. Siderurgica S.A. Hunedoara, one can say that:

- 9 rolls (i.e. rolls no.3, 4, 5, 6, 8, 9, 11, 12, 13) went naturally out of using, and according to figure 7, they had the highest hardness values;
- 5 rolls (i.e. rolls no. 1, 2, 7, 9, 15) showed exfoliation, and the recorded durability was lower;
- 1 roll (roll no. 10) broke when driving, because of the mechanical shock.

Figure 8 shows this recorded situation as percentages.

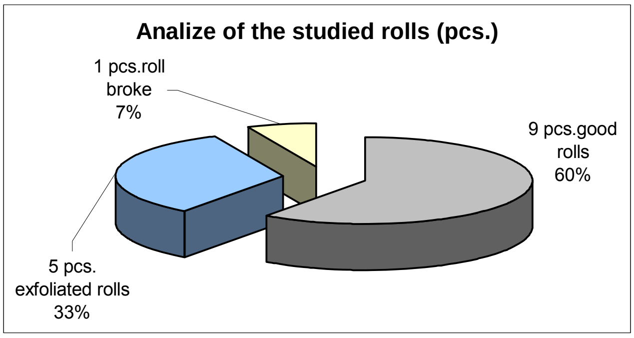


Fig.8. Analyze of the studied rolls.

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