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COMPARISON BETWEEN HARDNESS OF THE LAMINATION CYLINDERS, ADAMIT TYPE (OT-A3) AND PRELEVATED PROBES TO THEIR CASTING

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Abstract. The paper, having as purpose the determination of influence of wall thickness (cooling speeds) to casting of lamination cylinders and steel probes OT-A3 concluded that there are no considerable differences regarding the HRC hardness. This is explained by the fact that the plate of cast cylinders use shell like the cast probes.

1. INTRODUCTION

The most solicited machine organs of a housing lamination are the cylinders. This is determined by the properties that they must fulfill, to have high resistance: mechanical, chemical, and thermal, especially to abrasive wear. These desiderates cannot be satisfied unless by a small range of iron alloys, cast or forged, due to the lamination cylinders. Like a corollary of choice criteria of alloys is, in fact, the destination of lamination cylinders and, certainly, the manufacturing costs, as well as their durability in exploitation.

Satisfying the above mentioned requests could be made by the express use of cast cylinders of Adamit type alloys [1],[2],[6], where the most favorable chemical composition proved to be [6] C=1,7…2,2%; Si=0,6…1,5%; Mn=0,7…0,9%; Ni=1,0…2,0%; Cr=0,7…1,7%; Mo=0,3…0,5%; P_{max}=0,04%; S_{max}=0,02%.

But as the mechanical properties of the same cast allowed and determined on pieces are not the equivalent to the properties determined by the probes designed to the determination of mechanical properties due to the smaller sizes, the higher cooling speeds [7], it made necessary the comparison of mechanical properties determined by probes, but also by the properly cast pieces.

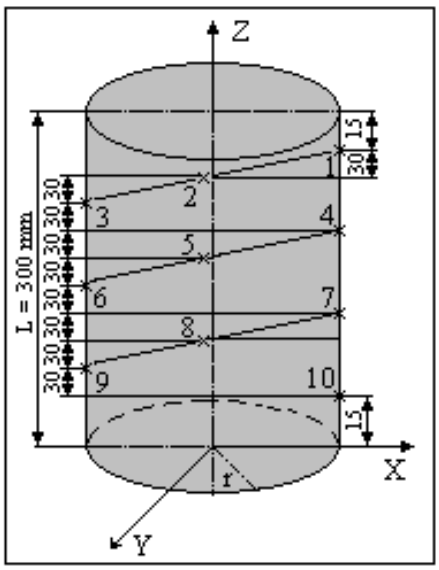

Fig. 1. Sizes of the cast probe and the presentation of points where registered the hardness: r – array of probe (r = 30mm); 1,2…10 – points where the hardness is determined, situated on the probe length L=300mm.

2. DETERMINATION OF MECHANICAL FEATURES OF ADAMIT STEEL OT-A3, CAST WITHIN A METALLURGIC ENTERPRISE

In the view of determination of mechanical properties, there have been cast probes of ϕ30x300mm. The HRC hardness on the height of these probes was measured to distances of 30 mm, obtaining 10 points. The measurement was made like in fig. 1, meaning in spiral to 120° on the circumference of probes, but the arrays φ_1 and φ_3 are reset in plan, to be distributed on height. The absolute values for the 12 probe, realized of three charges, are presented in table 1.

Table1. Hardness (HRC) registered on charges and on the height of probes.

Measured point / height [mm]	Charge no. 03728						Charge no. 03734				Charge no.. 03739					Average of the 3 charges
	Probes					Average	Probes			Average	Probes				Average	
	1	2	3	4	5		6	7	8		9	10	11	12		
1/285	42	43	44	41	44	42,8	53	53	49	51,7	54	43	42	44	45,8	46,74
2/255	44	44	47	49	48	46,4	45	44	49	46,0	51	49	51	51	50,5	47,63
3/225	47	48	45	51	47	47,6	48	51	43	47,3	48	51	49	51	49,8	48,23
4/195	43	41	43	41	43	42,2	52	52	49	51,0	51	50	49	46	49,0	47,40
5/165	48	49	49	48	49	48,6	49	45	49	47,7	45	52	52	50	49,8	48,67
6/135	48	51	47	51	47	48,8	47	46	49	47,3	49	43	52	49	48,3	48,13
7/105	48	42	44	43	48	45,0	51	49	51	50,3	49	52	51	52	51,0	48,78
8/75	49	49	51	46	49	48,8	44	43	45	44,0	44	52	48	49	48,3	47,02
9/45	49	52	49	50	46	49,2	42	44	43	43,0	49	50	49	48	49,0	47,07
10/15	46	43	45	46	44	44,8	47	49	52	49,3	51	47	49	51	49,5	47,88
Average probe	46,4	46,2	46,4	46,6	46,5		47,8	47,6	47,9		49,1	48,9	49,2	49,1		
Average charge	46,42						47,77				49,08					47,75

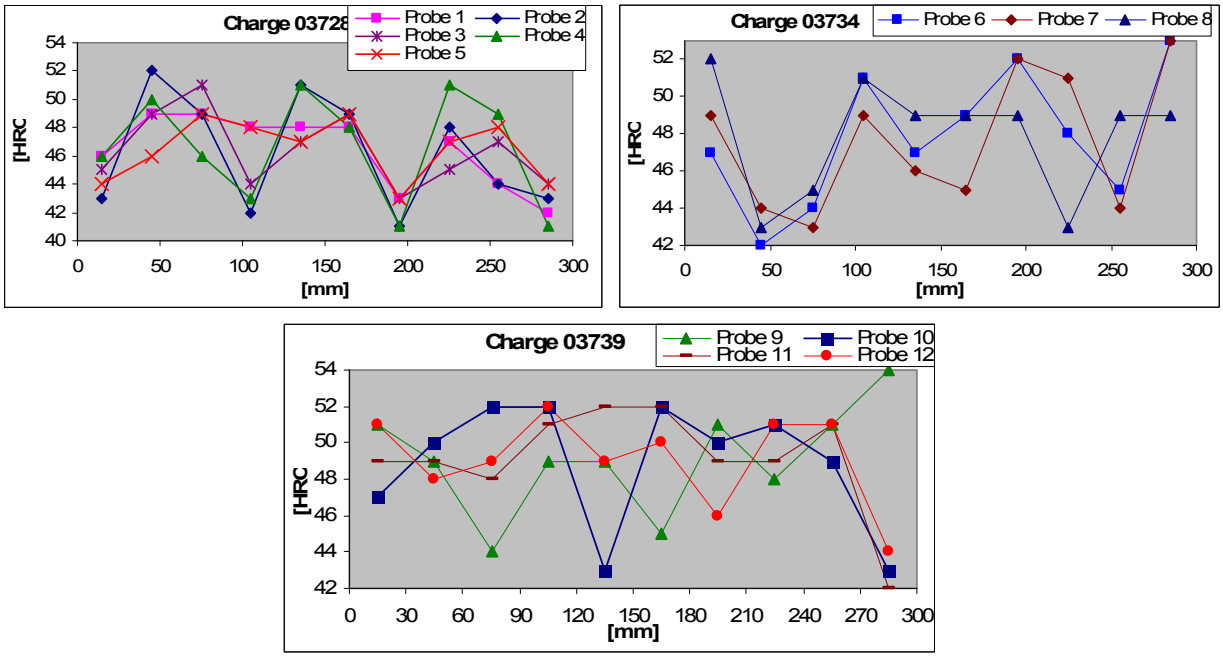

Fig. 2. Variation of hardness [HRC] pe height of probes, [mm], in different stages.

As observed in fig. 2, the hardness does not vary within considerable limits, but the maximum and minimum hardness on the three charges are values comprised in the 41…54 HRC interval.

But the tendency is the decreasing of hardness during the increasing of height of probe. If there are excluded the points of extreme values of hardness, then it may be stated that the hardness varies between 44…52 HRC. To stress the homogeneity of

hardness values within the three charges, it is evidenced under the form of a histogram in fig. 3, the variation of medium values of hardness.

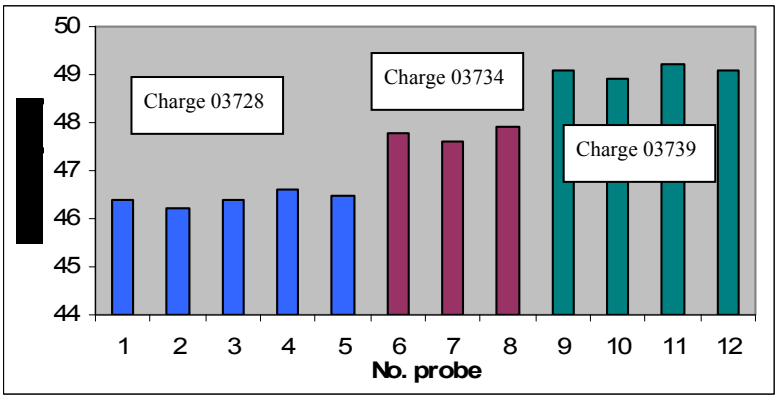

Fig.3. Variation of hardness [HRC] of cast probes in the 3 charges

It is remarked the fact that in each charge the difference of hardness [HRC] on probes is only 0,7HRC in case of charge 03728; 0,4HRC for the charge 03734 and 0,7 HRC at the charge 03739.

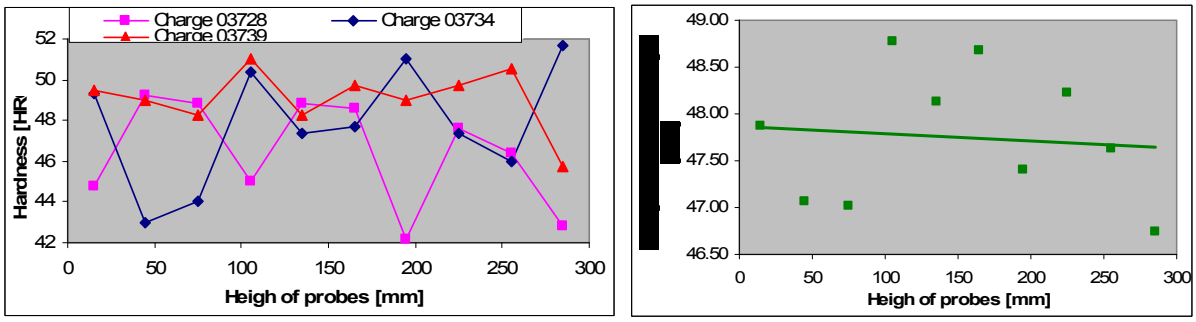

Fig. 4. Average hardness.

To explain the hardness differences, between the three charges in table 2, it is expressed the chemical composition of the 3 charges of which the probes were cast. It is observed that the chemical compositions are very close.

Table 2. Chemical composition of cast charges in probes [%]

No.	Rolls No./ Charge No.	Dimensions, Dxl, [mm] / Weight, [t]	Chemical composition, [%] as per Analyse Bulletin 49										No. casted sample
			C	Mn	Si	S	P	Cr	Ni	Cu	Mo	Ti	
1	0936/03728	550x900/5,4	1,86	0,73	0,73	0,005	0,021	1,05	1,62	0,2	0,32	0,04	1,2,3,4, 5
2	0937/03728	530x900/5,1											
3	0938/03728	460x900/4,2											
4	0939/03728	450x900/4,0											
			Chemical composition, [%] as per Analyse Bulletin 56										
			C	Mn	Si	S	P	Cr	Ni	Cu	Mo	Ti	
5	0940/03734	550x900/5,4	1,93	0,83	0,68	0,008	0,029	1,03	1,66	0,16	0,30	0,04	6,7,8
6	0941/03734	530x900/5,1											
7	0942/03734	480x900/4,5											
8	0943/03734	450x900/4,0											
			Chemical composition, [%] as per Analyse Bulletin 65										
			C	Mn	Si	S	P	Cr	Ni	Cu	Mo	Ti	
9	0952/03739	550x900/5,4	1,99	0,80	0,70	0,005	0,003	1,20	1,61	0,20	0,35	0,06	9,10,11 12
10	0953/03739	540x900/5,2											
11	0954/03739	460x900/4,2											
12	0955/03739	450x900/4,0											

4. CONCLUSIONS

From the trials made on Adamit lamination cylinders OT-A3 from metallurgical entreprise and the cast probes of the same steel resulted that:

- hardness is higher on the cast probes in shells towards those determined on plate, due to the cooling speeds bigger towards the plate of cylinder;
- hardness obtained on the height of probes is varied, even from one charge to another, this fact being explained by the determination system (HRC) on a relatively non-homogenous structure (pearl) from one probe to another. Maybe the HRC or HB determination would be more adequate;
- Average of hardness on the 3 charges is relatively homogenous and with a decrease tendency on the height of probes. This is due to the segregation on the height of probes.
- Difference of mechanical properties between probes and cylinders is due to the cooling speeds and to the special treatments.

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