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ROLLING CONTACT FATIGUE RESISTENCE ON THE BEARING STEEL HARDENED IN THE ULTRASONIC FIELD

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Abstract
Every technology of final heat treatement induce in the product a state of residual stress which sign and level depends of a complexity of factors; the most important of them are: the intensity of the heat change with the external, the differences of the specific volume between the phases and the constituents, etc.
The increase in the durability of the contacts hertzian remains in the actualite and preoccupe the collectives of specialists in the industry of bearings, the angrenages, etc. In the paper the authors have studies the influence of an ultrasonic hardening on the structure, hardness and the residuelles constraints of steel RUL1.
The great precision bearings are conditioned, in working, by dimensional stability in time and residual stresses. The authors show the influence of the unconventional thermal treatements upon fatigue strength of the surface layer of the RUL1 steel, with direct applications in the bearings industry and in the non-electrical measuring apparatuses production.
The secondary heat treatment applies to the elements of bearings also has a strong influence on durability like the geometrical precision. The research made in the foreign laboratories has study the influence of the parameters of the heat treatment on the geometrical precision, size stabilitee and deformations. The tests of durability are compliquees and knives and usually are not associees parameters metallografics.

1. INTRODUCTION

In the laboratory of the heat treatments of Mechanical Faculte of the University "Stefan cel Mare" of Suceava, Romania, have study the appliquations of ultrassons in heat treatments in the industry of the bearings.

2. EXPERIMENTAL RESULTS

One has uses a US instalation with power 400 W and frequency 40,5 Khz which ensures in the bath of cooling the intensity of 4 W/dm2. The US translator is piezoelectric, immerisble. The tests of durability are effectuees accelerate on a machine which ensures 23.000 contacts/min, chargee with 5.000 Mpa. The scheme of test is does in figure 1.

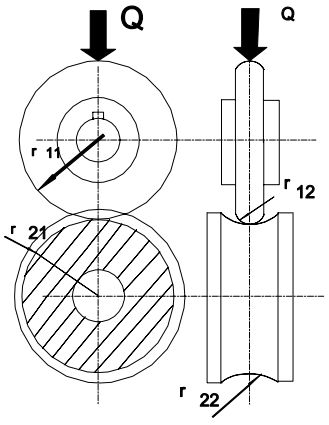

Fig.1: *The scheme of the durability test*

The interpretation of the experimental results have made by the method of Weibull. For research one uses rings of the bearings series 6205, on the steel RUL1, with the internal diameter 25 mm, exterior 30 mm and the width

12 mm. The chemical composition of steel RUL1 is does in table 1.

Table 1. The chemical composition of steel RUL1

C	Mn	Si	Cr	$S_{max.}$	$P_{max.}$	Nimax.	Mo	$Cu_{max.}$
0,95..1,1	0,25..0,45	0,35	1,3..1,6	0,002	0,027	0,3	-	0,25

After machining the rings has applied the secondary heat treatment. The alternatives of treatment are show in the table 2. One uses samples of 15 rings for each mode of heat treatment.

Table 2 The conditions of heat treatment

Code	T_i [^{0}C]	t_m [min]	Cooling conditions
A	840±1	40	Mineral Oil TT25 T=50 ^{0}C
B	840±1	40	Mineral Oil TT25 T=50 ^{0}C + US

After the heat treatments one has hardness measuring does in the table 3. The results of the tests of durability are presents in the table 4.

The values of the statistics of the samples for a probabilite of 95% are:

Code A $S_{calc.} = 0,324992 < S_{tab} = 0,73$
Code $S_{calc.} = 0,2553282 < S_{tab} = 0,73$
Who ensures a Weibull distribution.

Table 3. The hardness of rings after heat treatment

Cod	Duritatea HRC														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
A	59	59	60	60	60	60	60	60	61	61	61	61	62	62	63
B	62	62	62	62	62	62	63	63	63	63	63	63	63	63	64
Average sample A = 60,6															
Average sample B = 62,666															

Table 4. The durability test for each sample

Nr. Crt.	Code A		Code B	
	Durability [h]	F_i	Durability [h]	F_i
1	0,92	3,33	3	3,33
2	1,8	10	4,7	10
3	2,2	16,66	5	16,66
4	3	30	7	23,33
5	3	30	9,5	30
6	4,2	36,66	11	33,33
7	5,4	50	11,2	43,33
8	5,4	50	13	50
9	6,3	56,66	13,5	63,33
10	8	63,33	13,5	63,33
11	8,4	70	15,1	70
12	9,2	76,66	15,7	76,66
13	9,4	83,33	15,9	83,3
14	10,4	90	17	96,66
15	11,2	96,66	17	96,66

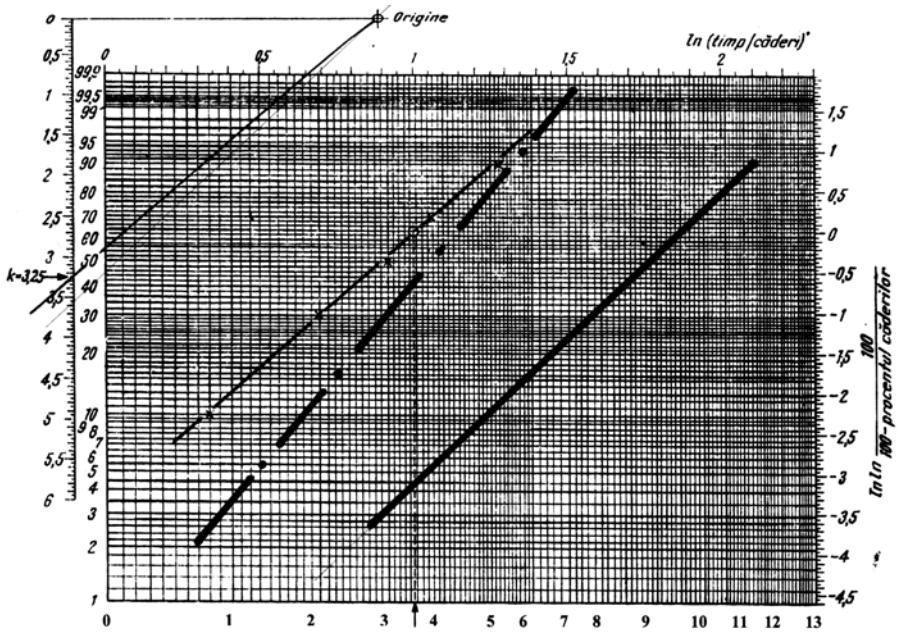

Fig.2: *The paper Weibull for each sample*

The qrafic representation of the durability on paper Weibull, Thompson-Nelson done (fig.2):

- for the sample A, the slope Weibull is :

e = 4,5

and the average of the good functional time MTBF is 4,3 h.

- for the sample B, the slope Weibull is :

e = 3,55

and the average of the good functional time MTBF is 9,4 h.

3. CONCLUSIONS

The US heat treatment of the elements of the bearings allows increase in hardness follows the eleimination of the phase qualefaction, which leads has the optimization of heat transfer.

The contribution to suplimentair of US energy during martensitic transformation decrease the abess of residuelle martensite contents and the increase the dimentional stability.

The costs relating to aquisition of the instalation is negligible with report/ratio are the benefit obtained.

4. BIBLIOGRAPHY

[1] **Nicolai BANCESCU** – Studies and researches on the increase of the rolling contact durability using unconventional treatments applied to the tribolayers, Ph.D. thesis, "Dunărea de Jos" University of Galați, 1995