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THE INFLUENCE OF TEMPERING TEMPERATURE AND TESTING ON STRENGHTNESS CHARACTERISTICS OF SOME ALLOYED STEELS FOR MACHINE CONSTRUCTIONS

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ABSTRACT

In the present work is studied the high temperature behave of the steels of high resistance from the class Cr-Mo-V. It was shown that under the high temperature effect, the ultimate tensile strength value, which is producing a certain degree of plastic deformation of the steel, is in general, lower then the determined value at open air temperature. From the tested samples these temperatures the broken pieces have been taken for measuring the hardness after tempering -at different temperatures- representing graphic their variation according to the testing temperatures (20° C, 300°C, 500°C) for cooling area at tempering.

KEYWORDS

alloyed steels, the thermal treated, mechanical characteristics

1. INTRODUCTION

The mechanical characteristics values of steels are depending as well on the time period of the tests at high temperatures, as for, in accordance with the duration of the load application; there are two groups of tests, as follows:

a) Short time duration tests, in which the heated sample is, tested same as at the usual temperature. In the case of the present work the tests has been done at short time duration.
b) Long time duration tests, in which the heated sample is charged with a constant or variable load for establishing the combined influence of high temperature and long time duration of the tests on resistance characteristics and deformation of the steel.

Industrial work area for rolled steel products, which have to resist at high temperatures, is up to 450 – 500° C, so is useful to study the mechanical characteristics variations in this area.

In case of low alloyed and alloyed steels, in case when it was used silicon – calcium as deoxidized, it was noticed an increasing of the yield point Rp 0,2 and of the elongation A5, and in the mean time a sensitive decreasing of the tensile strength Rm.

As well, at the deoxidized steels and with silicon-calcium, is noticed an increasing of the breaking energy values and minimizing of the dispersion for all mechanical characteristics.

Taking in consideration that from the steel 15VMoCr14X are produced components for undercarriage of the planes, which during operation are subjected to high and low temperatures, these has to keep their admitted properties in between –75°C up to +500°C.

For this, tensile tests were made at high temperatures and the results are shown in Table 1 for the Rp 0,2 characteristics.

The graphic representation of data from Table 1 is shown in Fig. 1.

Table 1.

Tempering temperature, °C	Test temperature, °C				
	100	200	300	400	500
550	98,7 95,8 97,2	89,7 85,6 87,4	89,7 87,4 85,6	79,1 85,3 82,2	74,1 75,3 74,8
	97,2	87,5	87,5	82,2	74,7
580	93,7 105,2 99,6	86,9 94,8 91,6	86,0 92,2 93,1	85,2 86,0 85,7	79,1 74,2 72,0
	99,5	91,1	90,4	85,6	78,1
610	106,7 101,0 103,8	98,3 94,9 96,7	95,4 92,0 93,3	87,5 88,4 87,9	79,1 80,4 79,8
	108,8	96,6	93,6	87,6	79,7
625	108,3 101,7 105,0	101,3 99,3 96,2	95,0 96,3 97,8	93,0 83,1 88,1	78,6 81,8 79,3
	105,0	98,9	96,3	88,1	79,9
640	103,2 101,6 102,4	93,1 97,1 95,0	89,2 94,1 91,4	98,2 83,2 86,4	83,2 75,1 79,5
	102,4	95,1	91,6	89,3	79,6
670	93,1 86,9 90,0	85,8 83,6 84,0	84,1 80,2 82,0	79,0 73,4 76,2	70,0 67,4 69,2
	90,0	84,4	82,1	76,2	68,8
700	82,1 80,0 80,3	79,4 74,4 76,6	72,6 73,4 72,5	63,0 67,9 65,9	60,1 64,2 62,0
	80,8	76,8	73,1	65,6	68,1

Guiding limit values which, has to be fulfilled by the steel 15VmoCr14X, are show in Table 2, and the graphic representation in Fig. 2.

Table 2.

Mechanical characteristic, daN/mm^2	Temperature, °C					
	100	200	300	400	500	600
$Rp_{0,2}$	86,4	80,9	79	75	68	52
Rm	106	93	90	88	84	60

From the samples tested, at high temperature, the broken pieces have been taken and it was measured the hardness after tempering temperatures, tests temperatures for the tempering cooling in free air and the values are given in Table 3.

Graphic representation of the hardness variation according to tempering temperature and test temperatures for tempering in free air is shown in Fig. 3.

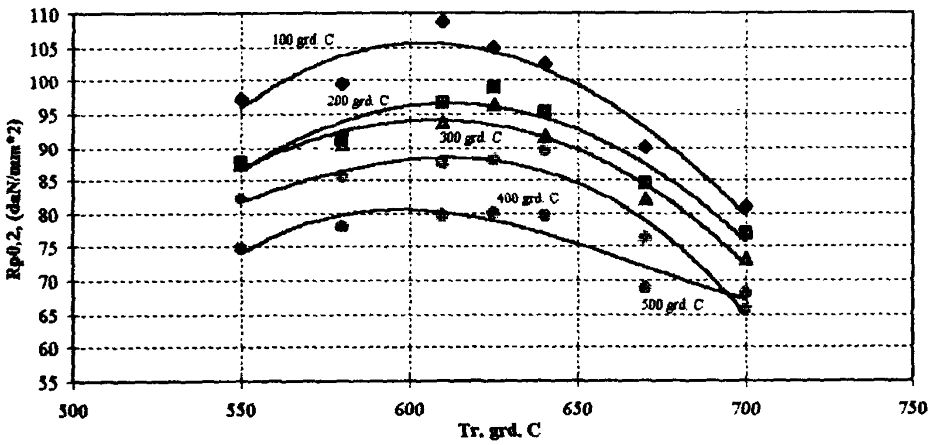

Fig. 1. The variation of the technical yield point with tempering temperature and test temperature.

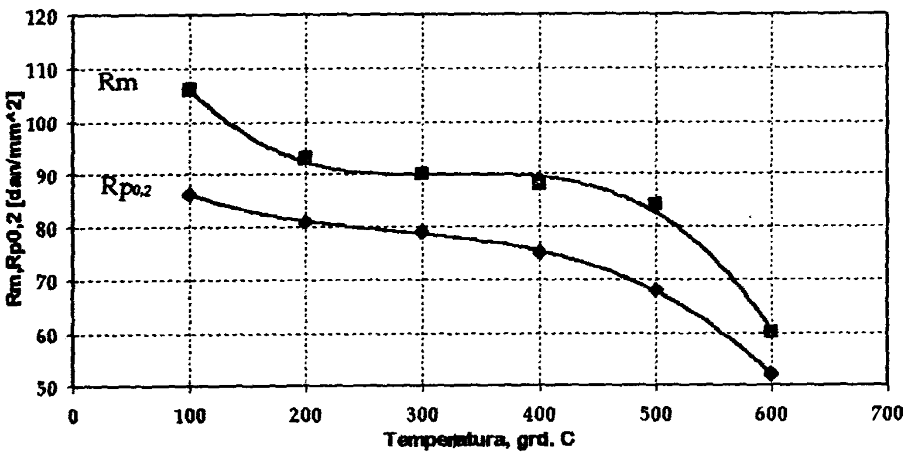

Fig. 2. The variation of the mechanical characteristics Rm and Rp 0,2 with tempering temperature.

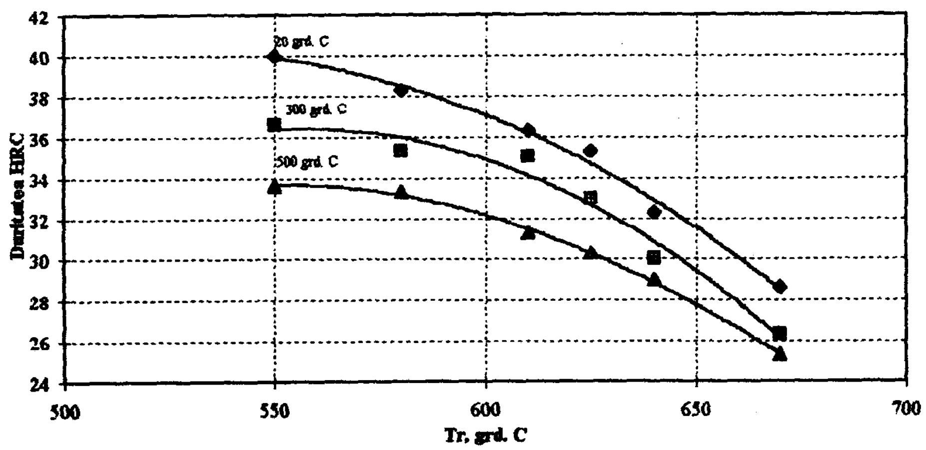

Fig. 3. the variation of the hardness with tempering and test temperature.

Table 3.

Tempering temperature,°C	Test temperature, °C and hardness HRC					
	20		300		500	
550	40 39 40	40 40 40	39 37 37	39 35 36	33 34 34	32 35 34
	39,6	40	37,6	36,6	33,6	33,6
580	38 39 40	38 39 38	36 35 35	37 34 35	34 32 32	32 31 31
	39	38,3	35,3	35,3	32,3	31,3
610	38 37 36	37 36 36	35 33 34	35 34 35	31 32 31	32 31 31
	37	36,3	34	35	31,3	31,3
625	37 33 34	36 35 35	35 33 33	34 32 33	31 29 30	31 30 30
	34,6	35,3	33,6	33	30	30,3
640	30 32 34	32 33 33	30 30 31	29 31 30	29 29 28	29 30 28
	32	32,6	30,3	30	28,6	29
670	28 29 28	29 29 28	28 27 26	25 28 26	24 25 24	25 27 24
	28,3	28,6	27	26,3	24,3	25,3

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