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Cooling of Structural Steel 45 during Thermal Processing Studying the Effect of Magnetic Field on Liquids

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In the metallurgical industry, it is of great importance to improve the quality of steel in the process of thermal treatment of structural and tool steels for the field of tool making. In the process of heat treatment, coolants are used in traditional ways. According to the results of our experience, it was found that in the development of the technological process of increasing the physical-mechanical, technological properties of materials under the influence of a magnetic field under different conditions of cooling fluids, it is possible to achieve high strength under the influence of a magnetic field to thermal treatment fluids of steel 45.

In the process of thermal processing of construction and tool steels, it is necessary to choose such objects in accordance with the development of the technological process and the study of the effects of the magnetic field on the types and conditions of cooling fluids, in which the metal or It is necessary to show that the transfer of new technology can improve the hardness and mechanical properties of new samples.

Thermal treatment of samples;

Water was selected as the cooling liquid during the thermal operation, selected in accordance with the state standard GOST 1050-74 (St 45). The state of the liquid is at rest.

Steel 45 according to the state standard GOST 1050-74 selected for the experiment.

Table-1.

Sample No. 1. (St 45) In the process of heating and cooling, the coolant (water) is H_2O at rest				
Steel brand	Hardness (HRC)	Find out ^{0} S	Release ^{0} S	Fluid condition (quiet)
St 45	51 HRC	840-860 ^{0} S	200 ^{0} S	V= 0.007 m^3
	32 HRC	850-860 ^{0} S	450 ^{0} S	
	28 HRC	840-860 ^{0} S	600 ^{0} S	

Carrying out the technology of thermal operation under the influence of a magnetic field to cooling fluids in motion and at rest. In the process of thermal treatment of samples, water (H_2O) as a cooling liquid is presented in the case of 300 m/T magnetic field induction in a rotating motion of 1 min/65 liters and a constant magnetic field is applied to it.

Sample #1. Structural steel 45 (St 45).

Table-2

Sample No. 1. (St 45) In the process of heating and dipping, the coolant (water) H2 O circulation 1 min / 65 l magnetic induction at 300 m/T				
Steel brand	Hardness (HRC)	Find out ^{0}S	Release ^{0}S	Fluid condition (circulation)
St 45	53 HRC	840-860 ^{0}S	200 ^{0}S	V= 0.007 m^3
	30 HRC	850-860 ^{0}S	450 ^{0}S	
	26HRC	840-860 ^{0}S	600 ^{0}S	

During the conducted experiments, the first experiment was conducted with water selected as the cooling liquid used in the process of thermal operation in a still state and without a magnetic field.

In the second experiment, the state of water was carried out in a circular motion for 1 minute/65 liters under the influence of a permanent magnetic field of 300m/T induction.

Calculating and choosing the time of the thermal operation mode: When calculating the total time required to heat up the workpiece, all the considerations described above are taken into account. But it is very difficult to accurately calculate the time of holding the part at a certain temperature, therefore, the holding time is found using practical coefficients, and the value of these coefficients is selected based on the above factors. For example, the coefficient of the time it takes to keep a cylindrical rod (its diameter is d) that the gas flame touches uniformly from all sides at a certain temperature is taken as 0.5-1 minute per millimeter of cylinder diameter (from 0.5-1 min/mm). The detail is very high

(800 ^{0}C and higher), the coefficient is 0.25-0.5 min/mm, and if it is heated in liquefied lead, it is 0.1-0.25 min/mm.

If the cross-section of the part (zagatovka) is in the form of a square (we take its right side as a), heat such a part at a certain temperature. The time required for heating is one and a half times the coefficient, and the coefficient of the time required to heat the part with a right angle cross-section (we take its short side as b) is taken twice as much. If the heating medium does not touch all sides of the part to be heated at once, for example, the part is placed at the bottom of the furnace, then the holding time is 1.5 to 4 times, depending on the location of the part. if there is, it will increase 1.5 - 2 times.

It should also be mentioned that it takes very little time (only a few seconds) to heat up the layer of As3 or As1 steel on the surface from the critical point of 30 - 500 ^{0}C, i.e. to the temperature of transformation of pearlite into austenite. , and the process of turning pearlite into austenite takes several minutes. Since the time of keeping the steel at a certain temperature includes the time of pearlite turning into austenite, the formula can be written as follows:

$T_U = T_t$

The above-mentioned values of retention time coefficients and, therefore, the total time required for heating are approximate.

These values can only be determined experimentally. In factories, ready-made norms of heating and holding time are used, and these norms are created by directly measuring the time of heating and holding the parts at the same temperature.

Various furnaces are used to heat the steel up to the forging temperature. These furnaces include flame furnaces, muffle furnaces, and crucible furnaces. We used muffle furnaces for the experiment.

We calculate the retrieval time for sample #1 based on guest demand

1. The diameter of the sample is 58 mm;

2. The height of the sample h – 18 mm;

3. If the part is heated to a very high temperature (800^0C and higher), the coefficient is 0.25 - 0.5 min/mm, and T t is set to 0.25 min/mm.

4. Total time - Tu

5. $T_u = T_t$*d*h

6. It took a total of 4 hours and 35 minutes to collect.

24.11.88 N 3811. Recommended temperature for release of the sample in accordance with the requirements of the state standard GOST 1050-74 is 200 ^{0}C

2 hours 600 0C – 1 hour.

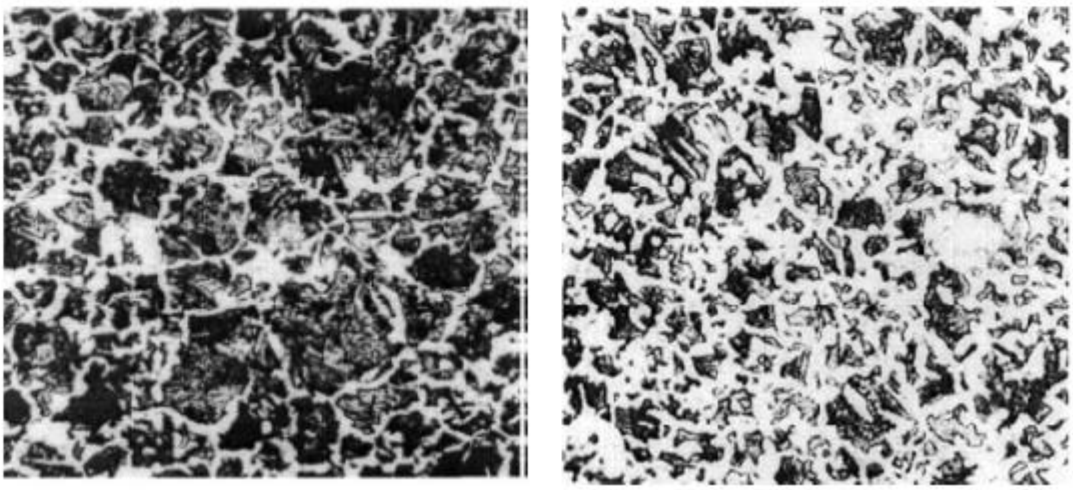
Microstructure analysis of the obtained sample *in the state of 1000-fold magnification without the effect of a magnetic field and in a magnetic field, water was used as a cooling liquid. This is in accordance with the requirements of the state standard GOST 1050-74, dated 24.11.88. In order to see the microstructure, the sample was polished with 1000, 1500, 2000 micron sanding paper step by step for 2-3 hours, then it was polished on the machine in a circular motion up to 150-750 times per minute in chrome powder.

Microstructure of samples;

Research samples made of steel grade 45 were obtained at a temperature of 840 - 860^0C in the order given in the section. We carried out the process of releasing the obtained sample at a temperature of $200\text{-}220^0$C in the given order. We analyzed the microstructure of the released samples in the following order. The microstructure of the samples after cooling in different liquids is shown in Fig. 1.

a – without magnet b – in magnetic field

1 - picture. Microstructure of samples cooled in different liquids x1000.



The hardness of the samples was measured after they were fired at low and high temperatures:

1. The hardness of the sample was measured at a temperature of 200 C, according to which the hardness of the sample was high. Changed from 51 HRC to 53HRC.

2. Hardness was measured at 450 C, according to which the hardness of the sample varied from 32 HRC to 30 HRC.
3. Hardness was measured at a temperature of 600 C, according to which the hardness of the sample varied from 24 HRC to 26 HRC.

Total hardness increased by 2.14%.

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