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Investigation of the generated heat during the treatment of metal samples. Part II: Heat in strain of metal cylindrical samples with different relation L/D.

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Abstract: *With strength tests extract information about certain mechanical properties of materials important for their further use in the production of various machines and equipment. With the testing of materials under pressure also obtained information about the plastic deformation of the workpiece and the form that will be received after loading. Since tests completed most of the demolition, it is normal to them to work with specimens rather than finished products.*

Keywords: *strength test, temperature, heat transfer, heat emission*

1. Experimental arrangement

The test pressure is related to the static methods in which the loading force is increased gradually to a value where cracks appear, or until the maximum power of the machine, due to the occurrence of hardening of the material using a hydraulic or electric press (Figure 1). The test specimen (cylindrical image) made of channel at top and bottom to allow deflection of samples to obtain a cylindrical rather than a "barrel-'(Figure 2), see Experimental images made of different materials, as follows from left to right - steel 3 Armco iron, cast iron, aluminum alloy and copper alloy. Differing in this study was that in addition to monitoring the normal parameters for these tests (rate of deformation during a deformation force at deflection and the dimensions of the test specimen after the deformation or fracture) we track the temperature of the model in real time. Thus it becomes possible to determine the heat and calculate how much of the work in a similar experiment goes deformation and what is converted into heat.

Figure.1. Press Instron 1195 testing tension and compression up to 10 tons.

Figure.2. Specimens made of different materials

As a result of each test pressure is removed indicator chart (general appearance of which is given in Figure 3). From these diagrams can define different areas as load, the maximum tensile strength and the relative deformation of the various samples.

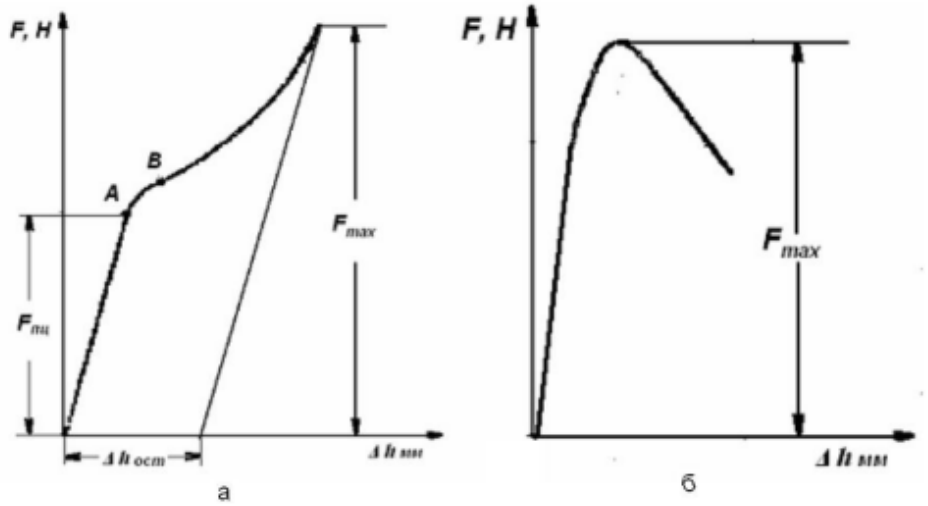

Figure 3. Charts load pressure a- steel 45 b- iron.

2. Results of experiments

From experiments made it is found that due to the low rate of deformation tests, the heat in the material when no cracking / breakage is evenly distributed in the whole volume of the specimen steel 3. It can be seen that the temperature rise is about 2 ^{o}C, which becomes extremely smooth due to the high ductility of steel 3.

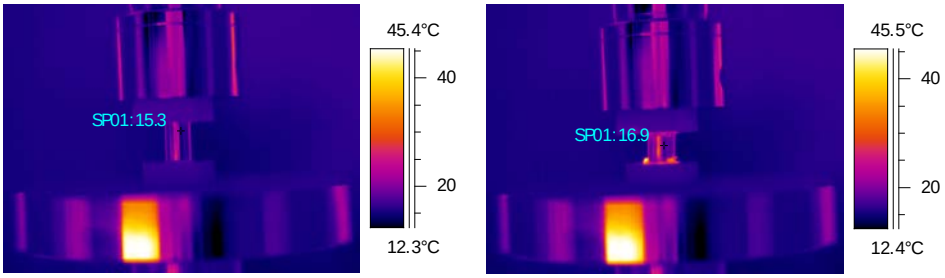

Figure 4. Images from infrared camera in different stages of loading, they can see the differences in temperature before, during and after loading steel 3.

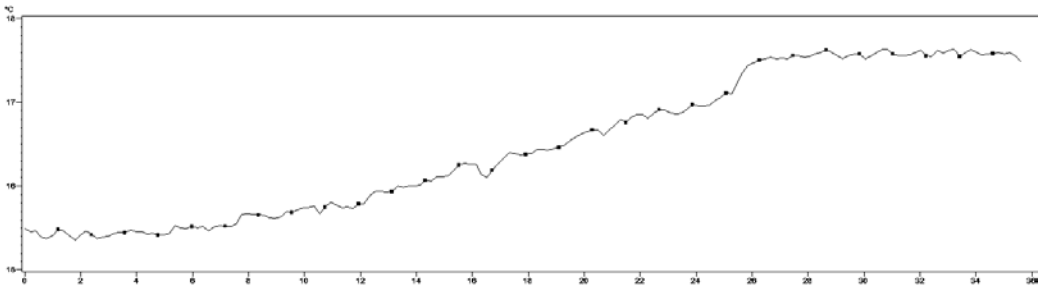

Figure 5. Diagram showing the heating and cooling of the sample steel 3.

In experiments with Armco iron was prepared substantially greater deformation, which is due to the plastic material in this case can be seen that the heat that is released is larger than in the steel 3. The temperature rose to about 14ºC . (Fig.6 and 7).

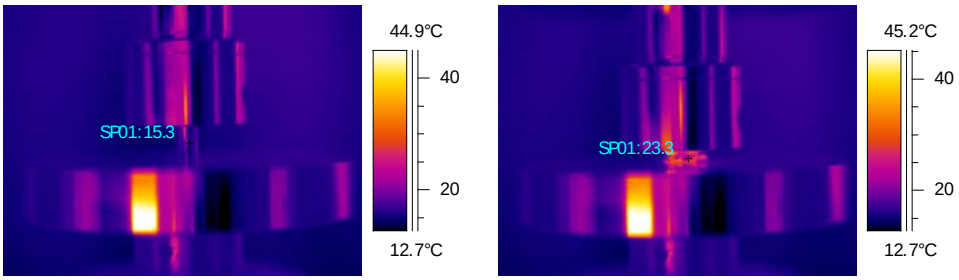

Figure 6. Images from infrared camera in different stages of loading, they can see the differences in temperature before, during and after the load of Armco iron.

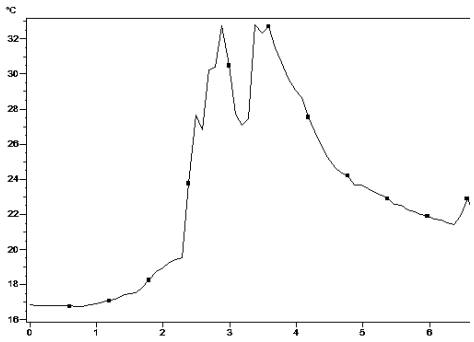

Figure 7. Diagram showing heating and cooling the sample from Armco iron.

In experiments with iron, are obtained interesting results, which are visible in Fig. 8 and 9 - gradual heating up to the moment of rupture of the specimen after the burst

of the specimen is possible to see, and the temperature inside it which is about 8ºC higher. This means that the heat is distributed from the inside out in the model.

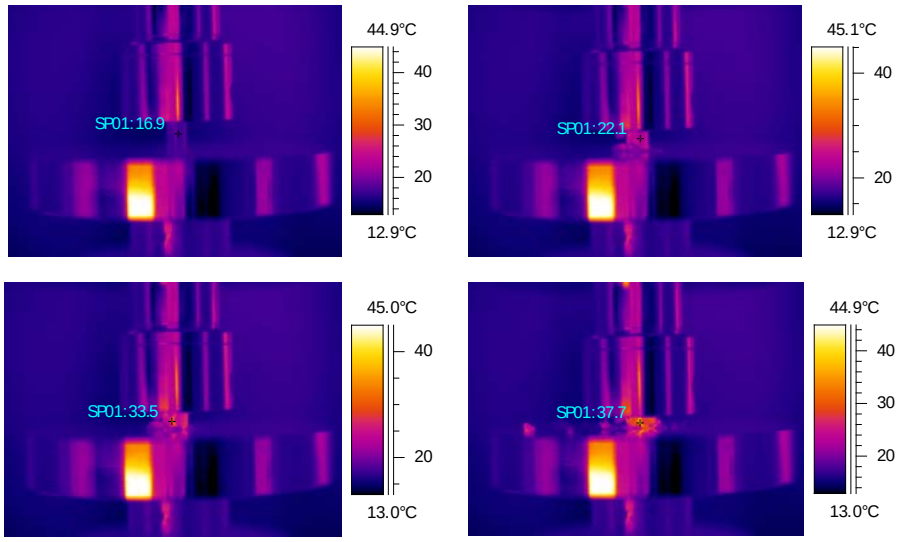

Figure 8. Images from infrared camera in different stages of loading, they can see the differences in temperature before, during and after the loading of iron.

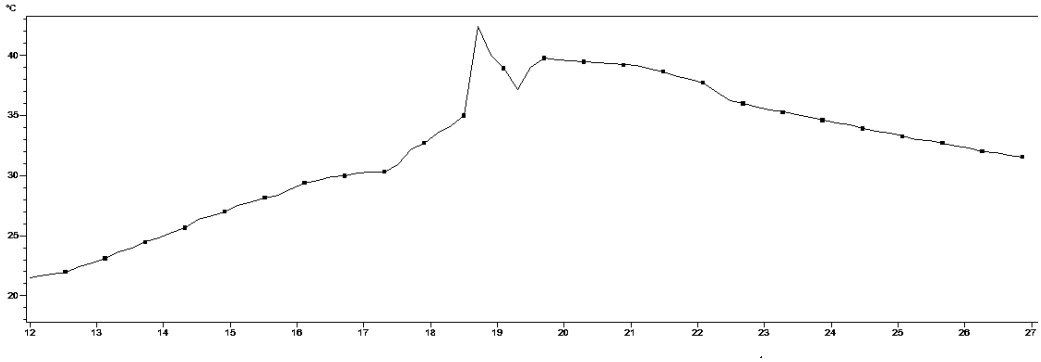

Figure 9. Diagram showing heating and cooling the sample from iron.

In experiments carried out with samples of the aluminum alloy, it can be seen that we have a large plastic deformation, but almost no heating of the samples (Figure 10 and 11), which can be explained by the relatively cool room in which the experiments have been conducted and the high thermal conductivity of aluminum alloy.

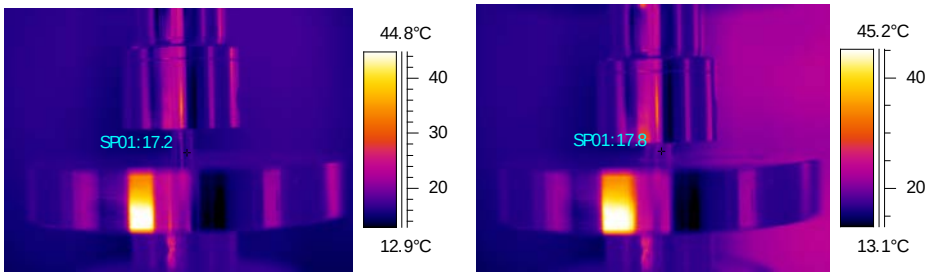

Figure 10. Images of an infrared camera in different stages of loading, they can see the difference in temperature before, during and after loading of the aluminum alloy.

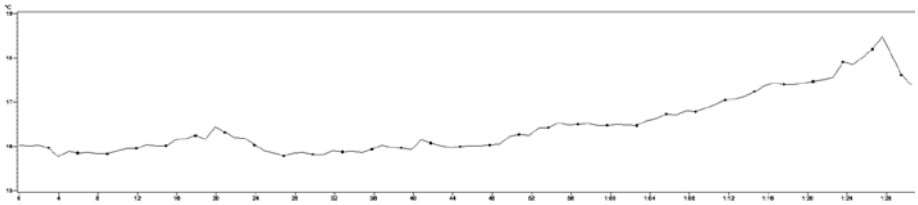

Figure 11. Diagram showing the heating pattern of an aluminum alloy.

Because of the higher plasticity of copper relative to aluminum alloy, the deformation is greater and the heating temperature higher.

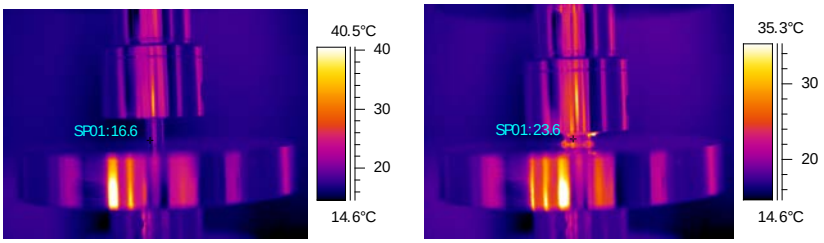

Figure 12. Images of an infrared camera in different stages of loading, they can see the difference in temperature before, during and after loading of copper.

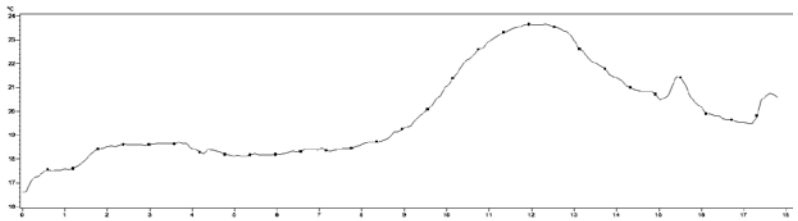

Figure 13. Diagram showing the heating pattern of an aluminum alloy.

3. Conclusions:

In the test with the pressure of cylindrical specimens, heat dissipation is uniformly distributed over the surface of the model, furthermore, it is found that the heat is distributed from the interior of the sample to the outer portion (the core temperature is significantly higher), it can be seen very well in samples of aluminum alloy and cast iron, wherein a crack in the specimen. Owing to the concave top and bottom specimens at strain retaining the cylindrical shape of the models rather than receive "Barrel" shape.

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Исследование генерируемого тепла при обработке образцов металлов. Часть II. Теплота деформации металлических цилиндрических образцов с различным отношением L / D.

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Р е з ю м е

При испытаниях на прочность извлекается информация о некоторых механических свойствах материалов, важных для их дальнейшего использования в производстве различных машин и оборудования. При испытаниях материалов под давлением также получена информация о пластической деформации заготовки и о форме, которая будет получена после загрузки. Поскольку испытания завершают большую часть разрушения, для них вполне нормально работать с образцами, а не с готовыми продуктами.

Ключевие слова: стресс тест, температура, трансфер тепла, емисия тепла