EXPERIMENTAL INSTALLATION FOR INVESTIGATION OF MECHANICAL PROPERTIES OF METEORITES.

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Introduction: Usually, meteorites are fragments of theirs parent bodies surface. So, their properties provide important information about the composition and evolution of asteroids and small bodies of the Solar system [1]. But frequently the body of the fallen meteorite is broken with the cracks and splits, like Chelyabinsk. In order to identify the different failure mechanisms, we have to experimentally investigate the strength properties of the small part of meteorite. Most industrial facilities for researching mechanical properties of materials don`t allow provide the estimation of such meteorites, because it need dimensions of sample at least 25 mm diameter and 50 mm length [2]. To avoid these constraints, we have designed special installation for evaluation such elastic mechanical values as Poisson`s ratio, Young`s modulus, and ultimate tensile and compression strengths.

Methods: Design of the developed installation for estimation of mechanical properties comprises sensors, electronic unit, personal computer. The cylindrical samples with dimensions starting from 5 mm in diameter and 10 mm length can be studied on it. The only limited factor is size of chondra, main components of chondrites. The study of so small samples can be performed by tiny foil strength sensors with nominal impedance from 300 Ohms to 1000 Ohms, whith different base size. Electronic unit has 4 channels. 2 channels intended for signals from sensors of relative longitudinal and transverse deformation. The third channel used for force sensor, which measure the force applying to sample. The fourth channel can be used for external temperature sensor in case when sample is only one. Usage sensors of relative longitudinal and transverse deformation in pair increase accuracy by 2 times per channel. Each pair of sensors connects to 32-bit analog to digital converter. All analog to digital convertors send digital data to controller, which proceed it and send on personal computer. The electronic unit has power station unit to stabilize supply current. The schematics of electronic unit optimize out signal and increase accuracy of evaluation. Installation can compensate the fluctuation of signal from temperature and added impedance of wires.

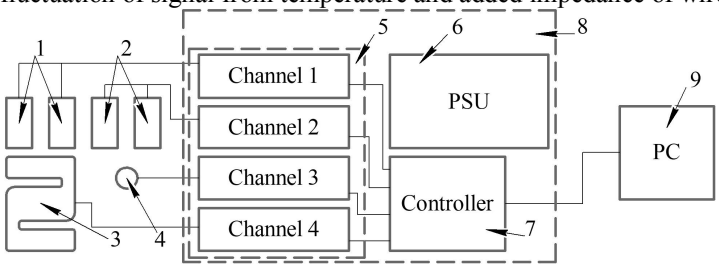

Figure 1. Block-scheme of installation. 1,2 – foil sensors, 3 – force sensor, 4 – temperatures sensor, 5 – ADC group, 6 – power station unit, 7 – controller, 8 – electronic unit, 9 – personal computer

Results and Discussion: Developed facilitie allowed us to perform measurement of mechanical properties of small samples of meteorites in according to GOST 28985-91 Rocks. Method for determination of deformation charactеristics is uniaxial compression. The calculation of the charactrestics can be carry out according to the following formulas: Young`s modulus:

$$E_y = \frac{\sigma_к - \sigma_н}{\varepsilon'_{1к} - \varepsilon'_{1н}} \quad (1)$$

Poisson`s ratio:

$$\mu = \frac{\varepsilon'_{2к} - \varepsilon'_{2н}}{\varepsilon'_{1к} - \varepsilon'_{1н}} \quad (2)$$

where σк, σн – tension at finish and at start of loading and unloading range of sample, ε1к, ε1н – relative longitudinal deformation of sample at finish and at start of range on loading, ε2к, ε2н – relative transverse deformation of sample at finish and at start of range on loading, ε'1к, ε'1н – relative longitudinal deformation of sample at finish and at start of range on unloading, ε'2к, ε'2н – relative transverse deformation of sample at finish and at start of range on un-loading.

Further, we will modify this installation to perform the Brazilian test. The great advntage of the Brazilian test is determination of the elastic modulus, tensile strength and fracture toughness of rock materials in one test. [3].

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