BRITTLE FRACTURE RESISTANCE OF CHINGA AND SEYMCHAN METEORITES UNDER STATIC AND IMPACT LOADING

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Introduction: Most scientific researches of meteorites are concerning their chemical and mineralogical aspects, but mechanical behavior of such kind of materials is not clear enough [1, 2]. Most of the iron and stony meteorites mechanical properties were obtained from compressive or tensile tests and very seldom from impact and fracture toughness tests [3-5]. Thus, in this study, a comparative evaluation of Chinga and Seymchan iron meteorites brittle fracture resistance by means of static fracture toughness and impact strength tests is presented.

Experimental: Tested samples were prepared from Chinga ataxite and the metal part of Seymchan PMG. Static fracture toughness tests of meteoritic materials were performed at room temperature on standard pre-cracked specimens with a thickness of 10 mm according to 3-point bend scheme using the universal testing machine INSTRON8801 and following the regulations of GOST 25.506-85. The initiation of fatigue crack as a stress concentrator was carried out on high-frequency resonant MIKROTRON (RUMUL) machine at a loading frequency of ≈ 100 Hz. Impact strength KCU values of meteoritic materials were performed according to the requirements of GOST9454 with use of instrumented Tinius Olsen IT542 impact test machine at temperatures of 190 and 300 K. The sizes of impact samples with an U-notch of 2 mm in depth were 10 x 10 x 55 mm. Scanning electron microscopes JEOL JSM-66490LV and TESCAN VEGA were used for fractographical analyses of studied materials.

Results and Discussion A subject of the real researches were substances of Chinga and Seymchan meteorites. According to experimental results presented in Table 1 static fracture toughness Kc value at room temperature of Chinga meteorite is in 1.5 times higher as compared with Seymchan meteorite. Because of rather a high ductility of both materials thickness of tested specimens does not correspond to Braun-Srawley plain-strain criteria. So the experimental K_c values are related to the plain-stress condition. It means that for gaining correct K_{1c} values (plain-strain fracture toughness) specimens of higher thickness are needed.

Table 1 -The values of impact strength (KCU) and static fracture toughness (Kc) of Chinga and Seymchan meteoritic materials impact strength. *Test temperature 300/190 K

Type of meteorite	KCU*, MJ/m^2	K_c, $MPa \cdot m^{1/2}$
Chinga ataxite	1.55/1.10	81.1
Seymchan octahedrite	0.67/0.19	55.5

Impact strength KCU values of Chinga ataxite are in 2.3 and 5.8 times higher in comparison with Seymchan meteorite at 300 and 190 K correspondingly. Fractographical observations of meteorites specimens surface have shown that higher values of impact strength and fracture toughness of Chinga meteorite are associated with mainly viscous dimples fracture mechanism of this material in comparison with Seymchan meteorite. The fracture relief of Seymchan meteorite impact and static specimens has more non-uniform structure and contains some pores alongside with the sites of brittle fracture relief elements.

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