Experimental study of the granules flow through a local narrowing

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Hydraulic fracturing is one of the most effective ways to increase the productivity of oil and gas fields. It can be defined as a mechanical method of influencing a producing formation, in which rock is fractured by pressure of fluid injection. To prevent the closure of cracks after reducing the pressure, special granular material is pumped into fissures. This material called propping agent or proppant. In this regard, there is a need to conduct extensive studies of fluid flow with proppant in a simplified model formulation

As shown in article [1], the phenomenon of bridging (formation of stable arches blocking the flow of particles) takes place during the gravitational flow of granules through the hole. Bridging is of particular interest, because this process may occur when proppant is pumped into cracks. This can have negative consequences since there is a risk that the proppant will not completely fill the cracks.

The aim of this work is to study the bridging criteria for the flow of gels with proppant in the applied problem of hydraulic fracturing. In particular, statistical and optical analysis of experimental data on the gravitational flow of granular particles through a hole in 2D and 3D formulation is required.

As a result of the work, two experimental stands were created for 2D and 3D cases. The process of conducting an experiment and collecting data was maximally automated. Statistical and optical data were analyzed and compared with already existing works on this topic. A number of studies were carried out with varying hole size and granule size for two cases: when the system is airborne or submerged. In the future, it is also planned to study the dependence of the appearance of bridging on the shape of the hole.

References

[1] Koivisto J., Durian D. J *Effect of interstitial fluid on the fraction of flow microstates that precede clogging in granular hoppers.* Physical Review E 2017 V. 95 P. 032904