MICROMECHANICS OF PERFORATION PENETRATION AND SAND PRODUCTION IN WEAK SANDSTONE FORMATIONS IN KAZAKHSTAN

N.H.Minh*, J.R.Kim, S.C.Fok, S.Spotar

School of Engineering, Nazarbayev University, Astana, Kazakhstan; *minh.nguyen@nu.edu.kz

INTRODUCTION.

Sand production is a major problem in many parts of the world, it is estimated that 60% of all petroleum reservoirs in the world are sandstones [1]. The exact mechanisms of sand production phenomena where sand particles are eroded from weak sandstone formations under the effect of oil-gas flows are still not fully understood. Despite great efforts to establish the prediction methods for sand production, it was claimed that the accuracy of most prediction models is not adequate for general field applications [2]. The negative impacts of sand production include eroding hardware, blocking tubulars, creating downhole cavities and the negative impacts to the environment when the eroded sand materials need to be separated and disposed [3]. Adding complication to the matter, sand production was also found to have positive impacts in improving oil productivity [4] and installation of conservative measures for sand control may lead to lower productivity. Understanding better the sanding mechanisms could help to balance the cost-effectiveness of different sand control measures currently employed in the field (e.g., gravel packs and filters). Optimizing recovery and sand control are listed among the major technical challenges for the oil-gas industries in Kazakhstan [5].

METHODOLOGY.

The behaviour of weak rocks that are likely to cause sand production can be studied using the principles of soil mechanics. It was particularly shown that the well-established Critical State Soil Mechanics framework can be used to examine the behavior of weak sandstones. The phenomenon of sand particles being detached from the parent rock at some specific locations is a problem initiated at a microscopic level, and this depends very much on the prior damage of the parent rock occurring when it is subjected to change in the *in-situ* stress condition and to the mechanical impact of the oil extraction process.

RESULTS AND DISCUSSION.

Research on sand production has been conducted using different approaches: analytical, laboratory experiments including centrifuge tests, continuum based modeling and a more recent trend using discrete modeling.

CONCLUSIONS.

In this project, we propose a comprehensive multidisciplinary study of sand production using laboratory experiments, microscopic modeling and continuum based modeling.

REFERENCES.

1. Bjorlykke K. (2010). Petroleum Geoscience: From Sedimentary Environments to Rock Physics, Springer.
2. Nouri A., Vaziri H., Kuru E., Islam R. (2006). A comparison of two sanding criteria in physical and numerical modeling of sand production. Journal of Petroleum Science and Engineering, 50(1): 55–70.
3. Carlson J., Gurley D., King G., Price-Smith C., Waters F. (1992). Sand control: Why and how? Oilfield Review, 4: 41-53.
4. Vaziri H.H., Lemoine E., Palmer I. D., McLennan J., Islam R. (2000). How can sand production yield a several-fold increase in productivity: Experimental and field data, in: Proceedings of SPE Annual Technical Conference and Exhibition, pp. 739–750.
5. Collective industry effort (2013). Kazakhstan upstream oil and gas technology and R&D roadmap, Kazakhstan.