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STUDYING THE INFLUENCE OF HETEROGENEITIES ON THE KGD BENCHMARK PROBLEM

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The study of the plane strain hydraulic fracturing propagation (KGD) was historically introduced in the works by Khristianovic & Zheltov [1], Geertsma & de Klerk [2], which presented the basis of the problem as fracture propagation caused by the fluid advancing along a line. In the last two decades, the 2D problem has been tackled analytically, assuming homogeneous elastic properties, constant value of critical toughness and homogeneous distribution of far field stresses. Some solutions were made available in specific cases such as viscosity, toughness or leak-off dominated cases, as reported by Desroches et al. [3], Garagash & Detournay [4] or Detournay [5].

This contribution discusses the effects observed in the solution of the KGD problem when the assumptions on homogeneous solid properties are removed. Firstly, the limit case of toughness dominated is considered, since the case of viscosity dominated regime would reduce significantly the influence of any solid heterogeneity.

Then, a solid with periodic layering of heterogeneous properties (such as toughness, elastic modulus or in situ stress field) is considered as the study case. The layering is designed to be orthogonal to the propagation direction and each single property is studied separately to provide a clear picture of the final effects. Both analytical and numerical tools are used to tackle the problem and retrieve information on the response of a heterogeneous solid to HF. It is possible to observe that the standard solutions of the KGD are not valid anymore and a substantial deviation in the results is noticed, including oscillation between solutions and significant delays in the advancement of the fracture.

REFERENCES

[1] Khristianovich, S.A. & Zheltov, V.P. 1955. Formation of vertical fractures by means of highly viscous liquid. In: Proc. 4-th World Petroleum Congress, Rome, pp. 579-586
[2] Geertsma, J. & de Klerk, F. 1969. A rapid method of predicting width and extent of hydraulically induced fractures. J. Pet. Tech., 21, pp. 1571-1581.
[3] Desroches, J., Detournay, E., Lenoach, B., Papanastasiou, P., Pearson, J.R.A., Thiercelin, M. and Cheng, A., 1994. The crack tip region in hydraulic fracturing. Proc. R. Soc. Lond. A, 447(1929), pp.39-48.
[4] Garagash, D. and Detournay, E., 2000. The tip region of a fluid-driven fracture in an elastic medium. Journal of applied mechanics, 67(1), pp.183-192.
[5] Detournay, E., 2004. Propagation regimes of fluid-driven fractures in impermeable rocks. International Journal of Geomechanics, 4(1), pp.35-45.