Slickwater is not water*

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In this talk, we will review the implications of the use of high rate slickwater hydraulic fracture treatments as often performed in unconventional gas reservoirs. In particular, due to the very large injection rate used (with rates up to 25 Barrels per minutes in a multistage context when not all the fractures within a stage propagate), the assumption of laminar flow in the fracture may be challenged - at least in the near-wellbore. This is particularly striking if one takes the properties of water to compute a fracture inlet Reynolds number: e.g. thus obtaining inlet Reynolds number up to $4,000$ for a PKN fracture geometry [6]. However, in practice, so-called "friction reducers" are always added in small quantities to the injected water in order to reduce the pressure drop in the wellbore (where the flow is turbulent) and thus minimize the pumping energy required on site (i.e. the numbers of pumping trucks). These friction reducers are high molecular weight (macro molecules) polymers (typically polyacrylamide-based), whose micellar structures completely change the transition from laminar to turbulent flow [5] - making the water "slick". The effect of the addition of these polymers do saturate at a finite concentration, where the so-called maximum drag reduction asymptote is reached. Such a "saturating" concentration is actually quite low such that it is always targeted in engineering practice.

We will present limiting solutions for hydraulic fracture growth in the case of a turbulent maximum drag reduction flow for both the height contained (PKN) and radial fracture geometries in the zero toughness limit. In particular, we will show that most turbulent flow regimes can be recasted as modified power-law fluids as first discussed in [4] for the turbulent rough Gauckler-Manning-Strickler regime. This allows to partly adapt a number of existing solutions for hydraulic fracture growth [3, 1, 2]. We will discuss our results in light of typical operational parameters, highlighting the importance of the drag reduction of slickwater at large Reynolds number.

References

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