TG12

Overcoming Hydraulic Fracturing Difficulties in the Sarah and Qasim Formations

K.M. Bartko* (Saudi Aramco) & K.M. Al-Naimi (Saudi Aramco)

SUMMARY

As Saudi Arabia increases their demand for natural gas inside the Kingdom, ongoing reservoir targets are moving increasingly to more challenging reservoirs which exhibit low permeability of <0.01 md. Reservoir pressure ranges from low or can be extremely high (11-13,000 psi) and the high temperature makes obtaining reservoir data increasingly difficult due to tool limitations. Two particular formations which have recently received attention is the Sarah and Qasim formation. The Sarah and Qasim formation creates a challenging environment for hydraulic fracturing due to the difficult environment and depth. This paper will identify these challenges and discuss course of actions to overcoming them.
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Hydraulic fracturing these formations are increasingly challenging due to mechanical limitations on the completion assembly and surface equipment. Maximum surface pressure limitations of 15,000 psi with a maximum bottom hole pressure limitation required the use of heavy weight brines up to 12.3 lb/gal. Heavy brines have been successful in the deep Gulf of Mexico frac packing however they have never been applied to a tight gas reservoir. A new fluid system using sodium bromide (Nabr) brine was developed for fluid stability at 375º F temperature, proppant transport capability, and minimal formation damage. The developed fluids also need to be developed to address the following:

- High capillary pressure conducive to water block
- Clay filling pores conducive to fines migration
- Illite clays could help promote water blocking
- High drawdown pressures during flow tests would magnify the two identified damages above

The new fluid was extensively tested and successfully field tested.

Development of a geomechanical model is extremely important in hydraulic fracturing operations for determination of fracture geometry. There is evidence that theses two formations will require individual fractures in each sand layer as the current fracture modeling is indicating multiple fractures are being generated. Work has been focused on an improved understanding of how the geology makeup of the Sarah and Qasim formations control fracture growth.

Tailoring hydraulic fracture designs to reservoir conditions is extremely important to ensure recovery. In certain areas Saudi Arabia the Sarah and Qasim formation produces condensate which requires a high conductive fracture to reduce the effects of multiphase flow. This additional criterion requires high concentrations of proppant at the wellbore which is difficult due to the high stress regime. Work is currently being performed to determine the impact the multiphase flow has on the fracture geometry and what concentration of proppant is required to limit the effect.

The Sarah and Qasim formation creates a challenging environment for hydraulic fracturing due to the difficult environment and depth. This paper will identify these challenges and discuss course of actions to overcoming them.