

Tracers and Pressure Transient Analysis Used to Better Understand Reservoir Connectivity, Wara-Greater Burgan-Kuwait

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ABSTRACT

The Wara reservoir in Greater Burgan field has been on production since 1948. The pressure has declined below bubble point pressure in several parts of the reservoir prompting the need for a pressure maintenance program. A Pilot scale water injection program and associated tracer application was initiated in 2010 to understand the waterflood response and gather information to design a full field scale waterflood. This paper highlights the results of the application of tracer and Pressure transient analysis (PTA) in mitigating the uncertainties and to develop improved waterflood strategies in the Wara reservoir. The highly heterogeneous nature of the Wara reservoir poses major challenges in managing the waterflood and improving its effectiveness. Complex depositional reservoir geometry coupled with the presence of faults / flow barriers and variation of fluid properties results in a complicated plumbing system in the Wara reservoir. Pressure transient studies provide insight to reservoir connectivity and presence of fault/baffles. Understanding the injector- producer connectivity is crucial in managing the waterflood effectively to optimize the volumetric sweep efficiency. The pilot tracer program offers insight to injector – producer connectivity, and water movement within the reservoir. The combination of PTA and tracer injection in the Wara reservoir has been extremely helpful in the following; - Understanding the injector-producer connectivity - Building a better subsurface description for development planning and reservoir simulation - Optimizing well spacing - Volumetric sweep and strategy for improvement - Identifying development opportunities An extensive tracer monitoring program in the pilot water injection area has provided valuable information in understanding the flood front movement in this area. In the Wara waterflood area tracer breakthrough times vary between 1 and 7 years of injection. This is an indication of the complex nature of the reservoir connectivity and fluid movement within the reservoir. Integration of PTA and the application of tracer injection in a complex and heterogeneous reservoir has provided valuable insights to waterflood behavior and enabled modifications to the development strategy to optimize sweep efficiency, well spacing and pattern development in where reservoir connectivity relatively low.