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## **Gas Shut-off Treatment in Oil Carbonate Reservoirs in Saudi Arabia**

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### **Abstract**

Gas coning or channeling is a serious problem in many oil fields. It can reduce oil production significantly. Therefore, it is important to minimize excessive gas production. Production at high gas/oil ratio is a problem, which occurs because of the high gas mobility in the formation. Gels and foams have often been used to reduce gas movement into the wellbore of oil wells.

Oil production from an oil producer in a carbonate reservoir declined due to excessive gas production. A detailed diagnostic work was conducted to determine the source and entry of gases into this well. In addition, several gelling systems were examined in the laboratory as a means for gas shut-off in this well.

The results of several logs identified two zones for gas production. The first zone 6,000- 6,500 ft is responsible for 80% of the gases produced from well A. Another zone, 7,200 – 7,400 ft is responsible for the remaining gases. Several chemical means were evaluated for total shut-off of these two zones. These systems were compatible with formation brines. The gelation time can be controlled by varying the cross-linker concentration, or by injecting a preflush to cool down the formation. A surfactant system with a source of calcium was evaluated to be used for gas shutoff purpose. This system produced a precipitate that can be removed by toluene and other hydrocarbons.

### **Introduction**

Field-S is characterized by low permeability reservoir overlain by a massive gas cap was initially developed in 1996 with one-km single lateral horizontal wells to effectively drain the hydrocarbon while reducing gas coning. The oil column in this field is overlain by a large gas cap, and underlain by an active aquifer. The temperature range of the formation is 180-195°F. The produced crude has °API stock gravity of 41 and a dynamic viscosity of 2.83 mPa.s at 70°F. Wells and production facilities are situated on the interdune subkhahs. The associated gas, representing an average gas oil ratio (GOR) of 750 SCF/STB, is separated, compressed to 3,500 psig, and re-injected into the gas cap. In terms of mineralogy, the formation is dominated by calcite (90-100 weight percent). The remaining minerals are minor dolomite (0-8 percent, occasionally reaching 13 percent in isolated intervals and trace amounts (usually less than 0.5 weight percent) of ankerite, quartz, pyrite, siderite and gypsum.

Producing at high GOR is a concern in this field due to limitations of the gas handling facility. Gas production is caused by fractures and coning as a result of the high mobility of gas in the formation. Unwanted gas production in oil producing wells is a factor that limits the productive life of oil wells because they have to be restricted to minimize gas production. Laboratory and field studies can be used to develop a well treatment to reduce gas production in oil producing wells. The method is based on the placement of a chemical blocking agent into the appropriate zones. Gels have often been used to reduce gas coning in reservoir.<sup>1,2</sup> Gas shut-off (GSO) using foam barriers has also been identified as a potential measure to control GOR downhole.<sup>3,4</sup>

The development cost of Field-S can be influenced by controlling the number and location of wells and the flow rate of each well. However, the flow rates are usually restricted when these wells encounter gas coning problems. Production from carbonate reservoirs with bottom water or gas cap is always associated with coning and/or channeling.

### **Identifying the Nature of the Problem**

To achieve a high success rate when addressing high GOR wells, the nature of the problem must first be identified. A critical aspect of diagnosing the coning problem is deciding whether fluid flow around the wellbore is radial or linear. Coning