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SPE 30775

Water Control Diagnostic Plots

K.S. Chan,* Schlumberger Dowell
*SPE Member

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This paper was prepared for presentation at the SPE Annual Technical Conference & Exhibition held in Dallas, U.S.A., 22-25 October, 1995.

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ABSTRACT

A new technique to determine excessive water and gas production mechanisms as seen in petroleum production wells has been developed and verified.

Based on systematic numerical simulation studies on reservoir water coning and channeling, it was discovered that log-log plots of WOR (Water/Oil Ratio) vs time or GOR (Gas/Oil Ratio) vs time show different characteristic trends for different mechanisms. The time derivatives of WOR and GOR were found to be capable of differentiating whether the well is experiencing water and gas coning, high-permeability layer breakthrough or near wellbore channeling.

This technique was applied on wells in several fields in Texas, California, the Gulf Coast and Alaska. Plots using the actual production history data determined the production problem mechanisms. Together with well tests and logs, the technique was used to select well treatment candidates and to optimize treatments to enhance the return of investment.

References and illustrations at end of paper.

INTRODUCTION

Over the last 30 years, technical efforts for water control were mainly on the development and implementation of gels to create flow barriers for suppressing water production. Various types of gels were applied in different types of formations and to solve different types of problems.[1,2] Quite often, excessive water production mechanisms were not clearly understood or confirmed. Although many successful treatments were reported, the overall treatment success ratio remains low.[3]

Through these field trials, the art of treatment job execution was progressively improved. Good practices in the process of candidate selection, job design, gel mixing and pumping and job quality control were recognized and adapted. More effective tools and placement techniques were also used. The desire to define different types of excessive water production problems began to surface.

In general, there were three basic classifications of the problems. Water coning, multilayer channeling and near wellbore problems are most noticeable among others. Field experience showed successful job design would not be the same for different mechanisms. However, there are no effective methods to discern these differences. In reality, the problem could be very complex, and usually is the combination of several

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757 4 water control diagnostic plots spe 30775 breakthrough, followed by a period of a negative slope Texas. The initial WOR was about 4 (80% water cut). indicative of cone buildup and a late period of gradual The reason could be a high initial water saturation. positive slope corresponding to the completion of the Waterflood started in this field at about 2000 days.

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An important problem in water control is the identification of the dominant reservoir or production mechanisms. Recently, Chan (Chan, K.S.: "Water Control Diagnostic Plots," paper SPE 30775 presented at the 1995 SPE Annual Technical Conference and Exhibition, Dallas, 22-25 October) postulated that a log-log plot of the water/oil ratio (WOR) produced vs. production time may be used to diagnose ...

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The WOR' curve in Fig. 8 shows this evolution: a very steep positive slope within a very short time after water 4 WATER CONTROL DIAGNOSTIC PLOTS SPE 30775 breakthrough, followed by a period of a negative slope indicative of cone buildup and a late period of gradual positive slope corresponding to the completion of the water-recycling conductive vertical channel construction.

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