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POSSIBILITY CALCULATION OF AN UPPER GAS RESERVOIR USAGE AS A GAS LIFT SOURCE IN THE CASE OF HORIZONTAL WELL

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An upper gas reservoir is a type of a reservoir from which gas is usually extracted to the surface and which usually lies above some oil reservoir. This sort of deposit position is relatively widespread, although usually both oil and gas resources are obtained as independent stratified formations.

The main goal of my research is to combine the extraction from both reservoirs into one well by using gas deposit as a source of a gas lift for creating the solution drive mechanism, and as a consequence, providing simultaneous rise of hydrocarbons to the surface.

The percentage of wells going on gas lift has increased considerably in recent years, particularly since the end of World War II. This popularity is due to improved equipment and other technical advances. Gas is much lighter than either water or oil, since that a mixture results with a much smaller fluid gradient [1].

The number of wells being drilled directionally is increasing and will continue to increase in the future. The reason for this is that more wells are being drilled from offshore platforms, therefore drilling nowadays utilizes one location for numerous wells, and most of these are highly deviated [2].

Very decided difference between horizontal and vertical flow is the difference in the effect of increased gas-oil ratios. For vertical flow, we call that increased gas-oil ratio causes a decrease in pressure for a certain set of conditions until the minimum gradient is reached. The opposite effect takes place for horizontal flow, that is, an increased gas-oil ratio causes an increase in pressure. The reason for this is that no fluids are being lifted vertically and therefore the gas merely represents additional fluids to be moved in the horizontal line [1]. According to this information, simple calculations were performed to show dependence of pressure drop and gas-oil ratio in truly horizontal pipe.

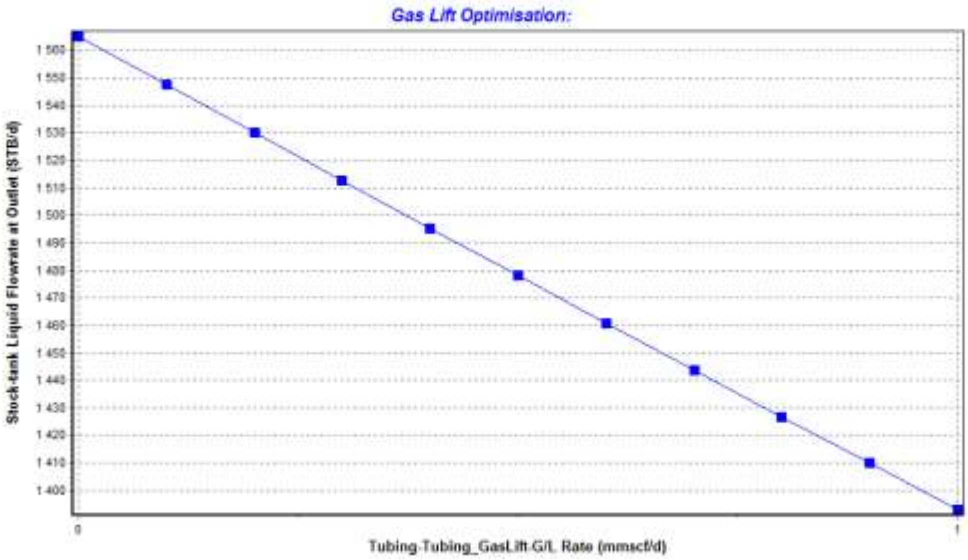

Figure 1 – Flowrate drop with increased gas-oil ratio in horizontal pipe

Consequently, the question I tried to answer in my research is whether it is economically profitable to use gas lift in horizontal wells directly from above gas layer, or not.

In order to deal with such a problem, a working physical model in Schlumberger PipeSim has been created.

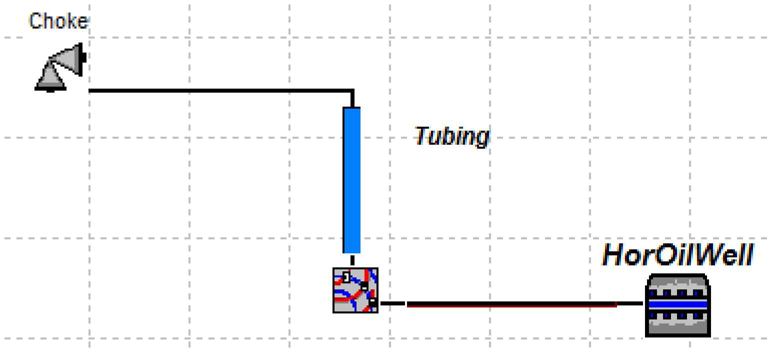

Figure 2 – Working physical model of the well

The first problem was to decide, which flow correlation needs to be used. According to the study of accuracy of pressure loss prediction methods, which is made by Lawson and Brill, the best correlations for vertical flow are those of Hagedorn & Brown and Beggs & Brill, but flow variables have a major effect. For horizontal flow best methods are those of Dukler and Beggs & Brill. Ney and Fuentes offered solution which combines the use of a vertical flow and horizontal. In order to deal with different degrees of well inclination, vertical correlation is used for TVD and horizontal for the difference between MD and TVD, so that Beggs & Brill correlation was used both for vertical and horizontal flow [3].

In reality, most of gas formations are situated not very far from the surface, and as a consequence, gas injection valve cannot be placed deeply into the wellbore. Fortunately, as Figure 1 suggests, it is better to put gas lift valve before the start of inclination, and that usually is exactly the place where gas reservoir is located.

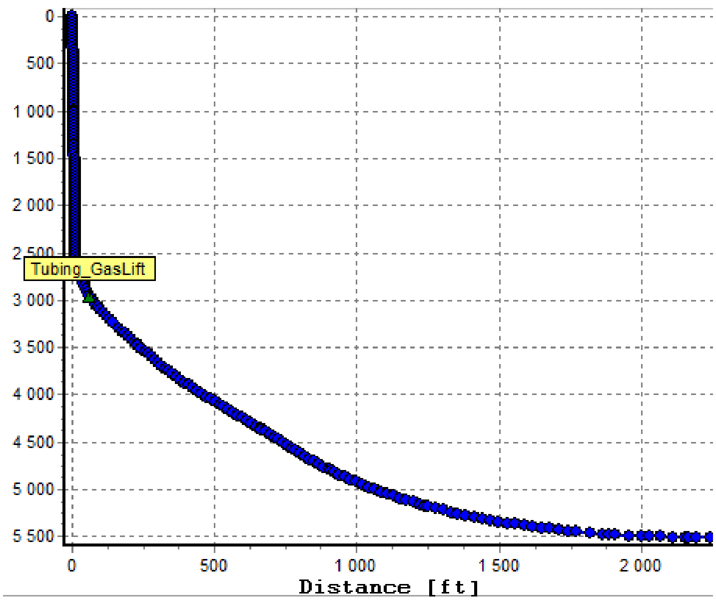

Figure 3 – The position of gas injection

The performance curve for the case depicted in Figure 3 has been established, showing that gas lift usage gives a sudden change in stock-tank oil production, imparting that combination of extraction of these two separate layers is, at least, possible.

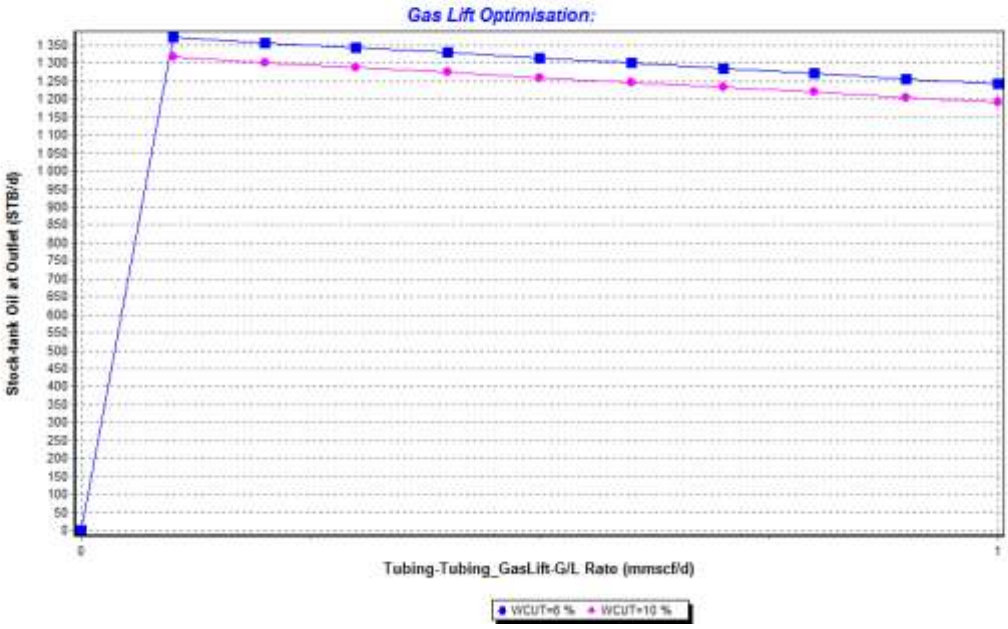

Figure 4 – The performance curve for Gas Lift

Alternatively, if we haul down gas lift valve to the point of approximately 5250 ft, the performance curve will stay completely unchanged, implying that flowrate of oil production is generally independent of gas layer position, unless it is not above vertical portion of the pipe. For further conclusions about economical profits we need to check oil production values with separate type of exploitation.

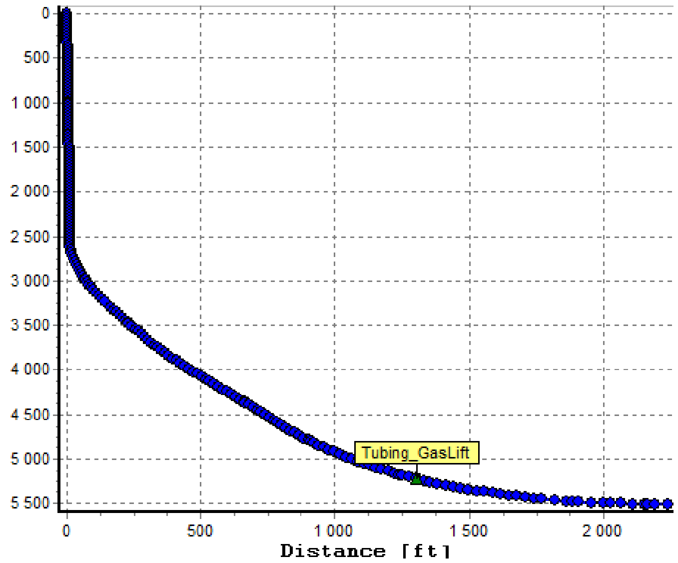

Figure 5 – The position of gas injection

By comparison, the performance curve for ESP is established, from which we can clearly see that altogether gas lift gives the least amounts of barrel production.

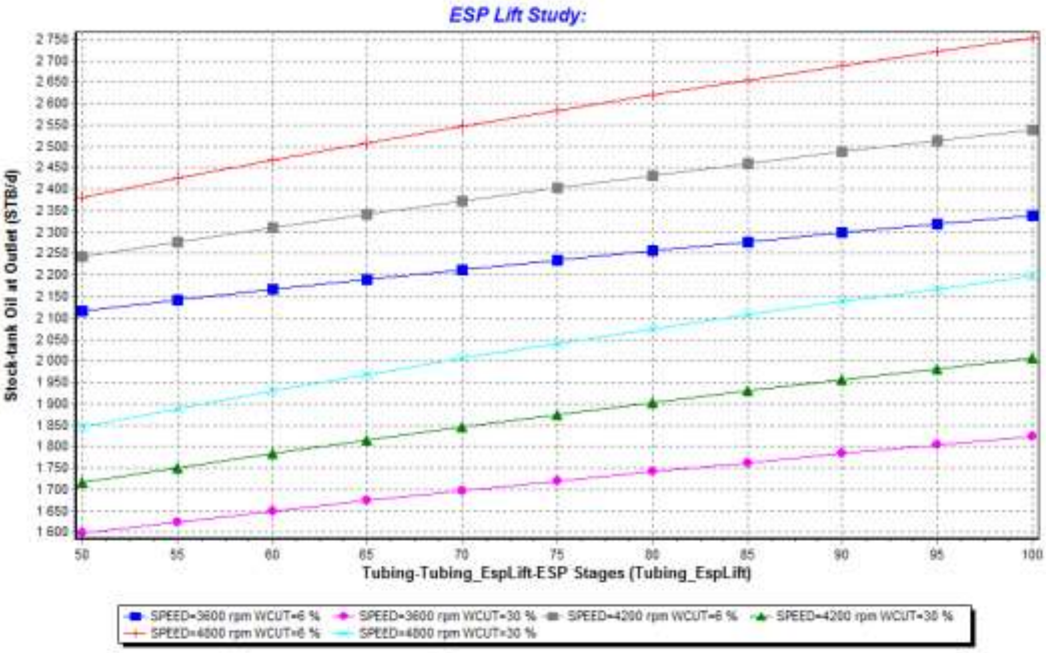

Figure 6 – The performance curve for ESP

To conclude, in my research work I have used modern calculation technologies for solving the hydraulic problem in oil and gas field. The comparison between ESP and Gas lift has been established and, in particular, it is shown that extraction from both reservoirs into one well by using gas deposit as a source of a gas lift for creating the solution drive mechanism is possible, but it is less productive, than ESP usage in the same conditions.

References

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