Gas Lift Performance of Some Horizontal Wells in Ahdeb Oil Field

Dr. Kareem Alwan **, Dr. Maha R. Abdulameer *, Mohammed Falih*

*University of Baghdad, College of Engineering, **PRDC

Abstract:

Ahdeb is one of the Iraqi oil fields, its crude characterized by medium API (22.5-28.9) and highly reservoir pressure depletion from Khasib formation due to lack of water drive. This makes it difficult to produce economic oil rates. Therefore, many water injection wells were drilled by the operators to maintain the reservoir pressure during production. In addition to that, electrical submersible pumps (ESP) were used in some productive wells. This study suggests exploitation of gas associated with oil production to be recycled to lift oil as a substitute for the ESP .The work in this study includes using PIPSIM software to build a model of four studied productive wells (AD1-11-2H, AD2-15-2H, AD4-13-3H, A4-19-1H) after choosing the suited correlation for each well. According to the statistical results, Mukherjee & Brill correlation is the best option for all wells.

The use of PIPESIM software include determining artificial lift performance to determine the optimum amount of gas injected, optimum injection pressure as well as the optimum injection depth and knowing the impact of these factors on production, as well as the determination of the optimal injection conditions when water cut changes. According to the current circumstances of the wells, the depth optimized for injection is the maximum allowable depth of injection which is deeper than the packer by 100 ft and the amount of injection gas is (1.5, 1, 1, and 1) MMscf/day for wells (AD2-11-2H, AD2-15-2H, AD4-13-3H, and AD4-19-2H) sequentially and injection pressure (2050, 2050, 2050, and 2000) psi for wells (AD2-11-2H, AD2-15-2H, AD4-13-3H, and AD4-19-2H) sequentially.

Introduction:

In the early phase of their production lifetime, most wells will flow naturally. Formation gas and reservoir pressure provide enough energy to transport fluid from the reservoir to the surface in a flowing well. This energy will deplete or water cut will increase with time of production, and at some point the available energy is no longer enough to lift the fluid from the bottom to the surface and the well flow will cease. To be able to produce from a well that does not flow naturally, or to increase production from a well that flows poorly, it is necessary to add energy to the produced fluids by using some sort of artificial lift.

Continuous gas lift is cost effective, easy to implement, and very efficient in a wide range of operating conditions, in addition to requiring less maintenance in comparison to other alternatives. Continuous gas lift is considered as one of the most typical methods of artificial lift in oil production where there is an abundance of resources of natural gas. Because of the existence of natural gas in the same field (Ahdeb oilfield) and the high percent of its success around the world, gas lift (gas lift design) must be considered by the operator in Ahdeb oilfield.

Gas Lift Operations - Lift Gas Response Curves

This operation will compute the response of the gas lift system to changes in any particular variable. Selection a set of gas lift rates and a range of sensitivity values is possible. The resulting gas lift response curves show the variations of production rate and possible gas injection depth as a function of injection rate or the sensitivity parameter.

It is possible to specify whether gas injection can happen at any depth in the wellbore (Optimum Depth of injection) or is restricted to the specified valve or mandrel depths only (Injection at Valve Depths only) as defined in the model tubing description.
This operation gives the ability to know how the well responds to different parameters before beginning with a gas lift design.

Gas Lift Performance (Indication of Casing Pressure & Gas Rate)

After the input of control design parameter and safety factor of gas lift design into PIPESIM, plots (1 to 4) were extracted. As can be concluded from these figures, by increasing the amount of injection gas (Sp. Gr. = 0.8), oil production increases until it reaches a point where injected gas amount has a small effect on oil production. This characteristic point is called the Economical Optimum Point. This optimum rate is renowned as over injection. After this point well fluid density reduction due to higher amount of injection gas is equal to friction force which increase due to higher amount of passing fluid volume through tubing. As the rate of injection gas increases, friction force has more predominant effect than hydrostatic pressure reduction. At this point, the maximum amount of well production rate can be achieved. By increasing gas pressure, the effect of gas injection on production decreases until at a special injection rate, that is if the gas injection rate increases, the effect on production will be inversed.

As can be concluded from these figures (1-4), by increasing the amount of injection gas (Sp. Gr. = 0.8, casing press. =1800 psi), oil production increases and then decreases. By amount of 1 MMscf/day gas injection, oil production from well AD2-11-2H, as an example, will increase up to 2220 STB/day, but by amount of (2-3) MMacf/day, oil production from the same well will be the same 2276 STB/day, further increase in gas injection 4 MMscf/day, oil production will drop to 2240 STB/day.

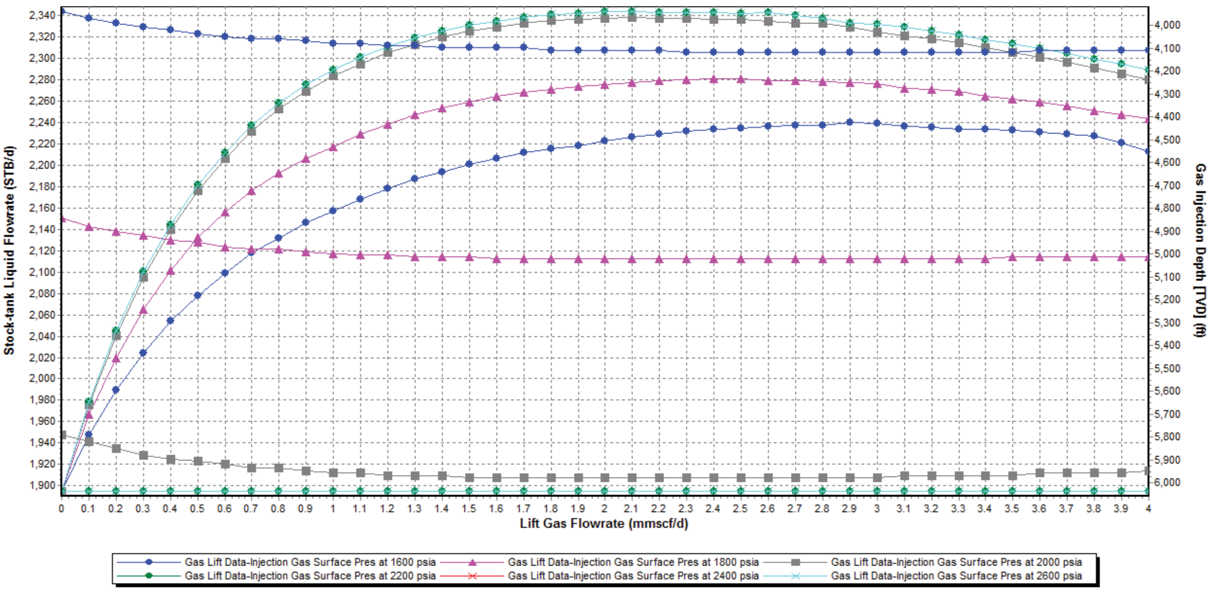

Fig. (1) Gas Lift Performance of well (AD2-11-2H)
Water cut = 0%, Gas inj. Temp.=100 F^o, and $\gamma_{ginj.}$ =0.8.

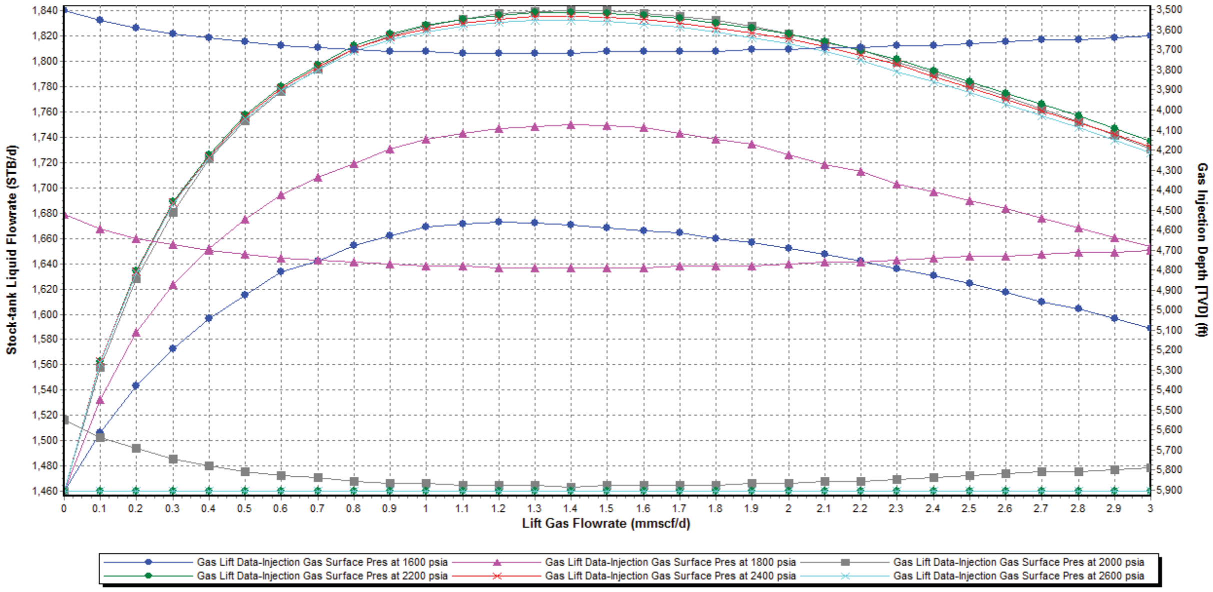

Fig. (2) Gas Lift Performance of well (AD2-15-2H)
Water cut = 0%, Gas inj. Temp.=100 F^o, and Ɣginj. =0.8.

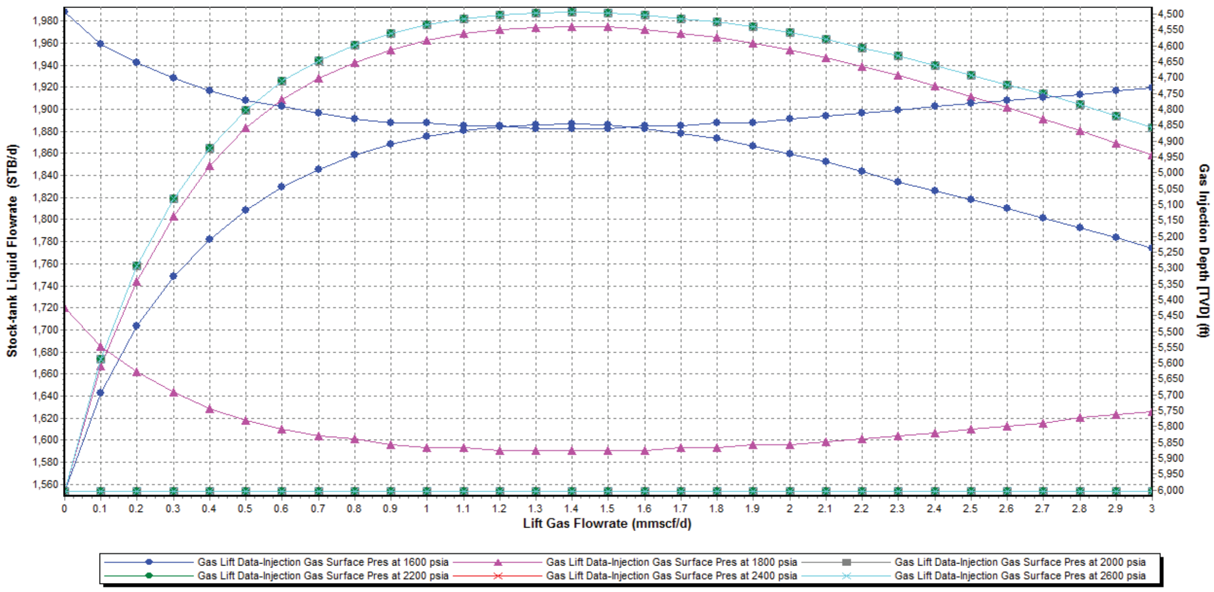

Fig. (3) Gas Lift Performance of well (AD4-13-3H)
Water cut =30%, Gas inj. Temp.=100 F^o, and Ɣginj. =0.8.

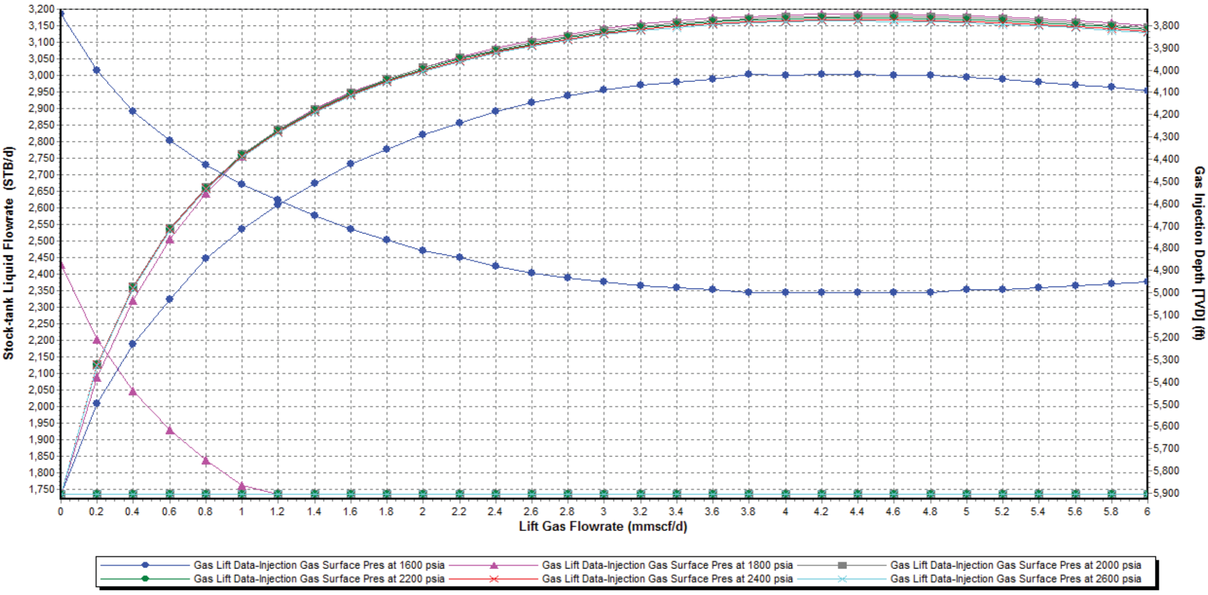

Fig. (4) Gas Lift Performance of well (AD4-19-1H)
Water cut =1.3%, Gas inj. Temp.=100 F^o, and Ɣginj. =0.8.

Gas Lift Performance (Variable Water Cut)

Water cut increase leads to flow gradient increase for the same well head pressure, reservoir pressure, and piping system. This gradient increases due to mixture density increase with maximizing water cut and minimizing total gas liquid ratio. This leads to a decrease in liquid rate due to a decrease in pressure draw down as shown in figures (5-8) for wells (AD2-11-2H, AD2-15-2H, AD4-13-3H, and AD4-19-1H) respectively. So, to increase production rate, gas injection rate must be increased to a limited rate as illustrated in the figures. Gas injection point must remain at the maximum depth for the life of installation of gas lift.

In figure (6), production is starting when gas injection rate rises to 0.1MMscf/day (Injection pressure= 2050 psi) at water cut > 20% and the meaning of that is kickoff happens at this amount of injected gas while production is continuous without injecting gas at water cut ≤ 20%.

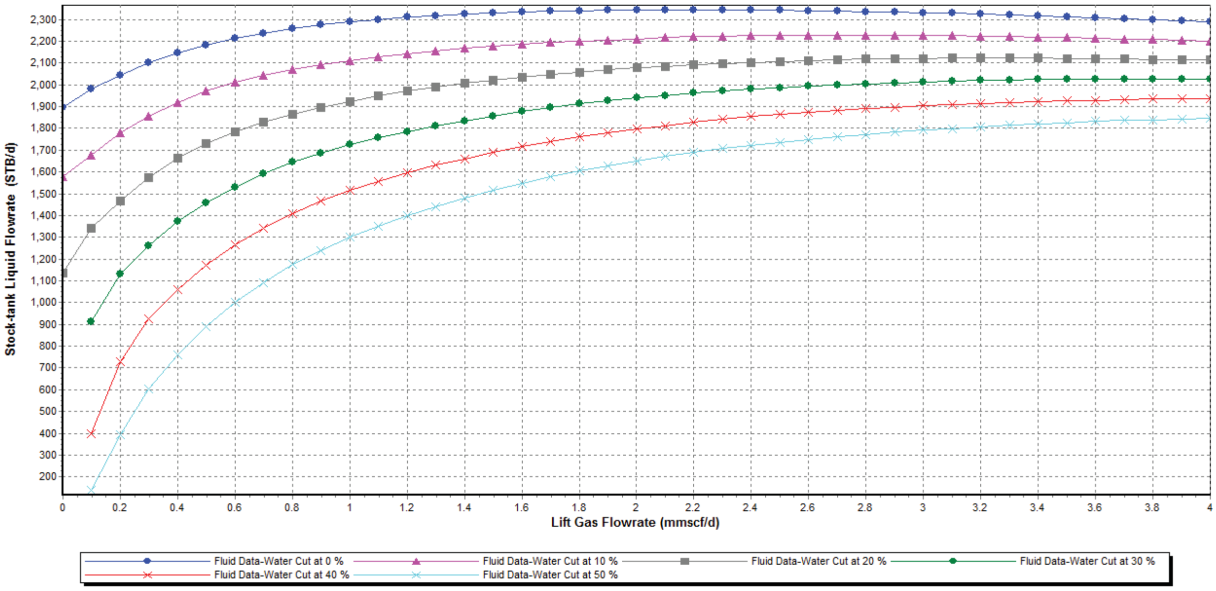

Fig.(5) Effect of Water Cut on Gas Lift Performance of well (AD2-11-2H) Injection Press. = 2050 psi, Gas inj. Temp.= 100 F°, $\gamma_{ginj.}$ =0.8.

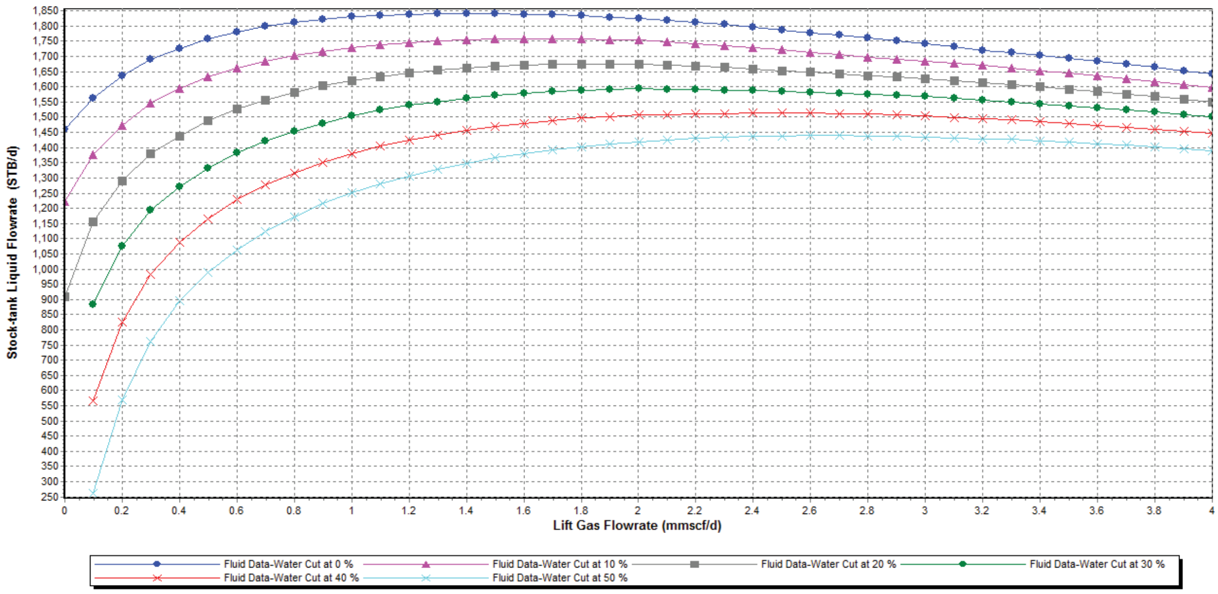

Fig. (6) Effect of Water Cut on Gas Lift Performance of well (AD2-15-2H) Injection Press. = 2050 psi, Gas inj. Temp.= 100 F°, γginj. =0.8.

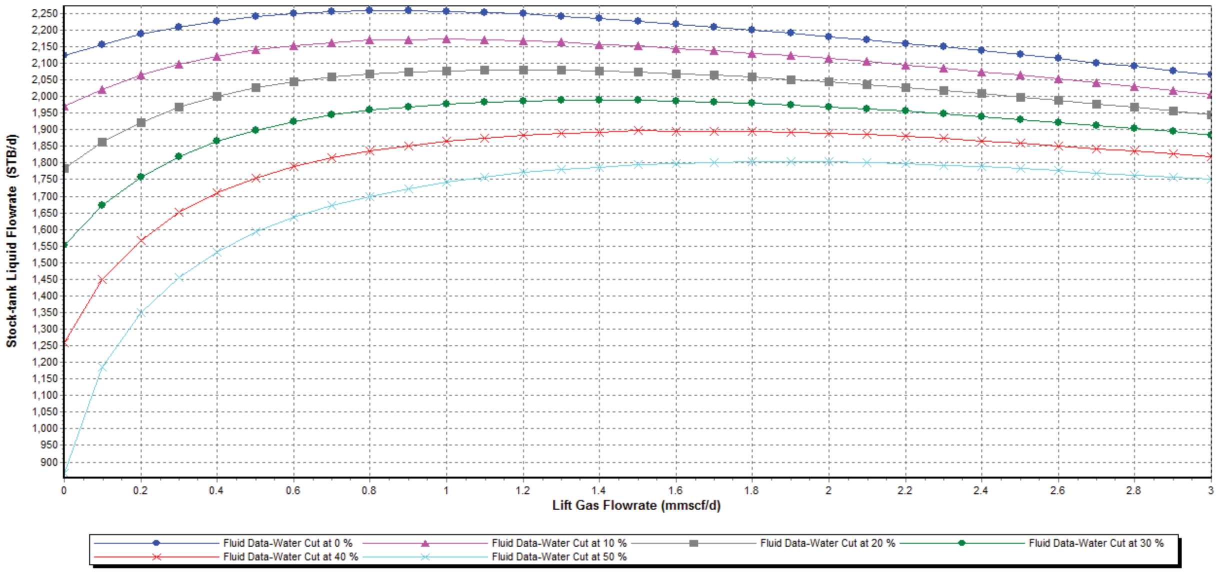

Fig. (7) Effect of Water Cut on Gas Lift Performance of well (AD4-13-3H) Injection Press. = 2050 psi, Gas inj. Temp. = 100 F°, Ɣginj. =0.8.

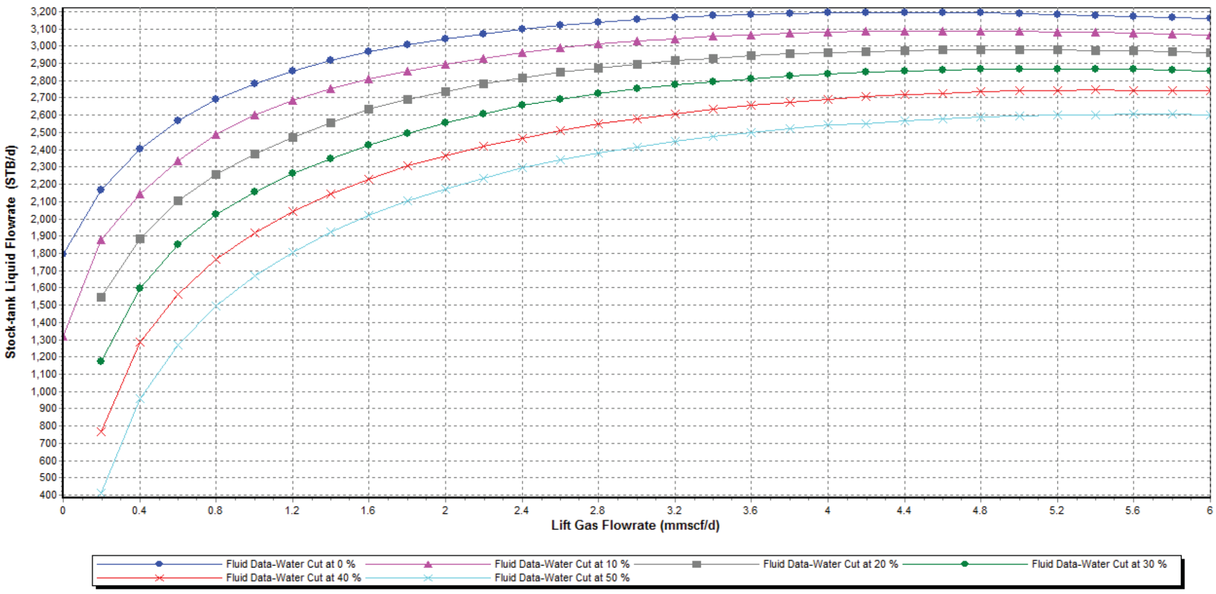

Fig. (8) Effect of Water Cut on Gas Lift Performance of well (AD4-19-1H) Injection Press. = 2000 psi, Gas inj. Temp. = 100 F°, Ɣginj. =0.8.

Conclusion

1- According to optimum design of gas injection in the studied wells, the optimum injection rate ranges from 1 to 1.5 MMscf/day.
2- Wells with higher water productivity require higher amount of injective gas due to the shortage of solution gas.
3- Economic production is possible from the wells of the field even though with water productivity close to 50 percent by a suitable design of gas lifting.
4- By increasing the amount of injection gas, oil production will increase, then, it will reduce due to the friction force increase in the tubing. So, there is an optimum rate for each condition set.
5- Valves setting must be at a maximum allowed depth for that production rate is not significantly affected when the reservoir pressure reduces or water cut increase. Whenever injection depth increases, production also increases.

References:

1. Schlumberger “Gas Lift Technology", (1999).
2. Mahmoud Safar Beiranvand “Design of a Gas Lift System to Increase Oil Production from an Iranian Offshore Well with High Water Cut", Australian Journal of Basic and Applied Sciences, 5(11): 1561-1565, 2011, ISSN 1991-8178.
3. Mohammed Falih Gamea "Selection of the Best Trend for Artificial Lift of an Iraqi Oil Field", M.S. Thesis, U. of Baghdad, (2015).
4. Pipesm Mannual Software, (2009).
5. Shale “Gas Lift Design Guide, December “artificial lift manual part 2a, Report EP 93 – 2702. (1993).
6. Ehsan Fatahi “Selection of the Best Artificial Lift Method in One of the Iranian Oil Field by the Employment of ELECTRE Model", British Journal of Applied Science & Technology 1(4): 172-180, (2011).
7. Al Waha Petroleum Co. "PVT report for horizontal wells {Dome-2 (AD2-12-2H), Dome-4(AD4-15-3H)}", Ltd. (2012).
8. Al Waha Petroleum Co. "Well Test analysis Reports for wells (AD2-11-2H, AD2-15-2H, AD4-13-3H, and AD4-19-1H)", Middle Oil Company/ Ministry of Oil, (2012-2013).
9. AL Waha Petroleum Co. "Geology and Engineering Data Summary", (2013).