International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161

Available at http://inpressco.com/category/ijcet

Research Article

To Design a Continuous Gas Lift Method for Improving Production in a Dead Well: A Case Study

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Received 09 July 2020, Accepted 02 Sept 2020, Available online 03 Sept 2020, **Vol.10, No.5 (Sept/Oct 2020)**

Abstract

In Petroleum industry the goal of production department is to obtain maximum oil production at minimum expenditures. The oil production from the wells decreases after some period due to decline in reservoir pressure, increase in water cut, water conning etc. in other words the revenue is lost. Therefore, the artificial lift system is installed on the wells depending upon its characteristics. Gas lift system is one of the most popular artificial lift systems to optimize oil recovery employed in petroleum industry. In gas lift system, gas injected into the well through gas lift valves which reduces the density of liquid column in the well which in turn causes the oil to be produced at the surface. This research study is conducted on well named A-1 in an onshore field Alpha, the well is considered dead due to increase in water cut (40%). The objectives of this research study are to unload the well by designing an efficient continuous gas lift method and then optimize the production by varying some parameters. For this purpose, a simulation model of base case well and gas lift case is designed on PROSPER software by entering the PVT properties, well properties and reservoir properties. After that a sensitivity analysis is performed on PROSPER by changing some variables such as; water cut, wellhead pressure, skin factor, gas injection rate and casing pressure. Subsequently designing the model of the well with gas lift method the well started to produce oil at suitable rate. After that the production is optimized by performing sensitivity analysis on some variables and optimum oil production rate vs gas injection rate is obtained.

Keywords: *Artificial Lift method, Continuous Gas Lift, Case Study, Simulation, Sensitivity Analysis*

1. Introduction

Artificial lift system is the most commonly employed production technology in oil and gas operations in the world. The wells that are unable to produce liquids up to the surface by their natural energy, need artificial lift methods for production. Some of them need artificial lift support from the commencement while others need later in their production life. Nowadays, most of the wells in the world are produced by employing artificial lift methods.

Gas lift method is the extensively deployed artificial lift method to enhance the oil production in the world. The main principal of gas lift is to inject the gas into the well to reduce the density of the liquid column, because the decreased reservoir pressure is insufficient to produce the fluids (Ioannis E. Tetoros, 2015).

The main task is to design a continuous gas lift system which will initiate the production in the loaded well. The PROSPER software is the tool for designing of the Base Case to investigate the existing state of the well, forecast and predict the forthcoming productivity with existing scenario.

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DOI: https://doi.org/10.14741/ijcet/v.10.5.2

After that, the gas lift case is designed to predict and forecast the well production by installing the gas lift on the well.

1.1 Gas Lift Method

The gas lift method consists of injecting the gas into the well from annulus which enters the tubing through the gas lift valve that is installed in the side pocket mandrel. The density of reservoir fluid in the wellbore is decreased due to gas injection and thus pressure differential is decreased. Therefore, fluid starts to flow from the wellbore up to the surface and optimum flow rate of oil is obtained. There are basically two types of gas lift method: The Intermittent gas lift and Continuous gas lift (Schlumberger, 2010).

For an effective gas lift process various parameter are considered. The optimum parameters make the production high and generate more revenue. There are many important characteristics of gas lift, but the rate of gas injection is vital one. Hence, an adequate amount of injection gas must be present from which an optimum amount of gas is required to be injected to obtain improved oil production as the additional gas injection

may cause reduction in production due to extra slippage between gas and liquid.

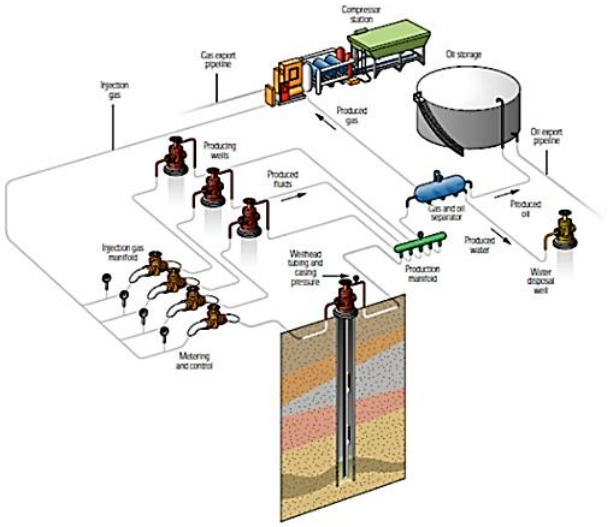

Fig.1 Gas Lift System Configurations (Knut Undheim Stanghelle 2009)

2. Research Methodology

2.1 Base Case Modelling

A base case well model is developed using the prevailing well and reservoir conditions on the simulator.

2.2 Gas Lift Case Modelling

After developing the base case model, we analyze that the well isn't producing e.g. dead well, so we design and install the continuous gas lift model on the well.

3. Results & Discussions

The data for this research work is acquired from a field named Alpha. Two simulation models are designed by using PROSPER software.

3.1 Base Case Model

The base case model of the well is designed by entering the current characteristics of the well such as; PVT properties, properties of reservoir, production data and downhole equipment data. Since we are modelling the base case, so no any artificial lift method is selected from the System Summary Section.

Table 1 PVT Properties of the fluid

Property	Value	Unit
Solution GOR	550	SCF/STB
Gas gravity	0.755	
Oil gravity	40	API
Salinity of water	86700	PPM
Mole percent CO_2	2.7	%
Mole percent H_2S	0	%
Mole percent N_2	4.8	%

After matching the PVT properties, the IPR of the well is generated.

Table 2 Properties of Reservoir and Wellbore

Properties	Value	Unit
Pressure of reservoir	1540	Psi
Temperature	210	^oF
Water cut	40	%
Gas oil ratio	550	SCF/STB
Pws	1622	Psi
Reservoir permeability	90	md
Relative permeability	-	
Wellbore radius	0.354	ft
Drainage area	23	acre
Skin factor	3	
Thickness of reservoir	49	ft
Dietz factor	30.99	

And then by entering the downhole equipment data and putting the operating parameters like Top node pressure and water cut the system performance is calculated. From the Figure 2, the IPR and VLP curves do not intersect each other therefore well is considered dead.

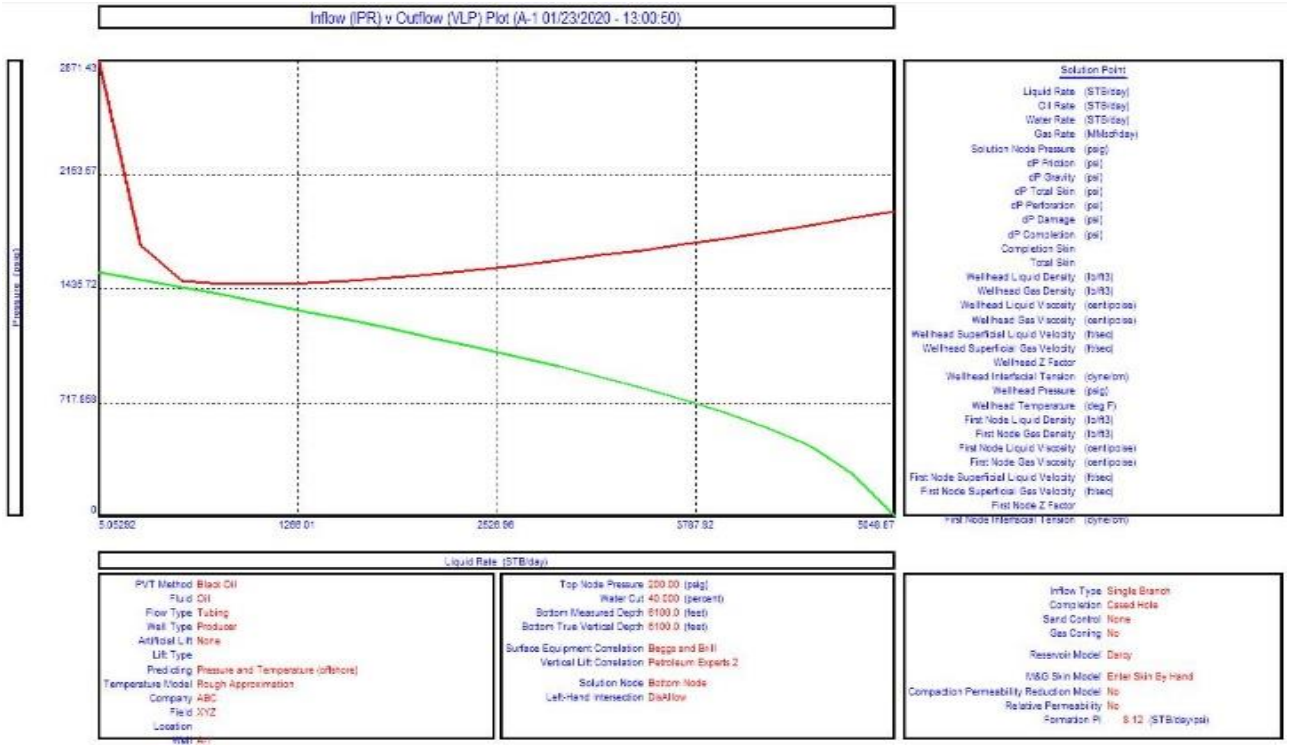

Fig. 2 IPR vs. VLP of Well without Gas Lift

3.2 Gas Lift Case Model

Gas lift method is selected from Artificial lift section from System Summary section. And then we enter the gal lift injection data by creating a new well in the model. Then the software will calculate the Gas Lift Performance Curve which is a relationship between Oil produced and gas injected as depicted in the Figure. 3.

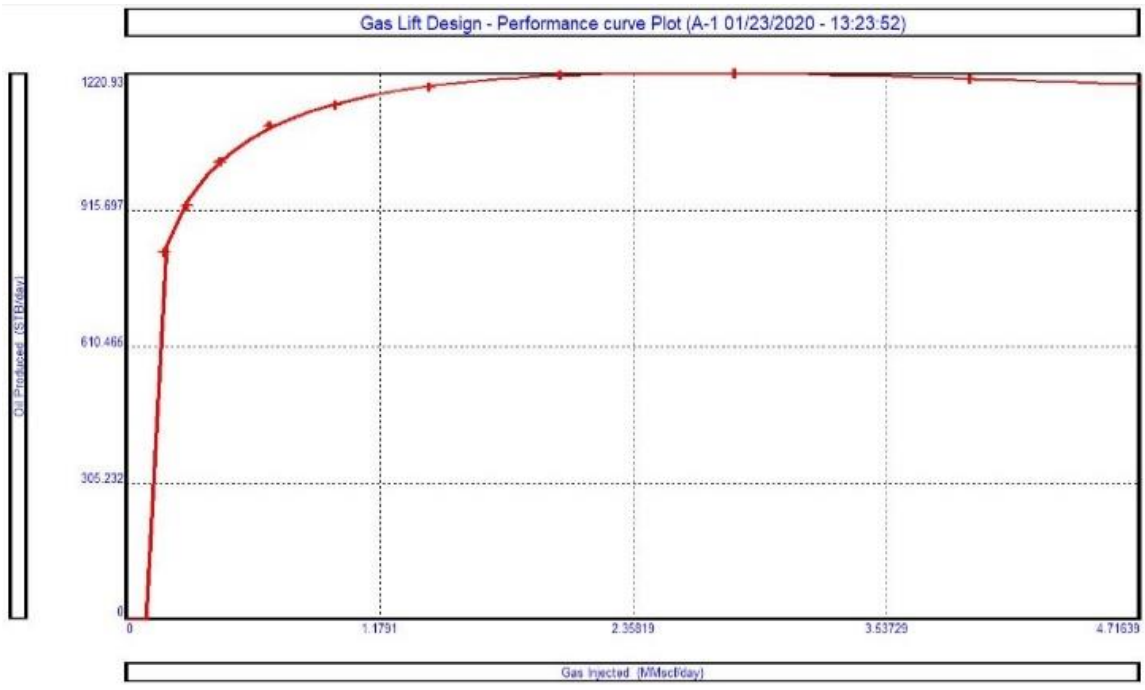

Fig. 3 Gas Lift Performance Curve

After that positioning of gas lift valves and gas injection rate is calculated by the software, and then the system performance is determined by entering system parameters, such as; water cut, Top node pressure etc. The results of Gas lift case are shown in Table 3 below.

Table 3 Results of Gas Lift Case

Parameter	Value	Units
Unloading valve depth	3586.3	Ft
Port size of Unloading valve	24	64ths inch
Operating valve depth	3950.53	Ft
Port size of Operating valve	32	64ths inch
Liquid rate	1565.1	STB/D
Gas rate	0.51649	MMSCF/D
Oil rate	939.1	STB/D
Water rate	626.0	STB/D

The IPR vs VLP of the Gas Lift Case is calculated and shown below

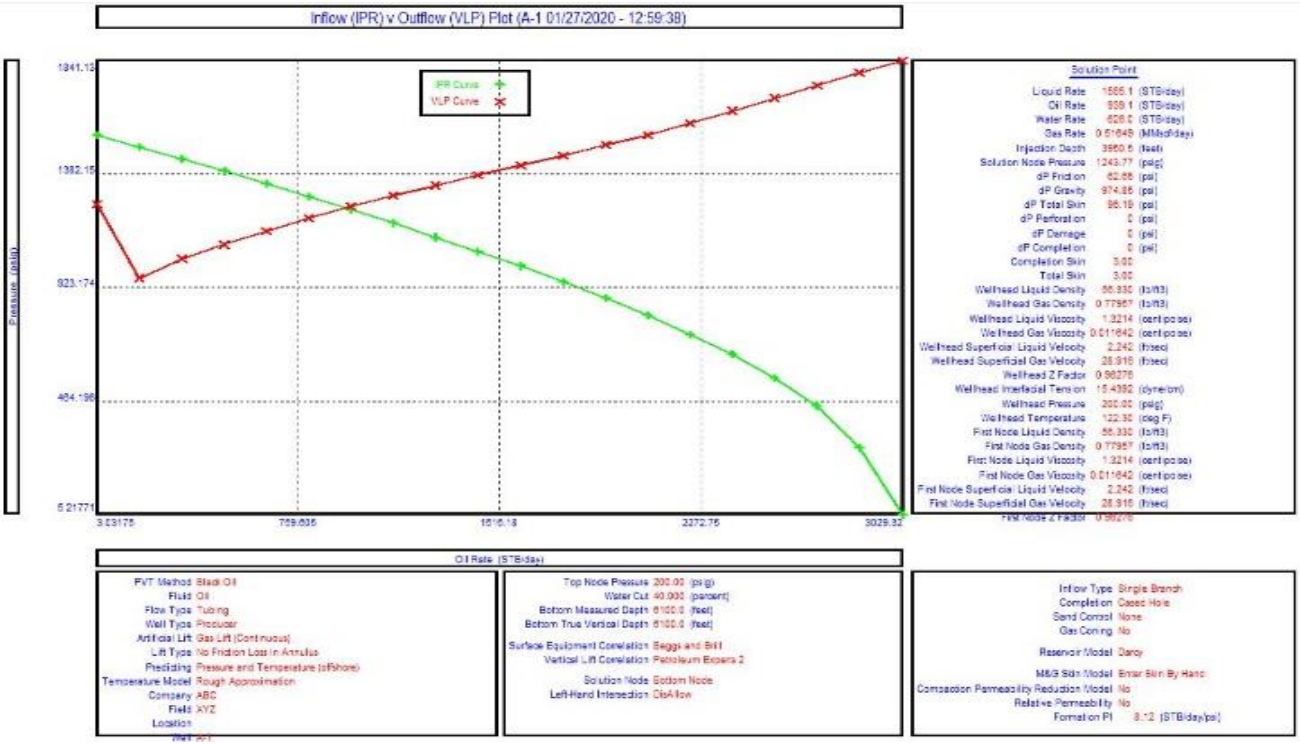

Fig 4 IPR vs VLP of Gas Lift Case

As we can observe that the inflow performance relationship (IPR) and vertical lift performance (VLP) curves intersect each other so the well is producing oil after installing the gas lift method. Now we perform sensitivity analysis on the well to check for the optimized parameters.

Conclusions

Before employing the gas lift optimization, the well wasn't producing due to high water cut (40%) and was loaded too. Therefore, the well is modelled in PROSPER software by entering the reservoir fluid and well properties for PVT matching and IPR and VLP curves are generated. After studying and designing simulation model of gas lift assisted well, the production in the well is initiated and well produces liquid at the rate of 1565.1 STB/D, Oil at the rate of 839.1 STB/D, and gas at the rate 0.51649 MMSCF/D, with the optimum injection gas rate of 1.1031 MMSCF/D. And Finally, the optimum gas injection depth for operating valve is obtained as 3950.53 ft.

Recommendations

Gas lift method is easy and simple to install and is a capable enhancing technique for liquid loaded wells. From thorough study of the well I would like to recommend that, gas lift method must be installed on the well as it will not only bring back dead well alive but can enhance its production too.

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