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Original Research Article

Investigation and Possibility of Applying Gas Injection Method to Increase Pressure in Well A in one of the South Iranian Oil Fields

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ABSTRACT

According to the studies, increasing the injection pressure at the surface will not have much effect on increasing the production flow of the well therefore, taking into account the economic cost, making changes to increase the injection gas pressure is not justified. Increasing the injection gas flow rate will cause a significant increase in the production flow. Therefore, it is recommended that control valves cannot be installed in order to control the injection flow gas due to the operational limitations, by installing appropriate reducers in the injection flow gas path to increase the oil flow. In order to investigate the effect of increasing injection gas flow rate on production from one well, one injection of gas with flow was performed at about 12000000 SCF / DAY and again injection rate was increased to 15000000 SCF / DAY and then the results were compared.

Keywords: Oil Field, Well, Gas Injection

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Introduction

The production rate of oil fields decreases over time due to various factors, so methods need to be used to offset the decline in oil and gas production [1]. Gas refining is one of the methods of artificial refining that is used to restore and increase the optimum discharge of oil wells [2]. In this method, the high-pressure gas is injected at a certain point into the fluid column in the well and thereby reduces the average density and subsequently the pressure on the bottom of the well then it will be reactivated [3-5]. In optimizing the operation, increasing production and taking advantage of the maximum performance of the well and its facilities are considered. In this project, using a mechanistic model, two-phase flow is modeled and parameters such as pressure profile, temperature, friction coefficients and phase velocities are calculated [6-10]. Then, the nodal analysis of the natural production of the well is simulated and the need for using the method is investigated [11]. Following are some effective parameters such as optimum flow rate for gas injection and optimum depth for gas injection [12]. When the reservoir energy (reservoir pressure) is not high enough for continuous production of wells, an artificial refining method is used in oil production [13-15]. Gas processing is one of the artificial processing methods used to increase oil production from wells [16, 17]. In this method, high pressure gas is injected into the well to lighten the fluid column and increase the pressure of the reservoir to produce oil [18]. The methods of filling wells are very different and tasteful. In each well, different people's ideas and ways of completing the well are different [19, 20]. The completion of the well begins before drilling begins and continues until completion and even after the well is in service [21]. A completion plan must be implemented in such a way that enable the highest production for the longest possible time with minimum cost [22]. Regardless of the way the well may be filled or open, it is important to choose the required flow paths and the sizes of these paths [23-25].

Modeling of gas lift system

Field profile studied

Oil field A, with an area of 38,850 hectares and an oil reservoir of 26,428 million barrels, was exploited in the oil field in the solar year 1317 A. The number of wells are 161 rings in this reservoir, including 3 oil rings, 2 gas rings, 2 observation rings and the rest are injectable,

descriptive, suspended, abandoned, etc., five operations units' number one to five are built on the above reservoir, which puts 22 rings of this field in the orbit by gas refining. This field is located at about 120 kilometers southeast of Ahvaz and is located in the middle of Dezful Depression and its structure in the Asmari Formation is long and asymmetric anticline. At the surface of the ground, a transverse fault at the southern edge of the anticline has acted and reversed that surface and removed the layers of the Gachsaran Formation (rock cover), thereby accumulating gas in the non-reservoir layers (section 7 of the Gachsaran Formation) and or reaches the surface of the earth. The main reservoirs of this field are the Asmari Formation (discovered in year 1315 by the drilling of well number 2) and Bangestan. These two reservoirs, although separated by the Natrava shales of the Pabdeh and Gurpi Formations, have complete contact between the two reservoirs through fractures. The Bangestan reservoir was discovered by a former oil consortium in year 1337 by drilling well number 3. Asmari's reserves of this field are more than 14.2 billion barrels. The gas injection was started at the year 1380. The purpose of this project was to inject 2000 million cubic feet of gas daily into the oil field to increase oil production by as much as 300,000 barrels per day. The gas was supplied by phases 6, 7 and 8 of the South Pars project. A project to increase gas injection capacity to 2 billion cubic feet to increase oil production by 300,000 barrels a day was awarded to Petroleum Engineering and Development Company (PEDEC) under an EPC contract (PEDEC), a consortium of condensing companies Hirbodan-Kesson. The scope of the project included installing 7 turbochargers and running more than 70 kilometers of pipeline and installing accessories and construction and commissioning operations. The nature of the project for the injection of natural gas from the reservoirs and the allocation of 104 million cubic meters of natural gas produced in phases 6, 7 and 8 of the South Pars gas field of sour gas required by the Qatar-Iran joint gas field. Thus, gas injection (as the largest gas injection project in the Middle East) has been transferred from Asalouyeh to Aghajari after drilling, extraction and processing operations by the world's longest sour gas pipeline. The main activity in the field of gas injection into the fields was the commissioning of the Aghajari gas injection station, which added a total of 60 million cubic meters daily to the country's gas injection capacity. The project involves the construction of a gas turbine compressor station with 7 rows of turbo compressors (with a total capacity of 2100 million cubic feet per day) that converts gas received from the Asalouyeh-Aghajari pipeline to a gas pressure of 70 to 240 bar through and injects to two pipelines through two vacuum trap machines. Transmission lines included the construction of 24-inch injection

pipelines of approximately 50 kilometers in length, as well as the construction of 6 and 8-inch injection pipelines split from the main lines, length about 2 kilometers and the construction of a 56-inch input to the station with length about 1.3 kilometers. Piping from the main injection pipe and installing pressure and valve control valves, up to the intake manifold valve for each of the 22 main injection wells, a 6 or 8-inch pipeline string starting from the original 24-inch pipeline crankcase and up each of the wells ends at 20 meters.

Reservoir flow function

The development of borehole barometers led to the testing of wells by simultaneously measuring the surface discharge and bottom pressure. The obvious reason to test them together is to determine if a given pressure bar is applied to the well How much is the flow produce at the bottom of the well? Therefore, many attempts have been made to express the relationship between the surface flow and the bottom pressure of the well in the practical range of production conditions. The term of Flow Performance Relationship (IPR) is used to define the relationship between oil level at the surface and flow pressure of the bottom of the well. The simplest and most applicable IPR equation is the straight line IPR, which indicates that the flow is directly proportional to the pressure drop in the reservoir. This constant is called the profitability index and is defined as the ratio of the flow rate and the pressure drop of the reservoir. Today, straight line IPR is used only for supersaturated oils. This equation can be written as follows:

$$q_o = j\,(p_R - p_{wf}) \qquad \textbf{(1)}$$

p_R : Average reservoir pressure (psia)

p_{wf} : Downstream well pressure (psia)

J: Profitability index (bbl/stb)

p_R The average reservoir pressure is the volume of the reservoir drained. Applying the initial reservoir pressure or pressure to the outer boundary of the drainage area instead of is not uncommon since these differences are usually small and can be ignored.

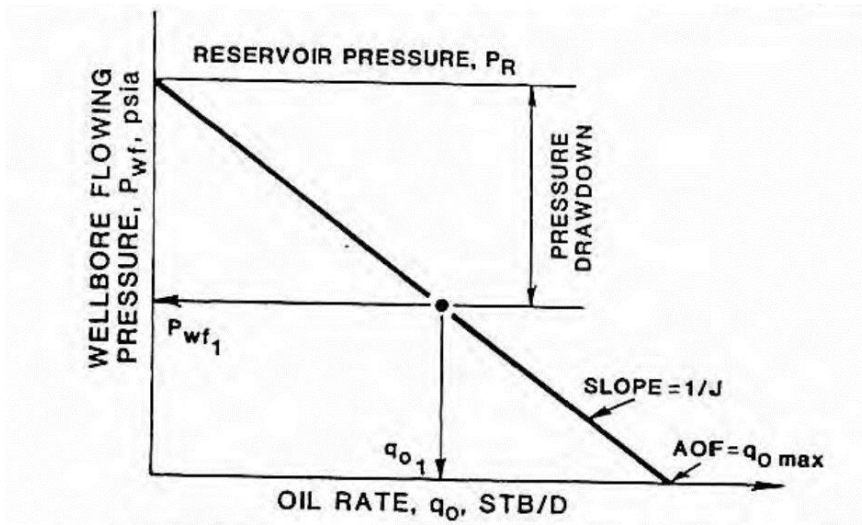

Figure 1. IPR curve for an oil reservoir

Field observations have shown that in supersaturated oil wells and water wells, Equation (1) is consistent with the accuracy required in the well performance calculations. The profitability index is a very useful concept to describe the relative potential of a well. This factor combines all properties of rock and fluid and geometrical considerations into one constant, so consideration of all of these factors is unnecessary. A constant interest index states that the ratio of flow to pressure drop is always the same for different flow rates. The flow conditions are quasi-steady state. Quite simply, the quasi-steady state indicates the conditions in which the total volume of drainage contributes to the production usually required to reach the quasi-steady state for a specified time. However, in formations with high permeability, the quasi-steady state is almost instantaneous.

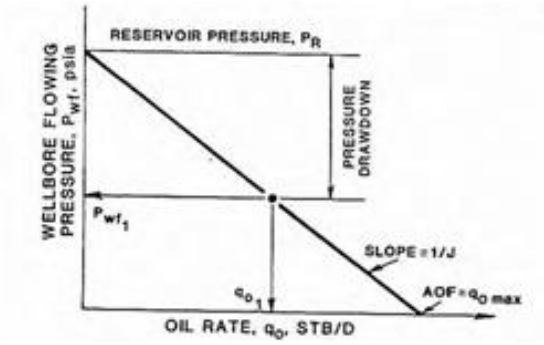

Figure 2. IPR curve indicating the presence of gas or two-phase currents

The effect of compressible gas and biphasic flow was observed in well pressure experiments where, instead of increasing linearly with pressure drop, pressure drops larger than linear need to

be increased. The relationship between pressure and flow in this case shows high curvature at high flows in terms of the profitability index, the value of J decreases with increasing pressure drop.

Internal schema of the well-studied

Well-studied has been made with three caverns in sizes 20, 13.38 and 95.8 inch which these caverns were excavated to the depths of 150, 1300 and 2500 m, respectively. The final depth of the well is 2700 m of excavation and the well has been completed in the Asmari Formation

Properties of fluid produced from wells

Oil in the field is corrosive due to its 15% water content and high salt content. This property should be considered in the design of surface equipment as well as inside the well. Other fluid properties are listed. Investigation of changes in oil volumetric coefficient with respect to temperature shows that oil volumetric coefficient increases with increasing temperature but no significant change at different times for volumetric coefficient is observed. Investigation of oil density changes with temperature also shows that oil density decreases with increasing temperature but there is no significant change with time. It should be noted that if the gas injection method is used in the well, the injection of gas will direct the oil to the production well and the rate of recovery of the reservoir oil will increase with the change of the thermodynamic properties of the reservoir fluid. The variation of reservoir-type texture in the hydrocarbon reservoirs has an important influence on the control of oil production and this effect in a way that controls the fluid displacement pressure during production. Areas of reservoir rock that form a weak link between the pores of the network have little effective efficiency.

Build a basic fluid flow model

Due to the properties mentioned above, the first step in constructing an initial fluid flow model is to investigate the possibility of natural flow formation without the use of a complementary sequence. The pressure at the well head due to the mountainous area and the need for high well pressure to overcome the pressure drop along the route is about 800 pam.

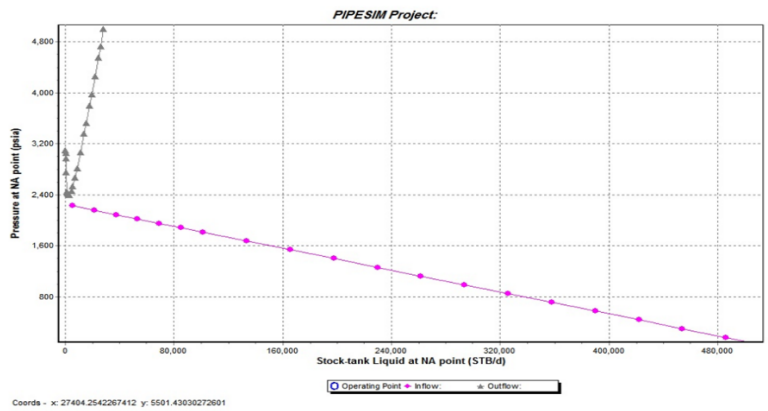

Figure 3. Flow performance diagram

As the flow chart shows, it is not possible to produce natural flow from this well. The next step in producing this well is using a complementary thread to the well. Due to the presence of gas and gas installations in the region, the use of a gas filtration supplement is the best option to complete the well. The first step in designing a complementary sequence is to select the appropriate flow correlation equation. Choosing the appropriate flow relationship has a great impact on the accuracy of the modeling results. Flow data obtained from the well by a barometer were used to select the flow equation.

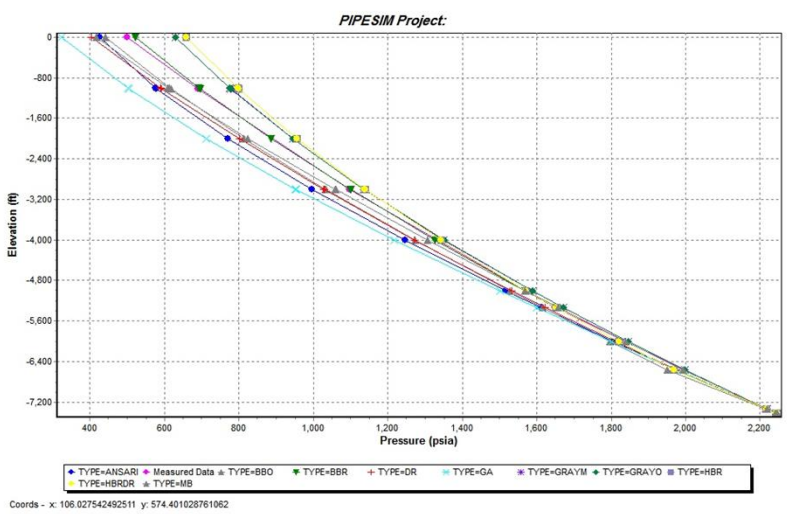

Figure 4. Selecting the appropriate flow relationship

From all the flow correlation relationships, the one that is most consistent with the actual data is the Beggs and Brill relation, and as a consequence it is used as a suitable relation to predict the pressure drop within the system.

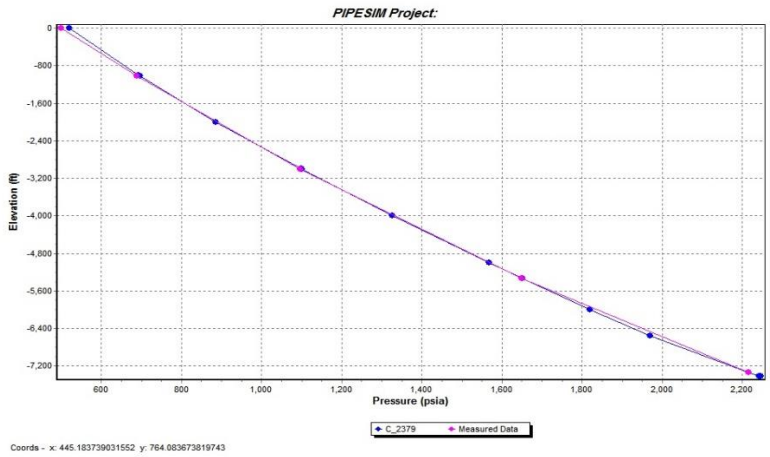

Figure 5. Accuracy of the selected flow relationship with real data

The selected flow relationship is in excellent agreement with the actual well data. It should be noted that in selecting the proper flow relationship the most important factor is the adjustment of the head pressure measured by the pressure predicted by the flow relationship. Selecting the appropriate flow correlation relationship is the next step in calculating the length and size, as well as the number and type of gas lift valves.

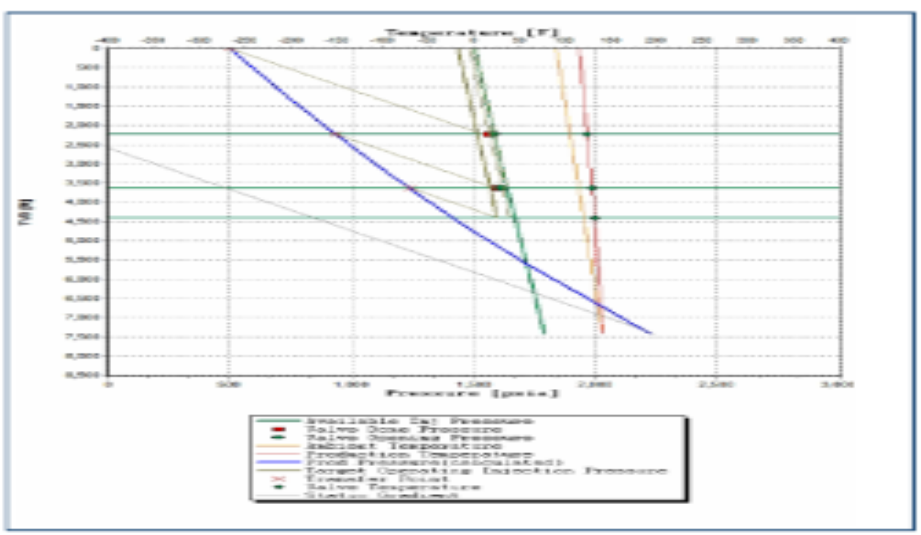

Figure 6. The number of valves for injection and their location in the supplementary field

To produce this well which could not flow naturally, three valves had to be installed in the depths of 677, 1107 and 1343 meters, respectively. If these valves are installed, it will be possible to produce them from

this well. It is clear that two BK-1 processor valves and one BKO type valve with 1.8 inch sizes must be installed to produce the well.

Nodal analysis using gas lift system

The best way to evaluate the success of using and applying a complementary approach is using nodal analysis or Nodal Analysis diagrams. To evaluate the success of supplementary gas lift thread, the nodal analysis diagrams are compared before and after running the supplementary gas lift thread.

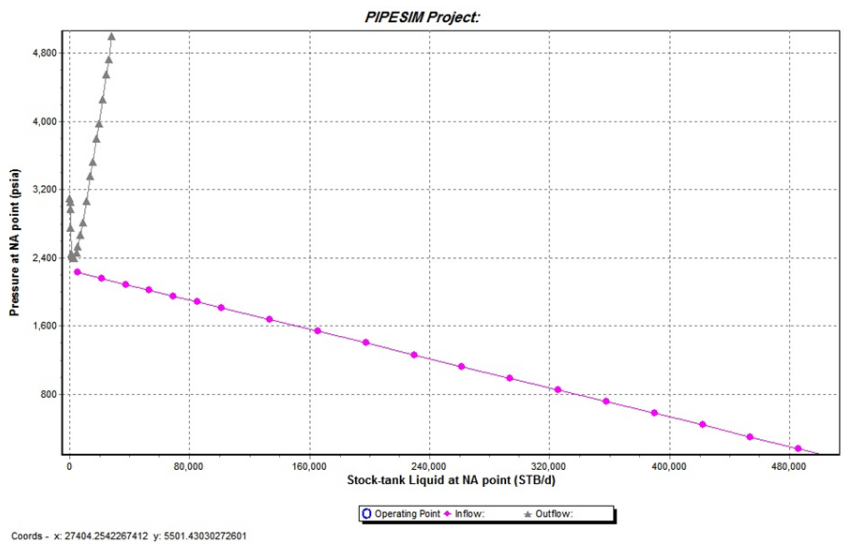

Figure 7. Nodal analysis diagram before the supplementary gas lift thread

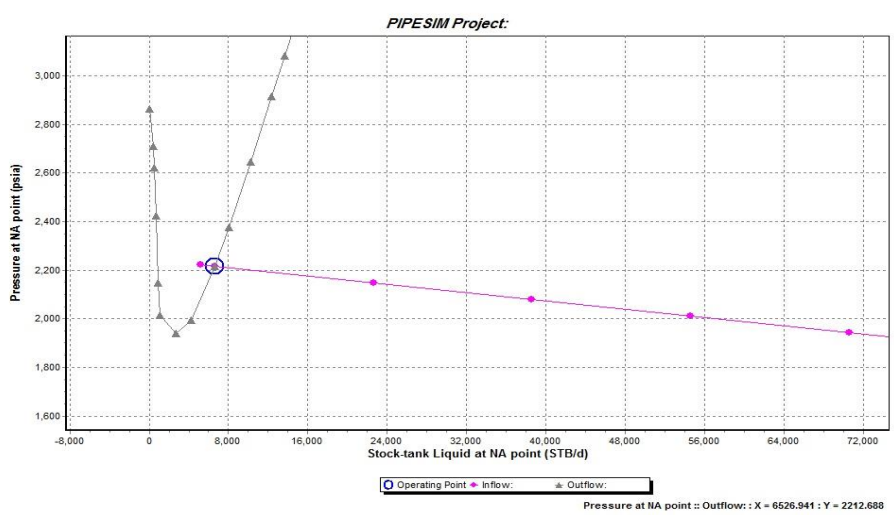

Figure 8. Nodal analysis diagram after the supplementary gas lift thread

It is known that there was no natural flow in the well before the application and installation of the Gas Lift System, but well will flow after the installation of the Gas Lift System with a flow rate 5500 barrels per day.

Effect of increasing injection gas pressure on production rate from wells

To investigate the effect of increasing injectable gas pressure, the injector gas pressure was first adjusted to 1500 PSI, and the next time, the injectable gas pressure was adjusted to 2000 PSI and the flows from injectable gas pressure were compared.

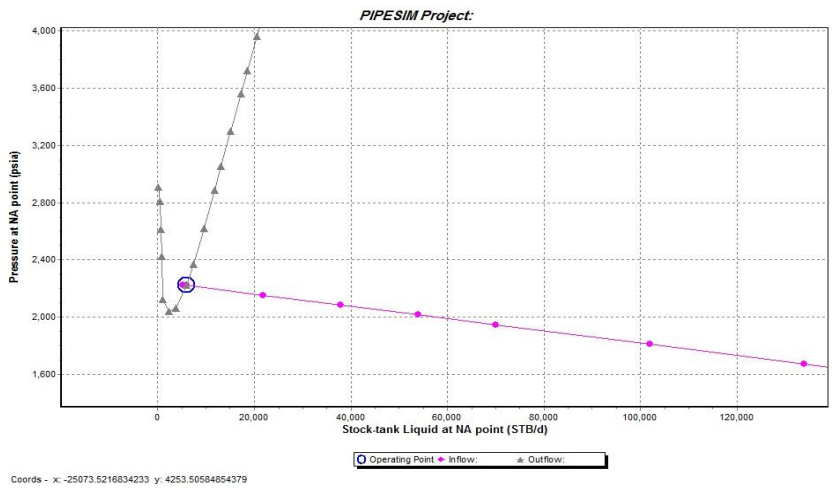

Figure 9. Nodal analysis diagram with injection pressure of 1500 PSI

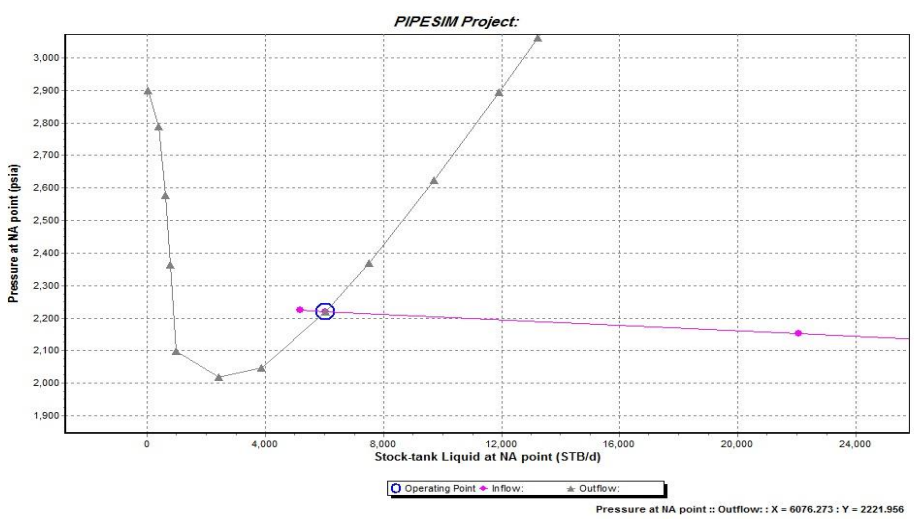

Figure 10. Nodal analysis diagram with injection pressure of 2000 PSI

It turns out that injectable gas pressure will not have a significant impact on production flow and flow will be increased for a 500 PSI increase in pressure only less than about 100 barrels per day that taking into account the economic benefits of this increase and the resulting flow of this pressure increase does not seem economical to do.

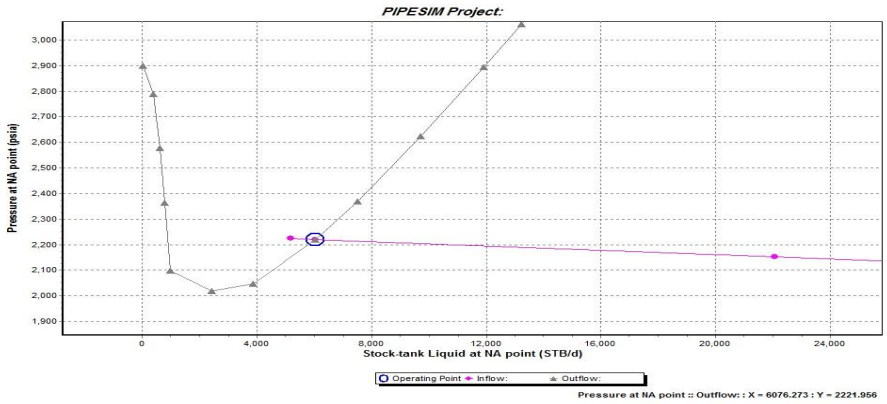

Figure 11. Nodal analysis graph with injection flow rate of about 1200000 SCF / DAY

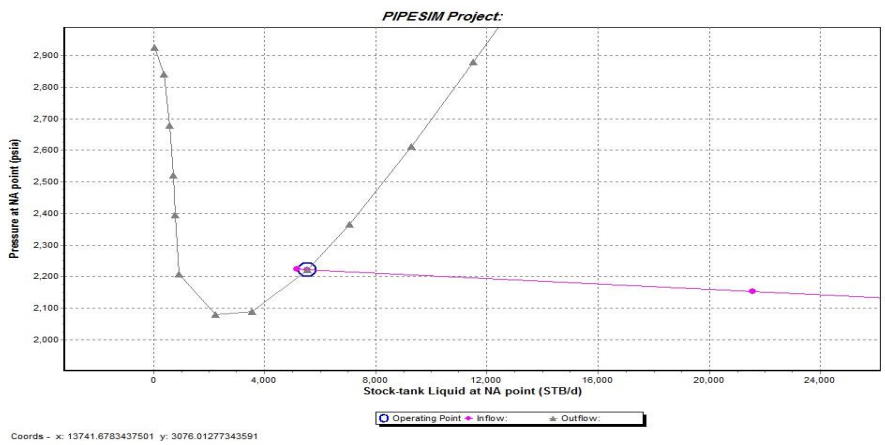

Figure 12. Nodal analysis graph with injection flow rate of about 1500000 SCF / DAY

It is known that with the increase in the flow rate, the injection flow gas from the well will change dramatically, with an increase of about 1,500 barrels per day.

Conclusion

This research can be divided into two parts. In the first part, chapters one and two of the thesis deal with the operational aspects of the subject under discussion. And in chapter four, issues were

discussed from a design perspective. Given that most wells in the oil-rich areas of Iran are in the second half of their lives and most of them will sooner or later need an artificial lift system, the importance of the subject chosen for the above research doubles. The reason for choosing gas lift system for artificial lift is compared to the pump inside the well, since our country has significant gas reserves and it is also possible to recover and reuse this gas.

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