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Possibility of Using Gas Injection Method for Increasing Pressure in Well A: the Case of Oil Fields in Southern Iran

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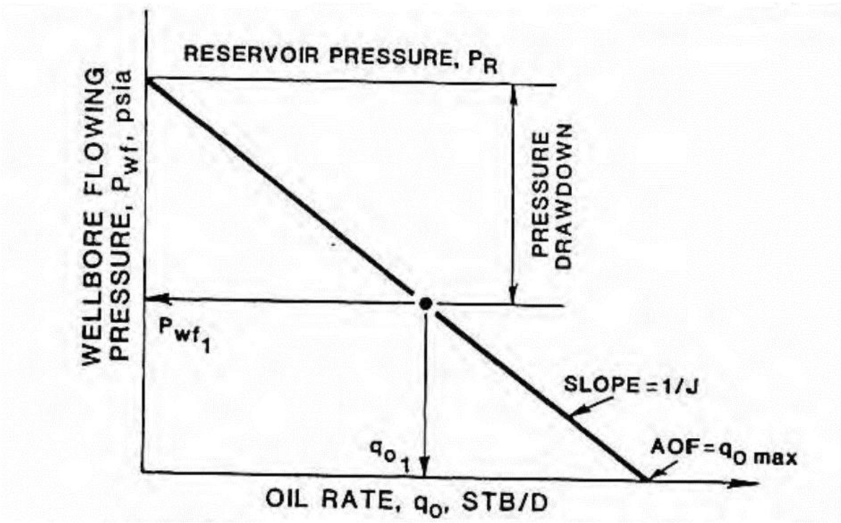
ABSTRACT

The hydrocarbon reservoir is a porous and permeable structure in the basement that houses a natural accumulation of hydrocarbons in liquid or gaseous form and is separated from the surrounding area by impermeable rocks. In a more concrete description, hydrocarbon reservoirs can be likened to an air-filled kite, in which the shell plays the role of the same impermeable rock, and as soon as this balanced medium is pierced, reservoir fluids, as air exits the kite rapidly by forces. The wells are driven. Of course, the strength of this natural drift decreases simultaneously with the production of the reservoir; Iranian reservoirs are, for example, said to have an average annual 10-8% natural drop in reservoir pressure and drop in production flow from the well - drop in production flow from the well with direct reservoir pressure drop. The correct division of a reservoir requires knowledge of the thermodynamic behavior of the phases in the reservoir, i.e. liquid, gas, solid, as well as knowledge of the forces affecting the production mechanism.

GRAPHICAL ABSTRACT



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1-Introduction

Oil field A with an area of 38,850 hectares and oil reserves of 26.428 million barrels was exploited in 1938 AD[1-4]. The number of wells in this reservoir is 161 wells, of which 73 are oil wells, 3 are gas wells, 36 are observation wells and the rest are injectable, descriptive, suspended, abandoned, etc.; five exploitation units' number one to five have been built on the above tank, which put 22 rings of this field in the production circuit through gas overflow [5-8]. The main reservoirs of this field are Asmari Formation and Bangestan. Although the two reservoirs are separated by impervious shales of Pabdeh and Gurpi formations, the complete connection between these two reservoirs is established through fractures [3, 9]. The Bangestan Reservoir was discovered by the former oil consortium in 1978 by drilling well No. 2 [10-14]. Asmari reserves of this field amount to 14.4 billion barrels [15]. The scope of work of the project included the installation of 7 turbo compressors and the implementation of more than 70 km of pipelines and the installation of ancillary equipment and construction and commissioning operations [16]. Allocation of 104 million cubic meters of gas produced in phases 6, 7, and 8 of the South Pars gas field required that sour gas be supplied from the joint gas field of Iran with Qatar [17-22].

The main activity in the field of gas injection to the fields is the establishment of Aghajari field gas injection station, which has added a total of 60 million cubic meters per day to the country's gas injection capacity [23-25].

1-1-Tank flow performance

The development of barometers under wells led to the implementation of well testing by simultaneously measuring the flow rate at the surface and bottom well pressure. The obvious reason to test together is to determine what will be the output flow at the bottom of the well if a certain compressive load is applied to the system at the wellhead. Therefore, many attempts were made to express the relationship between surface discharge and flow pressure at the bottom of the well in the practical range of production conditions.

Oil field performance prediction is essential for its development. For reservoir simulation, it is necessary to know the bottom pressure or fluids flow of each well. If well modeling is specified with the wellhead pressure conditions, to relate the wellhead pressure to the wellhead bottom pressure, it is necessary to perform the right well pressure drop calculations or VFP calculations. The performance of the reservoir is not enough to express the power of production or injection into a field. However, in addition to using the power of the reservoir, the power of the well and wellhead equipment must also be considered for the injection and production process. In this process, the inflow performance relationship (IPR) diagram is used to show the performance of the reservoir, and the tubing performance relationship (TPR) diagram is used to show the power of wells.

The term IPR flow relationship relation is used to define the relationship between oil flow at the surface and flow pressure at the bottom of the well. The efficiency index is called J and is defined as the ratio of discharge and reservoir pressure drop. Today, straight-line IPR is used only for supersaturated oils [26-31]. This equation can be written as follows:

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

p_R :Average tank pressure in terms of psia

p_{wf} :Current pressure at the bottom of the well in psia

J: bbl / stb efficiency index

The average reservoir pressure is the volume of the reservoir in which the well is drained.

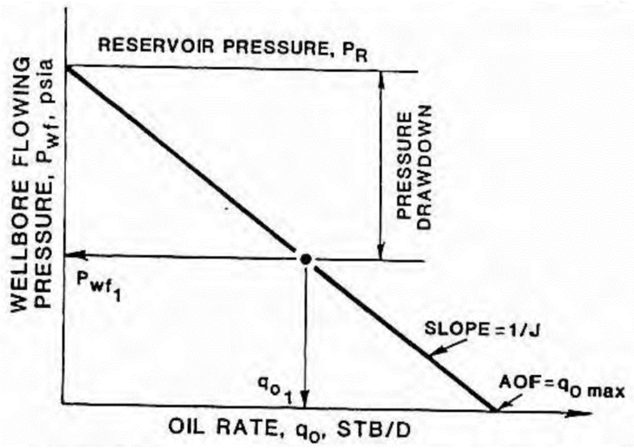

Figure 1. IPR curve for an oil tank

It is not uncommon to use the initial reservoir pressure or pressure at the outer boundary of the drainage area because the difference between these values is usually small and can be ignored. Field observations have been made in supersaturated oil wells and water wells. The yield index is a very useful concept to describe the relative potential of a well. This factor combines all rock and fluid properties and geometrical considerations into one constant, so it is unnecessary to consider all of these factors individually. In simple terms, a quasi-steady state indicates a condition in which the total volume of drainage contributes to production [32-35]. It usually takes some time to reach a quasi-steady state. Of course, in high permeability formations, a quasi-steady state is almost instantaneous, but in low permeability formations, quasi-steady-state conditions may not be achieved for years.

The effect of compressible gas and biphasic flow was observed in well pressure experiments, in which instead of flow linearly increasing with pressure drop, larger than linear pressure drops were required to increase the flow rate. The relationship between pressure and discharge, in this case, shows a large curvature in high discharges. In terms of the efficiency index, the value of J decreases with increasing pressure drop [5, 36].

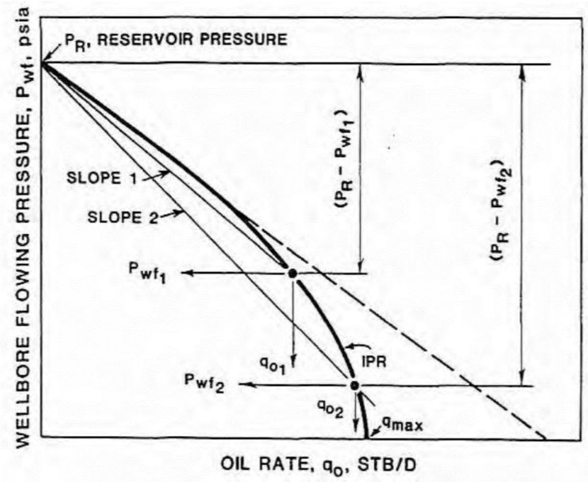

Figure 2. The curvature of the IPR curve indicates the presence of gas or biphasic current

1-2-Internal profile of the studied well

It should be considered that layers with different pressures should not be bonded together by drilling, because of flowing. The studied well consisted of three casing with sizes of "20", "3.8", "13", and "5.8", having been drilled to a depth of 150, 1300, and 2500 meters, respectively, and cemented.

The final depth of the well is 2700 meters and the well in Asmari Formation has been completed [37-40].

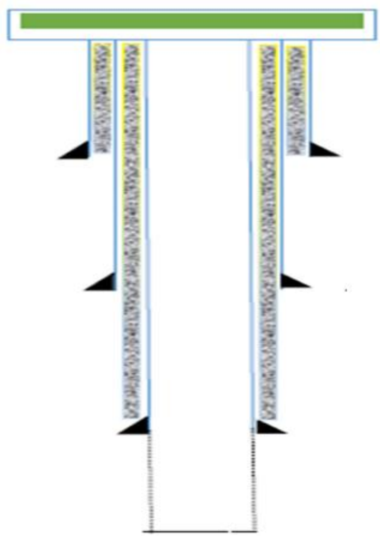

Figure 3. Inner diagram of the well under study

1-3-Properties of fluid produced from wells

The oil of this field has corrosive properties due to having 15% associated water and also high salt. This property should be considered in the design of surface equipment as well as inside the well. Examination of changes in oil volume coefficient to temperature shows that oil volume coefficient increases with increasing temperature, but there is no definite change in different times for volume coefficient. Also, the study of changes in oil density with temperature shows that oil density with the increase in temperature decreases but no significant change is observed concerning the time. It should be noted that if the gas injection method is used in the well, the gas injection causes oil to be directed to the produced well, and the amount of reservoir oil recovery increases by changing the thermodynamic properties of the reservoir fluid. The texture variability of the type of reservoir rock in hydrocarbon reservoirs has an important effect on the control of oil production and this effect is such that it controls the pressure of fluid displacement during production. Areas of reservoir rock that form the link between weak lattice pores have low effective efficiencies [40-43].

1-4-Construction of a fluid flow model

According to the properties mentioned above, the first step was to build a preliminary model of fluid flow to investigate the possibility of the natural flow of the formation without using a complementary string. The required pressure at the wellhead is about 800 feet due to the mountainous nature of the area and the need for high well pressure to overcome the pressure drop along the route [44-46].

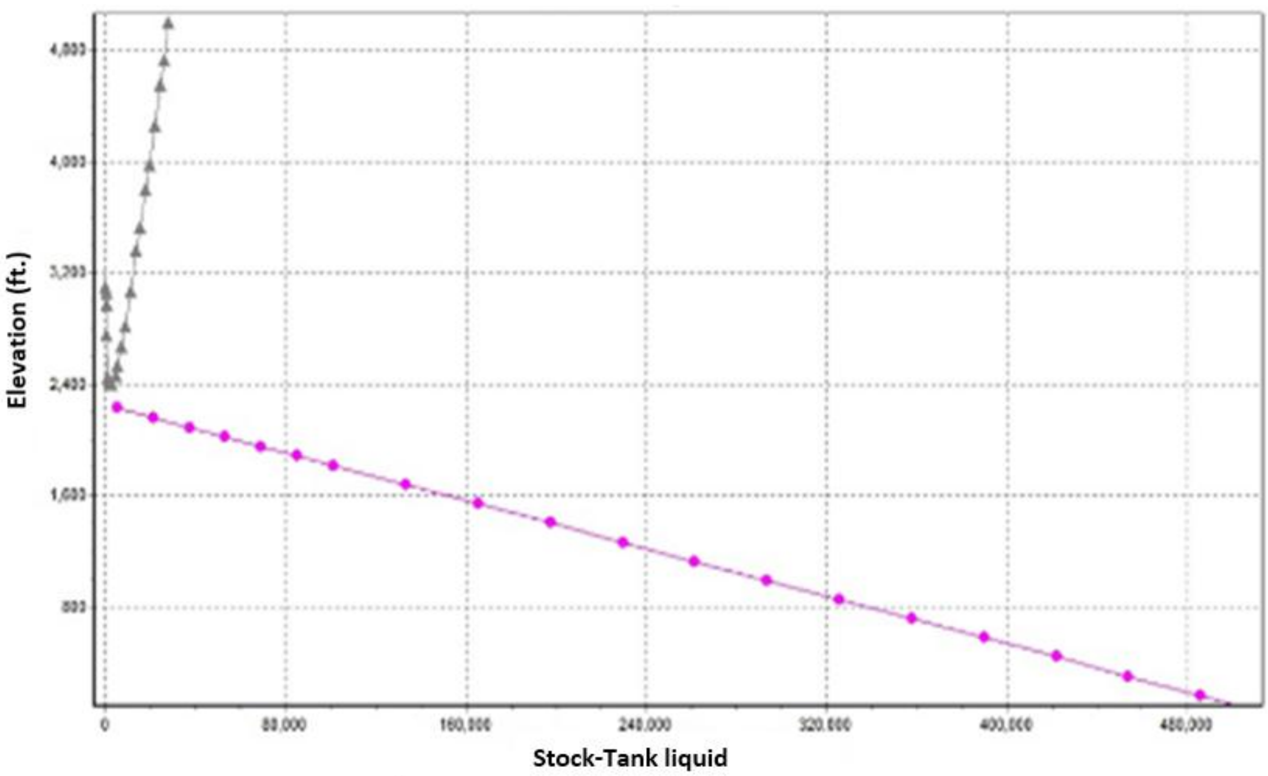

Figure 4. Flow performance diagram

As shown in Figure 4 and the flow performance diagram, it is not possible to produce Natural Flow from this well. The next step in producing from this well was to use a suitable supplementary string for this well. Due to the presence of gas and gas facilities in the area, using the supplementary gas overflow field was the best option to complete this well. The first step in designing the appropriate complementary string is to select the appropriate flow correlation equation. Choosing the right flow relationship has a huge impact on the accuracy of the modeling results. Flowing data taken from the well by a barometer was used to select the flow average Of all the flow correlations, the one that is most consistent with the actual data is the Beggs and Brill relationship; therefore, this relationship is used as a suitable relationship to predict the amount of pressure drop within the system [47-50].

According to figure 6, the selected flow relationship is very well matched with the actual well data. It should be noted that in choosing the right flow relationship, the most important factor is matching the wellhead pressure measured with the pressure predicted by the flow relationship. After selecting the appropriate flow relationship, the next step was to calculate the length and size, as well as the number and type of gas overflow valves.

According to figure 7, for the production of this well, which could not flow normally, three valves had to be installed at depths of 677, 1107, and 1968 meters, respectively. If these valves were installed, it would be possible to have production from this well.

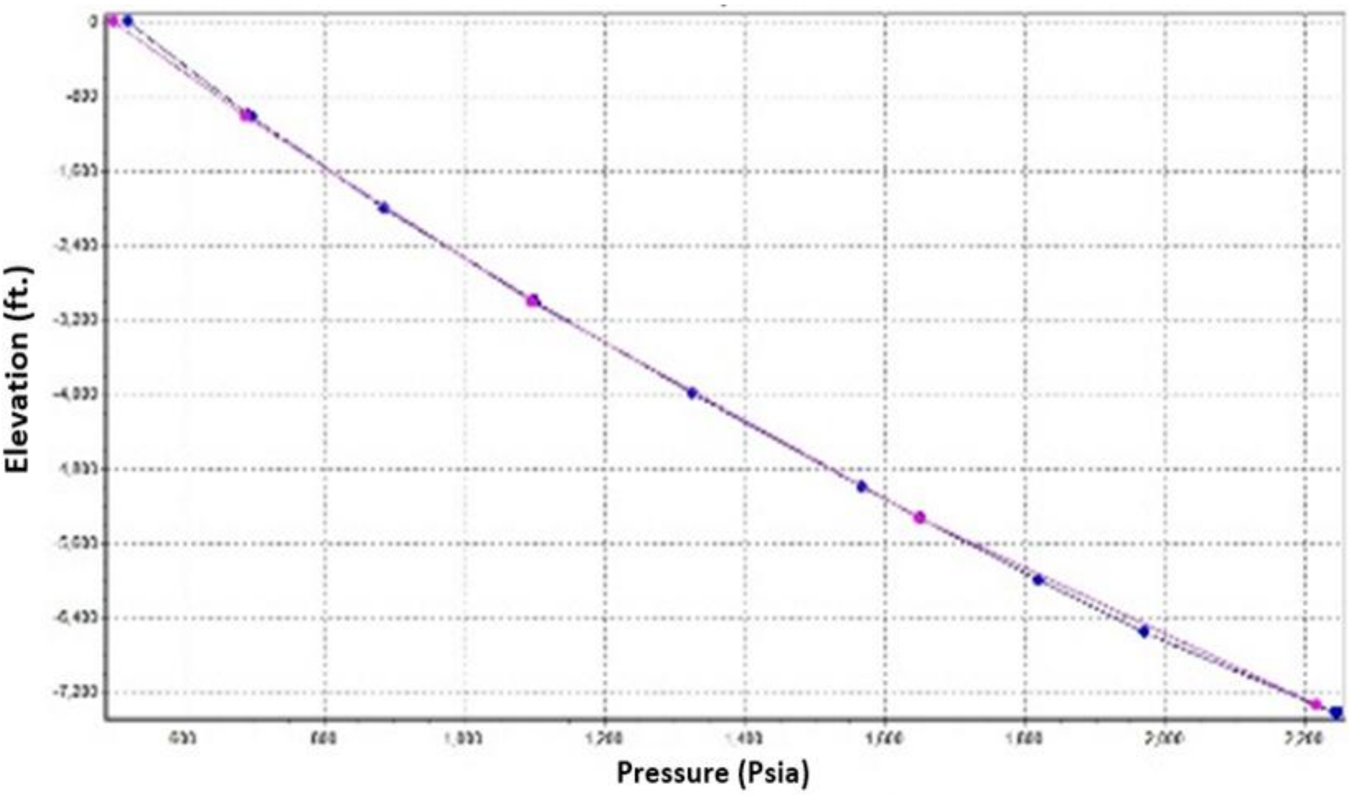

Figure 5. Selecting the appropriate flow relationship

2-Discussion

2-1-Node analysis using gas extraction system

The best way to evaluate the success of using and applying a complementary method is to use NODAL ANALYSIS. To evaluate the success of the application of the gas extraction course, the node analysis diagram before and after driving the gas extraction course was given and compared.

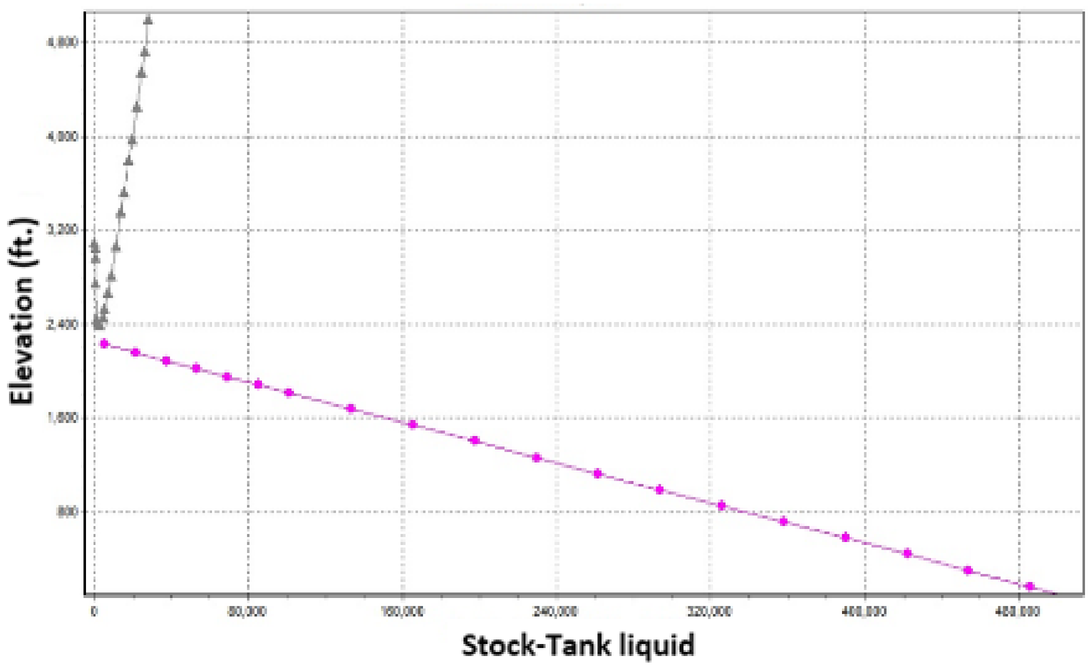

Figure 8. Node analysis diagram before applying the gas extraction supplementary string

Before using and installing the GAS LIFT SYSTEM, there was no possibility of a NATURAL FLOW in the well, but after installing the GAS LIFT system, the flow would be about 5500 barrels per day.

2-2-The effect of increasing the injection gas pressure on the production rate from the well

To investigate the effect of increasing the injection gas pressure, once the injection gas pressure was set to PSI1500, the next time the injection gas pressure was set to PSI 2000, and the discharges resulting from the injection gas pressure increase were compared. Injectable gas pressure will not have much effect on the production flow and for PSI500, the pressure increase will be less than about 100 barrels per day.

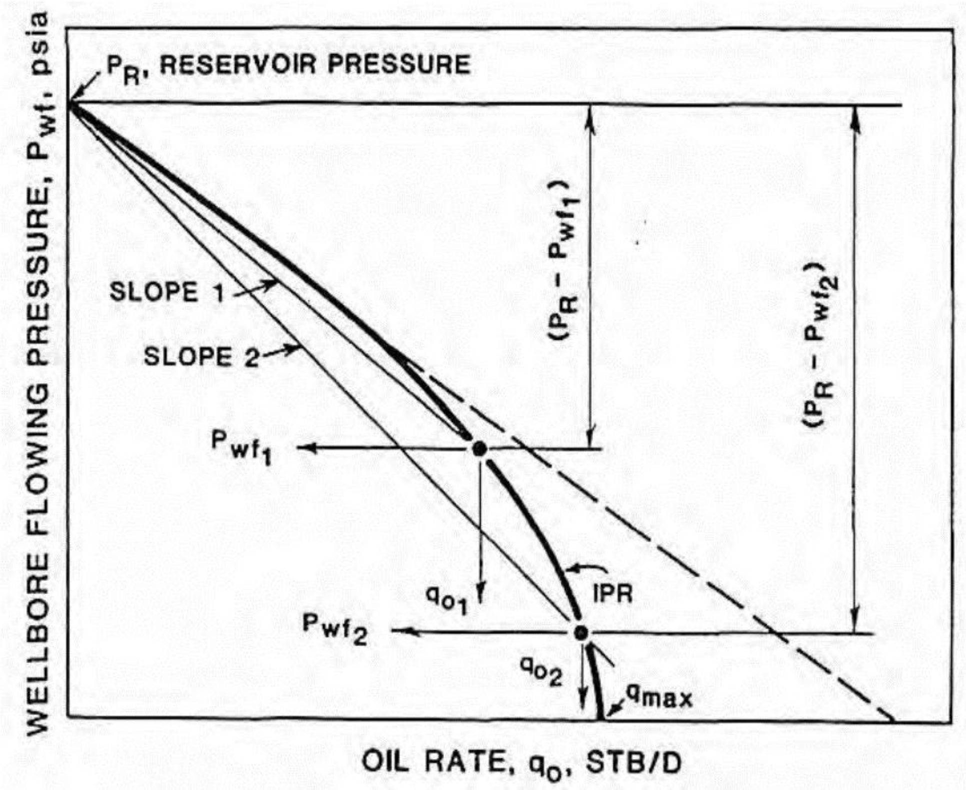

Figure 10. Node analysis diagram with PSI1500 injection pressure

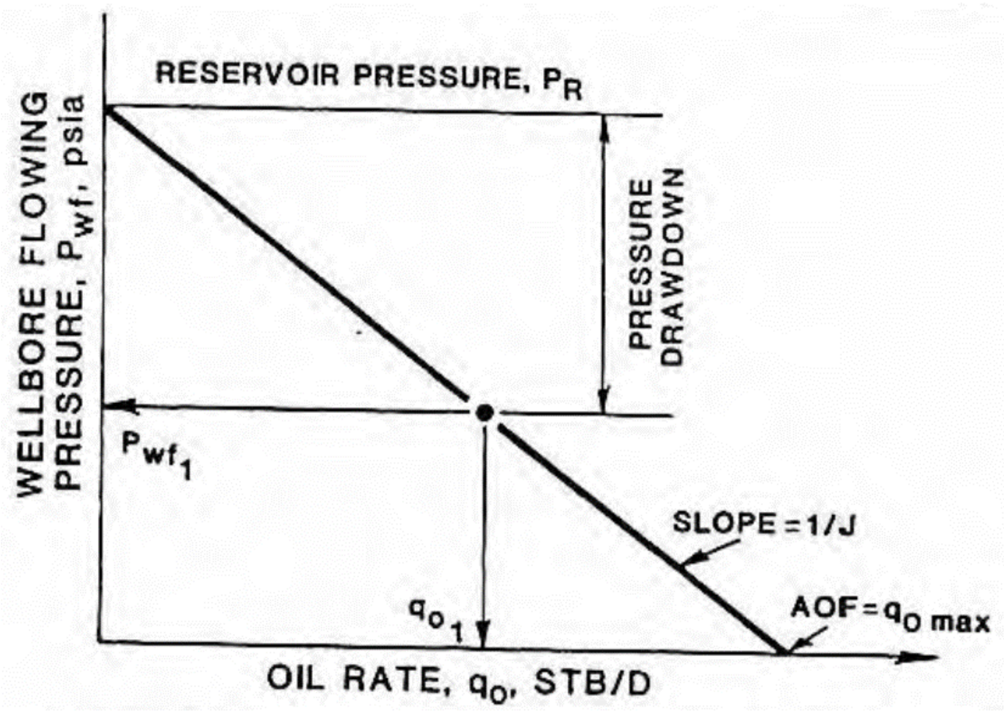

Figure 11. Node analysis diagram with PSI2000 injection pressure

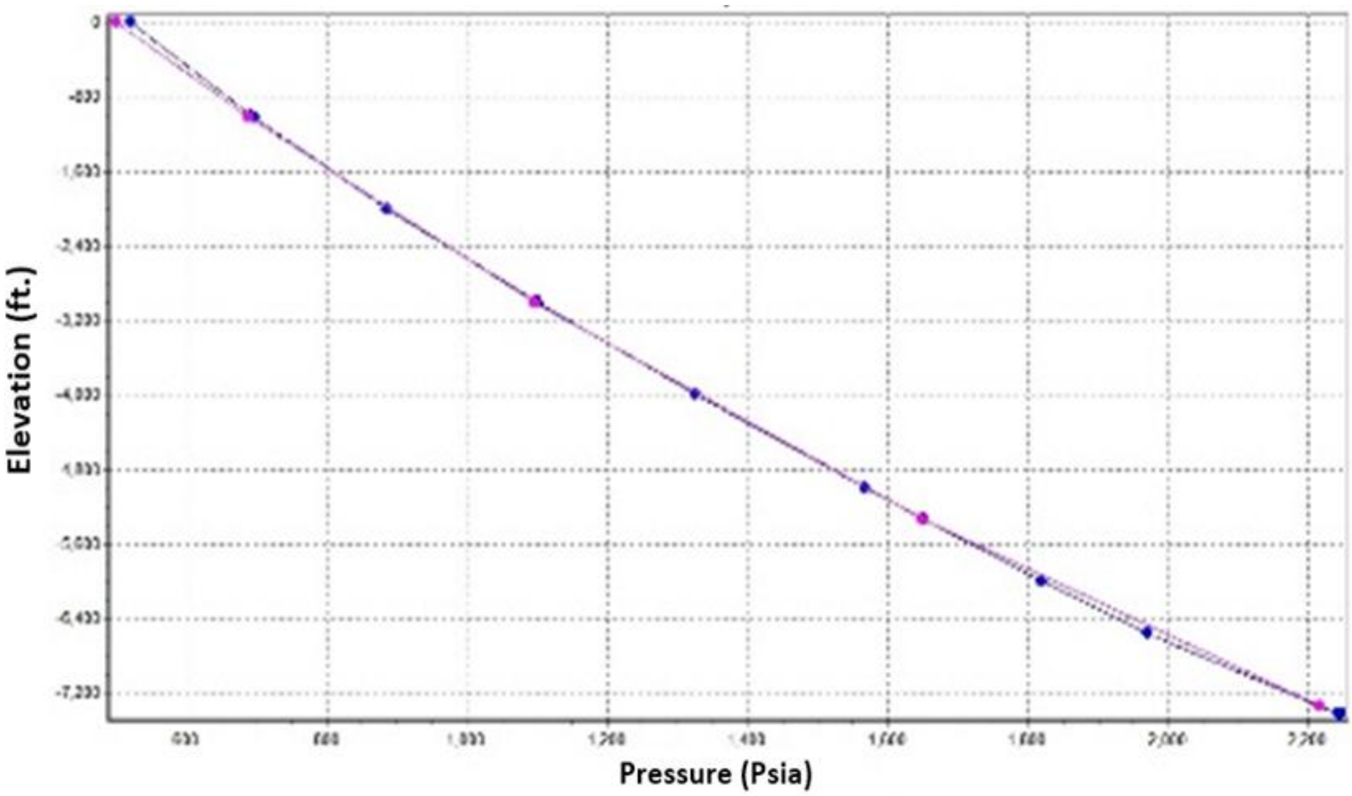

Figure 12. Node analysis diagram with an injection flow rate of about SCF / DAY 1200000

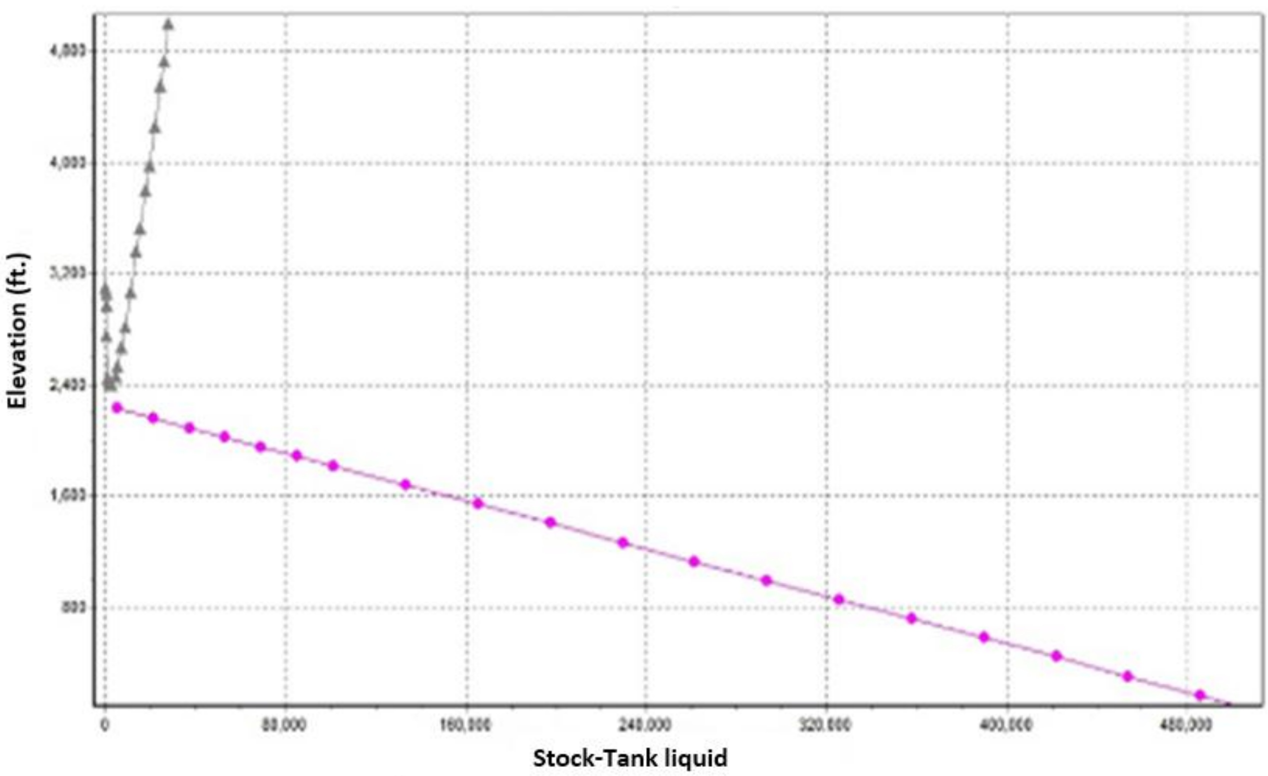

Figure 13. Node analysis diagram with an injection flow rate of about SCF / DAY 1500000

2-4-Effect of increasing injection gas flow rate on well production

To investigate the effect of increasing the injection gas flow rate on the production rate from the well, a gas injection with a flow rate of about 120,000 SCF / DAY was performed and the gas injection flow rate was increased to SCF / DAY 150,000,000 again. Then the results were compared.

By comparing figures 12 and 13, it is clear that with increasing flow rate, the gas injection will produce a significant change from the well and an increase of about 1500 barrels per day will be achieved. Considering injectable gas pressure and increasing injected gas flow, we found that the effect of increasing injected gas flow on the produced oil flow would be much greater.

3-Conclusion

Given that most of the wells in the oil-rich regions of Iran are in the second half of their life and most of them will sooner or later need an artificial overflow system, the importance of the topic selected for the above research becomes quite clear. The reason for choosing the overflow system with gas for artificial overflow method compared with the pump inside the well is that our country has significant gas reserves and it is also possible to restore and reuse this gas, so the best option to choose an artificial overflow system in the field Gas lift system.

1- According to the studies, increasing the gas injection pressure at the level will not have much effect on increasing the production flow of the well, and therefore, considering the economic efficiency, making changes to increase the injection gas pressure is not justified.

2- Increasing the flow of injected gas will cause a significant increase in the production flow. Therefore, it is recommended in places where due to operational limitations it is not possible to install control valves to control the flow of injected gas by installing a suitable reducer in the gas path. The injection increased the gas flow to increase the oil flow.

3- In the discussion of gas injection, it is one of the limiting factors of the injection gas composition. If the injection gas composition contains H_2S, it will cause severe corrosion in the gas injection and recovery facilities, which should be considered in the economic calculations of the project. It is recommended that this method not be used for the ultrasonic system if the hydrogen sulfide in the gas is high.

4. The advent of smart good technology with its capabilities has paved the way for the world's oil companies to carry out new projects. By considering the capabilities of this technology, these companies were able to use the potential of some oil tanks or other tanks to produce oil. One of these potentials is gas overflow. Where the flow rate and gas injection pressure are intelligently adjusted to the oil production flow, therefore, the use of this system is recommended in wells that have intelligent technology.

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