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# Study of Gas Injection Performance under Different Production Scenarios in one of the South-West Iranian Reservoirs

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**ABSTRACT:** One of the most effective methods in oil production and EOR is gas injection. Gas injection is the oldest of the fluid injection processes. The idea of using a gas for the purpose of maintaining reservoir pressure. Gas injection is performed in different type such as miscible and immiscible injection. In this paper, we used immiscible gas injection for secondary oil recovery. Also, three scenarios have been considered for this project.

***Keywords*:** Gas injection, Immiscible gas, Multi-scenario production, Secondary oil recovery.

## INTRODUCTION

After discovery, most oil reservoirs undergo a period of production called “primary oil recovery”. Primary oil recovery used natural reservoir energy to drive the oil through the pore network to producing well. Due to production of oil from a reservoir, the reservoir pressure will decrease. Eventually, the natural drive energy is dissipated. When this occurs, energy must be added to the reservoir to produce any additional oil. So we should use new methods and advanced techniques. One of these techniques is an injection of suitable material into the reservoir. Secondary oil recovery involved the introduction of energy into a reservoir by injecting gas or water under pressure where the gas is immiscible with oil. The technique was called “pressure maintenance”.

### *2. Study Method*

Gas is one of the most commonly injected fluids for production increasement and pressure maintenance. In gas injection project usually we should select between some kinds of gas based on reservoir parameters. Gas injection may be either a miscible or an immiscible displacement process.

### *2.1. Miscible Gas Injection*

Miscible displacement processes are defined as processes where the effectiveness of the displacement results primarily from miscibility between the oil in place and injected fluid. Displacement fluids, such as rich gas, carbon dioxide, hydrocarbon solvents, flue gas and nitrogen are considered.
The main mechanisms of this process are capillary pressure reduction and also reduce the reservoir fluid viscosity.

### *2.2. Immiscible Gas Injection*

Due to the abundance of gas (that Iran has the big gas reservoirs), immiscible gas injection is one of the most common methods for enhanced oil recovery. The idea of using a gas for the purpose of maintaining reservoir pressure and restoring oil well productivity. Theoretical calculations by Muskat (1946) showed that oil recovery could be greatly increased by pressure maintenance.
Gas can be injected into a reservoir to maintain the pressure (for example, dispersed gas injection) or to attempt to bank and sweep oil to producers (for example, gas-cap injection).

## 3. Study and Selection of Different Production Scenarios

Several scenarios have been proposed for the simulation. For running these scenarios, we should evaluate parameters that have influences on production and injection. In this section, we present our results for these scenarios.

### 3.1. First Production Scenario

This scenario consists of an injection well and three production well. The initial reservoir pressure is 4500 psi. The injection rate was taken constant, to be equal to 15000 Mscf/DAY. The injection pressure increases to 4800, 5300, 5800, 6200 and 6700 psi, respectively. The effect of the injection pressure increase in total oil production (FOPT), oil production rate (FOPR), water production rate (FWPR), gas oil ratio (FGOR), reservoir pressure (FPR) and oil recovery efficiencies (FOE) are shown in figure 1 to figure 6.

### 3.2. Second Production Scenario

In this scenario, we assume a constant injection pressure that is equal 4600 psi. The injection rate was considered 14000, 20000, 26000, 32000, 38000, 44000, 50000 Mscf/DAY, respectively. The number of wells is similar to the first scenario.

The effect of injection rate can be seen in figure 7 to figure 12. The values of FGOR, FPR, FOPR, FOPT and FOE after 8766 days are listed in table1.

Table1. The value of FGOR, FPR, FOPR, FOPT and FOE for second scenario

| | | FGOR (Mscf/STB) | FPR (PSIA) | FOPR (STB/DAY) | FOPT (STB) | FOE |
|---|---|---|---|---|---|---|
| Natural Recovery | | 2.2628138 | 911.80695 | 2056.1155 | 2.3059925E+8 | 0.17208943 |
| Gas inj. rate | 14000 | 4.3894987 | 932.39435 | 3353.1692 | 2.3867555E+8 | 0.17811668 |
| (Mscf) | 20000 | 7.1940069 | 934.01233 | 3699.8838 | 2.4124278E+8 | 0.18003261 |
| | 26000 | 7.7163353 | 940.4895 | 4209.8589 | 2.4386994E+8 | 0.18199302 |
| | 32000 | 7.5564842 | 951.75085 | 5842.6436 | 2.4864234E+8 | 0.1855547 |
| | 38000 | 8.2225494 | 963.771 | 6920.6338 | 2.5289552E+8 | 0.18872848 |
| | 44000 | 8.5384855 | 969.28473 | 7374.4233 | 2.5488589E+8 | 0.19021371 |
| | 50000 | 8.7905731 | 975.29626 | 7873.5 | 2.5691717E+8 | 0.19173084 |

Table2. The value of FGOR, FPR, FOPR, FOPT and FOE for third scenario

| | FGOR (Mscf/STB) | FPR (PSIA) | FOPR (STB/DAY) | FOPT (STB) | FOE |
|---|---|---|---|---|---|
| Natural Recovery | 2.2628138 | 911.80695 | 2056.1155 | 2.3059925E+8 | 0.17208943 |
| Two injection wells | 9.9870443 | 970.2077 | 6064.7266 | 2.2889358E+8 | 0.17081614 |
| Three injection wells | 12.203601 | 990.01788 | 7490.2261 | 2.418791E+8 | 0.18050641 |

### *3.3. Third Production Scenario*

For this scenario, we consider three production wells, but increase the number of injection wells to two and three wells. The injection rate and injection pressure were taken as 15000 Mscf/DAY and 46000 psi, respectively. In addition, the oil production rate of each production wells is 8250 STB/Day.

For this scenario, the results are presented in figure 13 to figure 18 and also listed in table 2 after 8766 days. The reservoir 3D model with three injection wells can be seen in the figure 19.

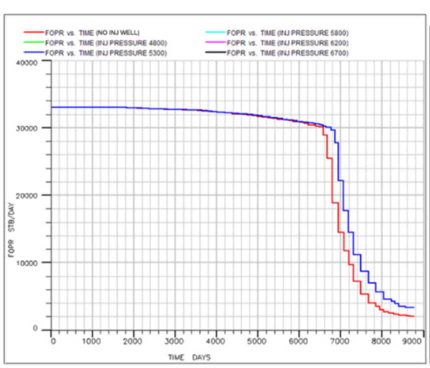


Figure 1. FOPR changing curve for first scenario

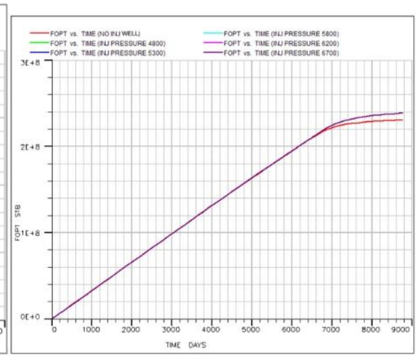


Figure 2. FOPT changing curve for first scenario

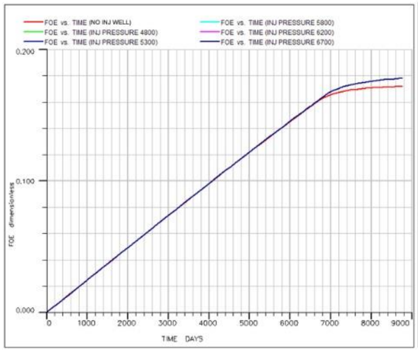


Figure 3. FOE changing curve for first scenario

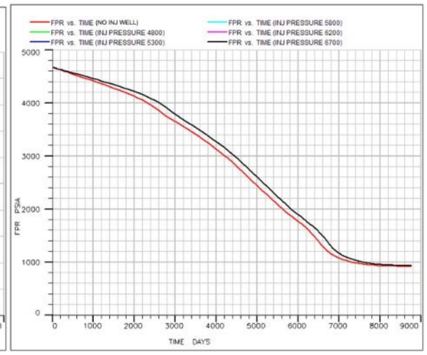


Figure 4. FPR changing curve for first scenario

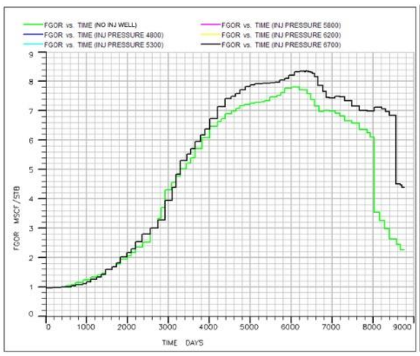


Figure 5. FGOR changing curve for first scenario

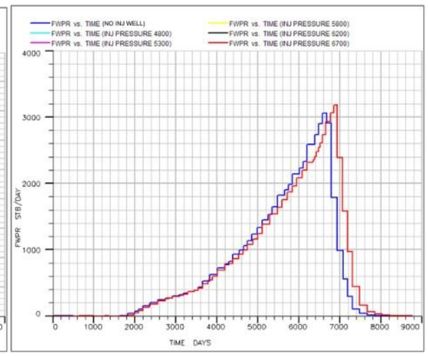


Figure 6. FWPR changing curve for first scenario

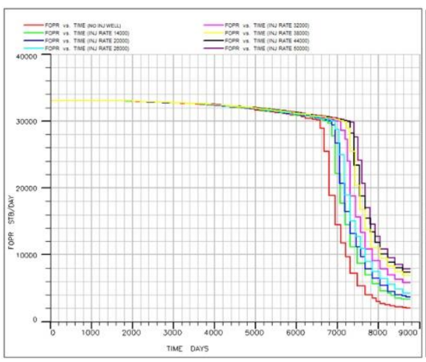


Figure 7. FOPR changing curve for second scenario

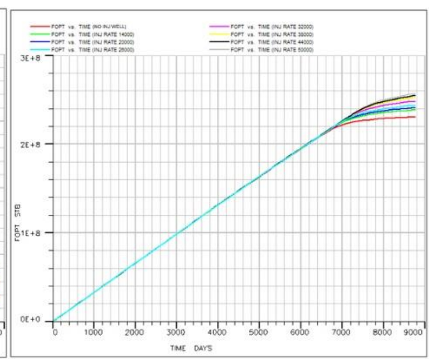


Figure 8. FOPT changing curve for second scenario

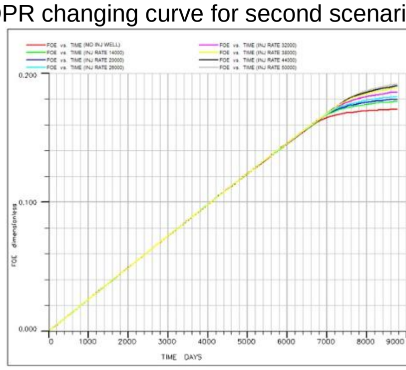


Figure 9. FOE changing curve for second scenario

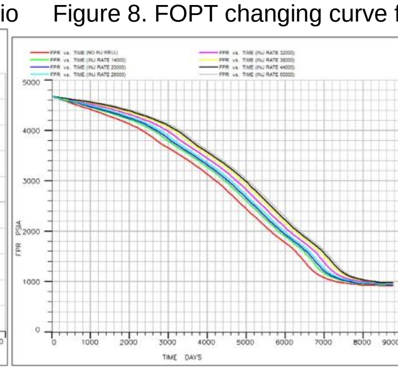
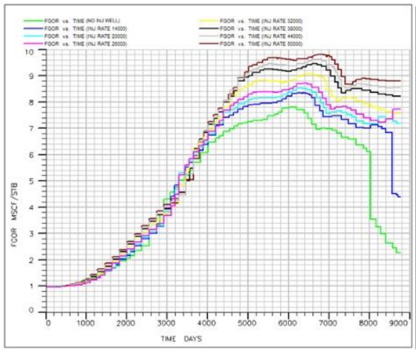


Figure 10. FPR changing curve for second scenario



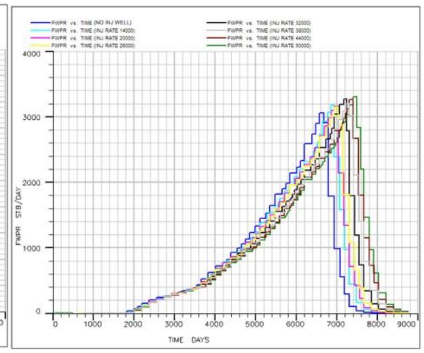
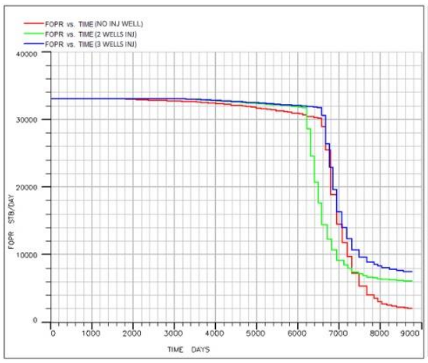




Figure 11. FGOR changing curve for second scenario Figure 12. FWPR changing curve for second scenario



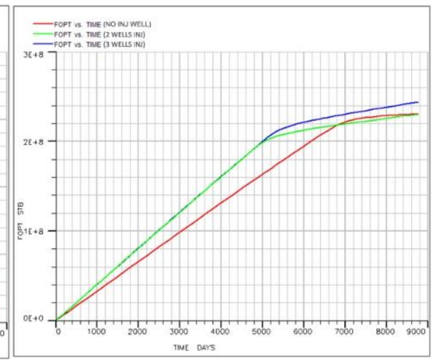
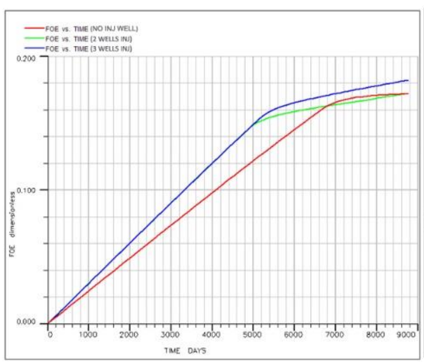




Figure 13. FOPR changing curve for third scenario Figure 14 .FOPT changing curve for third scenario



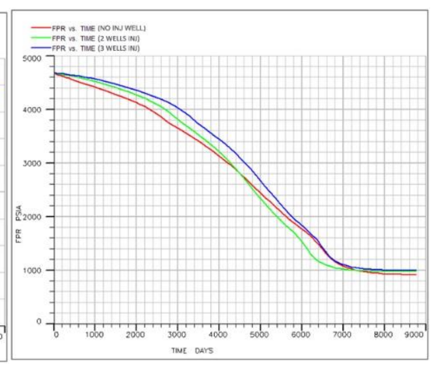
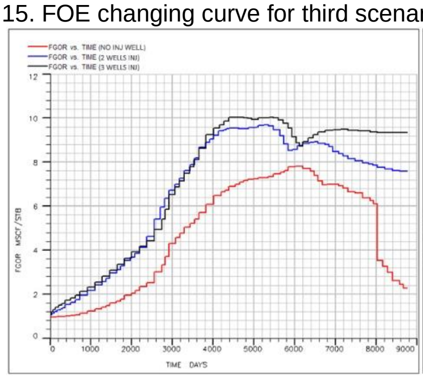




Figure 15. FOE changing curve for third scenario Figure16. FPR changing curve for third scenario



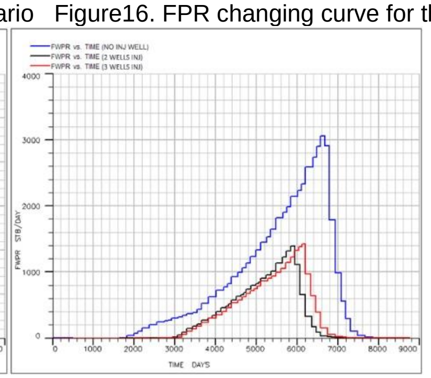




Figure 17. FGOR changing curve for third scenario Figure18. FWPR changing curve for third scenario

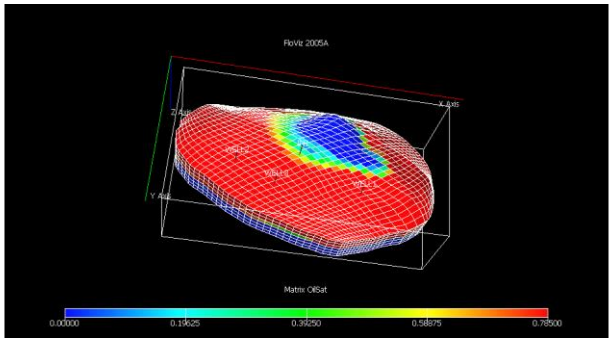


Figure 19. Reservoir 3D model

### *4. Concluding remarks*

In the present work, we have been applying some scenario for study of the performance of gas injection in one of the Iranian reservoirs. According to figure 1 to figure 18, the following results are obtained:

1) As evident from the figures, the injection pressure increase does not affect on FOPR, FOPT, FOE, FPR, FGOR and FWPR. In other words, this scenario does not have an effect on enhanced oil recovery.
2) In the variable injection rate scenario (second scenario), FOPR, FOPT, FGOR, FPR and FOE increase with increasing of injection rate. If the injection rate is equal to 50000 Mscf/DAY, the recovery factor will increase two percent.

When the number of injection wells increase, the value of FOPR, FOPT, FGOR, FPR and FOE will increase.

## REFERENCES

Dake LP. 1977. Fundamentals Reservoir Engineering, Sell Training The Hague.

Hally A. 1987. Enhance oil recovery by inert gas injection, Golf publishing company.

Kantzas A. 1989. Enhance oil recovery by inert gas injection, SPE 17379.

Lawrence JJ, Huflze JM and Wilkinson JR. 2003. reservoir simulation of Gas Injection Processes, SPE 13th Middle East petroleum show & conference, SPE paper, 81459.

Anne Y. 2007. Gas Injection and BreakThrough Trends as observed in ECBM Seguestration Pilot Projects and Field Demonstrations.

Tanveer R. 2008. a Techno Economical Evaluation miscible Flooding, Dalhouise University.

Mazen T. 2008. a Simulation Study to Verify Stone's Simultaneous Gas Injection Performance in a 5-spot pattern Master of Science Thesis, Texas A&M University.