AN APPROACH TO THE PRODUCTION OPTIMIZATION OF MEGHNA GAS FIELD

Kakon Sultana[1], MD. Zayed Bin Sultan[2]
[1]*Bsc in Petroleum and Mining Engineering, Chittagong University of Engineering and Technology*
[2]*Assistant Professor in Department of Petroleum and Mining Engineering, Chittagong University of Engineering and Technology*

***Abstract*- Natural gas has been the life line of the commercial energy resource of Bangladesh for several decades. It is the primary option to satisfy the environmentally clean energy, whereas coal is a dirty energy source and oil creates an unhealthy environment. In petroleum industry production optimization is one of the most important task for production engineer to meet the increasing demand for natural gas among the nation. If the production rate is not optimized then it is not either economic or it raises bad effects to the reservoir performance. This study aims at forecasting the optimized production rate of Meghna Gas Field. The major motive is to improve the IPR and VFP curve form the former one. The general conventional process of optimizing the production rate by cross plotting improved Inflow Performance Curve and Vertical Flowing Performance Curve in a graph paper. The two curves intercept in a single point which is considered as the best production rate against the respective wellbore flowing pressure.**

Index Terms- Production Optimization, IPR, VFP, Compressibility Factor, Wellhead Pressure, Perforation Height, Skin Factor, Wellbore Radius.

I. INTRODUCTION

The natural gas will remain a major factor in meeting the commercial energy need of the term country in the short to medium future. Natural gas refers to the naturally occurring hydrocarbon gas predominantly methane. Methan (CH4) is the lightest and simplest hydrocarbon molecule. Hydrocarbon molecules with 1 to 4 carbon atoms from the bulk is the natural gas. Bangladesh is the young deltaic sedimentary basin which meets the geologic requirements for generation and accumulation of natural gas in the subsurface. The country has proved natural gas rich province in the eastern part. Since the beginning of petroleum exploration in the area in 1910, a total 76 exploratory wells has been drilled till 2010 [1].

Total initial recoverable proven plus probable gas reserve of 26 fields, discovered so far in the country, has been estimated to be at 27.12 trillion cubic feet (TCF); out of this estimated proven recoverable reserve (P1) is 20.77 TCF while the recoverable probable (P2) reserve is 6.35 TCF. But now-a-days gas resources are facing difficulties to fulfill the demands. So it is high time to find out some solutions to increase the production rate of gas among the gas fields. Production engineering is a part of petroleum engineering that attempts to maximize production (or injection) in a worthy way. Production engineering technologies and methods of application are related directly and interdependently with other major areas of petroleum engineering such as formation evaluation, drilling and reservoir engineering [2].

Meghna gas field is situated in Bancharampur upzila under Brahmanbaria district some 40 km away of northern most east direction from capital city of Bangladesh, Dhaka. The field was discovered in 1990 by Petrobangla. It is a small gas filed and has been in production since 1997. In August 2018, average 12.35 million cubic feet of gas is produced daily from one well of the field [3].

IPR is defined as the well flowing bottom-hole pressure (Pwf) as a function of production rate. It describes the flow in the reservoir. The Pwf is defined in the pressure range betwen the average reservoir pressure and atmospheric pressure. Inflow performance curve represents the deliverability of a reservoir. VFP is also referred to as outflow. VFP represents the deliverability of the well. It describes the bottom-hole pressure as a function of flow rate. It relates the flow from the bottom-hole of the well to the wellhead. After the IPR and VFP curves are

plotted in a Cartesian graph paper, two curves intercept and the intercept point is the production rate of the particular well of a reservoir [4].

II. OBJECTIVE OF THE STUDY

This study focus on forecasting the optimized production rate of Meghna Gas Field. Based on the main above the main motives are the following

1. To represent the production rate of Meghna Gas field through cross plotting of IPR and VFP curve.
2. To improve IPR and VFP curve from the former one.
3. To predict the optimized production rate from the developed cross plotting of improved IPR and VFP curve.

III. METHODOLOGY

Inflow performance curve can be generated through theoretical study. Equation for steady state following of gas

$$P_e^{\,2} - p_{wf}^{\,2} = \frac{1424qT\mu Z}{kh}\left(ln\frac{r_e}{r_w} + S\right) \qquad (1)$$

Some parameters such as skin factor, perforation height, permeability, reservoir temperature, horizontal well or side tracking greatly effect reservoir behavior as well as reservoir performance so as the IPR curve. Mathematically outer flow performance is calculated using the following equation

$$P_{wf}^{\,2} = P_{tf}^{\,2}e^{s} + \frac{6.67x10^{-4}q^2fT^2Z^2}{d^5 cos\theta}(e^{s} - 1) \quad (2)$$

Tubing diameter, separator pressure, choke diameter, wellhead pressure all these factors significantly affect the well deliverability behavior so as the well performance. As a result the VFP curve shifts upward from the former one [5].

IV. RESULTS AND DISCUSSION

At first the initial IPR and VFP curves are represented in Cartesian graph paper. Then cross plotting of these two curves show a single interception point. That single intercepting point is the optimal gas flow rate of the respective field. Then the IPR and VFP curves are improved by changing their respective parameters. And the improved IPR and VFP curves provide a developed optimal gas flow rate.

a) Optimal Gas Flow Rate of Meghna Gas Field

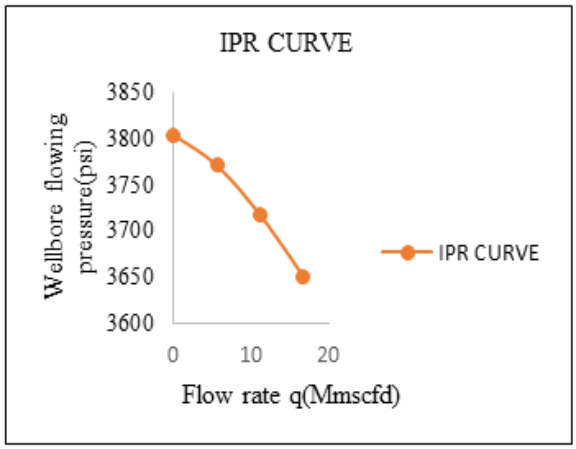

Figure 1: Inflow Performance Curve

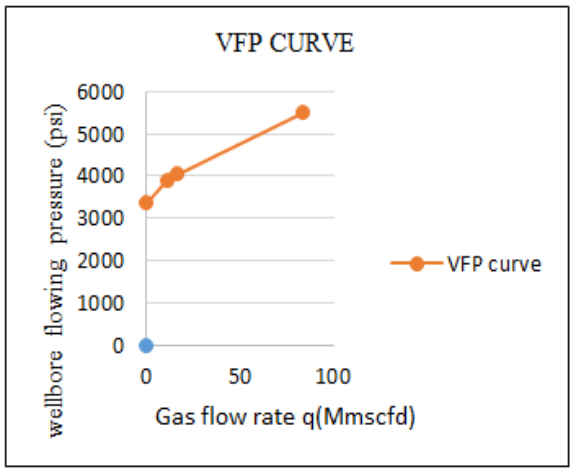

Figure 2: Vertical Flow Performance

c) Optimal gas flow rate

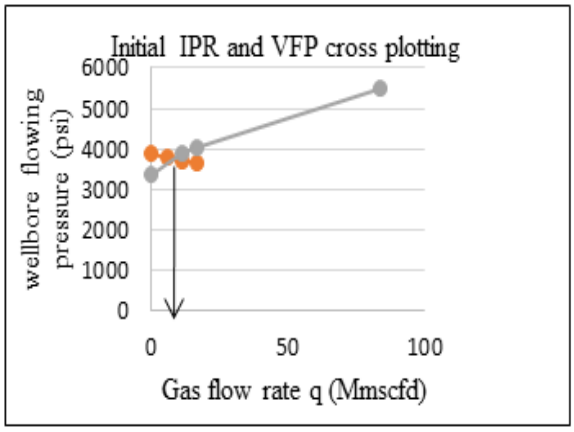

Figure 3: Optimal Gas Flow rate

b) Improve IPR curve

Now, using equation (1) and equation (2) and calculating with respective value of necessary parameters the following graphs are obtained.

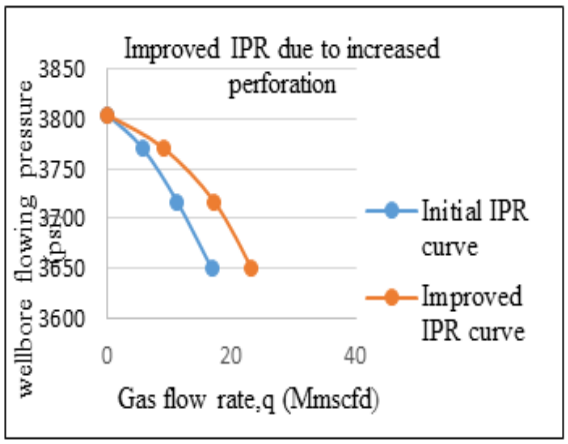

Figure 4: Improved IPR due to increased perforation height

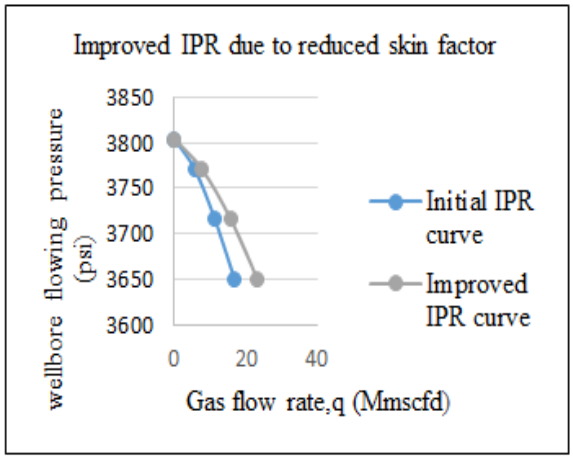

Figure 5: Improved IPR curve due to reduced skin

c) Improved VFP curve

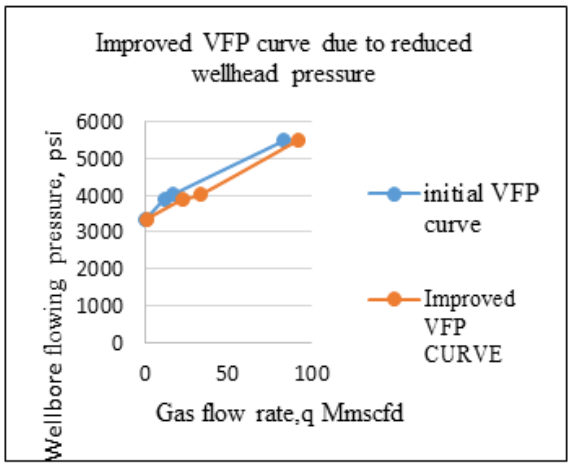

Figure 6: Improved VFP due to reduced wellhead pressure

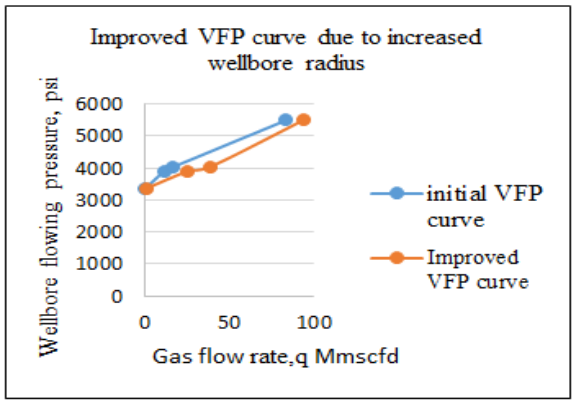

Figure 7: Improved VFP due to increased wellbore radius

d) Cross plotting of Improved IPR and VFP curve

Considering cross plotting of improved IPR due to increased perforation height and improved VFP due to reduced wellhead pressure the resultant optimal flow rate is shown in the following graph

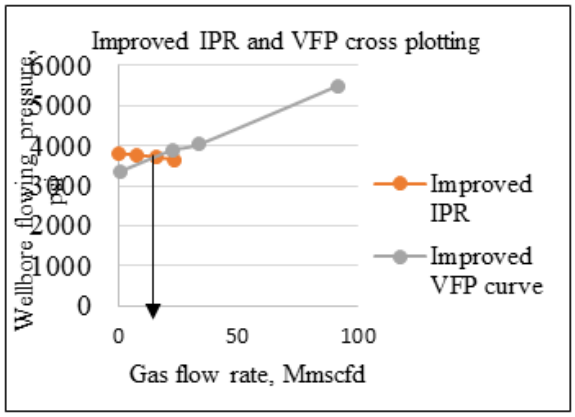

Figure 8: Optimized Gas Flow rate.

Now, considering cross plotting of improved IPR due to reduced skin factor and improved VFP due to reduced wellhead pressure the resultant optimal flow rate is shown in the following graph

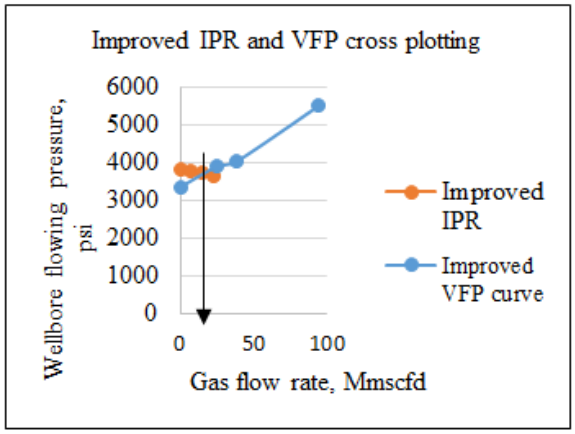

Figure 9: Optimized Gas Flow Rate

Now, considering cross plotting of improved IPR due to reduced skin factor and improved VFP due to increased wellbore radius the resultant optimal flow rate is shown in the following graph

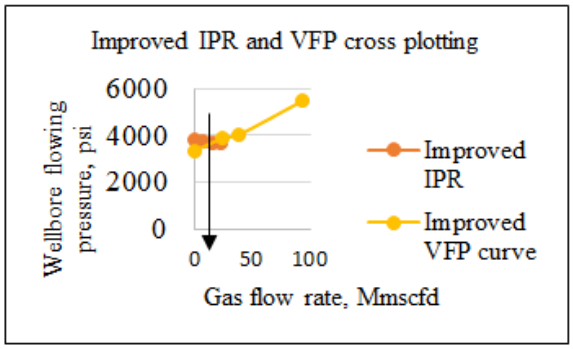

Figure 10: Optimized Gas Flow Rate

Considering cross plotting of improved IPR due to reduced skin factor and improved VFP due to increased wellbore radius the resultant optimal flow rate is shown in the following graph

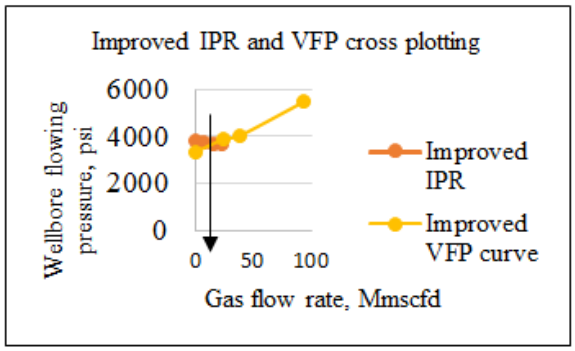

Figure 11: Optimized Gas Flow Rate

So, the above figures show the optimal gas flow rate of Meghna Gas Field and also the optimized gas flow rate.

As, it is seen that the production rate of Meghna Gas Field is nearly 13 MMscd. Which is also show in the cross plotting of IPR and VFP curve. Since, there are some factors that greatly affect the performance of reservoir and well. As a result the typical IPR and VFP also changed.

From the above figures we have seen that if perforation height is increased that the IPR curve shift right and also reduced skin factor shifts the IPR curve rightward. In the case of VFP increased wellbore radius and reduced wellhead pressure shift the VFP curve upward.

And the improved IPR and VFP curves give a new optimal production rate which is higher than the previous one in every case. The optimized production rate is forecasted as approximately 20 MMscd.

V. CONCLUSION

All the calculations corresponding to IPR and VFP analysis and other factors are done theoretically and manually. So simulation software has been used for this study work. All the calculations and other works are done theoretically and manually so the work is not absolutely accurate. Simulation work would give a more accurate result than this study. After analyzing IPR and VFP curves this study represents that the gas production rate increased if the reservoir and well behavior as well as the performance can be improved. After analyzing IPR curve which is a function of reservoir performance the following factors must be improved to enhance the reservoir performance as well as deliverability

1. Perforation height
2. Wellbore flowing pressure
3. Skin factor

After analyzing VFP curve which is a function of well performance the following factors must be improved to enhance the well performance as well as deliverability

1. Wellhead pressure
2. Wellbore radius

The resultant generalization indicates that the gas production rate of Meghna gas field can be optimized to a beneficial amount by the following considerations

1. Increasing perforation height
2. Reducing skin factor
3. Reducing wellhead pressure
4. Increasing wellbore radius

REFERENCES

[1] Badrul Imam, ENERGY RESSOURCES OF BANGLADESH, second edition, ch.3, pp 41-43.

[2] Petrobangla, "Annual Report-2016", pp-22.

[3] Badrul Imam, ENERGY RESSOURCES OF BANGLADESH, second edition, ch.3, pp. 132-133.

[4] Michael J. Economides, A. Daniel Hill, Christin Ehlig-Economides, Ding Zhu, PETROLEUM PRODUCTION SYSTEM, second edition, ch.9, pp. 255-256.

[5] John Lee, Robert A. Wattenbarger, Gas Reservoir Engineering, SPE textbook series, vol. 5.