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# Optimal Productivity Index from Gas Pay Zones with FAF Test

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***Abstract:*** ***Gas Condensate reservoirs are hydrocarbon liquid dissolved in saturated natural gas that comes out of solution when the pressure drops below the dew point. Condensate liquid saturation can build up near a well because of draw down below the dew point pressure, ultimately restricting the flow of gas. This phenomenon is called as "condensate blockage or banking". This improves the mobility of the gas with respect to the oil. If the gas does not have sufficient energy to carry the liquid to surface, then "liquid loading" in the wellbore occurs. If liquid falls back down the wellbore, the liquid percentage will increase and may eventually restrict the production that at this time. Besides, water-shutoff treatments in gas wells suffering from water influx are to reduce water production. In this paper it has been concluded that Artificial Lift technologies as the best selection in gas condensate reservoirs for more CGR recovery method can be used to solve this problem. To help this matter, as well, the Flow After Flow (FAF) well testing has been done for a gas condensate reservoir data to obtain some important outputs.***

***Keywords: Gas Condensate Reservoirs, Condensate Banking, Liquid Loading, FAF test.***

## I. INTRODUCTION

Natural gas production has become increasingly important throughout the world. So, it is important to emphasize gas reservoir engineering science. Although much of the technology for oil wells applies to gas wells, there are still many differences. It is pivotal to heed these discrepancies and to have a good and fundamental background in how to recognize and handle them. It is presented the best known solutions to all problems in this area of technology. A gas condensate is a single-phase fluid at original reservoir conditions. Gas condensate fluid are termed retrograde because their behavior can be the reverse of fluids comprising pure components. As reservoir pressure declines and passes through the dew point, liquid forms and the amount of liquid phase increases with pressure drop and as pressure continues to decline, the liquid re-vaporizes. Fluid composition is determined by capturing a representative sample of reservoir fluid. Surface samples can be obtained relatively easily by collecting liquid and gas samples from test or production separators.

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Samples can also be collected down-hole from wellbore fluids in gas condensate reservoirs, of course when wellbore flowing pressure is above the dew point pressure. Determining the fluid properties plays a particularly vital role in gas condensate reservoirs such as "Condensate Gas Ratio" (CGR).These considerations such as the need for artificial lift and stimulation technologies rely on accurate fluid sampling. While production, condensate liquid can be produced into the wellbore. If the gas does not have sufficient energy to carry the liquid to surface, then "liquid loading" in the wellbore occurs. If liquid falls back down the wellbore, the liquid percentage will increase and may eventually restrict the production that at this time, gas lift and pumping (Artificial Lift) technologies can be used to counter this problem. It is important to imply that best artificial lift method for production of increased liquids in the reservoir. Injecting dry gas into a formation to keep reservoir pressure above the dew point slowly displaces valuable heavy ends that are still in solution in the reservoir gas [1,4]. In this paper, the Production Technology and Well Testing of Gas Condensate reservoirs to reach to Open Flow Capacity with its problematic issues have been scrutinized and elucidated perfectly. For example, in year 2004, F.R. Wassmuth (Alberta Research Council) et al. SPE-89403-Pa studied about the Water Shutoff in Gas Wells: Proper Gel Placement is the Key to Success. In year 2007, Nampetch Yamali (U. of Texas Austin) et al. SPE-106640-MS studied about the Optimum Control of Unwanted Water Production in Gas Reservoirs.

## II. MATERIALS AND METHODS

Artificial Lift technologies and after that an optimum EGR recovery method can be used to solve the problematic issues. As well, in this paper, the Flow After Flow (FAF) well testing has been done for the gas reservoir data to obtain Open Flow Capacity. Miscible gas (N2-CO2-C1) injection in fractured gas condensate reservoirs can cause more condensate recovery and more decreasing of the accumulated condensate saturation in comparison to natural depletion and immiscible gas injection scenarios. In both miscible and immiscible gas injection scenarios, injection at higher pressure that less condensate is accumulated in the matrix block causes more condensate recovery. Productivity enhancement depends greatly on well and reservoir parameters such as horizontal well lengths, well placement, reservoir permeabilities and … Besides, the objectives of water-shutoff treatments in gas wells suffering from water influx are to reduce water production and, at the same time, increase gas-production rates and producible gas reserves. Further efforts focused on improving gel placement in both fractured and matrix reservoirs to improve the treatment efficiency.

## III. RESULTS AND DISCUSSION

Generally, different gas types are as the following table1:

**Table 1. Gas types in Gas Engineering**

Typical Components of Industry Streams

| | Components | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ | $H_2S$ | $N_2$ | $C_1$ | $C_2$ | $C_3$ | $iC_4$ | $nC_4$ | $iC_5$ | $nC_5$ | $C_6$ | $C_{7+}$ |
| Inert Gas | • | | • | | | | | | | | | |
| Acid Gas | • | • | | | | | | | | | | |
| LNG | | | • | • | • | • | • | • | | | | |
| Natural Gas | • | • | • | • | • | • | • | • | • | • | • | • |
| LPG | | | | | • | • | • | • | | | | |
| Natural Gasoline | | | | | | • | • | • | • | • | • | • |
| NGL | | | | | • | • | • | • | • | • | • | • |
| Condensate (Stabilized) | | | | | | | • | • | • | • | • | • |

It was implied that gas lift and pumping (Artificial Lift) technologies may be able to work out the problem of Condensate Banking in gas wells. Now in the following there is a terse definition for Artificial Lift methods selection: Sucker Rod Pump (SRP), Progressive Cavity Pump (PCP), Electric Submersible Pump (ESP), Hydraulic Pump (HP), Gas Lift.

Each of the above Artificial Lift methods have different situation applications. Artificial lift is defined as a system that adds energy to the wellbore fluid column with the objective of initiating and enhancing production from the well. Artificial lift is needed when reservoir drives do not sustain acceptable rates or cause fluids to flow at all in some cases. Lift processes transfer energy down hole or decrease fluid density in wellbore to reduce the hydrostatic load on formation. Artificial lift systems use a range of operating principles, including pumping and gas lifting.

Then in tertiary recovery step of production technology an optimum EGR recovery method can be used to solve the problems.

MCDM refers to making decisions in the presence of multiple, usually conflicting criteria. The problems of MCDM can be broadly classified into two categories: Multiple Attribute Decision Making (MADM) and Multiple Objective Decision Making (MODM), depending on whether the problem is a selection problem or a design problem. MODM methods have decision variable values that are determined in a continuous or integer domain, with either an infinitive or a large number of choices, the best of which should satisfy the decision maker's constraints and preference priorities. MADM methods, on the other hand, are generally discrete, with a limited number of predetermined alternatives.

ELimination Et Choix Traduisant la REalité (ELECTRE) model or method is one of the most prevalent Multi Criteria Decision Making (MCDM) methods. MCDM is an approach employed to solve problems involving selection from among a finite number of criteria. An MCDM method specifies how attribute information is to be processed in order to arrive at a choice. In addition, the Flow After Flow (FAF) well testing has been done for the gas reservoir data to obtain a high Productivity Index in the following analysis:

**Table .2 A few Data for a Gas Reservoir [Schlumberger]**

| **Reservoir Description** | | | |
|---|---|---|---|
| **Quantity** | **Value** | **Quantity** | **Value** |
| **h** | 300 ft | **So** | 0.0 |
| **NTG** | 1.0 | **Sw** | 0.0 |
| **ϕ** | 10.0 % | **Sg** | 1.0 |
| **Top depth** | 6000 ft | | |
| **RFT-pressure** | 5000 psia | **at** | 6000 ft |
| **Well Data** | | | |
| **Quantity** | **Value** | **Quantity** | **Value** |
| **Orientation** | Vertical-gas | **Top of Perf** | 6000 ft |
| **$r_w$** | 0.3 ft | **Bottom of Perf** | 6300 ft |
| **Fluid Properties (dead oil)** | | | |
| **Quantity** | **Value** | **Quantity** | **Value** |
| **$\mu_g$** | 0.025 cp | **$\rho_g$** | 0.001 g/cc |
| **$C_g$** | 1.35E-4 /psi | **T** | 212° F |
| **$B_g$** | 0.0038 | | |

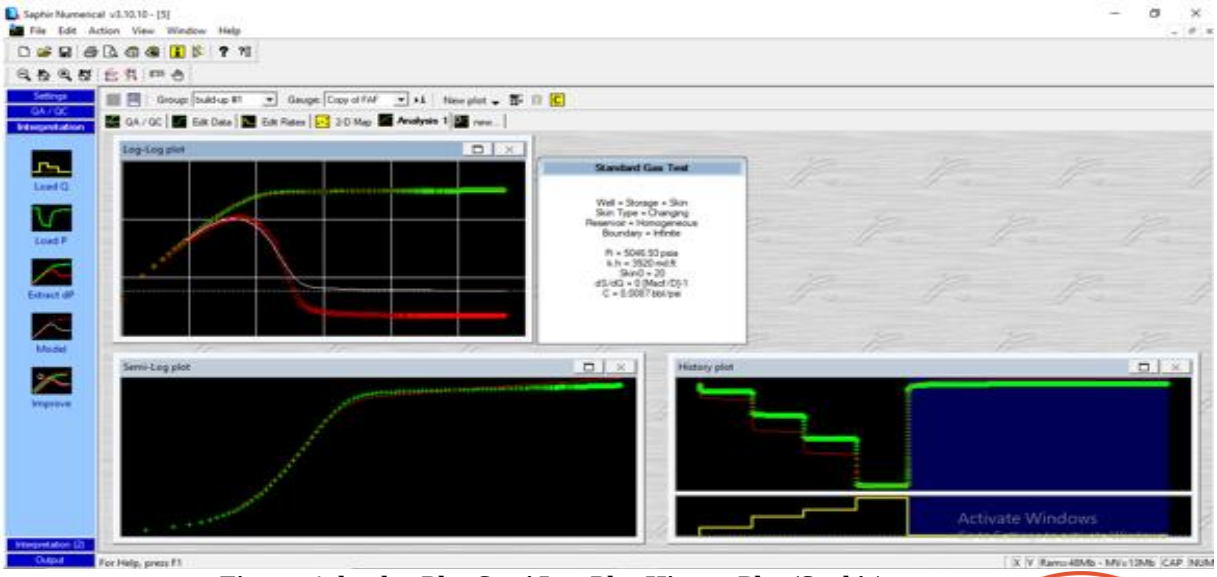


**Figure: 1. log-log Plot-Semi Log Plot-History Plot (Saphir)**

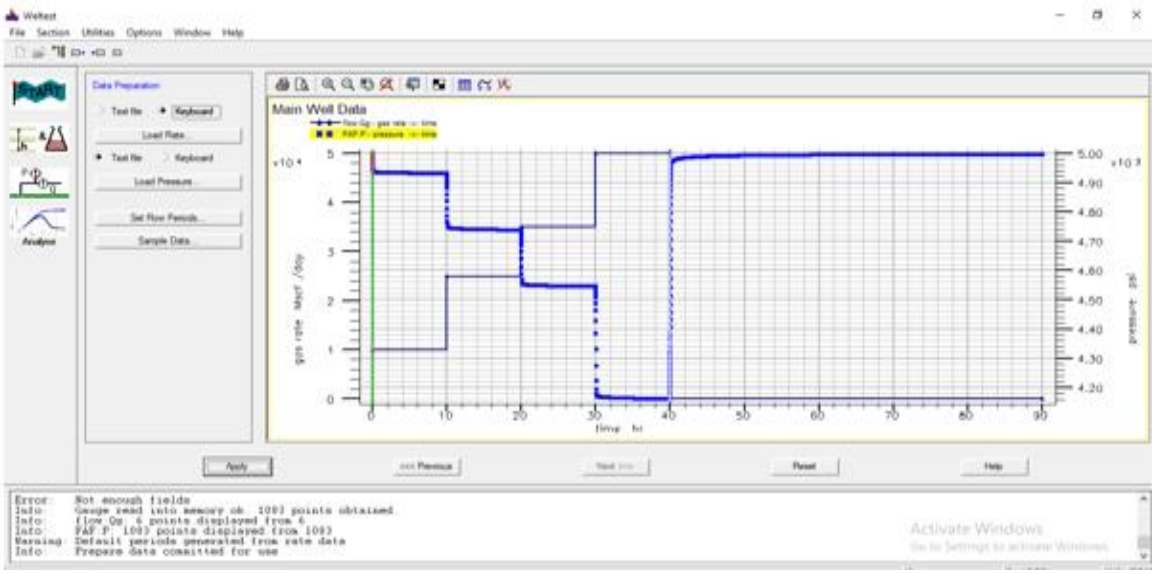


**Figure: 2. History plot (WT200)**

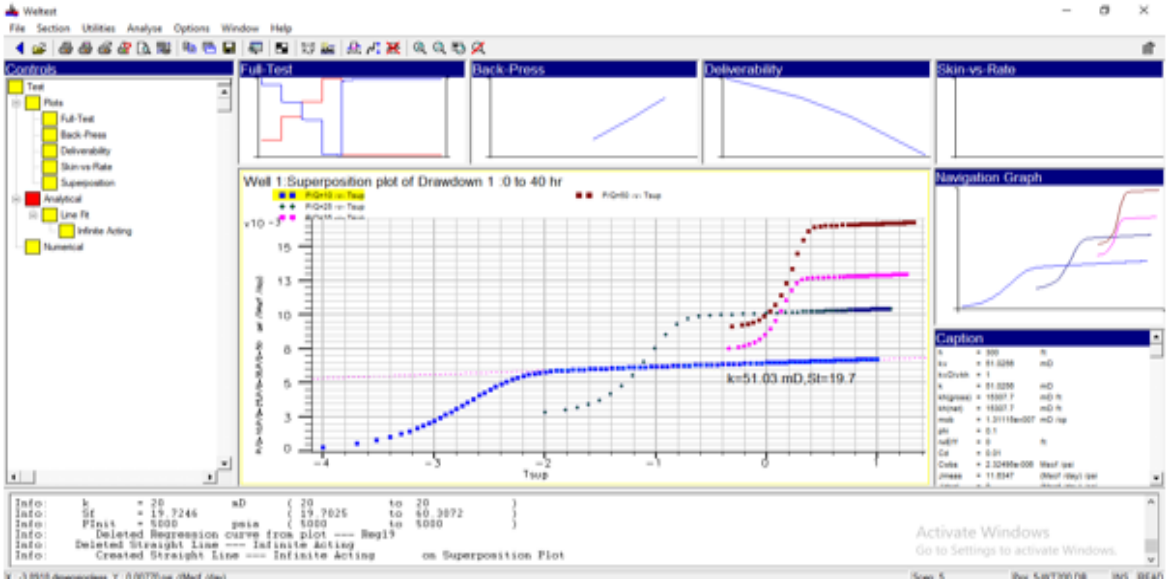


**Figure: 3. log-log plot (WT200)**

**Outputs:**
**K=51.03 md**
**S=19.7**
**Cd=0.01**
**Mobility= 1.3E007 md/cp**
**Productivity index=PI=J=11.92 (Mscf/day)/psi**

Condensate liquid saturation can build up near a well because of draw down below the dew point pressure, ultimately restricting the flow of gas. This phenomenon is called as “condensate blockage or banking”. Both the liquid and gas around the wellbore change in composition. The liquid becomes heavier and the gas becomes leaner. Viscosity of the liquid becomes higher and viscosity of the gas becomes lower with production. This improves the mobility of the gas with respect to the oil. While production, condensate liquid can be produced into the wellbore. If the gas does not have sufficient energy to carry the liquid to surface, then “liquid loading” in the wellbore occurs.

About the Optimum Control of Unwanted Water Production in Stratified Gas Reservoirs, it should be noticed that minimizing production of water from gas reservoirs is one of the main strategies for enhancing primary hydrocarbon production. Advances in intelligent well technology and simulation of reservoir-production system enable optimum inflow allocation of produced fluids by controlling perforations and valve settings. Water coning in naturally fractured gas reservoirs often results in excessive water production which can kill a well or severely curtail its economic life due to water handling costs. Water may be able to cone significant vertical distances (250 m) with coning exacerbated by a larger aquifer, higher production rates, and a smaller vertical distance between perforations and the gas-water contact among others. However, in all cases, the ultimate gas recovery was not significantly affected. This paper presents the application inorganic gels to control water production. In naturally fractured reservoirs as a case study with hostile high temperatures (260-310 F) found in the Cretaceous and Jurassic dolomitic limestone's of the south east of Mexico is presented together with a water exclusion case from the tertiary sandstones.

The objectives of water-shutoff treatments in gas wells suffering from water influx are to reduce water production and, at the same time, increase gas-production rates and producible gas reserves.

## IV. CONCLUSIONS

1. In this paper it has been concluded that gas lift and pumping (Artificial Lift) technologies and after that an optimum EGR best selection in gas condensate reservoirs for more CGR recovery method can be used to solve this problem. As well, the Flow After Flow (FAF) well testing has been done for a gas reservoir data to obtain Open Flow Capacity (OFC).
2. Condensate liquid saturation can build up near a well because of draw down below the dew point pressure, ultimately restricting the flow of gas. This phenomenon is called as “condensate blockage or banking”.
3. It was implied that gas lift and pumping (Artificial Lift) technologies may be able to work out the problem of Condensate Banking in gas wells. Now in the following there is a terse definition for Artificial Lift methods selection: Sucker Rod Pump (SRP), Progressive Cavity Pump (PCP), Electric Submersible Pump (ESP), Hydraulic Pump (HP), Gas Lift.
4. Both the liquid and gas around the wellbore change in composition. The liquid becomes heavier and the gas becomes leaner. Viscosity of the liquid becomes higher and viscosity of the gas becomes lower with production. This improves the mobility of the gas with respect to the oil. While production, condensate liquid can be produced into the wellbore. If the gas does not have sufficient energy to carry the liquid to surface, then “liquid loading” in the wellbore occurs.
5. The objectives of water-shutoff treatments in gas wells suffering from water influx are to reduce water production and, at the same time, increase gas-production rates and producible gas reserves. Further efforts focused on improving gel placement in both fractured and matrix reservoirs to improve the treatment efficiency.

## DECLARATION STATEMENT

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| Authors Contributions | All authors having equal contribution for this article. |

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