IATMI22-111

PVT Quality Control Data On Retrograde Reservoir Fluid For Compositional Fluid Modeling

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Abstract. Quality control of PVT data from laboratory measurements needs to be done before the data is used for fluid models. PVT data with good quality will help in the validity of the fluid model. Quality control is done by calculating the Gas Oil/Condensate Ratio and STO Oil/Condensate Density on the model based on the composition of the hydrocarbon fluid. The calculation results are then compared with the prices of the Gas Oil/Condensate Ratio and STO Oil/Condensate Density measurement results. Then these results are used as the basis for making fluid models. To validate, this fluid model is used to create a well model for calculating vertical lift performance. Quality Control results show that there is a discrepancy in the GOR parameter of 27%, with a tolerance of 10%. For STO oil/condensate density of 0.08 gr/cc with a tolerance of 0.02 gr/cc. Because the results of the discrepancy are above the tolerance limit, adjustments are made by making a composition gradient that is adjusted to the GOR from laboratory measurements of 43411 SCF/STB. The results of the calculation of vertical lift performance obtained good results, with the difference to the slickline measurement data, the average is below 2%. This result is much better than the results of the well model using the black oil model. This paper describes the fluid model validation method by integrating several other supporting data in addition to only laboratory measurements.

Keyword(s): PVT; Retrograde Reservoir; Compositional Fluid Modeling

1 Introduction

In some cases, reservoir fluid measurements in the laboratory encounter problems when modeled in simulations. One of the obstacles faced is the difficulty of obtaining a representative fluid model with measurement results in the laboratory. Especially when the measurements get results that are not linear with the thermodynamic equations that should apply. This measurement discrepancy can be caused by several factors such as sample conditioning, sampling time, and sample treatment during measurement. Therefore, it is necessary to quality control the results of fluid sample measurements in the laboratory. Quality control is carried out with the help of software that can calculate thermodynamic equations under various pressure and temperature conditions with a database of fluid composition measurements. The fluid composition of the measurement results is used as input data to calculate the physical properties of the fluid, especially GOR and Specific Gravity. If the GOR results in the model calculations are by the measurement results, then the fluid modeling process can be continued.

Ideally, if the fluid composition measurement is correct, the minimum GOR results in the model calculation will be appropriate, and the rest can be adjusted.

2 Quality Control

Quality Control is carried out on two fluid samples, from different wells, but in the same reservoir. The wells are Gabriela-1 Well, and Anastasya-2 Well, in the Taurus Reservoir. There are two samples in the Gabriela-1 well, namely the DST-1 sample and the DST-2 sample. In Anastasya-2 Well, there is one fluid sample, namely DST-1. The conditions and time of sampling can be seen in Table 2-1.

Table 1. Sampling Time and Condition

Reservoir	Well	Sampel	Sampel Date	TVD, ft	Formation	Initial Pressure, Psig	Bubble Point, Psig	Dew Point, Psig	Fluid Analysis
Taurus	Gabriela-1	DST-1	18-Apr-07	5966	Mentawa	2926	2926		Oil/Condensate
		DST-2	25-Apr-07	6542		2865.6		2622	Gas-Condensate
	Anastasya-2	DST-1	31-Mar-14	6156		2891.7			Gas-Condensate

Quality control is carried out through several steps. When referring to standard laboratory operations, recombination of the two fluid phases is carried out in each sample. This also applies when done with modeling. From the results of the recombination, the results of composition of the fluid from the recombination are obtained, and then the physical properties are calculated. The calculation results of the recombination fluid in the laboratory are then compared with the calculation of the recombination fluid in the model. Quality control is carried out using the PVTSim software. These steps can be seen in the flow chart in Figure 1. The result of Quality Control can be seen in Figure 2. and Table 1.

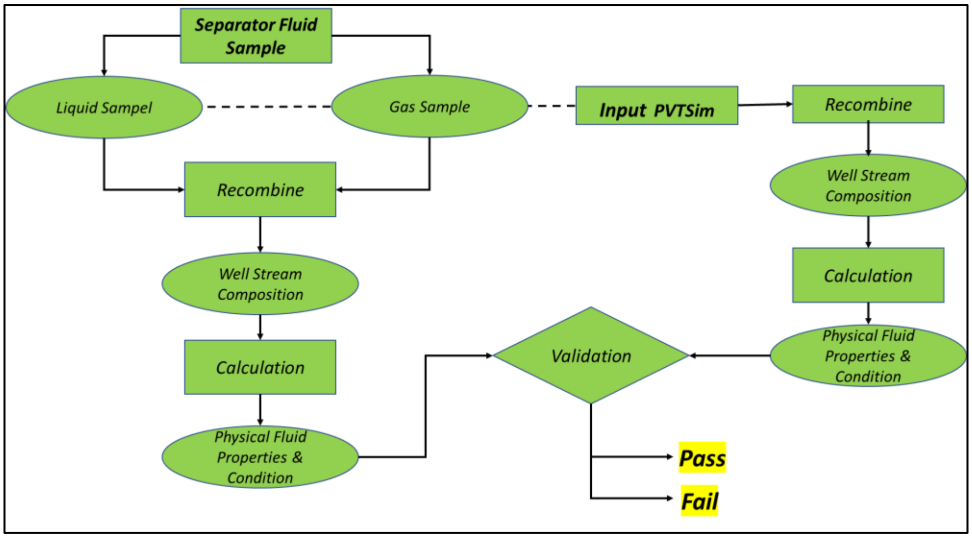

Figure 1. Flow Chart of Quality Control

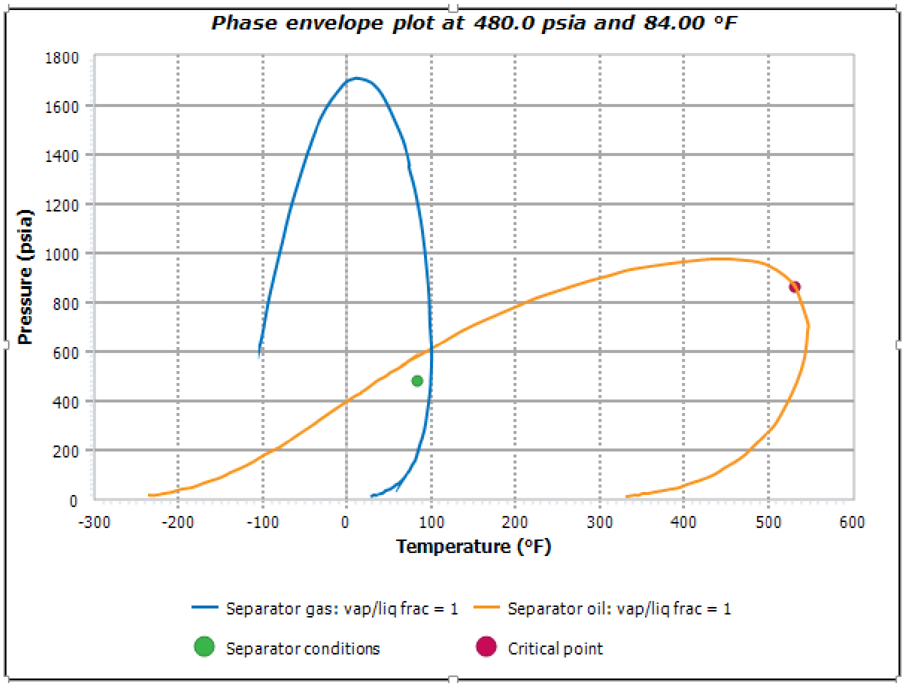

Figure 2. Quality Control Result

Table 2. Quality Control Result For All Sample

No	Parameter	Sampel DST-1 Gabriela-1 Deviation	Sampel DST-2 Gabriela-1 Deviation	Sampel DST-1 Anastasya-2 Deviation	Tolerance
1	Separator GOR	99.33 %	27.06 %	296.12 %	±10 %
2	STO Oil Density	0.0696 g/cm³	0.0824 g/cm³	0.8371 g/cm³	±0.02 g/cm³
3	Separator Condition	97.25 %	24.39 %	88.31 %	20 %
4	K-Factor	0.18	0.13	0.14	0.01
5	Separator Oil Saturation Pressure	22.98 %	17.92 %	84.69 %	±10 %

Based on the results of Quality Control, the three samples showed results that were far from the tolerance value for fluid modeling. The equilibrium point also does not intersect the phase diagram lines in the gas phase and the condensate/liquid phase. Ideally, it can be sampled again. However, the sampling process requires a lot of time. In addition, sampling in reservoirs that have been in production for a long time, the sample conditions are often difficult to bring at initial conditions. Therefore, the best solution for fluid modeling in the Taurus Reservoir is the extent to which existing fluid samples can be optimized with several approaches and validations.

3 Result, Analysis, And Validation

The GOR separator is a key parameter in the quality control of fluid data. This is because the GOR in the separator condition describes the conditions at the time of sampling. This means that the division of the gas phase and the oil phase based on the fluid composition from light to heavy must remain correct after recombination. Likewise for the fluid model to be made. As far as possible when the sample data in the liquid phase and the sample data in the gas phase are recombined in the software, they must match the GOR for measurements in the laboratory. Based on the results of the first quality control, it was decided to use the DST-2 sample from the Gabriela-1 Well, because it has the smallest deviation from the results of laboratory measurements. After obtaining the composition of the recombination fluid, then adjustment of the composition is carried out to obtain the appropriate GOR according to the measurement results. Then the composition of the new recombination fluid is obtained. In addition, adjustments were made to the Specific Gravity Condensate data. This process is assisted by PVTP software. To prove that the modification results are correct, the modified composition results are inputted into the PROSPER software for making well modeling. The results show that during VLP Matching the results after the modification gets better results than those before the modification. The analysis process, results, and validation can be described in Figure 3. and Figure 4.

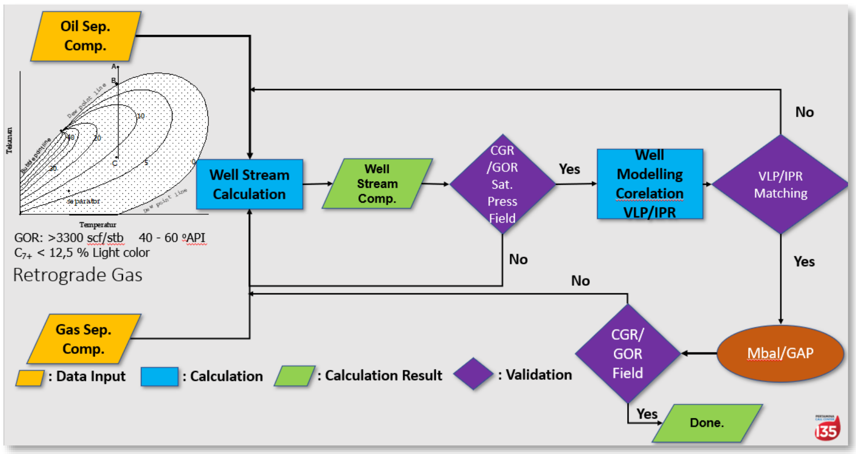

Figure 3. Flowchart PVT Validation

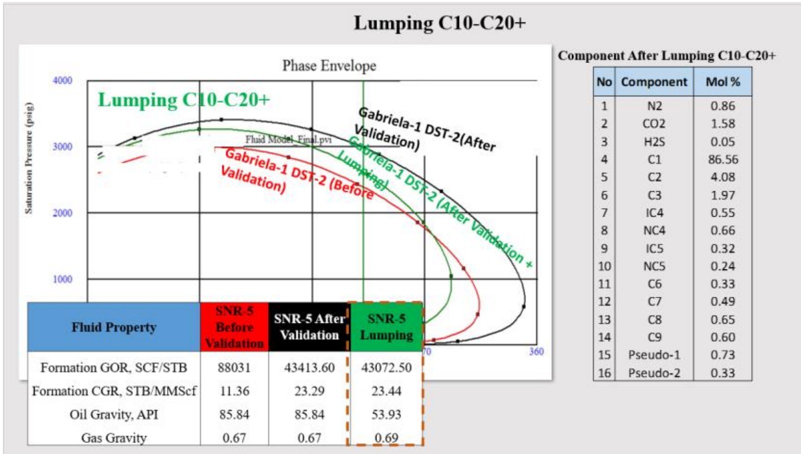

Figure 4. Phase Diagram After Validation, Lumping, And Calculation

4 Result

The final result of the analysis and validation is evidenced by the results of using PVT data after quality control and validation for the VLP Matching process in the well as shown in Figure 5. And Table 3.

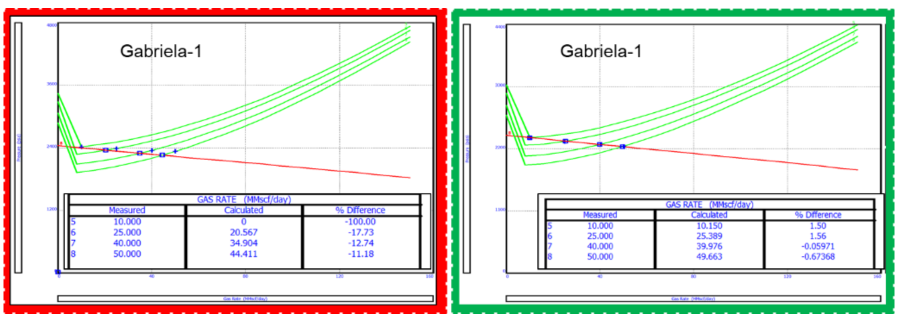

Figure 5. VLP Matching Before and After Validation

Table 3. Deviation Standard of VLP Matching For All Well

Well	Gas Rate Before Slickline 2019 @ 8 MMScf Before Validation (%Deviation)	Gas Rate Before Slickline 2019 @ 8 MMScf After Validation (%Deviation)
Gabriela-1	100%	1.30%
Gabriela-5	7.80%	2.30%
Gabriela-7	53%	1.04%
Gabriela-8	48.69%	1.26%
Gabriela-9	100%	1.26%
Gabriela-10	38.92%	1.71%
Anastasya-1	21.60%	1.62%
Anastasya-2	4.29%	0.82%
Anastasya-3	57.41%	0.69%
Anastasya-4	3.94%	1.10%
Anastasya-5	11.48%	0.98%

The results of the validation are then carried out by quality control by comparing the results with quality control before being validated showing better results as shown in Table 4.

Table 4. Quality Control Comparison

No	Parameter	Sampel DST-2 SNR-5 Deviation Before Validation	Sampel DST-2 SNR-5 Deviation After Validation	Tolerance
1	Separator GOR	27.06 %	4.48 %	±10 %
2	STO Oil Density	0.0824 g/cm³	0.0107 g/cm³	±0.02 g/cm³
3	Separator Condition	24.39 %	24.45 %	20 %
4	K-Factor	0.13	0.06	0.01
5	Separator Oil Saturation Pressure	17.92 %	17.99 %	±10 %

5 Conclusion

1. PVT data validation can be done by integrating various other data to obtain a representative fluid model

2. Validation results can improve the VLP matching deviation in the well model until it is less than 2 %

3. This validation method produces good quality control results with a standard deviation of separator GOR below 5% and by the tolerance standard

6 Reference

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