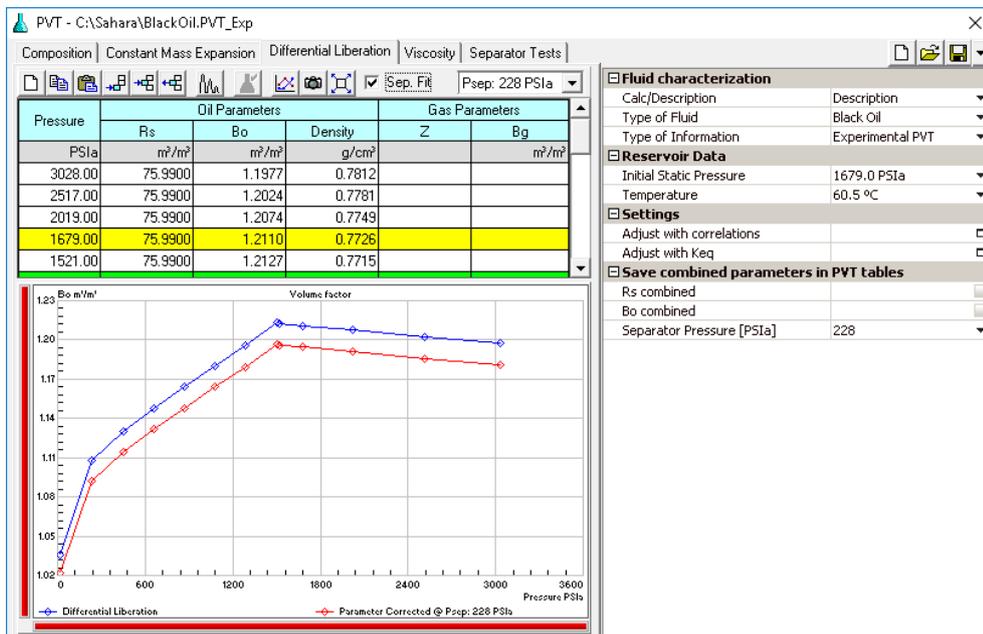


# PVT ANALYSIS AND COMPOSITIONAL SIMULATOR

PVT studies have been developed to obtain the parameters needed to describe the behavior of the fluids under different pressure, temperature and composition conditions.

Sahara allows obtaining these PVT parameters in different ways depending on the type of fluid studied and the available data. PVT tables can be generated using correlations or importing external data. It is also possible to load data from an analysis performed in the laboratory, for validation purposes.

If a laboratory PVT analysis has been loaded, the Compositional Simulator can be used to calculate all the PVT parameters from the equilibrium constants at any pressure, establishing only two parameters: the convergence pressure and a density factor.



**The tool offers the possibility of generating tables with PVT parameters. They can be used in other tools within Sahara to take into account the variations that occur when considering different conditions of pressure and temperature.**

**Sahara**

The Sahara PVT tool offers different ways to obtain PVT parameters depending on the type of fluid being studied, and to select the most appropriate calculation option according to the information available.

If the option chosen is to perform the calculation with correlations, it is necessary to determine the pressure domain in which the PVT parameters are to be obtained. There is a function that helps generate this range based on the maximum and minimum values, by determining the interval. Additionally, it is required to load some data associated with the fluid and to select a correlation for the calculation of each parameter.

If the option to load external data is chosen, parameter values at different pressures can be loaded so they can be used later in another Sahara tool.

Type of fluid	Type of information		
	Experimental	Correlation	External Data
Black Oil	✓	✓	✓
Volatile Oil	✓		
Dry Gas		✓	✓
Wet Gas		✓	✓
Gas Condensate	✓	✓	✓
Water		✓	✓

**Sahara proposes a wide variety of correlations available for each parameter, according to the type of fluid selected, which can be used in the PVT table generation.**

The screenshot shows the Sahara PVT software interface. The main window displays a table of PVT parameters and a graph of Gas deviation factor vs Pressure. The fluid is characterized as Gas Condensate.

Pressure	Zg	Bg	Mug	Z2p
361.93	1.0123	0.0041	0.0351	1.0123
264.70	0.9043	0.0050	0.0278	0.9258
200.00	0.8570	0.0062	0.0229	0.8533
150.00	0.8468	0.0082	0.0193	0.7996
100.00	0.8695	0.0126	0.0164	0.7479
50.00	0.9240	0.0264	0.0144	0.6982
14.70	0.9752	0.0904	0.0135	0.6644

The graph shows Gas deviation factor (Zg) on the y-axis (ranging from 0.6 to 4.8) and Pressure (kg/cm²) on the x-axis (ranging from 0 to 3000). The data points show a decreasing trend in Zg as pressure increases.

The Fluid characterization panel shows the following settings:

- Calc/Description: Description
- Type of Fluid: Gas Condensate
- Type of Information: Correlations
- Reservoir Data: Initial Static Pressure: 9014.7 PSia, Temperature: 274.0 °F
- Gas Condensate Data: Retrograde Dew Point Pressure: Correlation, Correlation: Marrufo et al., %C7+: Correlation
- Pseudocritical Properties: Specific gravity
- Nº Separators: 2 + Stock tank
- Stock Tank Oil Density: 54.8 API
- Separator Nº 1 Gas Density: 0.676 [air=1]
- Separator Nº 2 Gas Density: 1.015 [air=1]
- Stock Tank Gas Density: 1.568 [air=1]
- Enter: Rates
- Qg Separator Nº %1%: 888.0 Mcft/d
- Qg Separator Nº %2%: 51.5 Mcft/d
- Qg Tank: 12.8 Mcft/d
- Qliq Tank: 100.00 bbl/d
- Impurities Unit: %
- N2: 0
- CO2: 0
- H2S: 0
- Gas Condensate correlations: Z: Hall & Yarborough, Mug: Lee et al.

**PVT - Calculation with Correlations.** The image shows the PVT window set for the calculation of PVT tables with correlations, for a fluid characterized as Gas Condensate.

The three screenshots show consistency check results for differential liberation and separator tests.

**Differential Liberation Consistency (Left):** Shows a table of measured vs calculated density and difference percentage for various pressures. The maximum error value acceptable for this calculation rounds between 1% and 1.5%.

Pressure [PSia]	Measured Density [g/cm3]	Calculated Density [g/cm3]	Difference [%]
1290.00	0.771	0.777	0.726
1079.00	0.778	0.783	0.645
869.00	0.783	0.787	0.536
659.00	0.788	0.792	0.444
449.00	0.794	0.797	0.367
237.00	0.800	0.803	0.302
14.70	0.808	0.810	0.218
Global	0.771	0.777	0.726

**Differential Liberation Consistency (Middle):** Shows a graph of density vs pressure for various components (N2, CO2, C1-C9, C10). The maximum error value acceptable for this calculation rounds between 1% and 1.5%.

**Separator Tests Consistency (Right):** Shows a graph of Log(KcrP) [Pa] vs Wellbore Function [Pa]. The maximum error value acceptable for this calculation rounds between 1% and 1.5%.

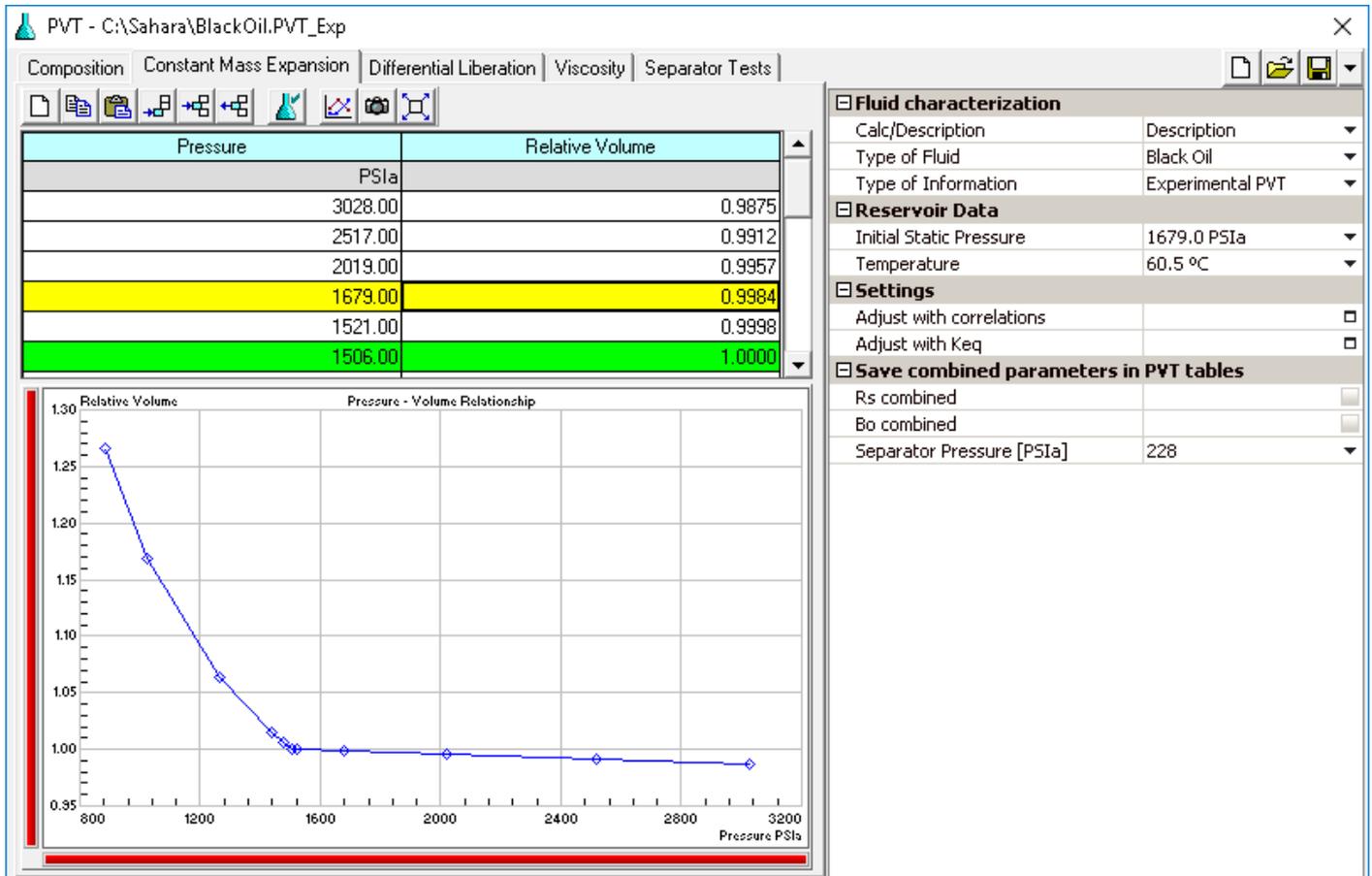
When loading an experimental PVT, it is possible to validate the different types of experiments for each type of fluid. The charts show the consistency check results for the differential liberation test and for the black oil separator tests.

If there is available laboratory information from the different tests performed on the fluid, it can be entered in the PVT window in order to validate the tests and save the information for later use.

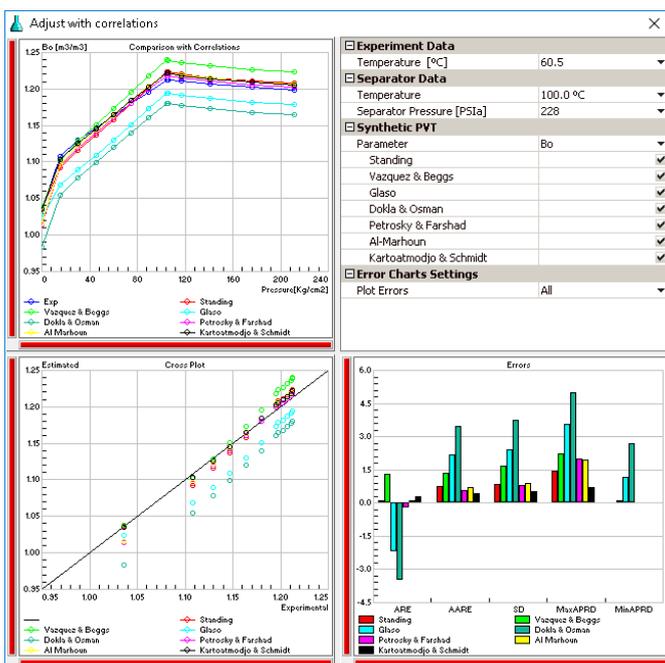
Depending on the type of fluid, the corresponding tests will be enabled and a consistency check can be performed for each of them.

If the fluid studied is oil or gas condensate, the gas composition for each stage, in which gas is liberated, can be entered.

For all the tables, the reservoir initial static pressure will be highlighted in yellow and the bubble or dew point pressure in green, as appropriate.



**PVT - Experimental PVT Load.** The PVT window is set to enter data of an experimental PVT of a fluid characterized as Black Oil, specifically in the Constant Mass Expansion test tab.



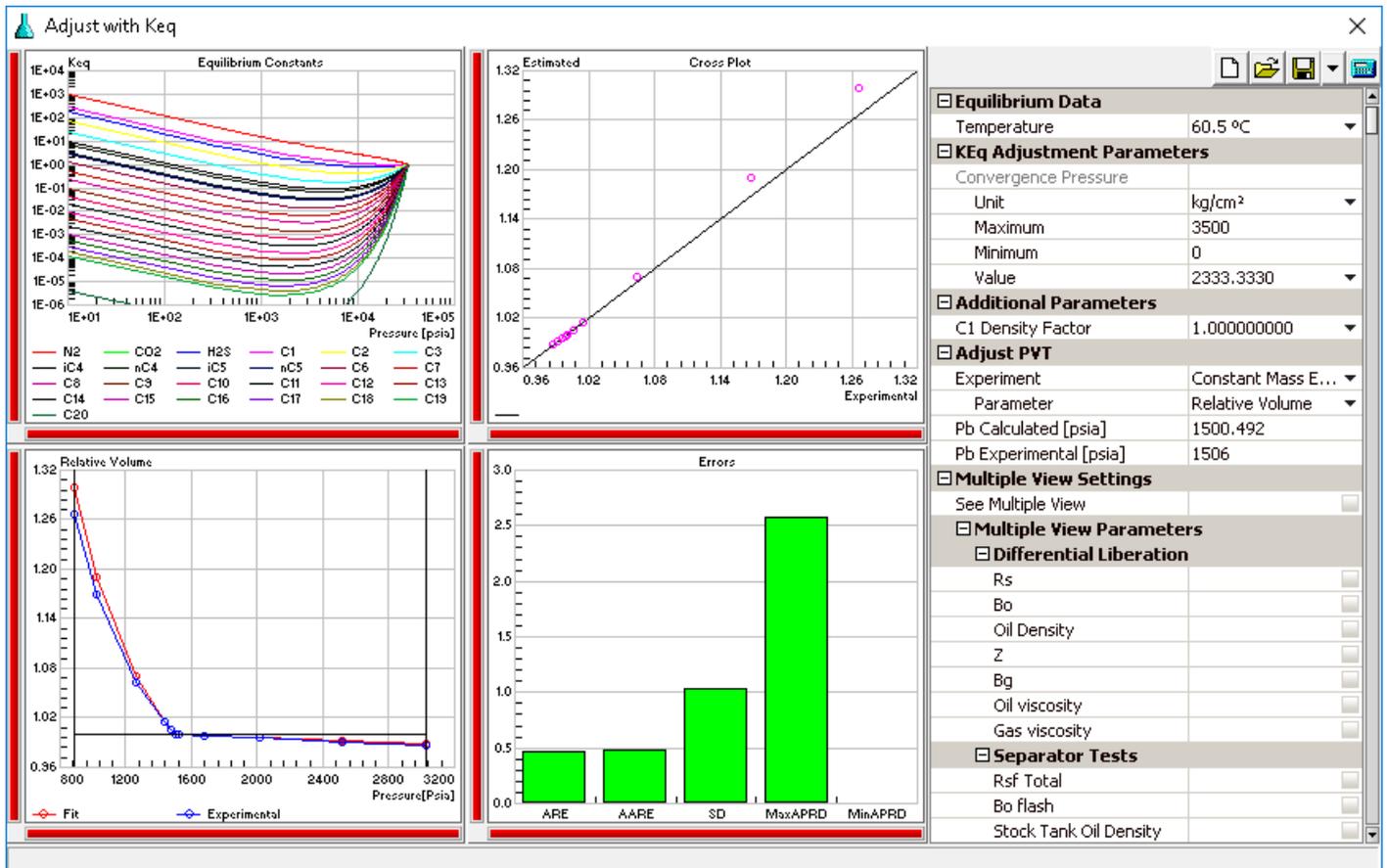
**Adjustment with Correlations.** This is the Adjust with Correlations window for the oil volume factor.

Additionally, if working with an experimental PVT, an adjustment with correlations or an adjustment with equilibrium constants can be made.

If the workflow selected is the Adjust with Correlations option, the most used correlations in the industry will be available for each parameter. It is possible to plot all of them or just a selection for comparison purposes.

A chart will be displayed showing the evolution of the selected parameter based on pressure changes, and another cross-plot chart will compare the experimental value with the estimated value for each of the selected correlations.

A third bar chart will display the different errors of all the correlations used for them to be compared: average relative error, average absolute relative error, standard deviation, maximum and minimum deviation.



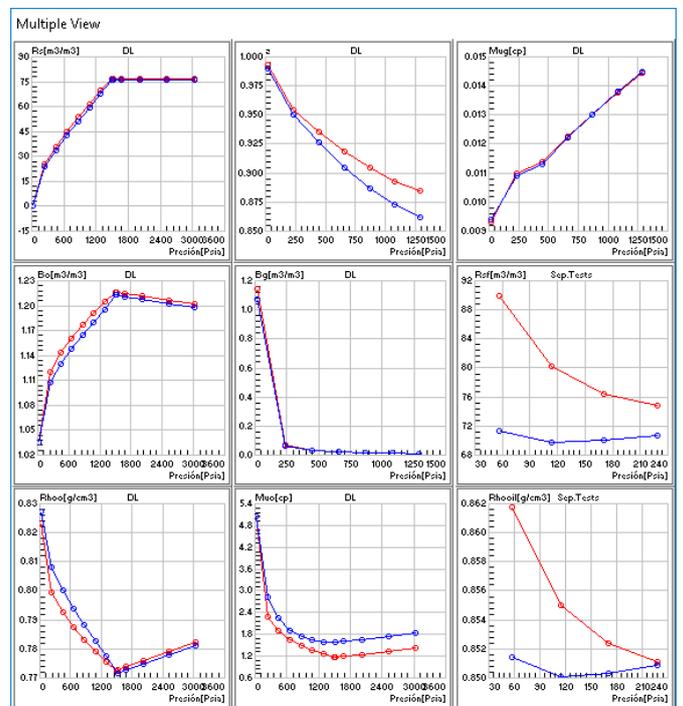
**Compositional Simulator.** A traditional analysis carried out with the compositional simulator is displayed, in which the relative volume calculated in the constant mass expansion test is used as the adjustment parameter.

The compositional simulator is based on the adjustment of the convergence pressure to determine the equilibrium constants, and in this way to get the estimation of the PVT parameters. A methane density factor can be used as an additional parameter for the adjustment.

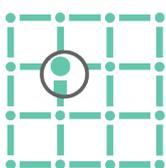
The window shows equilibrium constants charts for each component of the sample based on the pressure, a crossplot comparing the estimated value of the parameter with its experimental value, a comparative chart of the experimental and estimated value of the same parameter selected based on the pressure, and a bar chart comparing different statistics based on the relative percentage deviation of the calculation.

The parameters that have been loaded in the different tests of the PVT analysis can be adjusted using our PVT tool. The Properties table shows the options in each test, along with the parameters that have been loaded in the experimental PVT. An additional window can be used to display simultaneously in multiple charts the experimental values of the parameters and the values obtained when adjusting the convergence pressure.

After making the adjustment, the PVT tables can be saved for later use, as well as the adjustment itself for further work.



**Multiple View Window.** A chart is displayed for each parameter selected in the Compositional Simulator window.



**Argentina**

San Martín 793 2ºA, C1004AAO, Buenos Aires

+54 (11) 5236-0022

**USA**

2925 Richmond Ave Ste 1200, Houston, TX 77098

+1 (713) 840-6036

[www.interfaces.com.ar](http://www.interfaces.com.ar)

[sahara@interfaces.com.ar](mailto:sahara@interfaces.com.ar)

