EXPRO
WELL TESTING & COMMISSIONING

ISO-SPLIT® separators sampling

The techniques currently used in the oil and gas industry for the recombination of surface samples to obtain representative well stream compositions rely on correct measurement of oil and gas rates.

The efficiency of the test separator deteriorates however, with high gas loads. This is a consequence of the carry over of dispersed liquid in the gas phase. This carry over is not normally accounted for in the Gas/Oil Ratio (GOR) measured for the gas and liquid samples.

In a research project performed by Expro for Statoil, it was demonstrated that in the most extreme cases, separator efficiency was less than 50%.

The consequence of such errors in the compositions used for the prediction of reservoir, process and pipeline performance is apparent and should clearly justify a more considered approach to the fluid sampling.

Expro has developed the ISO-SPLIT® isokinetic sampling technique which:

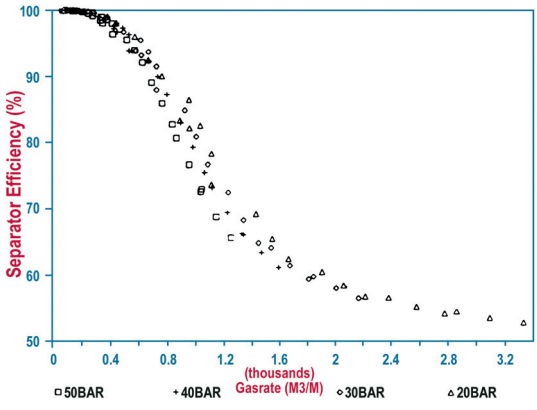
- Enables accurate determination of liquid carry over.
- Provides for a representative well stream composition.
- Is generally applicable over a wide range of GOR's

The technique involves:

- Isokinetic fluid sampling through an injectable probe positioned in the gas outlet of the separator.
- Analysis of upstream and down-stream samples taken via the probe.
- The determination of separator efficiency and thereby correction of the measured GOR for recombination of gas and liquid samples.

The technique has been tested on a large number of wells over a range of fluid systems, ie oil, rich gas/condensate and dry gas systems.

Using simulations, it is often possible to predict the expected



performance of a test separator under given hydraulic loads and the corresponding requirement for isokinetic sampling. On occasions, however, the efficiency of the test separator has been significantly lower that that predicted.

The technique has been widely used to obtain a correct recombination gas/liquid ratio for separator samples from volatile oil and gas/condensate reservoirs

OPERATING PROCEDURES

ISO-SPLIT® Isokinetic gas sampling

Isokinetic gas sampling was specifically designed as a means of obtaining a representative sample of a flowing stream of two or more phases. The test separator used during well testing is operating under conditions that require isokinetic sampling.

The ISO-SPLIT® technique is used to measure the liquid entrained in the gas outlet of separators. The separator itself causes a favourable situation for representative two phase sampling in the gas outlet stream, small droplets (<300 micron) with uniform distribution.

There is evidence to show that in the absence of severe foaming in the separator, 99% of the liquid carry over is dispersed as discrete droplets. An insignificant amount of the liquid will flow as a film on the wall of the tubing under conditions where the separator performance is reduced.

The isokinetic sampling probe can be inserted under full line pressure. Ideally, the sampling position should be where there is an undisturbed flow pattern and where pressure and temperature are as close as possible to that of the separator. Theoretically, the sampling criteria is met in a straight section, 8 to 10 I.D. downstream and 4 to 5 I.D. upstream of a change in the flow line geometry.

The isokinetic gas sample is taken via the injectable probe through an orifice facing into the gas stream.

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ISO-SPLIT® Isokinetic test separator sampling

In order to obtain a more representative well stream composition from test separator sampling, Petrotech employs three different methods of the ISO-SPLIT® technique.

All three methods are similar in terms of the sampling of the process stream, the differences occur in the processing and analysis of data for the different methods.

A data acquisition system is used as an integrity check and provides a record of the conditions during sampling.

Direct (on-site) measurement of separator efficiency and carryover tests

The production test separator outlet gas is sampled isokinetically via an upstream orifice in the injectable probe. The sampled stream is then processed at test separator conditions through a small separation vessel, typically one litre.

In cases of severe carry over, entrained liquid in the gas stream is accumulated in the separation vessel and measured gravimetrically or volumetrically.

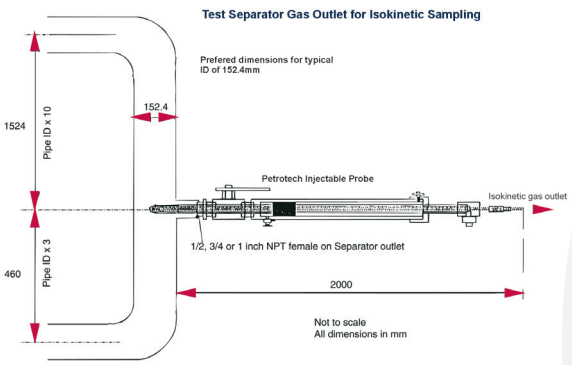
From precise measurement of the gas volumes through the small separation vessel a GOR for the processed stream is determined. A corrected GOR for the test separator efficiency can then be calculated.

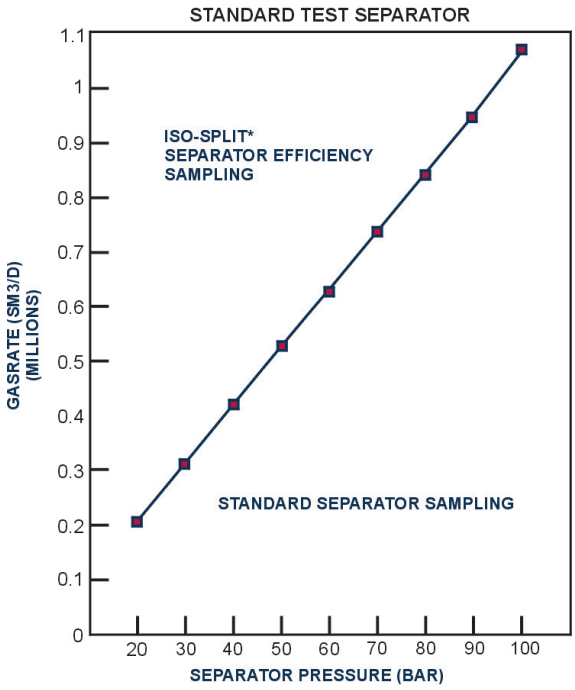
Determination of well fluid composition and carryover tests

This method is similar to that previously described (2.3). However, for this method the process stream is sampled via the injectable probe both upstream and downstream simultaneously.

The sampled stream is processed at low temperature (typically 0 °C) and separator pressure. Condensate and dry gas samples are obtained from the separation vessel for analysis and subsequent recombination to the separator gas composition.

The carry over and separator efficiency is determined by comparison and analysis of the recombined compositions.





Determination of well fluid composition and carryover tests for QA/QC

Two pressurised samples of the separator gas are taken simultaneously via the injectable probe in two 20 litre standard PVT gas sample vessels. As with the method above (2.4) one sample stream is taken upstream (isokinetically) as representative of the process stream containing liquid carry over. The second sample stream is taken downstream as representative of a dry gas stream containing no carry over.

Determinaton of carry over and test separator efficiency is performed using the composition of the upstream and the downstream gas samples and the recombined separator liquid.

OPERATIONAL CONDITIONS

Prior to performing isokinetic sampling from the test separator the gas flow rate must be determined under stable flowing conditions.

Once sampling has commenced there must be no significant changes in conditions at which the test separator is operating. In addition it is strongly recommended that accurate meter factors are performed prior to, and after the test using water. The meters should be checked at rates covering the range of expected production during the test.

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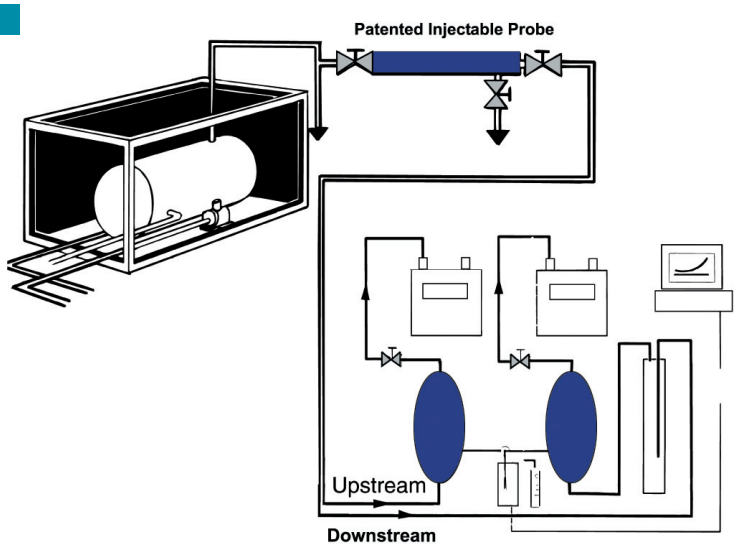
Technical Specifictions:

Injectable probe	
Test pressure:	315 bar / 4500 PSI
Working pressure:	200 bar/ 2900 PSI
Temperature:	-40 to 150°C
Service:	H2S and CO2
Sampling control system	
Isokinetic sampling rate:	Automatically controlled
Test pressure:	500 bar
Working pressure upstream of system:	350 bar
Working pressure downstream of system:	100 bar
Temperature:	-25 to 85°C
Service:	H2S and CO2
Sensors	
Pressure ratings:	100, 200, 500 and 700 bar
Temperature ratings:	0-200°C
Cables	
Capacitance :	70 nF/km
Inductance:	0.62 mH/km
Gas sample bottles	
Type:	Luxfur gas bottle
Displacement:	Vacuum
Pressure rating:	200 bar
Volume:	20 litre



EXTERNAL EQUIPMENT

To perform the isokinetic sampling from the test separator or a process line it is necessary to have a suitable sampling point for the insertion of the Expro injectable probe.

The preferred sampling point is in the vertical leg of the test separator gas outlet as illustrated, 5 pipe diameters (ID) downstream of the top bend.

The threaded connection required is 1/2” to 1” female NPT, (preferably 1”). Perpendicular to the sample point there has to be a free space of approximately 1.5 m for the movement of the probe.

The data acquisition system is PC based. Two 1/2” NPT sampling points are required on the oil outlet of the test separator for logging pressure and temperature during sampling.