Application Note

№KCP-12001

Petroleum

Moisture in Liquefied Petroleum Gases

Coulometric Titration (Direct Method) by Karl Fischer Moisture Titrator

Standard	ISO 10101		

- Abstract -

Moisture in LP gases can be determined by collecting in special sampler. Moisture concentration is generally determined with mass concentration (w/w% or w/wppm). However, when measuring the collected amount of gas with mass, there may be a case where an error in the collected amount becomes bigger if a big container is used. This application note describes the procedures for measurement of moisture in LP gases, which measures gas volume and calculates volume concentration (v/v% or v/vppm).

Measuring principle: Filled LP gases in sample adapter (volume 60mL). Vaporize LP gases and inject them into titration cell and measure moisture. Vapor in cell are injected into bottle gas washing and desiccant tube, and then measure flow rate by gas flow meter.

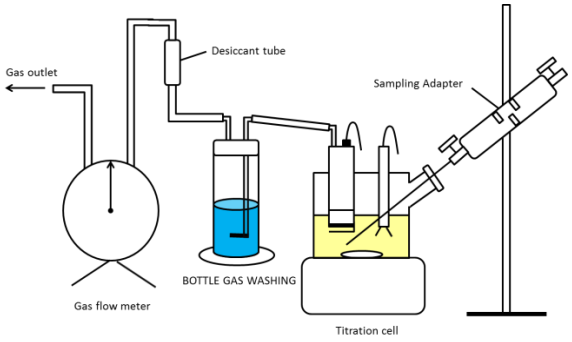

Fig. 1 Flow Diagram

- Cautions in measurement -

- When collecting sample gas in sampling adapter, leave space of 20 % or more of internal volume.
- Gas flow rate is determined from readings of gas flow meter of before and after measurement.
- Let vaporized sample gas go out through fume hood.
- Keep fire away. Sample gas is flammable.

- Reference -

◆ ISO 10101-3:1993 Natural gas — Determination of water by the Karl Fischer method — Part 3: Coulometric procedure

- Apparatus・Reagent -

Moisture Titrator : Karl Fischer moisture titrator coulometric method
Electrode: Electrolysis electrode, Twin platinum electrode for KF titration
Sampler: Sampling adapter for liquefied gas
Anolyte: KF reagent for general
Catholyte: KF reagent for general
Others: Gas flow meter (wet type), Bottle gas washing (water filling), Desiccant tube, Desiccant (phosphorus(V) oxide or magnesium perchlorate), Manometer, Thermometer

※Specification of gas flow meter

Drum Capacity	: 1 L/rev.
Measuring range	: min. 2 to max. 600 L/h
Maximum working pressure	: 1000 mmH2O

- Test procedure -

・Preparation

1) Place the gas cylinder upside down or incline it. Then connect the outlet of the gas cylinder and the sampling adapter with the sampling tube.
2) Open the valves at both ends of the sampling adapter.
3) Then open the sample gas cylinder valve little by little to vaporize a small amount of gas sample and release it through the sampling adapter.
4) Close the valves at the needle side of sampling adapter (exit side) and open the gas cylinder valve to let the sample gas in the sampling adapter.
At that time, leave space of 20% or more of internal volume of the sampling adapter.

・Titration

1) Place anolyte in titration cell of Karl Fischer moisture titrator, and catholyte in electrosys electrode.
2) Conduct Pre-Titr to dehydrate the titration cell.
3) All the sample gases in sampling adapter is vaporized and injected into cell by flow rate of 0.4 to 0.5(L/min) while anolyte is being stirred.
Measure vavorized gas volume with gas flow meter. → Sample volume.
4) Start titration once the sample gas is totally vaporized.

- Formula -

Moisture (v/v%) ＝ B×1.244×(760／P)×{(273＋t)／273}／(A×10000)

(v/vppm) ＝ B×1.244×(760／P)×{(273＋t)／273}／A

A:Sample gas vol.(L) 10000:Unit conversion coefficient (from v/vppm to v/v %)

B:Moisture (μg) 1.244:Molar volume of standard condition/Molecular mass of water=22.4(L)/18

t:Temperature (℃) 760:pressure of standard condition 760(mmHg)

P:Pressure (mmHg) 273:Temperature of standard condition 273(K)

- Measurement results -

Table 1. Measurement data (pressure : 752.8 mmHg, temperature : 25℃)

	Sample vol. (L)	Moisture (μg)	Concentration (v/vppm)
1	7.13	191.6	37.0
2	12.42	317.2	35.1
3	8.67	227.7	36.3

Statistics	
Mean (v/vppm)	36.1
SD (v/vppm)	0.91
RSD (%)	2.54

Table 2. Measurement parameters

MKC-610		MKC-520		MKC-501	
[Titration]		[Titration]		[Titration]	
t(stir)	0s	t(stir)	0s	t(stir)	0s
t(wait)	15s	t(wait)	15s	t(wait)	15s
t(max)	0s	t(max)	0s	t(max)	0s
Drift stop	Rel	Drift stop	Rel	Drift stop	Rel
Drift	0.1 μg/s		0.1 μg/s		0.1 μg/s
[Contorol]		Cont. Gain	5		
Cell type	2-Comp.	Stable	0.1 μg/min	[Calculation]	
stable	0.1 μg/min	Start	Manual	Unit	μg
Ctrl.gain	5	[Calculation]		Weight	var
E. Speed	Standard	Calc. No.	1	Drift Comp	Auto
Start mode	Manual	unit	μg		
End level	200mV	Weight	var		
Samp. Time	5s	Drift. Comp.	Auto		
[Calculation]					
Calc. Type	Sample				
Calc. No.	1				
unit	μg				
Fraction	Half adjast				
Drift. Comp.	Auto				

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