AQUACOUNTER Application Sheet	COM series	DATA No. F4	1st edition
Electronics	Measurement of acid value in transformer oil		

1. Measurement outline

The method of acid value measurement in electrical insulation oils such as transformer oil is stipulated in JIS C 2101, and it is one of the important performance evaluation test items for electrical insulation oils. The acid value is expressed as mg value of potassium hydroxide required for neutralizing 1g of sample.

In JIS C 2101, the sample is dissolved in solvent mixture of toluene/ethyl alcohol or toluene/2-propanol with addition of alkali blue 6B indicator for neutralization titration with potassium hydroxide titrant. The titration end point is the point at which the indicator color changes from blue to red.

This section introduces an example in which approximately 20g of sample was weighed precisely and dissolved in 120mL solvent mixture for potentiometric titration with potassium hydroxide titrant using glass electrode and reference electrode.

$$H^+ + KOH \rightarrow K^+ + H_2O$$

2. Reagents and Electrodes

(1) Reagents	Titrant	0.05mol/L KOH titrant (ethyl alcohol solution)
	Titration solvent	120mL toluene/ethyl alcohol solvent mixture
	Loading buffer	0.1mL alkali blue 6B indicator(0.1 – 0.2g alkali blue 6B indicator dissolved in 100mL ethyl alcohol and filtered)
(2) Electrodes *Standard accessories	Indicator electrode	*Glass electrode GE-101B to IE jack
	Reference electrode	*Reference electrode RE-201 to RE jack

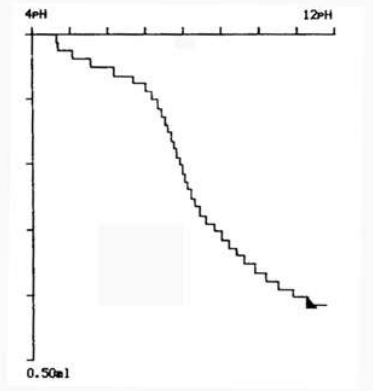
3. Measurement conditions example (for COM-1600S)

Master File No.1 Condition file: 1	
Method	SET
Amp No.	1
Buret No.	1
Meas Unit	pH
S-Timer	0 sec
CP	0 mL
Direction	UP
DP	0 mL
End Point (pH)	11.25
Over mL	0.1 mL
Max Vol	5 mL
Mode No.	21
Unit	mg/g
Blank	BLANK result value
Factor	Titer of the titrant
Molarity	0.05
K	56.1
Formula	(D-B)×K×F×M/S

Mode No.21	
Pre Int	0 sec
Del K	0
Del Sens	0 mV
Int Time	30 sec
Int Sens	0 mV
Brt Speed	2
Pulse	40

4. Measurement example

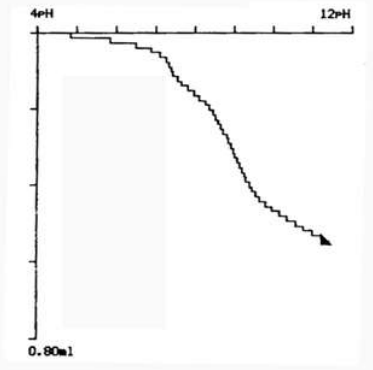
(1) Blank measurement example



Blank measurement results on solvent

Sample No.	Sample volume (g)	Titration value (mL)
1	120	0.399
2	120	0.383
	Avg.	0.391 ppm

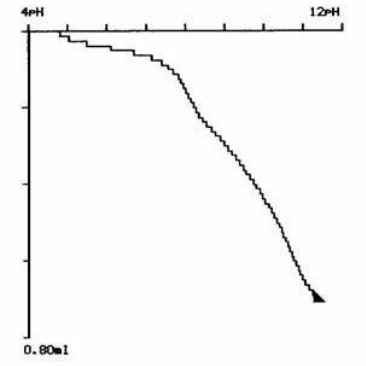
(2) Sample measurement example A



Measurement results on acid value in transformer oil A

Sample No.	Sample volume (g)	Titration value (mL)	Concentration (mg/g)
1	20.013	0.523	0.019
2	20.543	0.504	0.016
3	20.541	0.500	0.015
	Avg.		0.017 mg/g
	Std. Dev.		0.002 mg/g
	C.V.		12 %

(3) Sample measurement example B



Measurement results on acid value in transformer oil B

Sample No.	Sample volume (g)	Titration value (mL)	Concentration (mg/g)
1	1.612	0.681	0.454
2	2.124	0.747	0.434
3	2.115	0.759	0.452
	Avg.		0.447 mg/g
	Std. Dev.		0.011 mg/g
	C.V.		2.48 %

5. Outline

(1) About the effect of carbon dioxide gas in air

Since titration is conducted for a long period under basic conditions in this measurement, it is feared that carbon dioxide in air may be absorbed and cause titration error. This measurement was taken by aerating nitrogen gas into the beaker since it was a measurement on a low acid value.

(2) About electrode activation

Since this measurement is a non-aqueous titration which uses organic solvent and the electrode response speed decreases as the surface of the indicator electrode is dehydrated, it needs to be activated regularly by soaking in purified water (for 5 – 10 minutes). In addition, the liquid junction block for the reference electrode may also be dehydrated and increase electrical resistance. Thus it is necessary that the crystal of inner solution be removed regularly by soaking it in purified water or by loosening the sleeve for the liquid junction block.

(3) About end point detection method

In this measurement, the relationship between the color change point (blue to red) for the indicator (alkali blue 6B) and the pH had been studied in advance and the end point pH was set to pH11.25. When indicator titration is used instead of potentiometric titration, it is also possible to conduct photometric titration method (using 650nm filter) using an optical titration unit.

Key words

Acid value, transformer oil, JIS C 2101, electrical insulation oil, neutralization titration

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