HIRANUMA APPLICATION DATA	Automatic Titrator	Data No.	O9	Feb. 03, 2022
Factor standardization	**Standardization of ammonium iron(II) sulfate titrant**			

1. Abstract

Ammonium iron (II) sulfate is a reducing agent and is used as a titrant in redox titration because it has relatively stable properties among iron (II) compounds. The following are examples of usage: first, an excessive amount of potassium permanganate is added to react with target metal compound, such as chromium or vanadium, contained in the sample. Next, the potassium permanganate that remains unreacted is titrated with an ammonium iron(II) sulfate standard solution to indirectly quantify the target metal compound.

In the above example, 5 mol of ammonium iron (II) sulfate reacts quantitatively with 1 mol of potassium permanganate by the formula (1), and this reaction is also used for the standardization of iron (II) ammonium sulfate.

JIS K8001 and the Japanese Pharmacopoeia describe that the ammonium iron (II) sulfate standard solution to be standardized is taken into a titration vessel and the titration is performed with potassium permanganate standard solution. The titration curve shows an inflection point at the endpoint.

$$10FeSO_4 + 8H_2SO_4 + 2KMnO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O \quad \cdots(1)$$

1) Japanese Pharmacopoeia Eighteenth Edition

2) Japanese Industrial Standard JIS K8001 General rules for test methods of reagents

2. Configuration of instruments and reagents

(1) Configuration of instruments

Main unit	: Automatic Titrator	COM Series
	Optional buret	1 unit
Electrodes	: Platinum electrode	PT-301
	Reference electrode	RE-201Z

* It can also be applied to combinations of other platinum electrodes such as PR-701BZ.

(2) Reagents

Standard solution : 0.02 mol/L (0.1 N) potassium permanganate standard solution (f = 1.000, Buret No. 2), Used as a titrant

Sample to be standardized : 0.1 mol/L (0.1 N) ammonium iron (II) sulfate standard solution (Buret No.1), Used as a sample

Additive reagent : Phosphoric acid, Guaranteed reagent

3. Measurement procedure

(1) Add 40 mL of DI water, 5 mL of phosphoric acid, and a stirrer bar to a 100 mL beaker.

(2) Immerse the electrodes and start the measurement. 10 mL of 0.1 mol/L ammonium iron (II) sulfate standard solution is added to the beaker by the buret dispensing.

(3) Titration is subsequently performed with 0.02 mol/L potassium permanganate standard solution. The inflection point on the titration curve is detected as the end point.

4. Measurement conditions and results

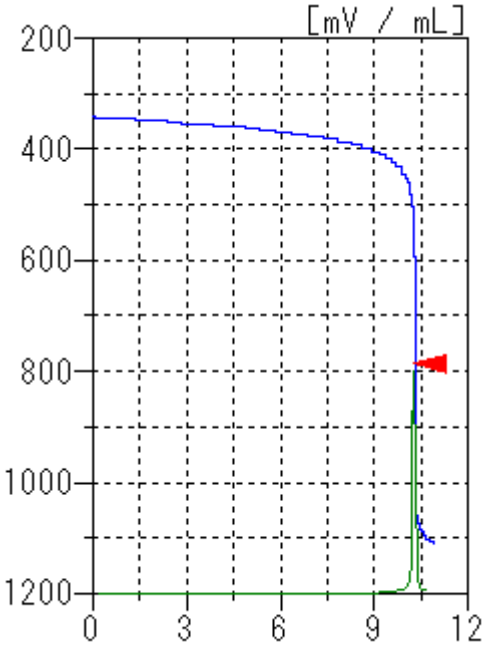
Examples of titration conditions

M. File	1+2							
Cndt No.	1							
Method	Disp							
Buret No.	1							
S-Timer	5	sec						
Disp Vol.	10	mL						
Cndt No.	2							
Method	Auto		ConstantNo.	2		Mode No.	4	
Buret No.	2		Size	10	mL	Pre Int	0	sec
Amp No.	2		Blank	0	mL	Del K	9	
D. Unit	mV		Molarity	0.1	mol/L	Del Sens	0	mV
S-Timer	5	sec	Factor	1.000	*1	Int Time	3	sec
C.P. mL	0	mL	K	0		Int Sens	3	mV
T Timer	0	sec	L	0		Brt Speed	2	
D.P. mL	1.0	mL				Pulse	40	
End Sens	200		Unit	Fact				
Over mL	0.5	mL	Formula	(D-B)/S*F				
Max.Vol.	20	mL	Digits	4				

*1: Factor of 0.02 mol/L potassium permanganate standard solution

Measurement results

Measurement No.	Sample size (mL)	Titrant volume (mL)	Factor	Statistic calculation		
1	10	10.275	1.0275	Avg.	1.027	
2	10	10.274	1.0274	SD	0.000_2	
3	10	10.271	1.0271	RSD	0.02	%



Examples of titration curves

5. Note

(1) About the factor calculation formula of the ammonium iron (II) sulfate standard solution

In measurement of the factor standardization, there are many case examples of titrating a standard material using the titrant to be standardized. In the procedure of JIS K8001 and Japanese Pharmacopoeia for ammonium iron (II) sulfate standard solution, the titrant and the sample are reversed. The potassium permanganate standard solution is used as the titrant, and the ammonium iron (II) sulfate standard solution to be standardized is used as the sample for titration.

In this case, the factor calculation formula is set as [(D-B)/S*F]. This formula is not initially installed in the titrator and must be set using the formula editing function.

The calculation formula is derived based on the following relational formula (2). The left side (subscript s) is the titrant of potassium permanganate standard solution and has already been standardized preliminary, and the right side (subscript t) is the sample of ammonium iron (II) sulfate standard solution to be standardized.

$$n_s \times M_s \times F_s \times (D - B) = n_t \times M_t \times F_t \times S \quad \cdots (2)$$

Potassium permanganate		Ammonium iron (II) sulfate	
n_s	: Valence (5)	n_t	: Valence (1)
M_s	: Molar concentration (0.02)	M_t	: Molar concentration (0.1)
F_s	: Factor (Known)	F_t	: Factor (Unknown)
D-B	: Titrant volume (mL)	S	: Sample size (mL)

Keywords : Factor standardization, Redox titration, Ammonium iron (II) sulfate, Potassium permanganate

*Some measurement would not be possible depending on optional configuration of system.