Content Determination of Sodium Metabisulfite

Via a iodometric back-titration with sodium thiosulfate ($Na_2S_2O_3$) the content of sodium metabisulfite ($Na_2S_2O_5$) in a solution is determined.

Sample	Metabisulfite, aqueous solution. (Used here: 12 mL of ~0.01 mol/L solution)
Compound	Sodium metabisulfite, $Na_2S_2O_5$ M = 190.10 g/mol, z = 4
Chemicals	10 mL KIO_3; 0.01 mol/L 10 mL KI; 0.06 mol/L 10 mL H_2SO_4; 0.35 mol/L
Titrant	Sodium thiosulfate, $Na_2S_2O_3$ c($Na_2S_2O_3$) = 0.01 mol/L
Standard	Potassium iodate, KIO_3
Indication	DM140-SC
Chemistry	See comments section for complete chemical reactions.
Calculation	R1 = VEQ Consumption (mL) R2 = (QENDDi[2]*6-Q)*C / m C = M/z Content $Na_2S_2O_5$ (g/L)
Waste disposal	Neutralize acidic waste before disposal
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Preparation and Procedures

An exact amount of metabisulfite sample solution is pipetted into a titration beaker.

Added to this are (either manually or by additional dosing units):

- 10 mL 0.01 mol/L KIO_3
- 10 mL 0.06 mol/L KI
- 10 mL 0.35 mol/L H_2SO_4

The amounts are chosen in such a way that an excess amount of iodine is generated and that consecutively a back-titration with sodium thiosulfate can be performed, to find out the iodine consumption of the sample (metabisulfite).

If larger amounts of sample are used or if the expected concentration is higher than ~ 0.01 M the amounts of KIO_3, KI and H_2SO_4 have to be adapted such that still an excess of iodine is present for a correct back-titration with sodium thiosulfate.

Remarks

When dissolved in water, sodium metabisulfite leads immediately to the formation of sulfur dioxide:

$Na_2S_2O_5 + H_2O \rightarrow 2\ NaHSO_3$

$HSO_3^- + H_3O^+ \rightarrow SO_2 + 2\ H_2O$

Literature:
http://en.wikipedia.org/wiki/Sodium_metabisulfite
http://de.wikipedia.org/wiki/Natriumdisulfit

Instruments	T50/T70/T90 with optionally 3 extra dosing units for dispensing of auxiliary reagents
Accessories	DV1010 burettes (3x) Titration beakers ME-101974 LabX pro titration software

Results

Samples

1/7	$Na_2S_2O_5$	12.0 mL
2/7	$Na_2S_2O_5$	12.0 mL
3/7	$Na_2S_2O_5$	12.0 mL
4/7	$Na_2S_2O_5$	12.0 mL
5/7	$Na_2S_2O_5$	12.0 mL
6/7	$Na_2S_2O_5$	12.0 mL
7/7	$Na_2S_2O_5$	12.0 mL

Results	Comment / ID	Rx	Result	Unit	Name
1/7	$Na_2S_2O_5$	R1 =	15.408	mL	Consumption
		R2 =	1.7660	g/L	Content $Na_2S_2O_5$
2/7	$Na_2S_2O_5$	R1 =	15.462	mL	Consumption
		R2 =	1.7639	g/L	Content $Na_2S_2O_5$
3/7	$Na_2S_2O_5$	R1 =	15.412	mL	Consumption
		R2 =	1.7659	g/L	Content $Na_2S_2O_5$
4/7	$Na_2S_2O_5$	R1 =	15.517	mL	Consumption
		R2 =	1.7617	g/L	Content $Na_2S_2O_5$
5/7	$Na_2S_2O_5$	R1 =	15.529	mL	Consumption
		R2 =	1.7612	g/L	Content $Na_2S_2O_5$
6/7	$Na_2S_2O_5$	R1 =	15.494	mL	Consumption
		R2 =	1.7626	g/L	Content $Na_2S_2O_5$
7/7	$Na_2S_2O_5$	R1 =	15.489	mL	Consumption
		R2 =	1.7628	g/L	Content $Na_2S_2O_5$

Statistics

Rx	Name	n	Mean value	Unit	s	srel [%]
R1	Consumption	7	15.473	mL	0.048	0.31
R2	Content $Na_2S_2O_5$	7	1.7634	g/L	0.0019	0.109

Titration curve

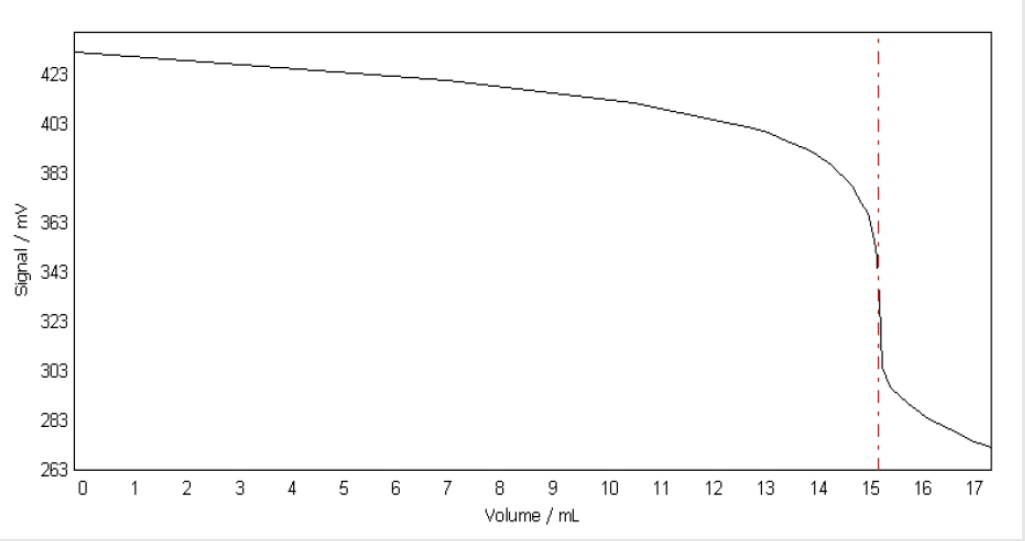

Table of measured values

	Volume mL	Increment mL	Signal mV	Change mV	1st deriv. mV/mL	Time s
	0	NaN	432.2	NaN	NaN	0
	7.143	7.143	420.8	-11.4	NaN	16
	10.714	3.571	411.6	-9.2	NaN	52
	12.500	1.786	403.6	-8.0	NaN	58
	12.900	0.400	401.8	-1.8	NaN	72
	13.300	0.400	399.3	-2.5	-9.87	76
	13.700	0.400	395.7	-3.6	-11.85	79
	14.100	0.400	391.9	-3.8	-14.41	82
	14.500	0.400	386.4	-5.5	-20.67	86
	14.900	0.400	377.8	-8.6	-43.57	90
	15.091	0.191	371.0	-6.8	-80.60	93
	15.196	0.105	367.0	-4.0	-111.55	96
	15.340	0.144	355.8	-11.2	-134.60	100
	15.390	0.050	348.4	-7.4	-136.58	104
EQP1	15.411644	NaN	341.1	NaN	-137.66	NaN
	15.440	0.050	331.6	-16.8	-131.42	110
	15.490	0.050	304.4	-27.2	-112.35	127
	15.540	0.050	300.9	-3.5	-123.37	132
	15.664	0.124	296.3	-4.6	-99.09	139
	15.968	0.304	289.6	-6.7	NaN	147
	16.368	0.400	283.3	-6.3	NaN	156
	16.768	0.400	279.4	-3.9	NaN	161
	17.168	0.400	275.2	-4.2	NaN	167
	17.568	0.400	272.2	-3.0	NaN	172

Comments

When sodium metabisulfite is dissolved in water, the following reaction occurs:

$Na_2S_2O_5 + H_2O \rightarrow 2\ NaHSO_3$

The formed bisulfite, $NaHSO_3$, can be measured quantitatively via a iodometric back titration.
In this titration, first an excess I_2 is generated with the chemicals added to the $Na_2S_2O_5$ sample, KIO_3, KI and H_2SO_4:

$IO_3^- + 5\ I^- + 6\ H^+ \rightarrow 3\ I_2 + 3\ H_2O$ (1 IO_3^- leads to 6 I^--ions, thus iodine excess in R2 is 6 x IO_3^-)

Part of this excess I_2 is used by the $Na_2S_2O_5$ sample that is present in the titration beaker as $NaHSO_3$ after its reaction with water:

$I_2 + SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2\ H^+ + 2\ I^-$ (z = 4 because $S_2O_5^{2-}$ gives 2 SO_3^{2-} and SO_3^{2-} reacts with 2 I^-)

The rest of iodine can be determined quantitatively by back-titration with sodium thiosulfate, $Na_2S_2O_3$:

$I_2 + 2\ S_2O_3 \rightarrow 2\ I^- + S_4O_6^{2-}$

Method

001 Titlе

Type	General titration
Compatible with	T50 / T70 / T90
ID	Metabisulfite
Title	$Na_2S_2O_5$ content with EQP redox
Author	admin
Date/Time	23.06.2009 08:30:27
Modified at	23.06.2009 15:23:07
Modified by	admin
Protect	No
SOP	None

002 Sample

Number of IDs	1
ID 1	$Na_2S_2O_5$
Entry type	Volume
Lower limit [mL]	5.0
Upper limit [mL]	15.0
Density [g/mL]	1.0
Correction factor	1.0
Temperature [°C]	25.0°C
Entry	Before

003 Titration stand (Manual stand)

Type	Manual stand
Titration stand	Manual stand 1

004 Dispense (normal) [1]

Titrant	KI
Concentration [mol/L]	0.06
Volume [mL]	10.0
Dosing rate [mL/min]	60.0
Condition	No

005 Dispense (normal) [2]

Titrant	KIO_3
Concentration [mol/L]	0.01
Volume [mL]	10.0
Dosing rate [mL/min]	60.0
Condition	No

006 Dispense (normal) [3]

Titrant	H_2SO_4
Concentration [mol/L]	0.35
Volume [mL]	10.0
Dosing rate [mL/min]	60.0
Condition	No

007 Stir

Speed [%]	30
Duration [s]	10
Condition	No

008 Titration (EQP) [1]

Titrant

Titrant	$Na_2S_2O_3$
Concentration [mol/L]	0.01

Sensor

Type	mV
Sensor	DM140-SC
Unit	mV

Temperature acquisition

Temperature acquisition	No

Stir

Speed [%]	30

Predispense

Mode	Volume
Volume [mL]	150/m
Waiting time [s]	10

Control

Control	User
Titrant addition	Dynamic
dE (set value) [mV]	6
dV (min) [mL]	0.05
dV (max) [mL]	0.4
Mode	Equilibrium controlled
dE [mV]	1.0
dt [s]	2
t (min) [s]	3
t (max) [s]	30

Evaluation and recognition

Procedure	Standard
Threshold [mV/mL]	50
Tendency	None
Ranges	0
Add. EQP criteria	No

Termination

At Vmax [mL]	40
At potential	No
At slope	No
After number of recognized EQPs	Yes
Number of EQPs	1
Combined termination criteria	No
Accompanying stating Condition	No

009 Calculation R1

Result	Consumption
Result unit	mL
Formula	R1=VEQ
Constant C=	1
M	M[None]
z	z[None]
Decimal places	3
Result limits	No
Record statistics	Yes
Extra statistical func.	No
Send to buffer	No
Condition	No

010 Calculation R1

Result	Consumption
Result unit	mL
Formula	R2=(QENDDi[2]*6-Q)*C/m
Constant C=	M/z
M	M[Metabisulfite]
z	z[Metabisulfite]
Decimal places	4
Result limits	No
Record statistics	Yes
Extra statistical func.	No
Send to buffer	No
Condition	No

011 End of sample