



CIO⁻ Determination in Bleach

Direct Titration with NaAsO₂

Introduction

A bleach solution contains mainly NaClO plus basic products such as NaOH and Na₂CO₃.

CIO⁻ can be determined directly by redox titration. The titration result is generally expressed as a % of CIO⁻.

Principle

Direct titration of CIO⁻ by NaAsO₂ uses the following redox reaction



Note that in this reaction, which involves 1 mole CIO⁻ for 1 mole AsO₂⁻, 2 oxidation numbers are exchanged (As (III) to As (V) and Cl(1) to Cl(-1)).

This reaction needs a pH of around pH 10.00

The titration is run according to a potentiometric pre-set end point titration using a combined platinum/reference electrode.

Electrode and reagents

MC3051Pt-9 Metal Electrode, combined platinum (part no. E31M003) with CL114 cable (part no. A94L114)

Distilled water

pH 10.00 Buffer Solution (part no.S11M014)

NaAsO₂ 0.1 eq/l solution in water

To prepare the 0.1 eq/l (or 0.05 mol/l) NaAsO₂ solution

As a 0.1 eq/l NaAsO₂ solution contains 1/40 As₂O₃ mol/l

Weigh 4.2467 (169.87/40) g of pure As₂O₃ and dissolve it in about 20 ml of 10M NaOH. You can gently heat the solution to have a quick dissolution

Add about 200 ml of pure water and 1M H₂SO₄ until the pH reaches 8.00

Leave the solution to reach room temperature

Dilute to 1000 ml exactly with a volumetric flask

End point titration settings

Burette volume:	25 ml
Stirring speed:	400 rpm
Working mode:	mV
Number of end points:	1
End point:	200 mV
Stirring delay:	30 seconds
Minimum speed:	0.1 ml/min
Maximum speed:	10 ml/min

Proportional band:	375 mV
End point delay:	5 seconds
Sample unit:	ml
Sample amount:	0.5
Titration:	Decreasing potential
Result:	g/l

Procedure

Install the titration system with the NaAsO₂ solution

Connect the electrode

Pipette (or preferably weigh) the sample amount

Dilute the sample with 50 ml of pH 10.00 buffer solution

Dip electrode and delivery tip in the solution

Start method by pressing the RUN key

Results

Commonly expressed as g/l of CIO⁻ (MW = 51.43 g/mol)

Use as titrant unit: mol/l (M)

As 1 mole of titrant reacts with 1 mole of CIO⁻ in sample:

$$R = V(\text{titr}) * C(\text{titr}) * 51.43 / V(\text{smp})$$

V(titr) = total volume of titrant to reach the end point (in ml)

C(titr) = concentration of titrant in mol/l

51.43 = molecular weight of CIOV(smp) = sample volume in ml

For a result in g/l

Enter

The sample amount in the SAMPLE screen

The titrant concentration in the TITRANT screen (in mol/l)

1 Titrant and 1 Sample in the COEFFICIENTS display

51.43 as molecular weight

The Titration Manager gives a result according the above formula.

Using eq/l as titrant unit

Enter

The sample amount in the SAMPLE screen

The titrant concentration in the TITRANT screen (in mol/l)

2 Titrants and 2 Samples in the COEFFICIENTS display

51.43 as molecular weight

The Titration Manager gives a result in g/l according to the above formula.

For a result as a %

As the Titration Manager cannot give a result in % if the sample unit is a volumetric unit, you can use the equation feature:

Equation number: 1
Equation result: % ClO
Equation formula: R1 / 10
R1 is the titration result calculated in g/l

5 determinations on a commercial concentrated bleach

Mean (as ClO⁻): 76.5 g/l
Standard deviation: 1.2 g/l
Rel. standard deviation: 1.6%

Working Range

As a commercially available concentrated bleach corresponds to a ClO⁻ concentration in g/l of around 80 (corresponding to a total volume of titrant of around 16 ml for 0.5 ml of sample), it is possible to use the dilution procedure to facilitate pipetting or weighing 0.5 ml of sample.

For example, pipette 5 ml of sample, dilute to 100 ml with water and take an aliquot of 10 ml.

In the SAMPLE display enter

DILUTION: YES
Sample: 5 ml
Final dilution volume: 100 ml
Aliquot: 10 ml