Iodometric Determination of Cu in Brass Sample Solution

IODINE TITRATIONS

Iodimetry: A direct titration with only 1 reaction:

analyte + **titrant (iodine I_2)** $\rightarrow$ **product (iodide I^-)**
unknown *known*

Iodometry is the titration of iodine (I_2) produced when an oxidizing analyte is added to excess I^-(iodide).

Then the iodine (I_2) is usually titrated with standard **thiosulfate** solution.

Iodometry: Not a direct titration because there are 2 reactions:

analyte + **I^-** $\rightarrow$ **I_2**
unknown

I_2 + **titrant (standard thiosulfate)** $\rightarrow$ **product**
Known

Iodometric titrations

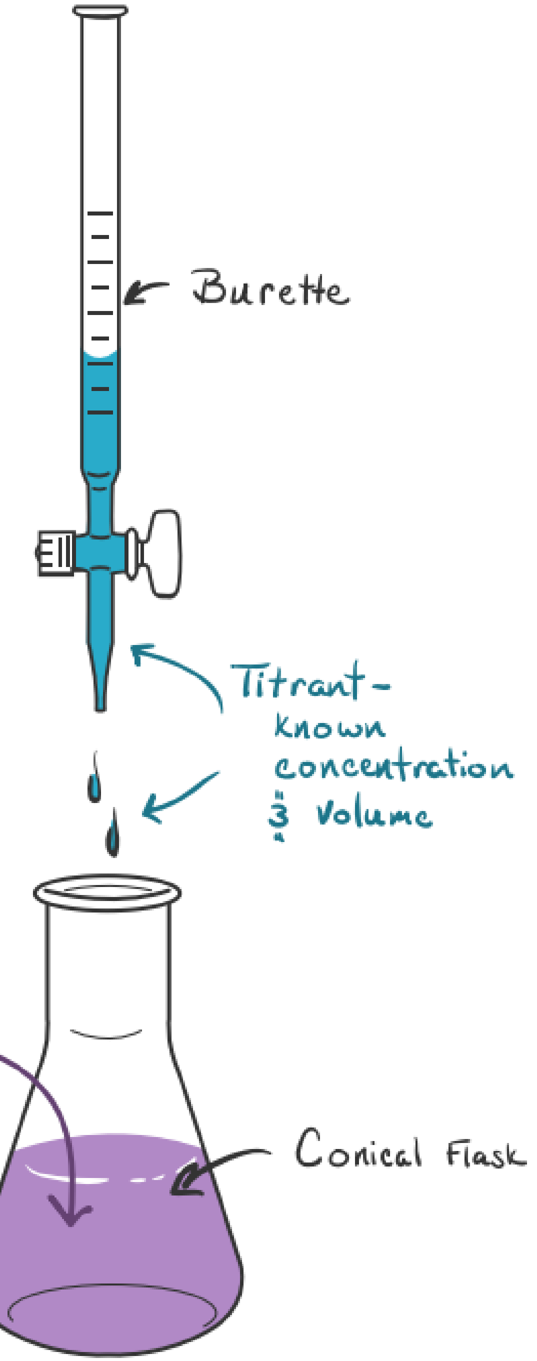
Iodine titrations in which some oxidizing agent liberate I_2 from an I^- solution and then liberated I_2 is titrated with a standard solution of reducing agent

Estimation of $CuSO_4$, $K_2Cr_2O_7$, $KMnO_4$, Fe^{3+}, H_2O_2, Br_2, Cl_2 etc.

$$2CuSO_4 + 4KI \longrightarrow Cu_2I_2 + 2K_2SO_4 + I_2$$

$$2Na_2S_2O_3 + I_2 \longrightarrow Na_2S_4O_6 + 2NaI$$

Titration Setup



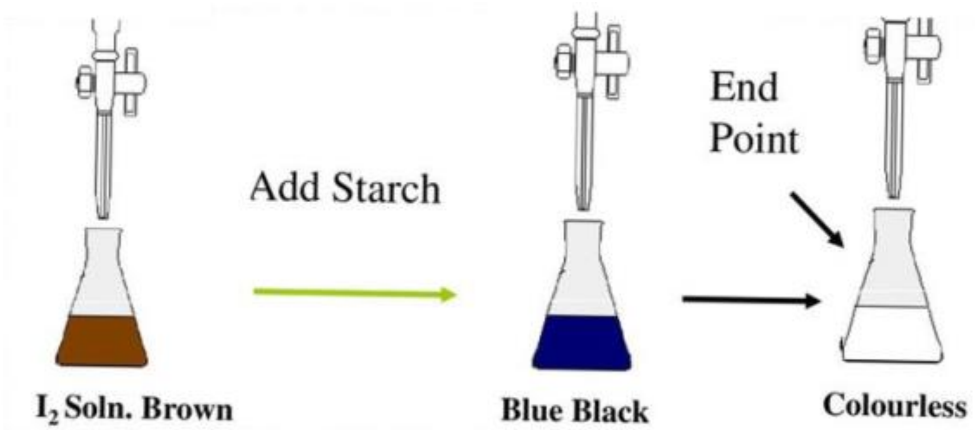
- **Detection of the end point – using chemical Indicator**

- In this titration a solution of **starch** is used as indicator

- Starch reacts with iodine in the presence of iodide to form an intensely blue-colored complex, which is visible at very low concentrations of iodine

$$I_2 + I^- \rightleftharpoons I_3^-$$

$$\text{Starch} + I_3^- \longrightarrow \text{Starch-}I_3$$



Aim: Estimation of Cu in brass sample using standard sodium thiosulfate solution (Iodometric titration)

Theory

Step 1:

$$2CuSO_4 + 4KI \longrightarrow Cu_2I_2 + 2K_2SO_4 + I_2$$

$$2Cu^{2+} + 2I^- \longrightarrow 2Cu^+ + I_2$$

Step 2:

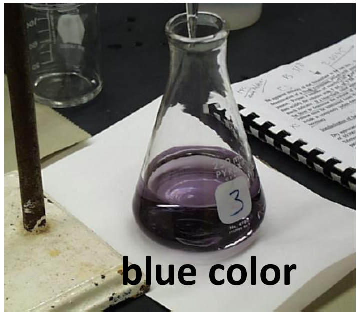
$$I_2 + I^- \rightleftharpoons I_3^-$$

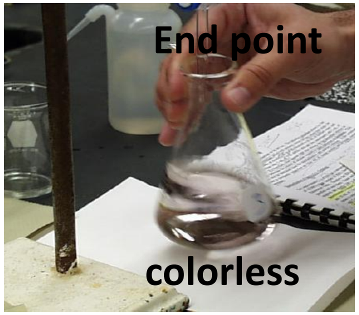
Step 3:

$$\underset{\text{(Colourless)}}{\text{Starch} + I_3^-} \longrightarrow \underset{\text{(Dark Blue)}}{\text{Starch-}I_3} \text{ (Starch-triiodide complex)}$$

Step 4:

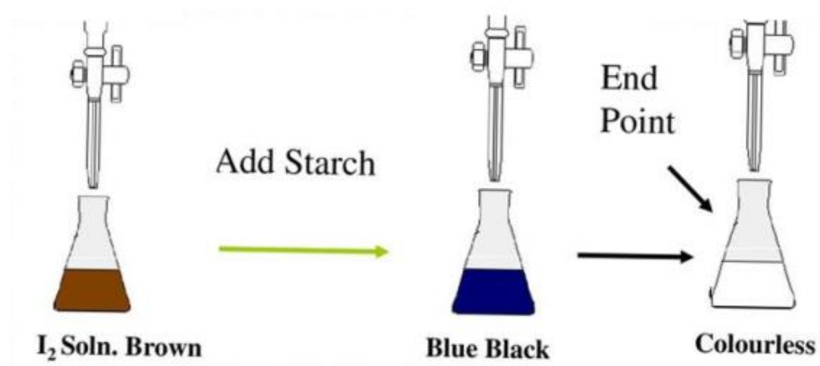
$$2S_2O_3^{2-} + I_2 \longrightarrow S_4O_6^{2-} + 2I^-$$





Procedure:

0.5g of brass is dissolved in 10mL conc. HNO_3 and dilute it upto 100 mL with distilled water in standard measuring flask. Pipette 10 mL of this diluted alloy solution (test solution) into a conical flask then add a few drops of dilute NH_4OH solution until a slight permanent precipitate remains. The precipitate is redissolved by adding acetic acid drop by drop till the solution becomes clear. Then about 5 mL of a 5% KI solution is added and titrate the liberated iodine with 0.05N $Na_2S_2O_3$ solution from the burette using 1% starch solution as an indicator. The end point is marked with the disappearance of blue color. Repeat the titration 3-4 times.



OBSERVATIONS

Burette: 0.05 N $Na_2S_2O_3$ Solution
Flask: 10 ml diluted alloy solution + NH_4OH (dropwise till slight permanent Precipitation) + HAc (till the precipitation dissolves) + 5% KI
Indicator: Starch solution (2-3 drop)
End point: Disappearance of Blue color

Observation table

Sr No	Initial Burette reading (ml)	Final Burette reading(ml)	Difference (ml)	Concurrent Reading (ml)
1	0.0	9.2	9.2	8.2
2	0.0	8.2	8.2	
3	0.0	8.2	8.2	
4	0.0	8.0	8.0	

Equations:

$2CuSO_4 + 4KI = Cu_2I_2 + 2K_2SO_4 + I_2$

$I_2 + 2Na_2S_2O_3 = Na_2S4O_6 + 2NaI$
(Sodium Tetrathionate)

$2Na_2S_2O_3 = I_2 = 2CuSO_4 = 2Cu$

$NaS_2O_3 = I = CuSO_4 = 2Cu$

Calculation:

1000 ml 1N $Na_2S_2O_3$ = 63.57g of Cu = 249.57 g $CuSO_4{\cdot}5H_2O$

1 ml 1N $Na_2S_2O_3$ = 0.06357g of Cu = 0.24957 g $CuSO_4{\cdot}5H_2O$

A ml of 0.05 N $Na_2S_2O_3$ = 8.2 ml

Quantity of Copper in the given solution = $A \times 0.05 \times 0.06357 \times 100/10$

= B = 0.26 g

% of Copper in the alloy = $X \times 100/W$ = 52%

Where W = weight of the alloy taken = 0.5 g

A = Constant Burette Reading and B = Quantity of Copper.

Results

1. 10 ml of diluted solution required = 8.2 ml of 0.05 N $Na_2S_2O_3$
2. Quantity of Copper in the given solution = 0.26 g
3. Percentage of Copper in the alloy = 52%.