

Salt Analysis

SHORT NOTES

INTRODUCTION

Qualitative analysis involves the detection of cation(s) and anion(s) of a salt or a mixture of salts.

Preliminary Test

1. Physical appearance (smell):

Table: 1

Take a pinch of the salt between your fingers and rub with a drop of water	
Smell	Inference
Ammoniacal smell	NH_4^+
Smell like that of rotten eggs	S^{2-}

2. Dry Heating Test:

This test is performed by heating a small amount of mixture in a dry test tube. Quite valuable information can be generated by carefully performing and noting the observations here. On heating, some salts undergo decomposition thus evolving the gases or may undergo characteristic changes in the colour of residue.

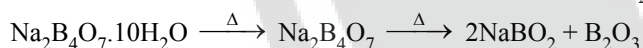
3. Flame test:

Table: 2

Colour of Flame	Inference
Crimson Red / Carmine Red	Lithium
Golden yellow	Sodium
Violet/Lilac	Potassium
Brick red	Calcium
Crimson	Strontium
Apple Green/Yellowish Green	Barium
Green with a Blue centre/Greenish Blue	Copper

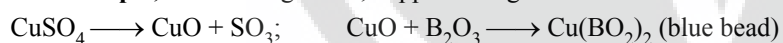
4. Borax Bead test:

On heating, borax forms a colourless glassy bead of NaBO_2 and B_2O_3 .



On heating with a coloured salt, the glassy bead forms a coloured metaborate in oxidising flame.

For example, In oxidising flame, copper salts give blue bead.



5. Solubility Chart:

Table: 3

S. No.	Anion	Solubility / Exception
1.	CO_3^{2-}	Except carbonates of alkali metals and of ammonium, all other normal carbonates are insoluble.
2.	SO_3^{2-}	Only the sulphites of the alkali metals and of ammonium are water soluble. The sulphite of other metals are either sparingly soluble or insoluble.
3.	S^{2-}	The acid, normal and polysulphide of alkali metals are soluble in water. The normal sulphides of most other metals are insoluble, those of the alkaline earths are sparingly soluble, but are gradually changed by contact with water into soluble hydrogen sulphides.
4.	NO_2^- , NO_3^-	Almost all nitrites and nitrates are soluble in water. AgNO_2 is sparingly soluble. Nitrates of mercury and bismuth give basic salts on treatment with water. These are soluble in dilute nitric acid.
5.	Cl^-	Most chlorides are soluble in water. PbCl_2 (sparingly soluble in cold but readily soluble in boiling water), Hg_2Cl_2 , AgCl , CuCl , BiOCl , SbOCl and Hg_2OCl_2 are insoluble in water.
6.	Br^-	Silver, mercury(I) and copper(I), bromides are insoluble. Lead bromide is sparingly soluble in cold but more soluble in boiling water. All other bromides are soluble in water.
7.	I^-	Silver, mercury(I), mercury(II), copper(I), lead and bismuth(III) iodides are the least soluble in water.

ANALYSIS OF ANIONS (ACIDIC RADICALS)

Analysis of anions (acidic radicals) can be broadly divided into two groups.

(A) **GROUP 'A' RADICALS:** It involves those anions which are characterised by volatile products by reaction with HCl/ H₂SO₄. It is further subdivided into two groups as given below.

(a) **Dilute Sulphuric acid/Dilute Hydrochloric acid:** The anions of this group liberate gases or acid vapours with dilute sulphuric acid/hydrochloric acid.

Table: 4

Observation	Inference	
	Gas	Radical
Effervescence with the evolution of a colourless and odourless gas which turns lime water milky	CO ₂	CO ₃ ²⁻
Evolution of colourless gas having smell of rotten egg which turns lead acetate paper black.	H ₂ S	S ²⁻
Colourless gas having suffocating odour (like burning sulphur) which turns acidified K ₂ Cr ₂ O ₇ paper green.	SO ₂	SO ₃ ²⁻
Evolution of reddish brown pungent smelling gas which turns (i) FeSO ₄ solution brownish-black and (ii) wet starch -iodide paper blue.	NO ₂	NO ₂ ⁻
No peculiar gas is evolved.	–	All above are absent

(b) **Concentrated Sulphuric acid group:** The anions of this group liberate acid vapours or gases with conc. H₂SO₄.

Table: 5

Observation	Inference	
	Gas	Radical
Colourless gas with pungent smell which gives dense white fumes with a glass rod dipped in NH ₄ OH.	HCl	Cl ⁻
Reddish brown gas with pungent smell, intensity of reddish brown fumes increases on addition of a pinch of solid MnO ₂ . Also, it turns starch paper, orange red.	Br ₂	Br ⁻
Evolution of violet vapours which turns starch paper, blue.	I ₂	I ⁻
Evolution of reddish brown fumes which intensifies on addition of copper turnings or bits of filter paper. Starch iodide paper develops a blue-black spot due to the formation of a I ₂ -starch complex. (NO ₂ liberated acts as oxidising agent).	NO ₂	NO ₃ ⁻

CLASSIFICATION OF CATIONS

Cations are classified into five groups on the basis of their behaviour with some reagents.

Table: 6

Group	Group Reagent	Ions	Colour and Ppt.
Group I	dil. HCl	Pb ²⁺	PbCl ₂ , White
Group II A Group II B	H ₂ S in dil. HCl	Cu ²⁺	CuS, PbS
Group III	NH ₄ OH in presence of NH ₄ Cl	Fe ³⁺ , Al ³⁺	Fe(OH) ₃ - Brown; Al(OH) ₃ - White
Group IV	H ₂ S in presence of NH ₃ and NH ₄ Cl or (NH ₄) ₂ S	Ni ²⁺ , Co ²⁺ , Zn ²⁺	ZnS - White or grey; CoS, NiS - Black
Group V	(NH ₄) ₂ CO ₃ in presence of NH ₄ Cl and NH ₄ OH	Ba ²⁺	BaCO ₃ - White
Group VI	No common group reagent	Mg ²⁺	Mg(NH ₄)PO ₄ - White