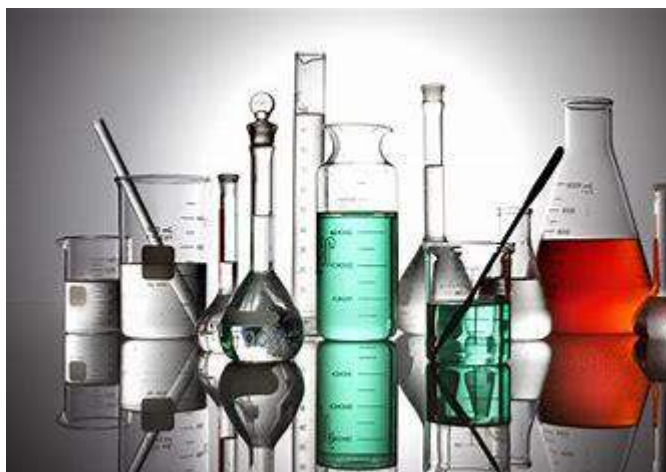


ENGINEERING CHEMISTRY PRACTICAL
(Laboratory manual for Diploma engineering)
SALT ANALYSIS CHART



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STUDY OF PHYSICAL PROPERTIES

PRELIMINARY TEST

	OBSERVATION	INFERENCE
(A)Color	Colorless Or White or Yellow	Most of Na^+ , K^+ , Mg^{2+} , Ca^{2+} , Al^{3+} , Zn^{2+} , NH_4^+ Salts etc
(B)Structure	(i)Crystalline	Most of the chlorides, nitrates, sulphates etc
	(ii)Amorphous	carbonates of sulphides of Ca^{2+} , Mg^{2+} , Zn^{2+} etc (except those of Na^+ , K^+ and NH_4^+)
(C)Solubility	Soluble in water	Carbonates of Na^+ , K^+ & NH_4^+ Sulphides of Na^+ , K^+ & NH_4^+ All halides All nitrates All sulphates

TEST FOR ACID RADICALS

DRY TEST FOR ACID RADICALS

EXPERIMENT	OBSERVATION	INFERENCE
(1)Heat a small quantity of the supplied salt in a clean, dry test tube first slowly and strongly for about 3-4 minutes.	A gas or vapor is evolved.	
	(i) A colorless, odourless gas (O_2) which rekindles a glowing spliter.	May be nitrate.
	(ii) A colorless, odourless gas (CO_2) which turns lime water milky.	May be carbonate.
	(iii)A reddish brown gas (NO_2) which turns filter paper dipped in FeSO_4 solution black	May be nitrates of heavy metals.
	(iv)A colorless gas NH_3 with pungent odour which turns red litmus paper blue.	May be ammonium.
	(v)A colourless gas (SO_2) with burning sulphur smell which turns acidified $\text{K}_2\text{Cr}_2\text{O}_7$ solution green.	May be sulphate.
	(vi)A colourless gas (H_2S) with rotten egg smell which turns lead acetate paper black.	May be hydrated sulphide salts.

	(vii) A colorless gas (HCl) with irritating smell which fumes in moist air. It produces dense white fumes with a glass rod dipped in conc. NH_4OH .	May be hydrated chloride salts.
	(viii) A greenish yellow (Cl_2) with irritating smell which turns starch-iodide paper blue.	May be unstable chloride salts.

WET TEST FOR ACID RADICALS

1-TEST FOR CARBONATE (CO_3^{2-})

EXPREMENT	OBSERVATION	INFERENCE
(A) Take 2ml of dil HCl or dil H_2SO_4 in a clean test tube. Warm it & add a little of the salt into it.	Effervescence takes place with the evolution of colorless, odourless gas.	It may be CO_2 from CO_3^{2-}
(B) Warm the above reaction mixture to get more gas & pass the gas slowly through lime water.	First lime water turns milky & with excess of gas, milkiness disappears, but this gas fails to change orange color of $\text{K}_2\text{Cr}_2\text{O}_7$ solution green.	CO_3^{2-} is confirmed

2- TEST FOR SULPHIDE (S^{2-})

EXPREMENT	OBSERVATION	INFERENCE
(A) Take about 2-3 ml of dil HCl or dil H_2SO_4 in a clean test tube .warm it & add a little of the salt into it.	Effervescence takes place with the evolution of colorless gas with rotten egg smell.	It may be H_2S gas from S^{2-}
(B) Warm the above reaction mixture & show a filter paper soaked with lead acetate solution to the evolved gas.	The filter paper turns black.	S^{2-} is confirmed

3- TEST FOR SULPHATE (SO_4^{2-})

EXPREMENT	OBSERVATION	INFERENCE
(A) Take about 1-2 ml of salt solution. Acidify with 1-2 ml of dil HCl. Add about 1ml of BaCl_2 solution. Add about 1ml of conc.HCl to the above solution and warm it.	A white precipitate is obtained. The precipitate is not soluble.	SO_4^{2-} is confirmed

4- TEST FOR NITRATE (NO₃⁻)

EXPREMENT	OBSERVATION	INFERENCE
(A)Take a pinch of the salt in a clean & dry test tube. Add few pieces of copper turning and 4-5 drops of conc. H ₂ SO ₄ & heat it.	Copious brown fumes are evolved & the solution turns green or bluish green.	Brown fume is due to NO ₂ from nitrate NO ₃ ⁻ salt.
(B)Show a filter paper soaked in freshly prepared FeSO ₄ solution to the above brown gas.	The paper turns black.	May be NO ₃ ⁻ .
(C)BROWN RING TEST: Take 1-2 ml of the salt solution. Add equal volume of conc. H ₂ SO ₄ slowly into the test tube. Cool the test tube perfectly under tap. Then slowly add 2-3ml of freshly prepared ferrous sulphate solution through the sides of the test tube.	A brown ring is formed at the junction of the two liquid layers.	The brown ring is due to the formation of [Fe (No)] SO ₄ ⁻ . NO ₃ ⁻ is confirmed.

5-TEST FOR CHLORIDE (Cl⁻)

EXPREMENT	OBSERVATION	INFERENCE
(A)Take a pinch of the salt in a clean and dry test tube and add 2-3 drops of conc. Sulphuric acid (H ₂ SO ₄) to it.	Effervescence takes place with the evolution of colorless gas which fumes in moist gas/air.	It may be HCl from Cl ⁻ .
(B) Warm the above reaction mixture and show a glass rod dipped in conc. NH ₄ OH to the mouth of the test tube.	Dense white fumes are produced and white solid deposited on the tip of the glass rod.	It is due to the formation of NH ₄ Cl. Cl ⁻ may present.
(C) Take a pinch of the salt in a clean and dry test tube .Add a little MnO ₂ and 2-3 drops of conc. Sulphuric acid (H ₂ SO ₄).Heat the reaction mixture.	A curdy white precipitate isn't formed. Greenish yellow gas is evolved which turns filter paper soaked in starch iodide solution blue.	Chlorine gas comes out from chloride which liberates from iodide. Cl ⁻ may present.
(D) Take 1-2 ml of the supplied salt solution. Acidify it with 1-2 ml of dil. Nitric acid (HNO ₃). Add few drops of silver nitrate (AgNO ₃) solution to it.	A curdy white precipitate is formed.	It is due to the formation of silver chloride (AgCl). Cl ⁻ may present.
(E) Wash the above precipitate with distilled water and divide it into two parts. Part-I: Add dil. Nitric acid (HNO ₃) and shake well. Part-II: Add dil. NH ₄ OH and shake well.	Part-I: the precipitate doesn't dissolve. Part-II the precipitate dissolves	AgCl isn't soluble in dil.HNO ₃ . AgCl is soluble in dil.NH ₄ OH due to formation of silver diamine complex. Cl ⁻ may present

TEST FOR BASIC RADICALS
DRY TEST FOR BASIC RADICALS

EXPERIMENT	OBSEVATION	INFERENCE
(1)HEATING IN A DRY TEST TUBE Heat a small quantity of the supplied Salt in a clean, dry test tube first slowly and then strongly for about 3-4 minutes.	(a) Water particles condense at the cooler part of the test tube.	(a) Salt contains water of crystallization.
	(b) A sublimate is formed white sublimate NH_4NO_3 is volatile but produces no white sublimate.	(A) Volatile salts may be NH_4^+ .
	(B) The salt decrepitates (produces cracking sound).	(c) Crystalline salts.
	(C) Deflagration takes place.	(d) Some nitrate salts.
	(D) Infusible takes place.	(e) May be $\text{Mg}^{2+}, \text{Al}^{3+}, \text{Zn}^{2+}$ etc.
	(E) The salt changes colour : yellow when hot & white when cold.	(f) May be Zn^{2+} salt.
	(F) The salt is fused on heating & solidified on cooling.	(g) May be alkali or alkaline earth metal salts.
	(G) T he salt is swelled up on heating.	(h) May be Al^{3+} salt.
(2)HEATING IN A CHARCOAL CAVITY Make a small cavity on a charcoal block. Fill the cavity with the supplied salt. Moisten the salt with a drop of water. Heat the salt strongly with the oxidizing flame for about three minutes with help of a blow pipe.	(i) The salt decrepitates or produces cracking sound.	Crystalline salts.
	(ii) The salt volatilizes completely with white fumes.	May be ammonium salts (perform soda lime & bulb tube test).
	(iii)the salt deflagrates (suddenly catches fire & burns vigorously)	May be nitrate.
	(iv) The salt may or may not melt but finally leaves a white infusible incandescent (giving light) residue.	$\text{Al}^{3+}, \text{Zn}^{2+}, \text{Mg}^{2+}$ or alkaline earth metal salts .(perform cobalt nitrate test)
	(v) The salt melts & sinks into the charcoal cavity on heating & reappears on cooling.	May be alkali or alkaline earth metal salts (perform flame test)
(3)SODALIME TEST (FOR VOLATILE SALTS) Take a pinch of the salt in a watch glass. Add a little sodalime ($\text{NaOH}+\text{CaO}$) & few drops of water to it. Rub it with the thumb.	A colourless gas with smell of ammonia is evolved which produces a dense white fume with conc. HCl.	NH_4^+ is present.

(4) COBALT NITRATE TEST (FOR INFUSIBLE SALT) Heat a small quantity of the salt in a charcoal cavity in the oxidizing flame with the help of a blow pipe till an infusible & incandescent residue is left. Moisten the residue with a drop of cobalt nitrate solution & heat in the oxidizing flame. Note the colour of the residue.	(a) blue (infusible) mass	May be Al^{3+} salt.	
	(b) green mass	May be Zn^{2+} salt.	
	(c) pink mass	May be Mg^{2+} salt.	
	(d) grey mass	May be Ca^{2+} salt (flame test is to be performed).	
(5) FLAME TEST (FOR FUSIBLE SALTS) Clean a nichrome wire or a platinum wire by rubbing it with a sand paper. Dip it in conc. HCl taken in a watch glass. Show it to the non-luminous Bunsen flame till it imparts no color to the Bunsen flame. Moisten the clean wire with conc. HCl & touch it with a little of the powdered salt. Show it to non-luminous flame. Observe the color of the flame in naked eye & through double glass.	COLOUR OF THE FLAME		
	In naked eye	Through double blue glass	
	(i) persistent golden yellow	colourless	May be Na^+ salt.
	(ii) violet	Crimson red	May be K^+ salt.
	(ii) Brick red	Light green	May be Ca^{2+} salt.

WET TEST FOR BASIC RADICALS

(1) TEST FOR Al^{3+}

EXPERIMENT	OBSERVATION	INFERENCE
(A) To 3ml of salt solution, add solution NH_4Cl till saturation. Then add NH_4OH till the solution is alkaline.	Gelatinous white ppt is formed.	May be Al^{3+} .
(B) To 2ml of salt solution (in water of dil HCl), add NaOH solution dropwise & then in excess.	Gelatinous ppt is first formed which dissolves in excess of NaOH solution.	Al^{3+} is confirmed.

(2)TEST FOR ZINC (Zn²⁺)

EXPERIMENT	OBSERVATION	INFERENCE
(A)To 3ml of salt solution in water dil HCl, add solid NH ₄ Cl till saturation. Then add NH ₄ OH till the solution is alkaline & H ₂ S gas is passed through it.	White ppt is obtained.	May be Zn ²⁺ .
(B)To 2ml of salt solution (in water or dil. HCl), add dil. NaOH solution dropwise & then in excess.	White ppt is formed which is soluble in excess.	Zn ²⁺ is confirmed.
(C)To 2ml of the salt solution, add a few drops of potassium ferrocyanide solution.	White ppt is obtained.	Zn ²⁺ is confirmed.

(3)TEST FOR MAGNESIUM (Mg²⁺)

EXPERIMENT	OBSERVATION	INFERENCE
(A)To 3ml of salt solution (in water or dil.HCl), add solid NH ₄ Cl till saturation. Then add NH ₄ OH to it till alkaline. Now add to it disodium hydrogen phosphate solution.	White ppt.	May be Mg ²⁺ .
(B)To 2ml of salt solution, add 1ml of dilute HCl. Now add 2-3 drops magneson reagent. Finally make the solution alkaline with NaOH solution.	A blue ppt is obtained.	Mg ²⁺ is confirmed.

(4)TEST FOR AMMONIUM (NH₄⁺)

EXPERIMENT	OBSERVATION	INFERENCE
(A) Take a little given salt in the test tube & add to it 1ml of NaOH solution. Boil the mixture.	Ammonia gas is evolved which gives dense white fumes with conc. HCl .	NH ₄ ⁺ is confirmed.
(B)To 2ml of the salt solution, add 1ml of. NaOH solution & then a few drop of Nessler's reagent.	Brown ppt is obtained.	NH ₄ ⁺ is confirmed.

(5)TEST FOR SODIUM (Na⁺)

EXPERIMENT	OBSERVATION	INFERENCE
(A)Perform flame test with the thin paste of given salt in conc. HCl.	Golden yellow flame invisible through blue glass.	Na ⁺ is confirmed.
(B)To 2ml of salt solution, add 1ml of potassium pyranthi-monate solution. Scratch the inner sides of the test tube with a glass rod.	White crystalline ppt.	Na ⁺ is confirmed.

(6)TEST FOR POTASSIUM (K⁺)

EXPERIMENT	OBSERVATION	INFERENCE
(A)Perform flame test with a paste of given salt in conc. HCl.	Violet colour with naked eye & crimson red through blue glass.	K ⁺ is confirmed.
(B)To 2ml of salt solution, add solid NaNO ₂ till saturation. Now add a few drops of cobalt nitrate solution & 1ml of dil. CH ₃ COOH to it keep the solution for sometime	Yellow ppt is obtained.	K ⁺ is confirmed.

(7)TEST FOR CALCIUM (Ca²⁺)

EXPERIMENT	OBSERVATION	INFERENCE
(A)To 3ml of salt solution (in water or dil. HCl), add solid NH ₄ Cl till saturation. Then add to it NH ₄ OH till solution is alkaline. Now add ammonium carbonate solution to it.	White ppt.	May be Ca ²⁺ .
(B)To 2ml of the salt solution (in water or dil HCl), add 1ml of ammonium oxalate solution. Make the solution alkaline with NH ₄ OH.	White ppt.	Ca ²⁺ is confirmed.

CONCLUSION:

Acid radical of the salt detected to be -----.

Basic radical of the salt detected to be -----.

Hence, the unknown supplied salt (No-----) is detected to be-----.