

PHARMACEUTICAL INORGANIC CHEMISTRY- BP104T

UNIT: 2 (ACIDS, BASES AND BUFFERS)

CLASS: 2

TOPIC: ELECTROLYTES USED IN REPLACEMENT THERAPY

The electrolyte concentration is maintained constant in body fluids. If a person undergoes surgery, remains ill or remain in an undesirable condition for a long time, the body cannot maintain or correct the electrolyte balance, then done by external administration which is termed as “Replacement Therapy”.

There are various conditions which lead to disturbance of electrolytic balance and ultimately disturb the physiological system.

- Major causes are:
- Any accident, haemorrhage, surgery, etc.
- Diarrhoea, vomiting, dehydration due to GIT infection.
- Drugs induced electrolytes elimination e.g. using thiazide or high ceiling diuretics leads to loss of K⁺
- Metabolic disorder leading to alkalosis or acidosis.
- Deficiency of essential ions or excessive elimination (e.g. hyponatremia, hypokalemia, hypocalcemia, hypomagnesemia etc)

However, there are two types of solutions of electrolytes which are used in replacement therapy.

1. **A solution for rapid initial replacement:** This solution is having sodium in the concentration range of 130-150 mEq/l, 98-110 mEq/l of chloride, 28-55 mEq/l of bicarbonate, 4-12 mEq/l of potassium, 3-5 mEq/l of calcium and 3 mEq/l of magnesium. These electrolyte concentrations thus closely resemble with the electrolyte concentration which are found in extracellular fluids.
2. **A solution for subsequent replacement:** The electrolyte composition of such solution is 40-120 mEq/l Na, 30-105 mEq/l Cl, 16-53 mEq/l HCO₃, 16-35 mEq/l K, 1-15 mEq/l Ca, 3-6 mEq/l Mg and 0-13 mEq/l of phosphorous.

SODIUM CHLORIDE (Na⁺)

Molecular Formula: NaCl

Molecular weight: 58.5 gm

Synonyms: Rock salt, common salt, Table salt Natural Source: Rock salt, Sea water.

Standards: Sodium chloride contains not less than 99.0% and not more than 100.5% of NaCl, calculated on dried basis.

Method of preparation:

In laboratory it is prepared by reaction between a strong acid (HCl) and a strong base (NaOH). The sodium chloride present in dissolved form; solid is obtained by evaporation of water. Industrially, it is prepared

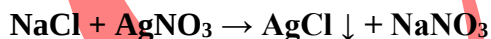
(i) By evaporating purified saline (sea water) deposits and further purification.

(ii) By purifying rock salt

Properties:

- It occurs in the form of white or colorless crystals.
- It is odorless and having saline (salty) taste.
- It is soluble in water but insoluble in alcohol.

With silver nitrate solution, it gives white insoluble precipitate of silver chloride which is soluble in ammonia.



Uses:

- It is source of both sodium and chloride ions.
- 0.9% solution of NaCl solution is isotonic with blood, used in wet dressing and irrigating body cavity.
- It is used alone or in combination with other salts or glucose when body fluid electrolytes are depleted.
- Used as electrolyte replenishes.
- When hypertonic solution is given orally, it induces vomiting and thus can use in case of poisoning as a first aid.

Storage: It is stored in tightly closed container in dry place as it absorbs moisture.

Some marked preparations of Sodium Chloride:

1. Sodium Chloride Eye Lotion (B.P)

- It contains 0.85-0.95% w/v of NaCl.
- It is prepared by dissolving sodium chloride in purified water, filtered, transferred to final container, avoiding the entry of micro-organisms and sterilized by heating in an autoclave.
- Sodium Chloride Solution (B.P)

- It contains 0.9% w/v sodium chloride, prepared in purified water and clarified by filtration.
- When normal saline is prescribed then above solution is dispensed.
- If the label states that it is sterile solution, then it should comply for test for sterility.

2. Sodium Chloride Hypertonic Injection:

It is having 1.6% w/v of sodium chloride. (pH 5-7.5)

Composition:

Sodium chloride - 16 gm

Water for injection sufficient to produce 1000 ml

3. Sodium Chloride Injection

It is sterile isotonic solution of sodium chloride in water for injection. It contains not less than 0.85% and not more than 0.95% w/v of NaCl. It contains no antimicrobial agents.

Composition:

Sodium Chloride - 9 gm

Water for injection sufficient to produce 1000 ml

Preparation:

The sodium chloride injection is prepared from the above ingredients by dissolving Sodium chloride in water for injection, filtered and immediately sterilizing by heating in an autoclave or by filtration.

Properties: It is clear and colorless solution.

Storage: It should be stored in single-dose containers of glass or plastic.

Uses:

- It is used alone or in combination with other salts or glucose when body fluid
- Electrolytes are depleted. o It is used as electrolyte replenisher.

4. Sodium Chloride and Dextrose Injection

It is sterile solution of sodium chloride and dextrose in water for injection.

It contains not less than 95% and not more than 105% of the stated amount of sodium chloride and dextrose.

Preparation: It is prepared by dissolving the calculated quantities of sodium chloride and dextrose in purified water. Finally it is sterilized immediately by autoclaving or by filtration.

Properties: It is clear, colorless solution.

Storage & labeling:

- It is stored in single dose container in a cool place. The label should state the strength as percentage w/v of sodium chloride and dextrose.
- When it is intended for I.V. use, the label must also state the appropriate concentration in mEq/l of sodium and chloride ions.

Uses:

It is used as a fluid, nutrient and electrolyte.

5. Mannitol and sodium chloride Injection:

It is sterile solution of sodium chloride and mannitol in various proportion of the above ingredients.

Eg: 5 and 10 % mannitol with 0.3 % NaCl, 15 and 20% mannitol with 0.45% NaCl

Uses: Electrolyte replenisher and diuretic.

POTASSIUM CHLORIDE

Molecular Formula: KCl

Molecular weight: 74.55 g/mol

Synonyms: kalii Chloridum

Natural Source: Sylvian and Carnallite (Minerals)

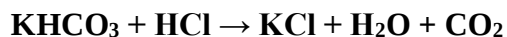
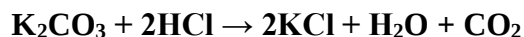
Standards: Potassium chloride contains not less than 99.0% and not more than 100.5% of KCl, calculated on dried basis.

Method of preparation:

It is mainly prepared from the natural minerals; carnallite ($\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$) the raw salt deposit is first of all grounded and then treated with hot water when the less soluble KCl

crystallizes out on cooling. The process has to be repeated for achieving almost complete recovery of KCl from the mother liquor and wash water.

In the laboratory, it is prepared by the action of HCl on potassium carbonate or bicarbonate.



Properties:

- It occurs as colorless prismatic or cubical crystals or as a white granular powder.
- The salt is odorless and having a saline taste.
- It is soluble in water, insoluble in alcohol and ether.
- It melts at 772°C.
- Its 10 percent aqueous solution is neutral to litmus paper.

Uses:

- It is used as an electrolytic replenisher.
- It also finds use when hypokalemia or hypochloremia alkalosis exists as has been the case after prolong diarrhea or vomiting.
- It is sometimes used as diuretics also.
- As an antidote, it is used in digitalis poisoning.
- Potassium chloride has been an ingredient of sodium chloride injection, Ringer's solution, ORS etc.

Storage: It is stored in tightly closed container in dry place as it absorbs moisture

Some marked preparations of Potassium Chloride:

1. Potassium Chloride and Sodium Chloride I.V. Infusion (B.P.)

It is a sterile solution containing 95.0 to 105.0% of the stated amount of sodium chloride and potassium chloride. The solution is prepared in water for injection and sterilized by heating in autoclave. Usual strength available are infusions containing 0.15, 0.20 and 0.30% w/v KCl, each containing 0.9 % w/v of NaCl, in 500 and 1000 ml containers.

2. Potassium Chloride and Glucose intravenous Infusion (B.P.)

It is a sterile solution in water for injection containing KCl 95.0 to 105.0 of the stated amount of glucose and potassium chloride.

Usual strengths available are intravenous infusions containing 0.15, 0.2 and 0.3 per cent w/v of KCl, each containing 5.0% w/v glucose in 500ml and 1000ml containers.

3. Potassium chloride, Sodium Chloride and Glucose intravenous infusion (B.P.)

It is a sterile solution of water for injection containing:

- KCl - 0.3%
- NaCl - 0.18%
- Glucose - 40%

Effervescent KCl Tablet: It Contains:

- KCl- 600mg
- KHCO₃ - 400mg
- KCl sustain release tablet of 600mg.

2 MARKS QUESTIONS

1. Write the composition of sodium chloride injection?
2. Define electrolyte replacement therapy?

5 MARKS QUESTIONS

1. Write about the electrolytes used in replacement therapy?
2. Write about any two marketed preparations of sodium chloride

10 MARKS QUESTIONS

1. Write a note on combination of electrolyte replacement therapy?
2. Write in detail about sodium chloride and potassium chloride
3. Write in detail about the marketed preparations of sodium chloride and potassium chloride