

Chapter 2: Exploring Substances: Acidic, Basic, and Neutral

1. Introduction to the Nature of Substances

- Substances found in our everyday environment can be broadly classified into three categories based on their chemical nature: acidic, basic, and neutral.
- **Acidic Substances:** These substances are generally characterized by a sour taste. Caution must be taken never to taste any unknown substance to determine its nature.
- **Basic Substances:** These substances generally feel soapy or slippery when rubbed between the fingers. They typically possess a bitter taste, though it is important to note that not all bitter-tasting items contain a base (for example, bitter gourd is bitter but not basic).
- **Neutral Substances:** These are substances that do not exhibit either acidic or basic properties. Examples include tap water, sugar solutions, and salt solutions.

2. Acids in Everyday Foods

Many common edible substances naturally contain specific acids:

- **Citrus fruits (like Lemon and Orange):** Contain Citric acid.
- **Amla:** Contains Ascorbic acid (Vitamin C) and Citric acid.
- **Tamarind and Unripe Mango:** Contain Tartaric acid.
- **Tomato:** Contains both Citric acid and Oxalic acid.

3. Natural Acid-Base Indicators

Acid-base indicators are specific substances that display different colours when placed in acidic versus basic solutions.

A. Litmus

- Litmus is a natural substance extracted from lichens. It is widely available either as a liquid solution or as strips of paper (blue and red litmus paper).
- **In Acidic Solutions:** Turns blue litmus paper to red. Examples that cause this change include lemon juice, amla juice, tamarind water, and vinegar.
- **In Basic Solutions:** Turns red litmus paper to blue. Examples that cause this change include soap solutions, baking soda solutions, lime water, and washing powder solutions.

- **In Neutral Solutions:** Does not change the colour of either red or blue litmus paper.

B. Red Rose Extract

- This indicator is prepared by immersing crushed red rose petals in hot water for 5 to 10 minutes until the water becomes coloured, and then filtering the liquid.
- **In Acidic Solutions:** The red rose extract gives a red colour.
- **In Basic Solutions:** The red rose extract turns to a green colour.

C. Turmeric (Haldi)

- Turmeric paper can be made by creating a paste of turmeric and water, coating filter paper with it, and drying it.
- **In Basic Solutions:** The yellow turmeric paper changes to a red colour.
- **In Acidic and Neutral Solutions:** The turmeric paper remains unchanged (yellow). Therefore, turmeric can identify bases but cannot differentiate between acidic and neutral substances.
- *Application Example:* A "magic" invisible ink trick can be performed by writing a message on paper using a soap solution (a base) and later spraying the paper with a turmeric solution, which will make the hidden writing appear red.

D. Olfactory Indicators

- These are substances whose odours change depending on whether they are placed in an acidic or a basic medium.
- An example includes finely chopped onions kept overnight with clean cotton cloth strips. Testing these strips with an acid (like tamarind water) versus a base (like baking soda solution) will result in observable changes in their odour.

4. Synthetic Indicators: These indicators are not found naturally; rather, they are made in laboratories using chemicals.

5. The Process of Neutralisation

- **Definition:** When an acidic solution is mixed with a basic solution in sufficient quantities, the two substances neutralise each other's effects. The resulting mixture is neither acidic nor basic.
- **The Reaction:** In a neutralisation reaction, a new substance called salt is formed alongside water. Additionally, this chemical process always evolves (releases) heat.
- **Word Equation:** Acid + Base $\rightarrow$ Salt + Water + Heat.

5. Applications of Neutralisation in Daily Life

- **Treating Ant Bites:** When a red ant bites, it injects an acidic liquid called formic acid into the skin, causing a stinging pain. This pain can be relieved by rubbing the affected area with moist baking soda, which acts as a base to neutralise the acid.
- **Agricultural Soil Treatment:** Excessive use of chemical fertilisers can make agricultural soil too acidic, severely hindering plant growth. Farmers treat acidic soil by adding lime (a base) to neutralise it. Conversely, if the soil is too basic, organic matter (like manure and composted leaves) is added because it releases acids that neutralise the soil's basic nature.
- **Managing Industrial Waste:** Factory waste is often acidic and can kill aquatic life like fish if dumped directly into rivers or lakes. This harmful waste is neutralised by adding basic substances to it before it is released into water bodies.

6. Scientific Heritage and Fascinating Facts

- **Acharya Prafulla Chandra Ray:** Known as the 'Father of Modern Indian Chemistry', P.C. Ray earned his doctorate in the UK before returning to advance scientific research in India. He established India's first pharmaceutical company in 1901, advocated for education in the mother tongue, and highlighted the achievements of ancient Indian scientists.
- **Lichens:** The source of litmus, lichens are a unique association of two living organisms: a fungus and an alga. They thrive on rocks and trees specifically in regions with clean air and abundant rainfall.
- **Hydrangea:** A plant found in cooler climates like the Himalayas and North-eastern states that acts as a natural soil indicator. It produces blue-coloured flowers when grown in acidic soil, and pink or red flowers when grown in basic soil.
- **Turmeric:** Belonging to the ginger family, this "Golden" spice is highly valued in the Ayurvedic system of medicine for its numerous health benefits and is a staple in traditional home remedies.