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ASAC 1101 : FUNDAMENTALS OF SOIL SCIENCE (2+1)

Level : B.Sc (Ag), I semester

Dr. Bishnuprasad Dash

**SOIL SCIENCE AND AGRICULTURAL CHEMISTRY
M.S.SWAMINATHAN SCHOOL OF AGRICULTURE,CUTM,
PARLAKHEMUNDI**

Topic

Salinity and Alkalinity

CONCEPTS COVERED

Concepts Covered:

- Causes of alkalinity and salinity
- Measurement of salinity and alkalinity
- Classification of saline soils
- Reclamation and management

Causes of salinity

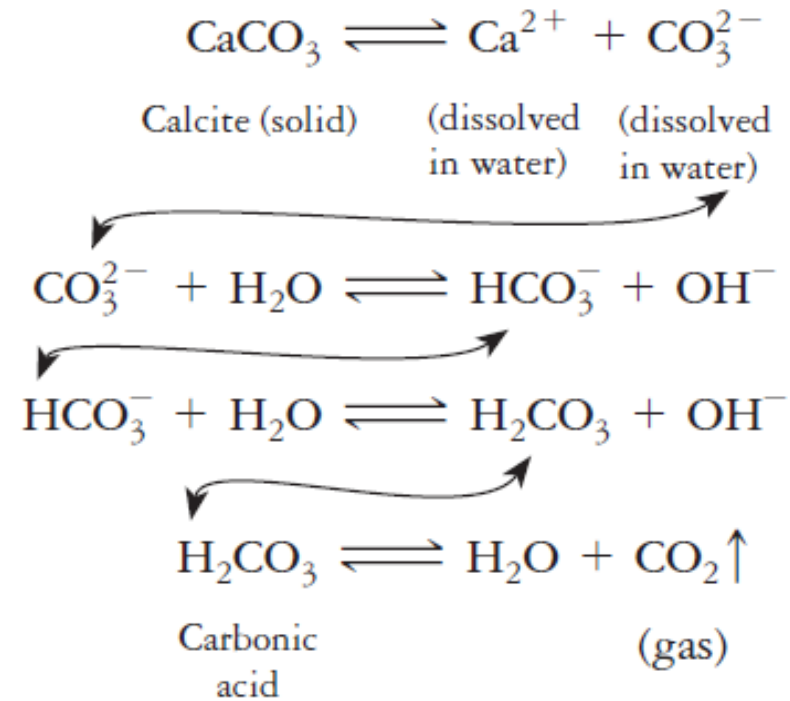
- Saline soils are generally developed in arid and semi-arid condition.
- Evaporation should be more than precipitation.
- The pH of the soils are >8.5 .
- Saline soils are developed in crop fields not only due to the climate but also due to the use of saline irrigation water and poor drainage condition.
- Weathering of salt containing minerals.

Causes of high soil pH

- Sources of alkalinity
- Influence of carbon dioxide and carbonates
- Role of the cations (Na^+ versus Ca^{2+})
- Influence of soluble salt level

Sources of Alkalinity

- $\text{Ca}^{2+}, \text{Mg}^{2+}, \text{Na}^+, \text{K}^+$ do not produce H^+ after reacting with water
- These do not produce OH^-
- But OH^- ions are produced from the dissolution of CaCO_3 (Calcite minerals) and HCO_3^-
- The amount of OH^- increases in the soil solutions and it increases the pH of the soil

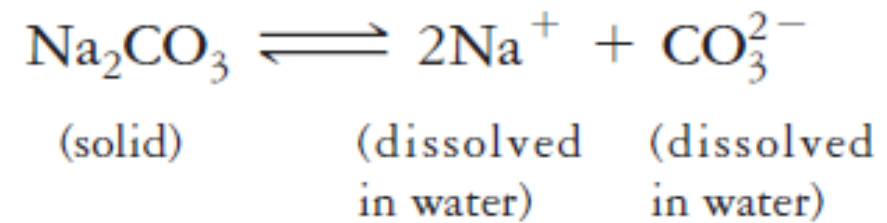


Influence of Carbon Dioxide and Carbonates

- The amount of CO_2 in soil is always more than the atmosphere: respiration
- But it will reduce the pH of the soil driving the reaction to the left.
- The increase in pH stopped when Ca^{2+} increases in the soil solution as it increases the precipitation of CaCO_3 .
- The CaCO_3 precipitates at pH 7-8. So, in calcareous soil the pH never goes beyond 8.4.
- If Na_2CO_3 is present which is more soluble than CaCO_3 then pH can be increased up to 10.5.

Role of the Cations (Na⁺ Versus Ca²⁺)

- Na₂CO₃ is more water soluble than the CaCO₃.
- So, it produces more OH⁻ and CO₃⁻ and it increases the pH up to 10.



Classes of salt-affected Soils

Properties	Saline soil (White alkali)	Saline-sodic soil	Sodic soil (Black alkali)
Structure	Very good	Good	Structure less
pH	Around 8.5.	8.5 < pH < 10	> 10
EC	> 4 dS/m	> 4 dS/m	< 4 dS/m
ESP	< 15	> 15	> 15
SAR	< 13	> 13	> 13
Major ions	Mainly Ca ²⁺ and Mg ²⁺ and SO ₄ ²⁻ , Cl ⁻	Salts of Ca ²⁺ and Mg ²⁺ with Na ⁺	Mainly Na ⁺ and CO ₃ ²⁻ HCO ₃ ⁻

Sodic Soils

- Sodic soils are, perhaps, the most troublesome of the salt-affected soils.
- $EC < 4$ dS/m but $SAR > 13$ and $ESP > 15$.
- The pH of the sodic soil exceed 8.5, rising to 10 or higher in some cases.
- The high pH is caused due to the presence of sodium carbonate which is highly soluble.
- So, the soil contains a high amount of CO_3^{2-} and HCO_3^- ions in the solution.
- At this high pH cause FA and HA of organic matter to dissolve. When the water evaporates, can give soil surface a black colour. These soils are called black alkali.

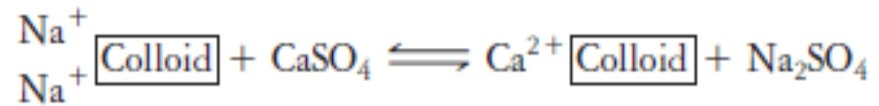
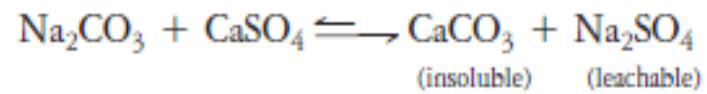
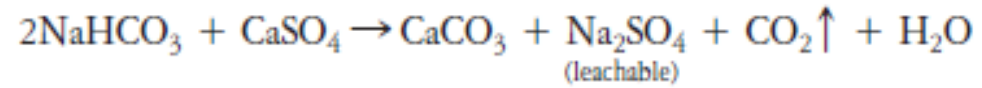
Management of soil salinity

- Irrigation water quality
- Growing salt tolerate crops

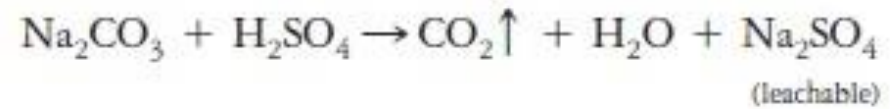
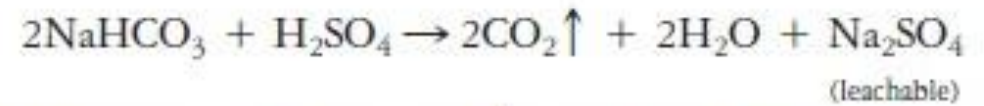
Reclamation of saline–sodic and sodic soils

- The Na^+ ion is replaced by other cations (Ca^{2+} mainly).
- pH of the soil is reduced by adding acid forming substances.
- Gypsum is generally used to reclaim sodic soil where exchange complex does not have Ca^{2+} ions.
- Otherwise any acid forming substances can be used for reclamation where Ca^{2+} ions are present in the exchange complex.

Gypsum



Sulfur and Sulfuric Acid



THANK YOU