The State of Gujarat is situated between $20^\circ1' - 24^\circ7' \ N$ and $68^\circ7' - 74^\circ4' \ E$ in western India. About 50,00000 acres of soil (about 11 percent of the total land) in the State are saline. There are arid-zone salines in the northern parts and sea-inundated salines along the entire sea-shore. About thirteen salines have been included for critical study in the present work. Due to wide variations in the chemical properties and the texture, a comparative study has been possible.

Some selected samples from different salines were taken for leaching-sea-water treatment-leaching, in order to understand the chemical nature of the soil during salination and desalination. It is possible to trace out that the variations in the behaviour could be first demarcated in respect of individual sample variation in arid-zone salines of Dhandhuka - Patana, Dhandhuka - Dholera, and Surendranagar - Nal Lake areas, where wide differences can be accounted for as due to presence of $\text{Na}_2\text{CO}_3 - \text{CaCO}_3$ in Dhandhuka - Patana area and presence of $\text{CaCO}_3 + \text{CaSO}_4$ in Surendranagar - Nal Lake area and high proportion of $\text{CaCO}_3$ in Dhandhuka - Dholera area.
The leaching - salinization - leaching curves for Cambay - Vadgam, Cambay - Dhuvaran and even Dhandhuka - Dholera show similar character which may be attributed to similar composition of sea salts and the same mineralogy of the soils. The curves for Jambusar - Kavi and Navsari - Dandi coastal salines also resemble very closely. Thus nature of the clay mineral, composition of the solution in equilibrium and the climatic effects are reflected in leaching curves. The changes in pH and conductivity reflect the salinity level, proportion of CaCO$_3$, proportion of gypsum, type of clay in the soil and its nature towards the phenomenon of hydrolysis.

The ESP - pH correlation will be an useful aid for quick diagnosis of saline and alkaline soils. It has been presumed that pH of the saturation extract is linearly related with the exchangeable sodium percentage in the soil. Somehow, the linear relation cannot be verified on a statistical basis. The factors influencing the ESP - pH correlation are:
(i) different salinity levels,
(ii) proportion of CaCO$_3$,
(iii) presence or absence of gypsum,
(iv) type of clay in the soil.

It is found that best correlation is possible in a calcareous moderately saline soil (EC: 12 - 40).

Infiltration rate of a solvent like water is a criteria for diagnosis for saline-alkali soils. Water is a solvent with very high dielectric constant, and is highly influenced by presence of different ions adsorbed on the surface of the soil. Infiltration rates for a sodium soil are low while those for a calcium soil are high. When a non-polar solvent like carbon disulphide, trickles from above the soil, the soil system offers very little resistance and therefore high infiltration rates are obtained both for a sodium soil and a calcium soil. It is noted by all workers in the field that determination of ESP is highly difficult. Therefore, in order to decide the correctness of an ESP value either from ESP - estimated or ESP - calculated from SAR, ratio of infiltration rates of CS$_2$: H$_2$D
appears to be a guide line. The ratio may be as high as 960 for a non-saline-alkali soil. The infiltration rates for a saline-alkali soil for different solvents can be arranged in the following order:

\[
\text{CS}_2 > \text{C}_6\text{H}_6 > \text{CH}_3-\text{CO-CH}_3 > \text{C}_2\text{H}_5\text{OH} > \text{H}_2\text{O}
\]

The infiltration rates for waters with different SAR and different salinity levels vary amongst themselves, even when the salinity level is the same and SAR has the same value, but if the type of SAR is \( \text{SAR}_{Ca} \), \( \text{SAR}_{Mg} \) or \( \text{SAR}_{Ca + Mg} \). Single, double or triple salt effect are also reflected sometimes in infiltration rates.

E.M.F. measurements for saline-alkali soils with the help of a Denison cell are likely to indicate the state of aggregation or dispersion in a soil due to differential aeration current being set up. In non-saline alkaline soils highest e.m.f. develops between the two electrodes. Somehow, interaction of electrolyte with electrodes appears to influence the differential aeration currents by introducing their own contribution.
A system of electrodes could be set up where reactions at electrodes can be avoided, then e.m.f. measurement will be useful as a criteria for saline-alkali soil classification.

Potentiometric titrations of saline-alkali soils show different patterns of $\Delta \text{pH}/\Delta v$ variations. These variations can be attributed, in general to the proportion of $\text{CaCO}_3$, proportion of $\text{Na}_2\text{CO}_3$ and the alkalinity resulting from Na-soil.

Seed germination experiments indicate that for some seeds such as maize and sorghum, seeds pre-treated with 1% NaCl show better germination than untreated seeds. Application of different amendments to a saline-alkali soil has been evaluated for the following amendments,

(i) 2% CaSO$_4$,
(ii) 5% petrol mud,
(iii) 2% CaSO$_4$ + 5% petrol mud and
(iv) 2% CaSO$_4$ + 5% petrol mud + 0.2% N-P-K solution.
It is found that petrol mud is a superior amendment for most of the seeds selected as compared to calcium sulphate. Therefore, it can be recommended that petrol mud which is cheaply available in Gujarat should be tried for improvement of salt affected soil. Petrol mud appears to improve the physical condition by aggregating soil particles and chemically it replaces the Na⁺ from the soil complex by H⁺.