In Chapter (1) a review has been made of the literature pertaining to flow of liquids in soil system and some reference of reclamation and germination of different seeds in saline and alkali soils. The structure of the soil itself is an important factor influencing the flow of fluids. Various formulae have been suggested in relation to hydraulic conductivity and infiltration rates in disturbed soils.

In Chapter (II) different methods of analysis adopted for determining soil types, texture chemical constituents etc. and some important physical properties (such as hydraulic conductivity, infiltration rates etc.) were described with the reference to the original literature. Location and description of soil samples and classification of soil clay separates are also included.

In Chapter (III), a study of hydraulic conductivity of some soils saturated with different bases in relation to various fertilizer solutions has been reported. The hydraulic conductivity of soils saturated with different bases obeyed the general order:

\[ \text{Ca}^{2+} > \text{H}^+ > \text{Mg}^{2+} > \text{K}^+ > \text{Li}^+ > \text{NH}_4^+ > \text{Na}^+ \]

in most of the cases. However, in some cases the order gets
changed. Therefore for such individual cases a detailed mineralogical study would be required for soil particles fractionated into sub-classes of silt, clay and sand.

It is curious to note the conductivity of all the fertilizers in most of the base saturated soils have increased from 500 PPM > 1000 PPM > 2000 PPM and in 2500 PPM sometimes it increased in some cases and decreased in some other cases. It is also interesting to observe that the same ion that is present in the base exchange complex of the soil and the same ion if it is present in the fertilizer has retarded the conductivity in many of the cases.

In Chapter (IV), effect of D.W. \( \text{H}_2\text{SO}_4 \), \( \text{FeSO}_4 \) and \( \text{CaSO}_4 \) (0.1 percent), solutions on different saline, alkali and saline-alkali soils has been studied. It has been observed that of all the electrolytes, \( \text{H}_2\text{SO}_4 \) has shown highest conductivity in many of the cases. This suggests that \( \text{H}_2\text{SO}_4 \) is a good reclaiming agent for both saline and alkali soils. \( \text{CaSO}_4 \) has shown good results provided that it should be supplied with fairly good amount of water.

In Chapter (V), infiltration rates of various soils at different ESP levels have been studied. The major control of water movement will depend on the
quantity of clay and type of the clay that is present in the soil. Other factors controlling the water movements are exchangeable sodium percentage, electrolyte solution concentration in the soil or that of the electrolyte solution \textit{in situ} used for the infiltration study. The present study of infiltration rates of eight different soils with different clay content, mineralogical framework were studied with distilled water, gypsum (0.1 percent and satd. soln.), FeSO$_4$ (0.1, 0.2 and 0.4 percent) W/V, Al$_2$(SO$_4$)$_3$ (0.1, 0.2 and 0.4 percent) W/V and H$_2$SO$_4$ (0.1, 0.2 and 0.4 percent) V/V.

It has been observed that montmorillonite soils of Ahmedabad, Anand and Navsari have shown higher infiltration rate values than those of mixed clay soils of Ambaji Lakhpat, Deesa, Dwarka and Shihore. Even in mixed clay types also Kaolinite, Quartz, Illite/Montmorillonite clay soil of Deesa has shown higher infiltration rates than Kaolinite + Quartz clay soils of Ambaji and Lakhpat.

It has been observed that decreases in Na content has increased the infiltration rates and the effect of amendments in most cases are in the order

\[ \text{H}_2\text{SO}_4 > \text{CaSO}_4 > \text{Al}_2(\text{SO}_4)_3 = \text{FeSO}_4 \]  

but in some cases the order has been changed to

\[ \text{H}_2\text{SO}_4 > \text{Al}_2(\text{SO}_4)_3 = \text{FeSO}_4 > \text{CaSO}_4 \]
This generalization is true because CaSO₄ will have higher infiltration rates than Al₂(SO₄)₃ and FeSO₄ provided that heavy rainfall areas or channal areas where water sources are sufficient. The second generalization order is true where there are low rainfall and where there is no extra source of water available. It was also been found that the increasing concentration of the electrolyte solution has shown higher infiltration rates.

In Chapter (VI), an attempt has been made to study seed germination under saline and alkali conditions (by using soils of different ESP and NaCl percentage). The general observation is that wheat is a salt tolerant crop and paddy is alkali tolerant raises a curious question whether there can be further stratification of saline-alkali conditions for different crop species. Many saline-alkali soils where paddy is grown as a monsoon crop, wheat can be grown as a winter crop, whereby the salt accumulation occurring during winter months due to capillary rise cannot have much effect on the standing wheat crop, and also that a congenial salt-free upper horizon will be created for the next paddy crop.

The seed-germination study has shown that wheat (Triticum Vulgare) and Bajra (Pennisatum galucum) are saline tolerant, while sorghum (Sorghum valgare) and
paddy (oriza sativa) can withstand a comparatively high ESP. Among the common pulses, Tuar (Cajanus Cajan) and Black gram (Phaseolus radiatus) seemed to be relatively more salinity as well as alkalinity tolerant. Among oil seeds Mustard (Brassica nigra) tolerated 0.4 percent NaCl salinity at 15 ESP, but as ESP increased its salinity tolerance was still reduced. Sunflower, on the other hand, had a good ESP tolerance. Among the vegetables Mogri (Raphanus sativus caudatus) seemed to be the most salt and alkali resistant crop followed by Raddish (Raphanus Sativus) and Thanthalja (Amaranthus gangeticus).

The salt and alkali tolerance of a plant is highly dependent on the movement of soil water minerals and air, which in turn is a factor related to climatic changes.

In Chapter (VII), some selected samples from different salines, alkali soils were taken for leaching — sea-water treatment leaching, in order to understand the chemical nature of the soil during salinization and desalinization. It is possible to trace out that the variations in the behaviour could be first demarcated in arid zone salines of Dhandhuka - Patana, Dhandhuka-Dholera and Surendranagar - Hal Lake areas, where wide differences can be accounted due to presence of Na$_2$CO$_3$ - CaCO$_3$ in Dhanduka - Patana areas and presence of
CaCO₃ + CaSO₄ in Surendranagar - Mal Lake area and high proportion of CaCO₃ in Dhandhuka - Dholera area.

The leaching salinization - leaching 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 Broach - 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 conditions are reflected in leaching curves. The changes in $pH$ and conductivity reflect the salinity level, proportion of CaCO₃, proportion of Gypsum, type of clay in the soil and its nature towards the phenomenon of hydrolysis.

Chapter (VIII), deals with the application of Sulphuric acid (industrial waste) and a mixture of chemicals sulphur + Iron sulphate (both industrial wastes) + Gypsum Humic acid has been developed to reclaim saline-alkali soils. During the last ten years the chemists of Dudhbagar Dairy (Mehasana) were confronted with the problem of disposing off the waste sulphuric acid which amounted to two tonnes per day. In 1974, Dr. A.K. Shah and his team of scientists from the department of chemistry making use of this acid waste for reclamation of saline-alkali soils. The first experiments were conducted in
Sogodia (Patan taluka) and Zilia (Chanasma taluka) both in North Gujarat.

The Central Soil salinity laboratory in India has suggested the use of sulphuric acid for alkali soils only but to present experiment revealed that in calcareous and saline soils also the results were quite encouraging. The formation of regularly spread Gypsum in soil by the action of sulphuric acid on the calcium present in the soil increased aggregation. This also increased soil permeability and removal of salts during the subsequent leaching. The chemistry Department of Gujarat University has already reclaimed 1500 acres of land by these methods. The soils can be reclaimed within ten days after treatment. Of course, addition of water and providing drainage are essential for the success of these methods. It is also ably supported by the fact that the yield has been found to increase to 2 - 10 fold in different crops by these methods.

These methods are significant from the point of view that there are 20 lac acres of saline alkali land in Gujarat and about one crore acres in the whole of India. Hence reclamation by these methods are challenging processes to being an economical revolution for the national development.

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