CHAPTER IX
METHODS OF ANALYSIS AND CHARACTERISATION OF SOIL SAMPLES.
CHAPTER II

METHODS OF ANALYSIS AND CHARACTERISATION OF SOIL SAMPLES

Collection and preparation of soils samples:

Soil samples were collected from three major areas encompassing the whole Gujarat State. These areas are (1) North Gujarat, (2) South Gujarat, and (3) Saurashtra.

Samples of soil were collected from saline alkali affected areas. The surface layer 2"-5" depth was removed and representative layers of the profiles were sampled after digging a pit of 3'X2'. The composite and final samples were prepared by method shown in Jackson (1). Each sample was placed in a jute bag with labels. A record slip was kept in each bag, showing location of the site, description of various profile feature. In some places the sites were selected in view of change in vegetation or of distinct profile feature.

About 1 kg of the original sample was stored in wide mouth glass bottle for observation of structure, colour etc. The remaining sample was put in sun-shine for air drying and was ground in steel mortar without crushing.
the ultimate particles. The sample was sieved through 1 mm. sieve which was used for chemical and mechanical analysis (was according to B.S.S.)

Analysis of the soil samples:
The following determinations were carried out with soil samples.

1. 1:5 extract of soil for determination of pH and electrical conductivity.
2. Alkaline earth carbonate, moisture content, organic matter.
3. Mechanical analysis.
4. Cation exchange capacity.
5. X-ray diffraction of clay fraction of the soil.
7. Infiltration Rate.

Methods of soil analysis:

1. Alkaline earth carbonates:
   Ref: (2) p.105.
   (3) p.135.
   (4) p.135.

   Alkaline earth carbonates were estimated volumetrically using standard hydrochloric acid, sodium hydroxide and bromothymol blue indicator.

2. Organic matter:
Organic matter was estimated volumetrically using standard dichromate solution.

3. Mechanical analysis.

Ref: (5) p. 241-244.
(2) p. 47-49.
(4) p. 59-77.
(6) p. 257.

Organic matter and CaCO₃ were decomposed from 20 gm. soil. Coarse sand was separated by the use of a standard sieve. The silt and clay fractions were determined by the pipette method.

4. Cation exchange capacity:

Ref: (1) p. 62-64.

Cation exchange capacity was determined by using NH₄Ac and ethanol.

5. X-ray Diffraction:

The clay suspension was oriented on an unglazed porcelain tile, dried and diffraction patterns were taken on Cu Kα radiation on Philips instrument.
Hydraulic conductivity:

Na-soil, Ca-soil, Mg-soil were prepared as follows:

The normal soil was treated with 2N solution of chloride salts of sodium, calcium and magnesium. The whole solution and soil was stirred well and kept overnight. The supernatant solution was decanted and the relevant salt solution was added and the process repeated, thrice. After removal of the solution, the soil was leached with distilled water till free from chloride and then finally washed with alcohol, sun dried, ground and stored.

Different salt solutions, admixture solutions and different amendments were applied to these soils and their hydraulic conductivities were determined using Witt's apparatus, (7), described below and shown in Fig: (2).)

The tests with this apparatus provide data on vertical hydraulic conductivity and the correlation between hydraulic conductivity and granular composition, porosity, minor structures etc. The data can be used for comparison with data obtained from other methods, and as a basis for computation of direction and intensity of flow under natural conditions. The apparatus consists of a brass cylinder 5 cm. in diameter and about 11 cm. in height with two parts.
The planning of drainage and irrigation projects is mostly based on geo-hydrological investigations. These investigations are carried out to obtain an insight into the present hydrological situation, to obtain hydrological constants of soil and to find out what criteria must be used for a good functioning of the future systems. The hydrological constants to be determined comprises the hydraulic conductivity $K$, and the transmissibility $K_D$ and the vertical resistance or a leakage factor $C$ of the aquifer.
TABLE NO: II-b.

X-RAY DATA OF CLAY SEPARATES FROM THE DIFFERENT SOIL SAMPLES STUDIED.

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>D-VALUES</th>
<th>CLAY TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baroda</td>
<td>3.55, 3.58, 3.451, 3.188, 3.21, 4.251, 4.773</td>
<td>K, Mh, K-f, Q, Ch.</td>
</tr>
<tr>
<td>Navsari</td>
<td>3.55, 3.58, 3.188, 4.095, 4.53, 4.773</td>
<td>K, Mh, K-f, Q, Ch.</td>
</tr>
<tr>
<td>Rajkot</td>
<td>3.58, 3.451, 4.251, 4.394, 4.846, 4.53, 4.648, 4.022</td>
<td>K, Mh, Q, G, Ch, M, V, Mu, Ni, Tc, Cr.</td>
</tr>
<tr>
<td>Broach</td>
<td>3.493, 3.55, 3.401, 4.211, 4.394, 4.354, 4.53</td>
<td>K, Mh, Q, Gb, V.</td>
</tr>
<tr>
<td>Aslali</td>
<td>5.277, 3.335, 5.184, 3.38, 3.059, 3.21, 4.058, 4.17, 4.272, 4.773</td>
<td>K, K-f, Q, Ch.</td>
</tr>
</tbody>
</table>

Where: K= kaolinite, M= montmorillonite, I= Illite, K-f= K-feldspar, C= calcite, H= halloysite, Cr= crystablontite, Q= quartz, Gy= gypsum, Gb= gibbsite, Gt= goethite, Mi= mica, Mu= muscovite, Mh= metahalloysite, P= pyrophillite, Ch= chlorite, Hb= hornblende, Tc= talc, V= vermiculite.

NOTE: SYMBOLS UNDERLINED SHOWS PROMINENT COMPONENT.
<table>
<thead>
<tr>
<th>Location</th>
<th>Conductivity (mhos/cm)</th>
<th>pH</th>
<th>Bulk Density</th>
<th>Sat. percentage</th>
<th>CaCO3 %</th>
<th>Org. Matter %</th>
<th>Total Sand %</th>
<th>Silt %</th>
<th>Clay %</th>
<th>Soil Texture</th>
<th>Clay Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anand</td>
<td>1.3</td>
<td>7.3</td>
<td>1.26</td>
<td>30.0</td>
<td>2.4</td>
<td>0.6</td>
<td>73.8</td>
<td>6.2</td>
<td>17.0</td>
<td>Sandy clay loam</td>
<td>Montmorillonite</td>
</tr>
<tr>
<td>Amreli</td>
<td>4.8</td>
<td>8.8</td>
<td>1.38</td>
<td>50.2</td>
<td>17.8</td>
<td>0.99</td>
<td>37.3</td>
<td>20.9</td>
<td>22.8</td>
<td>Clay loam</td>
<td>Kaolinite with quartz, Illite-Kaolinite-montmorillonite</td>
</tr>
<tr>
<td>Asalali</td>
<td>6.6</td>
<td>7.6</td>
<td>1.58</td>
<td>31-6</td>
<td>3.8</td>
<td>3.0</td>
<td>77.2</td>
<td>7.0</td>
<td>8.7</td>
<td>Loamy sand</td>
<td>Montmorillonite, Kaolinite-montmorillonite</td>
</tr>
<tr>
<td>Bagodara</td>
<td>4.0</td>
<td>8.4</td>
<td>1.52</td>
<td>39.2</td>
<td>11.2</td>
<td>2.9</td>
<td>55.5</td>
<td>9.1</td>
<td>21.2</td>
<td>Sandy clay loam</td>
<td>Montmorillonite</td>
</tr>
<tr>
<td>Baroda</td>
<td>2.0</td>
<td>7.4</td>
<td>1.31</td>
<td>31.0</td>
<td>0.7</td>
<td>1.2</td>
<td>77.1</td>
<td>4.3</td>
<td>17.2</td>
<td>Sandy clay loam</td>
<td>Montmorillonite, Kaolinite-montmorillonite</td>
</tr>
<tr>
<td>Broach</td>
<td>4.8</td>
<td>8.6</td>
<td>1.28</td>
<td>50.0</td>
<td>5.3</td>
<td>0.8</td>
<td>45.2</td>
<td>14.0</td>
<td>34.5</td>
<td>Sandy clay</td>
<td>Montmorillonite, Kaolinite-montmorillonite</td>
</tr>
<tr>
<td>Navsari</td>
<td>1.6</td>
<td>7.7</td>
<td>1.34</td>
<td>32.5</td>
<td>3.7</td>
<td>1.0</td>
<td>66.1</td>
<td>13.9</td>
<td>15.3</td>
<td>Sandy clay loam</td>
<td>Montmorillonite</td>
</tr>
<tr>
<td>Rajkot</td>
<td>7.0</td>
<td>9.6</td>
<td>1.52</td>
<td>47.5</td>
<td>39.2</td>
<td>0.65</td>
<td>26.2</td>
<td>11.0</td>
<td>23.1</td>
<td>Clay Loam</td>
<td>Montmorillonite, Kaolinite with quartz, gibbsite &amp; Chlorite</td>
</tr>
</tbody>
</table>
Apparatus for the laboratory determination of hydraulic conductivity (constant head method).

Infiltration rates were measured by the tube method described below:

In order to understand the nature of infiltration rates continued over a short period, the following method was used, which is actually a slight modification of the technique used by Dettman and Emerson. Of course, it is known that as the size of the tube is small, the measurement cannot be considered highly accurate, but in order to obtain comparative infiltration rates for different soils, this method was adopted for disturbed soil samples.

The soil was filled in hard glass test tube of length 20.0 cm and diameter 2.6 cm, with an arrangement of transverse holes to maintain 2.0 cm height of water over the soil filled by stroke method. In the lower part, sand was filled by placing cotton plug in the hole below. The level of water was maintained constant by adding water or solution from the reservoir.

Table II-a shows the characterisation chart for the soil samples. Table II-b shows the X-ray data.

Fig. II-8 shows the nature of the X-ray diffraction peaks for the different soils studied.
BIBLIOGRAPHY