Electro-osmotic Saturation of Triaxial Test Samples using Vertical Flow Technique

by

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Introduction

SATURATION of soil samples is invariably required in a triaxial test. Back pressure technique is used for this purpose. This technique is time consuming and cumbersome. The principle of electro-osmosis has been used for saturating the triaxial samples by Kirwan *et al* (1969). He used the radial flow technique where a hypodermic needle pushed into the centre of the sample acts as anode and a porous shell alround the sample as cathode. Excessive handling of the soil specimen may occur in this method while transferring the sample to the triaxial cell for testing. In this paper, instead of forcing water radially in the sample, a verticle flow technique has been used as suggested by Sridhara (1970). Undisturbed samples of the silt were used for saturation in this study.

Experimental Set-up and Procedure

Figure 1 shows the set up used in this investigation. Cathode is in the form of a perforated disc kept over the pedestal of the triaxial base,

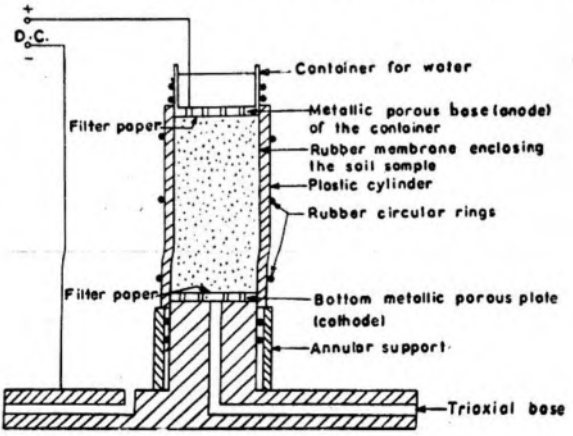

FIGURE 1 : Experimental set-up.

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while the perforated bottom of the water container placed over the top of the sample forms the anode. Filter papers are kept both at the top and the bottom of the sample. The sample is enclosed by a rubber membrane in the usual manner. A split plastic cylinder surrounding the sample is held tightly to it by means of rubber rings. This is required to prevent any lateral bulging of the sample during the saturation process. Direct current is then passed in the sample through the two electrodes. This forces water to flow from the top container into the sample. Current and Voltage are controlled in order to prevent overheating and electrophoresis. The split cylinder is removed after the saturation is complete and the specimen is then ready for testing. The soil used for the tests was locally available silt containing 85 percent silt fraction, 10 percent sand fraction and 5 percent clay fraction having liquid limit as 30 percent and plasticity index as 9 percent and *pH* as 7. Tests were performed on undisturbed compacted soil samples of 7·6 cm height and 3·8 cm diameter size.

Results

Water contents, both before and after saturation were determined from top, middle and bottom of the samples. The corresponding degree of saturation was then calculated. The results for undisturbed samples are presented in Table I.

TABLE I

Distribution of degree of saturation in the sample percent.

Sample No.	Approx. distance from top of sample in cm	Initial saturation	Final saturation
I	1·5	68·0	86·0
40 mA 100 V	4·0	68·8	82·4
3 hour run	6·0	69·0	81·3
II	1·5	66·5	96·0
40 mA 100 V	4·0	70·0	95·4
3½ hour run	6·0	68·0	91·5

Discussions and Remarks

The results show that for undisturbed samples of 7·6 cm height and 3·8 cm dia. size, three and a half hour run gave an average degree of saturation of about 94 percent. Therefore, it appears that 3½ to 4 hours for undisturbed samples are quite sufficient to achieve almost full saturation for silts.

The Current/Voltage had to be kept around 35 to 45 mA/ 80 to 100 V to avoid overheating.

No detectable change in the *pH* values of the samples under study was observed. Small amounts of metallic salts were found to be deposited on the electrodes after saturation. This deposition could however be retarded by using platinum gauge electrodes as suggested by Evans and Lewis (1966).

This technique has been used for saturating the soil samples of 7·6 cm height and 3·8 cm dia. size quite satisfactorily in connection with a number of projects undertaken by the authors.

An attempt was also made to saturate 20 cm × 10 cm dia. samples of the same soil using this technique. It was observed that nearly twelve hours may be necessary for achieving about 95 percent saturation at 150 mA/80 V. It is the contention of the authors that the radial flow technique is better for bigger size sample and the vertical flow technique is better for samples of smaller size.

Earlier, instead of using a split plastic cylinder encasing the soil sample, water was introduced in the cell and an effort was made to use this water for saturation. This method, however, did not work as it resulted in short circuiting. The cell had, therefore, to be removed and instead the split cylinder was used for preventing the sample bulging during saturation.

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