Chapter 4

Assessment of Alkali-Induced Heaving through Electrokinetics

4.1 General

The impact of alkali on the heaving behaviour of expansive and non-expansive soils analysed by different researchers has been discussed in chapter 2. Nevertheless, the effect of alkali contamination on other geotechnical properties of soil has not been precisely focused. To assess the effect of alkali contamination on the heaving and other geotechnical properties of soil, a detailed experimental program has been designed and discussed in chapter 3. In this chapter an investigation has been carried out to examine the alkali-induced heaving caused due to alkali-soil interaction at high concentrations of NaOH (8M, 12M, and 16M) as well as the effect of the alkali on geotechnical properties of soil by performing a series of geotechnical tests on soil with different concentrations of NaOH solutions. Despite that, this chapter also addresses the heaving behaviour of soil after alkali interaction in two different large-scale models using electrokinetics. The fabrication detail and dimensions of models, along with the apparatus used in the conduction of the large-scale model tank equipped with an electrokinetic experiment, have been provided in chapter 3.

4.2 Effect of Alkali Concentration on Soil

In this section, the heaving in soil due to NaOH inundation at different molar was studied. Further, the change in geotechnical properties of soil after the alkali interaction was also studied. The alteration in these properties are discussed in detail in subsequent sections.

4.2.1 Particle Size Analysis

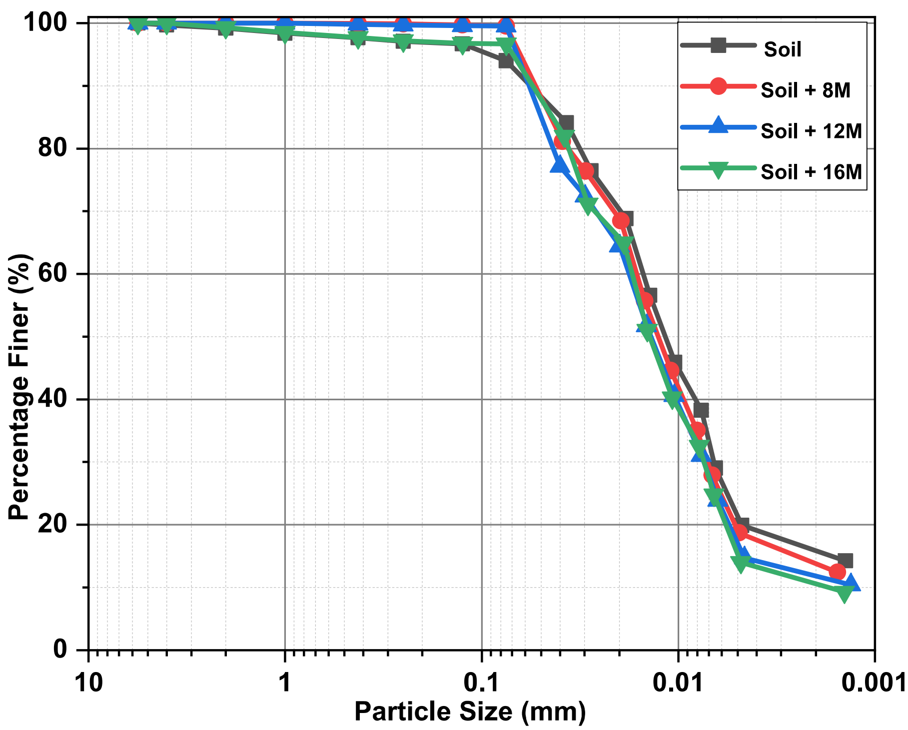


Figure 4.1: Particle size analysis of soil after alkali interaction

The change in particle size of soil due to interaction with 8M, 12M and 16M of NaOH are shown in Fig. 4.1. The figure depicts that after alkali interaction no significant change in gradation of soil particle was observed.

4.2.2 Atterberg Limits

Atterberg's limits are most common tests in the field of soil engineering. Atterberg's limits are very important in terms of soil classification. Atterberg's limits or consistency limits plays an important role in classifying soil on the basis of its behaviour under varying moisture content. It was observed that with an increase in the molarity of sodium hydroxide, the liquid limit and plastic limit values decrease drastically as shown in Fig. 4.2. The alkali contamination can affect the soil properties by two different mechanisms either by the increase in the pH of the soil which increases the negative charges on the surface of clay particles and causes repulsion of clay particles or due to increase in the electrolyte concentration which reduces the diffuse double layer repulsion and brings the particles closer (Ramakrishnegowda et al., 2011). Ultimately it causes the change in liquid limit and plastic limit values due to formation of new compounds after interaction with alkali. The new compound formed might have caused the rupture of the flocculated structure, which may also reduce the liquid limit. Similar findings were also reported by Sivapullaiah et al. (2010).

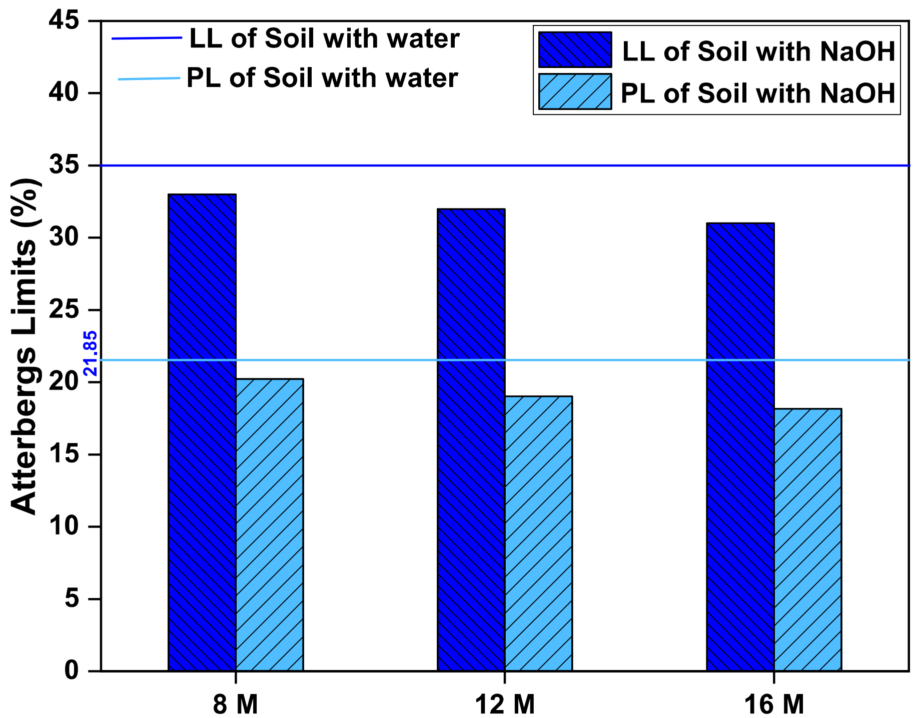


Figure 4.2: Atterberg limits of soil with NaOH solution

4.2.3 Specific Gravity

The specific gravity of soil solids is used while calculating the density of the soil solids. Any alteration in the chemical composition of soils due to its chemical reactions with alkali causes a change in the specific gravity of interacted soil. The specific gravity value of alkali-interacted soil was found to be lower than clean soil as shown in Fig. 4.3.

Sivapullaiah et al. (2005) reveals that the reduction in specific gravity of alkali-interacted soil occurs due to the formation of a new compound (NASH) whose specific gravity has been reported to be lower than that of soil. Higher is the formation of NASH lower will be the specific gravity.

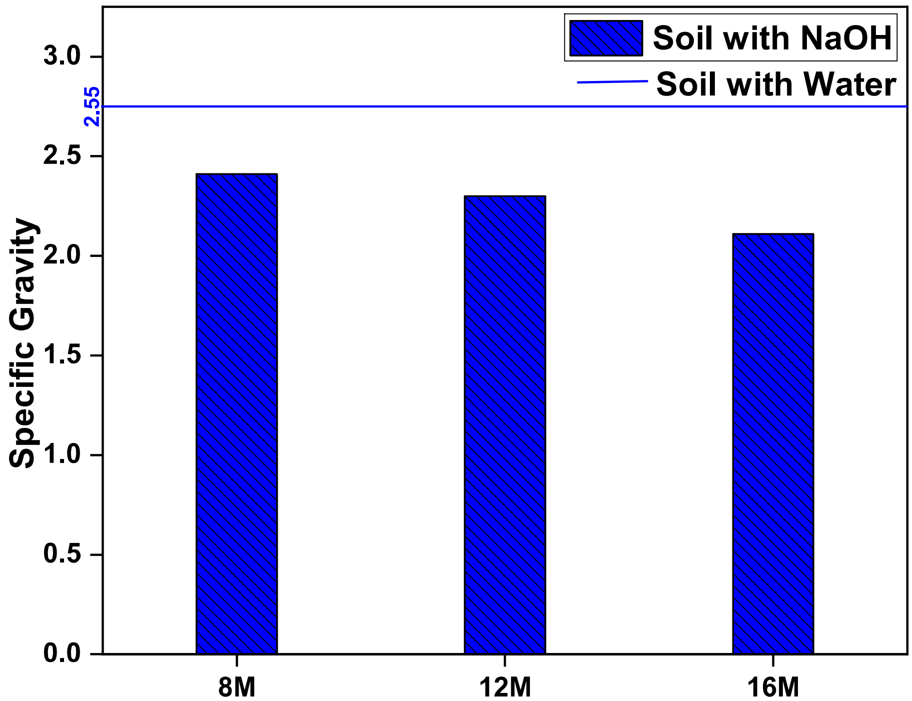


Figure 4.3: Specific Gravity of soil with alkali interaction

4.2.4 Compaction Characterstics

The compaction characteristics of uninteracted soil and alkali interacted soil were determined and are presented in Fig. 4.4. As it can be observed that the increase in the concentration of alkali solution increases both maximum dry density (MDD) and optimum moisture content (OMC) of the soil. The formation of new compounds due to the alkali interaction exhibits a high adsorption capacity of soil and behaves more non-plastic leading to changes in OMC and MDD. Similar results have also been reported by Soni and Varshney (2021).

4.2.5 Heaving Analysis

Alkali-induced soil heaving was measured in one-dimensional oedometer test. The soil was compacted in a consolidated ring of dimensions 6 cm in diameter and 2 cm in height

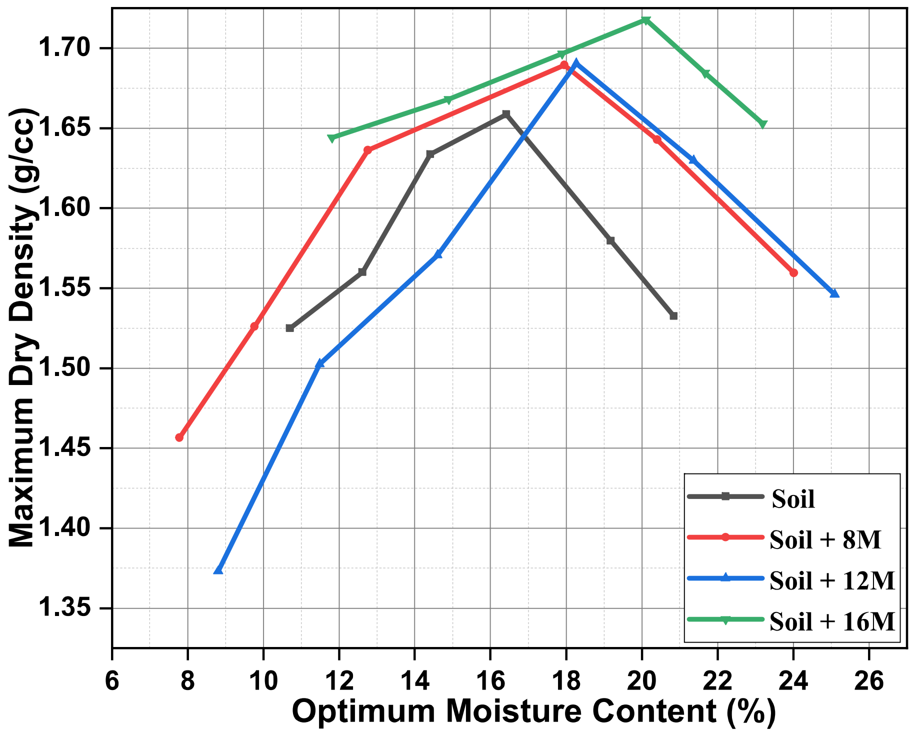


Figure 4.4: Compaction curve of soil with alkalli interaction

at its maximum dry density and optimum moisture content. The soil specimens were then inundated with different concentrations of alkali solution (8M, 12M and 16M) and heaving was measured under free loading conditions using a dial gauge. The percentage heave was calculated by the change in height of the sample to the original height of the sample after an interaction. The swelling in the soil after alkali interaction leads to a change in strength and deformation properties of soil which in turn influence the safety and stability of structure built on it.

The heaving due to alkali interaction depends upon the chemical composition, concentration of alkali, chemico-mineralogical composition and exchange capacity and etc (Reddy et al., 2017). Fig. 4.5 shows the effect of different molarity of NaOH solution on heaving behaviour of soil. The maximum heaving was observed to be about 5.55% upon inundation of 16M NaOH solution, whereas it is about 3.65% and 2.1% in case of samples inundated with 12M and 8M NaOH solutions respectively. The heaving after alkali interaction can be explained by two possible mechanisms first by the increase in pH of the soil which is attributed to the inundation of alkali solution which leads to an increase in negative charge on the clay particle resulting in greater repulsion between the soil particles

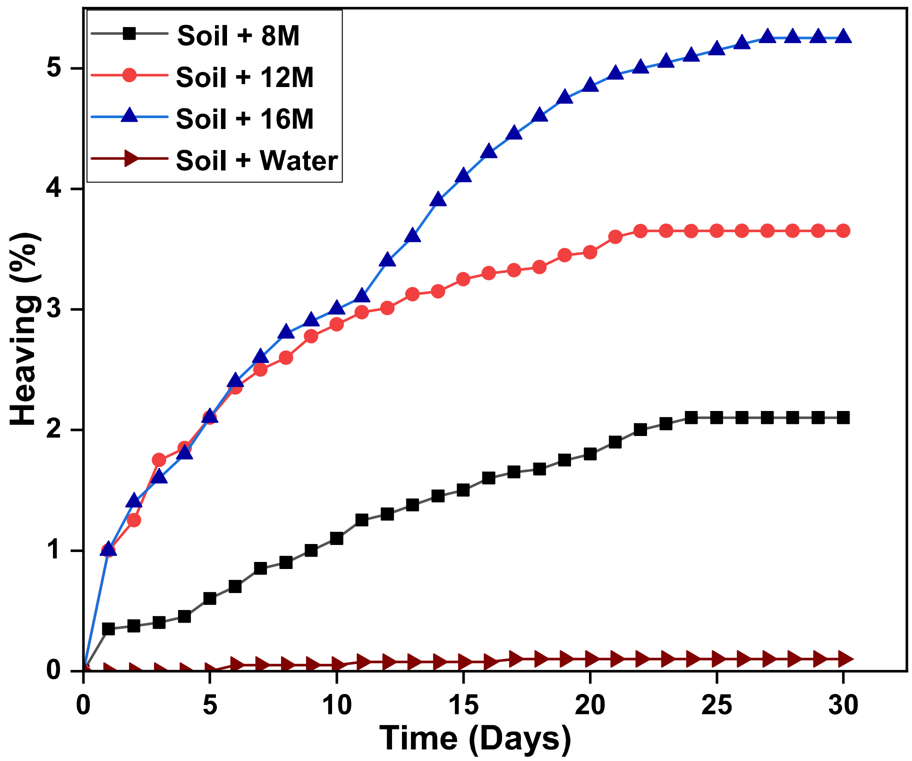


Figure 4.5: Heaving in soil due to inundation of NaOH Solutions

and thus increase in heaving of soil and second by the increased in NaOH concentration leading to the formation of the new compound, sodium aluminium silicate hydroxide hydrate (NASH). X-ray diffraction studies also confirm the formation of the peak of a new compound formed due to interaction of alkali with soil. Many other researchers also established that change in soil heaving is not only due to moisture variation but also due to active decomposition under highly alkaline solution conditions leading to formations of new compounds in voids of soil (Chavali et al., 2017; Reddy and Sivapullaiah, 2010; Sivapullaiah and Manju, 2006).

4.2.6 Heaving Pressure

Once the heaving in the soil had reached the equilibrium stage the samples were subjected to gradual loading till it reaches their original height. The total amount of load being applied on the heaved sample to allow it to reach its initial height of soil is considered as heaving pressure in case of alkali interacted soil. It has been observed that with the increasing concentration of alkali solution, heaving pressure increases for all molarities of alkali solution as shown in Fig. 4.6. The maximum heaving pressure observed is 661.95 kN/m^2 corresponding to 16M NaOH solution. It was observed that the effect of alkali solution in case of short duration interaction was found negligible, but for a longer period of interaction, a significant amount of heaving pressure was observed. The expansive behaviour of the soil can be explained as alkali-silica reaction due to the interaction of reactive silica with alkali solution thus causing the generation of gel compounds which finally lead to expansion of soil in the presence of moisture exerted heaving pressure due to inundated with alkali.

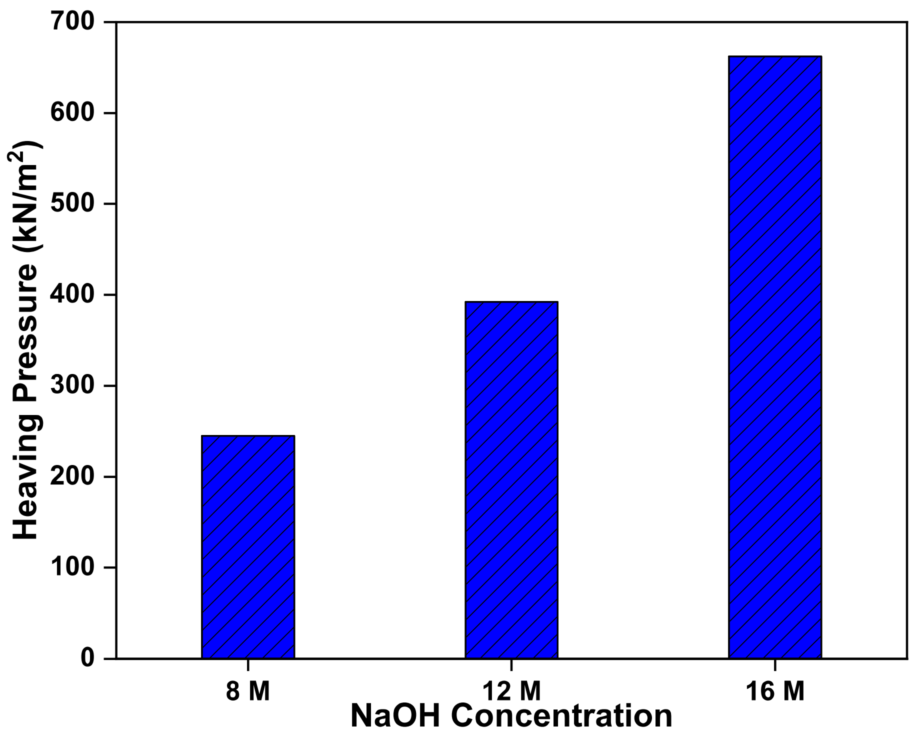


Figure 4.6: Heaving Pressure in soil due to inundation of NaOH Solutions

4.2.7 Unconfined Compressive Strength

The variation in unconfined compressive strength of soil with different concentrations of NaOH solution is shown in Fig. 4.7. The unconfined compressive strength decreases with the increasing concentration of alkali. This decrement in the unconfined compressive strength of the soil may be due to the formation of the new compounds due to the interaction of soil with sodium hydroxide.

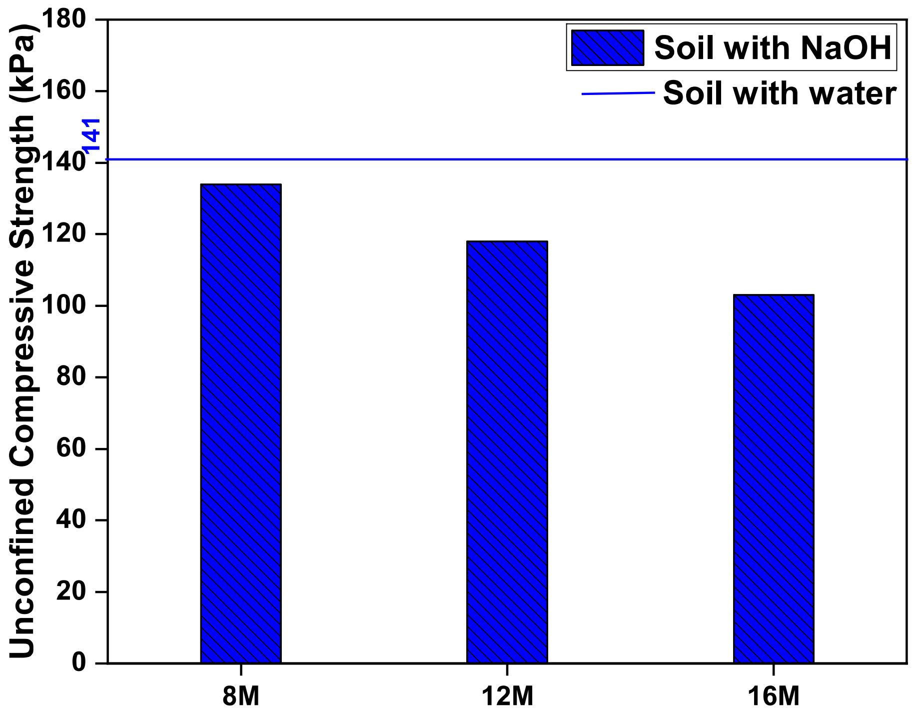


Figure 4.7: UCS value of alkali interacted soil

4.2.8 Shear Strength Parameters

The effect of different molarities of NaOH on the shear strength parameter of soil is shown in Fig. 4.8 and Fig. 4.9 respectively. The variation in the shear strength parameter of soil depends upon the concentration and interaction period of the contaminant. It was observed that the cohesion value of contaminated soil decreases and the angle of internal friction values show an increasing trend with an increase in the morality of NaOH solution.

4.2.9 Zeta Potential

Zeta potential is one of the physicochemical properties of fine-grained soils. Fig. 4.10 shows the variation in zeta potential value of soil with water and different molarity of NaOH solution. It has been observed that alkali solution has a significant influence on the zeta potential of soil. Interaction of alkali solution with the soil leads to an increase of zeta potential on their surfaces as compared to water.

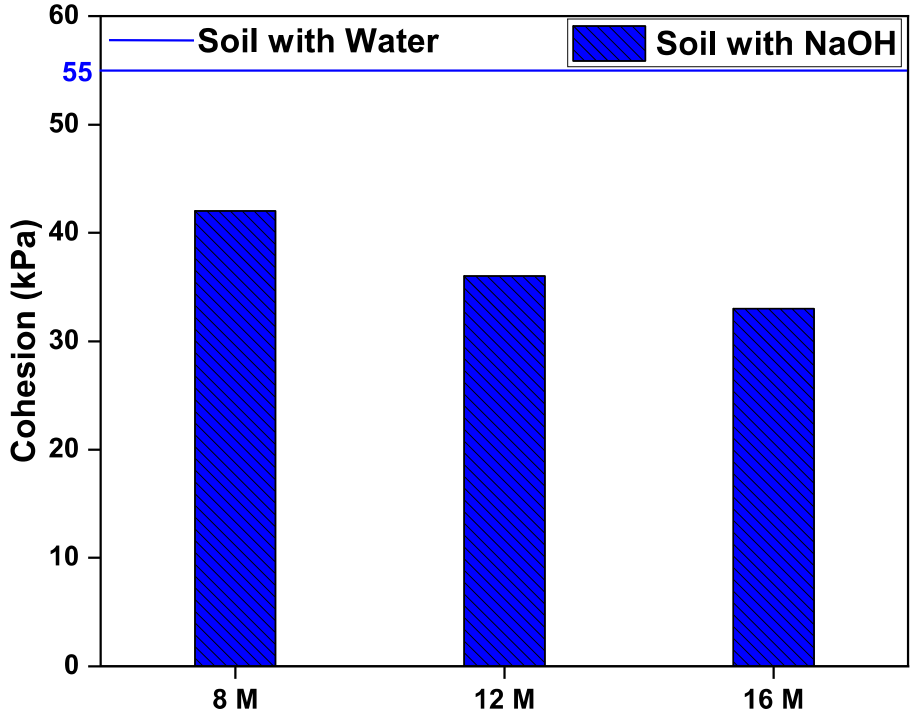


Figure 4.8: Variation in cohesion of soil with different molarities of NaOH solution

4.2.10 Dielectric Constant

Dielectric constant measurements were made for clean and alkali interacted soil at frequencies between 0 and 100000 Hz as shown in Fig. 4.11. It was observed that alkali interaction has a pronounced effect on dielectric behaviour. The dielectric constant value drastically increases on mixing with alkali solutions.

4.2.11 X-ray fluorescence analysis

XRF analysis has been performed to determine the chemical composition as shown in Fig.4.12. From XRF analysis it has been observed that the interaction of alkali with the soil leads to the leaching of silica from the soil. The decrease in Si/Al ratio confirms the leaching of silica due to alkali interaction. The Si concentration decreases with the interaction of alkali however the Al percentage increases. The change in concentration of Si and Al is attributed to the formation of new compounds.

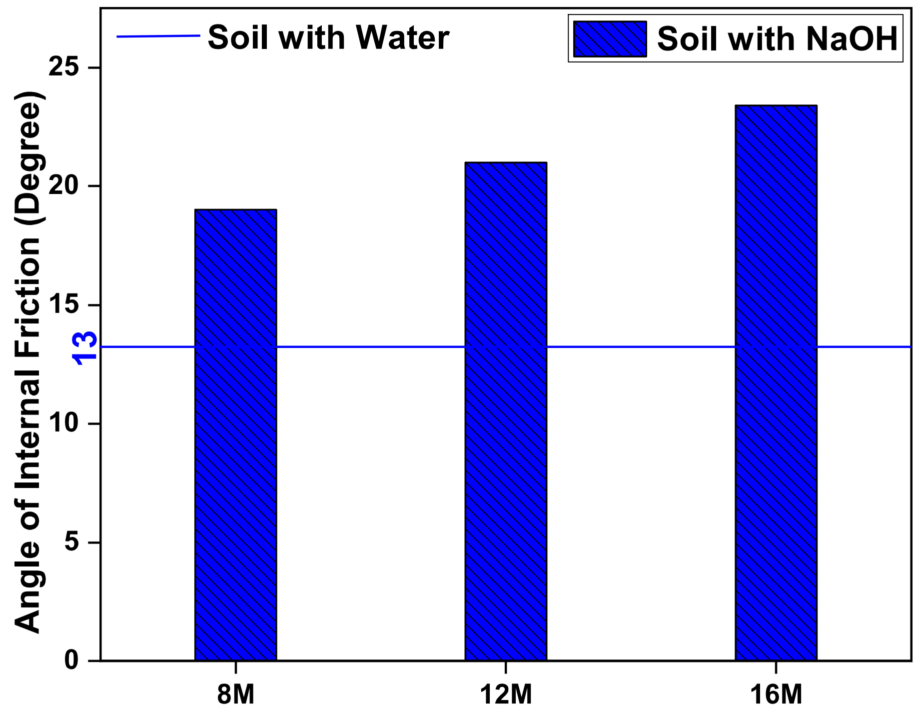


Figure 4.9: Variation in angle of internal friction of soil with different molarities of NaOH solution

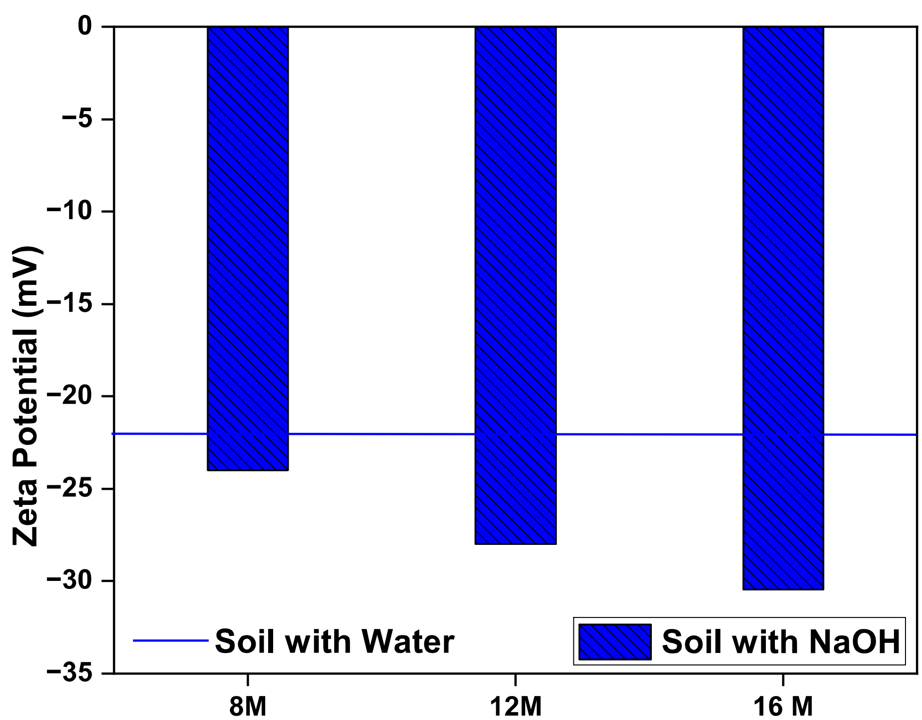


Figure 4.10: Zeta potential of soil after alkali interaction

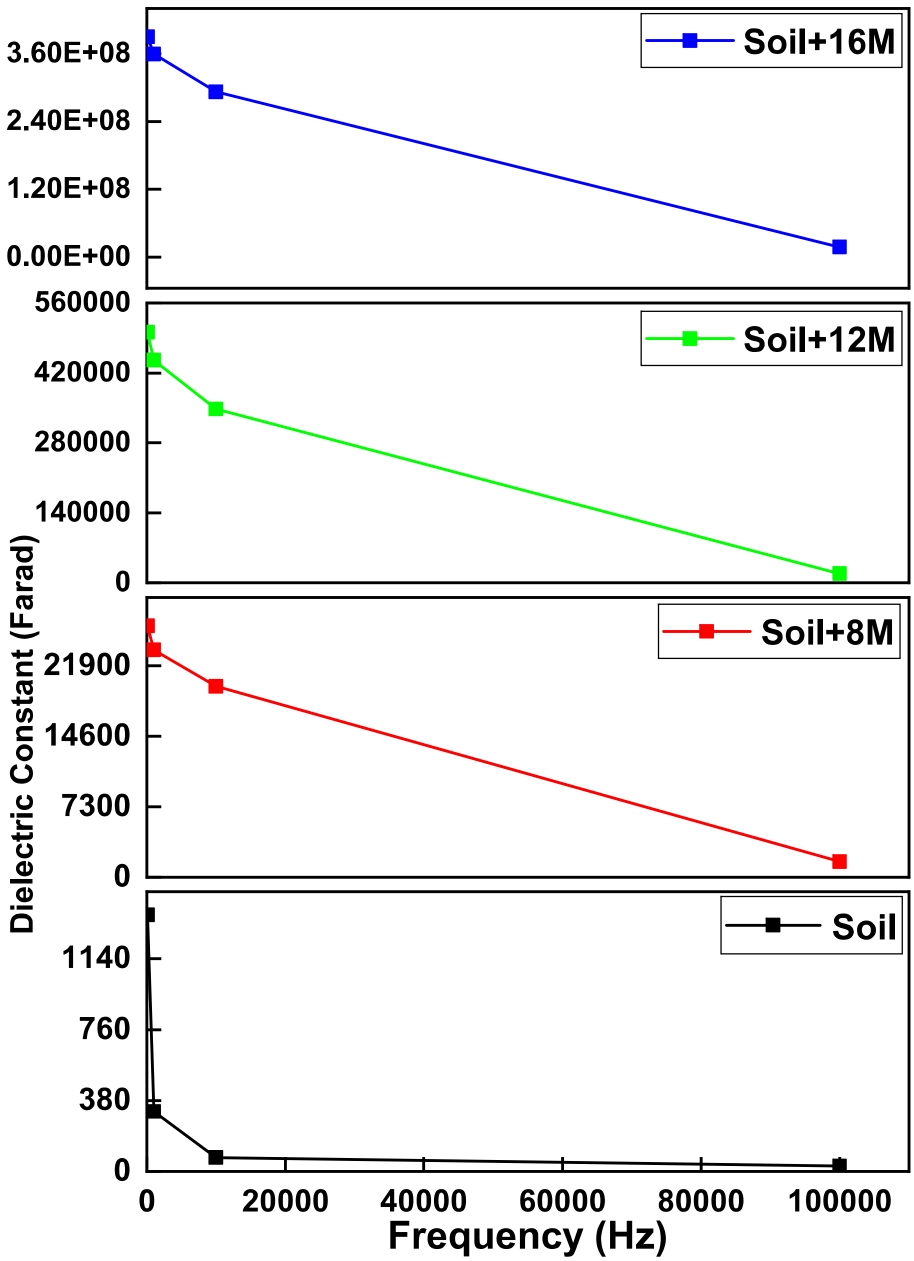


Figure 4.11: Dielectric Constant of soil after alkali interaction

4.2.12 Mineralogical Analysis

XRD analysis was performed to check for the formation of any new products in the soil after its interaction with 16M NaOH solution. The soil specimens were collected soon after the completion of the 60 days interaction period. These specimens were dried and grinded to a fine powder with mortar and pestle. X-ray diffractometer was used to scan the sample and identify the mineral composition of the soil specimen corresponding to XRD

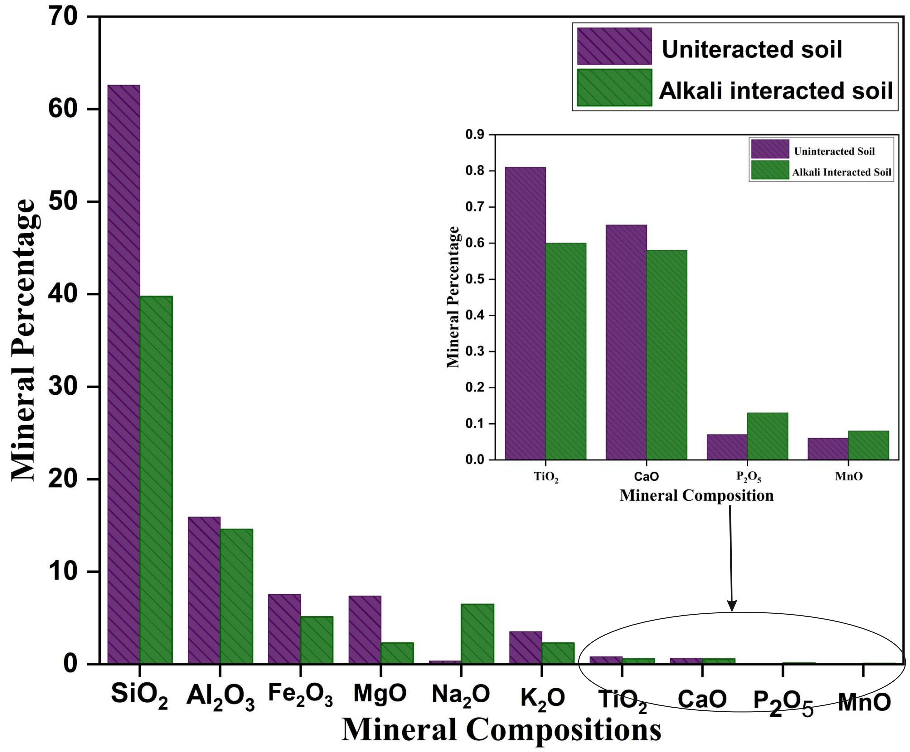


Figure 4.12: X-ray Chemical Composition of different soil inundated with water and alkali

peak position and intensities using JCPDS software. The X- Ray diffraction patterns for virgin and alkali interacted soil are shown in Fig. 4.13. New peaks corresponding to NASH have been observed by the XRD analysis which is a mineral of zeolite group (Sodium aluminium silicate hydrate) which is responsible for the heaving of soil.

4.2.13 Micro Structural Analysis

Morphological studies are carried out using a scanning electron microscope (SEM) to understand the morphological and elemental composition change occurring in the soil due to alkali interaction. SEM images of soil samples that interacted with water and 16 molars NaOH solutions are shown in Fig. 4.14. The SEM image of alkali interacted soil is clearly evident of severe disintegration and weathering of soil upon interaction with alkali solution as compared to uninteracted soil. It is also observed that the soil particle shows dispersive nature in the presence of alkali solution when compared with the original soil. Rosette-type particle morphology can also be seen in the SEM image that supports the morphological change in soil due to alkali interaction.

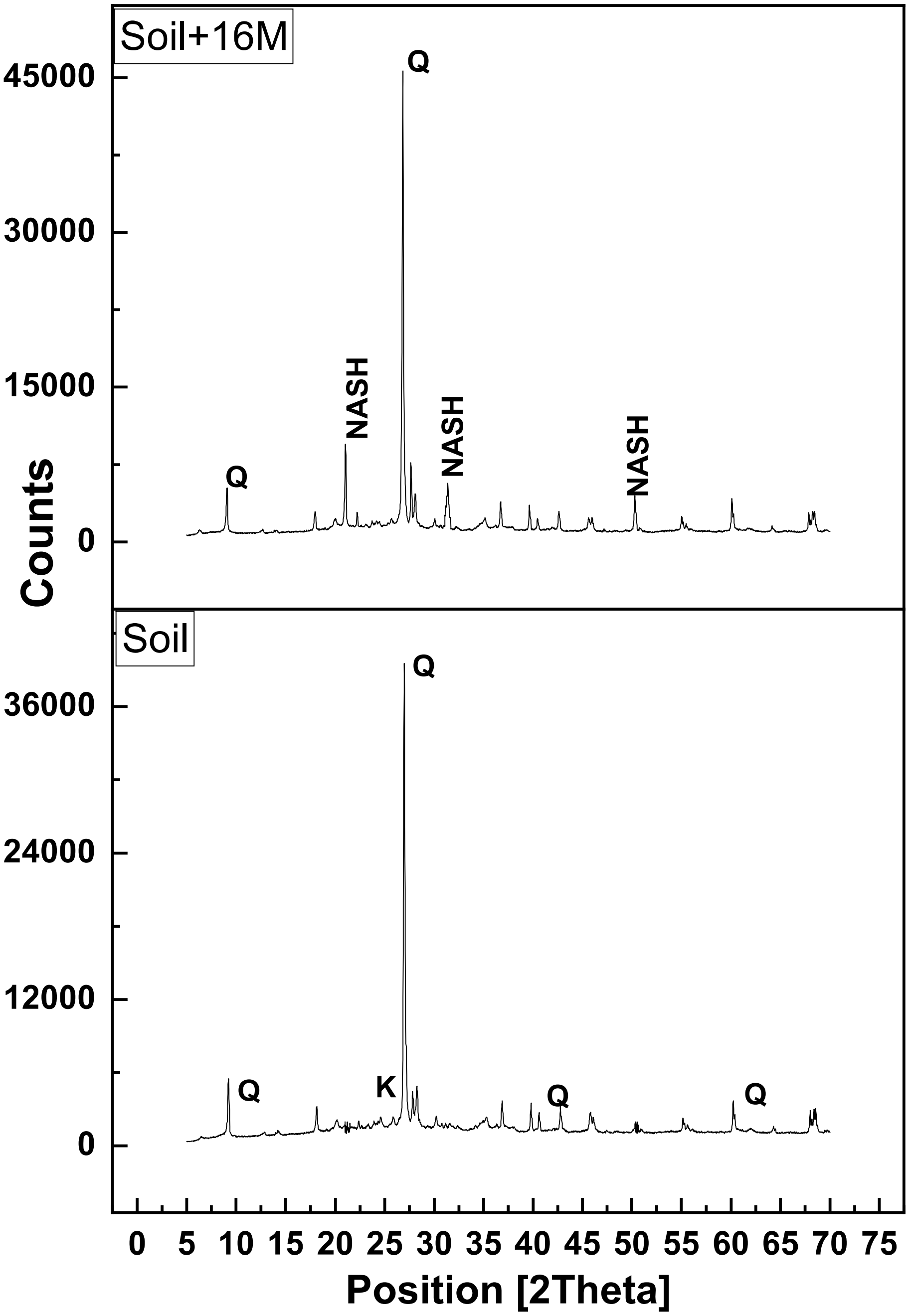
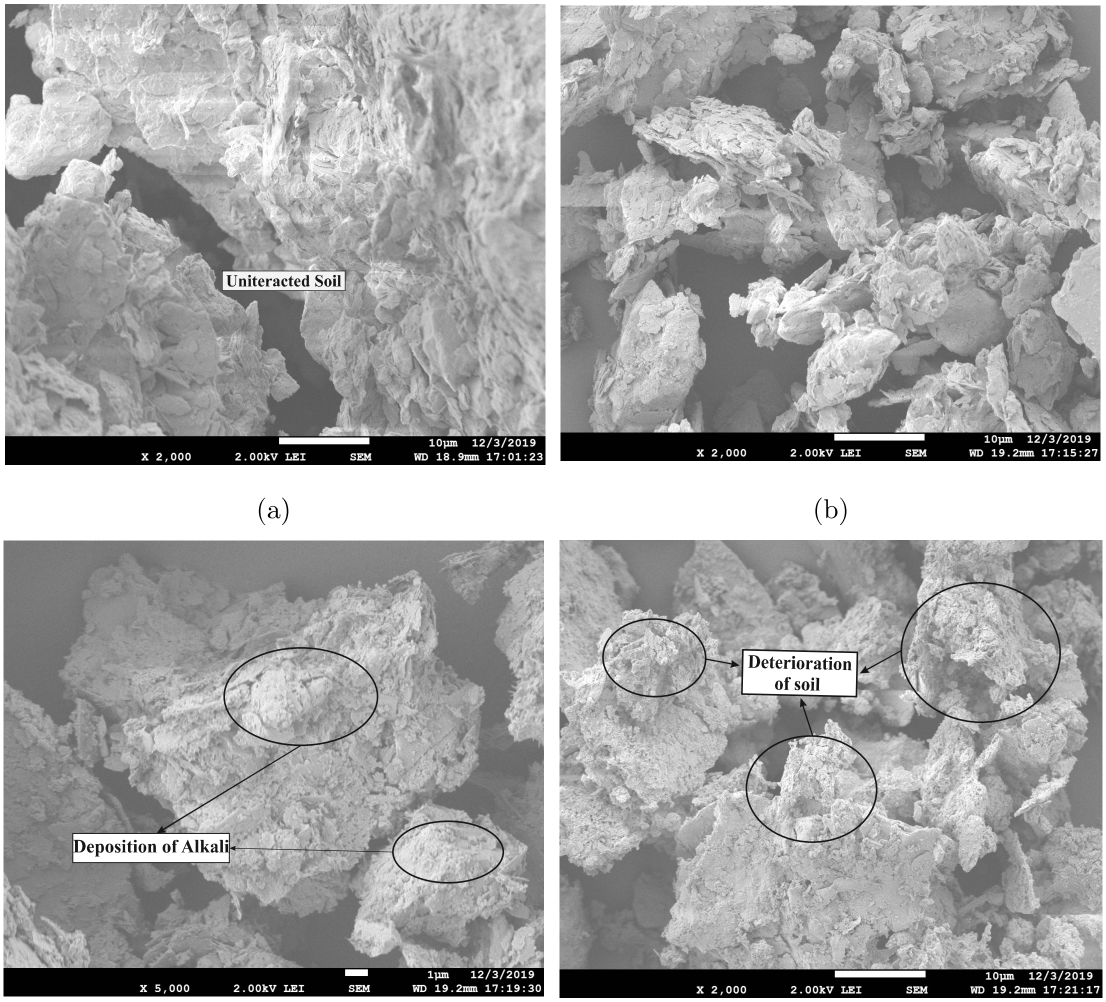


Figure 4.13: XRD analysis of uninteracted soil and alkali interacted soil with 16M NaOH solution

4.3 Alkali-Induced Soil Heaving in Large Scale Model through Electrokinetics

In this section, an attempt has been made to conduct EK equipped large-scale model study to analyse the heaving phenomena observed in fields. The effect of the model geometry



(c) (d)

Figure 4.14: SEM images of (a), (b) uninteracted soil and (c), (d) alkali interacted soil

has also been taken into account by using a rectangular and circular-shaped model. The results were compared in terms of percentage heaving and heaving pressure. Further, the effect of boundary geometry in EK-equipped models was analysed in terms of variations in voltage, temperature and electroosmotic discharge. The effect of alkali interaction using the EK technique on the engineering properties of the soil was also compared for both models.

The whole experimental analysis was conducted in two different setups the details of each type of experimental setup are explained in detail in the subsequent sections.

4.3.1 Rectangular Model Equipped with Electrokinetics

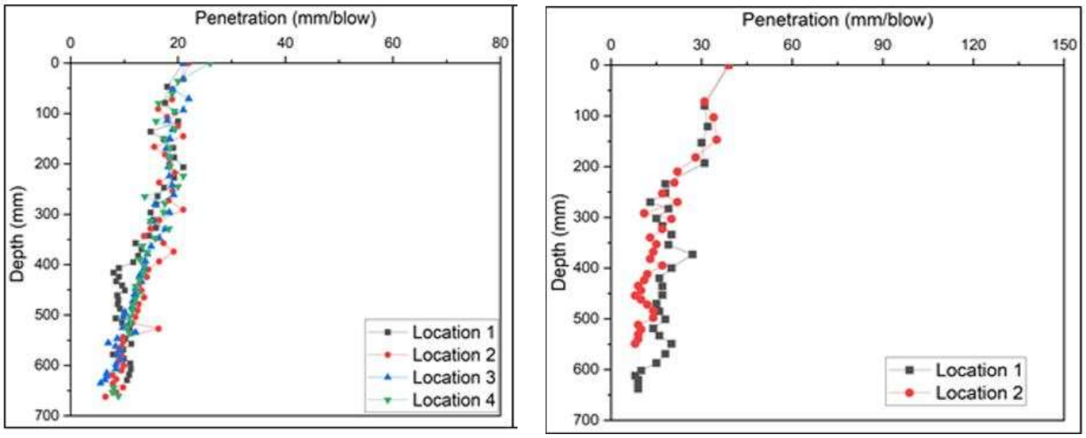
The first phase of the experiment involved a large-scale rectangular model testing to examine the heaving behaviour of alkali-interacted soil. The movement of the NaOH as the pore fluid takes place under the influence of an electric potential gradient. The schematic of the elevation and plan of the model testing tank has been discussed in detail in the chapter materials and methodology.

4.3.2 Circular Model Equipped with Electrokinetics

The second phase of the experiment was conducted in a large-scale circular model made up of reinforced cement concrete. The flow of NaOH in this model was also occurs under voltage gradient. The elevation and plan of which are discussed in detail in the chapter materials and methodology.

4.3.3 Sample Preparation

Preparation of the soil bed in the testing tank was a challenging task as any sort of non-homogeneity was not desirable. The soil bed was compacted to the density equivalent to the bulk density and moisture content corresponding to OMC. A pre-calculated amount of soil was mixed with the water corresponding to the OMC, and this soil was compacted in the tank in 5 layers. The bottom two layers were given a little less compactive effort as compared to the upper one in order to incorporate the settlement due to overburden stresses. Once the soil bed was prepared, a dynamic cone Penetration Test (DCPT) was conducted at different locations to check for uniformity in the prepared soil bed. The results were plotted in terms of penetration of the cone in mm per blow which is termed as Dynamic Penetration Index (DPI). In the case of the rectangular tank, DCPT tests were conducted at the four corners, while in the case of the circular tank, it was conducted at two diametrically opposite points. The results of the tests are shown in Fig. 4.15a shows the DCPT results for the rectangular model, while Fig. 4.15b shows DCPT results for the circular model. The DCPT profiles for both types of models were almost uniform for all locations except a slight decrease was observed at the bottom owing to the densification due to overburden stresses.



(a) (b)

Figure 4.15: CPT test results for (a) rectangular model and (b) circular model

4.3.4 Electrokinetic Mechanism

The soil used in the study comes under category of clay with low compressibility (CL) which show very low permeability. The movement of fluid in such type of soil take very long time, for the fast movement of the NaOH as the pore fluid electric potential gradient applied across the soil end. In large scale rectangular model, two electrodes were made up of a brass net sandwiched between two geotextile sheets which were then fixed against the acrylic sheets. A potential difference of 100 V across the two ends of the soil chamber was applied using these electrodes. The voltage sensor and temperature sensor, each 9 in number, were placed inside the soil sample to measure voltage and temperature change throughout the experiment. However, in large scale circular model the electrodes were placed on the inner wall surface of the soil chamber. A voltage difference of 30 V was applied across the soil through these electrodes. Four voltage sensor and temperature sensor were placed at the mid depth of soil to measure the voltage and temperature during the experiment. In both cases the percentage heaving and heaving pressure were measured under the effect of NaOH solution interaction. For this 16 molar NaOH solution was filled in anode chamber and voltage was applied through a DC supplier. The electroosmotic flow was measured by measuring the fluid collected in cathode chamber. After the completion of EK test the soil sample were collected, UCS and unconsolidated undrained test were conducted on the collected soil sample to examine the alteration in strength of soil after alkali interaction.

4.3.5 Comparison of Rectangular and Circular Model Equipped with EK

In this section comparison of the variation in the surface heaving, heaving pressure, voltage, temperature, EO flow during the EK test and change in different geotechnical properties of soil after alkali interaction in the rectangular EK model and the circular EK model are discussed.

4.3.5.1 Surface Heaving

The time vs heaving profiles for all the two test setups is shown in Fig. 4.16 and Fig. 4.17. The soil sample was mixed thoroughly with distilled water at optimum moisture content and compacted statically to the desired depth to achieve density nearest to maximum dry density. The heaving showed a continuous increase with time. Fig.4.16 shows the heaving

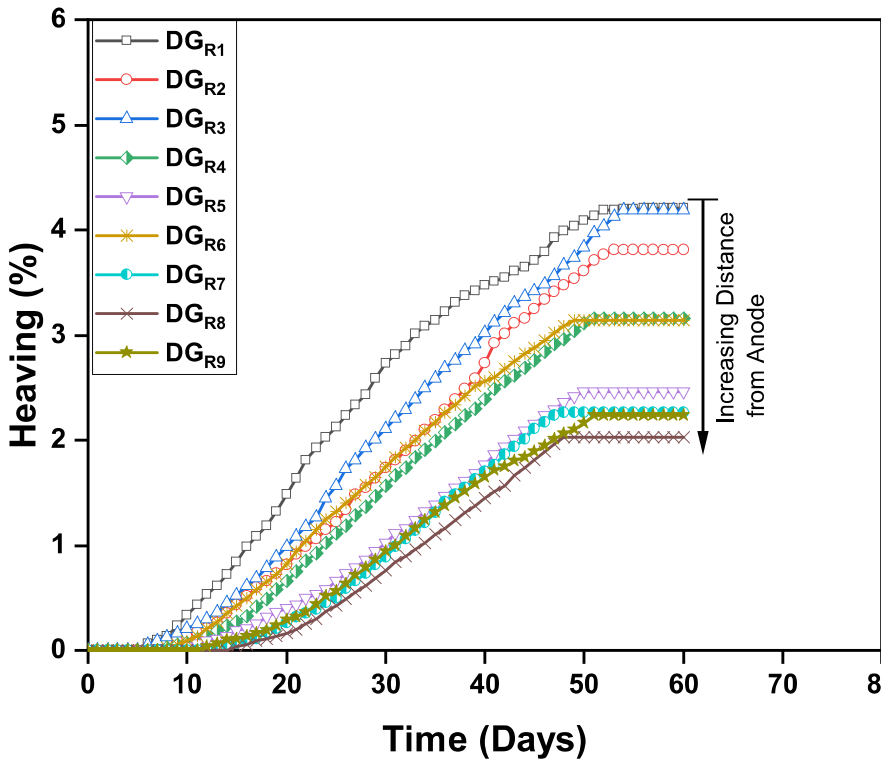


Figure 4.16: Heaving in soil inundated with16M NaOH solution in rectangular model

recorded in the nine dial gauges in the rectangular electrokinetic test set-up. The graph is evidence of an obvious increase in the heaving with time for all the dial gauges. However, when the distance from the anode was increased, the percentage of heaving decreased.

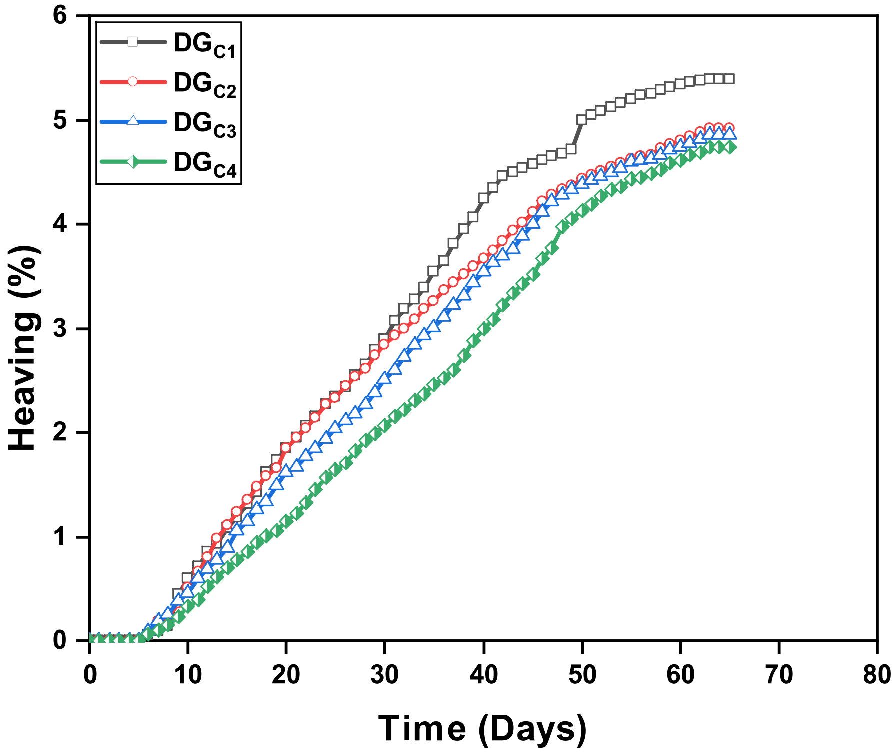


Figure 4.17: Heaving in soil inundated with16M NaOH solution in circular model

The maximum value of heaving in the case of rectangular test setup was 4.39% which was observed in the dial gauges nearest to the anode. The reason could be attributed to the fact that the soil nearer to the anode gets rapidly interacted with NaOH as the flow of the electrolyte is from anode to cathode. Further, it was also observed that the heaving shown by the dial gauges at the edges was slightly higher than those at the middle for a fixed distance from the anode. The possible reason behind this particular observation could be that the flow of electrolytes along the model boundaries would be faster due to less resistance offered at the soil-boundary interface. The time-heaving profile obtained from the four dial gauges in the circular test set-up is shown in Fig.4.17. It was seen that the heaving in the case of the circular electrokinetic model was increasing sharply with increasing interaction time. The maximum heaving observed, in this case, was 5.42%. The heaving in the four dial gauges did not show much deviation since the radial inward flow of electrolyte causes uniform soil-alkali interaction at a particular radial distance from the anode.

It is also worth noting that the rate of heaving, represented by the slope of the time-heaving curves, is maximum in the case of the circular model where the electrolyte flow was radial. Moreover, the rate of heaving in the case of oedometer increases initially and becomes constant after 25-30 days. In the case of the rectangular model, the rate of heaving increases initially up to 30-35 days, reduces thereafter and becomes constant after 50-55 days. Unlike in the above two experiments, the rate of heaving in the case of the circular model shows a sharp increase with time and did not show any reduction up to 60 days.

A comparison of the percentage heaving in the case of oedometer, rectangular electrokinetic setup and circular electrokinetic model are shown in Fig.4.18. From the figure, it can be served that the percentage heaving was maximum in the case of the oedometer test followed by the circular EK model and then the rectangular EK model. When heave is considered, the soil weight contributes an additional component of vertical load (Merifield et al., 2009). It could be possible that in the case of the large-scale EK models, a portion of the heaving at the bottom layers is suppressed by the overburden pressure of the overlying soil. This effect would not be prominent in case of oedometer as relatively very less amount of soil is used for the specimen.

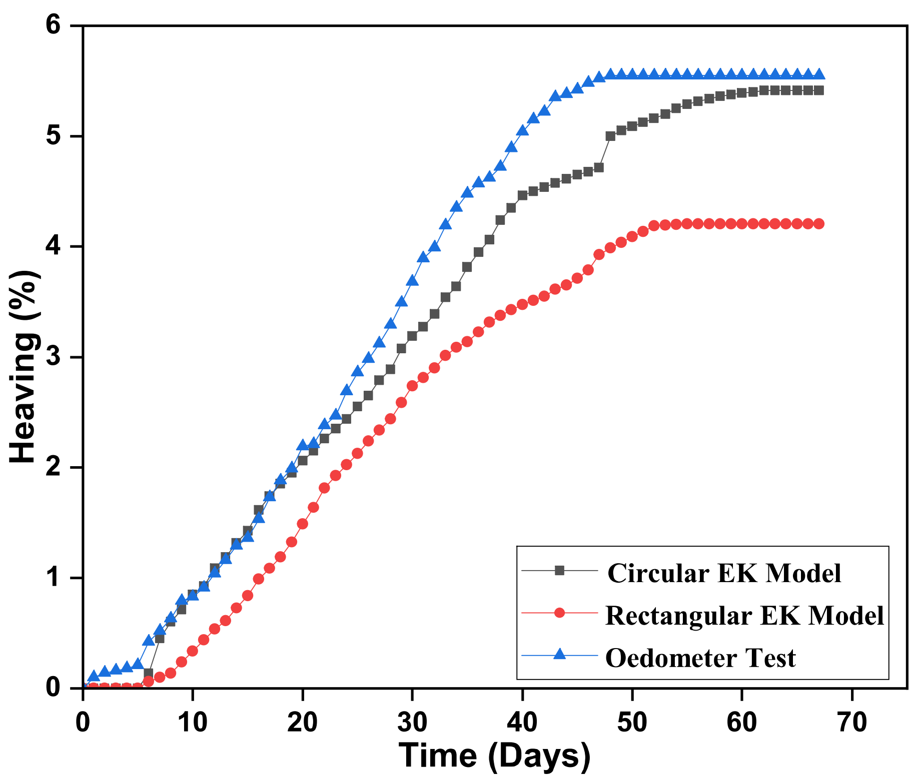


Figure 4.18: Effect of model boundaries on percentage heaving

4.3.5.2 Heaving Pressure in Large Scale Models

The heaving pressure in large scale models were measured through proving ring which is placed on the surface at three different locations which already shown in their respective plan. On the other hand, the heaving pressure in oedometer is the total amount of load required to bring back the deflection in the dial gauge to its original position. A comparative bar chart depicting the heaving pressure obtained in rectangular and circular large scale model tests is shown in Fig. 4.18. Again, the maximum heaving pressure was observed in oedometer test which is 661.95 kN/m^2 as shown in Fig. 4.19 while the heaving pressure in circular EK model and rectangular EK model is about 370 kN/m^2 and 184.36 kN/m^2 respectively. The heaving pressure in all the three proving rings in circular model is approximately same while in case of rectangular model, the heaving pressure reduces as the distance from the anode increases.

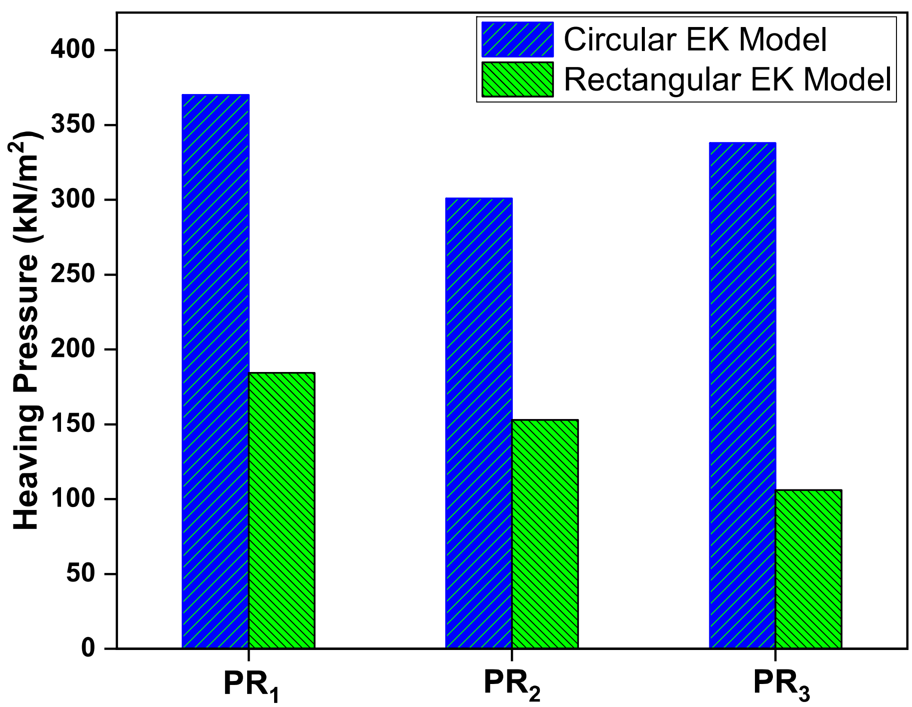


Figure 4.19: Heaving pressure in soil due to alkali interaction in large scale models

4.3.5.3 Variation of Electric Potential

The plot of the electric potential versus time as measured during the alkali interaction of soil in large scale rectangular and circular models equipped with EK are shown in Fig.4.20

and Fig. 4.21 respectively. The electric potential was measured using voltage sensors at the mid depth just below the dial gauges.Fig.4.20 shows the variation of electrical potential in the rectangular model. The recorded electric potential showed a decrease on moving from anode to cathode. The electric potential increases as the flow starts from anode to cathode and then decreases with the precipitation of sodium ion across the soil specimen.

However, a non-uniformity in electric potential variation were observed due to non-uniform flow of electrolytic solution in the soil sample. This non uniformity in flow may be occurred due to large volume of soil and non-uniform precipitation of sodium ion in the soil sample. Likewise, Fig.4.21 depicts that in circular model, a similar electric potential

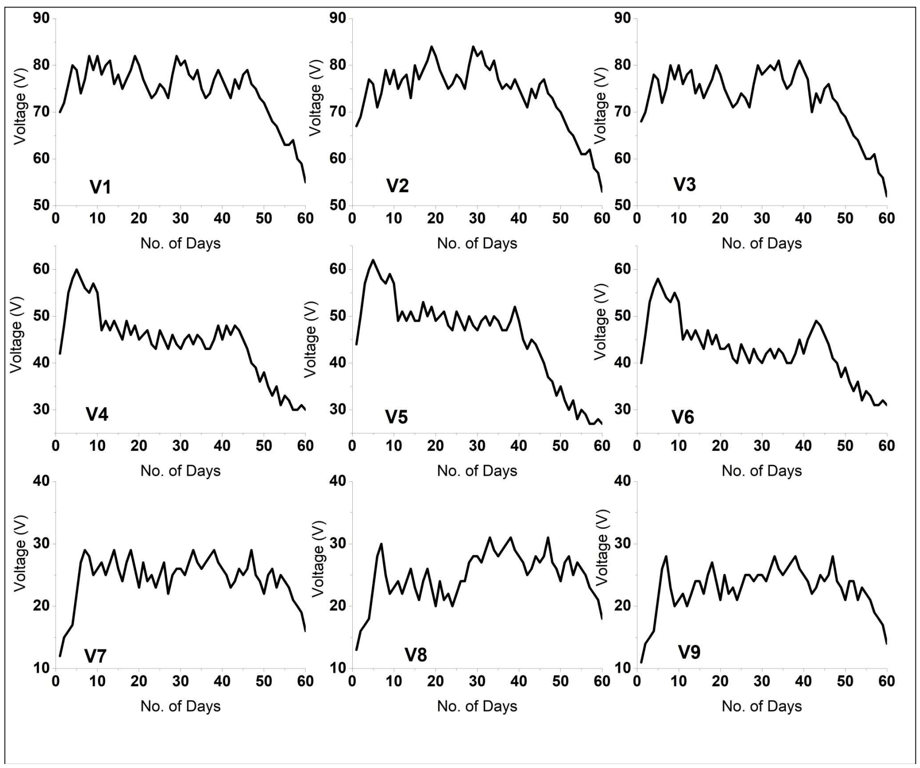


Figure 4.20: Variation of electrical potential in rectangular model

profile was observed with time for all four locations which indicates the uniformity in flow at every location. As the experiment continues, the electrical potential increases due to movement of ions from anode to cathode. After 15 days, a linear decrement in electrical potential was observed with time which occurs due to precipitation of sodium hydroxide into the soil. After the precipitation of sodium hydroxide, the electric potential becomes constant across the soil sample. Therefore, it is apparent that the change in electrical potential of circular model were approximately same, however in rectangular model the electrical potential varies from anode to cathode.

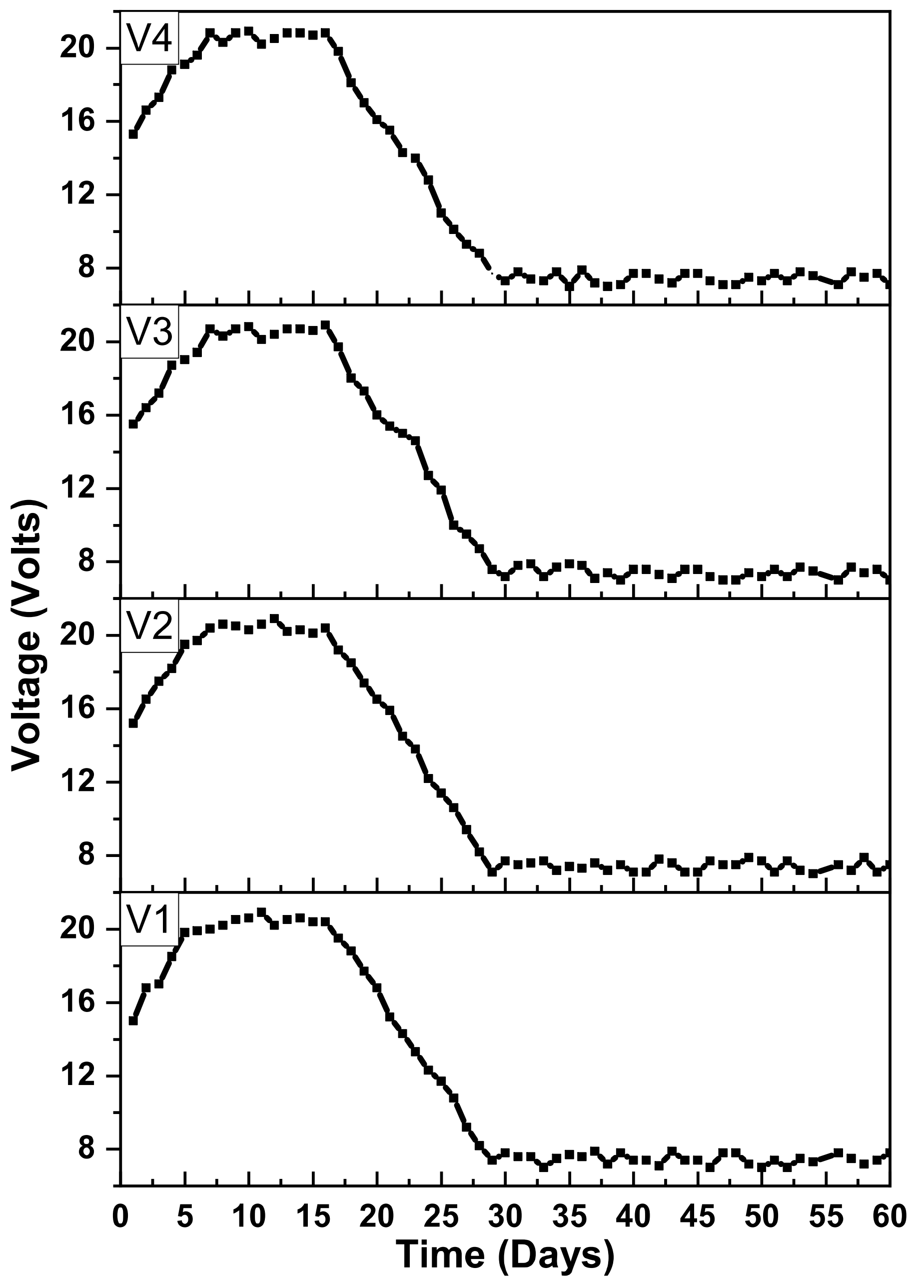


Figure 4.21: Variation of electrical potential in circular model

4.3.5.4 Variation of Temperature

Fig. 4.22 and Fig. 4.23 shows the variation of temperature with time in rectangular and circular model equipped respectively. The change in temperature in soil mainly occurs due to chemical reaction between soil and alkali solution and the electrochemical reaction.

No substantial change in the temperature was observed at all the locations for the both types of models.

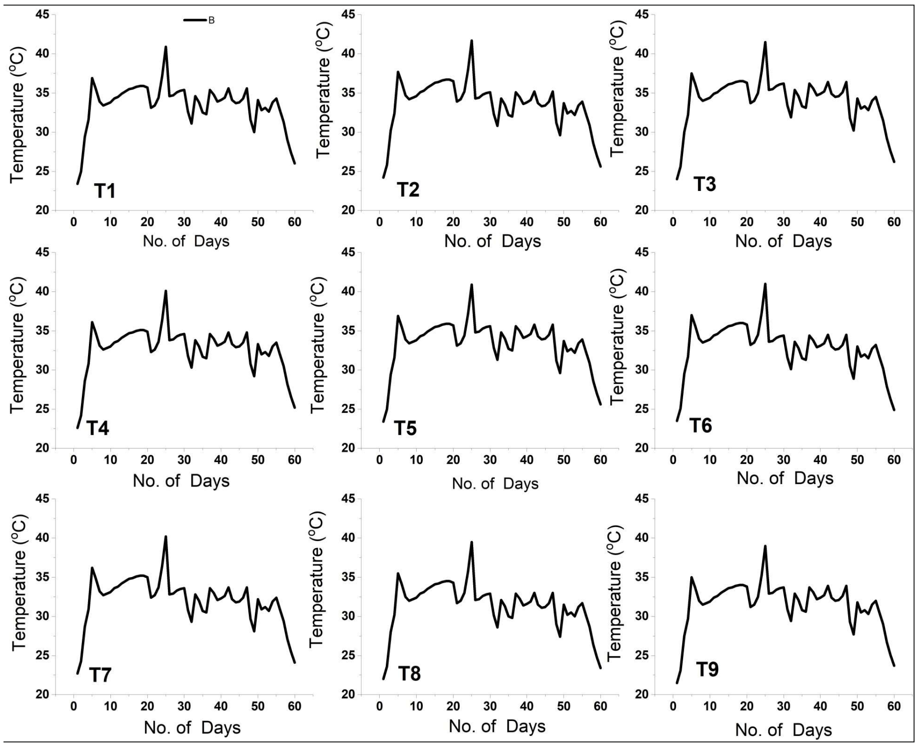


Figure 4.22: Variation of temperature in rectangular model

4.3.5.5 Variation of EO Flow

Fig. 4.24 illustrate the variation in cumulative discharge in cathode chamber with time during the EK process. In rectangular model the change in depth of electrolytic solution collected in cathode chamber while in circular model, the solution was directly collected from bottom of the chamber. The continuous increasing trend of discharge volume with time indicates the continuity of EK process.

4.3.5.6 Unconfined Compressive Strength

Unconfined compressive strength (UCS) test was conducted to analyse the change in strength of soil specimen after alkali interaction. The UCS value of the uninteracted soil conducted before its interaction with NaOH was found to be 141 kPa. Fig. 4.25 shows the UCS values of alkali interacted soil in circular EK model collected from mid depth below the location of dial gauges. The UCS value was in the range of 84-93 kPa for all

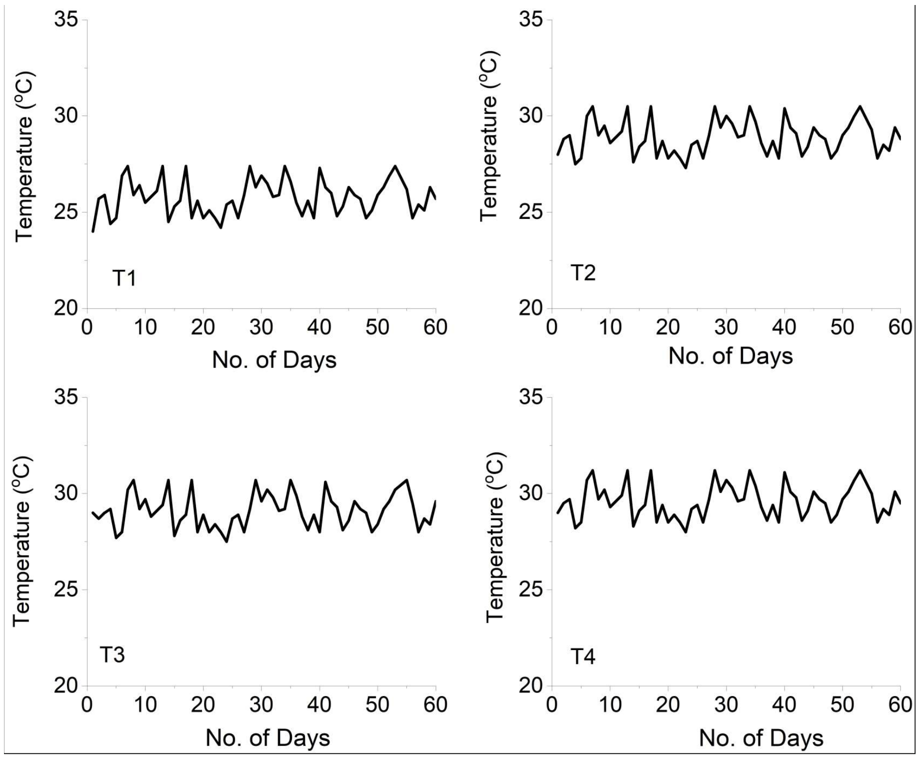


Figure 4.23: Variation of temperature in circular model

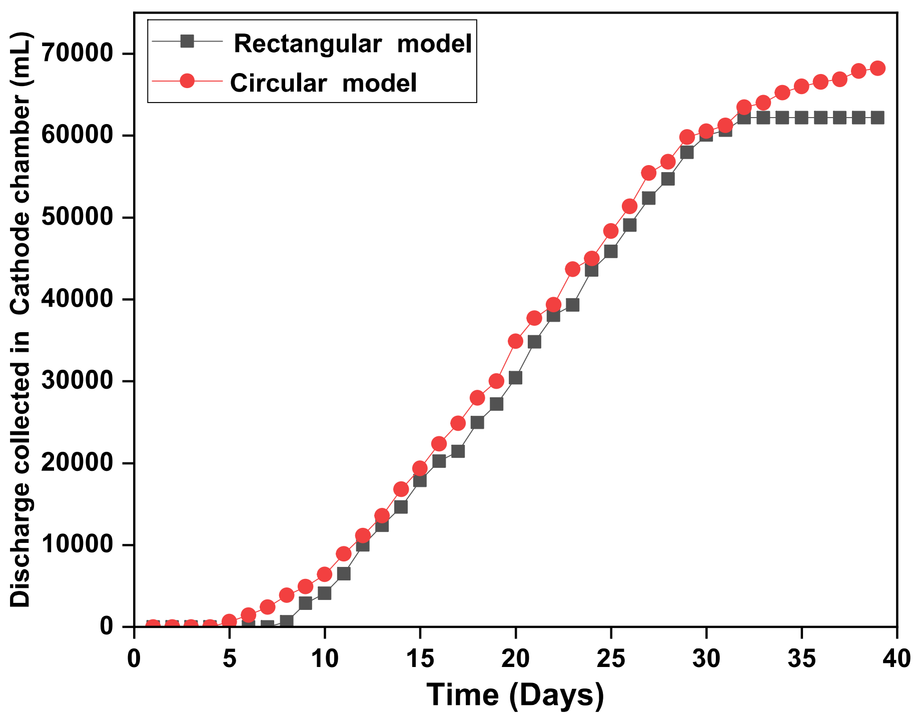


Figure 4.24: Variation in discharge volume of electroosmotic flow in large scale model

four specimens after an interaction period of 60 days. Similarly, Fig. 4.26 shows the UCS value of alkali interacted soil in rectangular EK model collected from the mid depth below the location of dial gauges. The UCS values were in the range of 90 to 124 kPa after an interaction period of 60 days. The samples collected from the mid-section showed highest UCS value as compared to the left and right sections. This particular observation can be related to the percentage heaving where the lowest heaving was observed at the mid-section. The reduction in UCS value with respect to uninteracted soil after alkali

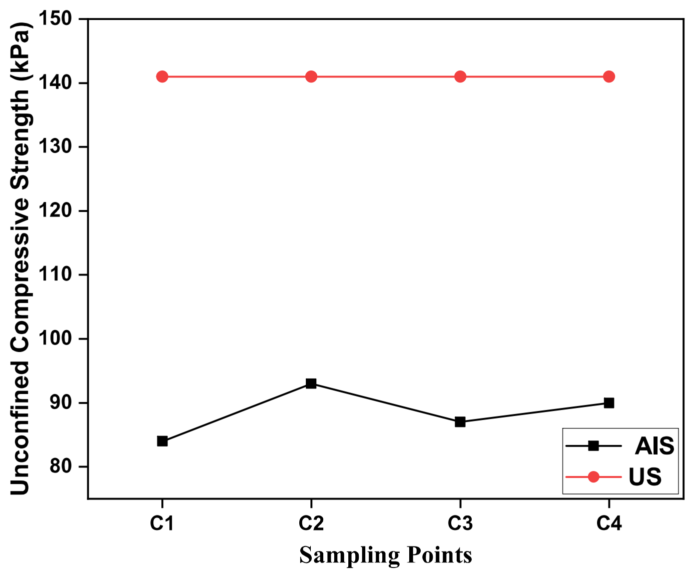


Figure 4.25: Variation in UCS value of soil sample collected from circular model

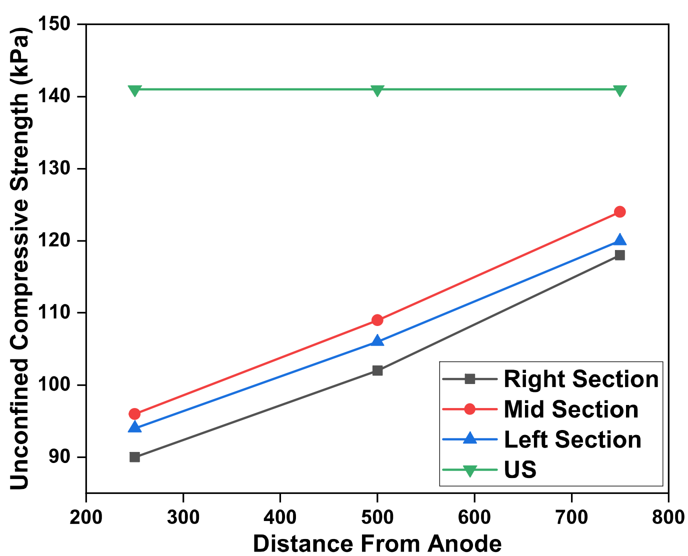


Figure 4.26: Variation in UCS value of soil sample collected from reactangular model

interaction can be attributed to the dissolution of clay minerals in alkaline environment and formation of new compounds (Sivapullaiah et al., 2005). From the UCS graph of circular and rectangular EK model, it was also observed that the UCS value in circular model at all four sampling points were similar whereas in rectangular model, the reduction in the UCS values was less pronounced on moving from anode to cathode. This was due to the fact that the intensity of the alkali interaction was not same at all the points at a given time as flow of electrolyte from anode to cathode causes the electrolyte to reach different sampling points at different times.

4.3.5.7 Shear Strength Parameters

Unconsolidated Undrained triaxial tests were also conducted at the collected specimens at three confining stresses of 50 kPa, 100 kPa and 150 kPa. The shear strength parameters calculated from the obtained results for rectangular EK model is shown in Fig. 4.27 and Fig. 4.28 respectively. Fig. 4.27 shows the variation of friction angle with the

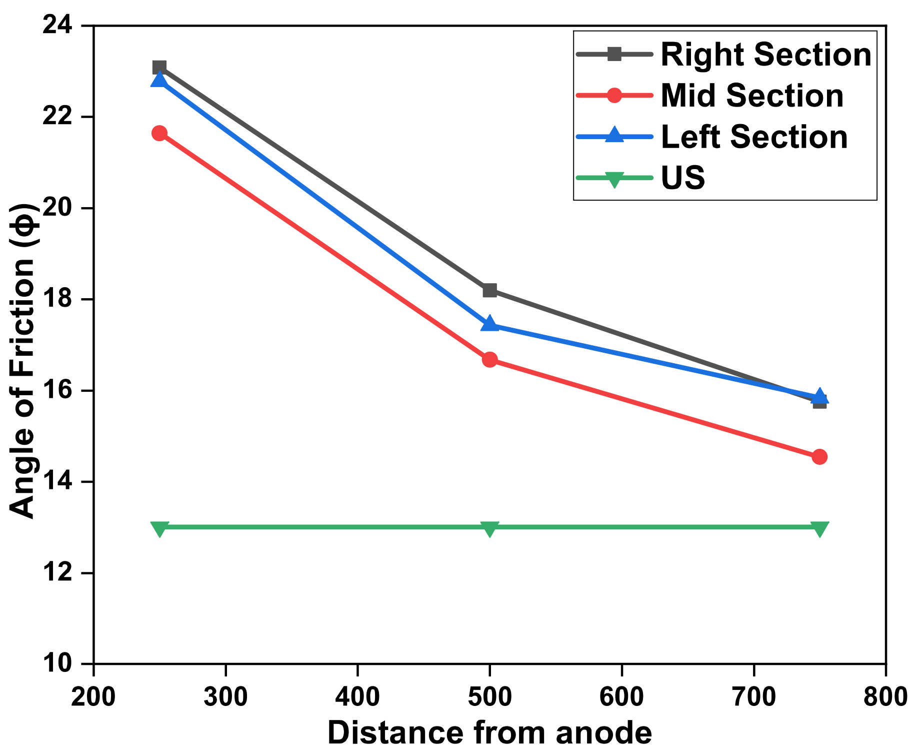


Figure 4.27: Variation in angle of internal friction and of soil sample collected from rectangular model

distance from anode along all the three sections. The cohesion and internal friction angle

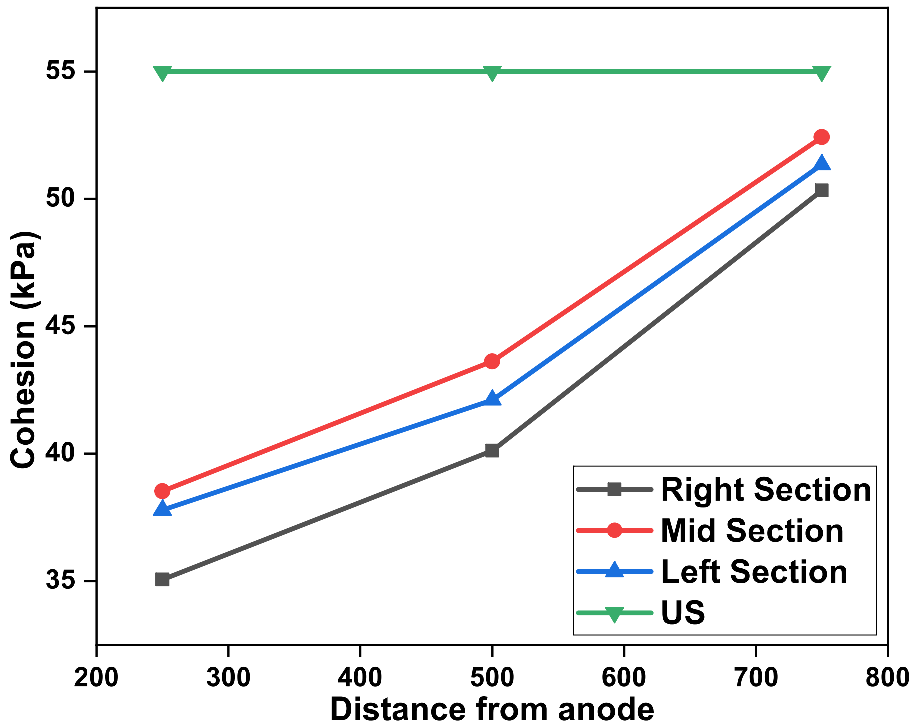


Figure 4.28: Variation in cohesion value of soil sample collected from rectangular model

of uninteracted soil sample is obtained as 55 kPa and 13^o. The interaction of NaOH cause increase in the friction angle. The friction angle is reduced as the distance from the anode increases. Furthermore, the cohesion was decreases as the molarity of the NaOH was increased as can be seen in Fig. 4.28. Higher decrement in cohesion values were found for the samples nearer to the anode. These changes in cohesion values decrease as the distance from the anode increases. Similarly, Fig. 4.29 and Fig. 4.30 shows the variation of friction angle and cohesion respectively for the circular EK model. The values of friction angle and cohesion were almost similar for all the soil samples. However, there was a definite change in the cohesion as well as in the friction angle of the soil after its interaction with NaOH.

In an attempt to find the possible reason behind such change in the friction angle and cohesion, it was realized that the pH value is a vital parameter which may potentially influence the mechanical response of the clayey soils. As reported by Gratchev and Sassa (2009), edge surface of the clay particle is highly dependent on pH. In highly alkaline medium when pH is very high, these edges become more negative due to adsorption of OH- ions. This induces the face-to-face association of the particles which is responsible

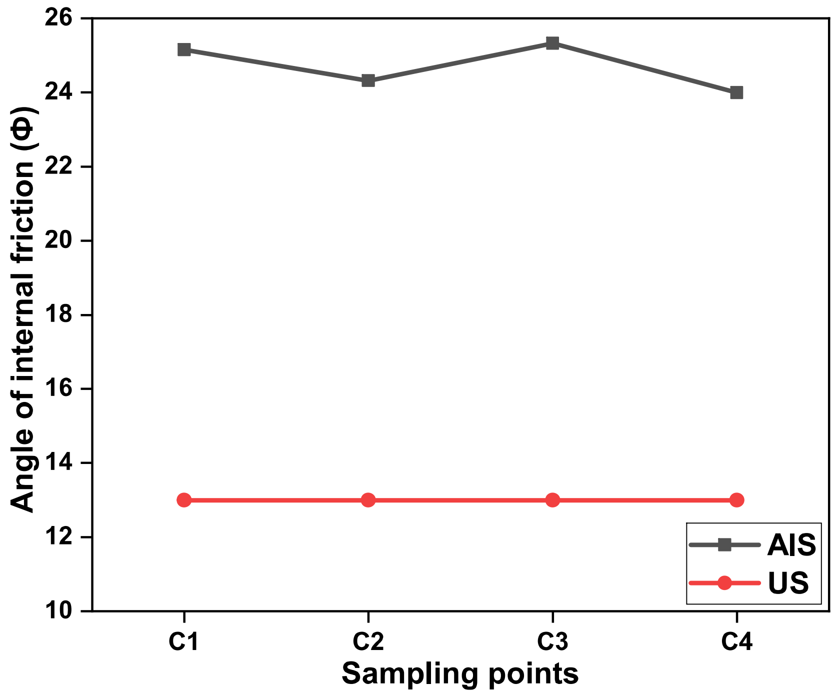


Figure 4.29: Variation in angle of internal friction of soil sample collected from circular model

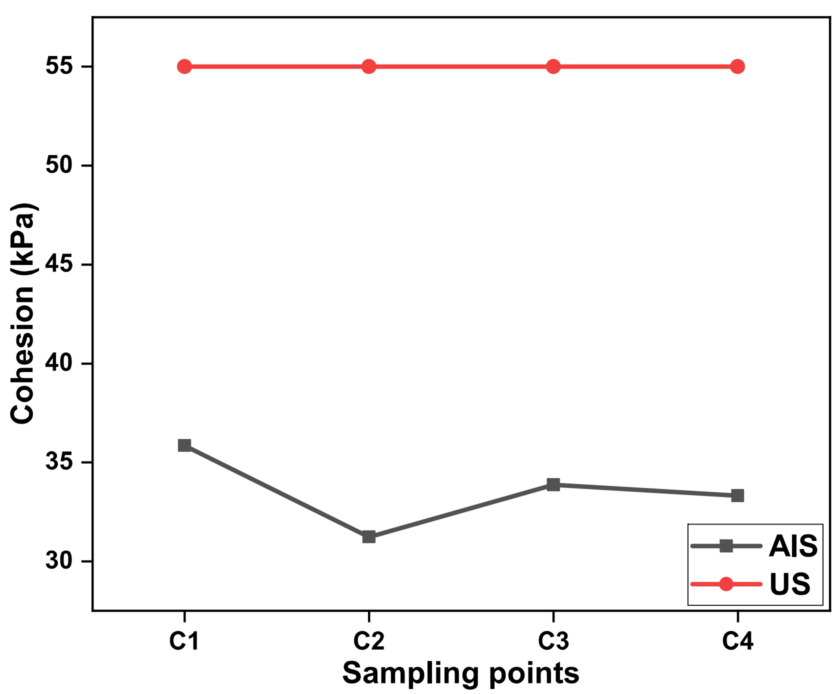


Figure 4.30: Variation in cohesion value of soil sample collected from circular model

for change in the shear strength parameters.

4.4 Summary

In this chapter, the variation in geotechnical properties and heaving properties of soil with different concentrations of NaOH solution was analyzed and compared. The maximum percentage heaving is about 5.55%, and heaving pressure is about 661.95 kN/m^2 was observed for 16M NaOH solution. The test results also show that the maximum change in geotechnical properties of soil was observed in the case of soil interacted with 16M NaOH solution. Further, the concentration of alkali solution corresponding to maximum heaving in conventional oedometer test was selected for the heaving studies in large-scale rectangular and, circular models by using electrokinetics to simulate the field conditions. The heaving behaviour along with the other of soil in the rectangular and circular electrokinetic model, was compared. The test results show that the variation in parameters was more uniform in the case of the circular electrokinetic model as compared to the rectangular electrokinetic model. The maximum percentage of heaving and heaving pressure was observed in a circular model equipped with electrokinetics which was about 5.42% and 370 kN/m^2, respectively. The remediation technique to control the alkali-induced heaving and to enhance the geotechnical properties of alkali-interacted soil has been presented and discussed in detail in the following chapter.