Experimental Study of Bentonite

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Abstract

Use of geotechnical three-way expansion force measuring instrument, study the change of dry density on the influence of the expansive properties of bentonite. The experimental results showed that: related to the size of the expansion properties of bentonite and dry density, when the dry density is greater than 1.65 g/cm3, more significant expansion feature, inflation is more potent. When bentonite involved in sand, sand mixture will form the skeleton, expansion properties will change. By sanding, therefore, can change the properties of bentonite. Provide reasonable reference for practical engineering.

Keywords

Bentonite, Sanding, Expansion characteristics.

1. Introduction

In deep geological disposal repository, after the construction completion, due to the increasing of the underground water level, water immersion and upper load can produce effect of bentonite, make its expansion deformation, and inflation pressure influence on surrounding soils [1]. Bentonite has good thermal conductivity,low permeability, so is often chosen as buffer/backfill materials [2]. If the adding amount of quartz sand, bentonite ,this will improve the mixture of heat transfer coefficient of [3-4] and [5] of strength, and it also can keep the bentonite adsorption and permeability [6]. Involved in a certain amount of sand in the bentonite, through the formation of sand skeleton, study the properties of the mixture to produce change, in order to determine reasonable sanding rate range [7].

Many experts and scholars at home and abroad have studied the different features of bentonite expansion. Wei-min ye [8-9] to high temple son high-pressure solid bentonite one-way expansion force is researched; Qin Bing [10] to study the different time, such as dry density, moisture content and bentonite to the relationship between the expansive force; Sun [11], such as different sand ratio was studied by experiment and the influence of porosity ratio on compacted expansive force mixture. This article uses three-way expansion force measuring instrument, the bentonite three-way expansion stress test, study the change of dry density and so on influence on bentonite three-way expansion stress.

2. Test instrument is introduced

The instrument [12] is mainly composed of specimen box, expansion stress and the dependent variable measuring system, temperature control system, seepage system, etc. Instrument structure diagram, as shown in figure 1.

To study relationship between expansion stress - time. Through the infiltration system, make the device in the upper pipe outlet pipe, the lower pressure pipe coupling,using pressure water injection, make sample by uniform water invasion, speed up. Through reading instrument connected to the load sensor readout expansion stress of three directions. Record the size of the expansion stress and measuring time, draw the relation curve of expansion stress and time, analysis the relationship between different directions expansion stress and time.

Fig.1 Three-way swell-shrink instrument structure diagram

3. Test materials and test preparation

Selection of Inner Mongolia xinghe county high temple son formed bentonite as a test, the liquid limit by 274%, plastic limit by 41.8%, grain density 2.33 g/cm^3. Then use oven drying bentonite, calculating the moisture content of about 9.95%. Jack in the special mould vertical compaction into 40 mm square. Open the instrument above sealed cover, put the sample in a specimen box, then put permeable plate above the sample close to sample, cover and seal cover plate, tighten the bolt. Through the infiltration system, make the device in the upper pipe outlet pipe, the lower pipe inlet pipe, using pressure water injection,make the sample by uniform water invasion, Speed up. Through reading instrument connected to the load sensor readout expansion stress of three directions. Record the size of the expansion stress and determination of time, over 20 d.

4. Test results and analysis

4.1 Bentonite expansion stress change curve over time

Specified as vertical direction parallel to the direction of compaction, perpendicular to the direction of compaction rules for the horizontal direction. Horizontal direction contains two directions. In order to facilitate narrative, based on the average level to 2 expansion force and vertical expansion force as the analysis object. Below for the dry density is 1.9 g/cm^3 sample process of three-way expansion force changing with time curve

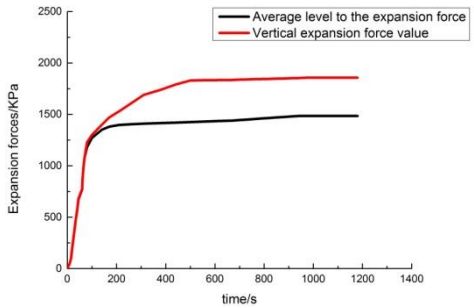

Fig.2 Three mixture to the expansive force changing with time curve

The figure 2 shows that bentonite expansion stress increases with the increase of time, and reach the maximum stable. bentonite expansion force can be in a very short period of time can reach the final expansion force of more than 85%. As the growth of the time, slowing expansion force, eventually reach a steady state. The process, the vertical expansion force is always greater than average level to the expansive force.

4.2 Bentonite expansion force with the change of dry density curve

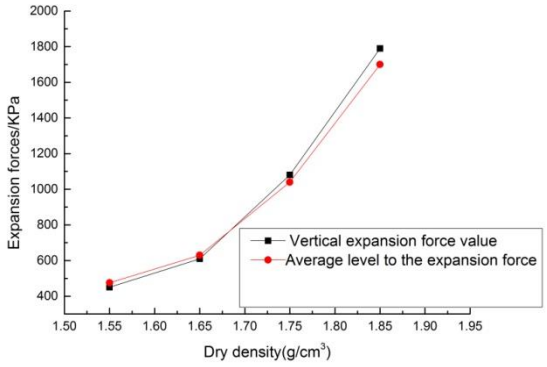

Fig.3 bentonite expansion force with the change of dry density curve

The figure shows that bentonite expansion force increases with the increase of dry density, bentonite horizontal expansion force mean value is always less than the vertical force. In the dry density is 1.55 ~ 1.65 g/cm^3 within the scope of horizontal expansion force mean and vertical force were similar, and its expansion force growth is slow; When the dry density is greater than 1.65 g/cm^3, mix expansion force numerical significantly increased, the mean to expansion and vertical expansion force and horizontal force difference gradually increased. Accordingly, reduce the dry density of bentonite can effectively restrain the expansion of the bentonite.

5. Critical sanding rate of bentonite

Sand and bentonite mixture formation sand skeleton when the range of reasonable sanding rate formula for [8]

$$\alpha \geq \alpha_L = -\frac{B\beta\rho_s}{e_{sm}\rho_m - B\beta\rho_s}, \quad (1)$$

Among them:

$$B = -\{1 + \frac{(1-\beta)\rho_m}{\beta\rho_{nm}}\} \quad (2)$$

Type: α_L for critical sanding rate. α for the mixture of sanding rate; β for montmorillonite in the quality percentage of bentonite. ρ_m for the density of montmorillonite in bentonite; ρ_s as the mixture of sand density; ρ_{nm} for excluding montmorillonite bentonite density;

By mixing the mixture of sand at a rate of 45%, for example, determine the critical sanding rate. Calculation parameter selection are as follows: a=0.67,b=0.43, esm=1.0[13], $\beta = 75\%$, ρ_m=2.79 g/cm3, $\rho_{nm} = 2.79$ g/cm3 , $\rho_s = 2.65$ g/cm3。 get into the formula of calculation:

$\alpha_s = 48.71\%$,To be seen, $\alpha_s \geq 48.71\%$, Skeleton sand mixture may form, So the critical sanding rate was 48.71%. The critical sanding rate for bentonite in this paper 48.71%.

6. Conclusion

Using three-way expansion force measuring instrument, the bentonite three-way expansion stress test, experimental study through analysis we can draw the following conclusion:

(1) Associated with dry density, bentonite expansion force expansion force increases with the increase of dry density.

(2) The sanding will change its expansion properties of bentonite, decreases with the increase of the mixed sand ratio.

(3) The existence of anisotropic bentonite expansion force, horizontal expansion force is always less than the vertical expansion force.

(4) The use of sand mixture formation skeleton is needed for the deviatoric stress, can get reasonable critical sanding rate.

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