study on sedimentation characteristics of soft clay

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Abstract: There are large areas of soft clay distributed in coastal areas of China, which are often used as raw materials for hydraulic fill engineering in recent years, and its sedimentation characteristics have attracted more and more attention. In this paper, the influence of initial water content on the sedimentation characteristics of soft clay is studied through the experiment. The results show that: (1) the sedimentation process of soft clay can be divided into two stages: sedimentation stage and self weight consolidation stage. The sedimentation stage has a short time, and the soil property index tends to be stable quickly; the self weight consolidation stage is very slow, and the soil property index almost has no change; (2) the larger the initial water content of soft clay, the greater the sedimentation rate and the faster the sedimentation; (3) the higher the initial water content, the faster the sedimentation, the higher the water content and the void ratio, the smaller the density.

1 Introduction

A large area of soft clay is distributed in coastal areas of China. Effective utilization of it can not only turn waste into treasure, but also reduce engineering cost. In recent years, it is often used as raw material for hydraulic fill engineering [1-3]. After hydraulic reclamation, the soft clay will first submerge under the action of its own weight, and its sedimentation rate is directly related to the progress of the project, so its sedimentary characteristics have attracted more and more attention. The sedimentation process of soft clay is affected by many factors, including the initial water content of soil, the type and concentration of cations in seawater, etc., and some related experimental studies have been carried out by scholars [4-6]. In this paper, the influence of initial water content on the sedimentation characteristics of slurry mixture was studied by the sedimentation test in Lianyungang soft clay.

2 test method

The test soil sample is soft clay, which is taken from Lianyungang Area, and its particle composition is shown in Table 1. The initial water content of each sample is 100%, 200% and 300%, respectively. In the test, the soft clay with different initial water content is made into suspension, which is placed in a 1000ml measuring cylinder. After full mixing, it is allowed to deposit under its own weight. The sedimentation process of soil sample under the action of self weight is observed. The volume of soil sample is measured according to different time, so as to calculate the void ratio, water content and density of soil sample.

Table1. composition of soil particles

particle size(mm)	0.25~0.075	0.075~0.05	0.05~0.01	0.01~0.005	<0.005	<0.002
soft clay	22.8	5.0	24.8	14.9	32.5	14.6

3 test result

As an important index to evaluate the deposition of slurry mixture, the sedimentation rate directly reflects the deposition of slurry mixture. Fig.1shows the sedimentation rate hydrograph of slurry mixture under different initial water content conditions. The results show that the sedimentation rate can be divided into two stages under the initial water content. In the first stage, the sedimentation rate changes greatly, and the curve shows a rapid downward trend. The sedimentation rate in this stage mainly depends on the initial water content of soil. The higher the initial water content of soil is, the greater the sedimentation rate is, and the faster the sedimentation rate decreases with time. Generally speaking, in this stage, it is the stage of rapid subsidence. In the second stage, the change of sedimentation rate is relatively gentle, indicating that the deposition in the previous stage has been basically completed and consolidation has begun. However, due to the buoyancy of water, the deformation is still in progress, but the precipitation rate changes very

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little, and this stage lasts for a long time.

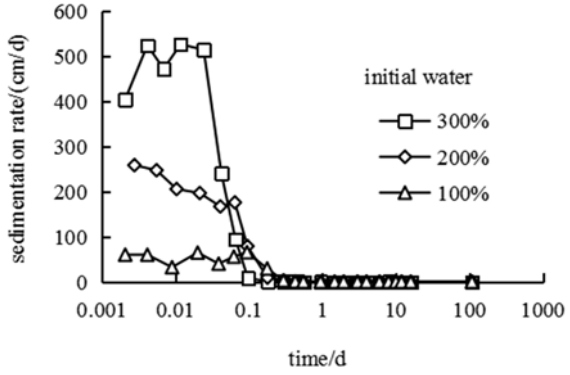

Fig 1. variation of sedimentation rate-time of soft clay

Figures 2 to 4 show the variation process lines of void ratio, water content and density of soft clay under different initial water content conditions. It can be seen from the figure that the change process of void ratio, water content and density of soft clay can be divided into sedimentation stage and self weight consolidation stage. In the sedimentation stage, the change is larger, the void ratio and water content decrease rapidly with time, and the density increases rapidly with time. In the stage of reconsolidation, they change very gently. After more than three months of self weight consolidation, the water content and void ratio of soft clay are only reduced by 1.4% and the density is only increased by 0.6% after 108 days of sedimentation. This change indicates that the physical index of soft clay has not been improved, which indicates that the self weight consolidation of soft clay is very slow. Only under the action of overlying load, can the consolidation of soft clay be accelerated. The shape is stable and the strength is increased. Therefore, the top layer of soft clay embankment should be filled with a certain thickness of rock as weight and protection.

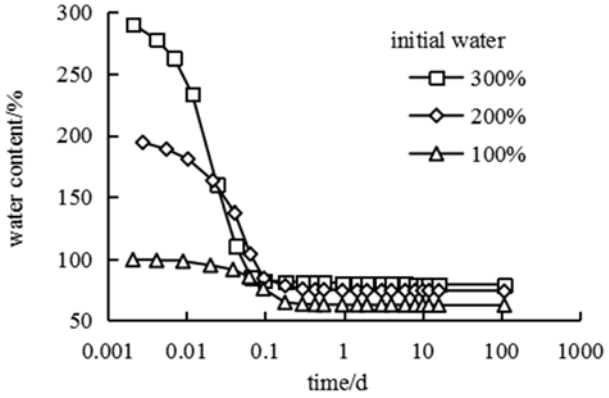

Fig 2. variation of water content-time of soft clay

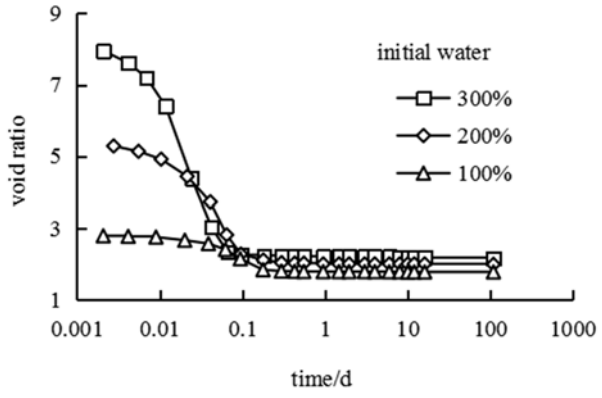

Fig 3. variation of void ratio-time of soft clay

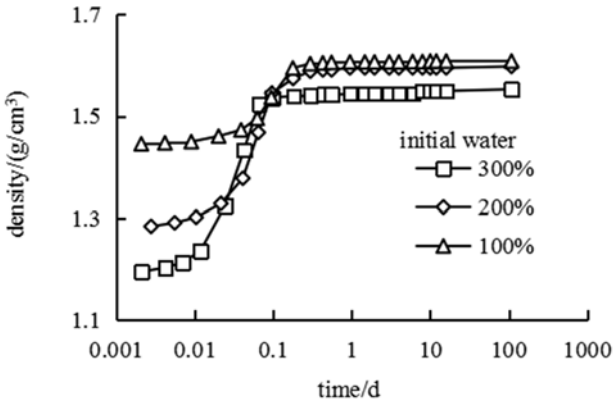

Fig 4. variation of density-time of soft clay

Figures 5 to 7 show the relationship between water content, density and void ratio of soft clay with initial water content at the end of sedimentation. It can be seen from the figure that the water content and void ratio of soft clay increase with the increase of initial water content at the end of sedimentation, and the density decreases with the increase of initial water content. In other words, the higher the initial water content, the greater the water content and void ratio of soft clay at the end of sedimentation, and the smaller the density. In hydraulic fill engineering, under the premise of ensuring the fluidity of filling soil, the initial water content of filling soil should be reduced as far as possible, so as to reduce the water content and void ratio at the end of filling sedimentation, increase the density, and ensure the stability of filling soil.

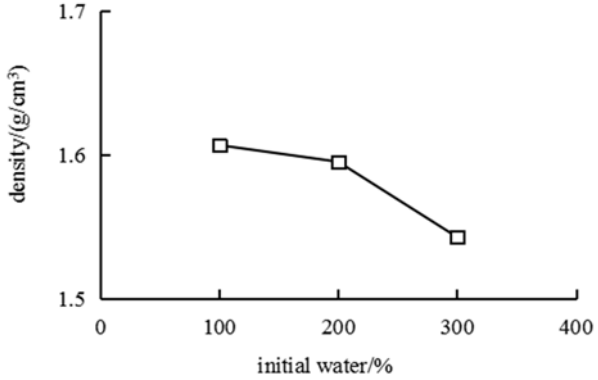

Fig 5. variation of density-initial water content of soft clay

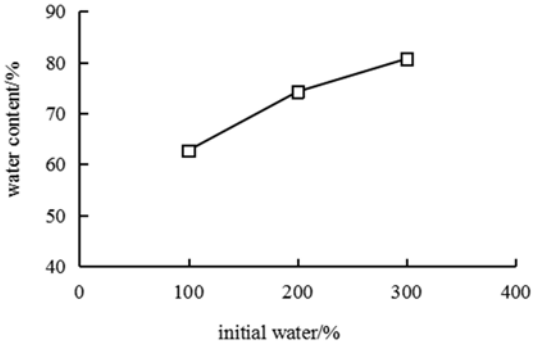

Fig 6. variation of water content-initial water content of soft clay

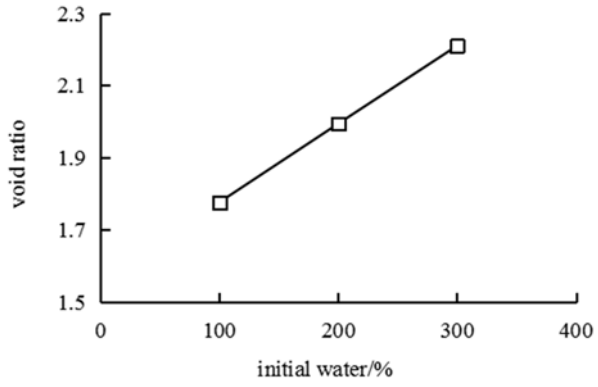

Fig 7. variation of void ratio-initial water content of soft clay

4 Conclusion

(1) The sedimentation process of soft clay can be divided into sedimentation stage and self weight consolidation stage. The time of sedimentation stage is short, and the soil property index tends to be stable quickly, while the soil property index of self weight consolidation stage almost does not change, which indicates that the self weight consolidation of soft clay is quite slow.

(2) The larger the initial water content of soft clay is, the greater the sedimentation rate is and the faster the sedimentation is.

(3) The larger the initial water content is, the greater the water content and pore ratio are at the end of sedimentation, and the smaller the density is.

(4) On the premise of ensuring the fluidity of soft clay, the initial moisture content of soft clay should be reduced as much as possible, so as to reduce the water content and void ratio at the end of sedimentation, and increase the density to ensure the stability of soft clay.

Reference

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