Study on fracture evolution of unsaturated red clay during drying process

Ziming Ye[1 *], Guiyuan Xiao[1,2], Tongzhong Wei[1], Zhihan Li[1], Tinghui Jiang[1]

[1] Key Laboratory of Guangxi Geotechnical Mechanics and Engineering, Guilin，China
[2] College of Civil and Architecture，Guilin U-niversity of Technology，Guilin，China
* yezitm@163.com

Introduction

In the context of global climate change, the extreme arid climate has occurred from time to time in recent years (Peron et al. 2009). More and more scholars have paid attention to the problem of soil desiccation and cracking. Water is one of the important components of soil three-phase. The direct impact of the engineering properties of the body is the most immediate cause of the engineering construction problems. The evaporation of moisture in the soil will lead to the shrinkage of the soil mass and the dry cracks, which will seriously affect the engineering properties of the soil.Such as permeability, compressibility , mechanical strength and so on. Resulting in a significant decrease in bearing capacity and strength, causing various engineering geological problems such as landslide hazards, dyke instability, soil and water loss, settlement of buildings and failure of anti-seepage barriers. (Boynton and Daniel, 1985; Miller et al., 1998; Yesiller et al.,2000; Albrecht and Benson, 2001; Philip et al., 2002; Jones et al., 2014;) Thus it can be seen that the influence range of dry shrinkage cracks of soils is extremely extensive and involves many disciplines such as civil engineering, geology, water conservancy and environmental engineering. This study aims to the law of fracture evolution in the drying process of red clay.

Materials and basic properties

The red clay needed in this experiment was taken from a site in Lingui District, Guilin City. The soil samples showed a reddish-brown color and a slightly wet soil. According to the standards of "Geotechnical Test Methods" (GB / T50123-1999).The basic physical properties are shown in table 1.

Table 1 The basic physical index of red clay in Lingui area

Soil properties	Value
Specific gravity	2.73
Liquid limit (%)	64
Plastic limit (%)	45
Plasticity index (%)	19
Porosity ratio	1.07
Compression modulus(MPa)	8.50

Sample preparation and test procedures

My experiment plan analyses the following steps.Firstly,ground the red clay and through 1mm sieve. Add 1.5 times liquid limit clay slurry with distilled water, seal and let stand for 8 hours to make the water evenly, then pour the mud into the round glassware to air dry naturally.Secondly,regularly take pictures of the sample (fracture observation), weighed (in order to statistical changes in the moisture content of the sample), observe the soil during the evolution of cracks in the process of drying. When the crack appears, shorten the time interval of weighing and taking photos, increase the number of weighing and taking pictures.Last,the crack structure parameters of red clay were obtained by IPP software analysis. Quantitative analysis reveals the evolution of cracks in red clay during drying.

Test results

Based on the red clay dry indoor simulation test, using vector technology to vectorize the fissures photos in various geometric elements extraction cracks, red clay fracture number and length area width and degree of cracks and other characteristic parameters with dry process increases, with fracture rate defined as follow:

$$F_R = \frac{S}{S_R}$$

Where S is the original area of the specimen,S_R is crack area.The variation of fracture rate with time is shown in Fig.1.

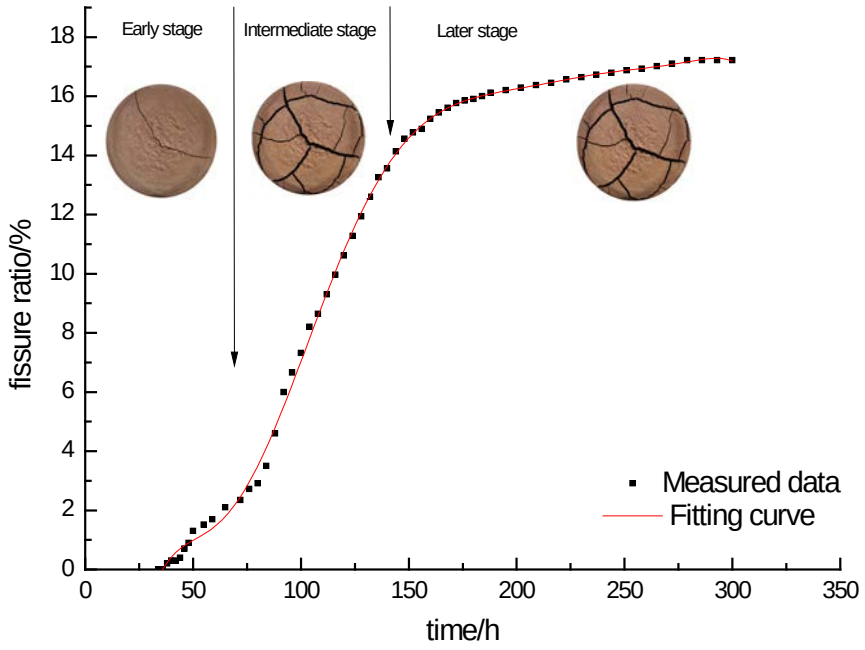

Fig.1: The picture of fracture rates change over the time

It can be seen that the fracture rate of cranny of red clay is becoming larger and larger with time, which is divided into three stages. In the first stage, the red clay belongs to the stage of water loss and the fracture development is slow; the second stage, the rapid development of the fissure, the crack rate from 2% to 14%; the third stage, the crack development is basically completed, eventually reached about 16.5%.Combined with scanning electron microscope and IPP software analysis, microstructure parameters of red clay, quantitative analysis reveals the evolution of dry red clay fracture and microstructure in the process, provide a theoretical basis for the prediction of red clay in hot and humid environment drying process.

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