Study of the swelling deformation characteristics of red clay

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Abstract::The paper is aimed at the phenomenon of red clay subgrade disease,taking the subgrade filling from the Yuqing-Kaili Expressway as the research object,doing the expansion test on the red clay,analysing of red clay expansion deformation law. The results showed that in the same compaction degree, different initial moisture content, the expansion rate of the sample with the optimum moisture content is minimum. And in the same initial moisture content, different compaction degree, the sample of high compaction degree has the small expansion quantity. The absolute expansion rate gradually increases with the expansion time, relative expansion rate decreases with the expansion time. That is the sample's speed of expansion is very high in 30min after the start, then the speed of expansion will slow down.

Foreword

Because the red clay has high moisture content, high plasticity, high void ratio and other special engineering properties,the red clay project achieve design goal during the period of the construction,with the operation time of the highway growing,the slope begin sliding and the pavement begin cracking.The primary cause is the degradation of strength properties of red clay filling under the action of wetting-drying cycles and repeated traffic load,the strength of the soil is gradually reduced, the stability of the soil is decreased, and the failure of the subgrade is eventually caused.Therefore, it is of practical significance to study the law of red clay expansion for the road construction in red clay areas.

Basic physical properties of Red clay

This experiment adopted by the soil samples taken from Yuqing - Kaili Expressway twelfth section . Soil characteristics as follows: brownish red, wet, the homogeneous soil, the compact structure , w ith certains small wormholes and the wholes of plant roots. On the grain composition ,most is the sil ty clay. According to the road test procedures (JTG E40-2007) method [5], the basic physical properti es of the soil is shown in table 1.

Table1 Basic physical properties of red clay

JTG E40-2007	>0.075mm/%	0.074～0.002mm/%		<0.002mm /%	
	17.25	71.41		11.34	
Optimum moisture content/%	Maximum dry unit weight g/cm^3	Plastic limit/%	Liquid limit/%	Coefficient of nonuniformity	Coefficient of graduation
37.2	1.46	38	59	9.38	1.6

Testing Program

Sample Preparation

Using the proctor compaction test to make the 20 groups of soil samples with a certain moisture content and a certain degree of compaction, the samples shown in table2

Table2 Sample preparation

Moisture content/%	Degree of Compaction/%			
30	75	85	90	96
34	75	85	90	96
37.2	75	85	90	96
40	75	85	90	96
44	75	85	90	96

Test Method

Put the prepared sample into water, measure the height of the sample at different time after expansion. The absolute expansion rate and relative expansion rate are calculated by the following formula.

a.Absolute expansion for i text □ $_{ai}$.

$$\square_{ai} = \frac{z_i - z_0}{z_0} \times 100\%$$

In the formula: z_i is the height of sample for i text (㎜);z_0 is the initial height of sample(㎜). If the absolute value of the number is bigger, it means the amount of expansion is bigger.

b. Relative expansion for i text □ $_{ri}$.

$$\square_{ri} = \frac{z_i - z_{i-1}}{z_{i-1}} \times 100\%$$

In the formula: z_i is the height of sample for i text (㎜); z_{i-1} is the height of sample for i-1 text (㎜). If the absolute value of the number is bigger, it means thespeed of expansion is higher.

Experiment Result

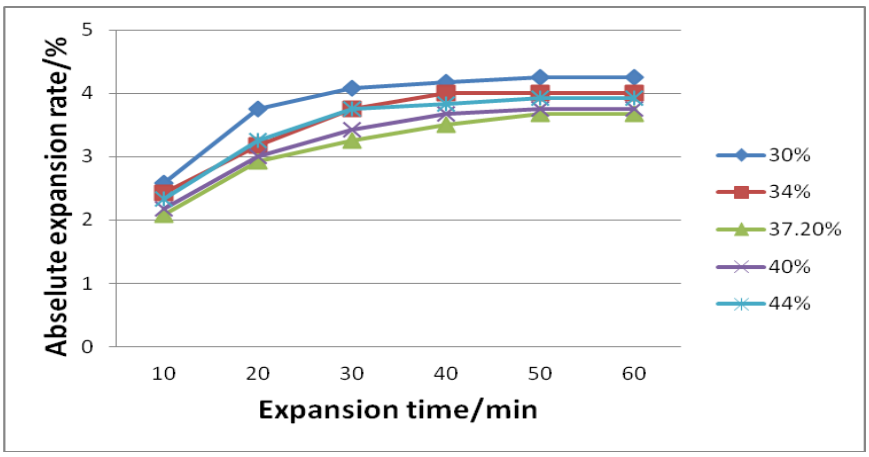

Fig.1 K=75% Relationship between absolute expansion rate and expansion time

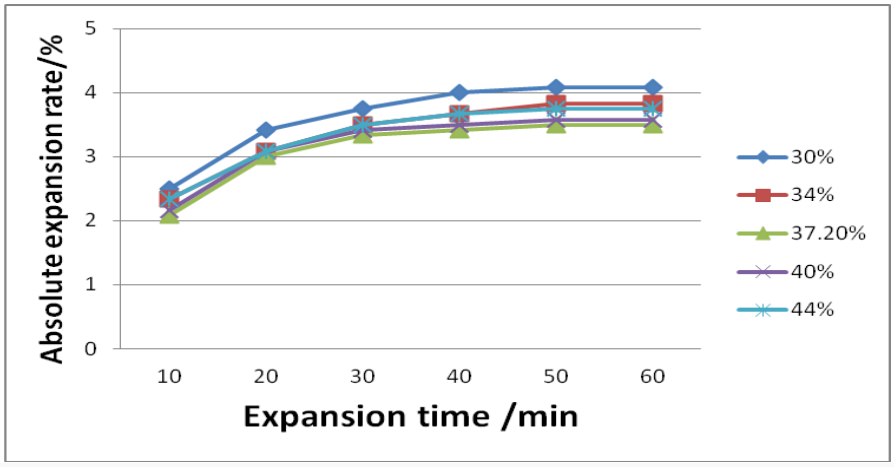

Fig.2 K=85% Relationship between absolute expansion rate and expansion time

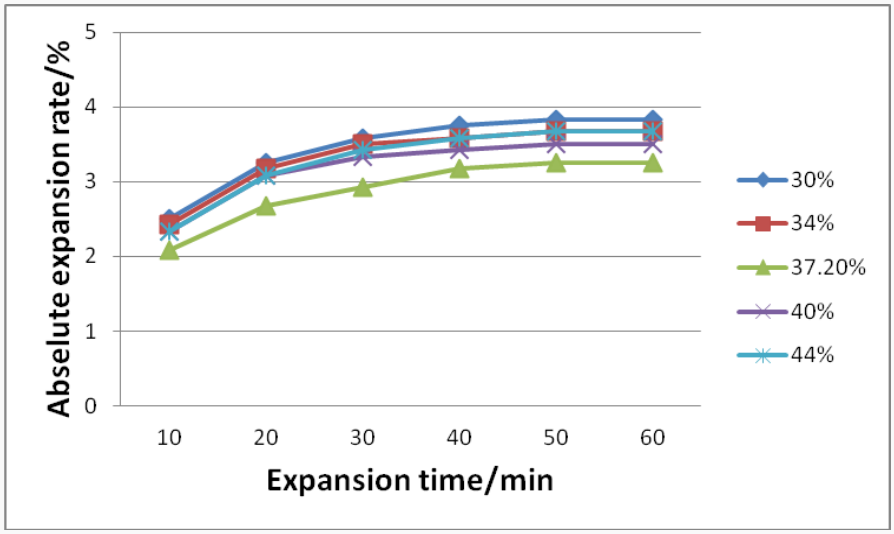

Fig.3 K=90% Relationship between absolute expansion rate and expansion time

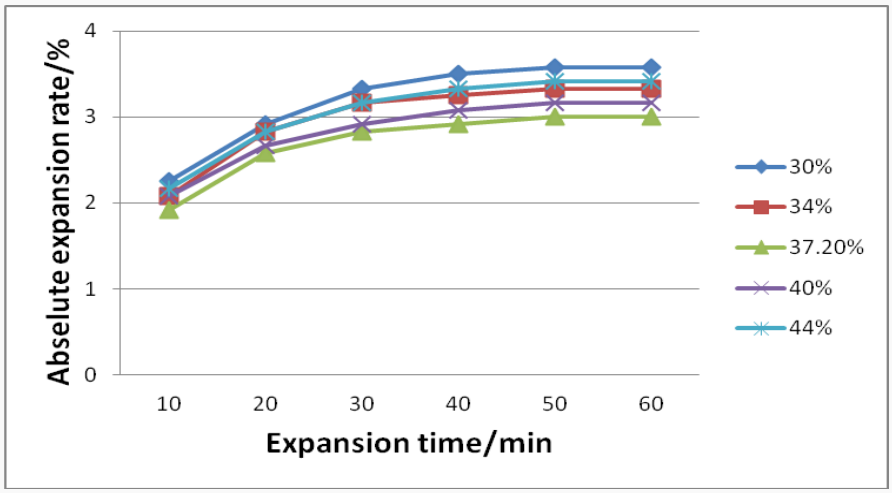

Fig. 4 K=96% Relationship between absolute expansion rate and expansion time

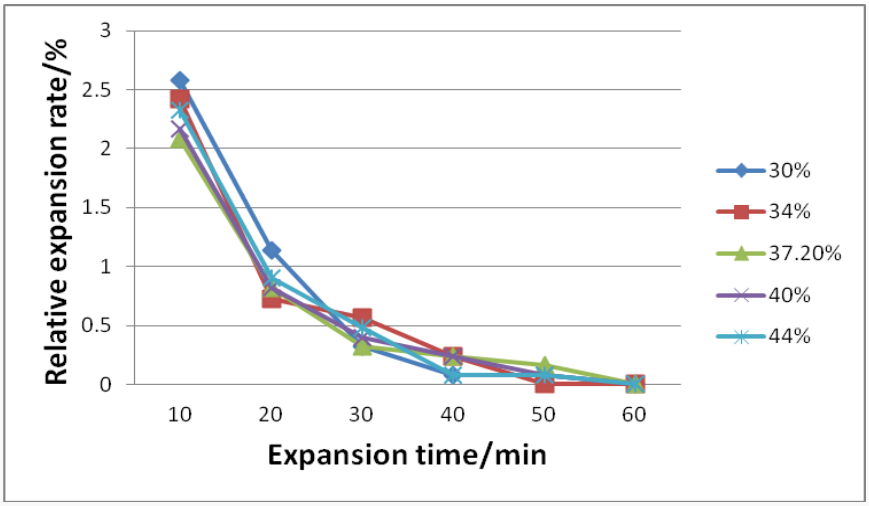

Fig. 5 K=70% Relationship between relative expansion rate and expansion time

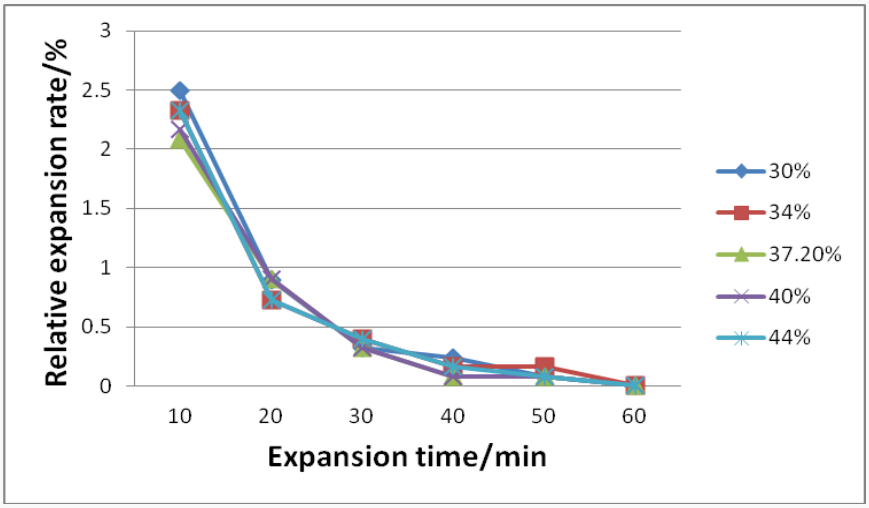

Fig. 6 K=85% Relationship between relative expansion rate and expansion time

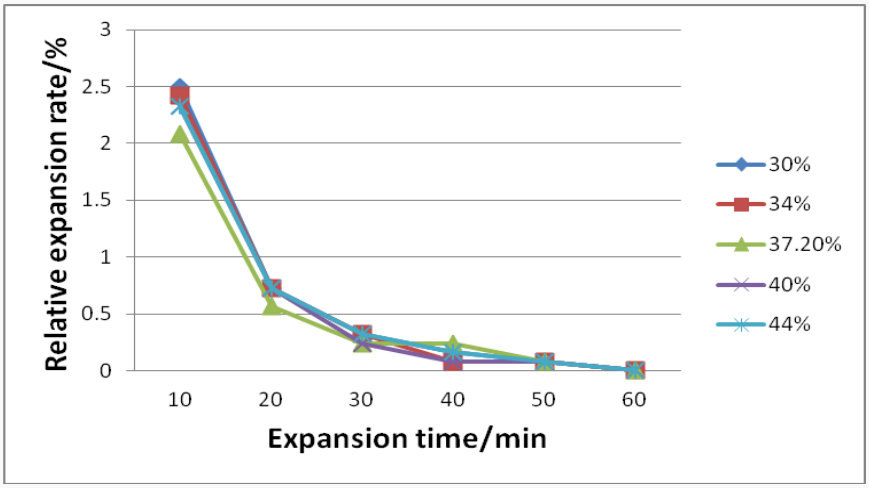

Fig.7 K=90% Relationship between relative expansion rate and expansion time

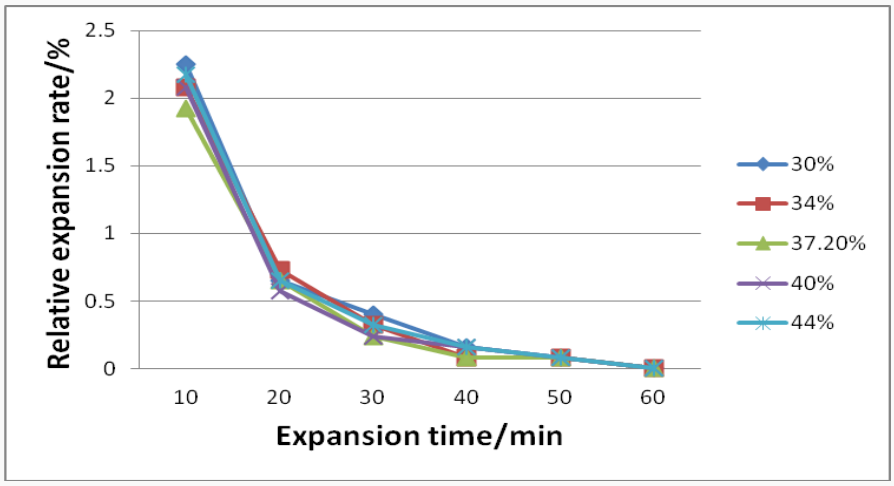

Fig. 8 K=96% Relationship between relative expansion rate and expansion time

Conclusion

(1) In same compaction degree, different initial moisture content, the expansion rate of the sample with the optimum moisture content is minimum. And in same initial moisture content, different compaction degree, the sample of high compaction degree has the small expansion quantity.

(2)The absolute expansion rate gradually increases with the expansion time, relative expansion rate decreases with the expansion time. That is the sample's speed of expansion is very high in 30min after the start, then the speed of expansion will slow down.

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