

METHOD A3

THE DETERMINATION OF THE PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

SCOPE

This method covers the determination of the plastic limit of a soil as defined hereunder by measuring the lowest moisture content at which the soil can be rolled into threads 3 mm in diameter without the threads crumbling. It also covers the calculation of the plasticity index from the liquid limit determined in Method A2, and the plastic limit.

Definition

Plastic limit: The plastic limit of a soil is the moisture content, expressed as a percentage of the mass of the oven-dried soil, at the boundary between the plastic and semi-solid states.

Plasticity index: The plasticity index of a soil is the numerical, difference between the liquid limit and the plastic limit of the soil and indicates the magnitude of the range of the moisture contents over which the soil is in a plastic condition.

2 APPARATUS

- 2.1 A ground-glass plate measuring 150 mm x 220 mm.
- 2.2 Suitable containers, such as weighing bottles with a capacity of 30 ml to 45 ml, or matched watch glasses which will prevent the loss of moisture during weighing.
- 2.3 A balance to weigh up to 100gram, accurate to 0,01 gram.
- 2.4 A drying oven, thermostatically controlled, and capable of maintaining a temperature of 105 to 110 EC.

3. METHOD

Approximately 2 to 3 gram of the moist soil set aside from the liquid limit determination is kneaded with the fingers into an ellipsoidal shape. It is then rolled into a thread of uniform diameter throughout its length. As a rule the rolling is done between the palms of the two hands, or, when dealing with slightly cohesive or cohesion less materials, between the finger of one hand and the palm of the other hand, so as to reduce the pressure on the thread. This is considered to be a satisfactory and convenient procedure and only in the case of highly plastic soils with very tough threads is the rolling done on the ground-glass plate, using either the fingers or the palm of the hand (see 5.1). When the diameter of the thread is 3 mm, the soil is again kneaded into an ellipsoidal shape and rolled out. This process is continued until the crumbling of the soil prevents the formation of a thread 3 mm in diameter. This means that the crumbling occurs when the thread has a diameter slightly greater than 3 mm, but this is regarded as a satisfactory end point, provided that just prior to that, the soil

has been rolled into a thread 3 mm in diameter. The operator should ensure that the thread is not broken up or crumbled by applying excessive pressure, but that it crumbles on account of a lack of plasticity. The crumbled soil thread is transferred to a tared weighing bottle (or other suitable container) for the determination of its moisture content. A duplicate determination should be carried out in precisely the same manner.

The containers with the soil samples are weighed to the nearest 0,01 gram, after which the samples are oven-dried to constant mass at 105 to 110EC. As a rule the material is dried overnight. When the containers are removed from the oven, the lids are replaced to prevent the absorption of hygroscopic moisture, and after being allowed to cool, they are weighed again. The determinations of mass are recorded on Form A2/1 or similar (see Method A2). The loss in mass is the mass of water which is expressed as a percentage of the oven-dried mass of the soil. Duplicate determinations should not vary by more than 1,5 units.

4 CALCULATIONS

- 4.1 Plastic limit : The plastic limit is expressed as the moisture content in percentage of the mass of the oven-dried soil and is calculated as follows:

$$\text{Plastic limit} = \frac{\text{Mass of water}}{\text{Mass of oven dried soil}} \times 100$$

The calculation should be carried out to the first decimal figure, and the average of the two determinations is taken as the plastic limit.

- 4.2 Plasticity index: The plasticity index is obtained by subtracting the plastic limit from the liquid limit, and is determined to the first decimal figure.

The plasticity index is reported with the liquid limit (Method A2) and the linear shrinkage (Method A4) to the nearest whole number on Form A1/2 or a similar form.

If the liquid limit cannot be determined, both the liquid limit and the plasticity index are reported as S.P. (slightly plastic) if there is slight shrinkage according to Method A4, or as N.P. (non-plastic) if there is no shrinkage at all.

5 NOTES

- 5.1 In the case of plastic soils, a considerable amount of kneading and rolling is required in order to reduce the moisture content of the moist material to the plastic limit. This is time consuming, and it is therefore suggested that the moist material from the liquid limit determination be spread out in a thin layer on the table and left to dry out appreciably before rolling is commenced. The moisture content should not be reduced by the admixture of dry soil.
- 5.2 If it is found impossible to determine the liquid limit, the determination of the plastic limit is not attempted.

REFERENCES

AASHTO Designation T90-61
ASTM Designation D424-59