Liquid Limit and Plastic Limit of Soils
D 4318 - 95

Preparation of Test Specimens for Determining Liquid and Plastic Limit of Soils

Sample Preparation Procedure for Liquid Limit

1. Select a 200 to 250 g specimen.
2. Adjust the water content of the specimen by adding distilled water and mixing on a glass plate with a spatula. This specimen should be close to but not past the liquid limit of the soil.
3. Place the prepared soil in a container and let the specimen stand for at least 16 h.

Sample Preparation Procedure for Plastic Limit

1. Select 20g specimen of the same sample used for the preparation for the liquid limit test. This sample should be dry enough so that it will not be sticky.
2. Place this sample in the same container and on top of the wetter specimen.
Liquid Limit and Plastic Limit of Soils
D 4318 - 95

"Abstracted, with permission, from the 1996 Annual Book of ASTM Standards, copyright
American
Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA
19428-2959"

Scope

This test method covers the determination of the liquid limit, plastic limit and plasticity index of
soils. The liquid and plastic limits of soils are often referred the as the Atterberg limits.

Definitions

Liquid Limit (LL or \(w_L\)) - the water content, in percent, of a soil at the arbitrarily defined
boundary between the semi-liquid and plastic states.

Plastic Limit (PL or \(w_P\)) - the water content, in percent, of a soil at the boundary between the
plastic and semi-solid states.

Plasticity Index (PI) - the range of water content over which a soil behaves plastically.

Significance and Use

This testing method is used as an integral part of several engineering classifications systems to
characterize the fine-grained fractions of soils and to specify the fine-grained fraction of
construction materials. The liquid limit, plastic limit and plasticity index of soils are also used
extensively, either individually or together, with other soil properties to correlate with
engineering behavior such as compressibility, permeability, compactibility, shrink-swell and
shear strength.

Apparatus

Liquid Limit Device - a mechanical device consisting of a brass cup suspended from a carriage
designed to control its drop onto a hard rubber base. The device may be operated by
either a hand crank or electric motor.

Cup - brass with mass (including cup hanger) of 185 to 215 g.

Cam - designed to raise the cup smoothly and continuously to its maximum height, over a
distance of at least 180° of cam rotation, without developing an upward or downward
velocity of the cup when the cam follower leaves the cam.

Flat Grooving Tool - a tool made of plastic or non-corroding metal having specified dimensions.
Gage - A metal gage block for adjusting the height of the drop of the cup to 10 mm.

Ground Glass Plate - used for rolling plastic limit threads.

**Calibration of Apparatus**

Determine that the liquid limit device is clean and in working order. Adjust the height of drop of the cup so that the point of the cup that comes in contact with the base rises to a height of 10 ± 0.2 mm.

**Procedure for Liquid Limit**

1. Place a portion of the prepared sample in the cup of the liquid limit device at the point where the cup rests on the base and spread it so that it is 10mm deep at its deepest point. Form a horizontal surface over the soil. Take care to eliminate air bubbles from the soil specimen. Keep the unused portion of the specimen in the storage container.
2. Form a groove in the soil by drawing the grooving tool, beveled edge forward, through the soil from the top of the cup to the bottom of the cup. When forming the groove, hold the tip of the grooving tool against the surface of the cup and keep the tool perpendicular to the surface of the cup.
3. Lift and drop the cup at a rate of 2 drops per second. Continue cranking until the two halves of the soil specimen meet each other at the bottom of the groove. The two halves must meet along a distance of 13mm (1/2 in).
4. Record the number of drops required to close the groove.
5. Remove a slice of soil and determine its water content, w.
6. Repeat steps 1 through 5 with a sample of soil at a slightly higher or lower water content. Whether water should be added or removed depends on the number of blows required to close the groove in the previous sample.

**Note:** The liquid limit is the water content at which it will takes 25 blows to close the groove over a distance of 13 mm. Run at least five tests increasing the water content each time. As the water content increases it will take less blows to close the groove.

**Procedure for Determination of the Plastic Limit**

1. From the 20g sample select a 1.5 to 2 g specimen for testing.
2. Roll the test specimen between the palm or fingers on the ground glass plate to from a thread of uniform diameter.
3. Continue rolling the thread until it reaches a uniform diameter of 3.2mm or 1/8 in.
4. When the thread becomes a diameter of 1/8 in. reform it into a ball.
5. Knead the soil for a few minutes to reduce its water content slightly.
6. Repeat steps 2 to 5 until the thread crumbles when it reaches a uniform diameter of 1/8 in.
7. When the soil reaches the point where it will crumble and when the thread is a uniform diameter of 1/8", it is at its plastic limit. Determine the water content of the soil.
Note: Repeat this procedure three times to compute an average plastic limit for the sample.

**Calculations**

**Liquid Limit, LL**

Plot the relationship between the water content, \( w \), and the corresponding number of drops, \( N \), of the cup on a semi-logarithmic graph with water content as the ordinates and arithmetical scale, and the number of drops on the abscissas on a logarithmic scale. Draw the best straight line through the five or more plotted points.

Take the water content corresponding to the intersection of the line with the 25 drop abscissa as the liquid limit, LL, of the soil.

**Plastic Limit, PL**

Compute the average of the water contents obtained from the three plastic limit tests. The plastic limit, PL, is the average of the three water contents.

**Plasticity Index**

Calculate the plasticity index as follows:

\[
PI = LL - PL
\]

where:

LL = liquid limit, and
PL = plastic limit.

**Report**

1. Sample identification information.
2. Liquid limit, plastic limit, and plasticity index to the nearest whole number.
## Water Content Data

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>