WSDOT Test Method T 113

Method of Test for Determination of Degradation Value

1. SCOPE

   a. This method covers the procedure for determining the susceptibility of an aggregate to degrade into plastic fines when abraded in the presence of water.

2. APPARATUS

   a. Balance — 5000 g capacity, sensitive to 0.1 g

   b. Degradation Shaker — Tyler Portable Sieve Shaker CL-305 modified to provide 300 ± 5 oscillations per minute with a 1¾ in. (44.5 mm) throw on the cam or a shaker with equivalent movement

   c. Washing Canister — Shall be either Plastic or Steel meeting the following:
      - Plastic Canister — 7½ in. ± ¼ in (190.5 mm ± 6.3 mm) diameter x 6 ± ½ in. (152.4 mm ± 12.5 mm) high. Sidewalls of the plastic canister should meet the bottom at 90 degrees with little or no fillet
      - Steel Canister: Meeting the requirements of AASHTO T 210 (ASTM D 3744)

   d. Sand equivalent graduated cylinder and rubber stopper

   e. Sand equivalent stock solution

   f. Sieves — ½ in. (12.5 mm), ⅜ in. (9.5 mm), ¼ in. (6.3 mm), U.S. No. 10 (2.00 mm) and U.S. No. 200 (0.075 mm) sieves conforming to the requirement of AASHTO M-92

   g. Graduates — 500 ml tall form, 100 ml

   h. Interval timer

   i. Funnel — Large enough to securely hold the nest of sieves and a mouth that fits into the 500 ml graduate

   j. Sieve Shaker – Shaker that meets the requirements of AASHTO T-27

   k. Oven – Sufficient size, capable of maintaining a uniform temperature of 230 ± 9°F (110 ± 5°C)

   l. Sprayer – Water sprayer, device to produce a low volume stream of water. i.e. 500 ml wash bottle

   m. Suitable Containers – Pans for washing and drying

3. SAMPLE PREPARATION

a. If testing pit run material: dry at 230 ± 9°F (110 ± 5°C) to allow for clean separation from the fine material. Separate the material over the ½ in. (12.5 mm) sieve and discard that finer than the ½ in. (12.5 mm) and proceed to step 3d.

b. If testing crushed and stockpiled material: dry at 230 ± 9°F (110 ± 5°C) to allow for clean separation from the fine material and proceed to step 3e.

c. If testing quarry material: if necessary, separate the material over the ½ in. (12.5 mm) sieve and discard that finer than the ½ in. (12.5 mm).

d. Crush the material to be tested to pass the ½ in. sieve (12.5 mm).

e. Split out an adequate amount of crushed material (approximately 5000 grams).

f. Sieve the approx. 5000 g split over a ½ in. (12.5 mm), ⅜ in. (9.5 mm), ¼ in. (6.3 mm), and U.S. No. 10 (2.00 mm) screens in a sieve shaker. Steps should be taken to avoid overloading the sieves. Use shaking time determined to meet the requirement of AASHTO T 27 Section 8.2 for the shaker being used.

g. By splitting or quartering, obtain from the sieved material approximately 550 g of ½ -⅜ (12.5-9.5 mm), 550 g of ⅜-¼ (9.5-6.3 mm), and 1100 g of ¼ -#10 (6.3-2.00 mm).

h. Combine the ½-⅜ (12.5-9.5 mm) with the ⅜-¼ (9.5-6.3 mm).

i. Wash the ½-¼ (12.5-6.3 mm) and ¼-#10 (6.3-2.00 mm) portions separately by placing in a container and adding sufficient water to cover it. Agitate vigorously to ensure complete separation of the material finer than No. 200 (0.075 mm) from coarser particles and bring the fine material into suspension above the coarser material.

Note 1: The use of a mechanical aggregate washer is NOT permitted in the washing procedure.

Immediately pour the wash water containing the suspended and dissolved solids over a U.S. No. 10 (2.00 mm) sieve, being careful not to pour out the coarser particles. Add a second charge of water to the portion remaining in the container, agitate, and repeat the operation until the wash water is reasonably clear. Return all material retained on the sieve to the container. Repeat the process for the second portion.

j. Place washed portions into suitable containers and dry to a constant weight at 230 ± 9°F (110 ± 5°C).

k. Allow to cool to room temperature.

l. From the washed and dried material, prepare two - 1000 g test samples as follows:

1. Quarter or split the ½-¼ (12.5-6.3 mm) to achieve two 500 ± 1 g portions; hand selection of up to 50 g to attain the 500 ± 1 grams is acceptable.

2. Split the ¼-#10 (6.3-2.00 mm) to achieve two 500 ± 1 g portions; hand selection of up to 50 g to attain the 500 ± 1 grams is acceptable.

3. Combine each of the ½-¼ (12.5-6.3 mm) portions with one of the ¼-#10 (6.3-2.00 mm) portions to create two - 1000 ± 2 g test samples consisting of ½-#10 (12.5-2.00 mm) material.

4. PROCEDURE

a. Place one test sample in the washing canister, add 200 ± 5 ml of water, cover tightly and place in degradation shaker.

b. Immediately agitate the material for 20 minutes.

c. At the end of the shaking time, empty the washing canister into nested U.S. No. 10 (2.00 mm) and U.S. No. 200 (0.075 mm) sieves fitted into the funnel placed over a 500 ml graduate to catch all wash water.

Note 2: IMPORTANT! It is critical to the test result that material finer than the U.S. No. 200 (0.075 m) is washed off the larger particles into the 500 ml graduate. This process has to be completed using approximately 300 ml of water such that the total amount water used in the test is only 500 ml. (200 ml with shaking, plus the 20-50 ml used for rinsing the canister and lid, plus that remaining to wash the fines off the particles) The process should be slow and meticulous, utilizing a high pressure, low volume spray of water. Use of a 500 ml squeeze type wash bottle has been found to work well for this process. The washing process should take 5 - 10 minutes.

d. Rinse material finer than U.S. No. 200 (0.075 mm) off the lid into the washing canister and then from the washing canister into the nested sieves using minimal amount of water. (20-50 ml).

e. Shake the nested sieves to spread the sample evenly. (Note 3).

f. Wash the sample using only 20-50 ml. of water. (Note 2).

g. Shake the nested sieves to release any water and 200- that may be sitting on the U.S. No. 200 (0.075 mm) sieve. (Note 3).

h. Raise the funnel and tilt slightly, insure that the mouth of the funnel remains over the 500 ml graduate and catches all of the wash water, to allow the sieves to drain easier. Observe the liquid for clarity.

i. Lower the funnel back into the 500 ml graduate.

j. Repeat steps 4e. through 4i. until the liquid in the graduate reaches the 500 ml mark. Do not allow drainage above the 500 ml mark.

Note 3: Shaking should be vigorous enough to move the aggregate but with care such that no spillage of wash water or loss of aggregate occurs.

k. Measure 7 ± 1 ml of sand equivalent stock solution and pour into a sand equivalent cylinder.

l. Bring all solids in the 500 ml graduate into suspension by capping the top with the palm of the hand and turning it completely upside down and back as rapidly as possible, allowing the air bubble to traverse from end to end. Repeat this cycle 10 times, shaking the graduate on the first inversion to release sediment on the bottom.

m. After the tenth cycle, immediately pour the agitated liquid into the sand equivalent cylinder to the 15 ± 0.1 inch. (381 ± 2.5 mm) mark before any settling occurs. (Note 4.)

Note 4: The pour should be immediate and continuous without pause. Allowing the agitated liquid to flow back into the 500 ml graduate and then resuming the pour will allow settling and yield inconsistent results.

n. Insert rubber stopper into the sand equivalent cylinder and mix the contents by turning the cylinder completely upside down and back as rapidly as possible, allowing the bubble to traverse from end to end. Repeat this cycle 20 times.

o. Gently place the sand equivalent cylinder on the table, remove stopper, and immediately start timer. Allow to stand undisturbed for 20 minutes. After 20 minutes read and record the height of the sediment column to the nearest 0.1 in. (2.5 mm).

p. Repeat steps 4a. thru 4o. for the second test sample.

5. CALCULATIONS

a. Calculate the degradation factors for the two test samples using the following formula:

$$D_1 = \frac{(15\text{-}H_1)}{(15 + 1.75H_1) \times 100} \qquad D_2 = \frac{(15\text{-}H_2)}{(15 + 1.75H_2) \times 100}$$

Note: Table 1 may be used to determine the values of D1and D2 by finding the corresponding H value.

b. Average the two degradation factors if they meet the requirements of Section 6, Repeatability:

$$D = \frac{(D_1+D_2)}{2}$$

Where:

D = Degradation Factor
D_1 = Degradation Factor for the first test sample
D_2 = Degradation Factor for the second test sample
H_1 = Height of Sediment in first sand equivalent cylinder
H_2 = Height of Sediment in second sand equivalent cylinder

c. Report the Degradation Factor (D) to the nearest whole number.

d. Degradation Factors range from 0 to 100, with higher values representing the best materials.

6. REPEATABILITY

a. The two test samples, D_1 & D_2 must agree within 6 points.

b. Repeat the entire test if variation between the test samples exceeds 6 points, see following calculation:

Absolute Value $(D_1\text{-}D_2) > 6$

$$D = \frac{(15\text{-}H)}{(15 + 1.75H)} \times 100$$

H	D	H	D	H	D	H	D	H	D
0.0	100	3.1	58	6.1	35	9.1	19	12.1	8
0.1	98	3.2	57	6.2	34	9.2	19	12.2	8
0.2	96	3.3	56	6.3	33	9.3	18	12.3	7
0.3	95	3.4	55	6.4	33	9.4	18	12.4	7
0.4	93	3.5	54	6.5	32	9.5	17	12.5	7
0.5	91	3.6	54	6.6	32	9.6	17	12.6	6
0.6	90	3.7	53	6.7	31	9.7	17	12.7	6
0.7	88	3.8	52	6.8	30	9.8	16	12.8	6
0.8	87	3.9	51	6.9	30	9.9	16	12.9	6
0.9	85	4.0	50	7.0	29	10.0	15	13.0	5
1.0	84								
1.1	82	4.1	49	7.1	29	10.1	15	13.1	5
1.2	81	4.2	48	7.2	28	10.2	15	13.2	5
1.3	79	4.3	48	7.3	28	10.3	14	13.3	4
1.4	78	4.4	47	7.4	27	10.4	14	13.4	4
1.5	77	4.5	46	7.5	27	10.5	13	13.5	4
1.6	75	4.6	45	7.6	26	10.6	13	13.6	4
1.7	74	4.7	44	7.7	26	10.7	13	13.7	3
1.8	73	4.8	44	7.8	25	10.8	12	13.8	3
1.9	71	4.9	43	7.9	25	10.9	12	13.9	3
2.0	70	5.0	42	8.0	24	11.0	12	14.0	3
2.1	69	5.1	41	8.1	24	11.1	11	14.1	2
2.2	68	5.2	41	8.2	23	11.2	11	14.2	2
2.3	67	5.3	40	8.3	23	11.3	11	14.3	2
2.4	66	5.4	39	8.4	22	11.4	10	14.4	1
2.5	65	5.5	39	8.5	22	11.5	10	14.5	1
2.6	63	5.6	38	8.6	21	11.6	10	14.6	1
2.7	62	5.7	37	8.7	21	11.7	9	14.7	1
2.8	61	5.8	37	8.8	20	11.8	9	14.8	0
2.9	60	5.9	36	8.9	20	11.9	9	14.9	0
3.0	59	6.0	35	9.0	20	12.0	8	15.0	0

Degradation Value "D"
Table 1

Performance Exam Checklist

Method of Test for Determination of Degradation Value
WSDOT TM 113

Participant Name _____ Exam Date _____

Procedure Element	Yes	No
Equipment:		
1. Balance - 5000g capacity, sensitive to 0.1g- Calibrated?	❒	❒
2. Degradation Shaker – 1¾" throw, 300 ± 5 oscillations per minute – Verified?	❒	❒
3. Canister – plastic, 7½ in. diameter x 6 in. high, walls meet floor at 90 deg with min fillet, or steel meeting AASHTO T210, or ASTM D 3744?	❒	❒
4. Sand Equivalent Cylinder & Rubber Stopper?	❒	❒
5. Sand Equivalent Stock Solution?	❒	❒
6. Sieves – ½, ⅜, ¼, No. 10, No. 200 – Verified?	❒	❒
7. Graduates – 500 ml tall form & 100 ml?	❒	❒
8. Interval Timer – Verified?	❒	❒
9. Funnel – Large enough to hold the sieves with a mouth that fits in the 500 ml graduate?	❒	❒
10. Sieve Shaker(s) – Verified?	❒	❒
11. Oven – verified at 230 ± 9°F.- Calibrated?	❒	❒
12. Sprayer – produces a low volume stream of water?	❒	❒
13. Containers – suitable for drying and washing?	❒	❒
Procedure:		
1. a. Pit Run – Dried and separated over the ½ in., ½-discarded?	❒	❒
b. Processed material – Dried?	❒	❒
c. Quarry material – prepared for crushing?	❒	❒
2. Material crushed to pass the ½"?	❒	❒
3. Split out approx. 5000g?	❒	❒
4. Separate the material over the ½, ⅜, ¼, and No. 10?	❒	❒
5. Split or quarter approx. 550g ½-⅜, 550g ⅜-¼, & 1100g ¼-No. 10?	❒	❒
6. Combine the ½-⅜ with the ⅜-¼?	❒	❒
7. Hand wash the ½-¼ and ¼-No. 10 separately?	❒	❒
8. Dry the portions in suitable containers at 230 ± 9 to a constant weight?	❒	❒
9. Split of quarter the two sizes into two 500 ± 1g portions, hand selection ok to 50g?	❒	❒

Procedure Element	Yes	No
10. Combine to create two 1000 ± 2g, ½ - No. 10 test samples?	❒	❒
11. Place one sample into a canister, cover with 200 ± 5 ml water, cover & shake for 20 min.?	❒	❒
12. Empty canister into the nested No. 10 & No. 200 fitted in the funnel over the 500 ml grad.?	❒	❒
13. Rinse the lid into the canister and then the canister into the nested sieves?	❒	❒
14. Shake the sieves to spread the sample?	❒	❒
15. Wash using only 20-50 ml.?	❒	❒
16. Shake the sieves to release trapped water and then lift observing liquid for clarity?	❒	❒
17. Repeat 14-16 until water reaches the 500 ml mark – water not to exceed 500 ml?	❒	❒
18. No loss of fines or liquid during the washing process?	❒	❒
19. Place 7 ± 1 ml of SE Stock Solution in a SE Graduated Cylinder?	❒	❒
20. Turn capped 500 ml upside down & back allowing bubble to traverse 10 cycles?	❒	❒
21. Immediately pour into a SE Cylinder to the 15 ± .1 mark – no settling allowed?	❒	❒
22. Rubber stopper inserted and SE Cylinder turned upside down & back 20 cycles?	❒	❒
23. Place gently, remove stopper, start timer, allow to sit undisturbed for 20 min.?	❒	❒
24. Record height of column to nearest 0.1 in.?	❒	❒
25. Repeat for second sample?	❒	❒
26. Calculations performed correctly?	❒	❒
27. Second sample must be within 6 points?	❒	❒

First attempt: Pass ❒ Fail ❒ Second attempt: Pass ❒ Fail ❒

Signature of Examiner _____

Comments: