

Sodium Sulfate Soundness

Sulfate Soundness

- Provides estimate or index of durability
- Durability
 - resistance to weathering
 - important in frost-susceptible regions
- AASHTO T104
 - Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
 - Results different for two sulfates

Solution Preparation: Sodium or Magnesium Sulfate

- Prepare solution at 77 °F or higher
- Cool solution to 68.5 - 71.5 °F
- Keep solution at 'cooled' temperature for 48 hours

Test Procedure

- Wash and dry sample to constant weight at temperature of 230 ± 9 °F
- Separate sample into specified size fractions
- Recombine fractions for a total weight

Sample Size

5,000 ± 300 g	2-½ to 1-½ in.
1,500 ± 50 g	1-½ to ¾ in.
1,000 ± 10 g	¾ to ⅝ in.
300 ± 5 g	⅝ in. to No. 4

Example: ¾ to ⅝ in.

670 ± 5 g ¾ to ½ in.

330 ± 5 g ½ to ⅝ in.

1 pound = 454 grams

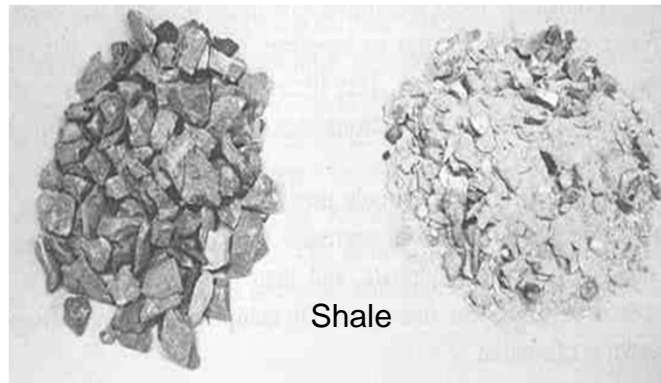
Test Procedure

- Immerse sample in the solution
 - 16 to 18 hours
 - 70 ± 1.5 °F
- Remove and drain sample for 15 ± 5 minutes
- Dry sample to constant weight at 230 ± 9 °F
- Cool sample to 68 to 77 °F
- Repeat process for 5 cycles of immersion and drying
 - Why?

Freeze-Thaw Simulation

- Soaking ... solution fills pores
- Drying ... dehydrates salts in pores
- Soaking ... rehydrates salts, causing expansion
 - Simulates expansion of water upon freezing

Weathering



Test Procedure

- Wash sulfate salt off sample
 - Circulate hot water (100-120 °F)
- Dry and sieve sample
 - Hand sieve to minimize further degradation

Sieve Selection To Determine Loss

Aggregate Size	Sieve
2-½ to 1-½ in.	1-¼ in.
1-½ in. to ¾ in.	⅝ in.
¾ to ⅜ in.	5/16 in.
⅜ in. to No. 4	No. 5

Sodium Sulfate Soundness

- Initial mass (weight) of sample fraction
- Final mass (weight) of intact particles retained on sieve
- Percent Loss
= $\frac{\text{Initial Mass} - \text{Final Intact Mass}}{\text{Initial Mass}} \times 100\%$
- Determine a weighted average for each size fraction, based on the grading of the original sample for a total percent loss

Example

- Original mass of sample: 2175 g
- Mass of particles after test: 1847 g

$$\% \text{ loss} = \frac{(2175g - 1847g)}{2175g} \times 100\% = \boxed{15.1\%}$$

SCDOT Specifications Sodium Sulfate Soundness

Material Use	Specification
Used in HMA Surface Courses	15% Max
Used in Structural Concrete	15% Max
Used in Structural Concrete (Marine Limestone)	25% Max

Comments

- 'Sound' rock = Lower percentage
- Sedimentary rock tends to have higher percentage
- Calcium carbonate (limestone)
 - chemically attacked by sulfates
 - erroneous (higher) soundness
 - use filtered solution
- High variability / low repeatability

Common Errors

- Improper temperature of solution
- Improper solution concentration (specific gravity)
- Insufficient drying times
- Not all salt removed by washing
- Further breakdown of particles while sieving