ASPHALT BINDER

Section 3 – Aggregates
For PMP

1

Physical Properties

- Texture
- Gradation
- Absorption

2

Texture

- Definition – Appearance
- Function of shape
- Shape
  - Angular
  - Rounded
  - Bulky
  - Flat / Elongated

3

Gradation

- Size
  - Fractionation
  - Gradation
- Uniform
- Well
- Gap
- Open

Section 3 - 4

4

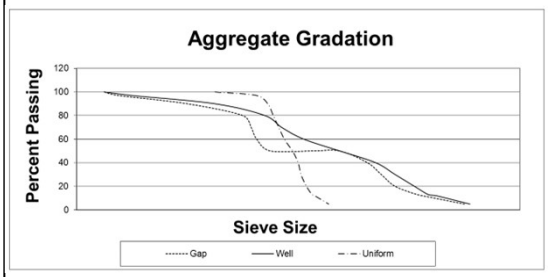
Particle Size

- Fractionation
- Gradation

Section 3 - 5

5

Aggregate Gradation



Section 3 - 6

6

Gradation

- Nominal maximum Size: One sieve size larger than the first sieve to retain more than 10 percent
- Maximum Size: one sieve size larger than nominal maximum size.

Section 3 - 7

7

Absorption

- Surface Porosity
  - Hydrophobic – repels
  - Hydrophylic – attracts
- High Absorption = High % Binder
  - AFFINITY FOR ASPHALT
- Mechanical
  - Absorption
- Chemical
  - Asphalt / Aggregate
- Stripping

Section 3 - 8

8

Aggregate Tests

- Coarse aggregate angularity
- Fine aggregate angularity
- Flat and elongated particles
- Clay content
- Soundness
- Durability
- Deleterious materials

Section 3 - 9

9

ASTM D 5821
(Coarse Aggregate Angularity)

- ASTM D 5821 – Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
- Summary: The percentage of aggregate larger than #4 with one or more fractured faces is determined
- Significance: Internal friction of coarse aggregate affect the workability, consolidation, strength, stability, and VMA of asphalt mixes. More fractured faces will result in a higher internal friction.

10

AASHTO T 304
(Fine Aggregate Angularity)

- AASHTO T 304 (Method A) – Standard Test Method for Uncompacted Void Content of Fine Aggregate (MTM 824.0)
- Summary: The void content of a loose sample of #8 to #100 fine aggregate is determined as a percent of the original mass.
- Significance: Void content is influenced by particle shape, texture and gradation. It can be an indicator of: water demand in concrete; flowability or workability; influence of fine aggregate on VMA; and bituminous concrete stability

11

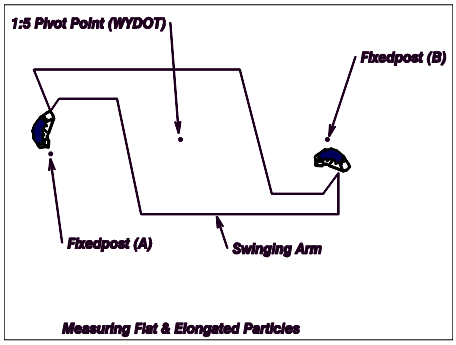
ASTM D4791
(Flat and Elongated Particles)

ASTM D4791 – Flat and Elongated Particles in Coarse Aggregate (MTM 835.0)

- Summary: Individual particles of aggregate are measured to determine the ratio of length to thickness.
- Significance: Flat and elongated particles affect workability and consolidation and may indicate degradation.
- Influenced by crushing method & aggregate mineralogy.

12

Measuring Flat & Elongated Particles



Section 3 - 13

13

AASHTO T 176 (Clay Content)

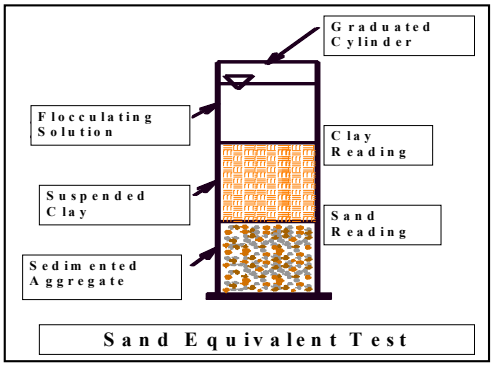
AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test (MTM 836.0)

- **Summary: A sample of fine aggregate is mixed with a flocculating solution in a graduated cylinder. The cylinder height of suspended clay and sedimented sand is measured.**
- **Significance: Clay content would affect the aggregate surface area and the asphalt content**

Section 3 - 14

14

Sand Equivalent Test



Section 3 - 15

15

AASHTO T 96 (Durability)

AASHTO T 96 – Resistance to Degradation by Abrasion and Impact in the Los Angeles Machine (MTM 818.0) 2004

- **Summary: A sample of coarse aggregate is placed in a steel drum along with a certain number of steel spheres. The drum is rotated 500 times and the sample is then washed over a #12 sieve. The difference in mass between initial and final mass is the % loss**
- **Significance: Abrasion loss is related to aggregate quality or durability.**

Section 3 - 16

16

AASHTO T 104 (Soundness)

AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

- **Summary: An aggregate sample is exposed to repeated immersions in saturated solutions of sodium or magnesium sulfate followed by oven drying.**
- **Significance: The percent loss over various sieves is related to the freeze/thaw resistance of the aggregate.**

Section 3 - 17

17

AASHTO T 112 (Deleterious Material)

AASHTO T 112: Clay Lumps and Friable Particles in Aggregate

- **Summary: Wet sieving aggregate size fractions over specified sieves. The percentage of mass lost is reported as the percentage of clay lumps.**
- **Significance: The percent to clay lumps will affect the optimum asphalt content and the performance of the asphalt mix.**

Section 3 - 18

18

Crushing and Stockpiling

- Material up to 18" processed
- Separate Stockpiles
  - Coarse Aggregate – Retained on #4
  - Fine Aggregate – Passing #4
  - Pit Run Filler
- Stockpiling

Section 3 - 19

19

Specifications

Asphalt Binder– PMP

- WYDOT Standard Specifications 803.5
- Shall consist of crushed stones, crushed gravel or natural gravel
  - Uniform quality; crushed; sound, tough, durable particles
  - Coarse and Fine Aggregates shall be stockpiled in separate piles
  - Pit Run Filler in separate pile.

Section 3 - 20

20

Specifications (continued)

Asphalt Binder– PMP (continued)

- Aggregate
- Gradation
  - Four available; Table 803.5.5-1
  - Selected based on use, cost, and conservation of materials
- Types
  - Five Types: Table 803.5.5-2

Section 3 - 21

21

Table 803.5.5-1

Gradation Requirements, Marshall and Superpave Mixes

Sieve	% Passing, Nominal Maximum Size			
	1 in	3/4 in	1/2 in	3/8 in
1 1/4 in	100	-	-	-
1 in	90-100	100	-	-
3/4 in	65-90	90-100	100	-
1/2 in	50-85	55-90	90-100	100
3/8 in	40-75	45-85	55-90	90-100
No. 4	30-60	30-65	35-70	45-85
No. 8	20-45	20-50	20-55	30-65
No. 30	5-25	5-30	5-35	10-40
No. 200	2-7	2-7	2-7	2-7

22

Table 803.5.5-2

Aggregate Properties, Flexible Pavements

Properties	Agg I	Agg II	Agg III	Agg IV	Agg V
LA Abrasio maximum loss, %	35	40	40	40	40
Flat and Elongated (1 to 5 ratio) maximum, %	10	10	10	10	-
Sand Equivalent minimum (2)	45	45	45	40	40
Fractured Faces minimum (1)	95/90	95/90	85/80	75/-	55/-
Fine Aggregate Angularity minimum (2)	45	45	45	40	40
Plasticity Index (2)	NP	NP	NP	NP	NP
Soundness ($MgSO_4$) maximum loss %	18	18	18	18	18

(1) "95/90" denotes that 95 percent of the coarse aggregate has one or more fractured faces and 90 percent has two or more fractured faces.

(2) Based on the minus No. 4 fraction of the composite blend

23

Specifications (continued)

Plant Mix Wearing Course

- **WYDOT 803.6**
- **Shall be crushed stone or gravel**
- **Shall meet the requirements for Agg I in Table 803.5.5-2**
- **Gradation – Table 803.6.1-1**
- **When specified on the plans, provide aggregate that is in accordance with one of the requirements in Table 803.6.2-1, Polish Resistant Aggregate Requirements**

24

Table 803.6.1-1

Gradation Requirements, Plant Mix Wearing Course

Sieve	% Passing
½ in	100
3/8 in	97-100
No. 4	25-45
No. 8	10-25
No. 200	2-7

25

Table 803.6.2-1

Polish Resistant Aggregate Requirements

Test Method	Description	Specification
AASHTO T279	9 hour (Polish Value), minimum	32
AASHTO T 242	(1) Skid Number, minimum	40

(1) Base the skid number on historical skid numbers accumulated for a period of at least five years for a pavement that has carried traffic exceeding 3,500,000 accumulated 18-kip equivalent single axel loads.

26

Specifications (continued)

Microsurfacing

- Mineral aggregate shall be 100% crushed.
- Prior to crushing a minimum of 95% of aggregate shall be retained on ½ in sieve
- Sand equivalent ≥ 65%
- L.A. abrasion loss ≤ 30%
- Contractor shall supply information on aggregate properties and JMF
- Gradation Table 803.7-1
- When specified on the plans, provide aggregate that is in accordance with one of the requirements in Table 803.6.2-1, Polish Resistant Aggregate Requirements

27

Table 803.7-1

Gradation Requirements, Microsurfacing

Sieve	% Passing
3/8 in	100
No. 4	70-90
No. 8	45-70
No. 16	28-50
No. 30	19-34
No. 50	12-25
No. 100	7-18
No. 200	5-15

Section 3 - 28

28