


Construction of Quality Hot Mix Asphalt Pavements - 1 Day Course 



## Aggregates


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## Aggregate Summary

- Aggregate is a vital component of HMA
- Aggregate can be obtained from a number of sources, including in RAP from roadway
- Aggregate must be properly processed and handled to ensure quality
- Aggregate properties must be measured to ensure compliance with specifications and to calculate mixture volumetrics
- There is a trend to increase the % of RAP due to cost and environmental reasons


HMA Component Materials 






## Aggregate

- Aggregates are also referred to as rock, granular material, mineral aggregate
- Aggregates consist of any hard, inert mineral used in the production of hot mix asphalt






## Aggregate


**Typical aggregates include crushed stone, crushed gravel, crushed slag, sand and rock dust**

- Aggregates usually make up 94-96% by weight, or 83-84% by volume of an asphalt paving mixture
- Aggregates are the main load-bearing components within asphalt paving mixtures




## Aggregate Sources


- Natural aggregates
- Processed aggregates
- Synthetic or manufactured aggregates
- Reclaimed Asphalt Pavement (RAP)




### Aggregate Sources




Excavating natural gravel and sand





Quarrying aggregates prior to crushing and screening




Blast-furnace slag aggregate




### Quarrying Aggregate - Blasting

Holes are drilled into ledge and filled with explosives - diameter and distance between holes, geology, determines resulting boulder size.




Ledge is then "shot"




Resulting rock is scooped up, placed into haul truck, and carried to the primary crusher.

### Aggregate Classifications





- **Sedimentary**
  - Limestone
  - Sandstone
  - Gravel, natural sand
- **Metamorphic**
  - Gneiss (from shale or granite)
  - Schist (from basalt)
  - Quartzite (from sandstone)
  - Marble (from limestone)
- **Igneous**
  - Extrusive
    - basalt (traprock)
    - rhyolite
    - andesite
  - Intrusive
    - granite
    - diorite
    - gabbro

### Effects of Aggregate Properties on Mixtures




Property	Effects on Mixture
Mineral type	Resistance to polishing, affinity to asphalt
Particle size	Asphalt content, lift thickness
Particle shape	Resistance to deformation, volumetric properties
Cleanliness	Adhesion between asphalt and aggregates, mixture volumetric properties
Toughness	Resistance to degradation, weathering

### Basic Aggregate Types






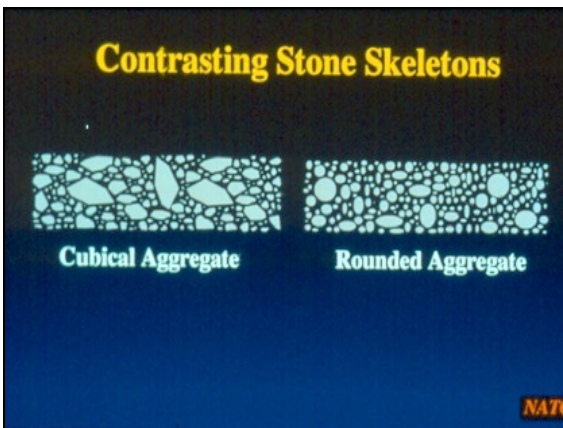
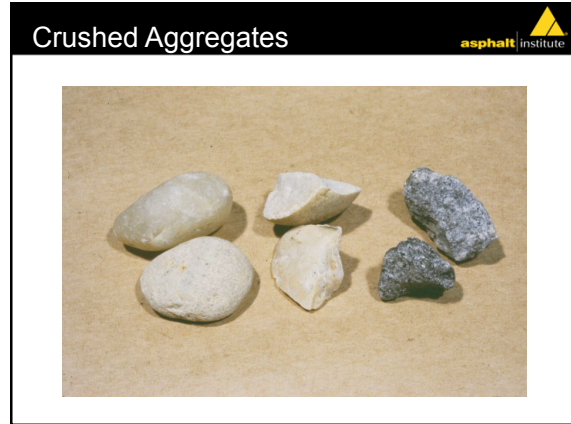
### Aggregates in Asphalt Construction




**Processed aggregates** Require processing; i.e., crushing, sizing, and/or washing to remove fines prior to use

- Natural Pit Materials
- Quarried Bedrock



### Stockpiling Aggregates




- Good stockpiling procedures are crucial to HMA production.
- If the material in the stockpile is segregated or contaminated, the HMA will be also
- Coarse aggregate piles segregate easier than fine aggregate piles

### Stockpiling Aggregates


- Use clean, well drained surfaces for stockpiling aggregates
- Maintain proper gradation within the stockpiles by one of the following methods:
  - Keeping the stockpiles widely spaced
  - Using bulkheads between stockpiles Bulkheads should extend the full depth
  - Storing aggregate in bins
  - Horizontal stockpiling with separated piles

### Stockpiling Aggregates




Good spacing between stockpiles


Use of bulkheads to maintain separation



Horizontal stockpiles with separate aggregate piles




### Handling Stockpiled Aggregates




- **Angularity of the aggregate is an essential component of good HMA.**
- **Each time the aggregate is moved and stockpiled, the aggregate degrades and the edges become more rounded**
- **Handling should be minimized as much as possible**

### Evaluating Aggregate Properties




- **Particle Size Analysis (Gradation)**
- **Specific Gravity**
- **Clay Content (Sand Equivalent)**
- **Toughness (L.A. Abrasion)**
- **Particle Shape**
  - **% Fractured Faces**
  - **Flat and Elongated Particles**
  - **Fine Aggregate Angularity**

### Aggregate Properties


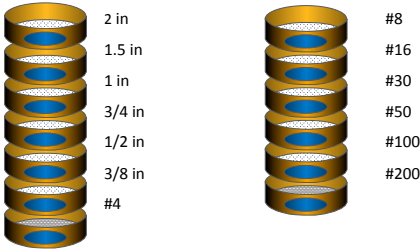


Aggregate Gradation

- Two methods of performing test
  - Dry sieve Analysis (ASTM 136/AASHTO T 27/MDT 202)
  - Wet sieve Analysis (ASTM 117/AASHTO T 11/MDT 202)
- Reporting methods
  - Percent passing
  - Percent retained




### Standard Aggregate Sieves

2 in	#8
1.5 in	#16
1 in	#30
3/4 in	#50
1/2 in	#100
3/8 in	#200
#4	

### Aggregate Properties



Aggregate Gradation

- Determined from a sieve analysis
- Aggregate Fractions
  - Coarse aggregate - Material retained by the No. 4 sieve
  - Fine aggregate - Material passing the No. 4 sieve
  - Mineral filler - Fraction passing the No. 200 sieve



### Toughness - Los Angeles Abrasion Test

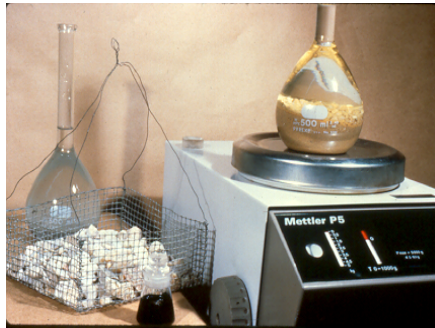


Approx. 10% loss for extremely hard igneous rocks

Approx. 60% loss for soft limestones and sandstones



### Aggregate Specific Gravity



### Plant Aggregate Stockpiles



### What is RAP ?



#### Reclaimed Asphalt Pavement

Old asphalt pavement that has been removed from the roadway by either milling or full-depth removal.

### RAP from Milling



## Reasons for Increasing RAP Content?

- What are reasons for higher RAP %?
  - Save money
    - RAP worth over \$30/ton in recovered binder and aggregate
  - Conserve resources
    - Shortage of binder and quality aggregate in many areas
  - Get rid of large stockpiles of RAP
  - Studies and experience show mixes with higher RAP % perform well

## Advances In Use of RAP

- Recent Trends
  - Increasing RAP % Allowed in HMA
  - Fractionization of RAP Stockpiles
  - Improved processing and plant equipment to allow higher percentages of RAP

## RAP Fractionization

- Trend is to process RAP stockpiles more thoroughly
  - Purpose of processing :
    - Eliminate oversize particles
    - Improve consistency of RAP stockpile
    - Allow more accurate blending of RAP materials
  - Fractionization
    - Use high speed screens to separate RAP stockpiles into separate stockpiles with different size fractions

## RAP Stockpile Fractionization



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## Questions?

