FAA Conference 2015
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Oldcastle Materials

# SUPERPAVE TRAINING

## SUPERPAVE

- SUPERPAVE the Industry standard
  - Initial Projects were let statewide in 1996
  - 100% SUPERPAVE Implementation on projects ***let*** in 1999

# SUPERPAVE Issues

- Specification encourages coarse mixes with low asphalt contents
  - Difficulty w/Compaction
  - Prone to Segregation

# Superpave FAA

- P401- Marshall Specification
  - Served the FAA well
  - EB 59
  - Struggled with Nequivalent

# SUPERPAVE

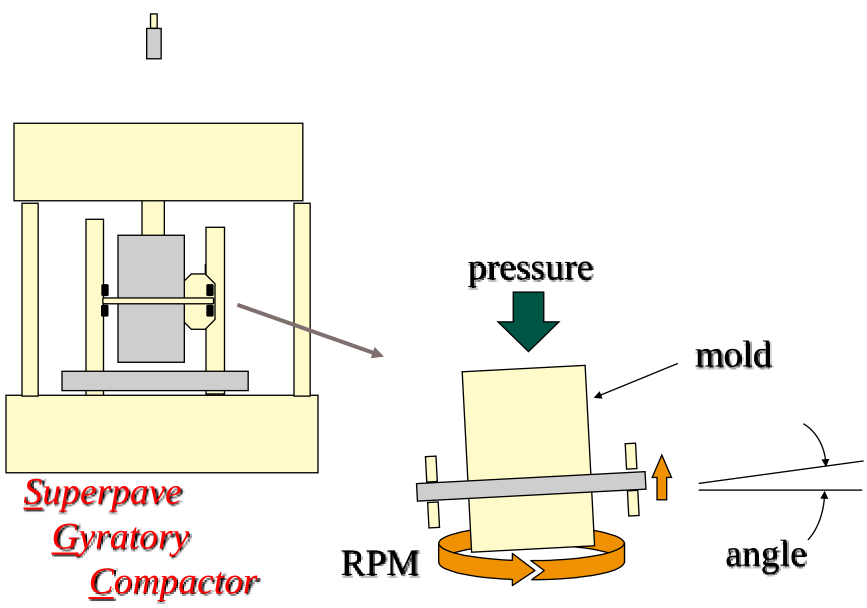
- "SYSTEM"
  - Mix Design
    - Aggregate Specs
    - PGB Binder Criteria
    - ESAL's
      - Gyratory Compactor
    - Volumetric Analysis
  - Compaction Requirements

# Features of P401 Superpave

- Superpave

# Gyratory Compactor

- Gyrations are a function of Mix ESAL's
  - MORE ESAL's- More gyrations
    - LESS ASPHALT (Rutting)
- Simulate the effect of traffic after over the "life cycle"



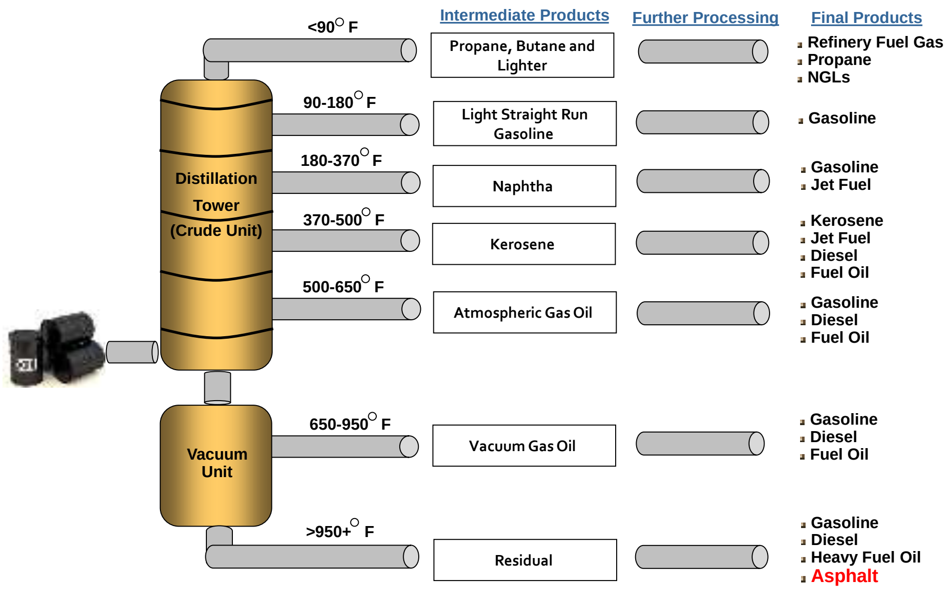
# Gyratory Compactor

- Sample size
  - 115 mm +/- 5 mm
  - Typically 4600 grams
- Number of Specimens
  - 3-5 Specimens
- Ndesign
  - 75 > 60,000 lbs
  - 50 < 60,000 lbs

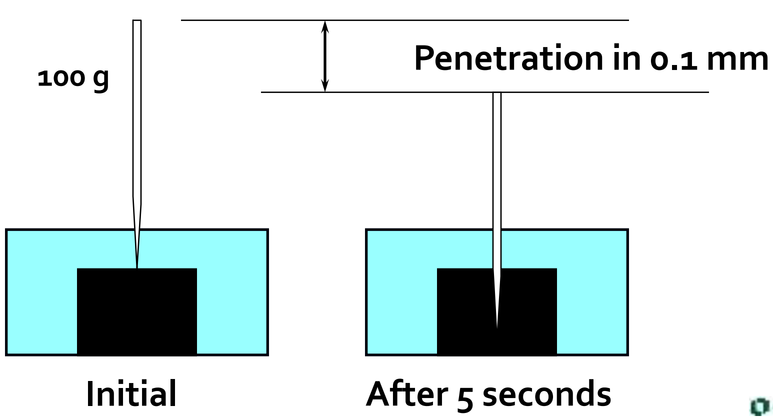
# Stability and Flow

- Requirements are removed for Superpave option

# Refining Process

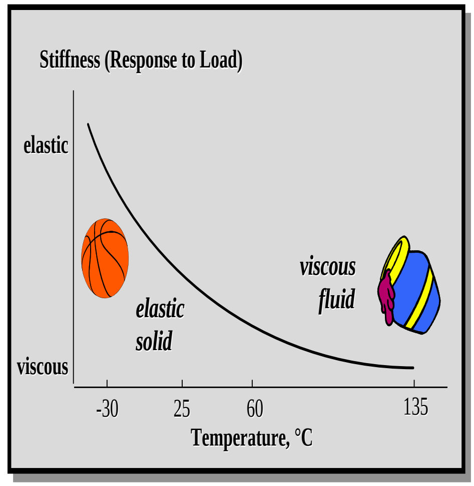



# Binder



# Binder

- Specifications evolved to characterize asphalt binder's viscosity in the 1960's.
- Viscosity is defined as resistance to flow
  - Asphalt is "temperature viscous"
    - Temperature of the material affects it stiffness (or resistance to flow)




# Binder Tests

- Need to further characterize asphalt binder due to widespread pavement failures (permanent deformation)
  - Radial tires
  - Increased truck traffic
    - Higher tire pressures
  - Changes in refining process

## Superpave Binder

- Rolling Thin Film Oven Test
- Pressure Aging Vessal
- Direct Tension Tester
- Dynamic Shear Rheometer
- Bending Beam Rheometer


Direct Tension Bath and Load

## Binder

Superpave Binder specification grading based on pavement climatic conditions from LTPP bind

**PG 64-22**

**Performance Grade**

**Average max pavement design temp**

**Min pavement design temp**

# Binder

- PG System
- Grade bumping
  - < 12,500 Standard
  - <100,000 – 1 grade
  - > 100,000- 2 grade
- "Plus" specifications
  - Elastic recovery to ensure that material polymer modified (70%)
- Highly polymerized materials that are difficult to use at reasonable temperatures

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# MSCR Binder

- MSCR
  - Multiple Stress Creep Recovery
  - AASHTO TP 70
- DSR
  - High and intermediate temperature grading
- NEW Grading for asphalt
- PG Grading appropriate for grading, followed by "letter" designation
- Changes to AASHTO M320, Table 1
  - PG 64-22S
    - Standard traffic loading
  - PG 64-22H
    - Heavy traffic loading
  - PG 64-22V
    - Very heavy traffic loading
  - PG 64-22E
    - Extremely heavy traffic loading

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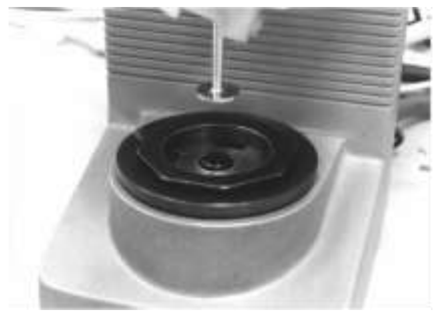
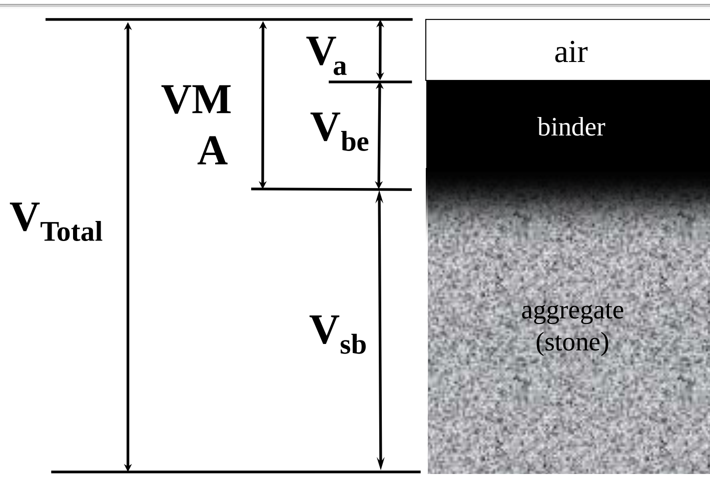
# Binder

- MSCR Implementation
  - Transition from AASHTO M 320 to AASHTO MP 19
- Regional User-Producer groups and agencies
- Expect some changes in binder



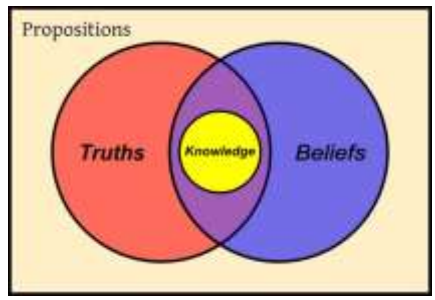


# Voids in Mineral Aggregate (VMA)



# VMA Historical perspective

- 1901- Referenced in FJ Warren patent application
- Early Marshall looked at VFA only ( 65-85%)
- 1956- McLeod proposes minimum VMA of 15% (based on 5% air voids and also revised in 1959 to differentiate NMAS)
- 1962- Asphalt Institute proposes McLeod recommendations and also drops VFA in MS-2 (AI reinstates VFA in 1992)
- Post 1962- Line in the sand…
- VMA vs. Film Thickness

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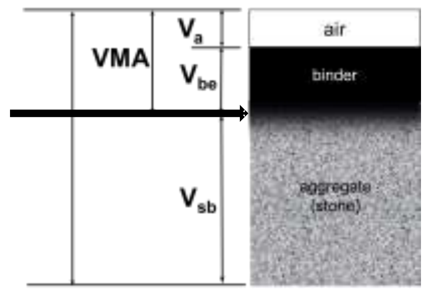
# VMA

$$VMA = 100 - \frac{G_{mb}\,P_s}{G_{sb}}$$

**VMA is the volume of air voids and effective binder (binder not absorbed into the aggregate), and in design is a powerful parameter to indicate that sufficient volume of binder is in the mixture**

## Volumetrics- VMA

- VMA
  - Excludes the portion of binder absorbed into the aggregate
  - As nominal maximum size decreases VMA increases (more volume of binder required to coat higher amount of surface area in finer mixtures)

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## Voids Filled with Asphalt

$$\text{VFA} = 100 \times \frac{\text{VMA} - V_a}{\text{VMA}}$$

**VFA is the percent of VMA that is filled with asphalt cement (related to "saturation" from soil mechanics)**

# M 323 Requirements for VMA

Table 6—Superpave HMA Design Requirements

| Design ESALs[a] (Million) | Required Relative Density, Percent of Theoretical Maximum Specific Gravity | | | Voids in the Mineral Aggregate (VMA), Percent Minimum | | | | | | Voids Filled with Asphalt (VFA) Range,[b] Percent | Dust-to-Binder Ratio Range[c] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Nominal Maximum Aggregate Size, mm | | | | | | | |
| | $N_{initial}$ | $N_{design}$ | $N_{max}$ | 37.5 | 25.0 | 19.0 | 12.5 | 9.5 | 4.75 | | |
| <0.3 | ≤91.5 | 96.0 | ≤98.0 | 11.0 | 12.0 | 13.0 | 14.0 | 15.0 | 16.0 | 70–80[d] | 0.6–1.2 |
| 0.3 to <3 | ≤90.5 | 96.0 | ≤98.0 | 11.0 | 12.0 | 13.0 | 14.0 | 15.0 | 16.0 | 65–78 | 0.6–1.2 |
| 3 to <10 | ≤89.0 | 96.0 | ≤98.0 | 11.0 | 12.0 | 13.0 | 14.0 | 15.0 | 16.0 | 65–75[e] | 0.6–1.2 |
| 10 to <30 | ≤89.0 | 96.0 | ≤98.0 | 11.0 | 12.0 | 13.0 | 14.0 | 15.0 | 16.0 | 65–75[e] | 0.6–1.2 |
| ≥30 | ≤89.0 | 96.0 | ≤98.0 | 11.0 | 12.0 | 13.0 | 14.0 | 15.0 | 16.0 | 65–75[e] | 0.6–1.2 |

[a] Design ESALs are the anticipated project traffic level expected on the design lane over a 20-year period. Regardless of the actual design life of the roadway, determine the design ESALs for 20 years.

[b] For 37.5-mm nominal maximum size mixtures, the specified lower limit of the VFA range shall be 64 percent for all design traffic levels.

[c] For 4.75-mm nominal maximum size mixtures, the dust-to-binder ratio shall be 0.9 to 2.0.

[d] For 25.0-mm nominal maximum size mixtures, the specified lower limit of the VFA range shall be 67 percent for design traffic levels <0.3 million ESALs.

[e] For design traffic levels >3 million ESALs, 9.5-mm nominal maximum size mixtures, the specified VFA range shall be 73 to 76 percent and for 4.75-mm nominal maximum size mixtures shall be 75 to 78 percent.

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# VMA

- Recommend that design VMA +0.5% desired production VMA
- Each 1% VMA = 0.4 liquid
- Aggregate characteristics including gradation, surface, texture and shape impact VMA

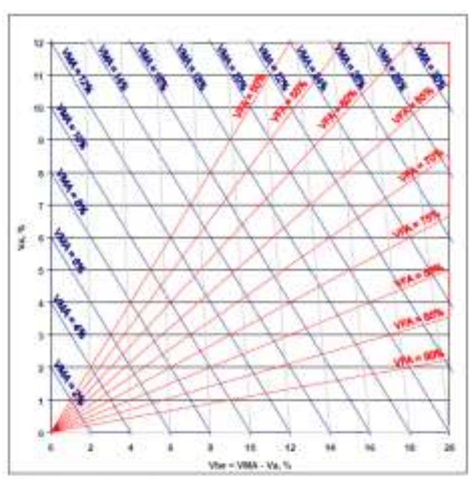

FIGURE 2: Universal Volumetric Chart

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# Thanks!!