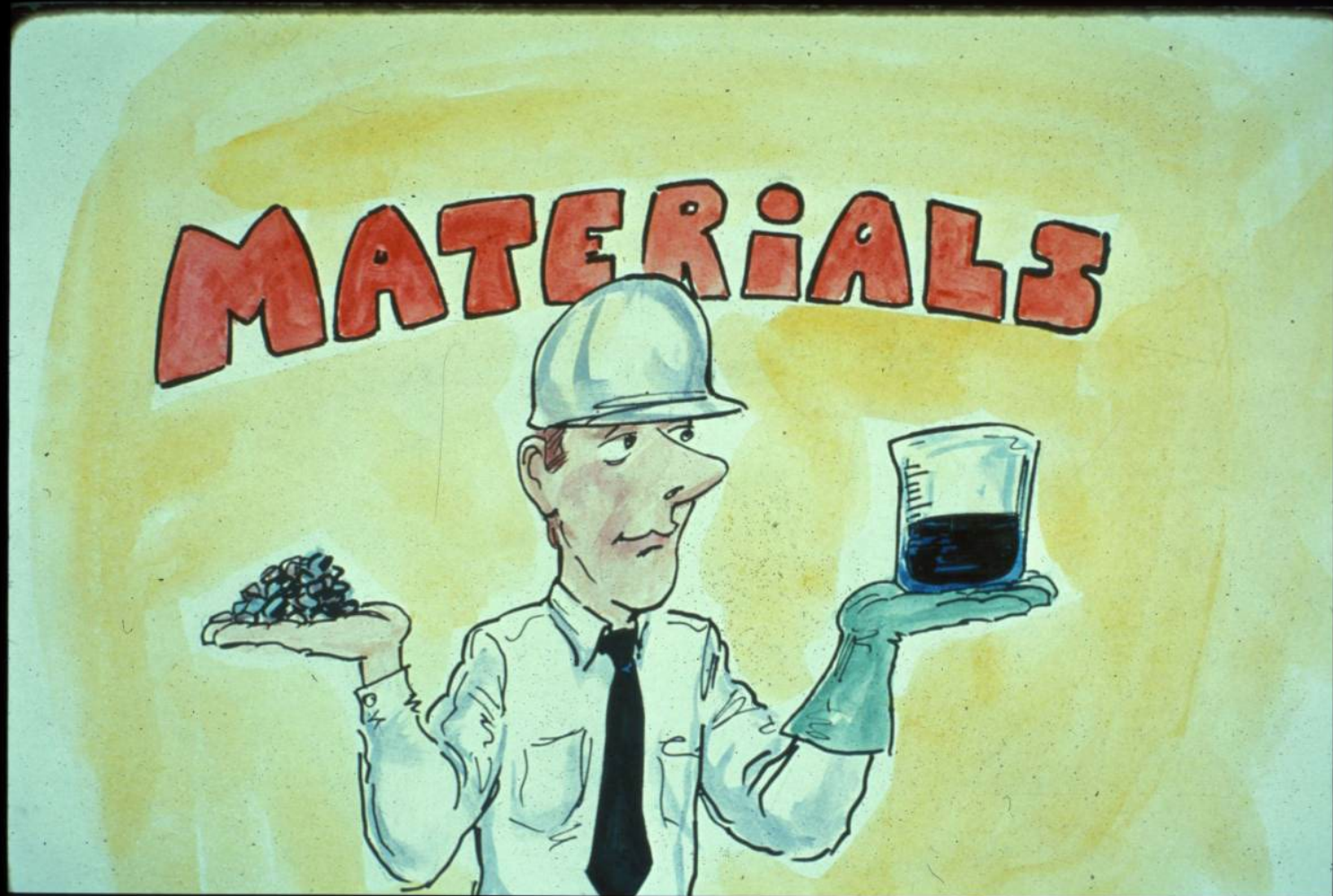
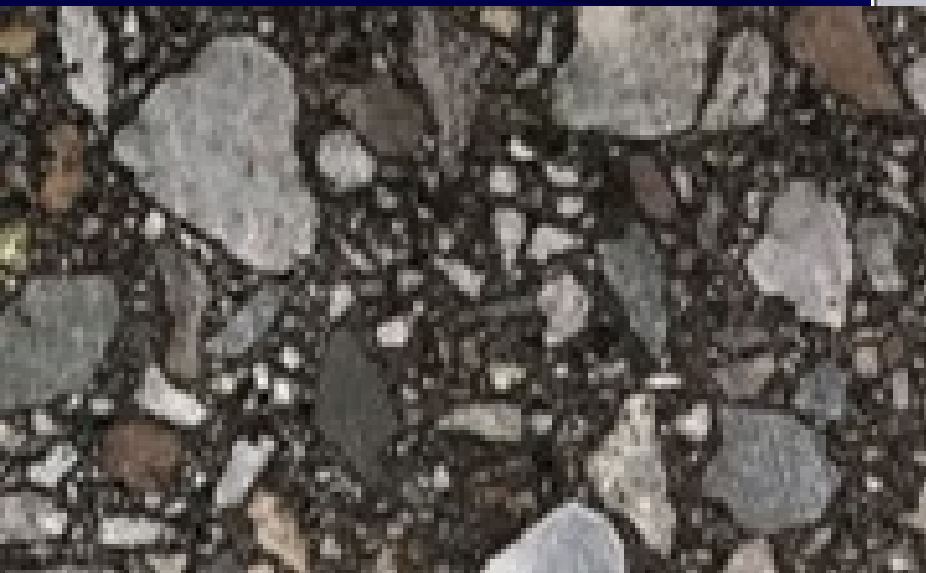
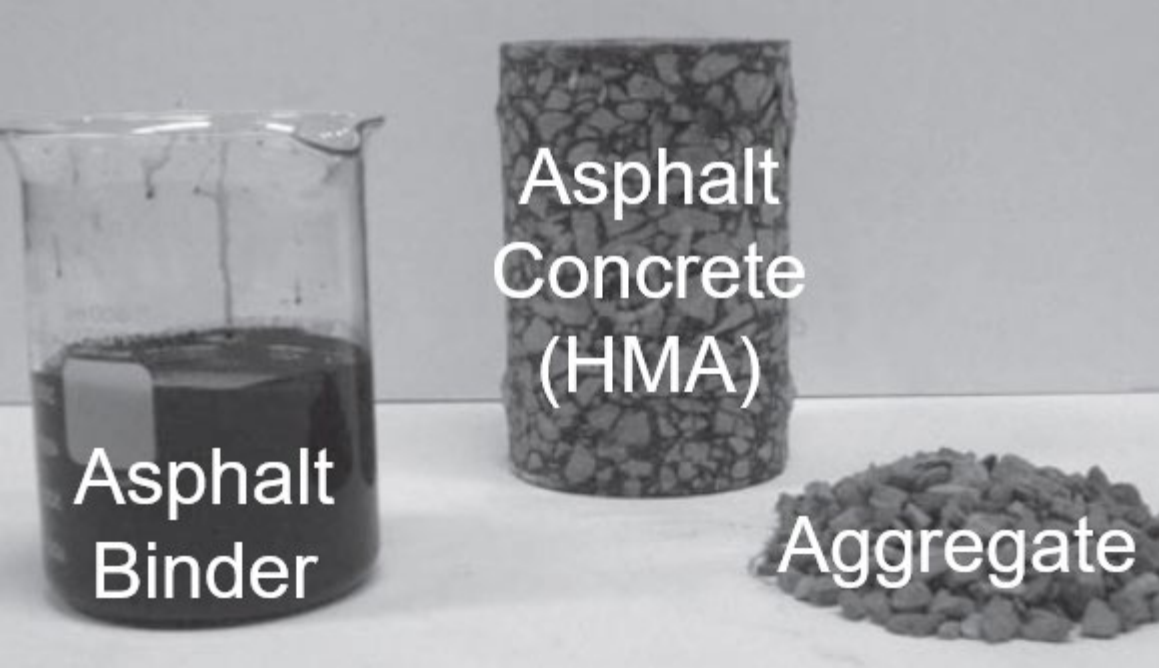


Materials for Maintenance and Rehabilitation of Asphalt Pavement



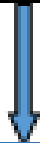


Bituminous Materials



Asphalt

Tar

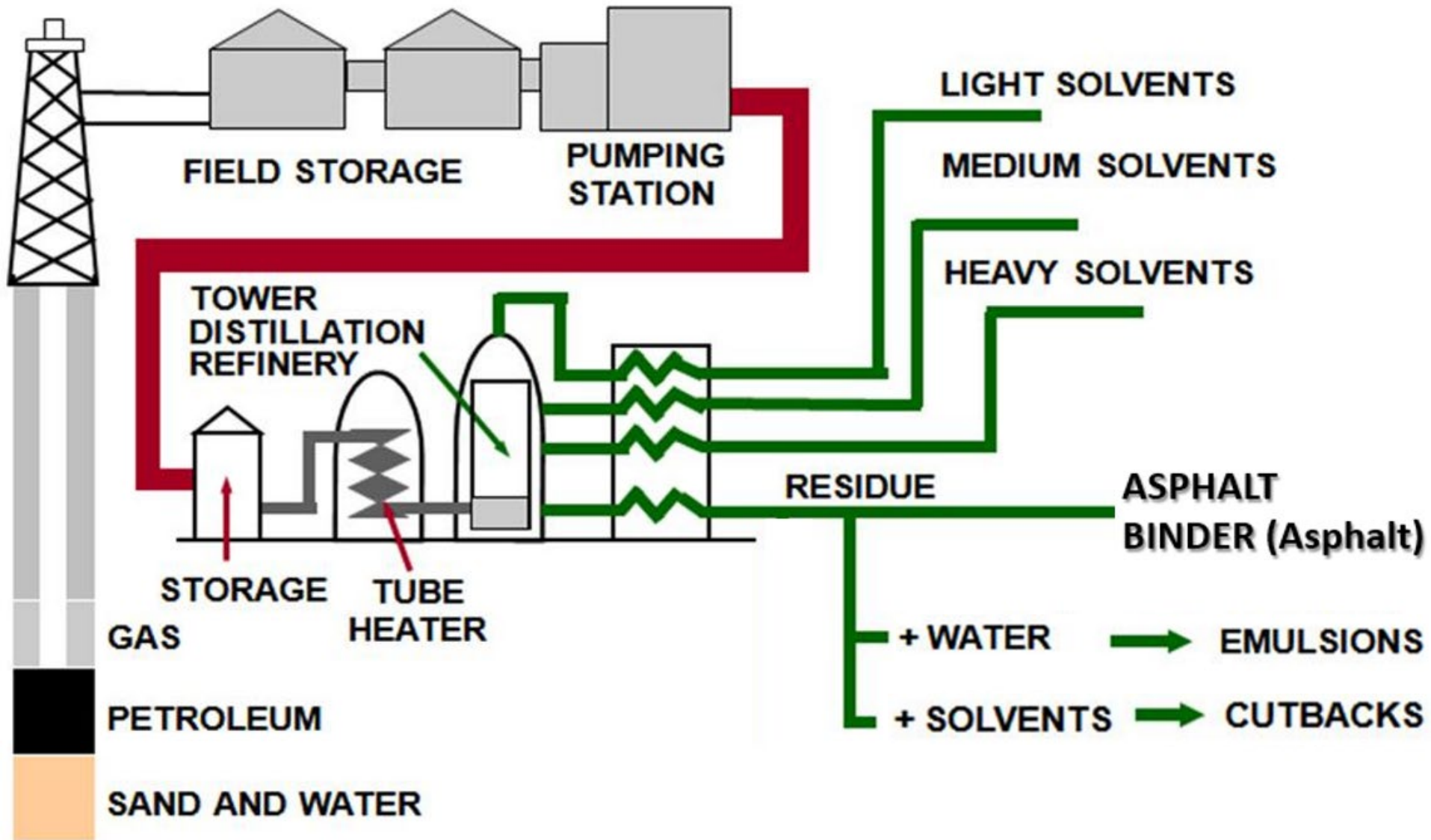


Asphalt Cement
(Asphalt)

Emulsion

Cutback

Source of Asphalt



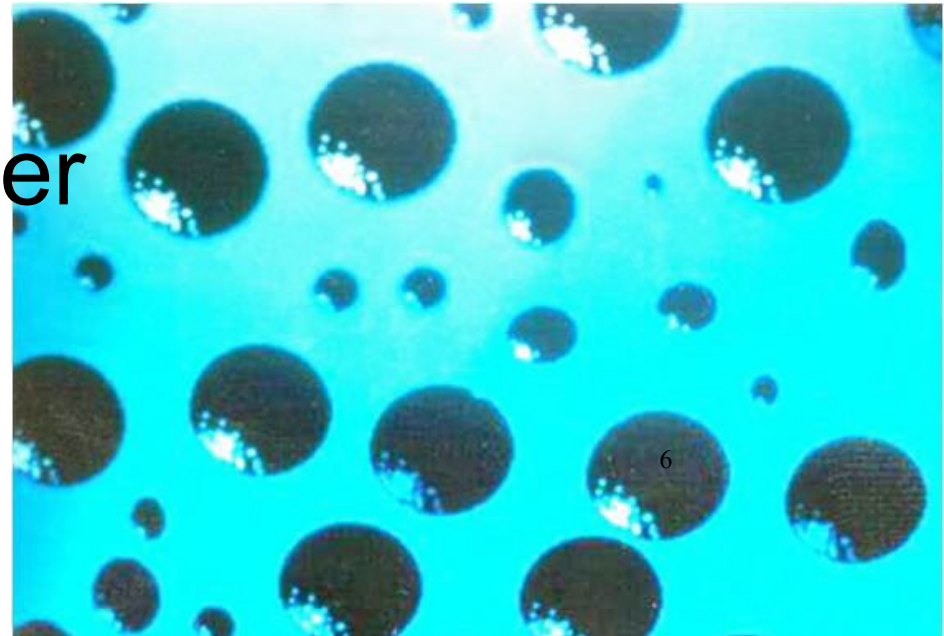
Asphalt Types Used in Pavement

- **Asphalt cement (asphalt binder)**
 - Used for HMA, patching, sealing and waterproofing
- **Asphalt emulsion**
 - Used for cold mix & maintenance applications
- **Asphalt cutback**
 - Used for cold mix & maintenance applications

Asphalt Emulsion

= Asphalt + water + emulsifying agent

- Maintenance treatments, patching, base and sub-base stabilization, cold mix
- Safer than cutback
- Environmentally better
- Approx. same cost



Asphalt Cutback = Asphalt + solvent

- Hazardous, volatile solvents and hydrocarbons are released
- Same uses as emulsion
- Not commonly used any more

Visco-Elastic Properties

Asphalt binder is a visco-elastic material.

- viscous at high temps, like a fluid
 - elastic at low temps, like a solid
 - its characteristics depend on both temperature and loading rate
- Complex chemical properties
- Asphalt binder's specifications based on physical properties

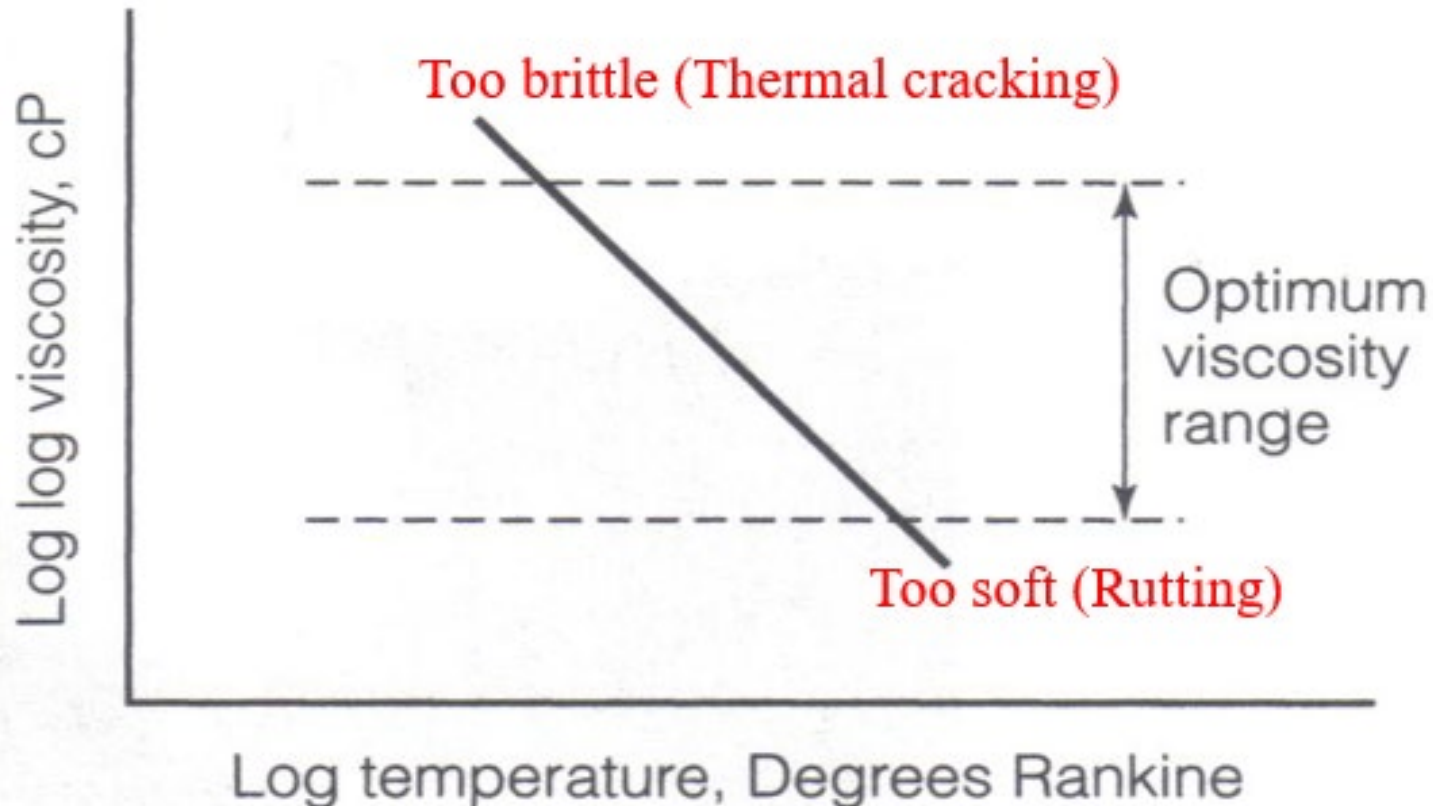
Use of Asphalt in Paving

Asphalt Emulsion

- Maintenance treatments, patching, base/sub-base stabilization, cold mix
- **Asphalt Concrete = Asphalt + aggregate**
 - *used mainly for hot mix asphalt pavement surfacing (HMA)*

Temperature Susceptibility of Asphalt

- Asphalt is highly affected by temperature
- Slope indicates degree of susceptibility
- Some additives can reduce temp. susceptibility



Thermal Cracking

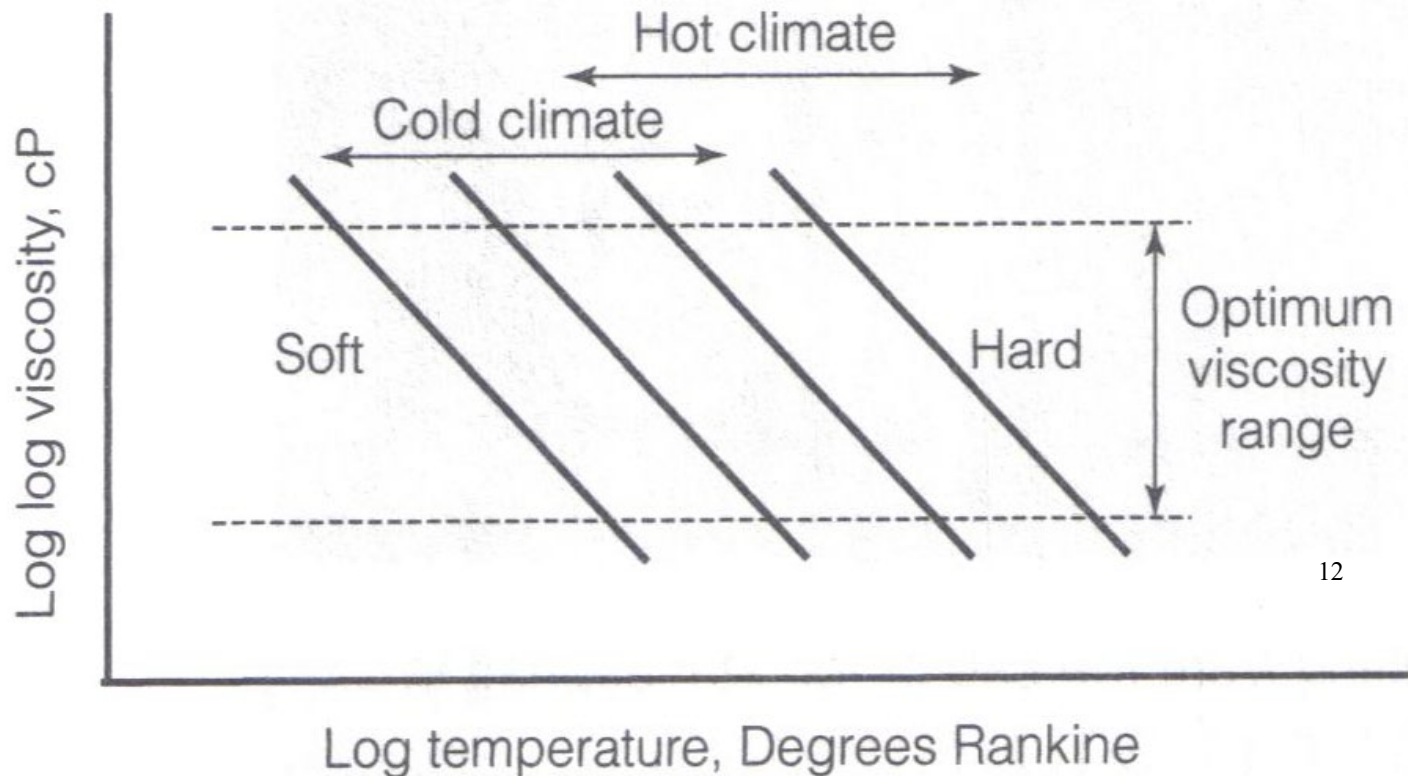


Rutting



➤ Asphalt comes in different grades (soft and hard)

- Soft (low viscosity) asphalt is used in cold climates to avoid thermal cracking
- Hard (high viscosity) asphalt is used in hot climates to avoid rutting



Superpave Binder Specs

Intended to improve pavement performance by reducing the potential to:

- ✓ Permanent deformation
- ✓ Fatigue cracking
- ✓ Low-temperature cracking
- ✓ Excessive aging from volatilization
- ✓ Pumping and handling

Superpave Grades

PG 64-16, PG 70-10, ...

PG # - #

Low-temperature grade

High-temperature grade

Performance graded

Binder Grades in the Performance Grade Specs

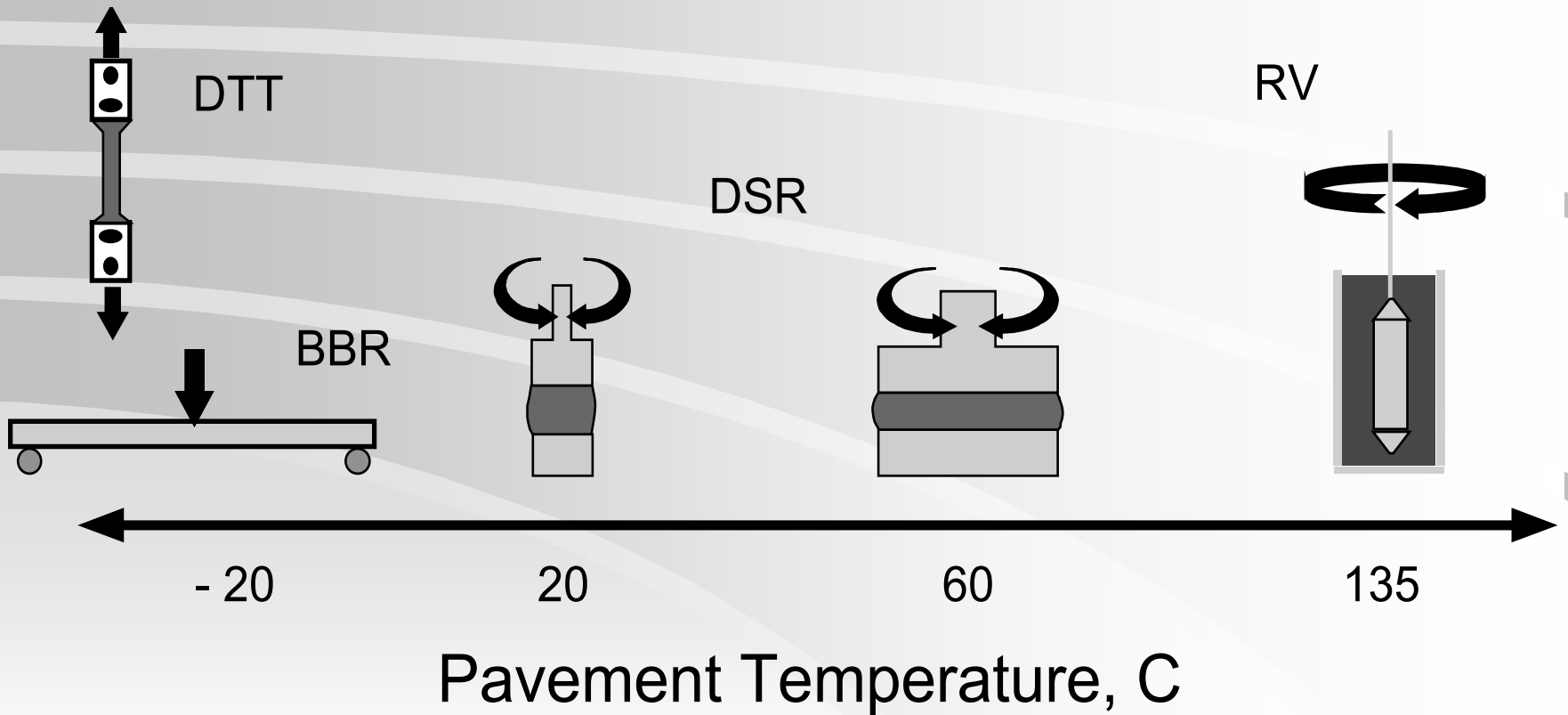
6 degree increments

**High Temperature
Grades (°C)**

Low Temperature Grades (°C)

PG 46	-34, -40, -46
PG 52	-10, -16, -22, -28, -34, -40, -46
PG 58	-16, -22, -28, -34, -40
PG 64	-10, -16, -22, -28, -34, -40
PG 70	-10, -16, -22, -28, -34, -40
PG 76	-10, -16, -22, -28, -34
PG 82	-10, -16, -22, -28, -34

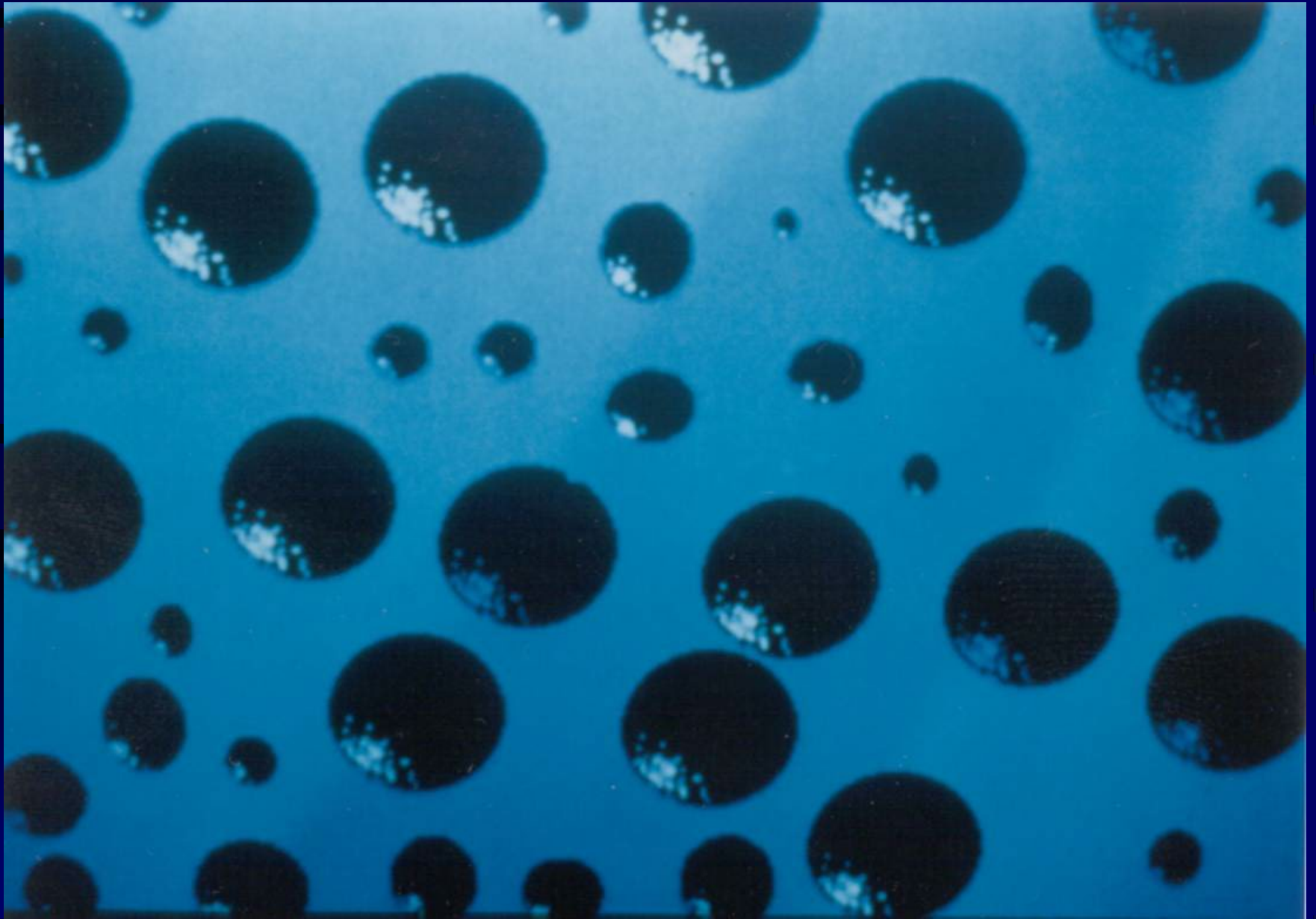
Superpave Binder Equipment



Modified Asphalt

- Many additives are available
- Additives can:
 - Reduce temperature susceptibility
 - Improve adhesion to aggregates
 - Increase resistance to permanent deformation
 - Increase resistance to fatigue cracking
 - Improve elasticity, ductility, and durability

Asphalt Emulsion



Emulsion Types & Grades

Anionic

RS-1, RS-2

MS-1, MS-2, MS-2h

HFMS-1, HFMS-2

HFMS-2h, HFMS-2s

SS-1, SS-1h

Cationic

CRS-1, CRS-2

CMS-2, CMS-2h

CSS-1, CSS-1h

Emulsion Nomenclature

CMS – 1 h

h = hard asphalt residue, s = soft

1,2 = indicates emulsion viscosity

M = medium set, Q = quick, R = rapid,
S=slow

C = cationic, HF = high float



Applications

- Quick Set
 - Slurry seal, microsurfacing
- Rapid Set
 - Chip seal, sand seal
- Medium Set
 - Crack seal
 - Fog seal
- Slow Set
 - Fog seal

Aggregate Properties



Aggregate Properties

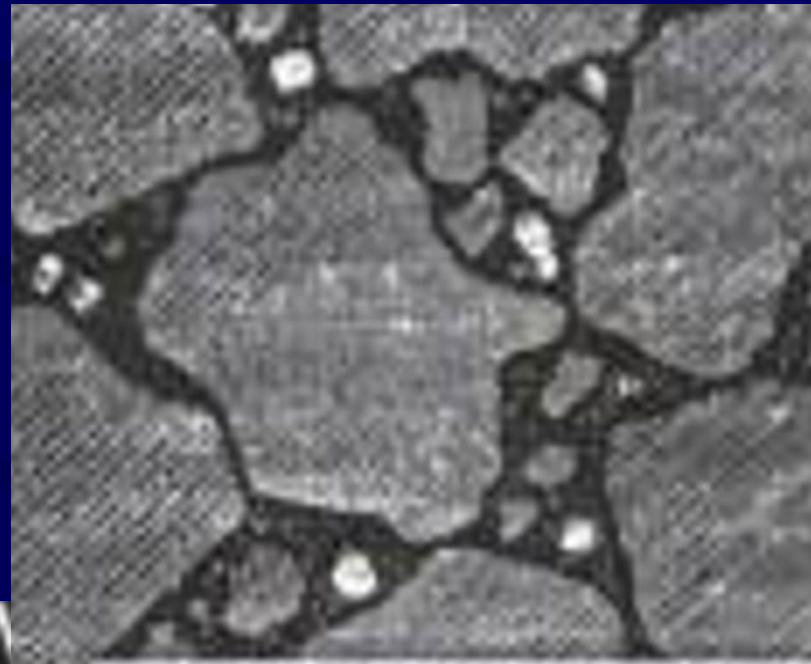
1. Gradation
2. Particle shape & surface texture
3. Toughness & hardness
4. Porosity

1. Aggregate Gradation





DENSE-GRADED



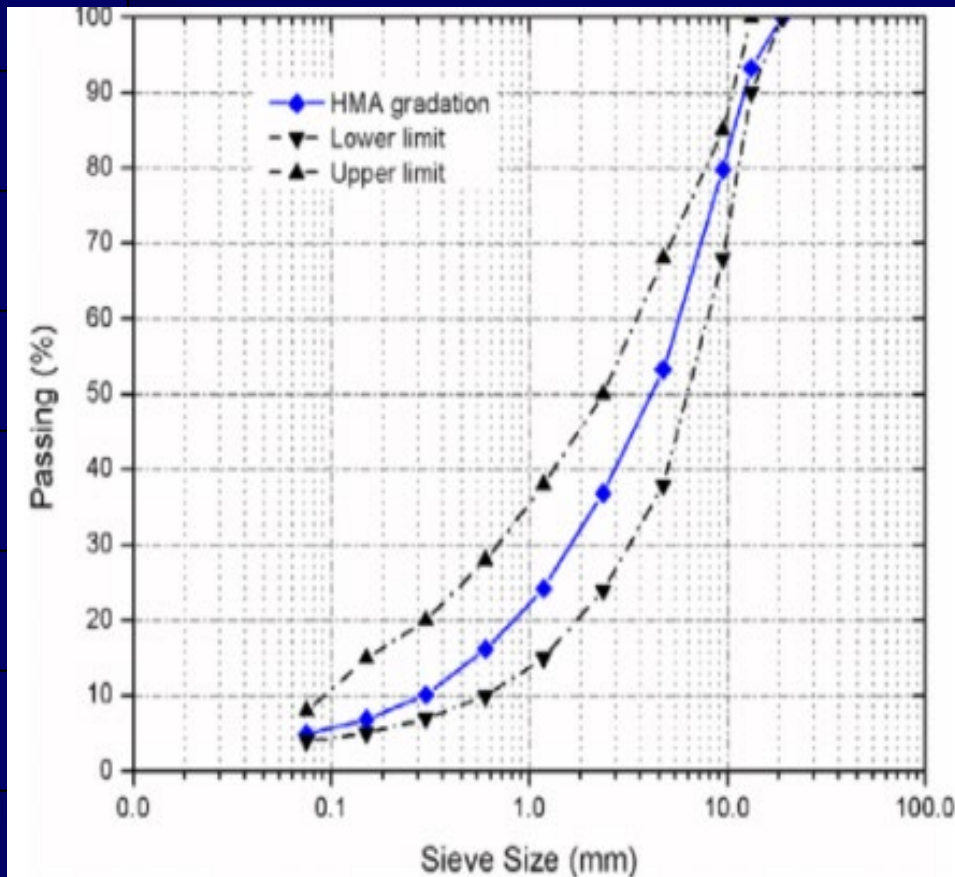
GAP-GRADED



OPEN-GRADED

Examples of Gradation Specifications

Sieve	Percent Passing
9.5 mm (3/8)	100
4.75 mm (No. 4)	95–100
2.36 mm (No. 8)	80–100
1.18 mm (No. 16)	50–85
0.60 mm (No. 30)	25–60
0.30 mm (No. 50)	10–30
0.15 mm (No. 100)	2–10



Which Gradation to Use?

- Dense HMA, slurry seals, microsurfacing
- Open Open-graded friction course
- Gap Asphalt rubber, SMA
- One-sized Chip seals

Open Graded Friction Course



2. Particle Shape & Texture

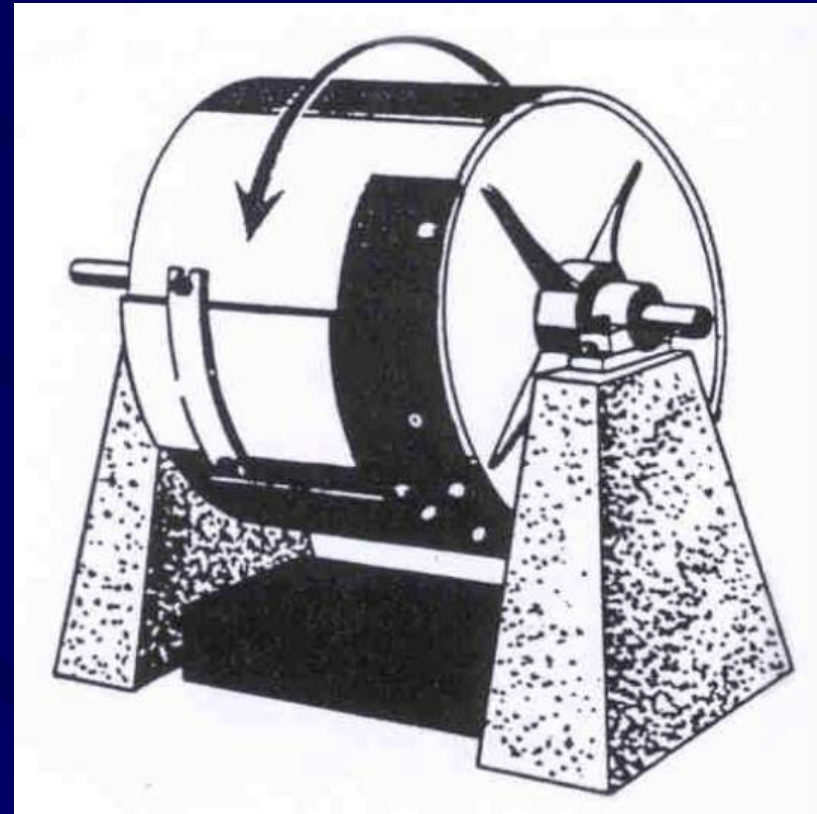
- Angular shape
- Rough texture



Crushing

3. Toughness & Hardness

- Resistance to mechanical degradation
- Los Angeles abrasion test



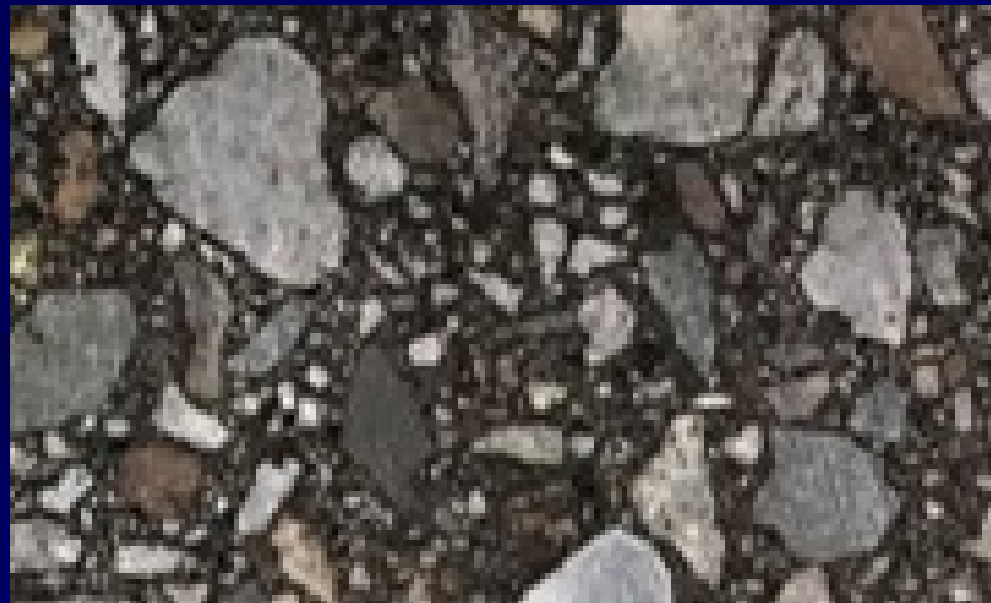
4. Porosity

- No porosity reduces adhesion
- High porosity absorbs too much asphalt
- “Low porosity” is required



Asphalt Concrete (Hot-Mix Asphalt)

- Asphalt binder + aggr.
(dense gradation)
- Asphalt binder is about
4 - 6% by weight of
mix, but it needs to be
carefully designed



Superpave Mix Design

Find asphalt content using available binder & aggregate:

- a) Aggregate selection
- b) Binder selection
- c) Aggregate gradation
- d) Design binder content
- e) Evaluate moisture susceptibility

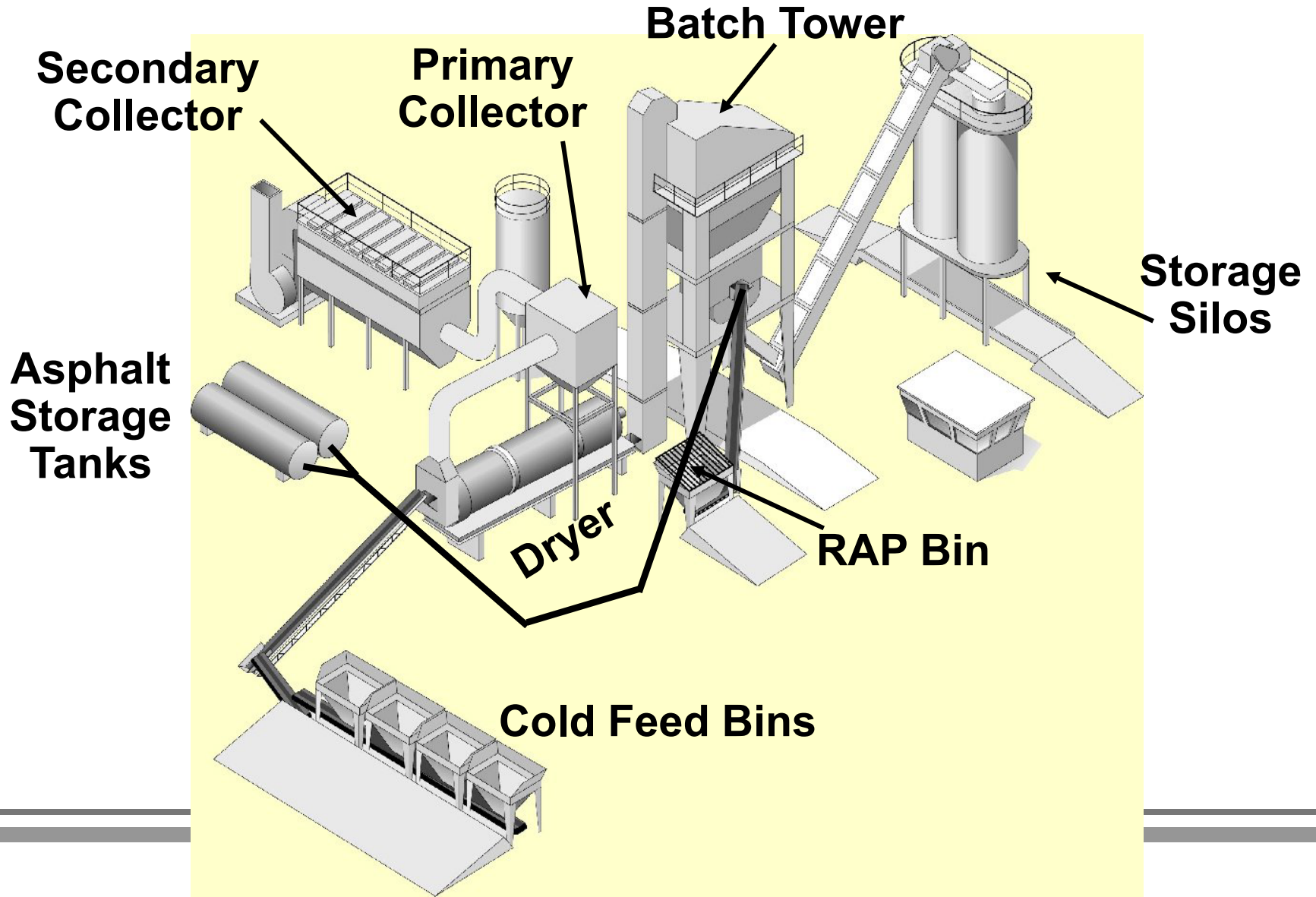


Gyrotory Compactor

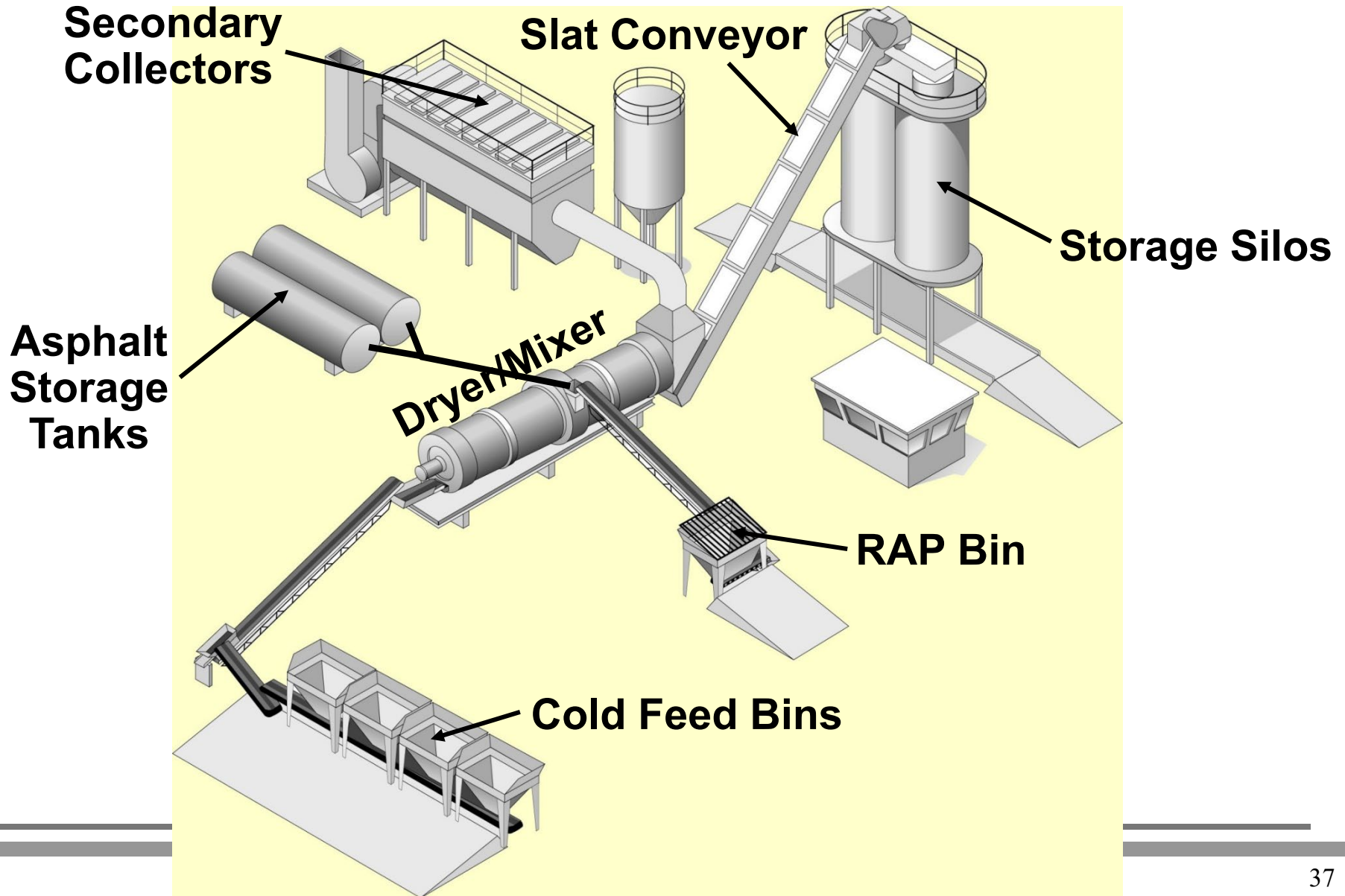
HMA Production & Construction

- Materials to plant
 - Aggregate – stockpiles to minimize segregation
 - Tank binder – kept at elevated temperature
 - Plant types
 - Batch
 - Drum
- Plant
 - Mix asphalt and aggr. to required proportions
 - Discharge to trucks for haul to job site
- Paver
 - Place hot mix to desired thickness & smoothness
- Compactors
 - Achieve desired density

Batch Plant



Drum-Mix Plant



HMA Placement

