Module 3-1

Hot-Mix Asphalt Mixture Overview

Objectives

Describe basic properties of asphalt cement

Provide a brief introduction to SuperPave liquid asphalt cement specifications

Describe basic aggregate gradations used to produce hot-mix asphalt

Introduction

This module describes the unique properties of asphalt cement and mineral aggregate and how they are affected by:

- **Construction**
- **Traffic loading**
- **Environment**
- **Time**

General Asphalt Cement Properties

Adheres well to most rock

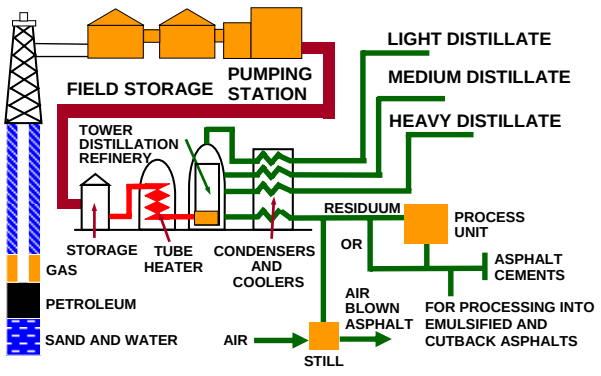
Waterproof

Fairly durable

Resistant to reaction with most acids, alkalis, and salts

Temperature sensitive

Source of Asphalt Cement



Asphalt Composition

Corbett (Differential Absorption)	Rostler (Acid Separation)
asphaltenes	asphaltenes
petrolenes	maltenes
saturates	paraffins
napthene aromatics	second acidaffins first acidaffins
polar aromatics	nitrogen bases

Asphaltenes

Represent 5% to 25% of the asphalt

- **Insoluble**
- **Black**
- **Hard**
- **Glassy**

Maltenes

Saturates (paraffins)

Nitrogen base resins

Aromatics (acidaffins)

Asphalt Viscosity

High Temperature

Intermediate Temperature

Low Temperature

Polymer-Modified Asphalt

The temperature viscosity properties of asphalt cement can be improved by the addition of polymers

- **High temperature properties determined by type and amount of polymer added**
- **Low temperature properties largely determined by base asphalt cement grade**

Polymer-Modified Asphalt

Polymer classified as:

- **Elastomers for improvement of elastic properties of asphalt cements**
- **Plastomers for improvement of stiffness of asphalt cements**

Polymer-Modified Asphalt

Asphalt properties that can be improved with modifiers

- **Temperature susceptibility**
- **Adhesion to aggregates**
- **Resistance to permanent deformation**
- **Resistance to fatigue cracking**
- **Elasticity, ductility, durability**

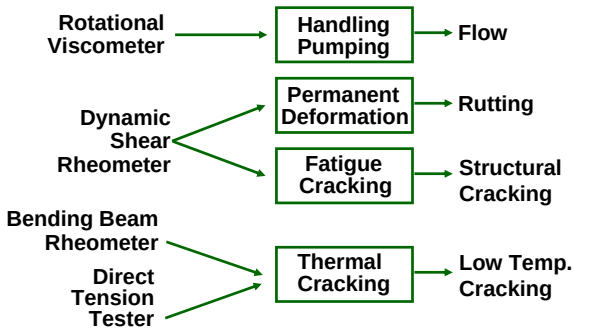
New Superpave Binder Specifications

The Superpave binder specification is intended to improve performance by reducing the potential for the asphalt cement to contribute to permanent deformation, low temperature cracking, and early fatigue cracking in HMA pavements

Superpave Binder Specifications

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

Test Equipment — Performance Property



Superpave Binder Specifications

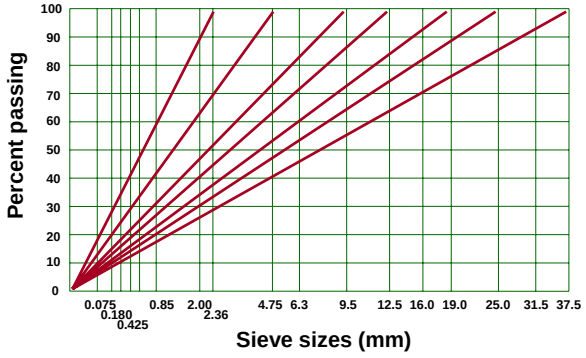
Performance Grade	PG-52							PG-58		
	-10	-16	-22	-28	-34	-40	-46	-16	-22	-28
Average 7-day Maximum Pavement Design Temp. C	<52							<58		
Minimum Pavement Design Temperature.C	>-10	>-16	>-22	>-28	>-34	>-40	>-46	>-16	>-22	>-28
Original Binder										
Flash Point Temp. T48: Minimum. C	230									
Viscosity, ASTM D 4402 Maximum, Pa - s (3000 cP) Test Temp. C	135									
Dynamic Shear, TP5: G*/sin 8 , Minimum, 1.00 kPa Test Temp @ 10 rad/sec. C	52							58		

Spec Requirement Remains Constant — Test Temperature Changes

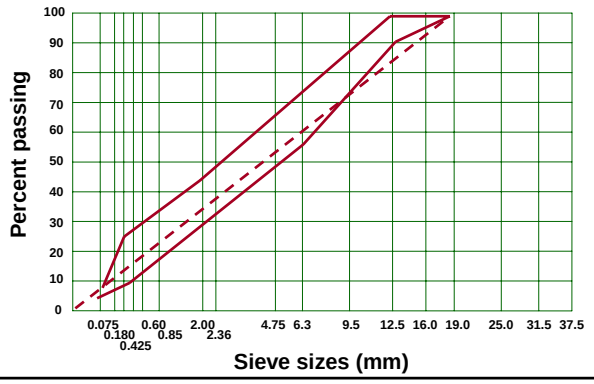
Aggregate Properties

Dense-graded mix
Open-graded mix
Gap-graded mix

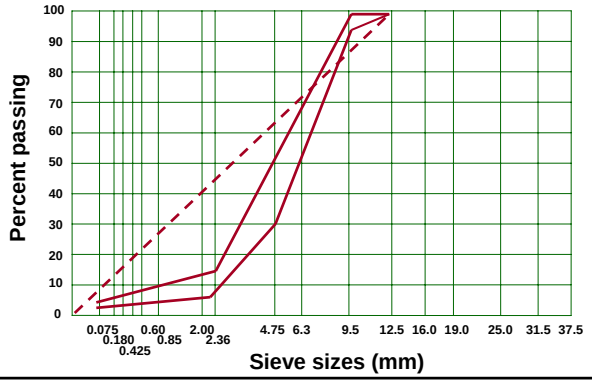
Sieve Sizes Raised to 0.45 Power



Dense-Graded Mix



Open-Graded Mix

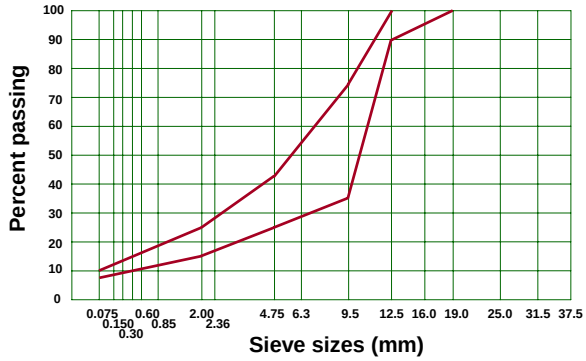


Open-Graded Mix

List of advantages from FHWA TA

- Provides good high speed friction qualities
- Reduces the potential for hydroplaning
- Reduces the amount of splash and spray
- Provides reduction in tire noise
- Improves visibility of pavement markings
- Conserves high quality aggregate

Gap-Graded Mix



Gap-Graded Mix

Stone Matrix Asphalt (SMA) mixes developed and used in Europe are a form of gap-graded mix

SMA provide very stable high performance HMA using gap-graded aggregate to produce large stone contact stabilized with very thick asphalt films

Summary

The properties of the asphalt binder depend on its chemical and mechanical properties which change with time, environment, and applied loading

The properties of the aggregate depend largely on the grading of the aggregate

The ultimate performance of the HMA depends on all aspects of both materials