

Questions and Answers 4

MISCELLANEOUS ON BITUMEN

Q1 What are the main fractions of bitumen?

- Carbenes
- Asphaltenes (the name of asphalt came from this element).
- Maltenes.

Q2 List the names used for bitumen in the American literature?

Asphalt, Asphalt cement, or asphalt binder.

Q3 What are the sources of bitumen?

- Natural Bitumen: Bitumen is found naturally in some rocks (heat up the rocks and extract bitumen)
- Refinery Bitumen: Bitumen can be obtained from the distillation process of crude oil
{Note: Only heavy oil produces bitumen, but not light oil. The Kingdom of Saudi Arabia produces refinery bitumen}.

Q4 Bitumen is a solid material in normal temperatures and therefore cannot be mixed to aggregates to form asphalt concrete. Name and explain three methods that you can use to overcome this difficulty.

- (1) Raise up the temperature of bitumen to reduce its viscosity (Remember: bitumen is thermoplastic), thus you can mix with aggregates [this is the method widely used in the Kingdom of Saudi Arabia to produce Hot Mix Asphalt (HMA)]
{Do not heat up bitumen to a temperature higher than the flash point!! Why?}
- (2) Use cutbacks: The viscosity of solid bitumen can be gently reduced by adding Kerosene, thus you can mix with aggregate. The kerosene will evaporate after lying of the asphalt.
- (3) Use bitumen emulsions: (Bitumen + water + emulsifier).The bitumen emulsion can be mixed with aggregates and laid on the road surface. The asphalt concrete will become solid as soon as water evaporates.

Q5 Name and discuss the *mechanisms* causing the ageing of bitumen

Ageing or hardening of bitumen results from exposure to atmosphere and it occurs due to the following mechanisms:

- Oxidation: Oxygen molecules from the air combine with bitumen. The bitumen becomes brittle and therefore breakable.

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- Loss of volatiles: some of the bitumen elements evaporate as a result of high temperature. The bitumen becomes brittle. Much of the loss of volatiles occurs during the production of the HMA.

Q6 Name the Superpave tests that were designed to take ageing into account when designing asphalt concrete mix.

The tests include:

- The Rolling Thin Film Oven (RTFO) – simulates the ageing that occurs during mixing and construction.
- The Pressure Ageing Vessel (PAV) tests – simulates the ageing during the service life of the road.

Q7 Name the performance grade (PG) bitumen mostly used in the Kingdom of Saudi Arabia (Explain all the terms in your answer).

The PG64-22, it considers the range of temperature within the climatic region of KSA

PG = stands for performance grade

64 = Bitumen meets the specification for a design high pavement temperature up to 64°C (temperature calculated 20 mm below the pavement surface).

-22 = Bitumen meets the specifications for a design low pavement temperature warmer than -22°C (measured at the surface of the pavement).

Q8 Name the penetration grade equivalent to the PG64-22

Pen 60 to 70

Q9 can you now tell why the Superpave bitumen specifications is superior to the penetration grade?

The Superpave specifications consider the range of temperature on which the pavement has to perform. The penetration grade is determined taking into account a single temperature point (135°C)!!

Exercise (for students own interest): Write an essay to state all the differences between the “old bitumen specifications” and the “Superpave specifications”. [The student is advised to carry out a Google search: Type words and phrases such as “Bitumen”, “asphalt binder”, “Superpave specifications”, “Performance grade bitumen”, and “Penetration grade bitumen”]