

HIGHWAY CONSTRUCTION MATERIALS (ASPHALT & AGGREGATE)

Highway and Transportation Engineering

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First Class

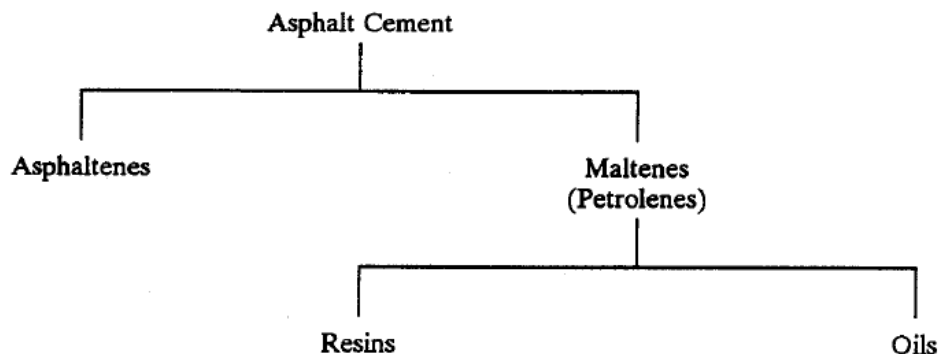
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Lecture 5

Fractions of Asphalt

Conceptual Compositional Model

Asphalt cements are considered to be made up of **asphaltenes**, **resins**, and **oils** as shown in the following chart:



Asphaltenes. Asphaltenes are generally dark brown, friable solids. The type of nonpolar solvent used to precipitate the asphaltenes affects the determination of its total amount in the asphalt cement. Higher amounts are precipitated by **n-pentane** than by **n-heptane** because the number of carbon atoms in n-pentane is less than that in n-heptane.

- Asphaltenes are the most complex components with the highest polarity. Therefore, they have a very high tendency to interact and associate.
- They are mixtures of many compounds that have a strong tendency to associate in **conglomerates** تكتلات.
- Asphaltenes play a major role as the viscosity-building ("bodying") component of asphalt cements.
- The amounts and characteristics of asphaltenes vary considerably from asphalt to asphalt. Low asphaltene content (less than about 10 percent) or weakly associating asphaltenes have been linked with tenderness in HMA.

Resins. Resins are generally dark and semi-solid or solid in character.

- They are fluid when heated and become brittle when cold.
- They work as agents that disperse (or "**peptize**" يستوعب او يحل) the asphaltenes throughout the oils to provide a homogeneous liquid.
- They are soluble in **n-pentane**, but adsorb on **fuller's earth** or **alumina**.
- On oxidation resins yield asphaltene type molecules.

Oils. Oils are usually colorless or white liquids.

- They are soluble in most solvents.
- They have **paraffinic** and **naphthenic** structures with no oxygen and nitrogen usually present.
- On oxidation they yield **asphaltene** and **resin** molecules.

Asphalt as a Colloidal System نظام غروي

Asphalt cement is not a true solution, but is considered a colloidal system. The colloidal nature of asphalt cement has a dispersion of **micelles** المذيلات in an oily medium. The relative amounts and characteristics of **asphaltenes, resins, and oils** present in an asphalt cement influence its physical properties and performance in a HMA mixture.

These influences make the asphalt act as a "sol," "sol-gel," or "gel."

"Sol:" "Sol" asphalt cements typify a system in which the resins keep the asphaltenes highly "peptized" (or dispersed) in the oily phase.

- "Sol" asphalt cements largely exhibit Newtonian flow characteristics.
- Nitrogen bases are primarily responsible for "sol" characteristics.

"Sol-Gel:" It is intermediate between "sol" and "gel."

"Gel:" "Gel" asphalt cements typify a system in which resins are not very effective in "peptizing" asphaltenes. Excessive presence of paraffins in relation to nitrogen bases also tends to reduce solubility, leading to increased "gel" characteristics, and suggesting increased separation of the dispersed and dispersing phases.

- "Gel" asphalt cements exhibit largely non-Newtonian behavior.