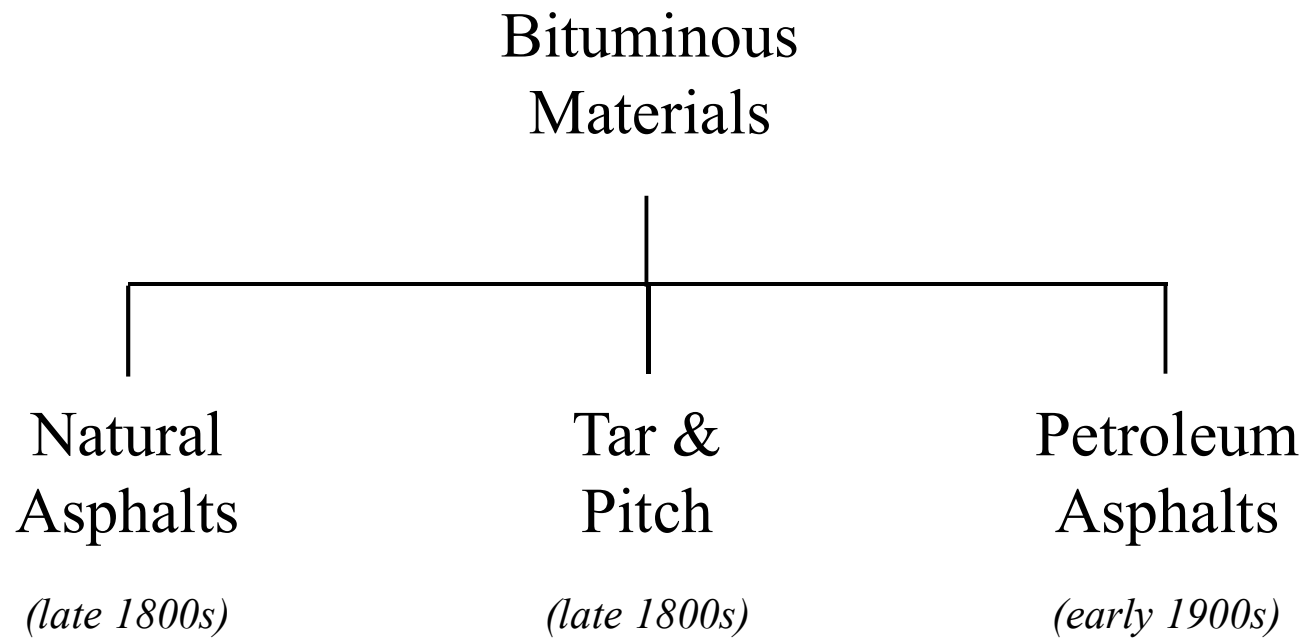


Asphalt Paving Materials

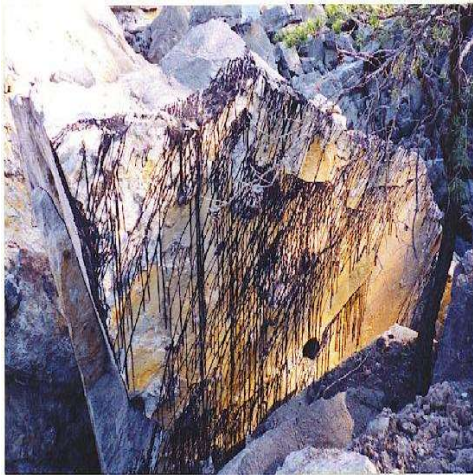
Bituminous Materials

Bitumen—also known as asphalt or tar—is a black, oily, viscous form of petroleum, which is a naturally occurring organic byproduct of decomposed plants. Natural bitumen is the thickest form of petroleum there is, and is made up of 83% carbon, 10% hydrogen and lesser amounts of oxygen, nitrogen, sulfur, and other elements.

Bituminous Materials



Natural Asphalt



Rock Asphalt



Asphalt Sand



Native Asphalt

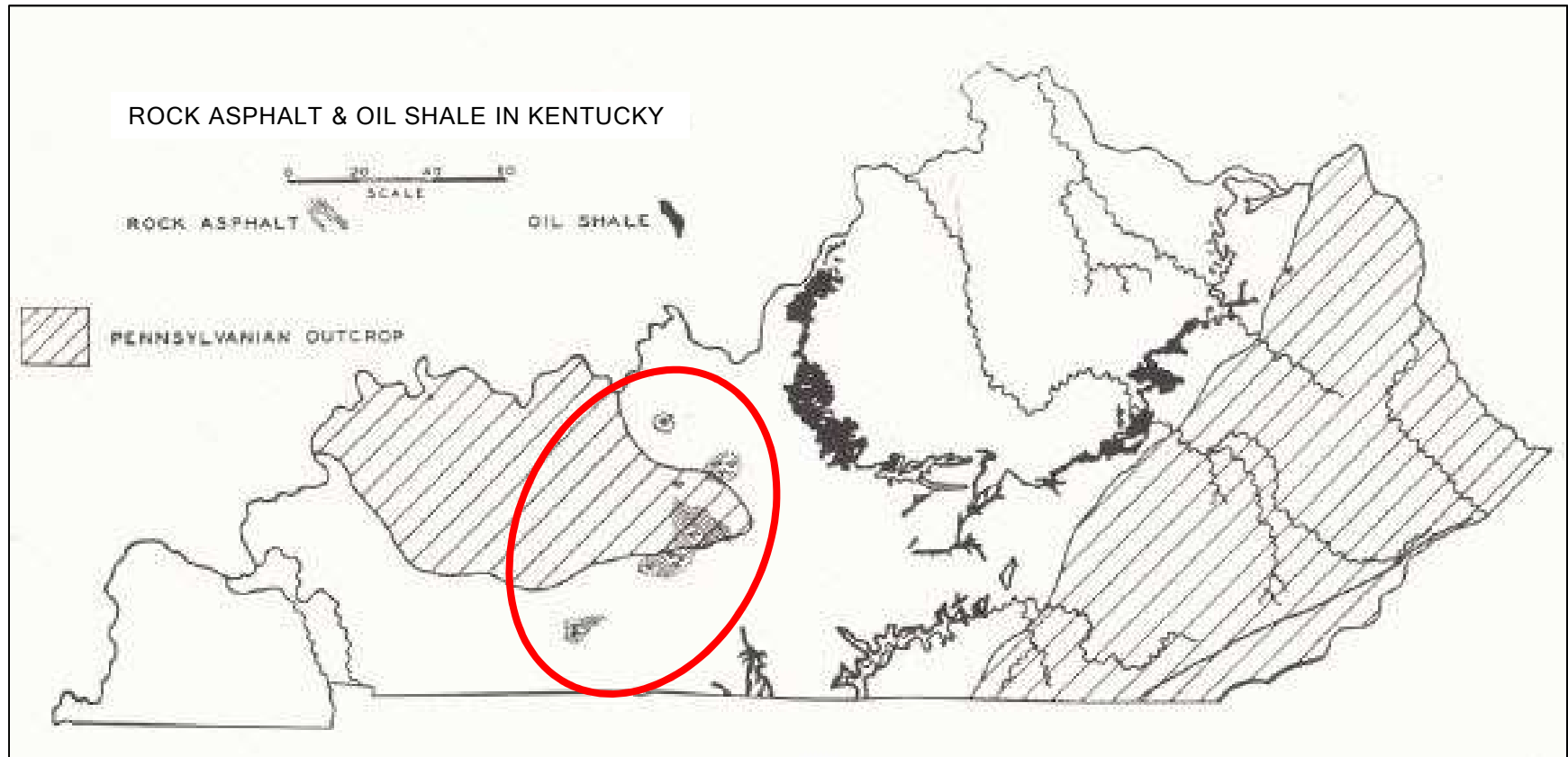
Rock Asphalt

Asphalt rock is formed when natural layers of petroleum harden in the pores of sedimentary rocks such as limestone or sandstone. Over time, the lighter components evaporate away leaving material that ranges in consistency from a thick liquid to a crumbly sand or stone. Only about 5% to 15% of the composition of asphalt rocks is asphalt.

Rock Asphalt



Rock Asphalt



Asphalt Sands

Asphalt sands (also called oil or tar sands) are either loose sands or partially consolidated sandstone containing a mixture of sand, clay, water, and bitumen. It is increasingly used as a source for crude oil thanks to technological developments such as steam extraction.

Asphalt Sands



Asphalt Sands



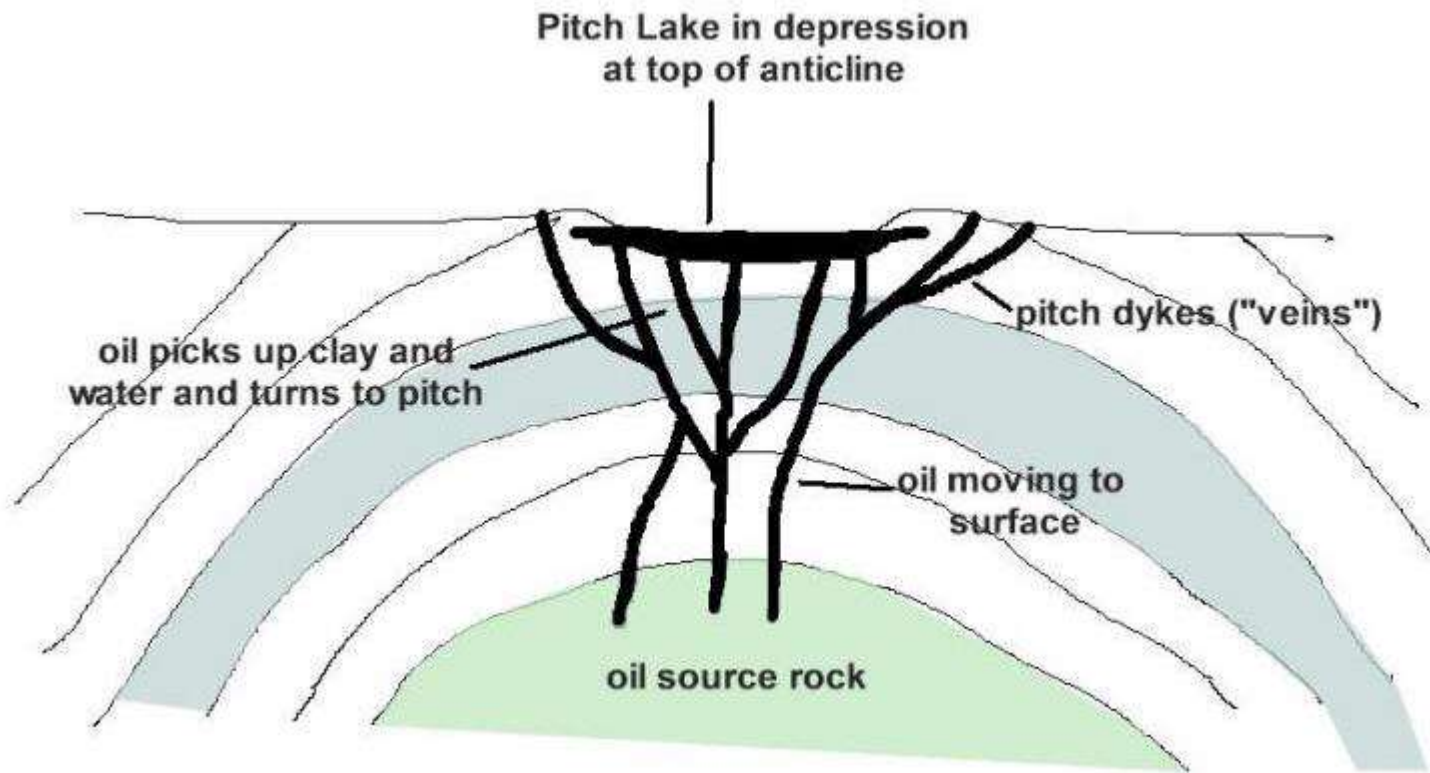
Asphalt Sands



Native Asphalt

Native asphalts are seepages of natural asphalt that rise to the surface from deeper oil-bearing rocks and collect in depressions on the ground surface. The lighter components evaporate to leave behind a viscous or semi-solid deposit. The asphalt is so viscous you can walk on the surface. But if you stand on the surface for too long, you will slowly sink into it!

Native Asphalt



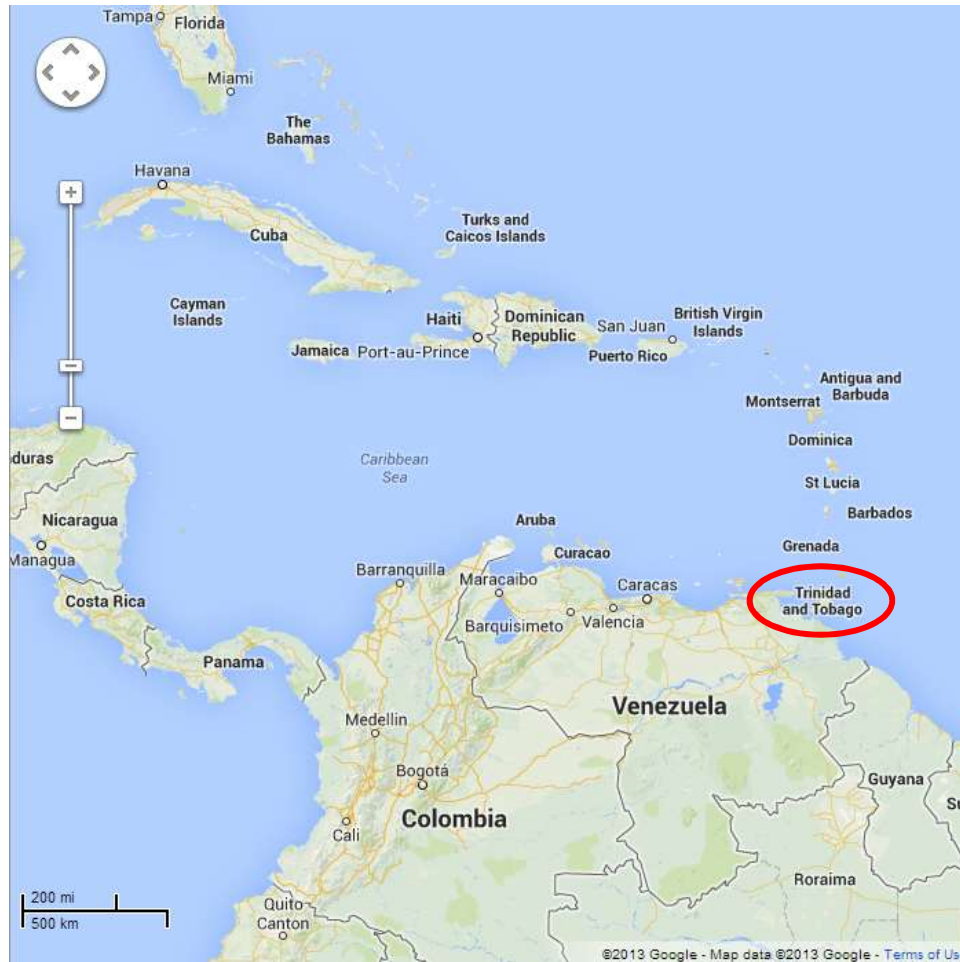
Native Asphalt



La Brea “Tar” Pits



Pitch Lake, Trinidad



Pitch Lake, Trinidad



Pitch Lake, Trinidad, W.I.

Pitch Lake, Trinidad



Pitch Lake, Trinidad



Pitch Lake, Trinidad



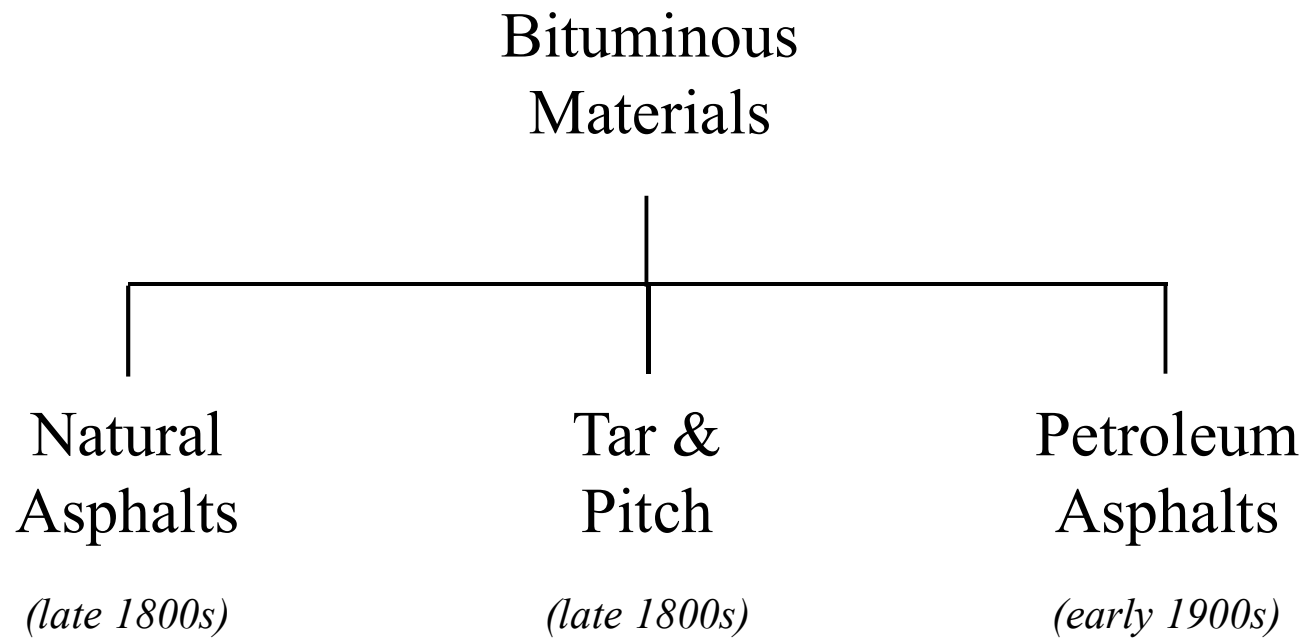
Pitch Lake, Trinidad



Pitch Lake, Trinidad



Bituminous Materials



Tar / Pitch

Tar is a dark brown or black viscous liquid of hydrocarbons and free carbon, obtained from a variety of organic materials such as coal, wood, or peat. The material is heated without oxygen (so the source material doesn't burn) until the tar liquefies and seeps out.

Wood Tar

Wood tar (primarily made from pine wood) has many uses as a disinfectant, a flavoring agent for candies and alcohol, a spice for meat, and a water repellent. It is also used in cosmetics and anti-dandruff shampoos.

Turpentine and charcoal are the byproducts of wood tar distillation.

Wood Tar Kiln, Sweden



<https://en.wikipedia.org/wiki/Tar>

Coal Tar

Coal tar is produced by heating coal without oxygen to produce coke and oil gas. Coal tar was used to construct the first surfaced roads. This is where we get the term “tarmac” or “tar macadam”. Today it can still be found in some parking lot sealers though it’s being phased out due to environmental and health concerns.

Dunlap, TN Coking Ovens



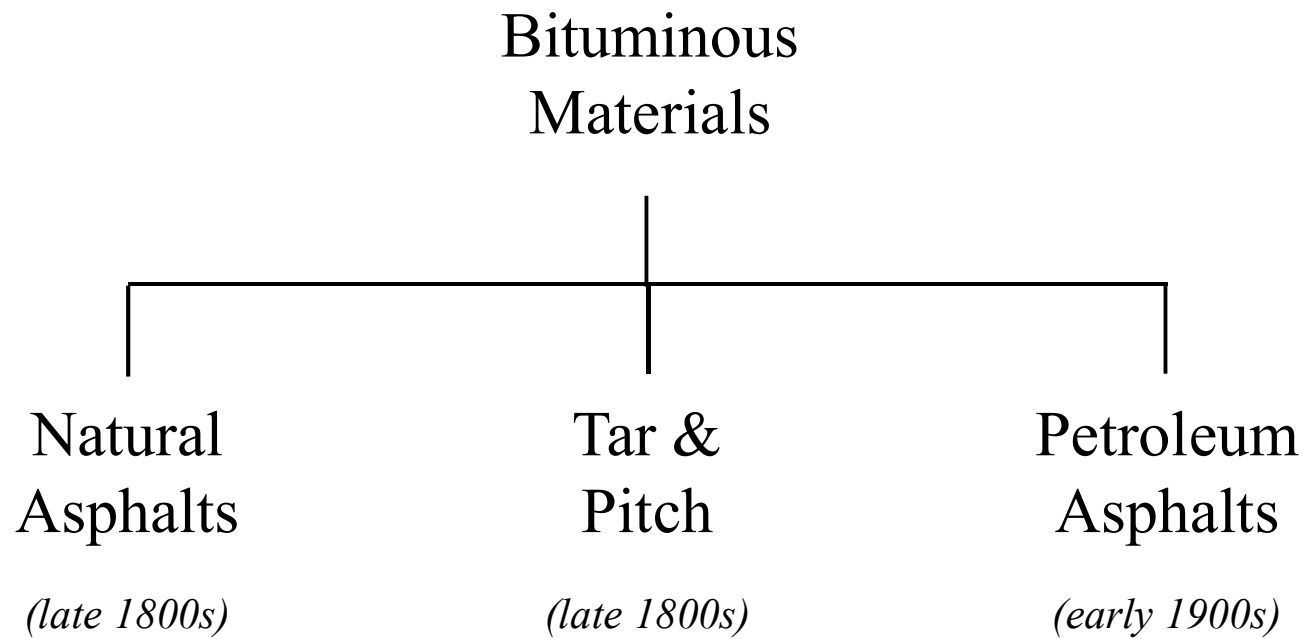
Chickamauga Coking Ovens



Pennsylvania Coking Ovens



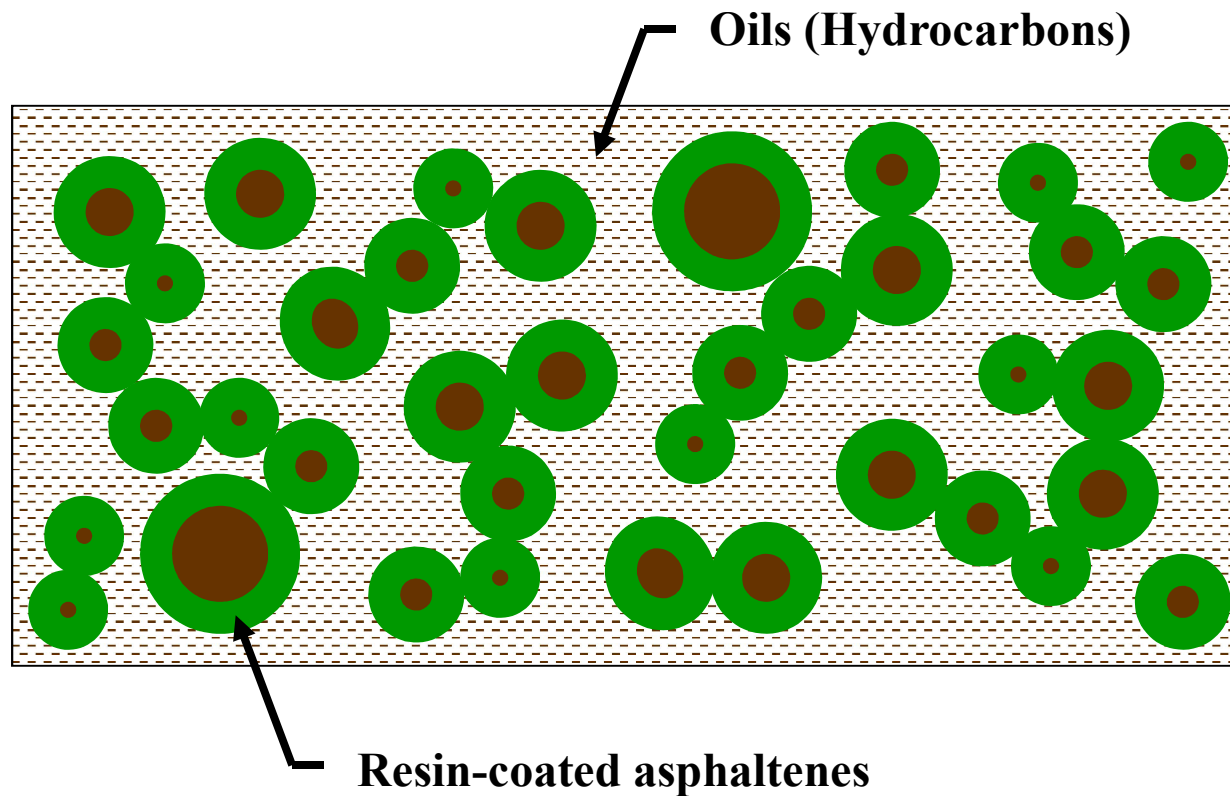
Bituminous Materials



Petroleum Asphalt

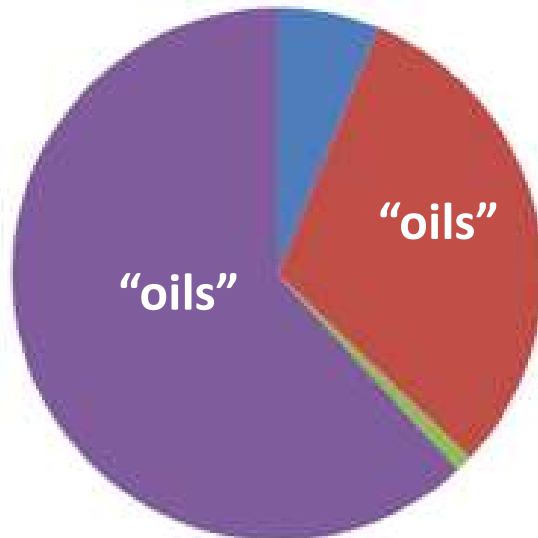
Petroleum asphalt is produced as a byproduct of crude oil distillation. It is the fraction of the crude oil with the highest boiling point (greater than 500°C) so it represents the residual left over after everything else (gasoline, kerosene, diesel, etc.) has boiled off in the distillation process.

Crude Oil Chemistry

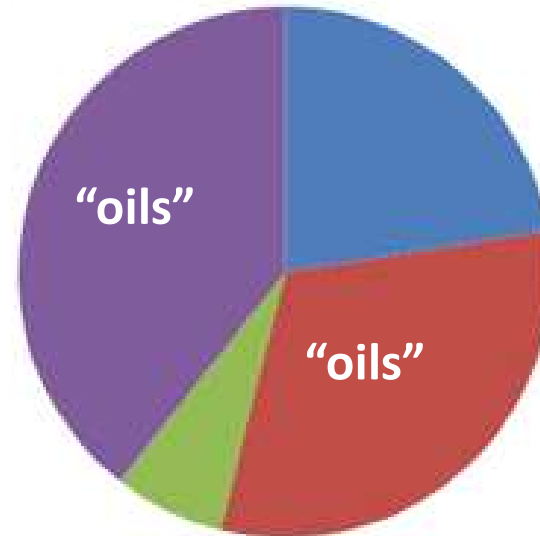


Crude Oil

Light Crude



Heavy Crude

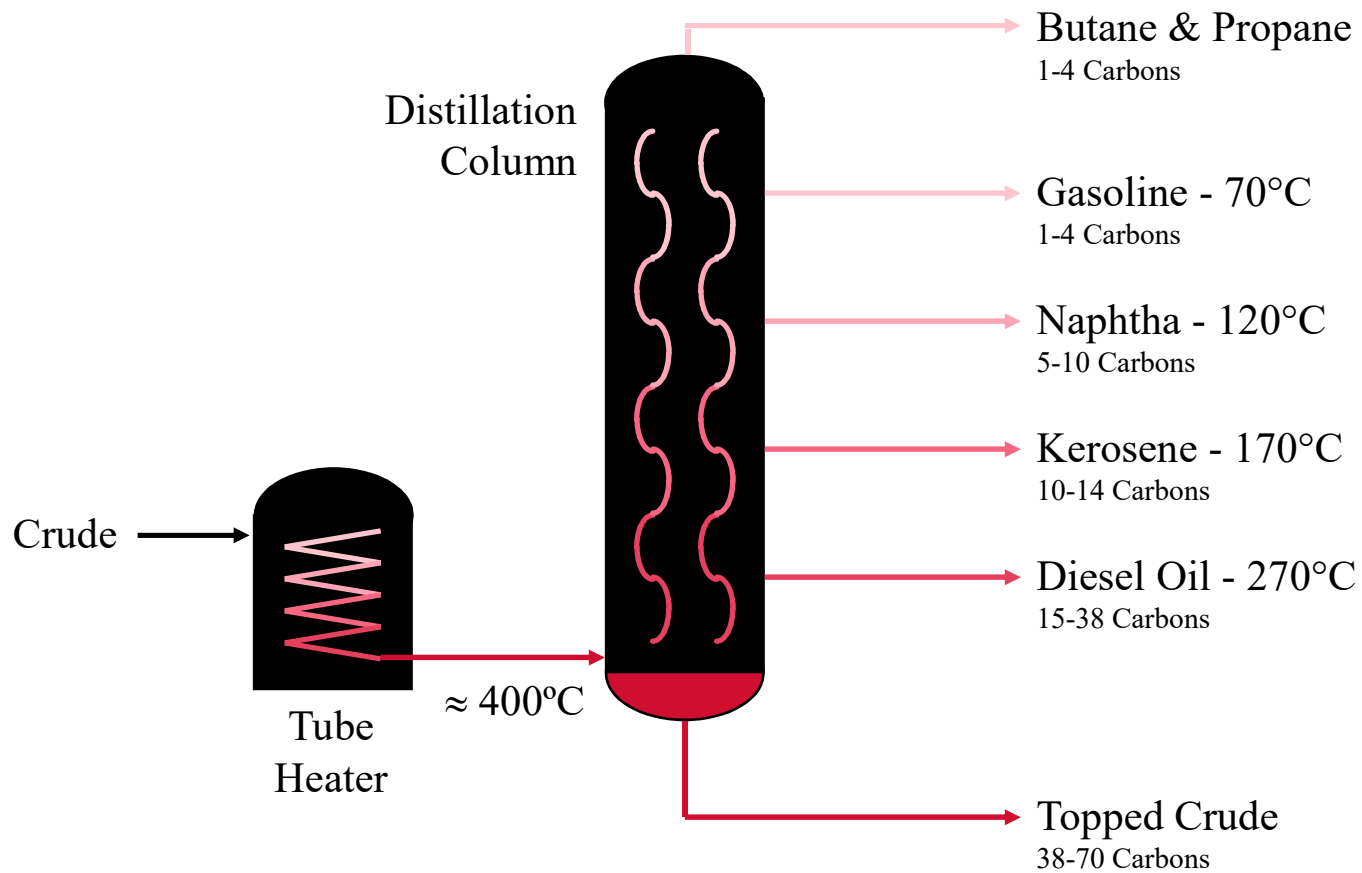


■ Resins
■ Aromatic Hydrocarbons

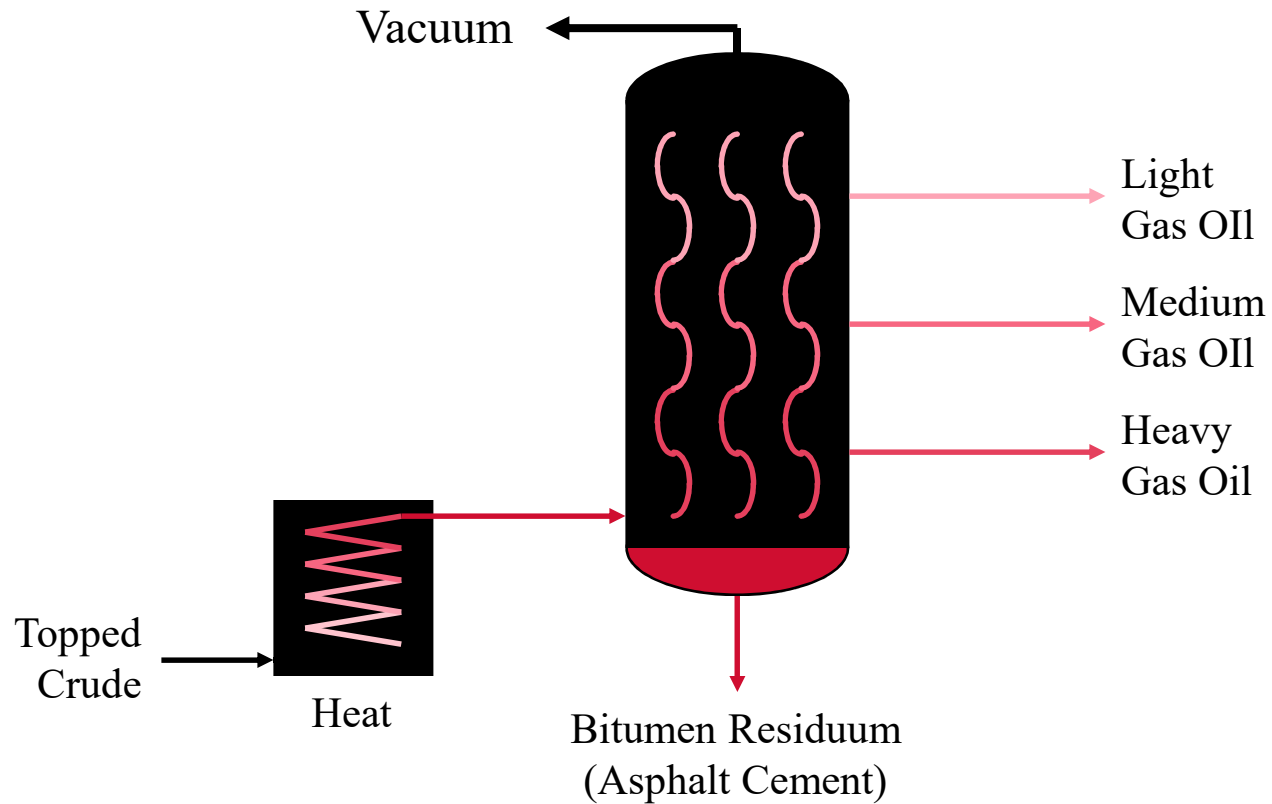
■ Asphaltenes
■ Saturated Hydrocarbons

GeoChemBio.com

Atmospheric Distillation

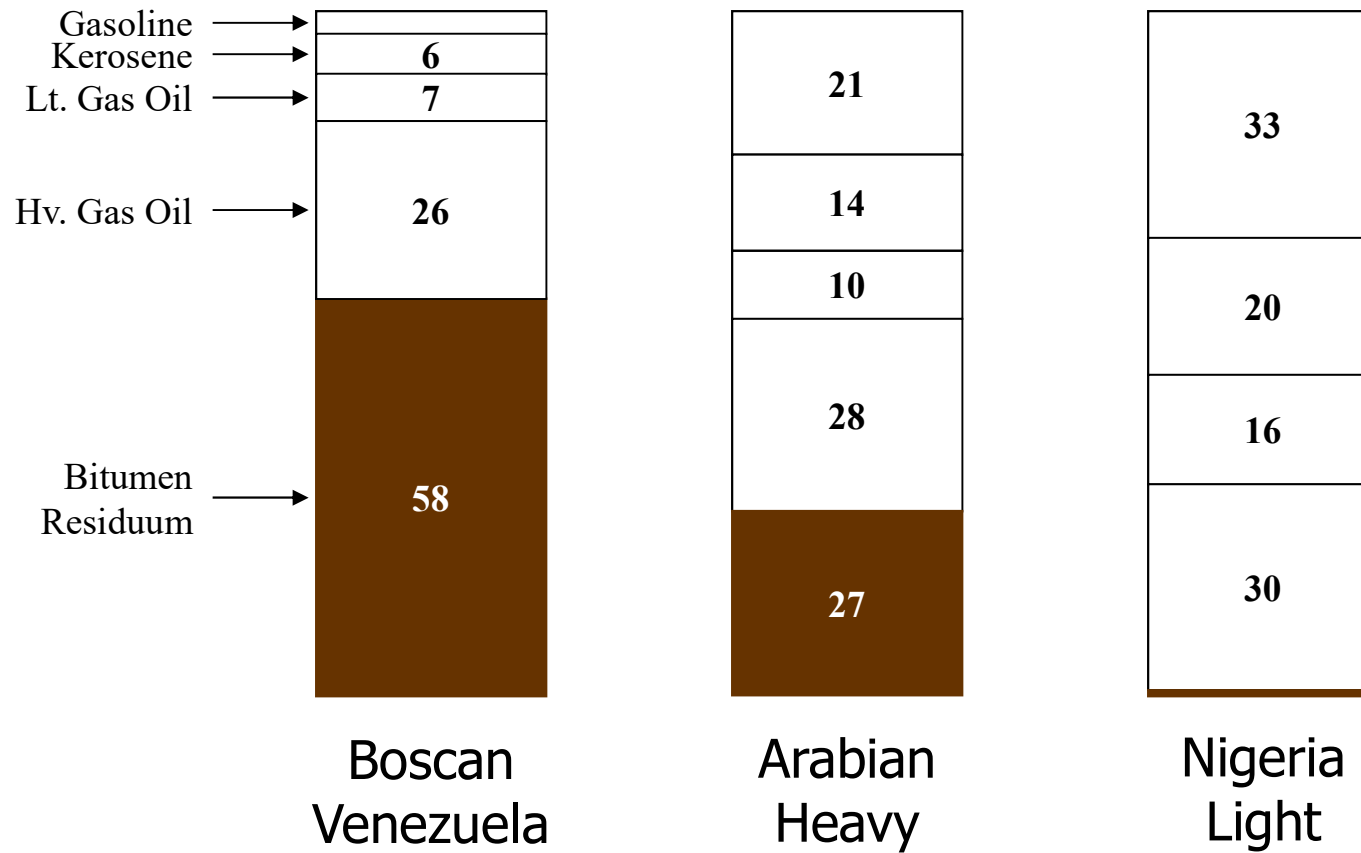


Vacuum Distillation



Vaporizes the topped crude without using excessive heat (“cracking”)

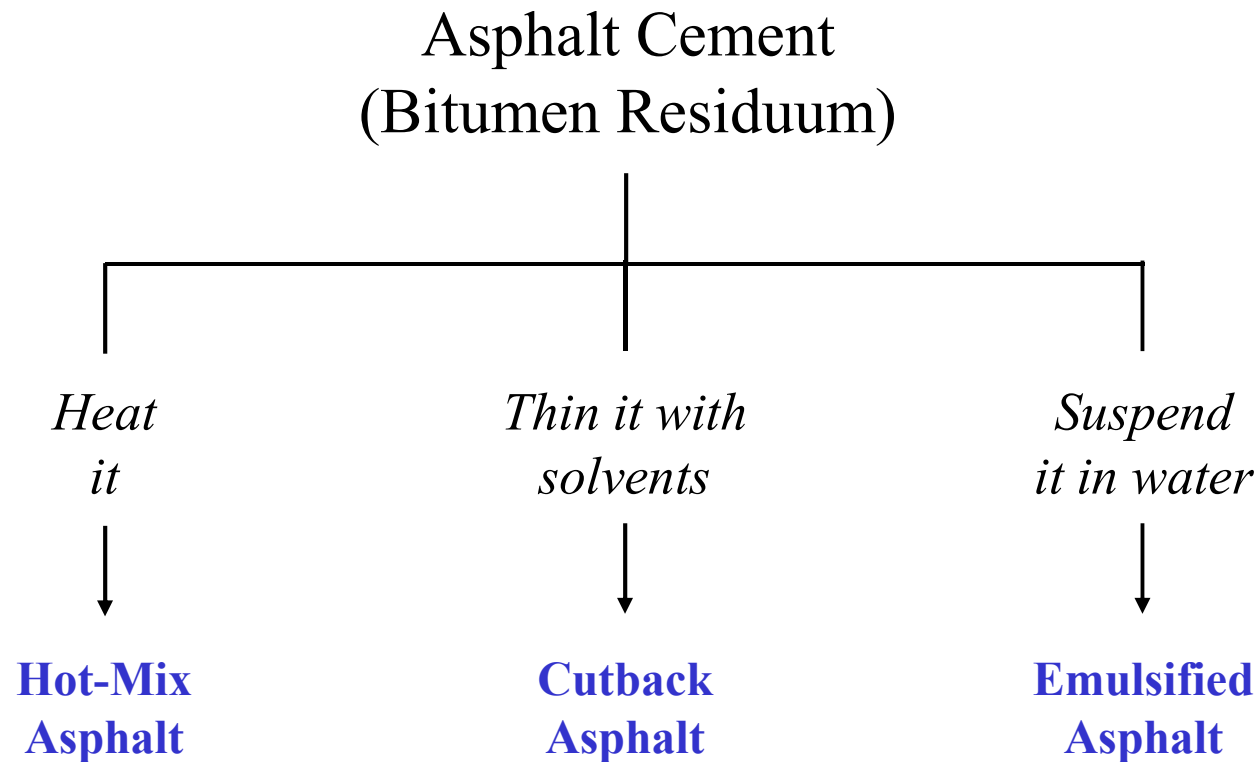
Crude Oil



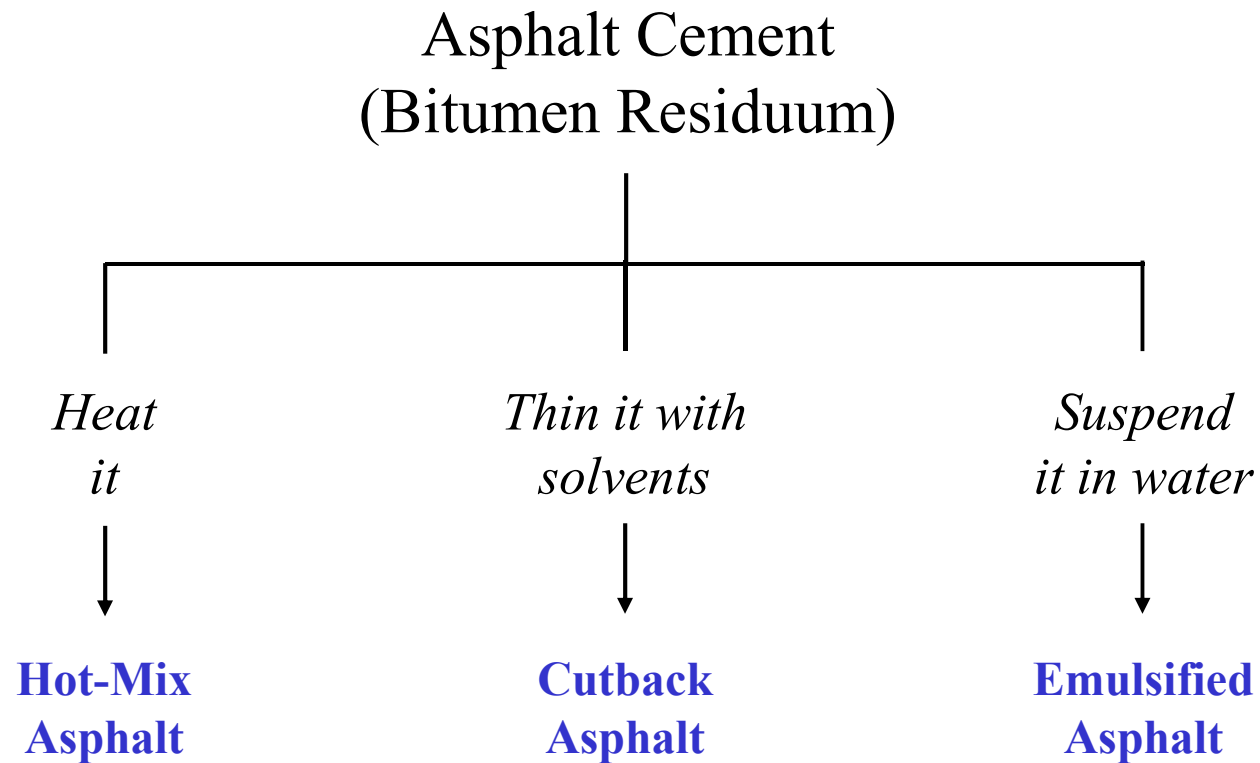
Petroleum Asphalt

Petroleum asphalt at room temperature is very stiff. In order to mix it with aggregate to make asphalt concrete, it has to be liquefied.

Liquefying Asphalt Cement



Liquefying Asphalt Cement



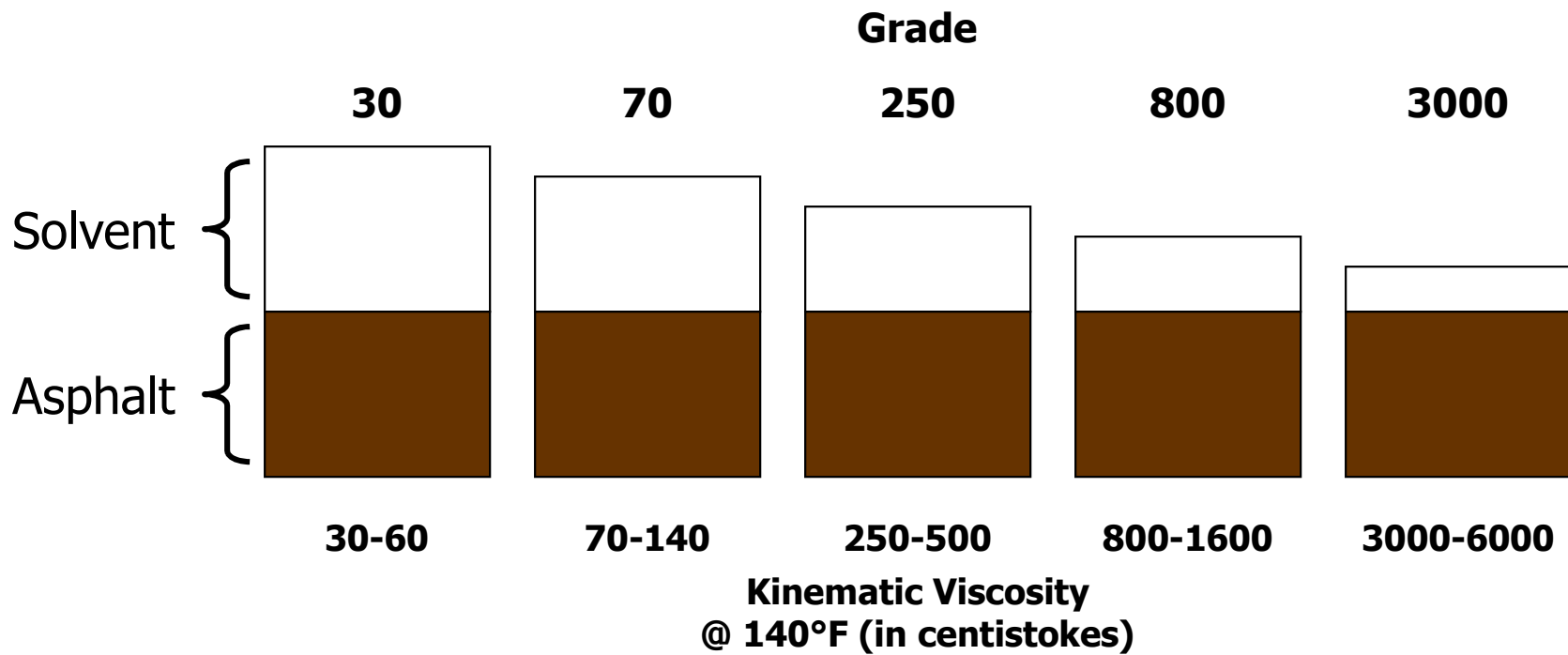
Cutback Asphalt

Cutback asphalt is asphalt cement that has been blended with a solvent in order to reduce its viscosity. After a cutback asphalt is applied the solvent evaporates leaving behind asphalt cement residue on the surface to which it was applied. A cutback asphalt is said to “cure” as the petroleum solvent evaporates away.

Cutback Asphalt

Cutback asphalt is classified according to the rate at which it cures (fast, medium, slow) and the viscosity of the liquid. The curing rate is a function of the boiling point of solvent used. The viscosity is based on how much solvent is used.

Cutback Asphalt



Cutback Asphalt

⊕ Rapid Curing (RC)

Asphalt cement thinned with **gasoline** or **naphtha**
Used for tack and seal coats (surface applications)

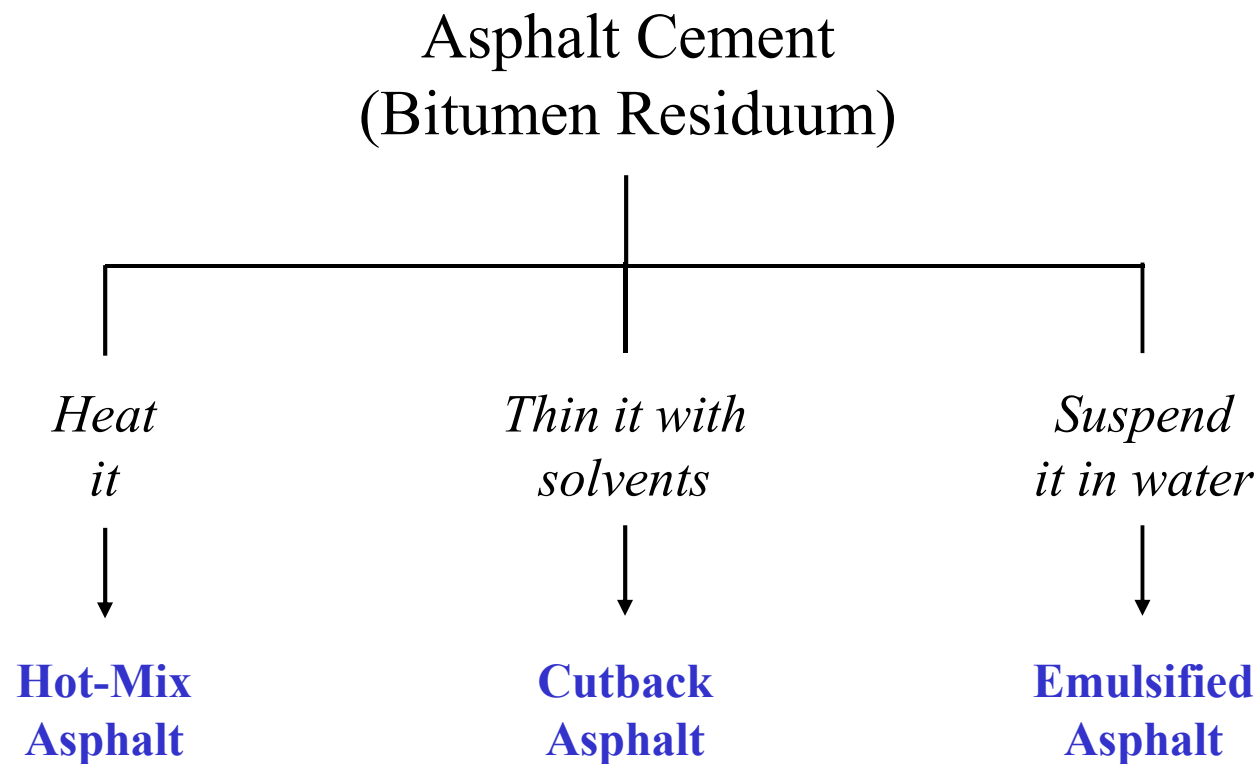
⊕ Medium Curing (MC)

Asphalt cement thinned with **kerosene**
Used for prime coats, cold-laid pavement bases

⊕ Slow Curing (SC)

Asphalt cement thinned with **diesel oil** or **gas oils**
Used for cold-laid pavement bases

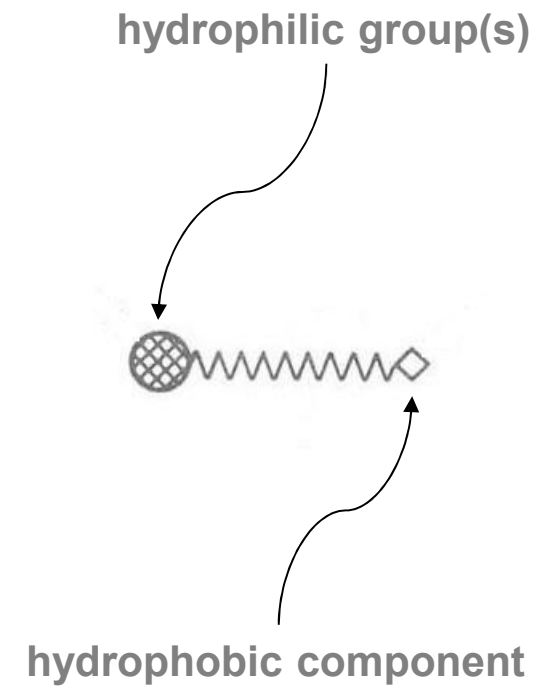
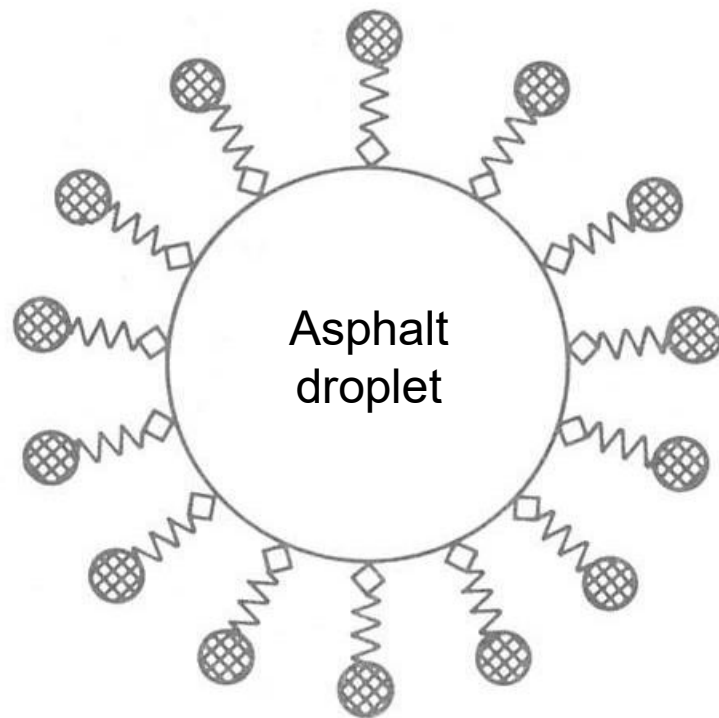
Liquefying Asphalt Cement



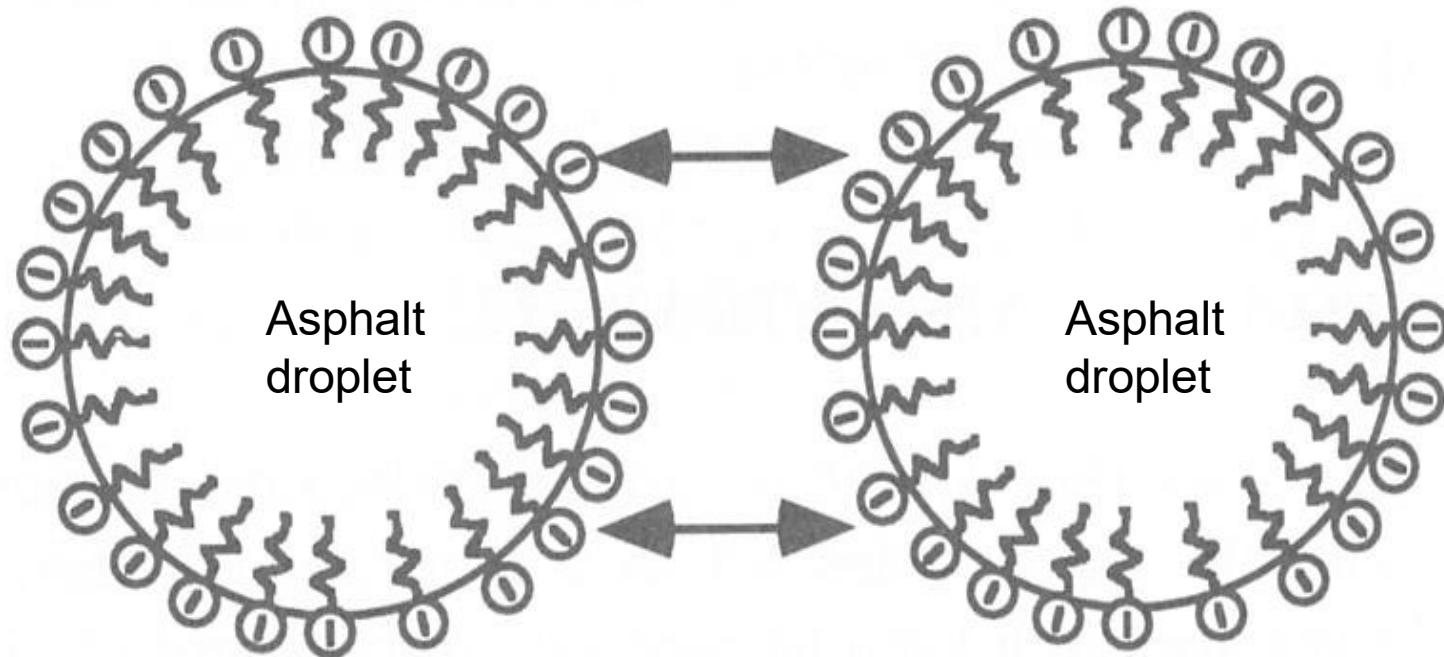
Emulsified Asphalt

Emulsified asphalt is a suspension of very small asphalt cement droplet in water, which is assisted by an emulsifying agent (e.g., soap) that disrupts the surface tension of the water and imparts an electrical charge to the surface of the asphalt cement droplets so that they do not coalesce into larger droplets and fall out of suspension.

Emulsified Asphalt

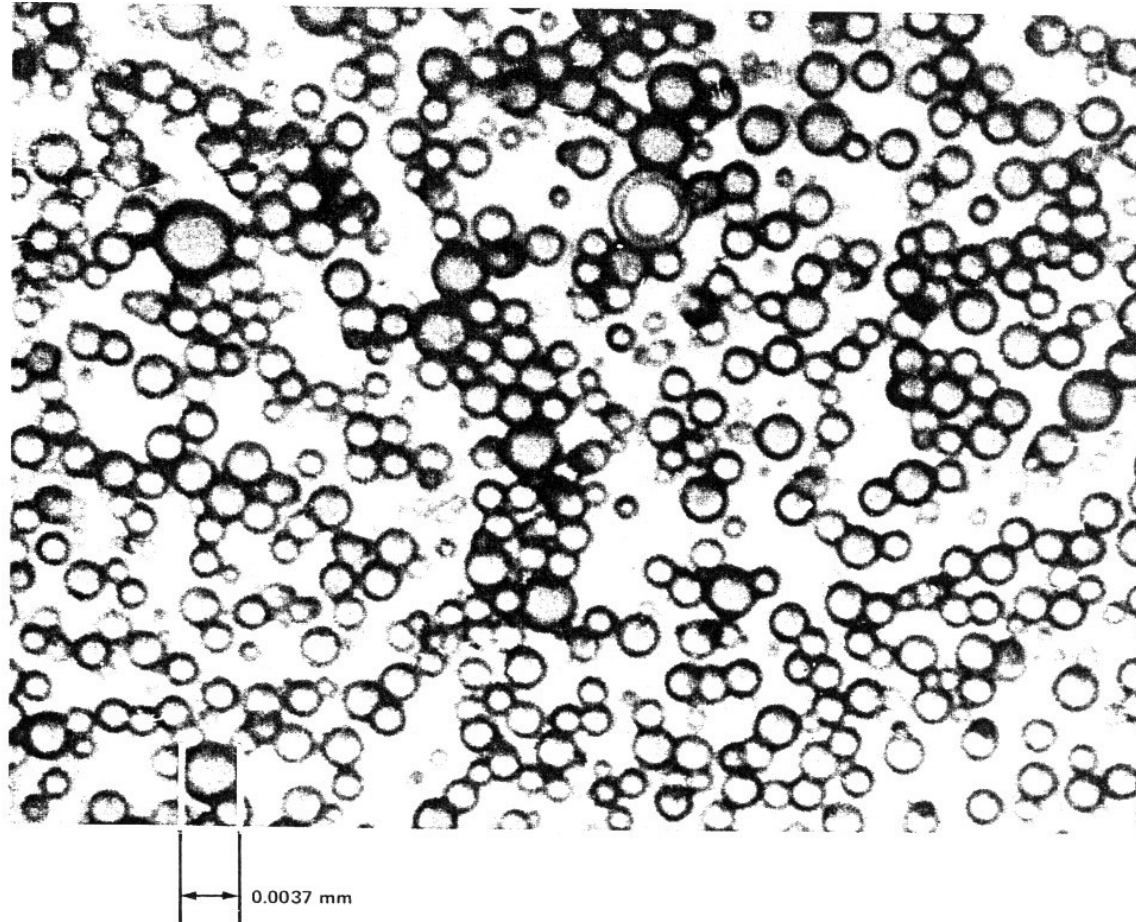


Emulsified Asphalt



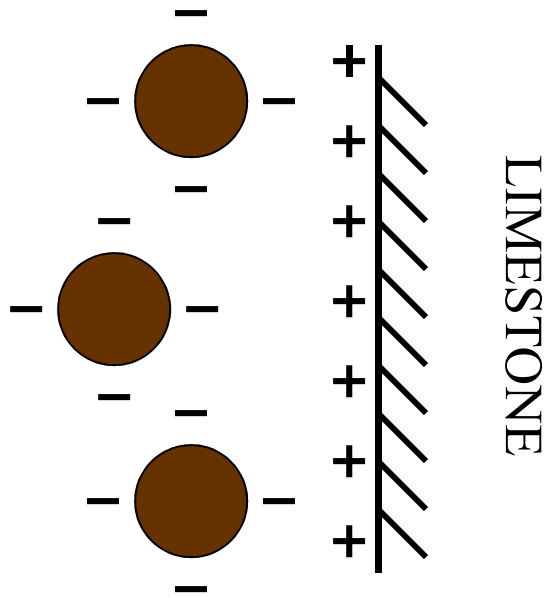
Repulsion between negative surface charges prevents coalescence

Emulsified Asphalt

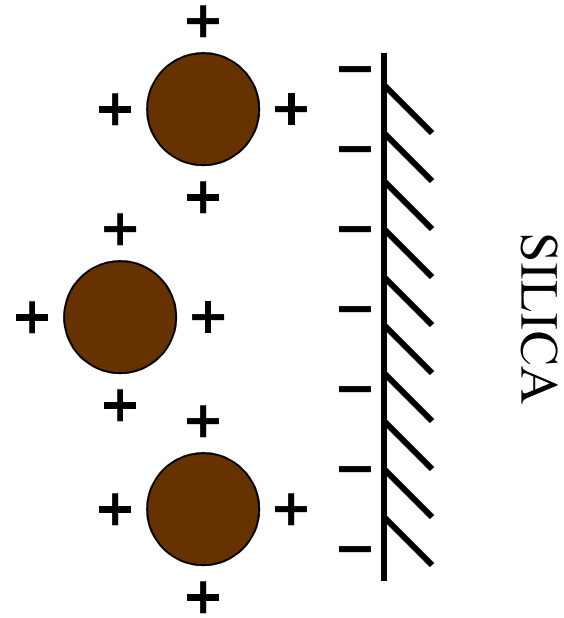


Emulsified Asphalt

Anionic Emulsifier



Cationic Emulsifier



Emulsified Asphalt

Emulsified asphalts appear as a thick brown liquid when first applied. When the asphalt droplets start to adhere to the aggregate the color changes to black and the emulsion is said to “break” (i.e., separate). As the water evaporates, the emulsion behaves more like pure asphalt cement. Once all the water has evaporated, the emulsion is said to have “set”.

Emulsified Asphalt

There are three main emulsion grades: rapid set, medium set and slow set. The terms relate to the amount of time it takes for the emulsion to set and the amount of mixing that can be performed before the emulsion breaks. Slow setting emulsions can stand up to more mixing than fast setting emulsions.

Emulsified Asphalt

- ⊕ Rapid Setting (RS or CRS)
Used for surface coats, penetration macadam
- ⊕ Medium Setting (MS or CMS)
Used for open-graded asphalt-treated base
- ⊕ Slow Setting (SS or CSS)
Used for dense-graded asphalt-treated base