

Period #14 Notes: BITUMINOUS MATERIALS (I)

A. Brief Overview

There are two basic classes of bituminous materials: (1) asphalt; and (2) tar. These materials are generally used as water-proofing sealants, and as a binder to hold aggregate together in bituminous pavements. In this set of notes we will discuss the differences between these two bituminous materials, and the sources of these two materials.

B. Characteristics of Bituminous Materials

Common characteristics of bituminous materials are that:

1. They are highly temperature sensitive. At “high” temperatures, bituminous materials feature highly fluid consistencies, whereas at “low” temperatures they tend to become very stiff and brittle. This change of consistency with temperature is generally called *temperature sensitivity* or *temperature susceptibility*.

2. They age or oxidize. Over time, bituminous materials undergo an oxidation process. As the oxidation process continues, the bituminous material tends to become increasingly brittle and thus more prone to cracking/fracturing. The rate of oxidation increases with temperature of the bituminous material. There is usually a color change of bituminous materials as they oxidize. Fresh asphalt is usually black in color and turns grey as it ages. Fresh tar is usually black/brown in color and also turns grey as it ages.

C. Sources of Asphalt

Asphalt comes primarily from two sources: (1) naturally occurring asphalt deposits; and (2) from the refinement of crude petroleum.

1. Natural Asphalt Deposits

Naturally occurring asphalt deposits occur in various locations around the planet. Although these deposits are sometimes called "tar pits" they are in fact natural asphalt deposits. The asphalts in these natural deposits can exist in hard or soft solid form. Just a few examples of natural asphalt deposits are: (1) the Trinidad Lake deposits on the Caribbean Island of Trinidad; (2) the "Tar sands" of Western Canada; (3) the Gilsonite deposits of Utah; and (4) the La Brea Tar Pits of Southern California.

While in earlier times, these natural deposits were the most common source for asphalt, the more common source today is from refinement of crude petroleum.

2. Refinement of Petroleum

Unrefined petroleum consists of a spectrum of different products of different volatilities. From highest to least volatility these products are: gasoline, kerosene, light oils, heavy oils, and asphalt residuum. Crude petroleum from different natural deposits generally vary in their yield of these different products.

A simple index that helps to determine the composition of crude petroleum is the API Gravity Index. Here API denotes the American Petroleum Institute.

The API Gravity Index of a given fluid is determined by the following formula:

$$API \text{ Gravity Index} = \frac{141.5}{G_s} - 131.5 \quad (15.1)$$

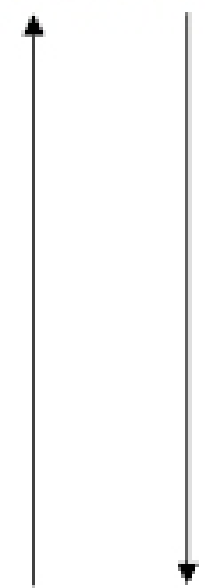
In the equation above, G_s denotes the specific gravity of the fluid at atmospheric pressure (14.7 psi) and $T=60^\circ\text{F}$.

Example: Water at the reference temperature and pressure has $G_g=1$.
Accordingly, the API Gravity Index of water is 10.

The API GI is thus inversely related to the specific gravity of the material. Generally speaking, the lower the API GI of a petroleum, the higher will be its asphalt content, and the lower its content of volatile phases like gasoline and kerosene.

Some examples of the variation in crude petroleum from different oil fields around the world are listed below in Table 15.1.

Table 15.1. Nature of crude petroleum from different sources.

Composition	Crude Type	API GI	Source
High gasoline, low asphalt content  High asphalt, low gasoline content	A	34	Arabian Light, Saudia Arabia
		32	Kuwait
	B	28	Hawkins, USA
		26	Tiajuana, Venezuela
	C	19	Galan, Colombia
		18	Cyrus, Iran
	D	16	Lloydminster, Canada
		15	Obeja, Venezuela
	E	12	Panuco, Mexico
		10	Boscan, Venezuela