

don, for nearly 12 months where the traffic is heavy, amounting to 90 tons per square foot per hour for 24 hours, and is not perceptibly worn.

Another section of road is about to be laid in Cannon Street in the heart of the City of London, the corporation having granted the necessary permission to the acting agent of the Federated Malay States Government in order that its advantages can be better observed by all interested in the new development.

ROAD OIL SPECIFICATIONS AND TESTS.

In the California Highway Bulletin for July, 1914, Mr. Clarence B. Osborne, Geologist to the California Highway Commission, presents the following specifications for and results of tests of asphaltic oil for road building. He states that in the preparation of such specifications the engineer has three problems presented: (1) He must have requirements controlling the chemical purity of the oil, i.e., he desires an oil that is free from foreign material and products of decomposition produced during refining. (2) He must control the chemical composition of the oil. (3) He must control the physical properties of an oil so that it will actually perform its proper function in the road construction.

Specifications for chemical purity of road oil are as follows:

(1) It shall not contain more than one-half of one per cent. of sediment by volume.

The presence of even ten times this amount of sediment is not detrimental, as the oil in use on the road eventually carries as high as 90% of mineral aggregate. This specification is used to prevent the buying of sediment at the price of road oil.

(2) It shall not contain more than one per cent. of water by volume.

The presence of water in a road oil makes the oil difficult to handle when heated above 212° F., because the steam formed makes the oil boil or froth. Also, as in the case of sediment, unless the proper deduction is made water will be paid for at the price of road oil.

(3) It must, when freed from water, be soluble to at least ninety-nine and five-tenths per cent. (99.5%) in pure carbon disulphide.

This will give the per cent. of bitumen in the road oil.

(4) The bitumen soluble in carbon disulphide must be soluble in carbon tetrachloride to the extent of at least ninety-nine per cent. (99.0%).

The failure to pass this specification is supposed to be an indication of an overheated or "cracked" oil. Carbon tetrachloride is not a stable solvent in bright light and the solubility test is influenced if the test is performed in bright light.

Another specification sometimes used to determine a "cracked" oil is as follows:

(5) In CS₂ bromine solution. The bitumen soluble in carbon disulphide must be soluble to the extent of at least ninety-nine and eighty-five one hundredths per cent. (99.85%) in a solution of one hundred and thirty-five (135.0) milligrams of bromine to one hundred (100.0) cubic centimeters of the carbon disulphide, when twenty-five (25.0) cubic centimeters of the solution are poured on two (2.0) grams of the oil in an Erlenmeyer flask, which is then shaken in the dark for three (3.0) minutes, the solution being immediately filtered through a Gooch crucible

using a suction equal to a column of mercury more than eight (8.0) inches high.

When the solution has all passed through the crucible, the crucible is washed with pure carbon disulphide, dried at from two hundred and twelve (212.0) to two hundred and twenty degrees Fahrenheit and weighed.

This test had its origin in the examination of vegetable and animal fats. The unsaturated fatty acids form insoluble bromides. This bromide carbon disulphide solvent is not stable, however. An oil having an excess of 0.15% of insoluble material would fail to pass this specification, and yet this failure might be due entirely to the unstable solvent.

The specifications to govern the different constituents that make up the bitumen of the road oil are partly included in the specifications numbered (3), (4) and (5).

The road oils are generally classified as to their asphalt content. This asphalt is not a definite chemical compound determined by chemical analysis. To determine the asphaltic content, the road oil is hardened by heating it in an asphalt oven at a high temperature. Part of the light or volatile oils, is driven off in this heating and the residue is hardened. The degree of hardness is measured by the depth of penetration of a No. 2 needle when acting under a load of 100 grams for five seconds, the residue being maintained at 77° F. If the needle penetrates 8 mm. in this test the residue, called asphalt, is said to be asphalt of 80 penetration. As can readily be seen, this residue may contain many different bitumens. The test is not a measure of a definite chemical compound.

If the assayer for copper should call all the metal extracted "copper" when the metal was of a certain hardness, then it can readily be seen that any alloy of soft and hard metals that made this certain hardness would be classified as copper. This is the practical result of the specification for a road oil when it is required to contain a certain percentage of asphaltum.

The early oil-bound macadam roads built with asphaltic oils usually required an oil containing 70 to 75% of asphalt of 80 penetration. This oil was not heavy, that is, it lacked body (i.e., low viscosity), and it was a weak binder but it was easily applied to the road surface.

The use of pressure tank wagons with sprayers for applying heated road oil has made it possible to use an oil of much higher asphalt content and of higher viscosity. The road oil that is now commonly demanded for oil-bound macadam, or for bituminous-covered concrete highways, is one that contains 90% of 80 penetration asphalt. The following specifications are suggested for such an oil:

(6) It shall contain 90 per cent. of 80 penetration asphalt.

This per cent. of asphalt is determined by heating 20 grams of the road oil in a 2-oz. salve tin in a standard asphalt oven, the temperature of the oven being maintained at 400° F. When the asphaltic residue has a penetration of 80, the oil shall not have lost in excess of 10% by weight.

The asphaltic content is the classification of the oil refineries of their different grades of road oil. The specification is of value more on this account than for any information of practical value furnished to the road builder.

(7) It shall show an open flash point not less than 350 degrees Fahrenheit.

This requirement prevents the use of an oil carrying very volatile constituents that would readily evaporate and might also be dangerously combustible at the time