ASPHALT AND ITS USES.

Mr. Charles Ekstrand, M.E., in a paper on "Asphalt, Its History, Manufacture and Uses," read before the Brooklyn Engineers' Club, sums up in the following way the points that are important to obtain a good asphalt:

(1) The selection of the best crude oil for good asphalt production.

(2) The proper treatment for the material required.

(3) As low heat as possible, and that heat applied the shortest possible time.

(4) All the heavy oils, such as lubricating oils, which do not evaporate quickly, must be retained in the asphalt.

(5) No mixing of oils, or of asphalts obtained from different oils must be done, as each oil varying in its chemical constituents, varies also in its physical characteristics and requires different treatment.

(6) It must be uniform in character and tests.

The treatment that asphalt should receive during its reduction, depends on the uses to which the asphalt is to be put.

There are two main divisions in the treatment of asphalt, *viz.*, distillation with the addition of steam, and of air.

In the first method the oil is heated to about 300° F. when steam is introduced through perforated pipes into the bottom of the vessel, the temperature gradually raised until it is sufficiently high to distill over enough of the lower boiling point fractions, in order to leave a residue which fulfils the requirements of the material wanted. The steam in this case acts as a cooling agent and also as a mechanical carrier of the light hydro-carbons which it is desired to drive off.

The asphalt so made is suitable for paving, either sheet asphalt or penetration method, for waterproofing, saturating, roofing, etc.

Its high boiling point, small percentage of loss at elevated temperature (300-400° F.), slight change at extreme temperatures, and slight action of water makes it extremely well adapted for the above uses.

Following are the characteristics of a paving asphalt of a penetration widely used:

Sp. Gr. at 77	1.048	Sol. in 76° naphtha	78.6%
M. P. (Mabery)	143° F.	Sol. in carbon tetrachloride	99.85%
Pen. at 32° F.	1.7 m.m.	Sol. in carbon bisulphide	99.9%
Pen. at 77° F.	5.5 m.m.	Loss on 20 grams 5 hrs. 325° F.	0.3%
Pen. at 115° F.	19.6 m.m.	Flash open cup	550° F.
Ductility at 77	Over 100 c.m.	Ash	None

The range in penetrations between 32° and 115° F. shows an interesting characteristic of the heavy crude asphalts. Its high ductility is generally considered in its favor. For waterproofing, an asphalt of a higher penetration is generally used.

The test of such material follows:

Sp. Gr.	1.045	Sol. in carbon tetrachloride	99.9%
M. P. (Mabery)	130° F.	Sol. in carbon bisulphide	99.9%
Pen. at 77	8.3 m.m.	Loss on 20 grams 5 min. 325° F.	0.5%
Ductility at 77	Over 100 c.m.	Ash	None

The asphalt must be of good saturating qualities, small effect of temperature changes, and insoluble in water to make it effective. For roofing, a higher melting point material is usually used.

There is more asphalt used for road building than for all other purposes put together. Numerous methods of application have been in use for years and new methods are constantly being devised. For the heaviest traffic, such as that prevailing in business streets of a city, the sheet asphalt on concrete foundation is very satisfactory and lasting. Other methods of application are the bitulithic or graded method, Telford bituminous macadam, Topeka mixture, penetration method, etc. The best method for any street or road should be carefully determined by an engineer having intimate knowledge of the various methods, and a careful consideration for the weight of traffic to which the street will be subjected after paving. To make a good asphalt pavement it is necessary to have good asphalt, but very poor paving can be done with good asphalt. The asphalt being only the binder and the waterproofing, the wear and tear comes on the stone and sand, and it is necessary that these are of the highest quality and properly graded so as to have a compact mass with just enough of bitumen to bind each particle together and to prevent moisture from penetrating below the surface. It is also necessary to have a good foundation so that no sagging or sinking can take place under the traffic load. Having all the above of the very best that can be found, they only constitute 50 per cent. of what is necessary for a good asphalt pavement. The other 50 per cent. lies in the judgment used in selecting the proper hardness of the bitumen and in the care with which the materials are graded and mixed and applied. In other words, one-half of a good pavement depends on the quality of material, and the other half depends on the quality of brains, labor and application.

The greatest enemy to a good asphalt pavement is moisture. It is necessary that the bitumen be absolutely free from moisture, that the stone and aggregates are free from moisture when mixed with the bitumen, and that the mixture is kept free from moisture until it is laid in place and rolled down to a compact mass. If the stone is put down cold, containing more or less moisture, and the bitumen is put on hot, when this hot bitumen surrounds the stone, the moisture will be expanded and forced toward the surface, forming a film between the stone and the bitumen, which will prevent a perfect union between the two. Eventually disintegration will take place, and more moisture admitted to the interior of the pavement, ruts will form and grow, and the road will soon be a horrible example. The only thing to recommend the system is its low first cost. Maintenance will necessarily be heavy.

Following are some points that are important to consider to obtain the best results in asphalt paving:

(1) Select the best quality asphalt.

(2) Select the proper grade of asphalt for the traffic load expected on the street, and for the condition of the street, *i.e.*, a sunny street and heavy load need a harder grade of asphalt, a shaded street and a light load needs a softer grade of asphalt.

Climatic conditions should also be taken into account.

(3) Select the best and hardest wearing material for the aggregates.

(4) Adequate foundation, and a good crown on the street so as to shed all surface moisture rapidly.

(5) Proper proportioning and mixing of the aggregates so as to have a minimum of voids.