

various portions of the river bed. When prospecting outlying country for available sand deposits, a small frying pan is a very convenient utensil to carry, together with the sand sieves and scales. By means of it, samples of sand taken from various pits can be dried over a small fire and sifted on the spot, which avoids the necessity of carefully marking them for identification and taking a lot of samples back to the laboratory or office. When securing samples of materials for examination, these should be carefully selected so that they really represent an average of the materials. The quantities necessary for examination are about as follows:

Refined asphalt or asphalt cement.....	1 pound
Residuum flux	½ to 1 quart
Crushed stone or gravel	1 to 3 pounds
Sand	1 pound
Filler	½ pound

When these are sent to a central testing laboratory they should be plainly marked with the following information:

- Kind of material,
- Date material was received at paving yard,
- Date when sample was sent,
- Quantity of material represented by sample,
- Name of manufacturer or from whom purchased,
- Name of paving contractor who is to use the material represented by the samples,
- Name of city or town in which work is being done.

Method of Obtaining Samples.

Refined Asphalt.—This is usually shipped in barrels containing from 300 to 500 pounds each. It will depend on circumstances and the quantity of material on hand how many barrels should be examined. Where the barrels are marked with the dates or batch numbers and different batches are represented, it will usually be sufficient to take a single sample from each batch. Certain specifications give a permissible limit of variation in the penetration or consistency of different shipments of asphalt. In such cases it will be necessary to test for penetration a sample from each batch number, in which case all of the samples taken must be kept separate. Where no such provision is included in the specifications and the inspector is assured from his past experience that the particular manufacturer from whom the material was purchased is careful in his output, a fewer number of samples will be necessary than under other circumstances. In some cases an average sample made up of different samples taken from the requisite number of barrels will be all that is required. The packages or barrels used by different manufacturers are very often characteristic of the product, and this is also true of the odor and general appearance of the material. A qualified inspector will often be able to determine from observation whether or not the contractor's statement as to the source of the material which he intends to use is correct. In taking the samples, material should be selected which is free from dirt, etc., and which has not been exposed to the air. In other words, a piece of refined asphalt should not be taken from the top or immediately adjacent to the outside of the barrel.

Asphalt Cement.—This is quite often shipped in tank cars and in such cases a single sample taken, preferably after the contents of the car have been melted, will be sufficient.

Crushed Stone or Gravel.—Various samples from different portions of the pile should be taken and mixed together, and from the mixed portion sufficient should be

selected for test. It is always advisable to dig into the surface of the pile a little way in order to get material which has not been exposed to the atmosphere and which possibly has lost through the action of wind or rain, or both, a considerable portion of its fine material.

Sand.—It is almost impossible to secure a fairly representative sample of dry sand, as the coarser grains have a different angle of flow from the finer grains and are found in different portions of the pile. The pile should always therefore be dug into some distance below the surface until damp sand is reached. After sampling the pile in this way in a number of places, the samples so obtained should be mixed together and sufficient taken for test from the mixed lot.

Filler.—This is usually Portland cement or finely ground lime dust, and comes in bags. No particular difficulty attends the sampling of this material, but a sufficient number of bags should be opened and samples obtained from them and mixed together in order that the sample sent for test shall correctly represent the average quality of the material.

The examination of the samples so obtained is usually conducted in accordance with detailed specifications. As these vary somewhat in their requirements, it is impossible to lay down a general rule which will cover the examination of raw materials for paving work. After the materials have been examined in the laboratory and found to be suitable for the work and in accordance with the specifications, the inspector can frequently be of great service in suggesting to the contractor the best formula to use. All paving specifications allow considerable leeway as to the composition of the mineral aggregate and the percentage of bitumen required in the mixture. Sometimes the decision lies entirely with the engineer on the work and where he is fully competent to decide these questions it should, of course, be left to him. As the contractor usually has to assume a guarantee on the completed work, he naturally feels that he should be consulted as to the formula used. Sometimes his desire to reduce the cost of his work will lead him to employ a formula which, while complying with the minimum requirements of the specifications, is really not suited to the work in hand. Whenever possible, co-operation between the inspector and the contractor will always secure the best results and a little tact used in this connection will usually be all that is required. It frequently happens that two or more kinds of sand or stone have to be mixed together in order to secure a suitable mineral aggregate. Many contractors are exceedingly careless in keeping their different kinds of materials separated. Unless this is done it is impossible to make a uniform mixture of the various materials and provision for the piling in separate and convenient places of the different materials should always be made before they are delivered. This is a very important consideration and lack of attention to it will not only hamper the execution of the work but its quality as well. It is necessary and advisable to impress on all the dealers furnishing raw materials the necessity of a uniform supply. This is particularly the case with sand dealers, who are often small men who have been accustomed to supply sand to builders and parties requiring it in small amounts. Almost invariably, men of this type will not realize the great difference which a, to them, small variation in the mesh composition of the sand will make to the paving contractor.

Inspection of Materials and Processes During Construction Work.—These may be sub-divided into plant and street inspection.