gravel, and the weight per cubic foot, can easily be determined with simple apparatus.

In practical use, frequent analysis must be made and the proportions changed as often as is necessary to agree with the variations in the material.

Comparison With Other Methods

Fig. 8 shows a comparison between three methods of proportioning pit-run gravels to produce concrete of equivalent strength, the "Sand" method, as described in this paper, the "Fineness Modulus" method of Abrams, and the "Surface Area" method of Edwards. The proportions necessary to use with gravels containing various percentages of sand, to make concrete equivalent in strength to that of a 1: 4½ mixture in which the gravel contained 42 per cent. of sand, were computed by each method. The materials, and approximately the mixtures, are those shown in Table IV.

The proportions shown on this diagram are the theoretical mixtures as computed. In the greatest number of instances in which this material is used, it will not be practicable to state the proportions any closer than the nearest half or quarter part of aggregate. When the proportions in the diagram are changed so that the parts of aggregate to one part of cement conform to the nearest quarter part, it will be found that there is very little difference between the "Sand" and "Fineness Modulus" methods. The "Surface Area" method appears to call for somewhat richer mixtures.

LETTER TO THE EDITOR—CORRECTION

Sir,—We are very pleased with the notice given our penetration dial in your issue of July 10th, but wish to call your attention to an error in connection therewith. While it is true that the idea of advocating concordant action in specifying the penetration of asphalt for the various types of pavement made with that material, where traffic conditions and climate are the same, was indicated by the paper I prepared for the last convention of the A.S.M.I. at Buffalo, in October, 1918, nevertheless the idea of the dial belongs to our chief chemist, Leroy M. Law. Accordingly, I feel that you should not credit me with a creation which is the result of the skill and ingenuity of another.

J. R. DRANEY,
General Sales Manager,
U. S. Asphalt Refining Co.

New York City, July 14th, 1919.

JAPANESE WATER POWER SURVEY

THE value of water power as an indispensable adjunct to industrial development is being universally recognized. Japan has lately set aside a sum equivalent to over $400,000 for the investigation of sites for hydro-electric power plants and for the collection of reliable data for use in connection with future hydro-electric undertakings in that country. The programme of work includes the selection of 635 power sites; the only sites to be surveyed at present are those where more than 1,000 h.p. can be obtained by economical exploitation. There is also provision for the establishment of numerous stream-gauging stations and of new meteorological observatories. This work is to be completed by the end of next September.

Canada is justly proud of her water power resources, both latent and developed, and, in this connection, it is of interest to note the progress made in Japan. Hydro-electric plants in that country already utilize more than 1,000,000 h.p., and a further 2,000,000 h.p. is under lease for development. Construction work for about one-half of the latter quantity is now being proceeded with, and it is estimated that some 5,000,000 h.p. is capable of development on commercial lines. In Canada, the total hydro-electric power developed is over 1,800,000 h.p.—By L. G. Denis, writing in "Conservation," an official journal published by the Commission of Conservation, Ottawa.

TNT AS A BLASTING EXPLOSIVE

By Charles E. Munroe and Spencer P. Howell
Bureau of Mines, Washington, D.C.

TRINITROTOLUENE is an explosive which is obtained by acting upon toluene with nitric acid in the presence of sulphuric acid. Toluene is a liquid substance which is produced from soft coal in the process of making coke, coal gas and coal tar, and it is recovered for use from both the gas and the tar. It is also made in other ways. The name TNT is an abbreviation of trinitrotoluene, which is the name given by chemists to the explosive in order to state its composition while designating it, and to thus distinguish it from many other nitrotoluenes known to them.

History

TNT has been known to chemists since 1863, and it was adopted as a military service explosive by 1902, but it did not become widely known until the Great War, when it came to be extensively used as bursting charges for high explosive shells, depth bombs, mines, torpedoes and other devices, and in demolitions where very violent detonation effects were sought to be produced with the largest measure of safety from these effects to the users. It was also used in admixture with other substances to produce other military explosives, such as amatol and sodatol.

Safety

Because of the devastating effects produced by the explosion of these devices charged with TNT, and because of the many most disastrous accidents which have occurred during the manufacture and transportation of large quantities of TNT under the hurried conditions necessitated by war conditions, many have been led to conclude that TNT is an especially dangerous explosive, but it really possesses characteristics which render it less dangerous than many explosives generally used in our industries. Thus it has been found more difficult to explode it with certainty than nitroglycerine, dynamite or gun cotton. In fact it was considered so safe that in 1910 the British government, on advice of its explosives experts, issued an order-in-council exempting it from being deemed an explosive, and subject therefore to the explosives regulations, during manufacture and storage unconditionally, and when conveyed and imported, provided it was perfectly packed. But this order has since been rescinded, and it may be proper to say in this connection that all substances possessing explosive properties should be treated with special care and surrounded by safeguards.

Industrial Use

With the cessation of hostilities this continent found itself with very large supplies of TNT on hand. So large, indeed, that it was deemed unwise to keep all of it in storage awaiting future military use, and it was proposed to devote many million pounds of it to industrial use. Now, although nitrotoluenes in admixture with other substances have been used as industrial explosives to a certain extent for more than a decade, TNT, as such, for several reasons, and especially because when its special value as a military explosive was recognized stocks of it were accumulated for war purposes, has not been used in industrial blasting except tentatively. It is not surprising, therefore, that objections should have been made to its suggested use as an industrial blasting agent, and doubts expressed as to its operativeness. It is the purpose of this paper to show how TNT may be safely and efficiently used in industrial blasting operations by those skilled in blasting and to correct many erroneous or misleading statements which have been circulated as to the properties of TNT by giving the results of careful experiments and observations, many of which have recently been made at the United States Bureau of Mines Experiment Station.

General Characteristics

When chemically pure TNT is a pale yellow, crystalline substance which acquires a deep yellow to brown color on exposure to light. It melts at about 80.5°C. (177.9°F.), and