the same cask of cement when the times were thirty six and sixty seconds for the tests respectively. The tests will be described as follows :—

(1) Colour.
(2) Specific gravity.
(3) Grinding.
(4) Setting properties.
(5) Strength.
(6) Soundness.
(7) Coolness.
(8) Miscellaneous tests.

The engineer selects samples from every tenth barrel, or from the equivalent of the tenth barrel when packed in sacks, taking care to properly mark all the casks in the batch. Each sample should fill a 4-in. airtight cubical box, and should be sent for testing immediately. No average should on any account be allowed in testing. The author has drawn up four diagrams illustrating how a complete record of tests can be kept for official reference for any period.

TESTS.

(1) Colour.—Good Portland cement should be of a grey or greenish-grey colour. A browny colour indicates an excess of clay and shows the cement is inferior. A coarse bluish-grey cement shows that it is probably over lined. The colour may be observed by rubbing the cement on a piece of white paper.

(2) Test for Specific Gravity.—This test should always be carried out. Experiments which the author has made show that the specific gravity of good K.B. & S. English cement slightly exceeded 3·0, while an inferior cement was only 2·8. Adulterations of Portland cement most likely to be practised are made with materials which reduce the specific gravity. The test is therefore exceedingly valuable in determining a properly burned, non-adulterated Portland. No other hydraulic cement is so dense. The weight of Portland cement varies from 95 lb. to 120 lb. per striked bushel (21 bushels are equal to 1 cubic yard). The specific gravity of cements can be ascertained by Keate's specific gravity bottle, as described by Mr. Grant. The bottle consists of two bulbs, the lower somewhat exceeding the upper in capacity. The exact capacity of the lower bulb is of no importance. On the neck between the bulbs is a file mark b ; on the neck of the upper bulb is a similar mark a. The capacity of the upper bulb between the marks a and b must be determined, and may conveniently be 500 or 1,000 grains in water measure at 60 deg. Fahr.

In ascertaining the specific gravity of a solid in small fragments—small shot for example—the following is the mode of precedure : Fill the bottle with distilled water up to the mark b ; counterpoise the bottle so-filled in a balance ; drop the substance of which the specific gravity is to be taken gradually into a bottle until the water rises from b to a. Ascertain the weight of the material so added. If the capacity of the upper bulb be 1000 grains of water the weight of the material required to raise the water from b to a is its specific gravity. If the capacity of the upper bulb be 500 grains of water the weight of the substance added must be multiplied by two. The result will be the specific gravity. The principle of the apparatus is very simple. The capacity of the upper bulb is an exact measure of distilled water, and when the water is raised from b to a by dropping a solid into the bottle, the bulk of that solid, equivalent to the given volume of the distilled water, is ascertained, and the relation between the weights of the two is given by the weights of the substances added. The only precautions are that the air, which is apt to cling somewhat to the solid matter when dropped into liquid, is carefully removed, and that if a very volatile liquid be used in the place of water the bottle should be corked to prevent evaporation. With natural cements this test may be dispensed with.

(3) Test of Grinding.—It is a well-established fact that, other things being equal, the finer the cement the greater will its sand-carrying capacity be—that is, it will show much greater strength with the same charge of sand, or equal strength with a greater charge. There is no doubt but that the cementitious value of the material resides in the very fine part. Very few specifications state how much cement is to be operated on for this test, or how long the sieving process is to continue. Considerable difficulty is usually experienced in preventing the meshes of the sieve from clogging up. The author insists on the screens of all sieves being examined with a magnifying glass once a week to see that there are no apertures larger than the normal ones. The specification for the works of the Forth Bridge required that the cement should pass a sieve containing 2,500 meshes to the square inch, leaving a residue of not more than 5 per cent. by weight. The test of rubbing cement between the fingers is a practice to be condemned. The gauge of the wire of the sieves should be clearly stated in ordering. For a sieve of 2,500 meshes the gauge should be No. 39 S.W.G.

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