with a destructor plant in conjunction with an electric light plant was that the material was delivered practically steadily all day, whereas in the ordinary electric light station, the peak came on at the beginning of the dusk and went off very quickly from 6 to 7 o'clock. The type adopted at Shoreditch is, two furnaces are placed one on either side of a water tube boiler and the gases from the destructor pass sideways into the boiler furnace and thence between the tubes to the flues."

It has been found that there is often considerable difference between the value of the winter and summer refuse, the winter refuse generally being of higher value. To satisfactorily operate high temperature destructors, it is necessary to have forced draft, preferably heated, appliances for drying the refuse before putting it on the grates, and a combustion chamber in which all gases are mixed and brought to a high state of incandescence and their temperature equalized as far as possible.

NOTES ON CONCRETE.*

Cement.

This paper will consider concrete made from hydraulic cement only, as we now have on the market such a number of brands of this cement (both native and imported), of such excellent quality and such reasonable price, that in very rare cases will it be advisable to use lime in important engineering structures, requiring strength or durability when exposed to the action of water.

Such hydraulic or "Portland" cements are generally manufactured by the grinding together and fusing and subsequent grinding of clay and limestone in proper proportion. The clay may be in the form of shale, and the limestone in the form of marl, and we, therefore, have "rock cements" made from shale and limestone or from argillaceous limestones or "marl cements" made from marl and clay.

Cement made from blast furnace slag is made extensively in Europe, and appears to be highly esteemed.

By careful attention to the chemical constituents and fine grinding, the tensile strength and uniformity of behavior of these artificial cements have been very greatly improved of recent years, and in these and all other good qualities, I am glad to be in a position to state that several of our Canadian cements are excelled by none in the market.

"Standard Specifications for Portland Cement," prepared by a committee of the C. Soc. C.E., January, 1903, requires that:

"A maximum residue of 10 per cent. shall be retained on a sieve of 10,000 meshes per square inch, and the whole of the cement shall pass through a sieve of 2,500 meshes to the square inch.

"The specific gravity shall be between 3.09 and 3.25 for cement not over two months old."

Tensile strengths in pounds per square inch are required as follows:

	Tensile Strengths.			Compressive. Strengths.
	3 Days.	7 Days.	28 Days.	28 Days.
Neat	250	400	500	....
3 standard sand to 1 cement.		125	200	2,000 lbs.

The above specification is lenient, and it is common to specify a fineness such that at least 95 per cent. shall pass through a 100 mesh sieve, and that neat cement shall bear a tensile strain per square inch at 3 days of 300 lbs.; 7 days, 450 lbs.; 28 days, 600 lbs.

The writer has been offered Canadian cement at market price guaranteed 95 per cent. to pass through a 100 mesh sieve, and about 80 per cent. to pass through a 200 mesh sieve, to test neat, in 2 days, 250 lbs.; 7 days, 800 lbs.; 28 days, 900 lbs.; and 3 to 1:—7 days, 250 lbs.; 28 days, 350 lbs.; 3 months, 400 lbs.

The time of setting generally desirable is for initial set from one to two hours, final set about 5 to 8 hours.

Perhaps the most important quality of cement (that of "soundness"), is best tested by making neat cement mortar pats about 3 inches diameter and ¼-inch thick in centre with thin edges on clean pieces of glass. These pats are allowed to set under a damp cloth and are then exposed to warm vapor—about 130 degrees F—in a covered vessel for several hours, and afterwards boiled in water for several hours longer. These pats on removal from the water should not be curled up nor distorted nor show cracks on the surface. When separated from the glass the pats should, when broken, break with a sharp, crisp ring and show a good measure of strength.

The above boiling test for soundness is generally considered severe, and probably some good cements will not stand successfully the boiling test, which is not definitely specified by the committee of the C. Soc. C.E. At the same time most manufacturers in Canada sell their cement subject to this test, and it is believed that an unsound cement will fail under this test.

The test for soundness is given more in detail than some of the other tests because, for small or not very important works, it is not practicable to start a complete laboratory for testing, and in such cases, the engineer is perfectly safe if his cement stands the test for soundness, feels fine like flour when rubbed between the fingers, and sets in a reasonable time. For all extensive or important works a testing laboratory is necessary, and should be established under charge of a competent engineer to test all concrete materials, to determine not only the quality of the cement but the amount of clay in the sand, gravel and broken stone, and the most economical proportions of these materials to use in the different portions of the works.

Before leaving the subject of cement, it may be noted that though we know so much about the chemistry of cement, there are many problems yet unsolved, and among them is the effect of varying proportions of magnesia which is not yet satisfactorily determined, though generally we specify that cement shall not contain over 3 per cent. of magnesia.

Sand.

Sand to be used with cement is generally specified to be sharp, clean and coarse. Standard sand used for testing purposes is quartz crushed to pass through a 20-mesh screen and be retained on a 30-mesh screen. Experiments made by E. C. Clarke, of the Boston Drainage Works, show that the finer the sand the less the strength. Experiments made by O. B. Suhr, resident engineer of the Niagara Construction Co., of Niagara Falls, Ont., indicate that the best results were obtained with a sand containing all sizes of particles in proportions to make a dense mixture, and, therefore, pit sand briquettes gave higher tensile tests than crushed granite sand, and crushed limestone—to pass through a ⅛-inch mesh—used as sand, gave about the same tensile strengths as pit sand.

The results of experiments carried out by the writer during the past season are in accord with these results.

Tests for abrasive strengths carried out by Mr. Suhr, show that cubes of neat cement, crushed granite sand and cement 3 to 1, pit sand and cement 3 to 1, and crushed limestone and cement 3 to 1, showed results advancing in strength in the order named, probably on account of the limestone and cement being of comparatively equal hardness, while the quartz particles in the granite sand broke out leaving the softer cement exposed to the wear.

Captain H. Taylor made experiments with standard sand, beach sand from mouth of Merrimac river and crusher dust with cement 3 to 1, 4 to 1, and 5 to 1. He found the tensile strength of the dust mortar to be about double that of mortar made from standard sand and about 2½ times that from beach sand. In accordance with these results, it was determined to construct the Boston Harbor Works on concrete, using crusher dust for sand.

Clarke found that adding clay gives a much more dense, plastic, water-tight paste. Half a part of clay did not seem to weaken mortar materially except in the case of sample blocks exposed to the weather for 2½ years after a week's hardening in water.

Some experiments noted in the Engineering News during the past year indicate that a small proportion of clay added to the mortar gives it an increased tensile strength.

(To be continued.)

*Abstract of a paper read by R. W. Leonard, C.E., St. Catharines, Ont., before the Canadian Mining Institute, Montreal meeting, March, 1905.