PORTLAND CEMENT TESTS.

At the meeting of the International Association for Testing Materials, the question of accelerated tests for constancy of volume in Portland cement, was under considerable discussion. In last week's issue of *The Canadian Engineer* we published a portion of a paper by Professor Max Gary as resards tests of this description in Germany. That portion of Professor Gary's paper which deals with accelerated tests in France is now given.

Accelerated Tests in France.—According to the paper by Mr. J. Bied during the last 20 years or so, hot water tests have been currently applied to hydraulic binding media in France, and the employment of the Le Chatelier needle cylinder apparatus for this purpose has been absolutely general and free from any objection. It is therefore perfectly natural that a French industrial laboratory should have taken up the matter of investigating the value of the objections raised against the method by the committee on the time of setting and by Messrs. Strebel in Germany and Butler in England.

Having read with a fair amount of attention the publications on this subject, I think that, leaving out of consideration the question of knowing whether or not the expansion in cold water previous to immersion in hot water should be disregarded—which point is quite independent of the test itself—the objections urged against the Le Chatelier hot test can be reduced to three:—

(a) The test would lead to the rejection of cements which would have behaved well in cold water.

(b) If the test be applied immediately after grinding, it will lead to the passing of cements which would, on the contrary, be rejected if the test were not applied until after aeration for a fortnight or a month.

(c) Finally, the test lacks precision, and furnishes results deficient in concordance, when employed in the same or in different laboratories.

These three objections will now be examined in turn.

The Le Chatelier test is likely to cause the rejection of good cements.

Here it is at once necessary to state the case properly, which does not seem to have been done. From a general point of view, the reproach is perhaps well founded, for I have kept in my laboratory for several months specimens of cements which gave an expansion of 50 mm. under the Le Chatelier test without exhibiting any trace of expansion in cold water. If, however, one takes up the point of view of the consumer, the reproach is unfounded, for the two following reasons:—

(a) The Le Chatelier test seems to eliminate all bad cements; and this is the main thing.

(b) Any manufacturer who knows his business can, without any sensible addition to the cost of production, make cements that will pass the Le Chatelier test.

Though it is not my place to point out what means should be adopted to attain this result, I am certain that many manufacturers, and those not the least important, will be entirely of my opinion.

Under these conditions the question of knowing whether the Le Chatelier test eliminates certain good cements should not even be mentioned by cement makers. The consumers are the best judges of the guarantees with which they should surround themselves, whilst the only part the manufacturers should play is to advise consumers on the possibilities of manufacture.

In the present instance, however, it is possible, without increase of cost, to manufacture a cement which will satisfy the Le Chatelier tests; and it is for the consumers alone, and not the manufacturers—one would think—to take up the matter.

It would seem, a priori, that the fact that cements which, though non-expanding when freshly ground, expand after aeration is due to the action of the added calcium sulphate on the calcium aluminate present in the cements.

A long time ago Candlot showed that cements which are retarded by the addition of gypsum, resume their quickness of setting after being aerated. According to Camerman, this little recognized phenomenon is the real cause of numerous accidents.

The company with which I am connected only makes cements which are excessively siliceous and do not contain more than 2 or 3 per cent. of alumina, so that it might be expected that the tests essayed with these would be less decisive than in the case of normal Portland cements. Nevertheless, they were not sufficiently so to be worthy of consideration.

A check specimen of the siliceous cement was mixed with 1, 2, 3 and 5 per cent. of its own weight of gypsum. The Le Chatelier test was applied immediately after mixing, and also after storage for 15 days in the open air.

Eight cylindrical test pieces were prepared from each product, and all the moulds were new and from the same source. After being made, they were kept in water at 17 deg. C. for 24 hours, between two sheets of glass, and then immersed in cold water in a water bath, the temperature of which was raised to 95 deg. C. in half an hour, and maintained thereat for 4¹/₂ hours.

A summary of the results indicates that aeration lessens the expansion of the check specimen and of the cements containing 1 and 2 per cent. of added gypsum, but increases the expansion of the test pieces with 3 and 5 per cent. of gypsum. The increase, however, is too small for the experiments to be considered decisive, and they consequently need to be completed.

The third objection urged against the Le Chatelier test is lack of precision.

It would perhaps be interesting in the first place to define what is to be understood by precision. There is no doubt that the Le Chatelier test does not attain the precision sought and obtained by Regnault in his experiments; but that it is not at least quite as accurate, as the other customary tests applied to hydraulic binding media remains to be proved.

After a series of tests carried out with new moulds from the same source, we have investigated successively:---

(a) The influence of the width of the shoulders by which the needles are fixed on the test pieces;

(b) the influence of the age, or degree of wear, of the moulds;

(c) the influence of the method of storage;

(d) the influence of the time elapsing between the final setting of the cement and the immersion in hot water.

From this series of tests it may be concluded that the form of the needle shoulder, and the age of the moulds, or rather the extent to which they have been used, have an influence on the results obtained, while the mode of immersion has but little influence; and that, on the contrary the results are influenced considerably by the time elapsing between the definitely ascertained completion of setting and the immersion of the test pieces in hot water, at least in the case of products with slow initial setting.

It is, in fact, characteristic of the Le Chatelier test that it does not give the measure of the absolute expansion at a given moment, but rather the difference between the effort of expansion and the effort of resistance opposed to this expansion by the cement in consequence of its own previous hardening.