The final phase of the investigation will be a careful examination of the more remote portions of the watershed to ascertain whether natural run-off conditions will be materially influenced by the permanent retention of existing swamp area, and furthermore, if any benefit might be gained by allowing areas now drained and reclaimed to lapse into their natural state.

In view of the important interests involved, and the practical certainty of a continuous annual increase in the extent of flood damage in the Grand River Valley, there can be no question as to the necessity of an investigation to determine the means by which this abnormal condition can be remedied or ameliorated.

As the solution of this problem will depend primarily upon data collected in the field, and as the investigation so far made seems to indicate that appreciable benefit is to be derived from the works projected, it is recommended that surveys be carried out along the lines above described, and with the least possible delay.

In conclusion, it is important to note that any experience obtained, or evidence of benefit derived from the carrying out of a flood control scheme on the Grand River, could be advantageously applied to several other streams in the Southwestern peninsula which suffer from lack of natural control. Among the most important of these streams are Thames, the Maitland and the Saugeen.

A NEW SPECIFICATION FOR SULPHATE CONTENT IN PORTLAND CEMENT.

A proposed new standard specification for the allowable SO_3 content in Portland cement was recently presented to the International Association for Testing Materials by the German Portland Cement Manufacturers' Association. The substance of the suggestion was as follows:—

Sulphates are found to some extent in all Portland cement, their presence being due, in part, to the raw materials and the fuel used in the manufacture, and partly also to the admixture of crude gypsum (hydrated calcium sulphate) during the grinding process. In a formal analysis of a Portland cement, the quantity of sulphates present is always stated in terms of sulphur trioxide or anhydrous sulphuric acid (SO_3).

The small quantities of SO_3 occurring in normal Portland cement are quite uninjurious to its practical application; and it is only when the amount exceeds a certain limit that during storage under water, a supplementary expansion —which may sometimes be dangerous—occurs in the hardened cement, owing to the formation of calcium-aluminum sulphate.

The permissible amount of SO_3 in standard specifications varies from 3 per cent. to 1.2 per cent., depending upon use in fresh or salt water. After an extensive series of tests, a universal percentage of 2.5 per cent. was strongly recommended for all cases, in view of the fact that it has been shown that the presence of SO_3 is not a vital agent in the deterioration of concrete exposed to sea water, but that this deterioration is due to the penetration of the magnesium sulphate of the sea water into the porous cement mortar. Obviously the way to remedy this is to obtain as compact a mortar as possible in the construction.

An interesting series of comparative experiments has been started by the Royal Laboratory for Testing Materials, Gross-Lichterfelde, at the Island of Lylt in the North Sea. These tests are to continue over a period of ten years, and were started in 1907, the materials used being a Portland cement, S, containing 1.19 per cent. of SO_3, and a second Portland cement, B, with 0.57 per cent. Both cements were also tested with their SO_3 content raised to 2.5 per cent. by the addition of crude gypsum.

In considering the tensile values after hardening for one year, it appears that these values are lower throughout in sea water than in fresh water and the open air; and that, in spite of the low percentage of SO_3, cement B behaves less favorably than cement S in sea water. In both cases the raising of the SO_3 content to 2.5 per cent. by the addition of gypsum increased the tensile strength, both in fresh water and in sea water, with the exception of the mixture 1:4 of cement S. This mixture gave a slightly lower value in sea water; but the accuracy of this determination has yet to be confirmed at a later stage of hardening. The results of the tensile tests after one year's hardening show that the presence of even 2.5 per cent. of SO_3 in cement does not have any injurious influence during hardening in sea water.

The concrete blocks made from cement B showed at the end of 1½ years' hardening in sea water (autumn, 1909) such an amount of attrition that the fragments of granite were exposed. The blocks from the same cement with the SO_3 content increased to 2.5 per cent. behaved somewhat better. On the other hand, all the blocks made from cement S had remained in perfect condition. This observation was confirmed in general by the second inspection during the following year, which showed that the cement B, which was alleged to be particularly suitable for marine structures, turned out much worse than the cement S with the higher SO_3 content.

The same conclusion also resulted from the contemporaneous examinations of the plates set up in the mole at the harbor of Munkmarsch. The plates mixed in the proportions 1:2 and 1:4 of cement B exhibited concentric cracks, even at the first inspection, and many of them were burst across the middle; whereas the corresponding plates from cement S were perfect. It should also be noted that the plates made from cement B after raising its SO_3 content to 2.5 per cent. showed less extensive cracking than those made of the cement in its original conditions, i.e., with only 0.57 per cent. of SO_3.

After about three years' exposure of the plates to the influence of sea water, the chemical examination of the plates failed to reveal more than slight alterations due to sea water, in the case of the cement with the higher SO_3 content, whether in its original condition or after enrichment. The cement lower in SO_3 and used in its original condition, was found to have sustained extensive chemical changes under the action of sea water, though only to a smaller extent when enriched to 2.5 per cent. From these results it follows indubitably that the presence of up to 2.5 per cent. of SO_3 in Portland cement produces no injurious effects of any kind, whether in sea water or fresh water.

Moreover, the favorable experience that has everywhere been gained in marine construction works with sements of this kind, namely, containing a higher percentage of SO_3 than is prescribed in countries which issue special specifications for such works, demonstrates that the higher SO_3 content of the cements in question has not led to any injurious effects in practice, provided the cement has been properly used. It is therefore recommended that a uniform permissible maximum limit of SO_3—namely, 2.5 per cent.—be generally adopted in specifications for Portland cement, whatever may be the purpose for which the cement is intended to be used.