ures above.

Final control of waterproofing is obtained by filter wells installed below the watertight panel for measuring the total flow of residual losses passing through the panel.

When the work accepted the results were as follows:

- 99.5 % reduction of infiltration through the Dam.
- Total suppression of sand washaway.
- Suppression of fissures above the Dam.

These results were obtained by injecting:

1600 metric tons of cement.
650 " " " clay.
585 " " " fine sand.
416 " " " chemicals.

The work was carried out without stopping or hindering the work of the plant.

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CLAY-CEMENT MIXTURES IN SOIL INJECTION

SOCIÉTÉ DE SONDAGES, INJECTIONS, FORAGES

SUMMARY OF THE FRENCH REPORT

1. If increasing quantities of clay of suitable qualities are admixed to a given cement, it appears that the mechanical properties of the various samples at first deteriorate but slowly; it is only after an important proportion of clay has been reached (40% to 50% of the mixture, by weight) that these properties deteriorate rapidly.

The observed effects are caused at the same time by two phenomena: one physical, the other chemical. The results obtained are all the better as the clay is finer, and richer in alumina and silica. For example, in the case of clay of medium fineness containing 15% of alumina and 40% of silica, the strength is still about one half of that of pure cement when the proportion of clay reaches 45%, by weight, of the mixture. Beyond that proportion resistance decreases rapidly and shrinkage becomes too important.

The interest of clay-cement mixtures for soil improvement through injection appears clearly. As a matter of fact they generally utilize but a very small fraction of mechanical resistance of the binder. They rarely suffer the addition of inert materials of superior grade than that of the binder. In addition to the economy the following advantages have been established

-Curing time practically unchanged;
-Mixture of finer grade than that of pure cement;
-Greater resistance to corrosion;
-Improved imperviousness and resistance to physical action of water.

2. If a small proportion of clay with marked colloidal properties (for instance bentonite) is added to a mortar or a pure cement paste, and if these newly prepared mixtures are exposed to the action of running water, an important decrease of the usual washaway becomes apparent.

It should be noted that a good fine clay can also be used, provided it is treated specially, with a view to developing its thixotropical properties.

This procedure is very useful, if injections of cement or mortar are to be made in a moving acquiferous medium, liable to washing away the injected materials.

Conclusion. The importance which the admixture of clay to cement presents in many cases can be realized (through the application of either of the two phenomena described above or even of both combined) at a time when extensive works of reconstruction are to be carried out in the best possible economic conditions and particularly in reducing to the greatest possible extent the consumption of scarce and expensive products.

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