ALKALI-RESISTING CONCRETE.

Tests which have been carried on by the engineers of the United States Reclamation Service to develop a modified cement that would resist the action of alkalis and be cheaper than the commercial Portland cement is in the west were recently embodied in a paper read before the International Association for Testing Materials, and reads as follows:—

Sand Cement.—A good cement, comparing favorably in strength with the Portland cement used in its manufacture, can be made by regrinding Portland cement with certain proportions of inert materials (such as rock or sand, granite, basalt, sandstone, and tufa), the mixture being ground to a greater fineness than that of the original cement. The amount of diluting material may range from 30 to 50 per cent., depending on the fineness of grinding practiced.

In connection with the materials used in these tests, special interest has of late attached to the use of puzzolanic materials such as tufas, in which a portion of the silica is considered to be in "soluble" form such that it will enter into chemical combination with the uncombined lime in the Portland cement with which it is ground. That such materials can be used to good advantage in making a cement of this class has been proved by their successful use for this purpose in the construction of the new waterworks system for the city of Los Angeles in California. They are also of interest as being of possible assistance in the solution of the alkali problem. They are, however, of a lower specific gravity than most of the other materials (such as quartz sands, granites, etc.) which are generally available for making a cement of this class; and in the writer's opinion it has not yet been proved that they should be chosen in preference to these latter materials when both are available, as, on account of their lighter weight, they would tend to produce a cement of a lower strength than these heavier and harder materials.

As a result of the above investigations the use of cements of this general class has been adopted for two large masonry dams, and for the auxiliary works in connection with a large earthen dam whose construction work is about to be commenced by the Service. Grinding mills will be erected and the sand-cement manufactured at the sites of these structures, using Portland cement purchased in the usual manner, and the field materials available at these points.

With regard to the general use of cements of this class, it is evident that they are not applicable for use on small structures in scattered locations, on account of the cost of erection and operation of the grinding plant required. In the case, however, of a single structure requiring a large amount of cement, and located at a point where the cost of Portland cement is high, it would appear that they can be safely used, provided proper care is exercised in the selection of materials and in the process of manufacture, with a considerable saving in the cost of the structure as a result.

Disintegration of Concrete by Alkali Action.—Among the problems met by the engineers of the Reclamation Service, as well as by other engineers in the arid regions of the Western States, is that of the destruction of concrete by alkali action under certain conditions and in certain localities.

These arid regions contain numerous deposits of so-called "alkali," and in many places the ground waters are strongly impregnated with these salts in solution. This general term "alkali" is used to include a variety of substances, of which the salts of sodium and potassium are among the most common, although salts of calcium and magnesium are also included in the general term. As the use of cement and concrete in these regions is a comparatively recent matter, any effect that this alkaline water might have on concrete structures with which it comes into contact has until recently been a matter of conjecture if it has been considered at all.

Investigation of the subject, in the form of analysis of samples representing the alkali deposits and the ground waters where disintegration has occurred, shows that the sulphates, and especially sodium and magnesium sulphates, either singly or together, are the principal salts acting to cause this disintegration. The chemical action involved seems to be analogous to a considerable extent to the destructive action of sea water on concrete, in which magnesium sulphate is considered to be the principal salt acting to cause disintegration.

The conditions most favorable to attack appear to be where the concrete in small structures, such as culverts, etc., is subject to the action of seepage water coming through from the soil at the back, or of water which has become highly saturated and concentrated owing to light and sluggish flow in the water-courses in which the structures stand. Conditions of alternate exposure to water and air as produced by a varying flow in these water-courses are also especially favorable to the development of this action. It is hardly necessary to add that the character of the concrete also has a marked effect on the extent to which the destructive action will take place, a dense, well-made grade of concrete being, of course, more impervious and less readily attacked than concrete of a less dense, porous nature.

On a recent visit by the writer to one of the projects of the Service, where alkali conditions are prevalent, a marked contrast was noted between a tunnel lining on this project, which was in excellent condition, and another on private work in the same vicinity, which had been badly attacked by alkali action, and where the concrete work was evidently of an inferior quality. It is also probable that the character of the materials used for concrete aggregates, as well as the workmanship, may have some influence in the matter.

To refer briefly to the best method of remedying the difficulty, the main point is the production of a dense and impervious concrete, such that seepage of the alkaline waters through the concrete will be prevented. As to whether this can be best brought about by the use of a specially prepared rich and dense mixture without any other form of treatment, or whether some form of waterproofing treatment will be the best solution, is a question now under investigation.

TELEPHONES FOR FIRE PROTECTION.

According to the British Columbia report of the provincial forest branch it is their intention to construct telephone lines and pack trails where they are most needed throughout the province as a protecion from forest fires. Over the greater part of British Columbia neither of these essentials is at hand. As a means of rapid communication, the telephone is obviously the most desirable, considered from the standpoint of usefulness and cost of construction and maintenance. For woods work, a single wire (ground circuit) strung on trees has proven very satisfactory, and may be constructed at a remarkably low figure considering the protection afforded. In the national forests of the Western States such lines have been built at a cost per mile varying from $30 to $80, depending on the accessibility of the country through which they run. Branching from trunk lines as mentioned above, there may be built cheap, temporary lines to "lookout points." A system of telephone lines is a tremendous aid in the prevention of forest fires, but should be accompanied by a system of good roads.