

Engineering Department

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Cementing or Binding Power.

Binding power is the property possessed by rock dust to act as a cement on the coarser fragments composing crushed stone and gravel roads. It is possessed in a very much higher degree by some varieties of rocks than by others, and it may be said to depend to a very great extent on compression and the presence of water for its full development. The absence of this property is so pronounced with some varieties of rock that they cannot be made to compact under the roller or traffic without the addition of some cementing agent.

The resistance which the "binding surface" of a road offers to the action of wind and rain, as well as to the wear and tear of traffic, makes this property of the highest value. Further than this, the hardness and toughness of the cemented surface more than of the rock itself represents the hardness and toughness of the road; for, if a road is sufficient to destroy the bond of cementation of the upper surface, the stones below are soon loosened and forced out of place. The protection from water given to the foundation by some varieties of rock is practically impervious except when water accumulates in depressions of the surface. The writer has examined the foundation of a road built of such a rock after a day and a half of rain, and found it perfectly dry. There are other varieties of rock, however, of which quartzite is a good example, which have no power to resist the percolation of water. This property has been studied but little, but it is probably due in a large measure to the resistance offered by the walls of the fine particles, combined with capillary attraction. It seems to accompany cementing value to a great extent.

It is difficult to say what brings about this cementation or binding of rock dust, for the subject has received but little investigation. It is clear, however, that with many varieties of rock it is due to several causes. Experiments made on a number of different kinds of rock dust showed that the more finely they were pulverized the higher would be the cementing value when subjected to pressure, both with and without water; and an increase in pressure seems to produce a corresponding increase in cementation. Further than this, in a number of cases similarly made briquettes of the same rock dust gave distinct indication that destruction to the bond of cementation by impact bore a definite relation to the amount of energy expended; i. e., about the same amount of energy was required to destroy the bond in each briquette, even when applied in different loads. The inference drawn from such results would be that cementation in such materials is to a con-

siderable extent mechanical, that is, the interlocking of the fine particles of dust caused by pressure.

Another important fact brought out was, that every variety of rock experimented on gave higher cementing results when compressed while wet, which is analogous to the results obtained by road builders, who almost invariably find that the binder of screenings compacts better when watered before rolling. This at first led to the belief that this result was entirely due to a chemical change affected by the water; but briquettes made of pulverized glass, mixed with pure alcohol instead of water, gave practically the same results, although the very slight cementing powers of the glass rendered it almost impossible to obtain numerical results. The only explanation of this fact which at present suggests itself, is that any mobile liquid which will wet the fine particles of dust acts as a lubricant, allowing them to come in close contact when under pressure. By a process, little understood, water has the power of attracting the fine particles of rock dust and cementing them together. This is well illustrated when a drop of water falls on a dry road surface by the dust immediately buckling into an irregular shape, which is retained until destroyed by some force. On examining one of these little clods after drying it will be seen that it sensibly coheres. The solidifying of mud by the drying up of puddles of water on clayey soil is another example, and so this same process can be traced even to the clay concretions. These phenomena may be due to totally different causes; nevertheless, it is the cementation of rock dust, brought about by the presence of water, and in each case the finer the dust the more perfect this action. It may be due to chemical action, to physical rearrangement of the particles, or more likely to a combination of such causes. There also seems to be a tendency for very fine rock dust to assume a gelatinous plastic state.

This cohesion of the dust particles when wet, probably has as much to do with the preservation of roads as any other factor; for when wet the dust better resists the action of wind and rain, and, as already pointed out, it compacts and binds together in this state. This is well illustrated by the necessity of watering roads in dry weather, which in giving protection from dust, prevents an enormous loss of material from the road.

Municipal Improvement Statistics.

The publication of information as to the cost of installation and operation of municipal public works and services, is a matter which is at present receiving the

attention of various societies in the United States, among these being the American Society of Civil Engineers, the American Municipal Improvements Association and the New England Waterworks Association. The latest phase of the movement is the proposed co-operation throughout the United States of all Municipal Societies, representatives from each to meet in conference at an early date, and arrange for united action in urging upon the different state governments, the growing importance of information relating to the cost and improved methods of public water-supply, sewerage systems, street lighting, park improvement, fire protection, street improvements and the very numerous other functions which pertain to the engineering side of good local government.

Municipal ownership of waterworks plants, electric lighting and power plants, has of recent years been commonly added to the more ordinary services, such as sewerage, streets and parks. Many other matters, of which are telephones, public baths, abattoirs and street railways, are slowly but surely making a place for themselves upon the debated ground of municipal ownership. The strongest argument in opposition to the operation of these as a part of the municipal socialism, is the likelihood of improper management, a possibility very much lessened by publicity, such as the proposed comparative statistics will afford. Added to this is the convenience which such information would be to all municipal councillors and officials, who now find it very difficult to procure a knowledge of the construction and operation of these works, such as will enable them, either expeditiously or satisfactorily, to deal with the various problems as they present themselves.

Much valuable time is wasted by councillors, much useless discussion takes place at regular and special sessions of the council, much money is thrown away on poorly devised work, merely because of the difficulty of obtaining the true results of experience of other and perhaps neighboring towns.

Whether as an aid to municipalities undertaking first construction, or to municipalities endeavoring to operate and maintain these works economically and efficiently, the data which the American Engineering and Municipal Societies seek to have published, will be of very great value. In Massachusetts where a sewerage commission, a waterworks commission, a gas and electric light commission and a highway commission are all working separately, we find the most complete information available; and while so elaborate a collection of commissioners appears neither advisable nor desirable, there is certainly a vast amount of experience now being wasted which would be of incalculable benefit to municipal government, if properly collected, and made available for general use.