3) Davis, R.E., Kelly, J.W., Troxell, G.E., and Davis H.E. "Properties of Mortars and Concretes Containing Portland-Puzzolan Cements", Proc. Am. Conc. Inst., Vol. XXXII, 1936.
4) Palmieri, M. "What Is Pozzolana?" Concrete CMS 43(5), 1935.
5) Bowles, Oliver. Mineral Trade Notes - U.S. Bureau of Mines, Aug. 20, 1938.
6) Yung, V.N. "Theory of Hardening of Lime-Pozzuolana Cements", Leningrad, 1936.
7) Steopoe, A. Tonind. Ztg., 58, 59, 60 (1934-5-6) Zement, 24, 26 (1935-7)
8) McDowell, Chester. "Progress Report on Development and Use of Strength Tests for Subgrade Soils and Flexible Base Materials", Proc.Hwy. Research Board, 1946.
9) Rondelet, J. "L'Art de Batir", Paris, 1805.
10) Dockery, W.D. and Manigault, D.E.H., "Lime Stabilization and Low Cost Road Construction", Roads and Streets, August, 1947.

-o-o-o-o-o-o-o-

IX c 11

THE CONTROL OF CEMENT INJECTIONS BY MEANS OF BORE CORES

WALTER BERNATZIK

Innsbruck, Austria

When injecting cement, it frequently occurs that the borehole is newly bored out after injection is completed. If injecting is carried out with the help of pumps, in which case the movement of the piston causes oscillations of pressure, the cement, after having been subjected to a renewed process of boring shows in cross section a system of lines which is very instructive as a means of watching the success of the injecting process, and must therefore be considered a very valuable help for judging the results obtained by the work carried out.
During the process of injecting part of the water contained in the cement suspension escapes to the bottom through the walls of the bore hole, which are invariably more or less permeable to water. The cement grains follow a streamline course, and are projected against the wall of the borehole under an angle the elevation of which depends on the pressure exercised. Grains having a diameter below a certain figure which depends on the above mentioned angle, stick to the walls, whilst grains with a larger diameter are reflected. As, however, smaller grains are of lighter colour than larger ones, each movement of the piston leaves a mark similar to an "annual ring" within the borehole which becomes visible in the break-surface of the bore core.
Thus, ill. 1 shows the core of a borehole which has been slowly and evenly closed.
Ill. 2 shows the system of lines of a core artificially produced in the laboratory. Ill. 2a shows conditions in the case of two permeable windows arranged opposite to each other in the wall of the borehole, which otherwise is impermeable. In ill. 2 c conditions are similar, there is, however, only one window, whilst ill. 2b is a longitudinal section showing the transition from one zone to the other.

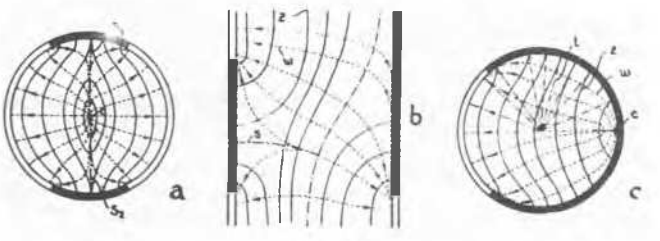

FIG. 2

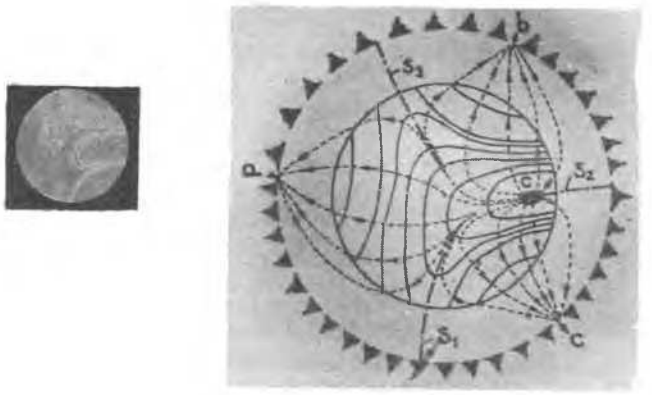

FIG. 3

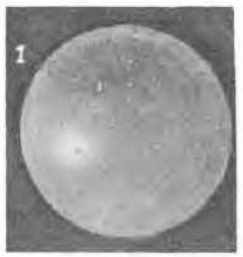

FIG. 1

Ill. 3a shows the course taken by the lines of one core from the borehole with three separate outflows as per ill. 3b.
Ill. 4 shows a vertical joint which was formed in the bottom as the result of pressure.
Ill. 5 is a bore core, in which the still fresh cement was split in the longitudinal direction by a vertical joint of the adjoining hole. The dark cement vein at b was filled up from the neighbouring hole, a result desirable when carrying out the work of caulking.
Ill. 6 is a longitudinal section through a bore core which was torn off through the formation

FIG. 4

FIG. 5

FIG. 6

of a horizontal joint in the adjoining hole, a result not desired when carrying out the work of caulking.
The study of the formation of the afore mentioned lines in the bore cores is an essential addition to other methods on control and study carried out during the work of injecting, and is in frequent cases the only means of adapting the working process quickly and correctly to existing local conditions.

REFERENCE

1) Bernatzik: Die Zementeinpressung und ihre Überprüfung durch Zementbohrkerne. Bautechnik 1942 H 13/14 u. 15

-o-o-o-o-o-o-

IX c 12

RULES GOVERNING THE USE OF SOIL - CONCRETE

M. SINDZINGRE
Ingenieur des Ponts et Chaussées

SUMMARY OF THE FRENCH REPORT

American engineers have first defined a certain number of rules necessary to obtain satisfactory soil-concretes. These rules have been completed by engineers of the Direction des Travaux Publics de Tunisie and adapted to clays generally used in Europe and the French Union.

This rather special technique has made considerable headway. The rules which govern it at present are not only necessary but very often quite sufficient.

They concern the plasticity of the clays which make up the concrete, the liquid limit of the mortar, its absorption limits, its plasticity index, degree of compaction etc.

There are marked differences in soil-concretes according as to whether the material is smooth or crushed. In one or the other case even a very thorough compaction, has not quite the same effect. Crushed materials are wedged and as it were bound by rolling. Voids between them present only a small surface to the penetration of rainwater. Things are quite different if the aggregate is smooth. Technical precautions are indispensible in such a case in order to mobilize capillary tensions of evaporation, and to prevent the detrimental effect of rainwater.

In that case two characteristic coefficients of clay-mortar become of special importance; they are its liquid limit and permeability. They are not absolutely independent of each other.

Soil-concretes are non-saturated mediae. As such they can behave like elastic solids even if the aggregate is made up of smooth material, provided the loads are consistent with the depth. It is therefore preferable to adopt test methods similar to those used for elastic non-saturated mediae (permeability, Young's modulus, Poisson's coefficient, modulus of reaction) instead of persisting in plasticity tests (C.B.R.) appropriated for saturated mediae. Thus it is possible to attack the problems connected with heavy-duty runways from a more scientific angle.

From that standpoint, soil-concrete is a material with which it is possible to obtain economically elastic slabs for pressure distribution upon the subgrade. This latter is not necessarily flexible, as tradition would have it.

Moreover detailed studies on soil-concretes lead to consider certain questions of highway construction in a new light. The binder of crushed-stone base-courses is a real clay-mortar. It should be impregnated with binders rich in polar molecules. Base-courses of crushed stone of smaller grade coated with clay mortar can be obtained mechanically by in-place mixing and compacting and also by using by products.

The above are some of the aspects suggested by present-day knowledge of the question.

-o-o-o-o-o-o-