REINFORCEMENT OF FOUNDATIONS AS PART OF RECONSTRUCTION OF THE STEBNIKOV POTASH PLANT

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The effectiveness of using drilled injection piles to reinforce foundations while reconstructing an operating plant without shutting it down was shown.

The site of the Stebnikov plant is located on the Carpathian highland and is composed of Quaternary alluvial and slopewash loams and clays with occasional lenses of gravel and pebble deposits and peat, underlaid by Tertiary clays (Fig. 1 and Table 1). The surface of the clays is uneven, generally sloping to the east, as does the whole area.

The main structure of the enrichment plant is a full-frame, eight-span building 138 × 108 m in size, 39 m high (see Fig. 1), assembled from metalwork. The foundations under the structure's columns are made of drilled and cast-in-place piles 0.5 m in diameter and 5.8 m long from the bottom of the foundation mat, with camouflet enlargements resting on Neogene clays. Drilling and concreting of the holes were done with the help of casings. According to results of uncovering of a pile in 1966, the diameter of the enlargement was 1.6 m.

In the process of reconstruction of the potash plant, which produces "Kalimag-40" fertilizer, changes in the construction and loads on the structure's foundations were suggested: dismantling of the roof on span A-B, and an increase in technological loads on the columns by 15-40% in comparison with existing loads in spans D-I. During operation of the structure, fluid had fallen on the floor since 1965, consisting mainly of anions of hydrochloric and sulfuric acids, which were found in the ground down to a depth of 2-3 m when test holes were drilled.

Acid anions affected physico-mechanical properties of soils at the base of foundation mats, and also the concrete body of the mat and its junction with the piles. When soil properties were compared according to data from 1965 and 1988 (see Table 1), a significant improvement in them was discovered: specific cohesion rose during this period by 38-56%; the angle of internal friction, by 10-50%; and the modulus of deformation, by 8-72%. Such changes are hardly possible just as a consequence of the chemical action of technological fluids.

Some improvement of soil properties under the foot of the foundation mat occurred as a result of the structure's operation (see Table 1). Thus, the modulus of deformation of soils according to results of surveys in 1965 was 15-20% lower than what was determined in 1988 from soil specimens taken from under foundation mats G-6, F-13, and E-17; the density of soils directly under foundation mats was 15-17% higher than that of undisturbed surrounding soils.

Inspection of above-ground parts of the structure and analysis of data from levelling of crane girders performed in 1968-1986 in spans G-H, H-I, and F-G showed that uneven settling did not occur during the structure's operation.

The main task of inspection of the structure's bases and foundations was to determine:
1) the condition of foundation mats and junctions of piles with them under the action of fluids aggressive in relation to concrete;
2) the actual resistance of piles under the foundation mat, by means of static loading of them.

Although such works on static loading under a foundation mat are very complicated and laborious, they were justified in connection with the absence of any data from static tests of drilled and cast-in-place with camouflet enlargements in the given area. Moreover, in the process of operation, changes had occurred in the density of soils under the foundation mats and the piles' resistance.

Inspection of foundations of the plant's main structure included the following works (Fig. 2a): uncovering of foundations E-17, F-6, E-8, D-10, and G-14; separation of foundation mats from the ground and of piles to be tested from the foundation mats; and static loading of piles with the jack braced on the top of the pile and the bottom of the foundation...
Fig. 1. Diagram of main structure of the Stebnikov potash plant's enrichment facility that was inspected, with indication of loads (M, N, Q) on the edge of the foundation. 1-3) engineering-geological elements (see Table 1, IGÉ-3-IGÉ-5, respectively).

Fig. 2. Diagram of inspection (a) and movements of foundations (b) with interpretation of results (c) according to a graph of static testing of a pile. I) mat of inspected foundation; II) pit around uncovered foundation; III) attachment for measuring emergence of separated pile from the soil; IV) pile separated from the foundation mat; V) jack; 0-1) emergence of foundation from the ground when the load is removed; 1-2) settlement of foundation when the foundation mat is separated from the soil; 2-3) settlement of the foundation when one of the piles is separated from the foundation mat; 0-4) graph of static loading of the pile.