and gas chemical stabilization, and to dispense with the use of impact machinery; this improves the working conditions for personnel.

The results of the field tests enable us to recommend the above-indicated method for broad application in the chemical stabilization of loess soils prone to slump-type settlement.

LITERATURE CITED

IMPROVING THE STRUCTURAL PROPERTIES OF HYDRAULIC SANDS

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At the present time, a method of site preparation for construction using the hydraulic locking of soil is widely used in Western Siberia. Fine and silty sands, which possess a low permeability and which cannot be used as the bearing layers of a foundation bed without preliminary improvement of their structural properties, are usually hydraulicked in this case.

Deep vibratory compaction, which can be carried out by vibratory equipment designed by the All-Union Scientific-Research Institute of Hydraulic and Sanitary Engineering is one of the rational methods of improving the properties of hydraulic soils [1]. Instructions [2] recommend this method, however, only for the compaction of silty sands.

For further development of the method of vibratory compaction and expansion of its range of application, we performed a series of laboratory and field investigations and developed an improved UGV-1 vibratory apparatus, which makes it possible not only to compact sands, but also to strengthen them with injections of cement grout, as well as to eliminate vertical sand drains in hydraulic beds underlain by weak saturated soils [3].

The UGV-1 apparatus (Fig. 1) consists of type V-401A vibratory embedment unit 1, compactor 2, which is assembled on self-propelled crane 3, and a set of equipment for fabricating and delivering water or strengthening grouts into the soil; this equipment includes grout pump 4, grout mixer 5, and water pump 6.

Technical characteristics of the UGV-1 are presented below.

V-401A vibratory embedment unit
- engine output, kw................................. 58
- current consumed, A................................ 100
- compactor diameter, mm.......................... 800-1200
- compactor height, mm............................ 6000
- compactor weight, kg............................ 500
- vibration amplitude, mm.......................... 5-6

SB-97 grout mixer
- tank capacity, liters.................................. 850

SO-50 grout pump
- grout delivery, liters/min.......................... 100
- delivery pressure, MPa.............................. 1.5
- calculated injection time, min........................ to 7
- Diameter of temporary grout conductor (conditional), mm.................. 32
- Lift capacity of servicing mechanisms, tons.......................... 6
- Thickness of compacted sand layer, mm................. to 4000

The compactor, which is built in two versions, consists of tubular rod 1 168 x 8 mm in diameter with combined cantilevers 2 315 and 515 mm long welded to it in a crosswise manner (Fig. 2). Each group of cantilevers, which are located in the same plane, are turned 45° with respect to the neighboring group. Their ends hold transverse plates 3 formed from band steel to increase the vibrating surface in the peripheral zone. On lower cantilevers 4, they are replaced by concentric rings to break up compacted interlayers of the hydraulic soil. The lower cantilevers are made of perforated pipes, which are connected by a pipeline located inside the bearing pipe to the grout mixer via a temporary grout-delivery conduit. Detachable drain formers covered by special conical caps were used to fabricate the drains.

The continuous-action SB-97 grout mixer, whose tank capacity is increased to 850 liters, is used to prepare the strengthening grouts. Water or grout is delivered by an SO-50 grout pump through a temporary pipeline 32 mm in diameter. This ensures a grout flow rate significantly higher than those rates for which cement particles precipitate out in sediments and the sediment returns to suspension.

In the first stage, we performed laboratory investigations of the possibility of the deep vibratory compaction of local soils. For this purpose, we used fine and silty quartz–feldspar sands taken from various sites. Experiments on vibratory compaction under laboratory conditions were performed in cylindrical troughs with a capacity of 0.07-0.1 m³, where a vibration-absorbing material was placed between the bottom and walls and the hydraulic soils being compacted. A model of the compactor had a length of 800 mm, while the sweep of the cantilevers that had been secured to the central rod in a crosswise pattern amounted to 50 and 100 mm. A 0.4-kW vibrator, which was hinge-suspended from a special frame, was used as a vibration exciter. The relative accelerations of the forced vibrations of the apparatus amounted to 4 g (where g is the acceleration of free fall).

The deep compaction of silty and fine sands with a fineness modulus $M_{cr}$ equal to 1.61 and 2.11, respectively, indicated that it is possible to compact them by the vibration method to a medium ($\varepsilon = 0.60$) and dense ($\varepsilon = 0.56$) structure, respectively, irrespective of the character of the compactor's motion in the sand mass. This made it possible to reject the complex stepwise regime for compactor movement, which is recommended in [2].