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STUDY OF THE REGULARITIES OF THE PROCESS OF MOISTENING LOESS SUBSIDENCE FOUNDATIONS OF HYDRAULIC STRUCTURES

Rustam Xujakulov
Doctor of Technical Sciences, Professor

Elyor Nabiev
Senior Lecturer, (Karshi Engineering and Economic Institute)

Abstract: The article present the study result patterns of the process of moistening of subsided loess soils which are widespread in the Kashkadarya region.

Key words: subsidence, loess soils, die tests, wet zone, water infiltration, pressure on the soil.

Introduction

The specificity of the work of hydraulic structures (GTS) is that in the overwhelming majority of cases, their soil bases are moistened to the level of maximum water saturation. However, in the first time after the commissioning of the GTS, the soil mass is moistened unevenly, which affects the nature of the interaction between the foundation and the structure.

Hydraulic structures and their subsidence foundations accept various loads and influences that differ in origin, duration, recurrence, etc.

- Hydrostatic and hydrodynamic pressure on structural elements of the base soil particle;
- Soil pressure pa elements of the structure;
- Pressure of the structure on the base during static work;
- The impact of changes in the own mass of the soil during its moistening on the stress state of the massif;
- The effect of the own weight of the structure elements on the stress-strain state of the structure;
- Transformation of stresses in a structure, caused by a change in the properties of the soil that serves as the base of the structure, due to its moistening by filtration and transported water;
- Dynamic loads caused by the passage through the construction of equipment, due to the seismicity of the area, etc.

Literature review

As noted earlier [1,2,3,4,5,6], used in the study of soil properties, stamp tests are very laborious and require a significant investment of time. A special device developed by the authors [7, 8] has significantly simplified the process, reduces labor costs, and also gives more information and the ability to visually observe the processes occurring in the bases of the dies, and continuously make the necessary measurements.

Materials and metods

This device was used to study the process of moistening loess subsidence soils in various regions of the Karshi steppe. Below are the results obtained in the study of soils in the areas of distribution canals 4-X and 2-X, massifs "Turkmenistan" and named after "Abdulla Qadiri", as well as in the area of distribution canal of the massif "Surkhan". The tests made it possible to visually note the following basic regularities of moistening and deformation of base soils [5].

Results

Sometime after the start of water infiltration into the soil, which depends on the size of the water source and the characteristics of the soil, three wetting zones are formed in the soil massif. The first is the zone of gravitational movement of moisture adjacent to the water source, then the zone of capillary movement and, finally, along the perimeter, the zone of film movement. From the moment of the formation of the third zone, the further propagation of water in depth and to the sides (advancement of the wetting front) in the massif occurs in a film form. At the same time, moisture goes only through small pores. Medium sizes and macropores do not take part in the process of moisture infiltration into the unmoistened soil mass in this period of time. Moreover, there is no filtration of water through the volume occupied by these pores, which in this case work as waterproof bodies. In this regard, the total pore cross section through which water infiltration into the ground occurs [3].

The boundary of the humidified zone of the soil massif, the movement of which was monitored through the screen when working with the installation, is clearly visible.

Figure 1 shows the graphs of the time dependence of the soaking depth of the base of a semicircular stamp at various pressures transmitted by the stamp to the ground. The diameter of the stamp is 35 cm. The stamp was installed in a semicircular pit 50 cm in diameter. Water was supplied to the pit at a rate of 6 liters / hour.

It can be seen from the graphs that the rate of movement of moisture into the depth of the massif decreases during the process of soaking moisture into the depth of the massif; the higher the pressure transmitted by the stamp to the soil, the more the pressure is transferred to the soil.

Figure 2 shows the depth of soaking of the bases of the dies as a function of the times of continuous soaking of the foundation pit for different areas of the dies transmitting a pressure of 0.15 MPa to the ground.

Obviously, the stamp (structure), which has a large area in the plan, with equal pressure transmitted to the base, compresses a larger volume of soil. In this regard, the speed of advancement of the border of the wetted zone in the bases of the dies is the lower, the larger the area of the stamp.

A decrease in the rate of advancement of the soil mass moistening boundary with an increase in pressure and die size can be explained by the fact that, in this case, the compaction deformations of the die base increase, the porosity of a part of the soil mass decreases and, accordingly, the zone with a reduced filtration capacity increases.

Thus, as a result of the experiments, it was found that when soaking the bases of the dies during the first 20-40 minutes, the depth of the wetting zone changes, practically, linearly, in proportion to the time of wetting. Then the rate of advance of the wetting front decreases, and the more intense, the larger the massif is subject to the process of subsidence.

Studies have shown that the rate of soaking of the soil mass is significantly influenced by the intensity of water supply to the soil, and with constant filling of the water source, also by the area of the water surface in the pit through which the infiltration occurs. As can be seen from Fig. 3, with an increase in the amount of water supplied to the pit per unit time, the rate

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of soil wetting increases. In this case, the filtration rate approaches a certain limit, which is reached in the case of continuous supply of a volume of water to the pit, which ensures its constant filling.

If water is supplied to the pit in an amount sufficient for its constant filling, then the intensity of the growth of the depth of the wetted zone increases with an increase in the area of the pit.

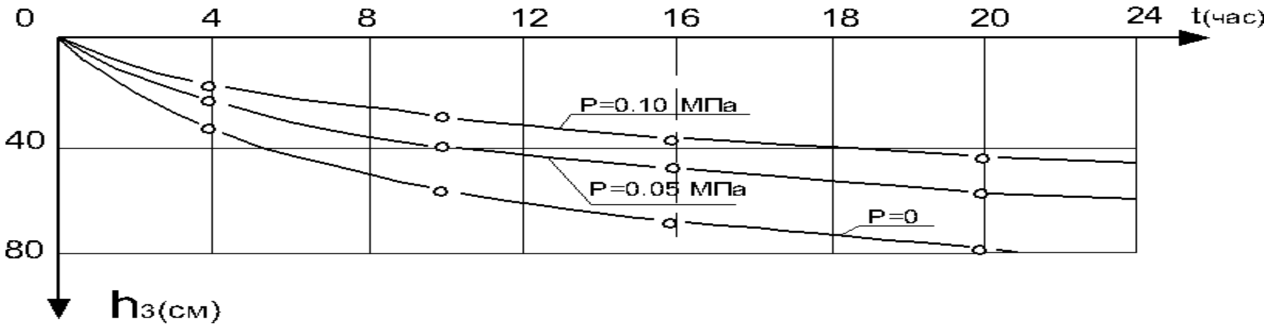

Рис.1. Зависимость глубины промачивания лессовых оснований под штампов с d=35 см, передающих на грунт различное давление от времени замачивания

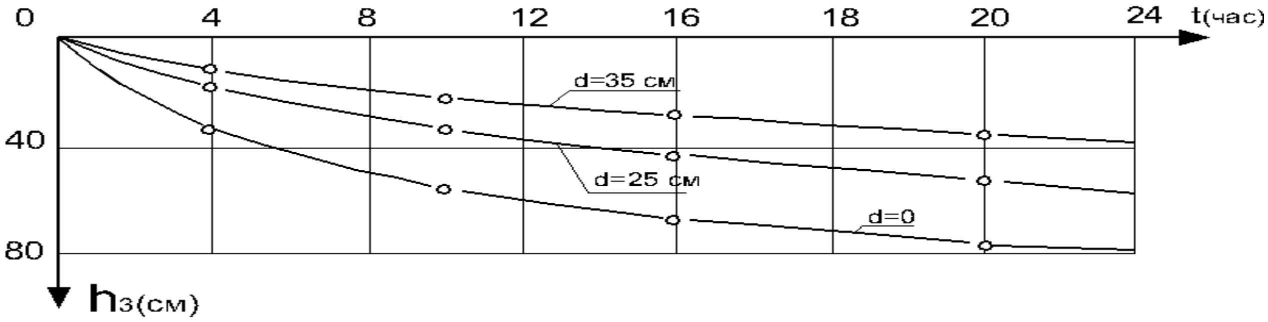

Рис.2. Зависимость глубины промачивания оснований различного диаметра штампов, передающих на грунт 0.15 МПа, от времени.

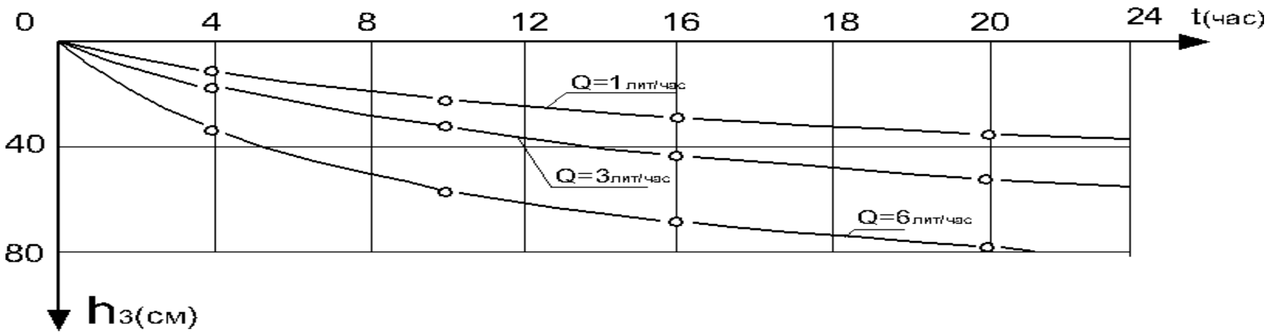

Рис.3. Глубина промачивания оснований штампов диаметром 25 см с давлением 0.1 МПа, в зависимости от интенсивности подачи воды.

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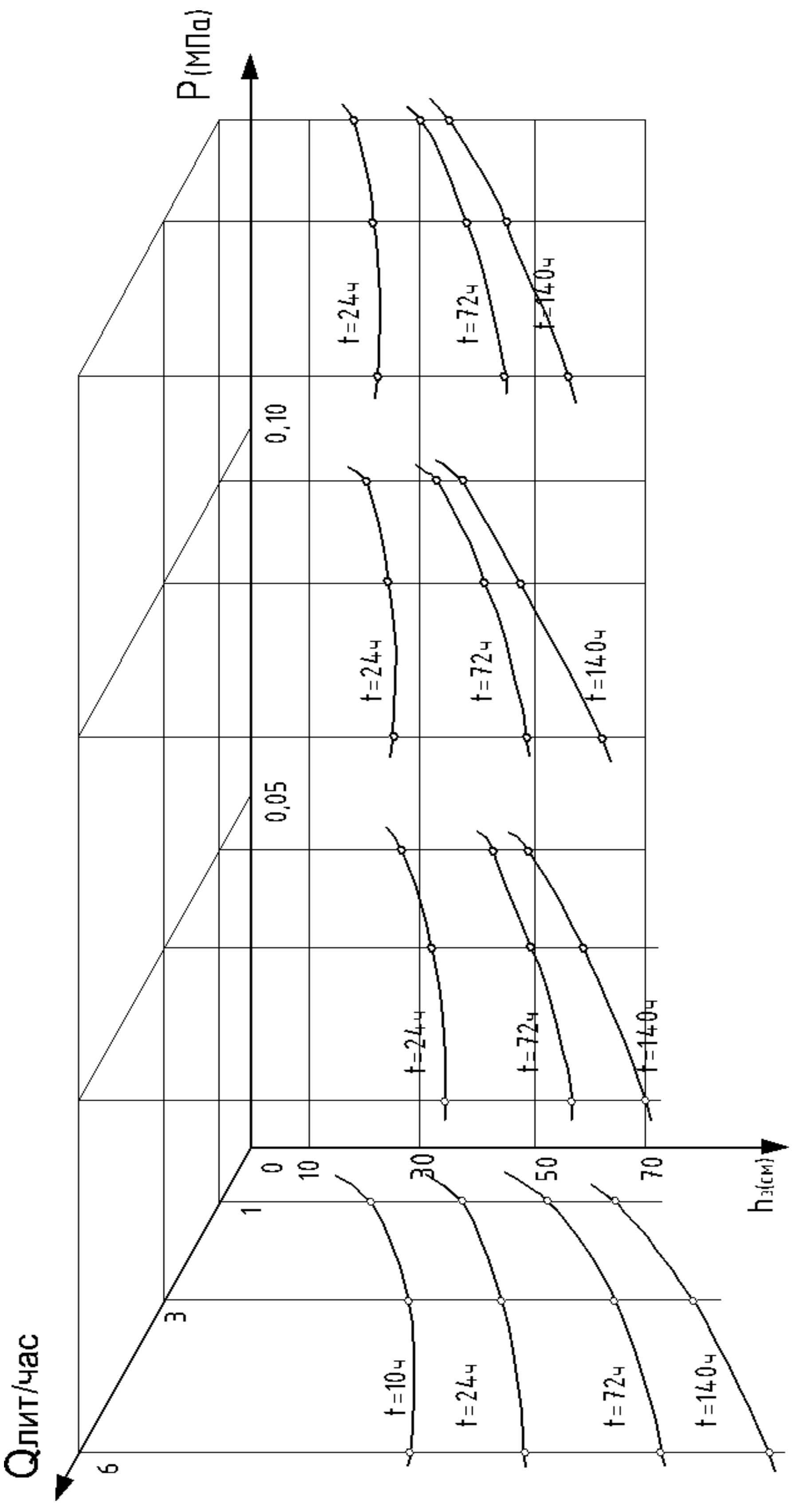

Рис.4. Объемная диаграмма процесса увлажнения лессовых оснований полукруглых штампов диаметром Д=25см (распределитель 4-х)

Час

Hour

Рис.1. Зависимость глубины промачивания лессовых основанний под штампов с d=35 cm, передающих на грунт различное давление от времени замачивания

Fig. 1. Dependence of the depth of soaking of loess bases for stamps with d = 35 cm, transmitting different pressures to the ground on the time of soaking

Рис.2. Зависимость глубины промачивания различного диаметра штампов, передающих на грунт 0,15 Мпа, от времени.

Fig. 2. Dependence of the soaking depth of various diameters of stamps, transmitting 0.15 MPa to the ground, on time.

Рис.3. Глубина промачивания оснований штампов диаметром 25 см с давлением 0,1 МПа, в зависимости от интенсивности подачи воды.

Fig. 3. The depth of soaking of the bases of stamps with a diameter of 25 cm with a pressure of 0.1 MPa, depending on the intensity of water supply.

Рис.4. Обьемная диаграмма процесс увлажнения лессовых оснований полукруглых штампов диаметром Д=25 см (распределитель 4-х)

Fig. 4. Volumetric diagram of the process of moistening loess bases of semicircular stamps with a diameter of D = 25 cm (distributor 4)

After stopping the water supply to the boiler, the contour of the wetted zone continues to advance due to the change in the moisture content of the wetted part of the massif. It stabilizes after the moisture content in the wetted part of the soil drops to a value not exceeding ω = 15-17%.

Visual observations showed that the shape of the moistening contour of the soil mass depends on the pressure transmitted by the stamp to the soil. In the absence of pressure or its low value, the soil massif is moistened evenly, both under the strain, and somewhat away from it. When the pressure transferred by the punch to the ground exceeds the initial subsidence, the process of moving the wetting front under the punch slows down, remaining practically unchanged on the side from it. After the depth of the soil moisture zone becomes greater than the thickness of the part of the massif subject to deformation, the line of the moisture contour gradually flattens out.

Figure 4. a volumetric diagram of the process of moistening loess bases of semicircular stamps with a diameter ocaf d = 25 cm through pits of the same shape, but of different area, is proposed. The diagram is based on the results of soil studies in the distributor zone 4-X.

In the semicircular pits with an area of F = 240-250 cm^2, water was supplied in an amount of Q = 1 liter / hour into the pits F = 480 - 500 cm^2 - Q = 3 liters / hour and into the pits F = 960 - 1000 cm^2 Q = 6 liters / hour ... If, sometime after the start of the experiment, the indicated amount of moisture turned out to be more than could be filtered into the soil through the pit, then the water was supplied in such a way as to maintain its level in the pit. However, such changes in water consumption were very insignificant and did not take place earlier than the fifth day after the start of the experiment.

As can be seen from the three-dimensional diagram of the process, the nature of the curves obtained when working with the device is similar to those obtained from the results of stamp tests of soils on the same site. This is quite natural, since only the scale of the experiment has changed.

Conclusion

Based on the results of working with the described device, we can conclude the following:

1. The use of the proposed device creates additional opportunities for studying the features of the process of moistening loess soils.
2. The constructed three-dimensional diagrams of the process of moistening loess soil clearly demonstrate that the rate of advance of the moistening front into the depth of the stamp base is the greater, the greater the intensity of moistening, the area of the water mirror in the pit, and the less, the longer the soaking time, the pressure transmitted by

the stamp to soil and area of this stamp.

3. (3) The rate of advance of the moistening front during the soaking of loess soils depends not only on the total porosity of the soil, but also on the type, size and location of pores.
4. The composition and direction of the group of factors influencing the features of the process of moistening the loess foundations of the stamps does not depend on the scale of modeling.

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