Consolidation of the multilayered soil basis

Consolidation de base multicouche sol

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ABSTRACT

The private decision of system of managements of movement and preservation of weight for forecasting concentration of a filtering liquid and the remained salt in the multilayered soil basis is offered. Having a precise picture of development dissolution and carrying out of salts in the multilayered basis for the set moment of time and knowing a condition of carrying out of salts in the soil bases, on factor k_z which characterizes development of the cumulative and deformation processes proceeding in the soil basis, is predicted development deposits of a building or a construction for set time. Relative deformation is described in time, as product of factor of replacement with specific volume of the born salts. At a vertical direction of a filtration of water, intriguing a parameter of relative compressibility on compressed thickness of the salted ground, we receive required law of development deposits of the multilayered soil basis with film and volumetric saline (at k=0 and 0,5 accordingly).

RÉSUMÉ

Être proposé le résolution particulier de système équation mouvement et conservation de masse pour prévision de concentration liquide d'infiltration et sel restant dans multicouche sol base. Il y ayant le clair tableau de développement dissolution et déport de sel dans multicouche base pour moment de temps de prescript et en savant un état deport de sel dans sol base sur coefficient k_z, dont caractérise développement processus communs et de déformation résulte dans sol base, on se pronostuque développement affaissement du bâtiment on édification sur temps de prescript. Déformation relatif se déscrit en temps comme un produit coefficient de substitution par volume spécifique de sel deports. Nous recevons un conformité cherché de développement dépôt de multicouche sol base avec salinité de pelliculeux et de volume (conformément à k=0 et 0,5), à direction de vertical filtrage de l'eau en intrigant l'indice compressibilité relatif à masse compressibilité de salinité de sol.

Keywords : multilayered soil basis, deformation processes, volumetric saline

1 INTRODUCTION

Suffusion setting in saline soils is associated with ejection of water soluble salts by filtration water flow. At that value of deformation depends on volume of washed out salts. Though no direct connection between these values in many cases observed, and attempts of theoretical solution of this problem do not give any satisfying answer.

Unresolved problem while there are questions of a long warping in time and its change in process logging and desalination the salted clayey grounds, especially at the maintenance of a considerable quantity of readily soluble salts, in the conditions of a difficult stress condition.

In building practice on the salted clayey grounds many cases when the bases of buildings and constructions suddenly lost durability and stability owing to their long warping are known. Destruction also can occur at sharp change of a physical condition of a ground (change of moisture content, density).

More often reason of an essential divergence of predicted and actual depths of immersion of buildings and constructions on clayey grounds of various genesis are: wrong selection of settlement models of an earth foundation, metrological errors of devices, are intended for carrying out field and laboratory researches, absence of authentic methods of definition rheological equations of a condition of a ground, an error at approximation of the received physical dependences, etc. is very important at calculation of the bases acceptance of a correct condition of a warping of priming coats taking into account chemical suffusion.

Suffusion depth of immersion in priming coats depend from the maintenance of salt and it is caused with carrying out by a filtrational water current of soluble in water salts. The size deformation in the bases depends on volume of the washed up salts (Unaibaev, 1999).

2 DEDUCTION OF SUFFUSION SETTING EQUATION

For defining connection between volume of salts washed out by filtration flow and suffusion setting at any stage of soil leaching, the authors introduced new dimensionless parameter – coefficient of replacement k_{zi}, showing which part of released volume is replaced by non-soluble particles of soil.

Parameter of saline soil compressibility is defined as ratio of relative suffusion setting to specific volume of washed out salts as per the following relation (Verigin, 1979):

$$k_{zi} = \frac{\delta \cdot \varepsilon_{s.f.i.}}{\beta_i \cdot D_0 \cdot \gamma_{dc}} \quad (1)$$

where $\varepsilon_{s.f.i}$ - relative suffusion soil compressibility under given pressure P_i; β_i- degree of soil leaching being equal to ratio of leached from soil salts weight to their initial weight, unit fractions; D_0 – initial weight degree of soil salinity, unit fractions.; δ- salts density, g/cm^3.

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At that value of replacement coefficient k_z can be more or less than 1. The case when $k_z > 1$ is explained by the fact that due to solution and washing out of salts, forming a frame between soil particles, relative suffusion setting appears to be higher that relative volume of washed out salts.

Thus the following dependence between relative suffusion deformation and volume of washed out salts can be defined:

$$\varepsilon_s(t) = k_z[\xi_0 - \xi(t)] \quad (2)$$

where ξ_0 – initial specific volume of salts in soil; $\xi(t)$ - specific volume of rest salts in soil per time t.

For predicting absolute suffusion setting let us integrate expression (2) within thickness of designed layer of saline soil.

$$S_{sf} = \int_{h_1}^{h_2} k_z[\xi_0 - \xi(t)]dx \quad (3)$$

where h_1, h_2 - upper and lower borders of suffusion compression respectively.

If in bases 3C total pressure from weight of soil and foundation is higher than initial pressure of suffusion compression P_{sf}, then instead of replacement coefficient under integral (3), average value k_{zi} against height of designed soil H_i can be taken. If within lythologic bed k_{zi} varies significantly (more than 0.05), then this bed of soils is divided into several design layers and suffusion setting of basis is defined as sum of settings of each soil layer.

For basis, comprised of soils with even distribution of salts, specific volume of rest salts in soil for time t is defined from solutions of N.N.Verigin

At the second stage of leaching process, when from the side of inflow face, desalted payer formed, absolute suffusion setting is defined as sum of two integrals.

$$S_{sf} = \int_0^l k_z \cdot \xi_0 \cdot dx + \int_l^H k_z[\xi_0 - \xi(t)]dx \quad (4)$$

where $l=\alpha(t - t_1)$ - height of totally desalted soil zone;
t_1 – duration of process first stage.

Process of desalting of complex soil basis, with some assumptions, is solved by the authors and described in work (Unaibaev, 1999) in details. Knowing mechanism of this process, it is possible to start description of connected process of suffusion compression. In initial period of suffusion compression, when active zone of leaching is situated in the first layer of saline soil, setting can be predicted as per dependence (Verigin, 1979) (for soils with film-lie salting type), where time $t<t_1$ and as per equation (Verigin, 1979) where time $t_1 < t < t_{02}$.

When second layer leaching process starts, suffusion setting of basis is defined as sum of settings of each soil layer.

United equation of movement and conservation of salts weight is solved for any possible variants on the layers joint, for soils with volume and film-like salting type, when parameter $M<1$ (Verigin, 1979).

3 ANALYSIS OF COMPUTATION RESULTS

For facilitating computation of multilayer basis suffusion setting in time, the author developed computer software SUF_SET1. As an example, by means of this program, prediction of suffusion setting of the existing foundation on soil basis, comprised of plastered clay sands and light loams at filtration of water in descending direction, was done.

Analysis of results show that on the joint of design layers variant 1 takes place, total desalting of the considered layer and inflow face of the following layer come simultaneously.

Suffusion setting of soil basis becomes stable only on 770-day. Out of plot of suffusion setting of basis we see that when transferring of active zone of solution from one layer to another, speed of deformation development decreases (Figure 1). This is explained by the fact that replacement coefficient of soil against height decreases.

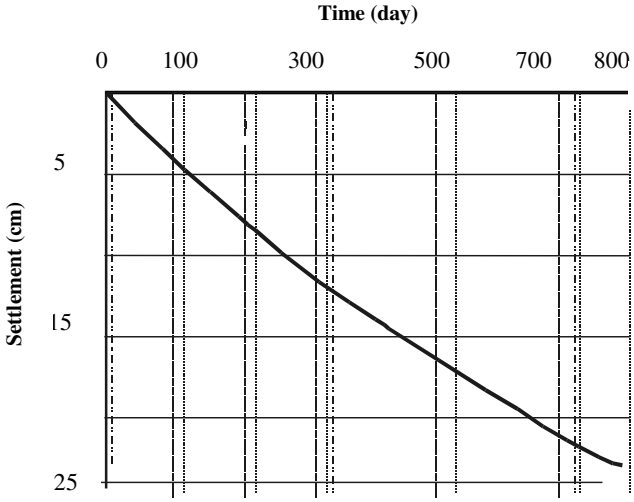

Figure 1. Plot of development of soil basis suffusion settlement

4 CONCLUSIONS

Suffusion depth of immersion in priming coats depend from the maintenance of salt and it is caused with carrying out by a filtrational water current of soluble in water salts. The size deformation in the bases depends on volume of the washed up salts.

For defining connection between volume of salts washed out by filtration flow and suffusion setting at any stage of soil leaching, the authors introduced new dimensionless parameter – coefficient of replacement k_{zi}, showing which part of released volume is replaced by non-soluble particles of soil.

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