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Research Article

THE PROGRESSION OF MODERN HYPERGENESIS WITH INCREASED EFFECTS OF TECHNOGENIC FACTORS ON THE EOCENE SWELLING CLAYS OF NORTHERN TAMDYTAU

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ABSTRACT
The article discusses the specific feature of bentonite clays. With the intensification of the effects of man-made factors on them, i.e. interaction with water, the leaching of soluble salts occurs, and the rock swells, resulting in a sharp change in its strength and deformation properties. This reduces the resistance of clays to deformation under engineering influence. The objective of this work is to establish the regularities of formation and changes in the composition, physico-mechanical properties and seismic properties of Eocene swelling clays, manifested in certain geological, hydrogeological and geochemical conditions. With the increased effects of technogenic factors on Eocene swelling clays, patterns of changes in the material composition, engineering-geological and seismic properties of clays were established and three zones with different depths of Eocene swelling clays were identified.

Keywords: *Eocene Clays, Swelling Deformation, Swelling, Carbonateness, Plastering, Swelling Pressure, Swelling Humidity*

INTRODUCTION

Bentonite clays are found in various climatic zones of Eurasia, starting from the tundra, in the southern steppes, semi-desert and desert regions of such areas as the southern part of Ukraine, the steppe part of the Crimea, the Pre-Caucasus, Kazakhstan, the Ustyurt plateau, Central Kyzylkum and the southern part of Uzbekistan, and in many other areas.

Currently, a huge number of large national economic construction projects, such as model residential complexes, industrial facilities of national economic importance are being built in areas of bentonite clay distribution.

A specific feature of bentonite clays is that when the effects of man-made factors increase, i.e. interaction with water, the leaching of soluble salts occurs, and the rock swells, resulting in a sharp change in its strength and deformation properties. This reduces the resistance of clays to deformation under engineering influenceи.

MATERIALS AND METHODS

Usually, the standard approach in determining the calculated parameters of the physico-mechanical properties of bentonite clays does not meet the requirements for swelling clays, primarily because of their high “sensitivity” to external influences. In the areas of bentonite clays, the practice of construction and operation of industrial and civil structures, the issue of obtaining reliable forecasts of the behavior of these soils in their interaction with man-made factors causing loss of bearing capacity is acute. Thus, the above is an urgent issue for studying the swelling clays of the northern Tamdytau with the increased effects of man-made factors.

In this regard, the objects of our studies were the Eocene swelling clays. And the main purpose of these studies is to develop theoretical provisions for the formation of the composition and physico–mechanical properties of Eocene swelling clays. And their change during leaching based on the disclosure and establishment of the role of strengthening the effects of man-made factors.

In accordance with the purpose of the research, the task of this work is to establish the regularities of formation and changes in the composition, physico-mechanical properties and seismic properties of Eocene swelling clays, manifested in certain geological, hydrogeological and geochemical conditions.

Basically, the theoretical foundations of the specific properties of swelling clays for solving various problems were developed by the founders of genetic soil science and lithology. (F.P.Savarensky-1936, V.I.Popov-1941, V.A.Priklonsky-1956-1957, E.M.Sergeev-1962, M.F. Vikulova-1957-1975, M.Z.Zakirov-1962-1985, V.D.Lomtadze-1975-1980, I.G.Korobanova-1980, V.I.Osipov-1979, M.M.Zakirov-1985-2020 and many others). Defining the main issues of lithology and engineering-geological study of swollen rocks, they put forward as a priority the problem of studying their interaction with water and the changes in the physical and mechanical properties of rocks caused by it.

The methodology for assessing and changing the physico-mechanical and seismic properties of swelling clays is based on the principle of a comprehensive study of their ion-salt, chemical-mineralogical, dispersed composition, texture, structure, physical condition, water-colloidal, strength and deformation properties.

The upper part of the earth's crust, where hypergenic processes occur (soil formation, weathering, salt accumulation, geochemical activity of groundwater), is called the hypergenesis zone. They usually include only natural phenomena, not including technogenesis (Tsykin P.A., 2013).

In specific geological conditions, hypergenic and technogenic processes occur in the same thermodynamic environment. Their study is of great theoretical and practical importance, since these deposits are most often the basis of various structures (E.M. Sergeeva, 1985).

In this regard, the foothills of the Northern Tamdytau are of interest, for example, we will consider the features of the formation of engineering-geological and seismic properties of Eocene clays. The features of the geological and tectonic development of the Northern Tamdytau determined the formation and development of clays of arid lithogenesis within their limits, characterized by various areas of outcrops, distribution, thickness, lithological properties, depth of occurrence. The intensity of hypergenesis processes is also determined by modern heat and moisture availability.

RESULTS AND DISCUSSION

Detailed studies of swelling clays have shown that the physico-mechanical properties of clays are determined by a natural combination of features of the composition, condition and nature of structural bonds.

A comprehensive study of swelling clays revealed different "sensitivity" with depth, and their relation to water, depending on the mineral composition of clays –montmorillonite, -on the content of the composition of cementing salts (amorphous silica and gypsum), on the concentration of pore waters, on the nature of fracturing.

It has been established that the inheritance of individual features of indigenous bentonite clays in their weathered and saline differences forms new qualitative and quantitative features in their composition and properties. Thus, in the highly modified zone of the presence of indigenous bentonite clays in the zones of hypergenesis, new formations in the form of nitrous forms of iron, gypsum, and iron oxides are observed.

The study of these changes in the material composition, engineering-geological and seismic properties of Eocene swelling clays with the depth of their occurrence, under the influence of modern hypergenesis, made it possible to identify 3 zones (Zakirov M.M., 1988; Zakirov M.M., Ochilov G.E. 2019).

In the first – highly modified zone – in addition to the soil-vegetation layer with a thickness of up to 0.2 m, enriched with plant residues, the upper layers of weathered bentonite clays are attributed. The total capacity is up to 0.2 m. the properties of deposits in this zone are closely related to the intensity of denudation processes, solar insolation, are determined by the granulometric and mineral composition and, in addition, largely depend on the fitness of the outputs.

Clays of montmorillonite-hydrosluidic composition, covered with a small layer of quaternary sediments, in recent geological periods were influenced by a dry arid climate with a shortage of precipitation. In this regard, salt accumulation processes were actively taking place here ($CaCO_4$ up to 10% and more $CaCO_3$ up to 20-25% NaCl up to 0.7-0.8% Na_2 SO_4 up to 2.5%). As a result, aggregation of clay particles, mechanical crushing associated with various weathering agents (sharp fluctuations in daily and annual temperatures, constant winds, root systems of saxaul plants, and many others). Sometimes there are plastic dikes filled with sand and fine gravel – products of weathering of the rocks composing the Tamdytau Mountains. In this zone, relatively low humidity (from 6 to 12%), skeleton density (up to 1.38

g /cm^3), low plasticity (up to 28), swelling (up to 1.6 times or 3.4%), reduced seismic wave velocities (up to 920 m/s) (Zakirov M.M., 1988; Zakirov M.M., Ochilov G.E. 2019, Zakirov M.M., Azizov U.A., 2012). The second – medium–modified zone - includes clays of montmorillonite-hydrosluidic composition. It should be emphasized that the change in engineering-geological properties and material composition is clearly manifested by the vertical section of clays. An increase in skeleton density (up to 1.45 g /cm3), humidity (up to 20%), clay fraction content (up to 65%), swelling (3.2 times, or 9.4%), plasticity (up to 42.8%), longitudinal wave velocity (up to 1600 m/s) is observed with increasing depth. This is due to an increase in the compacting gravitational load. However, these depths (up to 3.5 m) are affected by hypergenic changes associated with aridity of the climate (salinization of CaCO3 up to 10-15%, CaCO4 up to 5-10%, Na2 SO4 - up to 0.5% or less, etc.), with the appearance of drying cracks on the surface. Consequently, the influence of hypergenesis processes on Eocene clays with a depth gradually weakens and is felt weakly from about a depth of 3.5 – 4 m.

The third – slightly modified zone – includes clays of montmorillonite composition. Due to the depth of occurrence due to the pressure of the overlying formations, the clays of this zone are little changed and are characterized by high values of clay fraction (up to 84%), humidity (up to 30%), plasticity (up to 50%), swelling (up to 10.5 times, or up to 19.7%), longitudinal wave velocity (up to 1800 m/s), and on the other hand – a decrease in the content of water-soluble salts, fracturing (Zakirov M.M., 1988).

CONCLUSIONS

Thus, in changing the properties of Eocene clays, an important role belongs to the speed and duration of the intensification of the effects of man-made factors that affect the acceleration or weakening of the described processes. In this regard, during the construction of buildings, construction and operation of irrigation and hydrotechnical facilities, as well as in areas of flooded territories, attention should first of all be paid to the loss of strength properties of swelling clays, since stability control only by density and humidity on swelling clays cannot currently characterize the changed properties of clays with their additional moistening. Based on the above, it is necessary to predict the zones of possible active modern hypergenesis. Where, when interacting with surface or underground waters, their engineering-geological and seismic properties decrease.

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