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Research Article

CARRYING OUT ENGINEERING-GEOLOGICAL EXPLORATION WORKS IN THE DESIGN AND CONSTRUCTION OF BUILDINGS AND STRUCTURES IN SALINE AREAS, CHANGES IN STRENGTH INDICATORS AS A RESULT OF WETTING OF SALINE SOILS

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ABSTRACT
This article describes the engineering-geological prospecting in the design and construction of buildings and structures, methods of improving their efficiency, the need to determine the physical and mechanical properties of soils with high humidity in accordance with the requirements of regulatory documents and engineering-geological prospecting. Also described are the information on aerospace survey, aero visual observation and aerial photography.

Keywords: *Soils, Moisture, Highly Moist Soils, Physical and Mechanical Properties, Aerial Surveillance, Aerial Photography, Buildings And Structures, Aerospace Survey*

INTRODUCTION
Today, construction work is being carried out on a large scale in our country. The design and construction of buildings and structures in difficult climatic conditions requires special research. Engineer-geological explorations in the plots with high moisture soil base are performed according to the special program specified in the technical assignment. The program and the technical assignment are jointly developed by the project and research organizations.
The materials obtained as a result of the search should, in general, enable the following:
1. Quantitative assessment of the stability of the basis;
2. Predicting the value and duration of the base subsidence during the consolidation process.
In general, these materials should evaluate the possibility of using a layer of high humidity as a lifting base material. The program may be edited after receiving valid information by the design organization during the search.
In the design and construction of buildings and structures in difficult climatic conditions, we can include the following types of work in the engineering-geological explorations:
1. Collection, analysis and summarization of research and materials of previous years;
2. Acquisition and decoding of aerospace materials;
3. Reconnaissance inspection together with aerial visual and route observations;
4. Passing mountain carvings;
5. Geophysical study of the area;
6. Soil field inspection;
7. Hydrogeological studies;
8. Stationary observations;
9. Study of soil and water in laboratory conditions;
10. Prediction of possible changes in engineering-geological conditions;
11. In-house processing of materials;
12. It will consist of drawing up a technical report (conclusions).

When compacting soil to ensure the stability and strength of the foundation of buildings and structures, if their moisture content is less than the optimal moisture content indicated in Table 1, it is re-consolidated, if the moisture content is less than allowed, then the soil is additionally moistened.

Table 1

The ground	**The value of moisture indicators at the required density coefficient**		
	1-0.98	**0.95**	**0.90**
Dusty sands. large and light Supes	<1.35	1.6	non-standardized values
Light and dusty supes	0.8-1.25	0.75-1.35	0.7-1.6
Heavy dusty supes. light and light dusty supes	0.85-1.15	0.8-1.2	0.75-1.4
Heavy silts. heavy dusty muds	0.95-1.0	0.9-1.1	0.85-1.2
Less	0.8-1.20	0.7-1.25	0.7-1.40

When the humidity exceeds the permissible level. the primers should be dried. It is necessary to regularly monitor the activities of water-heat management in the area of buildings and structures.

MATERIALS AND METHODS

In the collection. analysis and generalization of research materials of the previous years. it is necessary to give importance to the history of the development of the geology of the area in the Quaternary period and the information on the analogue of the district. It is necessary to generalize the information about the man-made effects that lead to an increase in the level of ground water and swamping in the construction area. as well as to pay special attention to the development of wetlands. lakes. lagoons. alluvial and mixed genesis deposits during route monitoring.

It is necessary to use various methods of geophysical research to study the distribution and thickness of soils with high humidity on a maximum scale. as well as to study the strength of soils in the upper part of the earth's surface.

Drilling wells should be performed reliably on a compact. Lightweight, portable drilling rig. if necessary. from a power source. Sampling for laboratory testing of physical properties of moistened soils is done manually. Working with monoliths and special soil receivers to check deformation and strength parameters of moistened soil in a high laboratory. Production of monoliths in single-wall devices with a metal body for storing fat walls.

The main tests for the study of highly moistened soils in field conditions are carried out with cone-tipped probes and rotary cutters, as well as with a stamp and a pressure meter. The collection of data on the presence of soils with high humidity, their characteristics, distribution and properties is carried out taking into account the data of previous years and the experience of construction in the given area. It is necessary to use data from aerial photography and space photography. If there is insufficient information on the distribution, genesis, thickness, composition, state and properties of soils, as well as the hydrogeological and geomorphological conditions of the area under investigation. a reconnaissance search is determined.

When conducting engineering-geological explorations for the development of an engineering project all types of work listed above should be included in the engineering-geological explorations for the development of the project.

The composition and scope of exploration works in the plan according to RST Uz 20522-95 and to the separation of engineering-geological elements by depth normative and calculation values of soil properties including strength and deformation characteristics, hydrogeological dimensions, dimensions of the speed of development of geological processes, should also be sufficient to determine the aggressiveness of groundwater. It is recommended that the scale of engineering-geological maps be

1:10000-1:2000. A scale of 1:1000 and smaller can be obtained when properly based in the survey program.
The results of the geophysical research of the thickness of soil with high humidity supplement and the information obtained during the reconnaissance survey. the information on the non-uniformity of its structure. the direction and speed of movement of groundwater, and the variability of the physical and mechanical characteristics of soil with high humidity.
The main types of work performed at this stage of the project's production are: engineering-geological surveying of the high-moisture soil area, route observation, geophysical research, soil sampling and drilling of sounding boreholes.
It is proposed to make an engineering-geological survey on a scale of 1:10000-1:5000.
Electroresearch and seismoacoustic profiling. georadiolocation are proposed as the main methods of geophysical research.
Boreholes are dug in the form of a 50x50 m grid. depending on the size of the studied area. at a distance of 150 m from both sides of the highway axis. based on the data of aerial photography.
A sample is taken every 0.5-1.0 m in depth from soils with high moisture content when passing sounding boreholes. Materials on the hydrogeological order of the layer are collected.
Salts of sulfate. chloride. and carbonic acid often accumulate in salinity. and only in some cases. sodium and potassium salts of nitric acid accumulate in deserts. It is very harmful to most species.

Table 2: Salted supes-suglinokli in the territory of the Republic chemical composition of soils

Spread Region	levels.m	Chemical composition. %								total. %
		SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O+Na_2O	SO_3	CO_2	
Amudarya delta before the island	1-4	$\frac{45-58}{51}$	$\frac{11-13}{12}$	$\frac{8-10}{8}$	$\frac{10-13}{11}$	$\frac{3-5}{4}$	$\frac{3-4}{3}$	$\frac{0-1}{0.5}$	$\frac{8-10}{9}$	98
Khorezm Delta of Amudarya	1-3	$\frac{48-55}{52}$	$\frac{10-13}{12}$	$\frac{3-5}{4}$	$\frac{10-13}{11.5}$	$\frac{3-4}{3.5}$	$\frac{3-5}{4}$	$\frac{0-3}{1.5}$	$\frac{7-10}{8.5}$	97
Bukhara-Karakol water basin	1-5	$\frac{52-61}{57}$	$\frac{9-12}{11}$	$\frac{3-5}{4}$	$\frac{8-13}{11}$	$\frac{2-4}{3}$	$\frac{3-4}{3.5}$	$\frac{0-2}{1}$	$\frac{5-8}{6.5}$	97
Zarafshon water basin	6-22	$\frac{53-55}{54}$	$\frac{11-13}{12}$	$\frac{4-4.2}{4}$	$\frac{11-12}{11.5}$	$\frac{2-3}{2.5}$	$\frac{2-3}{2.5}$	$\frac{1-2}{1.5}$	$\frac{8-9}{8.5}$	96
Kashkadarya depression	2-8	$\frac{48-54}{52}$	$\frac{10-12}{11}$	$\frac{4-5}{4.5}$	$\frac{10-12}{11}$	$\frac{2.6-3.4}{3}$	$\frac{3-5}{4}$	$\frac{0.4-3}{2}$	$\frac{7-9}{8}$	95
Surkhandarya depression	1-30	$\frac{49-53}{51}$	$\frac{10-12}{11}$	$\frac{4-5}{4.5}$	$\frac{11-13}{12}$	$\frac{2.6-3.4}{3}$	$\frac{3-3.5}{3.5}$	$\frac{01-2}{1}$	$\frac{7-11}{9}$	95
Ferghana Concave	1-9	$\frac{52-54}{53}$	$\frac{11-12}{11}$	$\frac{4.2-5.3}{5}$	$\frac{10-13}{11}$	$\frac{2.8-4.1}{3.5}$	$\frac{3-4}{3.5}$	$\frac{1.4-3}{2}$	$\frac{7-10}{8.5}$	98
The average amount for Uzbekistan	1-30	$\frac{51-57}{54}$	$\frac{11-12}{11.5}$	$\frac{4-5}{4.5}$	$\frac{11-12}{11.5}$	$\frac{2.5-4}{3}$	$\frac{2.5-4}{3.5}$	$\frac{0.5-2}{1}$	$\frac{6.5-9}{8}$	97

Note: limit values are shown in the picture. average values are shown in the denominator.

The main cause of salinity is the rise and evaporation of the level of mineralized groundwater near the surface of the earth. In this case. salts gradually accumulate on the upper layers and surface of the soil. The ground water level where these processes take place and strong evaporation begins is called the critical depth. In order to stop salinization it is necessary to constantly reduce the level of groundwater from this point i.e., from the critical depth with the help of drainage. According to the chemical composition of salts. there are soda, soda sulfate, sulfate, sulfate chloride, chloride sulfate. chloride. and other salinities (Table 2).

The chemical composition of salts in soils is related to the chemical composition of underground and surface water moving in them. Natural waters (groundwater and surface water) form solutions enriched with various chemical elements. Their chemical composition is influenced by the influence of atmospheric precipitation and "alkaline dissolution" of rocks, evaporation, ion exchange. ion absorption. the influence of gases, the influence of organic compounds and organisms, and other physico-chemical processes is formed.

The chemical composition of groundwater is mainly formed due to the slightly soluble salts in the soil distributed in the aeration zone. The amount and composition of water components depends on many factors. mainly the distribution of some elements in the earth's crust, their solubility in water under this temperature and pressure.

Most chemically formed rocks dissolve well in groundwater. Chloride, sulfate and carbonate, alkaline compounds are common among them. The solubility of salts depends on the initial chemical composition of the dissolving water, the temperature of the environment. and the speed of water movement. The solubility of common salts at 18^0C is given in Table 3.

Table 3: Solubility of salts at 18^0C

Chemical composition of salts	Water solubility, g/l	Chemical composition of salts	Water solubility g/l
K_2CO_3	1117	Na_2SO_4	194
$CaCl_2$	745	K_2SO_4	111
$MgCl_2$	545	$MgCO_3$	25.79
$MgSO_4$	354	$CaSO_4$	2
$NaCl$	329	$Ca(OH)_2$	1.48
KCl	330	SiO_2	0.16
Na_2CO_3	193.9	$CaCO_3$	0.0634

In Table 3. chlorides are the most soluble. followed by sulfates and carbonate salts. Calcium carbonate salts are the most difficult soluble salts. Soil salinity is determined by the total amount of harmful salts (without gypsum). According to this sign saline soils are weak (the amount of harmful salts is 0.1-0.2%). medium (0.2-0.4%), strong (0.4-0.8%). They are divided into highly saline (salty; more than 0.8%) varieties. According to the chemical composition (type of salinity) natural saline soils are divided into chloride, sulfate chloride, chloride sulfate, sulfate, soda sulfate, sulfate soda, chloride soda, soda, sulfate or chloride hydrocarbon (alkaline earth elements) saline soils.

In order to prevent the negative consequences of soil salinity, it is necessary to ensure the correct irrigation regime, to wash highly saline soils in large quantities, and to radically change the direction of the salinization process, artificial drainage of groundwater using drains it is necessary to create a flow.

RESULTS

The amount of saline soils in the natural conditions of the territory of Uzbekistan according to the salinity level by region is presented in Table 4.

Table 4: Salted by regions in Uzbekistan the amount of salinity of soils %

№	Regions	Lightly salted	Medium salted	Strong salted	Extra salted
1.	Republic of Karakalpakstan	-	27.3	37.4	35.3
2.	Andijan	43.9	32.9	16.2	7
3.	Bukhara	57.5	30.7	7.6	4.2
4.	Jizzakh	17.5	38.6	29.1	14.8
5.	Kashkadarya	25.6	51.8	15.1	7.5
6.	Navoi	19.9	52.1	20.9	7.1
7.	Namangan	58.1	26	9.2	6.7
8.	Samarkand	50.8	39.7	7.7	1.8
9.	Surkhandarya	73	21.1	4.2	1.7
10.	Syrdarya	-	59.9	25.6	14.5
11.	Tashkent	71.3	22.5	4.4	1.8
12.	Ferghana	27.9	35.6	22.2	14.3
13.	Khorezm	-	59.1	28.1	12.8

The main factor in the formation of saline soils is mineralized groundwater and salty rocks lying close to the surface of the earth. The main condition of salinity is the impossibility of water flow in places and the amount of evaporation exceeding the amount of precipitation. Therefore saline soils are found in plains where water does not flow, in desert and hilly areas. The description of salinity directly depends on the hydrogeological and geomorphological conditions of the place. Mountainous plains are composed of carbonate rocks and usually consist of non-saline soils. Water-soluble sulfates and partially chlorides are found in the soils of the mountain plains and the lower part of the valleys.

As the places deepen. the amount of salt in the soil increases, especially in conditions of free drainage and when groundwater is close. The importance of chlorides in the salt composition in the lower part of the river valleys is significant. As you move away from the mountains, carbonate rocks are replaced by non-carbonate ones, then chloride-sulfate, sulfate-chloride, and finally chloride-type saline regions are found.

In the design and construction of buildings and structures in saline areas it is necessary to take into account the strength and compaction of soils. Sedimentary rocks are compressed under the influence of external forces as a result of which their porosity and volume decrease.

The compression process is represented by compressive strength, compressive coefficient and compressive modulus.

The compressive limit of rocks is equal to the value of the force expended for their maximum compression, expressed in MPa. When soils are compacted under the influence of external force. their particles become denser and their porosity decreases.

Compression of soils under the influence of external force without lateral expansion is called compressional compression.

Compression compression is determined by the reduction of the volume of the sample taken from the soil in the hydroproject compression device. as a result of gradually increasing the forces.

A sample is cut from the monolith on the cutting ring of the compression tool and installed on the tool. 2 indicators are installed on it. and the lever of the tool is balanced. Taking the initial calculation from the indicators. a force P=0.05 MPa is applied to the tool arm on a surface of 1 sm^2. Under the influence of the applied vertical force P. the soil is compressed. its volume decreases. and after a certain time the compression process ends. Then. calculating from the indicator arrow. it is determined how much the height (h) of this rock has been compressed by vertical force equal to P=0.05 MPa. Then. the rock is applied to the compression tool again i.e., a force equal to P=0.1 Mpa, under this force, the soil is compressed, and after the compression process is completed, water is poured into the compression tool (in this case. the soil is formed) and h is determined taking into account the indicators. This process is continued until the strength value is P=0.3 MPa.

The sources of salinity of saline soils are the process of enrichment with salts developed in saline rocks and mineralized waters that have evaporated and released a certain amount of salt. Sources of both types of salinity are found in the territory of Uzbekistan. At the same time, salinization of soils from saline rocks without the influence of groundwater is observed, even if it is low.

The location of saline soils in the lower part of water basins and their formation in flat relief conditions is the first condition arising from the geographical analysis of saline soils.

The second condition is the generalization of climatic conditions. In Uzbekistan. almost all of the districts where saline soils are distributed correspond to hot climatic conditions where the amount of precipitation does not exceed 200 mm during the year and the amount of evaporation is very high. In such conditions. soils become saline when they are moistened with groundwater through capillaries.

The third condition is the known movement law of groundwater. which explains the process of soil salinization. When moving from the mountains to the plain, the relief becomes flat and the heavy mineral particles in the soils increase the speed of the groundwater flow decreases the cross-sectional surface of the flow and the time of contact of the passing water with the rock or soil increases. As a result the probability of consumption of groundwater and the possibility of salt accumulation and evaporation from capillaries increases.

In the regions of Uzbekistan with different natural conditions. there are saline soils of different quantities and composition. The most common salts involved in salinization are: $NaCL$, $Na_2SO_4 \cdot 10N_2O$, $MgSO_4 \cdot 7N_2O$, $MgCL_2 \cdot 6N_2O$, $CaCL_2 \cdot 6N_2O$, $NaNCO_3$, $Na_2CO_3 \cdot 10N_2O$, $CaCO_3$ va $CaSO_4 \cdot 2N_2O$.

The amount of easily soluble salts in soil varies widely. The amount and type of the above-mentioned slightly soluble salts in the soil determines its physical and mechanical properties In order to correctly assess the salinity of soils, it is necessary to take into account a complex of the main natural factors affecting salt exchange (precipitation, climate, etc). In addition to easily soluble salts, saline soils contain a large amount of gypsum and carbonates, as mentioned earlier,

Table 5: Classification of soils according to V,M, Bezruk

Soil types	Total average amount of salts in the upper one-meter layer, by weight %	
	Chloride and sulfate chloride salinity	Sulfate, chloride-sulfate and soda salinity
1.Not salted	<0.3	<0.3
2.Lightly salted	0.3- 1.0	0.3- 0.5
3.Salted	1.0- 5.0	0.5- 2.0
4.Strong salted	5.0- 8.0	2.0- 5.0
5.Extra salted	>8.0	>5.0

Permissible amount of salts in loess soil % (according to A.A.Kirillov and N.N. Frolov).

Table 6

The class of the structure	When salts are present (at most)		
	Easily soluble	Moderately soluble	Easily and moderately soluble
I and II	5	7	5
III	7	10	7
IV and V	10	10	10

M.I.Terletskaya (1948-1977) developed a classification of plastered loess soils, which are mainly used as hydromelioration structures, in relation to suffusive deformations.

Table 7: Description of plastered saline soils (according to M.I.Terletskaya)

Suglinok	Amount of gypsum. %
I	II
Gypsum rocks	>70
Smut	60-70
Soot	40-60
Strongly plastered	20-40
Plastered	10-20
Lightly plastered	5-10
Not plastered	<5

Petrukhin (1973) developed a classification in which the minimum amount of water-soluble salts depends on the dispersion of soils in accordance with the design goals of civil and industrial buildings and foundations of buildings and structures.

In all given classifications of saline dispersed soils only easily and moderately soluble salts are taken into account. However, when exposed to man-made (sour) solutions it is necessary to add some carbonaceous powdery soils to the saline soils. S.G. Vishnyakov suggests the following classification of soils with carbonate soil.

Table 8: Classification of soils with carbonate soils (according to S.G.Vishnyakov)

Amount of soil material %	Type of material	$CaCO_3$%
50-75	Marl with soil	25-50
75-95	Limestone soil	5-25
95-100	Soil	0-5

DISCUSSION

Thus, when the amount of calcium carbonate in the soil is less than 5%, it is not taken into account. and when it is from 5% to 25%, the soil is called calcified. Usually, a large amount of carbonates is found in dusty soils of various origins.

Ground salts can dissolve under the influence of water and other solutions and spread in the ground. The leaching of soluble salts from the soil is called quantity or salt leaching or chemical suffocation.

Before the washing of active alkali, there is a process of dissolution of salts in soils or transition from absorbed state to solution. Such processes are interconnected, that is, the dissolution and dissolution of salts predetermines their removal from the soil.

The rate of leaching of salts from the ground with fresh water depends on the moisture content, which is controlled by the amount of the filtration coefficient: the rate of salt leaching is maximum during convective moisture transfer (filtration). Such a situation can be observed when the filtration coefficient is about 10^{-3} m.day and the pressure gradient is about 10^{-6} m day.

At low values of water permeability, most of the washing of salts occurs with diffusive buildings and structures and is slow.

Leaching of salts in the soil is also controlled by the composition and amount of salts in the water moving through the soil: the salts in the soil do not dissolve when a saturated solution with the same salt content as in the soil moves through the soil. For this reason. the fresh water falling into the saline ground passes a certain distance. becomes saturated with salts and loses its solvent properties. Salts can be actively dissolved and removed only when fresh water enters the ground.

When soil is exposed to specific solutions of salts, acids and alkalis, not only weakly and moderately soluble, but also hardly soluble salts can be completely removed from the soil.

As a result of long-term exposure of fresh water to the saline ground, in addition to strongly and moderately soluble salts (chlorides, sulfates), weakly soluble compounds (carbonates, sand, iron oxides) are released. They are natural cements of soils, which determine their strength and deformation properties. Therefore, the removal or weakening of such natural cements changes the composition and structure of soils and determines the change in their properties.

Saline dusty soil soils with a content of easily soluble salts less than 5% have little suffusive sedimentation. which is of practical importance.

Also. the values of Δh when the test results of saline soils were 0.05, 0.1, 0.2, 0.3 MPa were determined as follows:

$$\Delta h = S_1 - S_0 \qquad (1)$$

Here: S_1 - indicator reading when the soil is compacted under a certain force;
S_0 - initial value of the indicator.

It was observed that the porosity coefficient of the compacted soil decreases under the influence of each vertical force. This change was determined by the following expression:

$$e_p = e_0 - \frac{\Delta h}{h}(1 + e_0) \qquad (2)$$

here: Δh - the amount of compression of the examined ground under the influence of force P; h-the height of the examined ground without compaction.

e_0- the initial porosity coefficient of the soil.

The compression coefficient was determined by the following formula from the compression curve:

$$a = \frac{e_1 - e_2}{P_2 - P_1} \qquad (3)$$

here. a - compression coefficient; e_1 - coefficient of initial porosity; e_2 - the last porosity coefficient; R_1 - initial force applied to the ground.

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