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ГЕОЛОГИЯ ЖӘНЕ ТЕХНИКАЛЫҚ ҒЫЛЫМДАР СЕРИЯСЫ

♦

СЕРИЯ ГЕОЛОГИИ И ТЕХНИЧЕСКИХ НАУК

♦

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SOIL COVER OF THE "ZAOVRAZHNY" MICRO-DISTRICT, CHEBOKSARY, AND ITS ECOLOGICAL STATE

Abstract. In July-August 2017, soil and agrochemical investigations of the territory of the Zaovrazhny micro-district in Cheboksary city were carried out.

The territory of the new Zaovrazhny micro-district in Cheboksary is located to the west of the north-western residential area of Cheboksary; it is bounded from the north by the coastal fortifications of the Cheboksary storage reservoir, and on the southern side by the M-7 highway (Cheboksary-Moscow).

Light gray forest heavy loam soils are widespread in the micro-district, in the middle and lower parts of the slope altered by water erosion. The undistorted soils are characterized by the following morphological features: a sod horizon A_d of 5-10 cm in thickness, a humus-eluvial horizon A_l up to 15-20 cm. Below it, a transitional horizon A_lA_2 with a thickness of 5-15 cm is located. Gradually, A_1A_2 passes into the eluvial-illuvial horizon A_2B up to 20 cm thick. Illuvial horizon B consists of several subhorizons: B_1 – dark brownish-brown color with spots of humic substances and pseudopodzolic siliceous powder; it gradually shades into a more clarified B_2, followed by the transitional horizon BC and the soil-forming rock C (loess-like loam).

The content of heavy metals in the humus horizon and soil-forming rock, oil products, radio nuclides and benzapyrene corresponds to the background values and does not exceed the MPC.

The soil cover of the Zaovrazhny micro-district and its ecological state were studied for the first time.

Keywords: agrochemical properties, water erosion, humus horizon, soil-forming rocks, gray forest soils, heavy metals.

Introduction. The territory of the Zaovrazhny new micro-district in Cheboksary city is located to the west of the north-western residential area of Cheboksary; it is bounded from the north by the coastal fortifications of the Cheboksary storage reservoir, and on the southern side by the M-7 highway (Cheboksary-Moscow). The soil cover of the Zaovrazhny micro-district has not been studied, and its study and determination of the ecological state were studied for the first time.

Materials and methods. Soil research was carried out in accordance with GOST 17.4.2.03-86. When diagnosing the soil covering of the Zaovrazhny micro-district, the "Classification and Diagnostics of Soils of the USSR" (1977) was used. The content of labile phosphorus and exchangeable potassium was determined by the Kirsanov method, pH – ionometrically. Chemical, bacteriological, helminthological analyses of soil samples were carried out at the Federal State-Funded Budgetary Public Health Facility of the Hygienic and Epidemiological Center No 29 of the Federal Medical-Biological Agency of Russia, No. 2637, and also at the Federal State Institution of SCAS "Chuvashky".

The results of the research and their discussion. The territory of the Zaovrazhny micro-district is located in the North-Western part of Cheboksary and covers an area of 41 hectares. Until 2002, the territory of the micro-district was used as arable land.

In 2017, it was an idle field covered with sow-thistle, tansy and reed grass with young forest groups of 10-15 years of age, sometimes built up by cottages, with engineering networks (electricity, water supply) along the streets.

The site of the real surveys in geomorphological terms is confined to the right bank of the valley of the Volga river with a genetic type of surface – denudation, 300-350 m southeast of the site is the Shupashkarka river, the right feeder of the Volga river, from the northeast and partly from the southeast, the territory borders the allotment gardens, from the northwest - the forestry of the State Forest Fund.

The relief of the built-up area is gently-sloping, with a decrease to the north-east, towards the river Volga.The geological section before the studied depth of 10 m by drilling is mainly represented by Upper Permian and Middle Jurassic rocks, which are covered with quaternary sediments – loess-like loams. Covering loamy loess-like loams are heavy, hard, semisolid, hard-brown and light-brown, macroporous, with humusstains and streaks of calcification, ferruginous, with thin interlayers of sand [6].

Ground waters of a permanent aquifer are opened in the southern part of the site in boreholes at depths of 2.6-7.2 m in the upper fractured zone of Upper Permian sediments.

According to the chemical composition, groundwater is fresh (M = 0.3-0.5 g/l), hydrocarbonate, magnesium-calcium, from weakly acidic to slightly alkaline, lime, moderately hard, with pH 6.3-6.4.

As a result of the real soil studies, it was revealed that the soil cover on the territory of the Zaovrazhny micro-district in Cheboksary is represented by washed-away types (lightly washed, medium- and heavily washed) of light gray forest soil.

Not washed-away soils are characterized by the following morphological features: a sod horizon of 5-10 cm in thickness, a humus-eluvial horizon A_1 of light-gray or gray color, of low thickness (up to 15-20 cm).

The transitional horizon A_1A_2 is light-gray in color, a finely-nutty-lumpy structure, 5-15 cm of thickness. Gradually, A_1A_2 passes into the eluvial-illuvial horizon A_2B up to 20 cm thick, which is characterized by a finely-nutty structure, the silica powder on the faces of structural separates in combination with washing away stains of humus and other substances.

The illuvial horizon B consists of several subhorizons: B_1 is a dark brownish-brown color with spots of humic substances and pseudopodzolic silica powder; it gradually transforms into a more decolorized horizon B_2, followed by the transitional horizon BC and the soil-forming rock C (loess-like loam).

In the investigations, soils with upper plowed up part of the horizon A_2B were attributed to light washed types; to the medium-washed ones – when a large part or the whole of the A_2B horizon is involved in the plowing layer and its absence; and to heavily washed ones - soils, in the profile of which there were no horizons A_2B and B_1.

The morphological features of the reservoir soils are characterized by the fact that the former homogeneous arable Ap horizon was divided into two genetic horizons – A_1 and A_1A_2, which are presented in virgin soils.

Description of the profile of light washed light-gray forest hard loamy medium-thick soil on loess-like loam (section 1), laid on a reservoir covered with birch and aspens with a thinned herb layer (brome grass, chicory, milfoil, dandelion) is shown in table. 1.

Table 1 – Description of the profile of light washed light-gray forest soil

A_1	0-20 cm	Wet, gray, heavy loamy, lumpy, loose. There may be roots, worm channels, earthworms, grub worm, clear transition.
A_1A_2	20-25 cm	Wet, whitish-gray, heavy loamy, lumpy, dense, there are roots, spangles of silica, worm channels, clear transition.
A_2B	25-38 cm	Humidified, brownish-gray, heavy loamy, lumpy, finely-nutty, does not boil up from 10% hydrochloric acid.
B_1	38-49 cm	Humidified, brownish-brownish, heavy loamy, nutty, with spanglesof silica and humus stains, does not boil up from 10% hydrochloric acid.
B_2	49-91 cm	Humidified, brown, heavy loamy, large-nutty, with humusstains, does not boil up from 10% hydrochloric acid.
BC	91-130 cm	Moistened, brown, with root channels, rare humus stains, heavy loamy, structureless, does not boil up from 10% hydrochloric acid.
C	130-180 cm	Humidified, light-brown, heavy loamy, structureless, in the lower part slightly boil up from 10% hydrochloric acid.

In medium-washed light-gray forest soils on reservoirs with densely mixed herbs, the processes of water erosion are sharply weakened, in place of the former grayish-brown color of the arable layer, a sod horizon of A_d and humus-eluvial horizon A_1 or transitional A_1A_2 was formed. They are uniformly gray with inclusions of brownish-brown clayey lumps, sometimes with light silica powder.

Below them the transitional horizon A2B lies, the depth of the upper boundary of which the degree of soil erosion is determined (table 2). In heavily washed light-gray forest soils bordering the lower part of the slope, the processes of water erosion under mixed grass also became weaker, and in the place of the former arable layer, a sod horizon A_d was formed, that was underlaid by the illuvial horizon B.

Table 2 – Description of the profile of the medium-washed light-gray forest soil

A_d	0-8 cm	Wet, gray, with separate brownish-brown lumps, heavy loamy, lumpy, loose. The roots are densely interwoven, there are worm channels, earthworms, rare – the grub worm, the transition is clear.
A_1A_2	8-23 cm	Wet, whitish-gray, with separate whitish-brown lumps, heavy loamy, finely-nutty-lumpy, pressed, there are roots, silica spangles, worm channels, clear transition.
A_2B	23-26 cm	Humidified, brownish-gray, heavy loamy, lumpy, finely-nutty, dense, does not boil up from 10% hydrochloric acid.
B_1	26-36 cm	Moistened, brownish-brownish, heavy loamy, nutty, with spangles of silica and humus stains.
B_2	36-85 cm	Humidified, brown, heavy loamy, large-nutty, with humus stains.
BC	85-110 cm	Humidified, light-brown, heavy loamy, structureless, does not boil up from 10% hydrochloric acid.

In consequence of the weakening of the eluvial-eluvial soil-forming process due to the low water resistance of aggregates, strong lateral water flow, the profile of heavily washed light-gray forest soils is shortened (table 3).

Table 3 – Description of the profile of the heavily washed light-gray forest soil

A_d	0-7 cm	Wet, grayish-brown, heavy loamy, lumpy, loose. The roots are densely interwoven, there are worm channels, earthworms, grub worms, the transition is clear.
AB	7-16 cm	Wet, grayish-brownish-brown, heavy loamy, pressed,
B_2	16-59 cm	Humidified, brown, heavy loamy, large-nutty, with humus stains.
BC	59-82 cm	Humidified, light-brown, heavy loamy, structureless, does not boil up from 10% hydrochloric acid.

As a result of the soil investigations, a soil map of the Zaovrazhny micro-district was drawn upon a scale of 1:500 (GOST 17.4.2.03-86).

Soil studies have revealed that the total area of eroded soils on the territory of the micro-district is 86.7%, which corresponds to the conclusions obtained as a result of monitoring the soils of the Chuvash Republic - it was eroded more than 80% of the arable land [2, 5].

On the total area of 41 hectares, the following soil types of light-gray forest soils were formed (table 4).

Table 4 – Areas of soil types in the territory of the Zaovrazhny micro-district in Cheboksary

#	Name of the soil	Soil index	Area	
			ha	%
1	Light-gray forest heavy loamy medium-thick soils on loess-like loam	$Л_1$с/л	5.1	12.4
2	Light-gray forest heavy loamy medium-thick light washed soils on loess-like loam	$Л_1$с/л↓	20.7	50.6
3	Light-gray forest heavy loamy, medium-thick, medium-washed on loess-like loam	$Л_1$т/л↓↓	11.1	27.0
4	Light-gray forest heavy loamy, medium-thick, heavily washed on loess-like loam	$Л_1$т/л↓↓↓	4.1	10.0
	Total		41	100.0

The results of agrochemical analyses of soil samples characterize them as typical for light-gray forest soil of the northern natural-agricultural zone of Chuvashia [3, 4, 7].

The humus content in the soils of the site is low - from 1 to 3% (very low and low). The sum of exchange bases (S) in the upper soil horizon is 16.7-21.3 mg-e / 100 g, hydrolytic acidity (Ng) – 1.03-4.43 mg-e/100 g of soil. The content of labile phosphorus and exchangeable potassium is characteristic of light-gray forest soils: mainly medium and high. The saturation degree with soil bases is 82-94%. The reaction of soils varies from a medium to a neutral.

A study of the content of radionuclides (cesium-137 and strontium-90) in the upper horizon of the soil (B1) showed a low content of 8.6-12.20 and 3.3-4.4 Bq/kg, respectively.

According to the GOST 17.5.3.06-85 indices and calculations, the thickness of the fertile soil layer on the total area of the construction site with the area of 41 hectares is on average 20 cm. The total mass of the fertile soil layer with an average bulk density of 1.14 g/cm^3 is 2280 tons.

The total mass of a potentially fertile layer with the thickness of 25 cm and the average bulk density of 1.25 g/cm^3, located beneath the fertile layer, averages 3125 tons/ha.

Conclusion. As a result of the studies, the soil cover of the Zaovrazhny micro-district was revealed. The current state of soil quality in the micro-district area corresponds to sanitary and epidemiological requirements. The results of the research unequivocally testify to the ecological well-being of the territory of Cheboksary city of the Chuvash Republic [1], considering the new buildings located next to the ravine system.

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ЧЕБОКСАРЫ ҚАЛАСЫНЫҢ «ЗАОВРАЖНЫЙ» МӨЛТЕК АУДАНЫНДАҒЫ ТОПЫРАҚ ҚҰРАМЫ МЕН ЭКОЛОГИЯЛЫҚ ЖАҒДАЙЫ

Аннотация. 2017 жылдың шілде-тамыз айларында Чебоксары қаласындағы «Заовражный» мөлтек ауданындағы топырақтың агрохимиялық құрамы зерттелді.

Чебоксары қаласындағы жаңа «Заовражный» мөлтек ауданы территориясы Чебоксары қаласының солтүстік-батысында орналасқан; ол солтүстігінен Чебоксары су қоймасының жағалаулық су бекіністерімен, ал оңтүстік жағынан «М-7» көлік жолымен шектелген (Чебоксары-Москва).

Мөлтек ауданы территориясында ашық-сұр түсті орманның ауыр батпақты топырағы таралған, ал орта және төменгі тұстарында ол су эррозиясына ұшырап өзгерген. Сумен шайылған топырақтар келесідей морфологиялық белгілерімен сипатталады: $А_д$ дерналық қабатының қалыңдығы 5-10 см, қарашірікті-элювиальды

A_1қабаты 15-20 см дейін. Олардың астында қалыңдығы 5-15 см құрайтын A_1A_2өтпелі қабаты орналасқан. Біртіндеп A_1A_2 қалыңдығы 20 см дейін жететін A_2B элювиальды-иллювиалды қабатына өтеді. В –иллювиальды қабаты бірнеше қабат қатпарларынан тұрады: B_1 – қара-қоңыр түсті қарашірікті заттардық теңбілдері бар және лессивировты кремни реңді себінделерден құралады; ол біртіндеп ақшыл тартқан B_2 қабатына, содан кейін өтпелі ВС және топырақ құраушы С (лессогоұқсас суглинок) қабаттарына айналады.

Топырақ құраушы қарашірікті қабаты құрамындағы ауыр металдардың, мұнай өнімдерінің, радионуклеидтер мен бензапирендер мөлшерлері фондық мәндеріне сәйкес келеді және ШРК аспайды.

«Заовражный» мөлтек ауданындағы топырақ қабаты мен оның экологиялық жағдайы алғаш рет зерттелінді.

Түйін сөздер: агрохимиялық қасиеті, су эррозиясы, қарашірікті қабат, топырақ құраушы породалар, сұр түсті орман топырағы, ауыр металдар.

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ПОЧВЕННЫЙ ПОКРОВ МИКРОРАЙОНА «ЗАОВРАЖНЫЙ» Г. ЧЕБОКСАРЫ И ИХ ЭКОЛОГИЧЕСКОЕ СОСТОЯНИЕ

Аннотация. В июле-августе 2017 г. проводились почвенно-агрохимические исследования территории микрорайона «Заовражный» г. Чебоксары.

Территория нового микрорайона «Заовражный» г. Чебоксары расположена к западу от северо-западного жилого района г. Чебоксары; она с севера ограничена береговыми укреплениями Чебоксарского водохранилища, а с южной стороны автотрассой «М-7» (Чебоксары-Москва).

На территории микрорайона распространены светло-серые лесные тяжелосуглинистые почвы, в средней и нижней части склона измененные водной эрозией. Несмытые почвы характеризуются следующими морфологическими признаками: дерновый горизонт $A_д$ мощностью 5-10 см, гумусово-элювиальный горизонт A_1 до 15-20 см. Под ним расположен переходный горизонт A_1A_2 мощностью 5-15 см. Постепенно A_1A_2 переходит в элювиально-иллювиальный горизонт A_2B мощностью до 20 см. Иллювиальный горизонт В состоит из нескольких подгоризонтов: B_1 – темно-буровато-коричневой окраски с пятнами гумусовых веществ и лессивированной кремнеземистой присыпки; он постепенно переходит в более осветленный B_2, сменяющиеся переходным горизонтом ВС и почвообразующей породой С (лессовидный суглинок).

Содержание тяжелых металлов в гумусовом горизонте и почвообразующей породе, нефтепродуктов, радионуклеидов и бензапирена соответствует фоновым значениям и не превышают ПДК.

Почвенный покров микрорайона «Заовражный» и его экологическое состояние изучались впервые.

Ключевые слова: агрохимические свойства, водная эрозия, гумусовый горизонт, почвообразующие породы, серые лесные почвы, тяжелые металлы.

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