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GRANULOMETRIC COMPOSITION OF SOIL IN ASTANA CITY

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Abstract

Urban soil is one of the most polluted components of the environment. An increase in anthropogenic load on urban soils, as well as pollution by various wastes, the accumulation and compaction of particularly dangerous non-recyclable substances, covering the soil surface with a waterproof layer during construction provoke a violation of the structure and a change in the physical and chemical composition of the soil.

Soil serves as a natural filter that absorbs and neutralizes toxic substances released by anthropogenic influences. This activity occurs at different levels depending on the mechanical and granulometric characteristics of the soil. Therefore, when studying the state of pollution of urban soils, it is necessary to pay attention to the species composition of soils.

This article provides an assessment of the granulometric characteristics of soils in Astana. In the city of Astana, soil samples were analyzed from the microdistricts of Saryarka, Baikonur, Almaty, Yesil, Nura (60 points in total). The soils of the territory of the city of Astana are represented by the following types: dark chestnut soils and their varieties, meadow-chestnut soils and their varieties, solonchaks and

urbanozems; according to the granulometric composition of the soil, they are represented by heavy, medium and light loams.

Key words: city soil; anthropogenic load; soil granulometric composition; pollution.

Introduction

The expansion of urban areas worldwide is increasing the anthropogenic impact upon soil and highlights the important role of areas in supporting a sustainable future [1].

Intense and varied human activity in large cities and their surroundings leads to significant changes in the environment: the relief and hydrographic network change, natural vegetation is destroyed or replaced by urban phytocenoses, the soil cover is greatly transformed, climatic characteristics change, i.e. [2] a specific type of urban microclimate is formed. The main contribution to urban soil pollution comes from precipitation and emissions from the transport and road complex [3].

Indicators of “soil health” characterize the general ecological and ecosystem functions of the soil, while indicators of “soil quality” reflect the parameters of soil fertility [4].

Currently, when designing and creating urban landscapes, soils are often not given due attention. Landscaping work is carried out without taking into account soil properties. The soil is taken into account as soil, a substrate for new landscaping, for planting new green spaces and is not considered as an independent natural body with a certain set of characteristic chemicals, biological properties [5].

The interest of scientists in the study of urban soils is steadily growing following the increase in the area of urbanized territories. Currently, more than 3/5 of the world's population lives in urbanized areas. The most urbanized states (except for city states) are Kuwait (98,3%), Bahrain (96,2%), Qatar (95,3%), Malta (95%). In Northern and Western Europe, the urban population accounts for more than 80% [6].

Soil plays an important role in regulation the atmospheric composition and climate change [7].

The granulometric composition of urban soils is formed under the influence of natural and anthropogenic factors [8].

Currently, the problem of classifying urban soils remains one of the most pressing in soil-ecological studies of urban areas [9].

Contaminated soil acts are a source of secondary pollution of the surface layer of atmospheric air when it comes into direct contact with humans. HMs are conservative pollutants capable of migrating along trophic chains in any ecosystems and the danger of which is associated with mutagenic, toxic and carcinogenic effects on living organisms [10].

Monitoring of urbanized areas revealed a number of problems, including: flooding of the territories of large cities after precipitation; not maintained, often compacted condition of lawns, parks and other areas; soil erosion and others [11].

In assessing the ecological state of urban soils, forecasting and planning of urban infrastructure, landscaping, the main focus should be on the species composition of soils. It is known that soil pollution (associated with heavy metals, microbiological and helminthological) and the level of distribution of pollutants depend on the composition of the soil. Therefore, in a comprehensive assessment of the ecological state of the city's soil, it is important to first determine the granulometric composition of the soil. Currently, research on the conservation development of the natural ecosystem of Astana is of high relevance.

Purpose of the study: conducting soil surveys of the territory of the city of Astana. The objectives of the study are to determine of the granulometric composition of soils of each microdistricts of Astana city: Esil, Saryarka, Baikonur, Almaty and Nura.

Materials and methods

The area of the city of Astana is 797,3 thousand square meters. km., according to the 2023 census, the city of Astana has a population of -1,354.4 thousand people. The city is divided into the microdistricts of Almaty, Saryarka, Yesil, Baikonir and Nura [12].

The territory of Astana is located within two latitudinal soil zones - chernozem and chestnut, which are divided respectively into subzones of ordinary and southern chernozem, dark chestnut, chestnut and light chestnut soils. The northernmost part of the territory, located in a moderately arid steppe and with hilly, ridged and partly mountainous topography, is occupied by a subzone of ordinary chernozems [13].

The soil cover of Astana city is part of the Nura Yesil province and is composed of: dark chestnut, meadow-chestnut, meadow, floodplain, meadow- bog chestnut, marsh chestnut soils, saline soils, salt marshes, urban soils.

In total, soil samples were taken from 60 points throughout the city of Astana. Sampling points covered 5 microdistricts Esil, Saryarka, Baikonur, Almaty, and Nura (Fig. 1.)

Soil samples were taken at a depth of 0-30 cm, the determination of the granulometric composition was carried out based on the recommendations of "GOST 12536-2014, p. 4.4" [14].

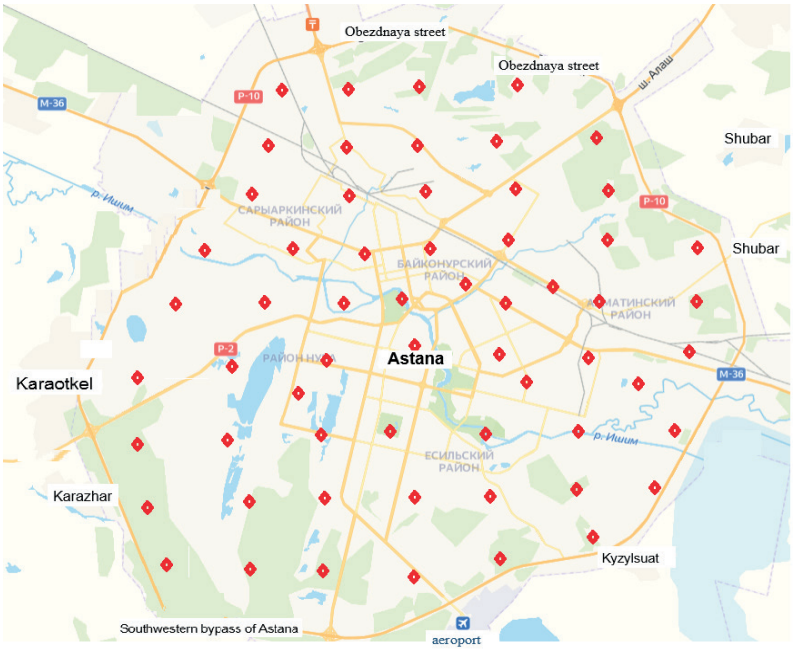

Figure 1 – Soil sampling points in the city of Astana

Results

A survey of the soil cover of the territory of the city of Astana showed that according to the classification of soils by granulometric composition (according to N.A. Kachinsky), the urban soils of the city are represented by medium loamy, heavy loamy and light loamy soils.

Thus, on the territory of the Saryarka region, out of 11 soil samples taken from a depth of 0-30 cm at various points in the region, 6 samples were heavy loams, with a physical clay content from 45.76 to 53.41%; 4 samples for medium loam, with a physical clay content from 30,99 to 38,6%, and only 1 sample for light loam, with a physical clay content of 26,69% (Table 1).

Table 1 – Content of physical clay in the soil layer 0-30 cm, Astana, %

Saryarka		Baikonur		Almaty		Yesil		Nura	
physical clay content, %	short name of the soil based on its granulometric composition	physical clay content, %	short name of the soil based on its granulometric composition	physical clay content, %	short name of the soil based on its granulometric composition	physical clay content, %	short name of the soil based on its granulometric composition	physical clay content, %	short name of the soil based on its granulometric composition
45,7591	Hl	38,04947	Ml	48,94788	Hl	51,1452	Hl	41,7442	Ml
49,9982	Hl	43,9781	Ml	33,86394	Ml	29,3076	Ll	47,8143	Hl
36,531	Ml	49,383	Hl	51,5593	Hl	44,7681	Ml	50,2324	Hl

Continuation of Table 1

30,9935	Ml	47,8967	Hl	43,6412	Ml	46,1751	Hl	48,1732	Hl
36,9033	Ml	41,6083	Ml	49,1181	Hl	38,6277	Ml	48,7664	Hl
26,6906	Ll	49,4329	Hl	52,6074	Hl	44,6143	Ml	43,4035	Ml
38,5993	Ml	50,8589	Hl	46,2608	Hl	43,2591	Ml	47,3981	Hl
50,9258	Hl	47,6179	Hl	39,9944	Ml	46,0611	Hl	46,3841	Hl
48,7882	Hl	36,2711	Ml	42,5322	Ml	48,9669	Hl	44,7272	Ml
50,2643	Hl	44,8993	Ml	44,6143	Ml	49,0323	Hl	43,9061	Ml
53,4073	Hl	46,6723	Hl	46,6741	Hl	49,9673	Hl	43,5417	Ml
		51,7113	Hl	44,106	Ml	47,9492	Hl	44,0557	Ml
								45,2284	Hl

*Hl – heavy loam, Ml – medium loam, Ll- light loam

Discussion

On the territory of the Baikonir region, out of 12 selected soil samples from a depth of 0-30 cm, 7 samples were classified as heavy loams (46.67-51.71%), 5 samples were classified as medium loams (36.27-44.9%). Out of 12 studied soil samples taken from a depth of 0-30 cm from various points in the Almaty region, 6 belonged to heavy loams (46.26-52.61%) and 6 to medium loams (33.86-44.61%). In the Yesil region, 7 soil samples are classified as heavy loam (45.23-50.23%), 4 soil samples are classified as medium loam (38.62-44.77%) and 1 sample is light loam (29.31%). On the territory of the Nura region, out of 13 selected soil samples from a depth of 0-30 cm, 7 samples were classified as heavy loams (45.23-50.23%), 6 samples were classified as medium loams (41.74-44.72%).

On average, the content of physical clay in the soil layer 0-30 cm in the Saryarka and Yesil districts was 42.92% and 44.99%, respectively, which corresponds to medium loam according to the classification of soils according to the granulometric composition (according to N.A. Kachinsky) (Fig. 2).

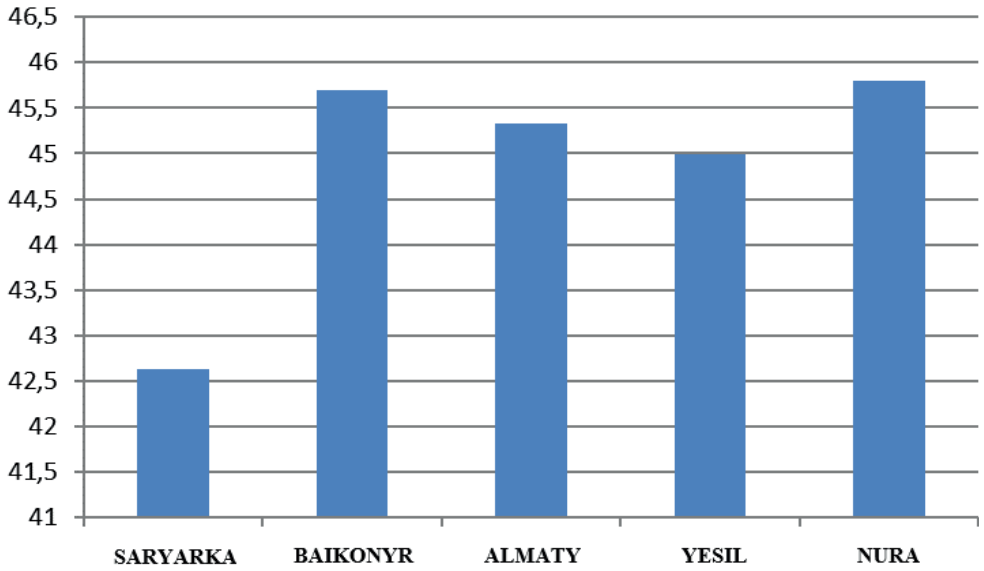

Figure 2 – The average content of physical clay (particles less than 0.01 mm) in the soil layer 0-30 cm in different areas of Astana, %

Average content of physical clay in the soil of the Baikonyr, Almaty and Nura boroughs was 45.7%, 45.33% and 45.8%, respectively, which corresponds to heavy loams.

Conclusions

Thus, studies have shown that the soils of the city of Astana, in terms of granulometric composition, are represented by heavy, medium and light loams. On average, the content of physical clay in the soil layer 0-30 cm in the Saryarka and Yesil boroughs was 42.92% and 44.99%, respectively, which corresponds to medium loams. This is due to the fact that the soil cover of these areas of the city includes light loams with a physical clay content of 26.69% and 29.31%, respectively. And the soil covers of the Baikonyr, Almaty and Nura boroughs is represented only by heavy and medium loams. And the average content of physical clay in the soil of the Baikonyr, Almaty and Nura boroughs was 45.7%, 45.33% and 45.8%, respectively, which corresponds to heavy loams.

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АСТАНА ҚАЛАСЫ ТОПЫРАҒЫНЫҢ ГРАНУЛОМЕТРИЯЛЫҚ ҚҰРАМЫ

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Түйін

Қала топырағы қоршаған ортаның ең ластанған компоненттерінің бірі болып табылады. Қала топырағының антропогендік жүктемесінің артуы, сонымен қатар әртүрлі қалдықтармен ластануы, оларда ерекше қауіпті өңделмейтін заттардың жиналуы және тығыздалуы, құрылыс кезінде жер бетін су өткізбейтін қабатпен жабу құрылымның бұзылуына және топырақтың физика-химиялық құрамының өзгеруіне әкеледі.

Топырақ - антропогендік әсерлерден бөлінетін улы заттарды сіңіретін, бейтараптандыратын табиғи сүзгі ретінде қызмет етеді. Бұл әрекет топырақтың механикалық, гранулометриялық ерекшеліктеріне байланысты әртүрлі деңгейде жүреді. Сондықтан, қала топырағының ластану жағдайын зерттеу кезінде, ең алдымен, топырақтың түрлік құрамына назар аудару қажет.

Бұл мақалада Астана қаласы топырағының гранулометриялық ерекшеліктеріне баға берілген. Астана қаласындағы Сарыарқа, Байқоңыр, Алматы, Есіл, Нұра шағын аудандарынан топырақ сынамалары талданды (барлығы 60 нүктеден). Астана қаласы аумағының топырағының түрлік құрамы: қара қоңыр топырақ және олардың сорттары, шалғынды - қоңыр топырақ және олардың сорттары, сортаң және урбандалған топырақ. Ал топырақтың гранулометриялық құрамы бойынша ауыр, орташа және жеңіл саздақтар.

Кілт сөздер: қала топырағы; антропогендік жүктеме; топырақтың гранулометриялық құрамы; ластану.

ГРАНУЛОМЕТРИЧЕСКИЙ СОСТАВ ПОЧВЫ ГОРОДА АСТАНА

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Аннотация

Городская почва является одним из наиболее загрязненных компонентов окружающей среды. Повышение антропогенной нагрузки на городские почвы, также загрязнение различными отходами, накопление и уплотнение в них особо опасных неперерабатываемых веществ, покрытие поверхности почвы водонепроницаемым слоем при строительстве, провоцируют нарушение структуры и изменение физико-химического состава почвы.

Почва служит естественным фильтром, который поглощает, нейтрализует токсичные вещества, выделяемые антропогенными воздействиями. Эта деятельность происходит на разных уровнях в зависимости от механических, гранулометрических особенностей почвы. Поэтому при изучении состояния загрязнения городских почв, в первую очередь, необходимо обратить внимание на видовой состав почв.

В данной статье дана оценка гранулометрических особенностей почв г. Астана. В городе Астана были проанализированы пробы почвы из микрорайонов Сарыарка, Байконур, Алматы, Есиль, Нура (всего 60 точек). Почвы территории города Астана представлены следующими видами: темнокаштановые почвы и их разновидности, лугово-каштановые почвы и их разновидности, солончаки и урбаноземы, по гранулометрическому составу почвы представлены тяжелыми, средними и легкими суглинками.

Ключевые слова: почва города; антропогенная нагрузка; гранулометрический состав почвы; загрязнение.