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Influence of granulometric composition structure of anthropogenic-reformed soil on ecology of infrastructure

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Abstract

As a result of long-term researches it has been established, that creation of a friable blanket on leached chernozem in the conditions of Western Siberia leads to its gradual pauperisation by physical clay (<0.01 mm) at the expense of washing away. Migrating on a soil profile, elementary soil particles accumulate in layers of 20–40 and 60–80 cm., forming the recondensed horizons with the lowered water permeability. In a layer of 20–40 cm. mainly collect an average and small silt, and in 60–80 cm. - clay fraction. Speed infiltration the generated layers almost on 40 % below values of a virgin soil. In the conditions of Siberia it can lead to stagnation of water in the top layers or to its unproductive loss at the expense of physical evaporation and a superficial drain. The received results can become a basis for optimisation of granulometric composition artificial ground and system engineering of preparation of the soil stabilising an ecological condition of anthropogenic-reformed territories.

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1. Introduction

Granulometric composition is considered to be one of the most important soil formation factors. It has a great effect on air, thermal, water-physical, physical-mechanical properties. Granulometric composition is used in soil description. It forms the basis of one of the main taxonomic units of modern soil classification - varieties. Since 19th

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century scientists repeatedly emphasized the role of granulometric composition as a fertility factor. It is considered to be one of the main characteristics of ecological soil state taken into account in monitoring of erosion process, degradation, heavy metals storage and migration and other harmful substances. When analyzed granulometric composition of main soil in the south of Western Siberia V.L. Tatarintsev [1]; A.S. Motorin and A.V. Bukin [2] established close correlation between heavy metals content and clay fraction of soil. Also it was confirmed with scientists of other regions [3-6]. Taking into account that granulometric composition of soil is stable during long period of time; the scientists didn't usually deal with a problem of its change under the influence of anthropogenic factor. Except for studies concerning artificial soil but in this case it was a matter of process of solid separate fractions mixing for obtaining soil with definite properties [7, 8]. Intensification of anthropogenic load to the soil made changes in modern soil formation on huge land territories - it is more evident in agrocenosis [9, 10]. There were appeared many ecological and agronomy research works showing change factors of fertility under the influence of human being, marking general fertility decrease. [11, 12]. In order to explain modern process of soil formation it is necessary to analyze particularly granulometric composition of soil and its changes under the influence of anthropogenic factor.

2. Study area and methods

The surveyed area included experimental plot of the State Northern Zauralye Agrarian University, the plot was established in 1968 on virgin leached chernozem (Luvic Voronic Chernozems WRB, 2006). The plot is situated in the northern forest-steppe of eastern edge of the Trans-Ural Plateau. Parent material is clay pulverescent loess-like loams (no more 10 meters thickness). After sampling in 1968, one part of the plot was ploughed and in tillage up to date, the other part is under natural vegetation in virgin state so far.

The object is leached chernozem, rich (fertile), middle loamy on carbonate loess-like loam with typical Western Siberian features and properties [13]. According to granulometric composition it belongs to clay pulverescent middle loamy variety. It is noted that there is redistribution of clay fractions within the soil profile. Thickness of a humus horizon makes up 57 cm., from which 41 cm. is a humus accumulative horizon. Boiling depth from HCI is 105 cm. Thickness of a horizon Bk is not exceeding 1 meter.

There are different grasses on virgin lands; the following plants are predominant: *Libanotis sibirica*, speedwell (*Veronica spicata*), meadow pea (*Lathyrus pratensis*), timothy grass (*Phleum pratense*), meadow foxtail (*Alopecurus pratensis*).

The recurrent surveys were carried out on virgin lands and in plowed field in 2012. It gave an opportunity to conduct comparative analyses of granulometric composition structure and to reveal anthropogenic migration of separate solid phase fractions. Soil sampling was conducted layer-by-layer in every 10cm. up to 2 meters depth in six multiple repeatability. Granulometric composition was determined by pipette method using pyrophosphate method of probe preparation (by Kachinskiy). In 2012 there was also used a laser granulometer Analisette - 22; water permeability was studied by cylinder method separately layer-by-layer in six multiple repeatability. Statistical analysis of results was conducted according to B.A. Dospekhov.

3. Results

It is noted that there is redistribution of clay fractions within the soil profile of analyzed leached chernozem. Its content normally increases from 30cm. depth forming horizon B2 without humus and carbonate, but with illuvial features of horizon. There is an excess of 8% towards humus -accumulative horizon (fig.1).

Topping of the profile up to 40 cm. depth differs from underlying layers of soil-forming stratum by small content of sand (>0.005 mm.) and a coarse silt (0.005 – 0.01 mm.), fine fractions (0.005 – 0.01 mm.).

On virgin plot in humus-accumulative horizon, physical clay content makes up 43-44%, whereas in deeper layers this index reached 50%. This indicates differentiation of leached chernozem profile and extraction of illuvial horizon within the profile. It is caused by modern movement of fine silt and clay fractions without their destruction [14].

From 1968 to 2012 there were not revealed any changes of physical clay distribution through the profile. There was a decline caused by measurement error and made up less 1% relative to initial value. This is explained by the fact that under herbaceous vegetation is formed desuctio-non-washing regime of soil preventing deep penetration of

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