The dependence of the technosols models functional properties from the primary stratigraphy designs

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Abstract. In the present article the assumption that the design of the soil-like artificial body in zero-moment of existence determines the dynamics and trajectory of soil-forming process was tasted. It was shown that an important aspect of the experiment is the search criteria that you can perform evaluation of the functional properties of the generated structures depending on their organization. The study of the water infiltration dynamics from the soil surface is highly informative non-destructive testing for evaluating the properties of the soil body. Studies showed that technosols as artificial creation have fundamental differences between the natural soils for which the classic Philip equitation was proposed. Technosoils are porous, but heterogeneous formations. The process of filtering in technosols is not laminar, periods of smooth water infiltration is outbreak by disastrous water absorption. To simulate this process it was showed that the better results may be obtained due to originally modified Philip equitation. Specific constant C describes the dynamics of the infiltration process the early stages of the experiment and is a specific indicator for technosols. In natural soils this constant is zero. The sorptivity of the pedozems was reveled to be depended from the underlying layer. Organic components contribute to the formation of aggregate most of which is water resistant. Such formations smooth density variation of clay soil resulting from swelling and shrinkage processes that can maintain stable structure of the pore space. As a result, the soil after phytomeliorative rotation gets such features as reduced infiltration rate, but increased level of filtration. The artificial mixture of clay has significant waterproof properties, which ultimately can lead to complete discontinuance of water absorption by technosols. Waterproof properties of soil may increase the risk of water erosion of technosols. For technosoils structural change of the pore space state are inherent in contact with water because hydrolabile units of their structure. Accordingly, during the infiltration process there are significant changes in the course of the rate of filtration of water.

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Introduction. Soil is a transitional link from the world of living nature in the world of the inanimate nature, from the biosphere to the geosphere (Karpachevsky, 1983). Soil linkages mechanisms with other biogeoceonosis components and its main feature – fertility are determined by the migration and transformation of matter and energy that occur in the soil depth under the influence of the introduction and removal of biogenic and abiogenic substances (Kharytonov et al., 2018). Material-energy metabolism of terrestrial biogeoceonosis in no small degree depends on the physical condition of the abiotic part of the soil (Karpachevsky, 2005). The soil is a most conservative component of the biogeoceonosis (Anderson et al., 1998). Its buffer properties contribute to the preservation of specific biogeoceonosis type, regulation of thermal and water regimes in biogeoceonosis, toxic substances neutralizing that are formed in biogeoceonosis during his life (Heuvelink, Webster, 2001; Rode, 1984).

In biogeoceonology soil is considered as a part of the internal environment converted by biota (Kunah, 2016). Study of space-time variability of the soils properties allowed to justify the concept of soil ecomorphes as a part of biogeocenotic cover (Zhukov, Zadorozhnaya, 2016). Soil ecomorphes and other biogeocenotic ecomorphes demonstrate regularly dynamics in the gradient humidity and trophicity of soils (Zhukov, Shatalin, 2016). Heterogeneous soil conditions are formed as a result of small biological cycle and determined by key species, creating the diversity of habitats (Zverkovskyi et al., 2017). Features of soil as habitat create ecological space for soil animals (Zhukov et al., 2016). Soil fertility is closely linked to its morphological characteristics, such as the color of the soil itself, the depth of the humus layer, the density of soil structure (Yakovenko, 2008). The soil is a hierarchical multi-level system, each level of which has its own elemental structure (Fridland, 1972).

The gradual formation of morphological structures is occurred in the technosols following the soil formation process after the beginning of their construction, which in the future will be converted into genetic horizons, which are homologous genetic horizons of natural soils (Zadorozhna et al., 2012). The formation of morphological organization of the soil-like bodies leads to gain them functional properties that approach them to natural soils (Zabaluev, 2010). This trend is particularly important in the context of agriculture reclamation which has the goal of restoring the use of the land in agricultural production (Bekarevich, 1971). You can expect that under the influence of general soil-forming factors over time the artificially created soil-like bodies will obtain properties and structure, similar to natural soils. But there remains an unknown trajectory of this process and its duration in time. Variable properties of technosols in space and time can be estimated by a number of informative and valuable indicators (Zhukov et al., 2016).

As a hypothesis can be considered the assumption that the design of the soil-like artificial body in zero-moment of existence determines the dynamics and trajectory of soil-forming process. An important aspect of the experiment is the search criteria that you can perform evaluation of the functional properties of the generated structures depending on their organization.

Materials and methods. At the research station of the State Agrarian and Economic University a field experiment with lysimeters, each of which contains a special combination of rocks or chernozem-like mass was started to test this hypothesis in the 1990s (Fig. 1) (Zabaluev, 2010).

The design of technosolsmodels allow to explore different options of soils combinations (Figure 2). First of all, these monomodels which are made up of only humus material, loess-like loam, reddish-brown clay and loam. Application of humus material is quite natural, since it is by definition is the most fertile and suitable for agricultural use. To some extent, such an option can be considered as control. But the formation of a powerful layer of humus mass does not solve all the problems of reclamation. During technological actions the humus mass properties change significantly so this mass cannot be considered as identical to genetic horizons of natural soil or agrozems.

Fig. 1. Experimental lysimeters to determine the optimal technosols stratigraphy on bioecological research station of the Dnipro State Agricultural and Economic University (Pokrov city, Dnipropetrovsk region, Ukraine)

The most important trend of such mass transformation due to reclamation technological actions is a dehumification. In addition, artificially created layers do not possess constructive strength. This aspect effects considerably on the progress of physical, chemical and biological processes in the technosol. Hence the dynamics of the monomodels with humus material are needed to be investigated. It should be added that the volume of humus material is limited. In this connection there is a need to construct technosols from rocks that are not phytotoxic and have the property fertility (Bekarevich, 1971). In this regard monomodels from rocks should also be regarded as basic. The technological mix of rock in which there is no a horizontal stratification can be seen as monomodel. Indeed, categories such as "blue-green clay", "loess-like loam" or "red-brown clay" is also a technological mixture with predominance of visual components on which such a mixture is named.

More complex models emphasize the idea that influence on the technosol properties may be down by using a combination of different components. These are pedozem variants (humus material from genetic horizons of the chernozems disturbed by mining development is applied for their formation) based on various rocks such as loess-like loam, clay gray-green, red-brown clay and loam. In such models an important aspect of varying is a thickness of the humus layer. Naturally, humus material is always placed on the technosol surface.

More complex models (three- or more component) attract interest, or with a vertical repetition layers in two-component models and their combination (regular repetition of two-component model, which is located on the third type of rock). Tree-component models are usually such that have the goal to create water-proof or waterborne layer (the so-called water-accumulative models) (Zabaluev, 2010). The origin of the rocks for reclamation may also be variable. Rocks can be taken directly from the of career side or after exposure to phytomeliorative rotation. The study of the water infiltration dynamics from the soil surface is highly informative non-destructive testing for evaluating the properties of the soil body.

Optimal infiltration intensity must be accompanied by favorable performance stability over time, which affects the coefficient of permeability. This coefficient, which exceeds 1.5, does not guarantee against the floating of the soil surface and the subsequent formation of crusts even after a short intense downpour (Medvedev et al., 2011). The resulting dynamic curves along with a high resolution differential ability are ecologically relevant, that reflect the properties of the soil as the habitat of living organisms. Important aspects water infiltration parameters are absolute levels of infiltration and filtration and extinction coefficient of the soil permeability.

Studies shown that technosols as artificial creation have fundamental differences between the natural soils for which the classic Philip equitation was proposed. Technosoils are porous, but heterogeneous formations. The process of filtering in technosols is not laminar, periods of smooth water infiltration is outbreak by disastrous water absorption. To simulate this process it was showed that the better results may be obtained due to the more complicated model:

$$Q = S_p \cdot t^{1/2} + A_p \cdot t + B,$$

where B is additional constant. Modeling done in Statistica 7.0 program in module User-Specified
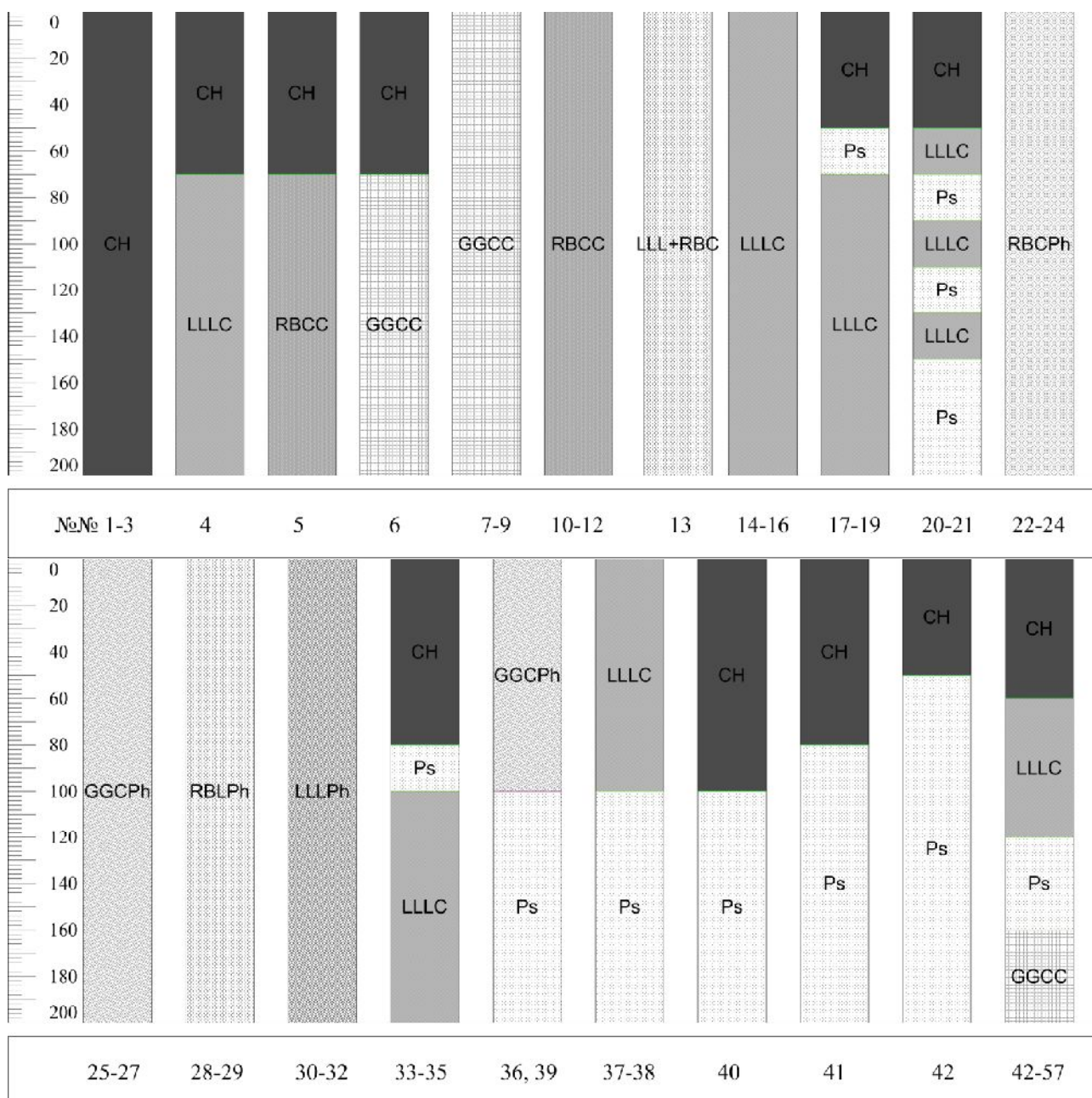
Fig. 2. Stratigraphy of the technosol models (1–57)
Legend: CH – chernozem-like humus mass; GGC_C – gray-green clay from the career side; GGC_Ph – gray-green clay after phytomeliorative rotation; LLL+RBC – technical mixture of loess-like loam (50%) and red-brown clay (50%); LLL_C – loess-like sandy loam from the career side; LLL_Ph – loess-like sandy loam after phytomeliorative rotation; Ps – sand; RBC_C – red-brown clay from the career side; RBC_Ph – red-brown clay after phytomeliorative rotation; RBL_Ph – red-brown sandy loam after phytomeliorative rotation.

Regression, method of least squares with Gauss-Newton estimation method.

Results and discussion. The Philip's equation constant is equal to zero. For some technosol models this constant is not statistically significantly different from zero (Table. 1). But constant often takes a negative value. Negative constants indicate the presence of some moisture absorption inhibition in the early stages, or a slower process than is typical for the whole study period. Arguably, air locks can cause slow moisture absorption at the beginning of the infiltration process.

Table 1. Codifying of the technosol models and Philip's equation parameters
(bold showing coefficients significant with $p< 0.05$)

	Models code			Philip's equation parameters		
	Upper layer	underlying layer	Origin	S	A	B
1	CH	CH	C	**207.44±77.06**	52.86±33.81	43.60±40.28
2	CH	CH	C	**539.61±149.62**	75.66±61.33	–120.20±83.76

	Models code			Philip's equation parameters		
	Upper layer	underlying layer	Origin	S	A	B
3	CH	CH	C	**465.09±92.87**	**106.32±31.50**	**−147.11±63.71**
4	CH	LLL	C	**746.42±96.46**	6.53±33.41	**−160.95±64.36**
5	CH	RBC	C	**287.05±45.21**	**69.68±15.66**	−60.93±30.18
6	CH	GGC	C	**366.62±133.48**	**233.30±46.13**	−50.76±89.36
7	GGC	GGC	C	**1044.83±54.20**	**−152.89±16.46**	**−164.21±41.61**
8	GGC	GGC	C	**1096.32±38.06**	**−130.29±13.93**	**−191.13±23.95**
9	GGC	GGC	C	**1070.58±46.13**	**−141.59±15.19**	**−177.67±32.78**
10	RBC	RBC	C	**753.81±119.60**	**178.96±43.60**	**−139.48±75.55**
11	RBC	RBC	C	**30.27±4.66**	**0.66±0.07**	**−364.85±73.31**
12	RBC	RBC	C	**1272.36±98.86**	9.68±35.84	**−327.95±62.94**
13	LLL	RBC	C	**422.04±29.61**	0.78±11.28	**−169.76±17.71**
14	LLL	LLL	C	**487.11±45.14**	**68.82±15.02**	**−102.36±31.09**
15	LLL	LLL	C	**657.95±68.83**	34.81±25.61	**−190.68±42.24**
16	LLL	LLL	C	**939.41±99.74**	−39.03±37.12	**−231.03±61.20**
17	CH	PS	Ph	**198.02±70.08**	**285.36±27.28**	−72.27±41.98
18	CH	PS	Ph	**236.82±78.44**	**258.07±31.44**	−23.13±45.41
19	CH	PS	Ph	105.27±66.89	**265.26±26.50**	−70.72±39.17
20	CH	PS	Ph	52.07±81.90	**373.80±33.71**	42.85±45.96
21	CH	PS	Ph	138.06±96.09	**164.88±39.17**	32.87±53.91
22	RBC	RBC	Ph	**430.40±102.96**	**116.77±46.12**	**−126.72±52.88**
23	RBC	RBC	Ph	**548.57±171.28**	141.63±76.64	−129.87±88.07
24	RBC	RBC	Ph	**564.21±191.12**	62.87±85.54	**−269.93±98.27**
25	GGC	GGC	Ph	**1681.36±151.94**	−20.59±55.55	108.00±93.82
26	GGC	GGC	Ph	**1427.78±70.55**	**−144.43±25.73**	−89.26±43.77
27	GGC	GGC	Ph	**1781.61±56.96**	**−131.14±20.77**	**−129.39±35.34**
28	KBL	KBL	Ph	**1254.28±94.84**	**165.69±35.70**	**455.28±57.54**
29	KBL	KBL	Ph	**184.21±65.54**	**82.82±31.77**	**218.99±31.01**
30	LLL	LLL	Ph	81.69±73.48	**170.01±33.45**	44.18±37.71
31	LLL	LLL	Ph	218.03±107.61	**144.25±48.97**	15.85±55.23
32	LLL	LLL	Ph	144.66±71.86	**113.02±32.91**	56.34±36.64
33	CH	PS	Ph	**351.73±56.92**	13.69±30.15	**743.10±24.40**
34	CH	PS	Ph	**637.60±80.35**	88.46±42.29	**830.13±34.79**
35	CH	PS	Ph	**856.23±44.24**	3.60±16.95	**82.16±26.43**
36	GGC	PS	F	**1716.95±87.25**	**−255.00±34.04**	**152.95±50.46**
37	LLL	PS	F	**793.88±90.60**	−33.72±39.75	**−246.83±48.03**
38	LLL	PS	F	**691.96±134.18**	−82.65±58.87	**−274.54±71.14**
39	GGC	PS	F	**1122.74±87.66**	**−179.01±38.46**	**−423.49±46.47**
40	CH	PS	F	**981.00±119.59**	−71.00±52.47	**−386.19±63.41**
41	CH	PS	F	**955.40±237.58**	42.22±102.31	**−375.05±128.66**
42	CH	PS	F	**969.24±238.80**	45.09±102.84	**−386.05±129.32**
43	CH	LLC+PS+GGC	C	**498.32±54.12**	**209.02±17.24**	**−238.78±39.46**
44	CH	LLC+PS+GGC	C	**832.41±55.60**	−21.25±17.71	**−341.71±40.54**
45	CH	LLC+PS+GGC	C	**513.57±30.57**	**47.02±9.74**	**−146.80±22.29**
46	CH	LLC+PS+GGC	C	**802.84±41.84**	12.27±13.33	**−295.01±30.51**

	Models code			Philip's equation parameters		
	Upper layer	underlying layer	Origin	S	A	B
47	CH	LLC+PS+GGC	C	606.49±28.60	50.18±9.11	–150.16±20.85
48	CH	LLC+PS+GGC	C	267.68±15.97	73.77±5.09	–95.58±11.65
49	CH	LLC+PS+GGC	C	945.82±63.05	–42.66±20.09	–394.48±45.97
50	CH	LLC+PS+GGC	C	534.39±23.65	25.48±7.53	–106.98±17.24
51	CH	LLC+PS+GGC	C	221.55±19.15	130.30±6.10	4.37±13.96
52	CH	LLC+PS+GGC	C	334.46±30.83	34.43±12.86	–15.98±17.21
53	CH	LLC+PS+GGC	C	333.08±22.58	11.59±9.42	14.24±12.60
54	CH	LLC+PS+GGC	C	356.31±36.34	54.98±15.16	–36.59±20.29
55	CH	LLC+PS+GGC	C	112.43±32.20	155.44±13.63	–39.93±17.62
56	CH	LLC+PS+GGC	C	337.78±54.87	138.58±23.23	–59.10±30.02
57	CH	LLC+PS+GGC	C	256.95±12.07	58.89±5.11	–93.81±6.60

Legend: CH – chernozem-like humus mass; GGC – gray-green clay; RBC – red-brown clay; LLL – loess-like sandy loam; KBL – red-brown loam; PS – sand; LLC+PS+GGC –successive layers of relevant soil; F – from agricultural fields; Ph – after phytomeliorative rotation; C – from the career side

The sorptivity of the pedozems (technosol with bulk humus chernozem-like material) depends from the underlying layer ($F = 2.06$, $p = 0.07$). If the analysis to remove information about the loess-like loam, the influence of the underlying rocks on the sorptivity loses the statistical significance ($F = 0.57$, $p = 0.68$). Thus, the use loess-like loam as underlying layer increases the sorptivity to the level of 746.4 ± 25.8 cm/ hours. The sorptivity is 459.6 ± 18.1 cm/ hours in case of application as underlying layer of all other tested types of substrates. The influence of the underlying rocks on the filtration intensity is statistically significant in a steady state under conditions of use in the upper layer of the chernozem-like mass ($F = 13.47$, $p< 0.01$). Most contribute to the increase of the *A* coefficient such bulk material as the sand (139.3 ± 12.0 cm/ hours) and gray-green clay (145.1 ± 8.5 cm/ hours). Application of complex substrate with successive heterogeneous layers LLC+PS+GGC, which is similar in the properties to the waterproof horizon, reduces the filtration intensity to a level 58.7 ± 3.7 cm/ hours. Except for specified substrates, the other substrates are not different in its influence on the filtration intensity ($F = 0.37$, $p = 0.69$). The application of homogeneous monomodels of chernozem-like mass, or loess-like loam or red-brown clay forms technosols for which filtration rate is 77.4 ± 4.7 cm/ hours.

Constant C describes the dynamics of the infiltration process the early stages of the experiment and is a specific indicator for technosols. In natural soils this constant is zero. In technosols constant C is statistically significantly depends on the characteristics of the underlying substrate in pedozems ($F = 7.48$, $p<0.01$). Constant C for sand is not statistically significantly different from zero. Other substrates lead to negative values of constant C. The

lowest value of constant C is typical for loess-like loam (–256.9±32.5 cm/ hours). Other substrates do not differ in their impact on this parameter ($F = 0.98$, $p = 0.40$). They coefficient C of the modified Philip equation is –105.6 ± 6.5 cm/ hours. Parameters of the modified Philip equation for the water infiltration dynamics of technosols models with gray-green clay in the upper layer are depend from the underlying rock. Sorptivity is statistically significantly higher if the underlying rock is sand compared with homogeneous model ($F = 12.94$, $p<0.001$).

Sorptivity of the technosols with sand is 1497.5 ± 58.4 cm/ hours and for homogeneous technosols this constant is 1255.1 ± 33.7 cm/ hours. The considerable sorptivity of the surface substrate composed of gray-green clay allows to quickly get the water during infiltration into deeper layers. The infiltration speed of grey-green clay rapidly decays as a result of water nonresistant structure of this substrate. In technosols, where there is a subsoil layer of sand, the rate of infiltration is maintained at a high level, more time than in monomodels. As a consequence will likely sorptivity of the technosols with sand as the subsoil layer is higher than in the case of monomodels with completely gray-green clay as the subsoil layer.

Sorptivity of the technosols with loess-like clay is statistically significantly depends on the type of subsoil layer ($F = 14.85$, $p<0.001$). The difference is statistically significant, depending on the texture of the underlying rock. If the sand as the underlying rock, the sorptivity is significantly higher (771.5±56.6 cm/ hours) than for rock texture which content more clay fraction. The difference of sorptivity between the loess-like loam and technological mixture of the loess-like loam and red-brown clay is statistically not significant ($F = 0.01$, $p = $

0.99). Sorptivity for them is 421.1±88.1 cm/ hours. Substrate origin for monomodels affects considerably on the technosols infiltration rate ($F = 37.00$, $p < 0.001$). Loess-like loam from career side is characterized by much higher sorptivity (585.3±38.1 cm/ hours) than the substrate after phytomeliorative rotation (256.9±38.1 cm/ hours). Thus, phytomeliorative rotation significantly affects on the water properties of rock. This effect most likely is due to enrich the soil as organic matter in the form of humus and half-decayed organic residues.

Organic components contribute to the formation of aggregate most of which is water resistant. Such formations smooth density variation of clay soil resulting from swelling and shrinkage processes that can maintain stable structure of the pore space. As a result, the soil after phytomeliorative rotation gets such features as reduced infiltration rate, but in-creased level of filtration. The level of filtering, which affects quantitative parameter A in the Philip equation is significantly higher compared to loess-like loam for technosol with sand as the underlying rocks and technological mixture ($F = 37.6$, $p < 0.001$). Coefficient A for monomodels of loess-like loam is 74.9±12.6 cm/ hours. Coefficient A is statistically significantly not different from zero (–25.8±21.8 cm/ hours) in variant with sand as subsoil layer. This indicates that Philip classic version of the equitation can be applied for simulation of infiltration process this model of technosol. Coefficient A takes a negative value (–73.0±12.6 cm/ hours) for technological mixtures of rocks as underlying layer, indicating that the decay of the filtering process takes place during the entire period of the experiment. In this regard the option of a complete cessation of water filtration can not be excluded.

Thus, the artificial mixture of clay has significant waterproof properties, which ultimately can lead to complete discontinuance of water absorption by technosols. It should be noted that in the state of water saturation of soils are in autumn and winter and early spring, just when there is the greatest rainfall and soil moisture absorption function is essential for storing water to be used during the growing season. Also waterproof properties of soil may increase the risk of water erosion of technosols. The filtration properties of loess-like loam are improved significantly ($F = 28.3$, $p < 0.001$) after being under phytomeliorative crop rotation. Loess-like loam from career side is characterized by filtering coefficient A 45.4±7.9 cm/ hours and after phytomeliorative rotation this coefficient is set to 104.5±7.9 cm/ hours.

The infiltration dynamic of loess-like loam on the initial stage is substantially depended from the underlying rocks ($F = 31.2$, $p < 0.001$). The highest value of constant C is reveled for monomodel with loess-like loam (–68.8±16.3 cm/ hours), and the lowest is for model with sand as the underlying rocks (–330.3±28.8 cm/ hours). Origin of the loess-like loam also effects on the value of the coefficient C ($F = 252.8$, $p < 0.001$). It describes the dynamics of moisture absorption in the first period of the experiment. For soils from career side coefficient C is negative (–176.4±9.6 cm/ hours). This indicates a certain level of "plateau" in infiltration rate that compensates for the extremely high level of infiltration in the early stages. Philip equitation provides infiltration dynamic modeling with monotonous decrease in the rate of water infiltration through the soil surface. This dynamic occurs under conditions of a certain level of stability of soil pore space. For technosoils structural change of the pore space state are inherent in contact with water because hydrolabile units of their structure. Accordingly, during the in-filtration process there are significant changes in the course of the rate of filtration of water. Coefficient C allows Philip equation to be a more flexible. Negative coefficient C indicates that in the infiltration early stages the decay of the water penetration rate into the soil occurs. The positive coefficient C indicates that the first portion of the water is absorbed with extremely high speed, then the process is relevant to the pre-conditions under which can be described by the Philip equation. Thus, the dynamics of water absorption in the early stages of the process are considerably different for loess-like loam depending on their origin.

Red-brown clay and loam are statistically significantly different in characteristics of sorptivity ($F = 19.9$, $p < 0.001$). The highest sorptivity is found for red-brown clay from career side (630.2±35.6 cm/ hours). This coefficient is somewhat lower for red-brown clay after phytomeliorative rotation (514.4±35.6 cm/ hours) and is the smallest for red-brown loam (294.3 ± 61.7 cm/ hours). Thus, the clay is more sorptive compared with loam. Being under phytomeliorative crop rotation reduces this parameter.

Parameter A indicating the filtering intensity of technosols. By this measure technosols are statistically significantly different ($F = 26.4$, $p < 0.001$). The highest filtration rate is characteristic for clay after phytomelioration (128.5±10.4 cm/ hours). A similar value is inherent for parameter of technosols with loam (108.1 ± 17.4 cm/ hours). The lowest coefficient A is fixed for clay from career side (29.8±10.0 cm/ hours). Thus, loam filtration properties are better than clay and phytomelioration can significantly improve the filtration properties of clays and bring them to the level of loam.

The dynamics of infiltration at the start of process is characterized by a parameter C. As it technosems are statistically significantly different ($F = 205.5$, $p<0.001$). Reddish-brown loam is characterized by a positive value C (44.2±32.3 cm/ hours). For clay is typical negative value of this parameter. For clay from career side coefficient C is the lowest (–289.1±20.1 cm/ hours), and is little more for clay after phytomelioration (–169.1±20.1 cm/ hours). Negative coefficient C corresponds to an intense process of infiltration, accompanied by sporadic infiltration failure. A positive coefficient is characteristic of the failed infiltration in the first time of experiment.

Conclusion. The study of the water infiltration dynamics from the soil surface is highly informative non-destructive testing for evaluating the properties of the soil body. Studies showed that technosols as artificial creation have fundamental differences between the natural soils for which the classic Philip equitation was proposed. Technosoils are porous, but heterogeneous formations. The process of filtering in technosols is not laminar, periods of smooth water infiltration is outbreak by disastrous water absorption. To simulate this process it was showed that the better results may be obtained due to originally modified Philip equitation. Specific constant C describes the dynamics of the infiltration process the early stages of the experiment and is a specific indicator for technosols. In natural soils this constant is zero. The sorptivity of the pedozems was reveled to be depended from the underlying layer. Organic components contribute to the formation of aggregate most of which is water resistant. Such formations smooth density variation of clay soil resulting from swelling and shrinkage processes that can maintain stable structure of the pore space. As a result, the soil after phytomeliorative rotation gets such features as reduced infiltration rate, but increased level of filtration. The artificial mixture of clay has significant waterproof properties, which ultimately can lead to complete discontinuance of water absorption by technosols. Waterproof properties of soil may increase the risk of water erosion of technosols. For technosoils structural change of the pore space state are inherent in contact with water because hydrolabile units of their structure. Accordingly, during the infiltration process there are significant changes in the course of the rate of filtration of water.

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