- POSTERS -

SOIL AS AN ACTIVE SYSTEM OF SELF- PURIFICATION FROM HEAVY METALS

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Abstract.

The paper presents the results of determination the self – purification capacity of the soils polluted with heavy metals (Mn, Cu, Zn, Pb) in laboratory conditions. Heavy metal pollution has led to soil acidification and increase the chemical forms of trace elements. The moderate and high pollution of soils did not affect the moisture, humus and exchangeable bases content. Indexes of self – purification capacity showed that clayey and loamy-clayey soils have a high property of cleaning than sandy-loamy soil and sand.

Introduction.

Pollution, remediation and treatment capacity of the soils are more complex problems caused the multitude of pollutants. Ensuring the protection of soil quality as a means of increasing soil resources and environmental protection, provides the use of remediation methods and technologies designed to neutralize or inactivate the flow of pollutants in soils. In terms of soil remediation, the practice is not achieved due to lack of scientific basis. Further development of experimental studies conducted in the process of self – purification ability and use of decontamination procedures is an example to highlight the concern of specialists to maintain a clean and healthy environment. Only a healthy soil has self – cleaning ability, but this capacity is limited by absorption and precipitation of chemical substances. Many of these problems have yet to a multidisciplinary solution.

Heavy metals from various sources and reached the soils, in different ways, can accumulate in the soils, where plants go in harmful effects. Some problems of soil pollution with heavy metals in Republic of Moldova are related in large quantities and uncontrolled use of chemical fertilizers, pesticides, agricultural wastes. Soils have a natural self – purification capacity in a limited environment functioning as remediation, neutralization, recycling and transformation of pollutants. Self – purification capacity is the property suffered soil pollution and to recover all or part of the original state of purity by physical, chemical and biological function. The purpose of research to modeling and simulation the processes of soil pollution with heavy metal salts induced experimental treatment and evaluation of their ability under laboratory conditions.

Material and methods.

The soils was artificially contaminated with salts of heavy metals (Mn, Cu,Zn, Pb) in doses 6 Clark and 18 Clark. The "Clark" is the index expressing the average quantity of the item in the crust, hydrosphere, geochemical systems, etc, the total weight of the system, expressed in % or g/kg. In the soils of Republic of Moldova 1 Clark, mg/kg: Mn= 500, Zn-50, Cu-20, Pb-10. In the experience was used the soil samples from the arable layer of chernozems with different texture: clayey, clayey-loamy, sandy-clayey and mix sand (composed from 45-82% SiO_2 in proportion and other minerals, calcite, mica, dolomite, etc). The variants of experience: unpolluted soil (control); moderate pollution soil with Mn, Zn, Cu, Pb in doses 6 Clark; heavily pollution soil with Mn, Zn, Cu, Pb in doses 18 Clark. The variants were doubled: A – natural soil with microbial activity; B - sterile soil with suppression microbial activity (Table 1).

Table 1.Scheme of laboratory experience

A - with microbial activity (natural)			**B – with suppression microbial activity (sterile)**		
Variant	Dose, mg/kg	Soil	Variant	Dose, mg/kg	Soil
Control	Mn – 500 Zn – 20 Cu – 50 Pb – 10	clayey	Control	Mn –500 Zn – 20 Cu – 50 Pb – 10	clayey
		clayey-loamy			clayey-loamy
		sandy-clayey			sandy-clayey
		sand			
6 Clark	Mn – 3000 Zn –300 Cu –120 Pb – 60	clayey	6 Clark	Mn – 3000 Zn –300 Cu –120 Pb – 60	clayey
		clayey-loamy			clayey-loamy
		sandy-clayey			sandy-clayey
		sand			
18 Clark	Mn – 9000 Zn – 900 Cu – 360 Pb – 180	clayey	18 Clark	Mn – 9000 Zn – 900 Cu – 360 Pb – 180	clayey
		clayey-loamy			clayey-loamy
		sandy-clayey			sandy-clayey
		sand			

Results and discussion.

In the soil samples used in laboratory experiments were determined physical-chemical properties at the beginning and end of observations. Determination of pH demonstrated that increased of heavy metals, soils becomes more acid: in unpolluted soil (control) the pH had values between 6,6 to 7,2; in heavily polluted soil pH was 4,7 to 5,7. At the end of the composting (over two weeks) the determination of pH values showed easy experimental deviations in polluted variants. Soil sterilization had no influence on pH values

on polluted variants. Artificially induced heavy metal doses did not affected the moisture, humus, Ca^{++} and Mg^{++} content in natural and sterile soils.

The total forms of heavy metals content were proportional with induced doses. With increasing soil level pollution in the soil increase proportional amount of mobile and soluble forms of microelements due to increasing soil acidity in the moderate and heavily polluted soils. Soil sterilization did not lead to deviations in total forms content in the control variants. The content of mobile forms in sterile variants increased in clayey and clayey-loamy with doses 6 and 18 Clark. None polluted and sterile (control) retain slightly less mobile and soluble forms of heavy metal, compared to moderate and strong polluted soils. In the soils with sandy-clayey and sand the content of mobile forms of heavy metals not changed. The soil texture is heavier, the higher the content of heavy metals retained in them.

Self – purification capacity of soil was assessed by calculated indicators based on the results of determination the total and chemical forms content of heavy metals, and correlation between them. The index of soil self – purification capacity is used to compare the different soils ability to retain the possibility of auto-cleaning and retention of pollutants in no active or inaccessible forms for plants. Self-cleaning capability and self indicators of soil against moderate and high pollution with heavy metals are relative coefficients and possess information about indicative ratio of pollution.

The results show that the higher the purification capacity index is greater, the higher is the property of self – purification and restoration of soil vital functions. Decontamination capacity of the soil was directly proportional to the dose of heavy metals and inversely to soil texture. The soil texture is heaver, the higher the self – cleaning capacity of the soil. The highest capacity of purification had clayey and clayey-loamy texture soils, the smallest - sandy-clayey texture soils and sand. The self – purification indicators of clayey soil is 10 times larger than sandy. The sand retention capacity has served only as a filter for sediment of heavy metals salts. Soil self – cleaning with suppression of micro-flora was lower in most variants (Table 2).

Table 2. The soil self – purification capacity and protection indicator

Heavy metal	6 Clark				18 Clark			
	A		B		A		B	
	1	2	1	2	1	2	1	2
Clay soil								
Mn	31	31	39	26	35	41	37	30
Cu	20	20	16	12	16	16	16	15
Zn	28	23	21	13	19	11	19	7
Pb	10	10	15	10	16	17	16	16

Heavy metal	6 Clark				18 Clark			
	A		B		A		B	
	1	2	1	2	1	2	1	2
Clayey-loamy soil								
Mn	10	7	16	11	14	11	19	18
Cu	11	10	14	10	11	14	14	14
Zn	23	21	18	12	16	13	17	6
Pb	11	9	13	8	10	14	13	14
Sandy-clayey soil								
Mn	7	5	11	2	11	5	16	3
Cu	6	4	8	5	8	11	4	1
Zn	16	13	16	10	13	24	13	5
Pb	5	3	6	3	8	1	3	1
Sand								
Mn	3	4	-	-	5	4	-	-
Cu	3	4	-	-	6	4	-	-
Zn	3	4	-	-	11	2	-	-
Pb	3	5	-	-	6	8	-	-

Conclusions

The soil ability to purification of heavy metals is directly proportional to the degree of pollution. The degree of heavy metals retention by soil components depends on the soil genesis, texture and humus content, chemical forms of pollutants. The soil texture is heavier; the stronger is the self – purification capacity of soils and restore the original initial functions.