УДК 631.41

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BRIEF CHARACTERISTIC OF MORPHOLOGICAL PROPERTIES OF THE SOIL COVER OF BURLINSKY DISTRICT (КНГКМ) WESTERN-KAZAKHSTAN REGION

In given article the characteristic of morphological properties of a soil cover of the Karashaganak field of the West Kazakhstan region is resulted.

On the basis of this work we put materials gathered while research expedition during growing period of 2002.

Researches took place in Burlinsky district (including Karashaganak gas condensate field) of Werstern Kazakhstan region, with sampling once in a month that helps cover the whole monitoring area.

Soil and plant cover monitoring aim is to determine local changes of soil characteristics under the natural factors and anthropogenic affects.

In the soil cover of research area predominate dark carbonate soils, solonized in different areas, frequently in complex with solonetz soil (often carbonate), in lower surface elements are marked meadow chestnut and dark chestnut soils washed off in different rate. There are western chernozems and livery normal soils on the plateau plain. The last one is very seldom soil. Soil sampling is determined according to all-Union State Standard 17.4.3.01-83; humidity - all-Union State Standard 28268-89; humus - all-Union State Standard 26213-91; nitrogen - all-Union State Standard 26107-84; phosphor - all-Union State Standard 26261-84.

Dark chestnut soils contains 4-5,5% of humus, with humic horizon depth 35-50 cm, gypsum and freely soluble salts occur from 0,7 till 2 m.

They have charcoal with brown shade colour, structure is cloddy or silty-cloddy (on plowlands).

Sub-type of dark chestnut soils on researched area is represented with the following kinds:

Dark chestnut normal, that are almost absent, occurring areas are strongly strained.

Dark chesnut solonized soils are characterized with horizon B lower part compactness, that is a reason of its colloid particles concentration. Such type of horizon has cloddy-prismoidal or blocky structure with different rate of intensity on varnish aggregate edges (brown cutan). The stronger solonetzicity the more intensive cutan. Humus quantity is about 5%, there is a nitrogen and phosphor (table 1).

Dark chestnut carbonate soils contain big amount of carbonates at the surface. They are formed on the carbonate formation.

Dark chestnut carbonate-solonized soils are formed on carbonate salty formations of heavy mechanical structure. They are solid and have chinked profile, become viscous and swell hard in wet condition. They consist of magnesium as well as natrium, humus is from 1,67 till 4,75% (table 1).

Dark chestnut solonized-salty sails are related to highly-salted formations. In their profile there is a big content of (>0,25%) water-soluble salt withing first meter.

Dark chestnut waste-solonized soils have morphological features of solonetzicity, but without visible content of exchange natrium. Solonetzicity in these soils is considered as feature of waste character.

Dark chestnut weak-developed disturbed soils are characterized incomplete evolution of profile and low depth of humus horizon (А+Б – lower than 20 cm).

For researched areas is typical – meadow chestnut soils. Nature creates best conditions for humus accumulation and for development processes of desalination and salination of soil.

Meadow chestnut soils have high depth of humus horizon (45-55 cm) and high concentration of nutrient elements (table 1), enough humus for horizon BC (2,54%).

Humus content, nitrogen and phosphor in livery and meadow chestnut soils

Table 1

Soil	Horizon depth	Hydroscopic moisture	Humus q-ty (in %)	Nitrogen content (in %)	Phosphor content (in %)
Livery solonized	A 0-28 B 29-45 Bc 45-102	4,34 4,81 5,45	4,78 3,82 0,27	0,045 0,048 0,014	0,146 0,146 0,041
Livery solonized-carbonate	A 0-25 B 26-48 Bc 48-110	3,94 4,92 4,84	4,75 2,90 1,67	0,031 0,038 0,028	0,102 0,091 0,085
meadow chestnut	A 0-42 B 43-60 Bc 61-122 C 122 -	5,45 5,06 4,48 6,79	4,64 4,52 2,54 -	0,052 0,040 0,018 -	0,122 0,069 0,130 -

In Burlinsk district on KNGKM territory prevails technozems. According to soil genetic classification [1] technozems are the soils created on the field of reclamation with or without the use of filling rich soil layer (RSL). In spite of lots of articles on soil theme formed with agricultural targeting reclamation technologies, technozems relations features and their ecological functions are poorly explored especially if to take into consideration that all characteristics have distinct regional and individual particularities. In particular no data about rich soil layer (RSL) properties and relations transformation characteristic. Studying technozem properties, conditions and ecological functions especially in Western Kazakhstan region severe climate conditions: unsteady and insufficient humifying, they become interested and also big money are needed for reclamation technologies realization.

Therefore researching of all processes occurring during all cycles of their creation and development is very important task.

In our researches we are trying to determine the trends, character and intensity of restoration of technozems genetic, agrochemical and agrophysical features and modes.

This aim realization requires the following sides of soil formation study:

Transformation of rich soil layer material on different stages of technological chain;

Transformation of technozems humus conditions in the process of reclamation;

Transformation of technozems physical features – consistence, stucturization, (agrophysical);

Changes of technozems agrychemical features and peculiarities of their nutrient status.

We believe that received research materials will be very useful for project development of disturbed lands reclamation on the KZ fields with the use of more effective technologies aimed at speed up and environmentally safe technogenic landscape soil cover recuperation.

We assume theoretical conclusions received in the result of soil and humus formation and technozems features and modes evolution researchs, will allow to solve the problems of ecology, reclamation and recuperating ecological systems functioning modes optimization more effectively.

If in natural state features, profiles and functions of rich soil layer are settled by soil formation processes, presence of biological, geochemical and other contingence of different genetic horizons, in storage pits mechanisms of initial substance features support don’t work. Instead of them develops other processes transforming initial features of this valuable material.

Hence is needed to study rate and targeting of material features changes that occur in removing and storing rich soil layer and its filling on reclamation lands.

For example take changes of density, porousness and structural properties of rich soil layers on different technozems formation stages (table 2).

These data are received in 1992-1996. The storage pit does not exist nowadays; obviously it was used for reclamation. But the results show that in pit storing the structural properties change, general and single porousness breakes.

Soil is a main habitat of all organic materials on Earth.

As already said the role of soil in ecological system is determined as a component of geochemical landscape, in which take place materials migration, energy, and technogenesis products. Anthropogenic influence on soil including heavy metals pollution, fire reveals mechanisms in ecological systems that were hidden before.

Heavy metals often become an activator of enzyme reaction and biochemical reaction in organisms (table 3).

Particular attention is given to complex joints in which microelements close pentamerous or hexamerous heterocycles – these are special forms of mineral joints in organisms (chlorophyll, hemoglobin).

In 1992 on the territory of Karashaganak field we found local microzones in which material constitution was different (humus quantity, heavy metals). Microorganisms' contribution had mosaic character. The reasons of that event are not cleared yet.

Perhaps in places with no microorganisms, soil abiotic accelerators worked. In places with and without microorganisms, rye grew well excluding some places (2% of total area) where rye seeding was depressed.

Obviously, heavy metals and other contaminators on these plots exerted toxic influence on the rye and in the areas where a small amount of microorganisms were discovered (up to 5000 per gram of soil, i.e. they were almost absent), then the role of catalysts in different soil, chemical reactions fulfilled the heavy metals.

Density, porousness and structural properties of rich soil layer on technozems formation stages

Table 2

Stage	Density g/cm^2		Porousness		Structural condition of rich soil layer	
	Solid phase	outfit	general	In separate outfits	Structure name	Structural properties index
Removal	2,53	1,52	51,0	39,9	Cloddy-silty	1,7
Storage pit formation	2,55	1,83	40,0	28,2	Cloddy-blocky	0,4
Rich soil layer storage:						
On storage pit surface	2,52	1,82	49,2	27,8	Debris-blocky	1,3
Inside storage pit (1,2 m)	2,54	1,88	38,2	26,0	Blocky	0,2
Livery carbonate control						
0-20 см	2,49	1,48	56,6	40,6	Cloddy	3,5
20-40см	2,58	1,54	48,4	40,3	Cloddy-nutty	1,2

Minor nutrients and their biological functions (according Leninger, 1985)

Table 3

Element	Biological functions samples
Fe^{2+} or Fe^{3+}	Cytochrome oxydase, catalysis, peroxydase cofactor
Iodine	Is needed for thyroid body hormones synthesis

Cu	Cytochrome oxydase cofactor
Mn^{2+}	Arginase and other ferments cofactor
Zn^{2+}	Dehydrogenase, DNA-polymerase, carbonic anhydrase, alcohol delydrogenase cofactor
Co	B_{12} vitamin component
Mo	Xanthine oxidase, нейратредуктазы cofactor
Se	глутатионпероксидазы and others' cofactor
Vanadium	Cofactor
Ni^{2+}	Urease cofactor
Mg^{2+}	Гепсокиназы, glucose - 6 – phosphatase cofactor
Chrome	Normal glucose utilization in blood
Stannic	Bones formation
Fluorine	Bones formation
Silicium	Bind webs and bones formation
Arsenic	Unknown

It is known that some chelate combinations of transitional metals catalyze numerous chemical processes in soil and in organisms [4], i.e. abiotic catalysts fulfill ecological function of soil microflora.

Heavy metals' activity (table 4) considerably increases at its combination with some organic system in particular with amino acid or with pyrole nitrogen. The complexes of metals are more active than simple salts or oxides of metals. A catalytic activity of mineral in comparison with albuminous matter (ferments) is very negligible, that's may be why a catalytic role of mineral matters of the soils have been out of consideration for a quite long time. Various anthropogenic impacts resulted in more detailed study of the mechanisms of the conduct of contaminators in the soil by scientists.

The use of heavy metals may find its application in environmental protection technologies. Nowadays, the salts of ferrum (nitrates, sufates, chlorides) are used as catalysts of decomposition of oil products in the soil (Watts, Di My, 1996), so abiotic catalysts can be used in solving of ecological problems.

Strong technogenic streams lead to the fact, that any subtypes, species, variety of soil lose their functions and in consequence the plants, phreatic waters are left infected, purification of water; neutralization of toxicants in soil stops. When the influence of contaminators in soil stops or decreases, then gradual and slow recovery of ecosystems is observed, because heightened amount of heavy metals gets to humiferous horizons in the zone of technoshpere that can be potential catalysts and in the humiferous horizons they form donor – accepted ties with organic composiotions in the way of complex compositions that have more higher catalytic ability.

Heavy metals catalytic activity [4]

Table 4

The forms of compositions of metals	Simple salts, oxides	Complex compositions of metals	Metals in ferments
Catalytic – activity – conditional units	1	10^4	10^7 - 10^{10}

For the sustainability of ecological systems in the industrial zone it is necessary to do one's best to preserve the correlation: industrial zone – field forest that considerably decreases pollution and probability of ecological crisis for a man. In industrial zone the old forest belts and the planting of the new ones, natural plots with woody and bushy vegetation reservoirs are as if the executors of cleaning functions, all the rest of the territory of the industrial zone - technogenic territory. It is necessary to strive for the correlation of woody, bushy stands, sowing of many grasses to the territory of industrial zone - technogenic (processing enterprises, technozems and others) has been increasing, then ecological situation of the industrial zone and the surrounding territory will be improved.

It is important to accept that modern oil – gas extracting industry is the source of tremendous stream of different substances into the biosphere, the significant part of which is goes to the soil. Besides the cleared up toxic impact of these contaminators (heavy metals) in particular on the organism, genetic impact on them, there is one more aspect here that should be highlighted - many heavy metals in the soil fulfill the role of catalysts in different soil chemical reactions.

Let's show the results of analysis of the soil coverage on heavy metals and the coefficient on concentration [Kci] (table 5). The analysis of the results of chemical analysis, c determination of the concentration of one's metal and summary index of pollution (Zc) [5] due to the formula:

$$Zc = \Sigma Kci - (n-1)$$

Where n – number of elements defined,

Kci - coefficient of the concentration i - of one's metal, equal to the ratio of the content of metals in the soils of the investigated territory of Klark;

Σ – the sum of coefficient of the concentration of chemical elements.

The coefficient of the concentration shows that only cadmium exceeds its klark in the soil for several times (from 7,6 till 10,46).

We have cleared out the coefficient of the concentration only of humiferous horizon (A) soil research are not finished yet.

If to calculate cadmium and other heavy metals content in comparison with the area background , then the soil is not polluted by heavy metals, if to compare with MAC, then: Pb, Zn, Cu, Mn content in the researched soil does not exceed MAC, but Cd does exceed MAC from 1,4 up to 5,4 times; Ni content up to 22 times, Cobalt from 1,4 up to 5,0 times.

Soil samples analysis for the content of heavy metals (mg/kg) and for concentration coefficient (Kci in the denominator)

Table 5

Soil name and associa-tions	Genetic horizons (in cm)	Zn	Cu	Pb	Cd	Co	Ni	Fe	Mn	Zc
1	2	3	4	5	6	7	8	9	10	11
Meadow chestnut, heavy loamy – lyme grass	Aa 0-9,16	14,00 0,168	17,40 0,36	12 0,76	1,2 9,2	18,60 1,03	38 0,64	14000 0,30	111,0 0,111	< 16
	A 16-62									
	B 62-102	56.0 0.68	19.6 0.42	13.40 0.84	1.00 7.6	13.2 0.74	41.2 0.72	16240.0 0.34	180.0 0.180	<16
K3 dark chestnut carbonate - salinized association miefoil-common wornwood	A 0-29	58,0 0,70	17,6 0,38	12,60 0,78	1,00 7,6	11,2 0,6	27,60 0,5	1248000 0,26	205,00 0,24	
K3 dark chestnut aril-brome grass – white wormwood	A 0-21	58,0 0,70	18,60 0,38	11,0 0,68	1,00 7,6	19,2 1,06	32,00 0,54	19480,0 0,42	208,0 0,208	<16
	C 40-56	52,00	15,00	8,80	1,40	7,60	27,40	12780,00	98,00	16-32
K3 salinized-carbonate										
Dark	A 0-19									

chestnut saline carbonate	B_1 19-34									
	B_2 34-52	162,00	17,40	10,80	1,00	16,80	37,80	19720,00	262,00	16-32
	Bc 52-…									
Meadow chestnut	A 0-32									
	B 32-57									
	Bc 57 -…									
K3 normal	An 0-15 arable	60,00 0,72	17,8 0,36	11,40 0,70	1,00 7,6	15,40 0,87	35,20 0,6	18200,00 0,42	205,0 0,205	<16
	A1 15-29	58,00 0,70	18,80 0,40	11,60 0,72	1,00 7,6	22,70 1,24	39,60 0,78	15360,00 0,32	180,00 0,180	<16
	B 29-45	56,00	19,40	13,60	1,2	15,40	30,20	14080,00	0,222	<16
	Bc 45-125	52,00	19,40	8,60	0,80	12,00	45,20	11560,00	184,00	
K2 meadow	A 0-28 (arable)									
	B 28-53									
	C 53-…									
K3 carbonate	A 0-15	64,00 0,78	20,40 0,42	12,60 0,78	1,40 10,76	12,00 0,66	52,00 0,88	15320,00 0,32	295,00 0,29	<16
	B 15-28	36,00	15,40	15,40	1,00	7,60	27,60	7800,00	312	<16
	Bc 28-43	50,00	18,40	10,80	1,7	21,20	36,80	17760,00	227	
	C 43-…	34,00	11,80	10,80	1,20	18,00	30,40	11520,00	126	
Meadow chestnut heavy loam - saline	A 0-31	60,00 0,72	17,00 0,36	10,80 0,68	1,00 7,6	18,00 1,00	39,00 0,79	16240,00 0,17	196,00 0,196	
	B 31-48									
	C 48-…	66,00	21,2	11,60	1,40	26,80	39,60	2096,00	188,00	16-32
K3	A 0-24	60,00	18,00	12,60	1,00	22,60	39,60	16280,00	224,00	
	B 24-42	48,00	14,80	13,00	0,80	19,40	35,80	14380,00	260,00	

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