Environmental Control of Phosphogypsum and Tars of Rozdil State Mining and Chemical Company "Sirka"

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Abstract – The purpose of this work is the environmental control of phosphogypsum and tars of Rozdil State Mining and Chemical Company "Sirka", definition of soil pollution in the area.

I. Introduction

Utilization, waste recycling and disposal of large-tonnage manufactures are important problems the relevant industries. It become environmental content of state level when hundreds thousands tons of solid waste, contaminated by toxic substances formed in the dumps.

Production and using of phosphate fertilizers produce significant amounts of phosphogypsum dumps — solid wastes, which contain heavy metals such as Cadmium and Plumbum.

Rozdil State Mining and Chemical Company "Sirka"is included in the "List of 100 objects that are major polluters of the environment in Ukraine." Waste of sulfur production, which emerged as a result of open pit mining of sulfur, were drawn up in tailings located in different parts of the territory and waste production of mineral fertilizers composed of phosphogypsum dumps. Also on industrial ground enterprise is kept modifier such as "MG", which is made of tar residues.

II. Materials and methods of research

On Rozdil State Mining and Chemical Company "Sirka" is:

- about 60 million t of sulfur ore tailings;
- 3,045,400 t of phosphogypsum;
- 1.5 million m^3 of acidic water;
- 17195 t modifier such as "MG", made from neutralized tar residues and boiler residual of maleic acid anhydrite;
- thousands t of substandard sulfur residues and other chemicals;
- thousands of hectares of land disturbed by mining works which are not used;
- ruins of buildings that will never be used for new production, etc.

Today on the territory of tailings and adjacent areas is not carried out any production activity. According to data of Rozdil State Mining and Chemical Company "Sirka" on the balance sheet are 3,045.418 t of phosphogypsum. Enterprise made waterproof dump phosphogypsum arranging the contour of neutralizing limestone layer. As a result, it isg eliminated acidic water from phosphogypsum dump into the river Dniester.

Despite the waterproof of bottoms dumps, long term storage of solid wastes, including phosphogypsum, leads to the penetration of toxic substances in soil and filtering, eventually forming areas of contamination.

Rains dissolved gypsum and wash out toxic compounds (fig. 1).

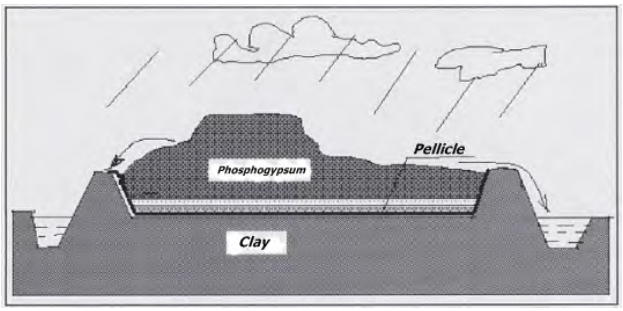

Fig. 1. Scheme structure of phosphogypsum dump

Pollutants after falling into soil do not remain inactive, they cause changes or positive or negative effects, change the the natural chemical balance of the ecosystem. Polluted soil is lost clear structure and characterized by a decrease of the overall density. All of this reduces the water permeability of the soil, a sharp deterioration in water-air regime.

Now, there aren't practically methods of forecasting the possible pollution of the environment and modeling of migration of heavy metals in soils.

According to this actual branch of research for Ukraine is developing measures to protect soils against the negative influence of toxic compounds contained in dumps.

The modifier "MG" is dangerous for the environment and is made of tar residues in 2001-2002, which it is imported from Hungary by state enterprise "Spetsservis". Since oil refining industry waste were stored on the territory of Rozdil State Mining and Chemical Company "Sirka". They were used as evidence in a criminal case. Currently, the criminal case is closed.

Up to this day, in spite of repeated appeals leadership of Rozdil State Mining and Chemical Company "Sirka" and the executive committee and city council members of Novorozdil various issue about export of tar residues haven't solved.

It is defined qualitative and quantitative composition of metals in soil samples near the landfill of phosphogypsum and near the area of the modifier by X-ray fluorescence (using analyzer EXPERT 3L (fig. 2)) method. EXPERT 3L analyzer is measured the mass fraction (%) of major chemical elements by X-ray fluorescence analysis. Range of measuring chemical elements (range control) is from Natrium (^{11}Na) to Uranium (^{92}U).

Fig. 2. analyzer EXPERT 3L

III. Research results

The soil, which is located near the dump of phosphogypsum contain the following metals (data for 2015.):

- Zinc (Zn) (0.014%), Arsen (As) (0.003%) — are Class I of danger of heavy metals (very dangerous);
- Nickel (Ni) (0.008%), Copper (Cu) (0.005%) — are Class II of danger of heavy metals (moderately dangerous);
- Iron (Fe) (2.009%), Mangan (Mn) (0.076%), Strontium (Sr) (1.845%) — are Class III of danger of heavy metals (low-dangerous);
- Silicon (Si) (4.171%), Sulfur (S) (34.629%), Calcium (Ca) (56.504%), Titanium (Ti) (0.414%), Yttrium (Y) (0.011%), Cerium (Ce) (0.298%), Rubidium (Rb) (0.004%), Niobium (Nb) (0.002%), Rhodium (Rh) (0.005%).

In the data in 2013 it is exceeding the Phosphorus (P) in 8.25 times (table 1).

TABLE 1

SOIL SAMPLES NEAR HEAP OF PHOSPHOGYPSUM, 2013

Element	Units of measu-rement	MPC or back-ground value	Result of measu-rement	Excess
Cadmium	mg/kg	0.68	0.51	
Cobalt	mg/kg	5	3.44	
Copper	mg/kg	3	2.01	
Nickel	mg/kg	4	0.97	
Plumbum	mg/kg	6	5.16	
Phospho-rus in terms of P_2O_5	mg/kg	31.08	256.44	8.25
Chrome	mg/kg	6	1.35	
Zinc	mg/kg	23	16.78	

In soil, which is located at the area of the modifier of the "MG" is contained the following metals (data for 2015):

- Zinc (Zn) (0.006%), Plumbum (Pb) (0.009%) - are Class I of danger of heavy metals (very dangerous);
- Mangan (Mn) (0.142%), Iron (Fe) (0.563%), Strontium (Sr) (2.521%) - are Class III of danger of heavy metals (low-dangerous);
- Silicon (Si) (1.570%), Sulfur (S) (17.897%), Calcium (Ca) (77.176%), Titanium (Ti) (0.101%), Argentum (Ag) (0.014%).

In the data for 2013 it is exceeding the Cadmium (Cd) (in 1.65 times), Plumbum (Pb) (in 1.42 times), nonpolar hydrocarbons (in 3.83 times) (table 2).

The spreading one of the most dangerous heavy metal which is depended on the distance from the industrial ground of the modifier is shown in fig. 3:

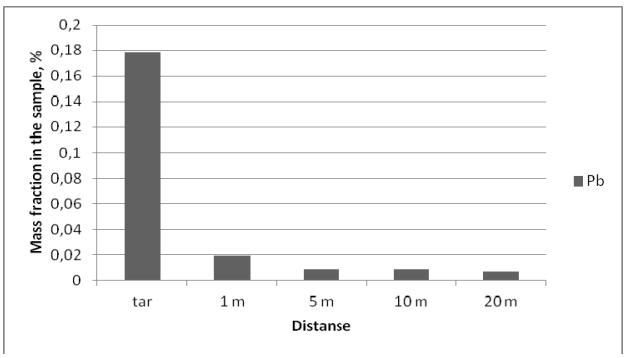

Fig. 3. The spread of Plumbum.

TABLE 2

SOIL SAMPLES NEAR AREA WITH MODIFIERS, 2013

Element	Units of measu-rement	MPC or back-ground value	Result of mea-sure-ment	Excess
Cadmium	mg/kg	0.68	1.12	1.65
Cobalt	mg/kg	5	4.45	
Copper	mg/kg	3	2.13	
Nickel	mg/kg	4	2.76	
Plumbum	mg/kg	6	8.49	1.42
nonpolar hydro-carbons (oil products)	mg/kg	245	938	3.83
Chrome	mg/kg	6	1.26	
Zinc	mg/kg	23	15.67	

Conclusion

Consequently, on the territory of Rozdil State Mining and Chemical Company "Sirka" are tailings, smelting sulfur, which is extracted from the quarry, dumps of phosphogypsum, tar modifiers, Strontium, Arsen, Zinc and other dangerous items. This causes to disruption of the ecological balance.

One solution of the problem of waste accumulation is developing technology of using recycled materials. For example, phosphogypsum can be used in the manufacture of building materials**.**

The main ways of using phosphogypsum in order to recycling are:

- manufacturing of building materials;
- agriculture;
- road construction;
- processing of phosphogypsum in sulfuric acid;
- extraction of various substances of phosphogypsum, including rare earth elements.

References

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