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THE ECOLOGY OF THE PHYTOCOENO-GENESIS PROCESS IN THE TAILING PONDS IN MARAMURES COUNTY

Monica MARIAN*, Leonard Mihaly-COZMUTA*, Camelia VARGA*, Anca Mihlay-COZMUTA*

*North University from Baia Mare, Romania, Baia Mare, Str. Victoriei Nr. 76.
E-mail: nitella_ro@yahoo.com,

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SINOPSIS

Intensive mining activities spanning long years in the past explain the set-up of alien antrophic formations in Maramures County. Tailing ponds, collecting waste generated during the separation process of heavy metals by flotation, typify there such formations. "Greening" attempts in the area, undertaken twenty years ago, consisted in planting such species as *Pinus nigra, Robinia pseudacacia* and *Betula verrucosa* but effective outcomes failed to materialize. The phytoceno-genesis process was so tedious that currently talking about vegetal associations is out of question. Depending on location and land slope, the coverage with vegetation does not exceed 1 – 25% of the land area and includes species coming from the neighboring ecosystems. The species of trees include *Betula verrucosa, Populus tremula, Robinia pseudacacia*, with rare presence for *Quercus petraea, Salix caprea*. Such species as *Frangula alnus, Rubus hirtus, Prunus serotina* belong among the bushes. Relative diversity defines the layer of grass including *Carex sp. Juncus sp., Hieracium pilosella, Erophila verna, Tussilago farfara, Viola arvensis, Festuca pratensis, Holcus lanatus, Calamagrostis epigeios, Rumex acetosella, Setaria glauca, Agrostis capillaris* as representative species. The paper reveals the findings of our analysis on the above vegetal associations as a whole, from an ecological perspective.

INTRODUCTION

Non-ferrous minerals represent an important economic resource for most European States. The amount of ore processed by the mining industry each year is about 60 billion tons, of which wastes account for almost 55%. Disposing of such enormous quantities of waste is a challenge for the mining industry and the issue is of concern to both authorities and citizens. Depending on the naure of the waste generated by mining activities, two methods to dispose of it generally apply. The discharge as tailings waste applies to the coarser particles coming from mine opening activities and they generally have no economic value. The fine particles resulting from mineral processing are mixed with water and deposited in the form of slurry in tailings ponds. The construction does not always take place in compliance with safety requirements and this poses a high level of risk in countries where safety recommendations are not strictly followed. Tailings ponds are constructed without any impervious core and, as such, process and rainfall water seep through the dam towards its free face. Uncontrolled water flowing through, beneath or – in the worst case – over the dam can lead to a loss of stability. Water management is a key safety factor for the handling of large amounts of heterogeneous wet slurries. One of the main causes of accidents and hazards in tailing facilities is lack of water management practices. Failure and collapse of tailings ponds has tremendous consequences including casualties, damage to property and pollution of the environment. Many studies have reported the impacts and risk factors of failure of tailings wastes and tailings ponds on surrounding environments. The International Committee of Large Dams, 2001, Hynes, 1999, Niederleithinger, 2003, Mine Water and the Environment, 2004, Bud, 2005, Campbell and Fitterman, 2006, Tosatti, 1985, the United Nations Environmental Program and the Australian Government Environment, 2000, reported cases of collapsed tailings waste. Some of the tragedies following the collapse of tailings ponds are: Chile, 1965 – over 200 people died, because of an earthquake that had destroyed 22 tailing ponds; Zambia, 1970 – 89 people died; Romania, 1971 – 99 people died; USA, Virginia, 1971 – 125 people died; China, 1988 – 20 people died; Bulgaria, 1966 – 107 people died.

MATERIAL AND METODS

Data regarding flora from the mining ponds from Bozanta Mare represent the results of our investigations made during 2007. The study started with a prealably reconnaisance of teritorry and of soil chemical characteristics. For each identified species we had in attention next features: biological form, floristic element, number of chromosomes and the ecological indices that are characterizing them. The biological forms number of chromosomes and floristic elements for each species are those that have been given by V. Ciocarlan, and the values for ecological indices (T-temperature, U – humidity, R – soil pH) have been established by V. Sanda, A. Popescu, M. Doltu, and N. Donita. The used nomenclature is that adopted by Ciocarlan. For the study of vegetation we used the method of the phyto-coenological school in Zurich-Montpellier, perfected by Braun-Blanque and J. Pavillard.

DISSCUSIONS

In Maramures County, the hot spot area of non-ferrous mining industry, are located over 20 tailings ponds, many of them still active. A special situation we can notice near to Baia Mare city, where in the same area are three tailing ponds (Figure 1) (Google Earth, 2007), one of them being under preservation.

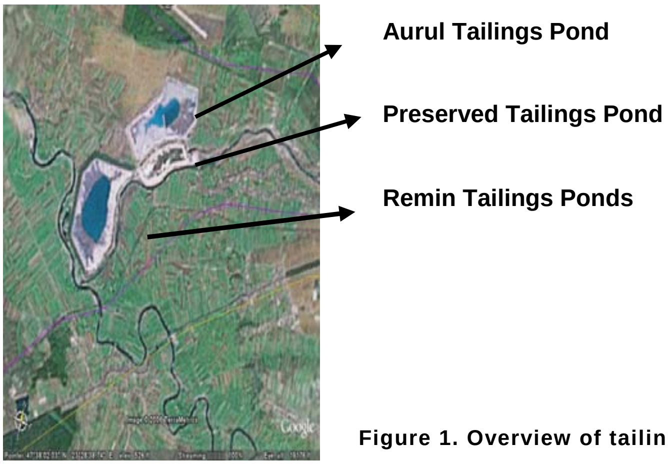

Figure 1. Overview of tailings ponds

The "*Preserved Tailings Pond*" is the oldest in the area and has been under preservation for more than 20 years.

The *Remin Tailings Pond* which was built in 1977 covers 1,050,000 m2, is 30 m deep and has an embankment of 18-20°. Hydrocyclones located on the wall of the pond mechanically purify the wastewater collected from the industrial plants of Baia Mare. The pond collects the liquid phase thus spilled and the solid waste is deposited on the wall for reinforcement purposes. A build-up rate of 2 m/annum has allowed for over 150,000,000 m3 of tailings to accumulate in the pond. Winds easily transport the dam's fine particles. There were a few attempts to consolidate the pond by planting trees of which bur (*Cirsium lanceolatum*) and acacia (*Robinia pseudaccacia*) are best adapted to the site.

The newest pond in the area is the *Transgold Tailings Pond*, where the wastewaters coming from the Transgold Plant (former AURUL) used to be discharged. The pond which is about 3.8 km long and covers 94,0000 m2 contains wastewaters with high amounts of heavy metals and cyanide.

The threatening of active tailings ponds on environment, as consequences of accident possiblly happening, is well known. As example we mention the ecological accident occurred by the end of December 1999 in Baia Mare at Aurum Tailing Ponds. A combination of melting snow and ice (accumulated in the tailings) and heavy rains resulted in a rapid rise of the water level that passed the dam's wall, leading to collapse. Inherent design deficiencies together with unexpected bad weather are among the possible reasons for the failure of the dam. The low temperatures at that time prohibited the build-up of the embankment by disrupting the operation of hydrocyclones thus, in turn, curtailing the accumulation of slurry on the dam. The failure of the water pumps to redirect water accumulation into a reservoir also contributed to the rise in the level of water in the dam. Over 100,000 m3 of wastewater spilled and contaminated the adjacent fields. A load of about 100 t of cyanide and heavy metals (particularly lead, copper and zinc) drained into the Lapus, Somes, Tisza, Danube Rivers and reached the Black Sea. Neutralisation of spilled cyanide was achieved with hypochlorite, but no measures were taken to reduce the concentration of cyanide in the tailings dam to bearable levels for plants and animals in the event that animals reached the pond or in case of future accidental spillage.

Beyond the threatening reprezented by the active ponds, we have to analyze the pollutant impact of tailings ponds under preservation to environment. In this case their physically and chemically stability should be consider. The study considers *Preserved Tailings Pond.*

According to Fodor and Baican 2001, the *physical stability* refers to the collapse of the dam as a consequence of circular sliding, sinking of the foundation and regressive erosion induced by the spilling of the wastewater over the dam. The main factors which influence the physical stability of the dam are the granulometry of the grains, the construction characteristics, the sesismic risk of area, the configuration of the tailing's foundation and also its physical, chemical and elastic properties. For the *Preserved Tailings Pond* mentioned above, the physical characteristics of the soils are presented in Table 1.

Nr. crt.	Parameter	Value
1	Texture	Sandy clay loam
2	Type	Alluvial
3	Organic matter, g· kg^{-1}	0.57
4	Organic carbon, g· kg^{-1}	0.38
5	Water holding capacity, mm/cm depth of soil	38.7
6	Cationic exchange capacity (CEC), cmol· kg^{-1}	12.6
7	Mineralogical composition: Quartzite (sand) Clay Feldspar Sulphides Sericite, Carbonates,	 40-45 20-25 10-15 7 – 8 23 – 7
8	Particle composition, % > 0.2 mm 0.2 ÷ 0.2 mm 0.1 ÷ 0.05 mm 0.05 ÷ 0.02 mm 0.02 ÷ 0.01 mm 0.01 ÷ 0.015 mm < 0.005 mm	 3 4 18 10 15 11 39
9	Physico-mechanical parameters of sandy clay loam Natural humidity, % Plasticity, % Porosity, % Coesivity factor, Kpa Specific weigh, KN· m^{-3}	 27-37 56-61 60-17 22.46 24.13

Table 1. Characteristics of soil

Due the fact that larger part (about 39%) of pond's dam is made by fine particles (under 0.005 mm – Table 1), large amounts of soil fine particle, strongly polluted with heavy metals, were transported by winds and deposited in neighborhoods. Large size particles were transported by the rains, and many ravines appeared (Figure 2). This erosion process reduces the physically stability of pond.

Figure 2. Ravines in the pond's dam

Chemical stability of the tailings pond and the soil around it is strongly affected by the potential acidity of the solid waste forming the dam. Pyrite (FeS2) accounts for the highest proportion of the chemical composition in the above-mentioned tailings ponds with chalcopyrite (CuFeS2), galena (PbS) and sphalerite (ZnS) being reported as well.

The high specific area of the ore's grains induced by their low granulometry favours oxidation in the presence of air, water and microorganisms [Alloway, 1990; Bryan, 1992]. In concentrations of 0.5-1%, pyrite is the main factor that causes acidity. According to Bud, 2005 the next chemical reactions occur:

(1) $FeS_2 + \frac{7}{2}O_2 + 8H_2O \rightarrow FeSO_4 \cdot 7H_2O + H_2SO_4$

The rate of the reaction increases 10^4-10^6 times in the presence of the ferooxidans bacteria (Dudka, 1997).

Ferrous sulphate (II) is oxidised to ferric sulphate (III):

(2) $6FeSO_4 + \frac{3}{2}O_2 + 3H_2O \rightarrow 2Fe_2(SO_4)_3 + 2Fe(OH)_3$

(3) $4FeSO_4 + 2H_2SO_4 + O_2 \rightarrow 2Fe_2(SO_4)_3 + 2H_2O$

The ferric sulphate (III) attacks the other compounds presented in the solide waste, as follows:

(4) $Fe_2(SO_4)_3 + FeS_2 \rightarrow 3FeSO_4 + 2S$

(5) $2Fe_2(SO_4)_3 + CuFeS_2 \rightarrow 5FeSO_4 + CuSO_4 + 2S$

(6) $Fe_2(SO_4)_3 + PbS \rightarrow PbSO_4 + 2FeSO_4 + S$

(7) $4Fe_2(SO_4)_3 + ZnS + 4H_2O \rightarrow ZnSO_4 + 8FeSO_4 + 4H_2SO_4$

(8) $S + \frac{3}{2}O_2 + H_2O \xrightarrow{bacteria} H_2SO_4$

The oxidation-hydrolysis reactions are very intense at high levels of precipitations. In their absence, the oxygen in the air will oxidize the sulphide to sulphates. As the chemical reactions (1) – (7) indicate, the result consists in soluble ($FeSO_4$, $CuSO_4$, $ZnSO_4$) and insoluble ($PbSO_4$) sulphates. During rains, the acidity of waters increases following the dissolution of soluble sulphates, that are subsequently transported in the soil. Chemical reactions (1), (7) and (8) indicate that large amounts of sulphuric acid are generated. If alkaline substances are present in the area (such as wastewaters coming from flotation plants, cyanuric wastewaters), partial or complete neutralization of the acidity resulting from the oxidation of the ore would occur. If the quantity of acid exceeds the quantity of alkaline substances, acidic drainage is released resulting in dissolution of heavy metals and subsequent pollution of the environment. Considering that average annual precipitation in the area (996 mm) exceeds evaporation (720 mm), the acid exfiltrations appear following pond's washing by rains. Due to the low permeability of soil as the presence of sandy clay loam in the structure (Table 1), acid wastewaters accumulation is favorized at the pond's base.

Considering the above presented elements, we can conclude that, even if the active tailing ponds wouldn't be presence in the studied area, the pond under the preservation is himself a threat for environment due to its pollutant potential. Knowing that, were some attemps to stabilized and integrate the ponds in environment, trying to cover it in vegetation. On one hand, the vegetation assures inclusion of pond in the landscape and the estetic repair of degraded land, but, the most important element is reprezented by covering and settling of toxic soils and thus avoiding their transportation by winds and their deposition over the neighbourhoods fertile soils and human habitats. Appearance of spontaneous vegetation on pond's dam is almost impossible, the conditions of this topos, which can not be named biotop, are extreme, the high concentrations of toxic substances (especially heavy metals) being the most drastically and limiting factor. That is why, ecological reconstruction is the only chance for *greening* of tailings pond.

Up to now, were a few attemps to cover in vegetation the studied pond. Some effects are visible, but they are not enough, because the actions were focused only on one component of ecosystem: re-built of trees layer, without any consideration for microbiota's or for grassy layer's recovery, the elements which are the most efficient in surface's cover and avoiding of powders mobility.

Twenty years ago, on the pond dam were planted black pine (*Pinus nigra*) and acacia (*Robinia pseudacacia*). Actual analysis of the area indicates that only a small part of them rezisted and growed (about 10-20%), only a few have 5-10 m in hight, and they did not cover more than 10% of pond's surface. In this situation we can not speak about a unitary crowning as is normal in a plantation. On the E mountainside of the pond there are not significant differences regarding the vegetation comparing with the refference hight. Some bigger *Pinus nigra and Robinia pseudacacia* (5-10 m in hight) are presented, but their crowning projection on soil do not cover more than 5%. In Table 2 are presented some characteristic of vegetation presented on E mountainside.

Survey number	1	2	3	4
Direction	E	E	SE	SE
Altitude	Base of dump	Base of dump	The first terrace	The first terrace
Trees' hight	5-10 m	5-10 m	3-4 m	3-5 m
Unity of crowning (degrees)	0,5	0,5	0,4	0,3
General cover (%)	20	20	15	10
Pinus nigra	1	1	-	+
Robinia pseudacacia	+	+	1	+
Betula verrucosa	+	-	+	+
Rhamnus frangula	-	-	+	-
Rubus hirtus	-	-	+	+
Agrostis capillaris	+-1	+	+	1
Equisetum arvense	+	-	-	-
Juncus effusus	+	+	-	-
Cardaminopsis halleri	+	+	-	-
Phragmites communis	-	-	+	-
Reinouttria japonica	-	+	+	+

Table 2. Characteristics of vegetation presented on E mountainside

The study analyzed the flora and vegetation presented on investigated tailings pond and near areas, to show the floristic differences which appear and the possible negative influences of pond on phytocoenosis in neighbourhood. Only few species were presence and the surface they cover is not enough. That is why the ravines crosse the slope as errosion effect of dam under the rains. The presence of ravines indicates that a great soil amount was transported to the pond's base. In case of E and S-E mountainsides, beyond the layer charged with heavy metals, as limiting factors acts a high level of sunstroke making harder the developing of grassy species which exploit the superficial horizon of sublayer as water source.

RAUNKIAER'S LIFE FORMS ANALYSES:

The structure of Raunkiaer's life forms: Mega Phanerophytes (from a past forestation trying) prevail with 54,54 %, followed by hemicryptophytes 18,18% and the other life's forms are in smaller proportion (fig. 3).

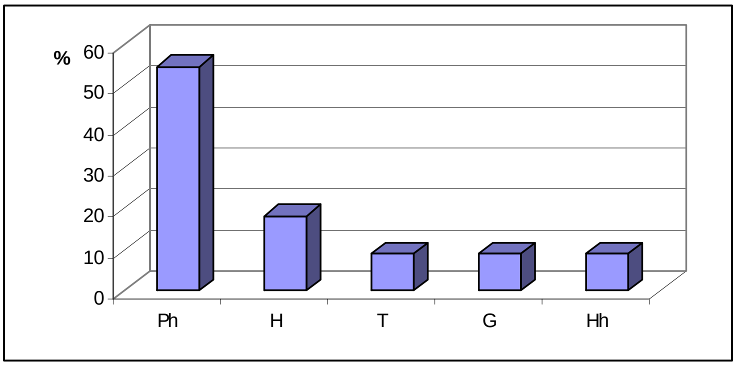

Fig. 3. Raunkiaer's life forms: PhM mega phanerophytes, Phm meso-phanerophytes, Phn- nano phanerophytes, H-hemicryptophytes, G-geophytes, Hh-helohydatophytes, ch-chamephytes.

In the floristic elements spectrum, prevail the Adventive species (27,27%), followed by the cosmopolite species and the eurasiatic species central European species, circumpolar species and cosmopolites.

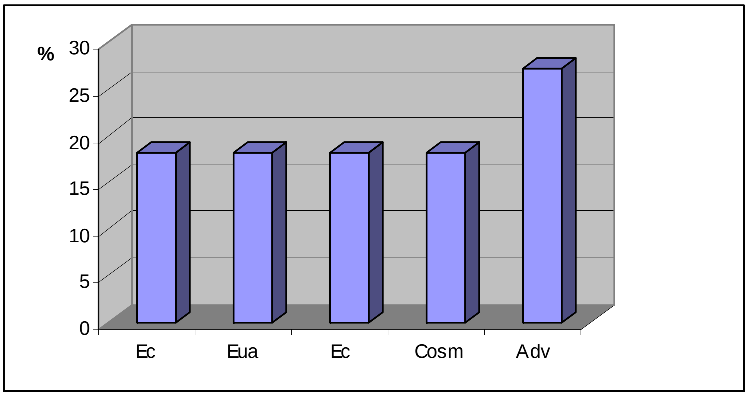

Fig. 4. Floristic elements spectrum

The diploidy index (DI=D/P x100) has a value of 37,5%.

Humidity indices spectrum (fig.5) reveals the presence and preponderance of mesophytes species (37,5%), followed by hygromesophytes (25%). The xeromesophytes (12,5%) and euryhygrous have both same percentage.

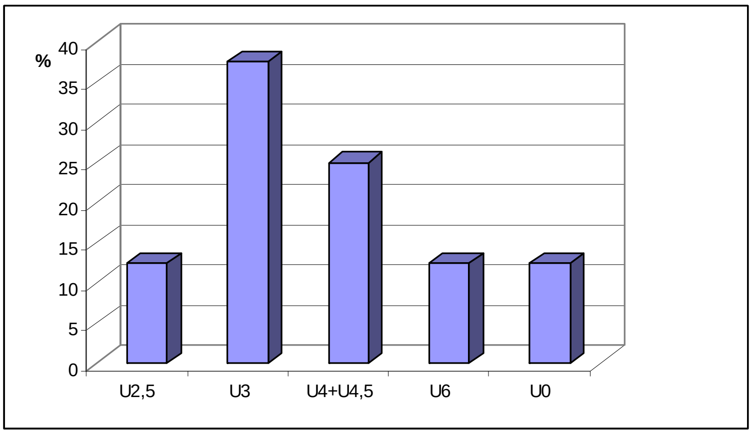

Fig. 5. Humidity indices spectrum

Temperature indices spectrum (fig. 6) demonstrates the prevalance of mesothermophylous (37,5%), followed by eurythermic (25%) species and microthermophylous species (12,5%).

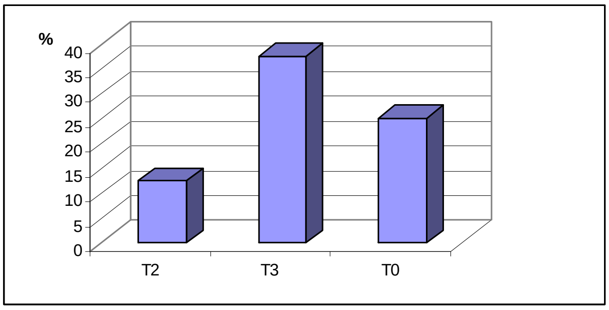

Fig. 6. Temperature indices spectrum

Soil pH spectrum (fig.7) reveals the most of cormophytes species indentified on these sterile deposits tolerate varied values of this indicator. Prevail the acido-neutrophilous species (37,5%), euriionics species (25%), and the low acido-neutrophilous species (25%) followed by the acidophilous species (12,5%).

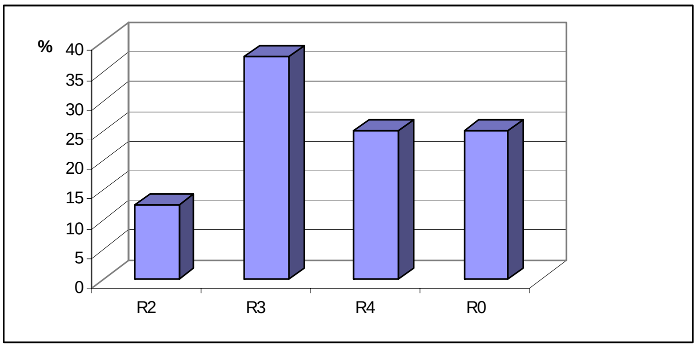

Fig. 7. Soil pH spectrum

On N-W pond's side the situation is positivelly different. We appreciate a lower sunstrokes on these sides, a lower dehydration level allows the developing of a larger numer of species. Some characteristics of vegetation presented on N-W mountainsides are presented in Table 3.

Survey number	1	2	3	4	5	6	7
Altitude	Base	Base	Terracy I at half pond	Terracy I at half pond	Terracy II clos to upper part	Terracy II clos to upper part	On upper part of pond
Direction	N	N	N	N-W	N	N-W	-
Slope, degree	30-40°	20°	0°	0°	0°	5°	0°
Crowning of trees	0,5	0,5	0,3	0,2	0,2	0,2	-
Covering of grassy layer %	80	50	10	5-10	5	20	1-2
Robinia pseudacacia	1-2	+-1	+-1	+	-	-	-
Populus tremula	+	+	+	+	-	-	-
Quercus robur	+	+	-	-	+	-	-
Betula verucosa	+	+	+	+	+	-	-
Prunus serotina	+	-	+	-	-	+	-
Agrostis capilaris	4	2	+-1	+	+-2	+-1	-
Juncus effusus	+	-	-	-	-	-	-
Juncus conglomeratus	+	-	-	-	-	-	-

Tussilago farfara	+	+	-	-	-	-	-
Phragmites communis	+	+	-	-	-	+	+
Festuca rubra	+	-	-	-	-	-	-
Holcus lanatus	+	+	-	-	+	+	-
Solanum dulcamara	+	-	-	-	-	-	-
Cichorium intybus	+	-	-	-	-	-	-
Galium cruciata	+	-	-	-	-	-	-
Lythrum salicaria	+	-	-	-	-	-	-
Melilotus albus	+	-	-	-	-	-	-
Verbascum phlomoides	+	-	-	-	-	-	-
Rumex acetosa	+	-	-	+	+	-	-
Carex hirta	+	+	1	-	-	-	-
Carex pairae	-	-	+	-	-	-	-
Erigeron annuus	-	-	+	+	-	+	-
Juncus bulbosus	-	-	-	+	-	-	-
Centaurea micranthos	-	-	-	+	-	-	-
Hieracium pratense	-	-	-	-	+	-	-
Rhamnus frangula	-	+	-	+	-	-	-
Poa pratensis	-	+	-	-	-	-	-
Crepis biennis	-	-	+	-	-	-	-
Rubus hirtus	-	-	-	+	+	-	-
Rumex acetosella	-	-	-	+	+	+	+
Hieracium pilosella	-	-	-	-	+	+	-
Setaria glauca	-	-	-	-	+	+	-
Calamagrostis epigeios	-	-	-	-	-	+	-
Convolvulus arvensis	-	-	-	-	-	+	-
Ornithogalum umbellatum	-	-	-	+	-	-	-
Scleranthus annuus	-	-	-	+	+	-	+
Stellaria media	-	-	-	-	-	+	-
Rosa canina	-	-	-	-	-	+	-
Viola saxatilis	-	-	-	-	1	1	-
Polygonum aviculare	-	-	-	-	-	+	-
Rumex crispus-	-	-	-	-	-	-	+
Amorpha fruticosa	-	-	-	+	-	-	+

Table 3. Characteristics of vegetation presented on N-W mountainsides

It is obviously that on mountainsides less exposed to the sun, the number of species is larger, which proves that limiting factor (as well important as the sublayer) is water missing. Also, we can notice that the surveys located at the pond's base, being in a kind of ecoton, with a soil un-washed by the rains, present considerable much more species than the mountainsides areas.

The upper part of pond's crowning is almost entirelly without vegetation. The planted trees in this area are completelly dried and the grassy layer is not settled. The exception is reprezented by the ex water evaporation surface, with a high level of humidity where a reed (*Phragmites communis*) compact association is developing.

On the first terracy , at half pond some species of mushrooms like: *Laccaria laccata, Scleroderma citrinum, Inocybe lacera, Xylaria hypoxylon, Suillus bovinus, Calvatia excipuliformis, Thelephora terrestris* were identified.

Raunkiaer's life forms analyses: The structure of Raunkiaer's life forms: hemicryptophytes prevail with 50%, 12,5% represent Mega Phanerophytes (from a past forestation trying), and the other life's forms are in smaller proportion (fig. 8). The great number of hemicryptophytes demonstrates the tendency of colonization of tailings by perennial herbaceous species.

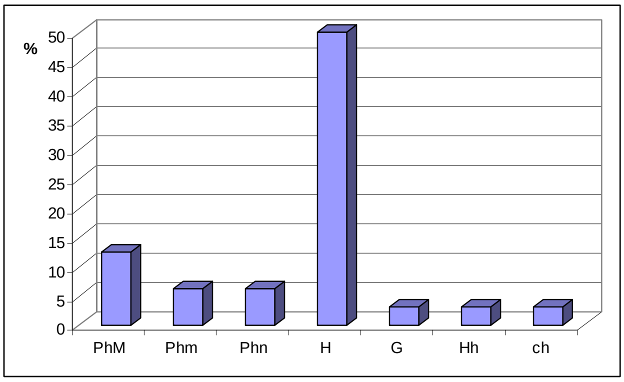

Fig. 8. Raunkiaer's life forms: PhM mega phanerophytes, Phm meso-phanerophytes, Phn- nano phanerophytes, H-hemicryptophytes, G-geophytes, Hh-helohydatophytes, ch-chamephytes.

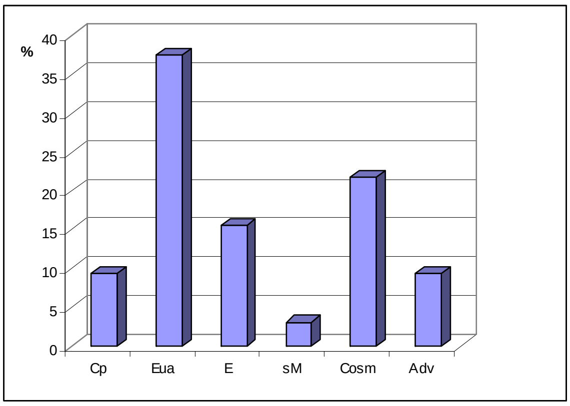

Fig. 9. Floristic elements spectrum

In the floristic elements spectrum, prevail the eurasiatic species (37,5%), followed by the cosmopolite species (21,8%) and the alien species (9,375). The eurasiatic and circumpolar elements represents the "native" species background and also the main source of colonizer species.

The diploidy index (DI=D/P x100) has a value of 33,33% reflected general ecological conditions and also the pressure generated by human activities.

Humidity indices spectrum (fig. 10) reveals the presence and preponderance of mesophytes species (33,33%) and xeromesophytes (30%), followed by mesohydrophylous (20%) and euryhygrous (3,33).

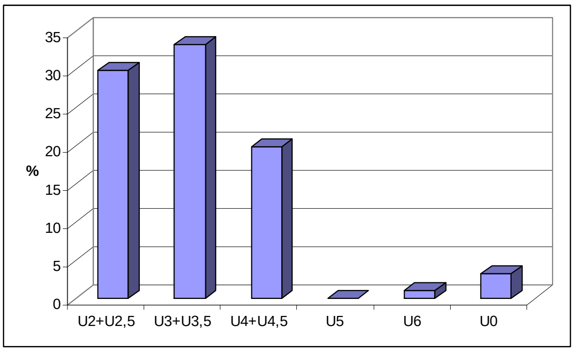

Fig. 10. Humidity indices spectrum

Temperature indices spectrum (fig. 11) demonstrates the prevalance of mesothermophylous (36,66%), followed by eurythermic (33,33%) species and microthermophylous species (16,66%).

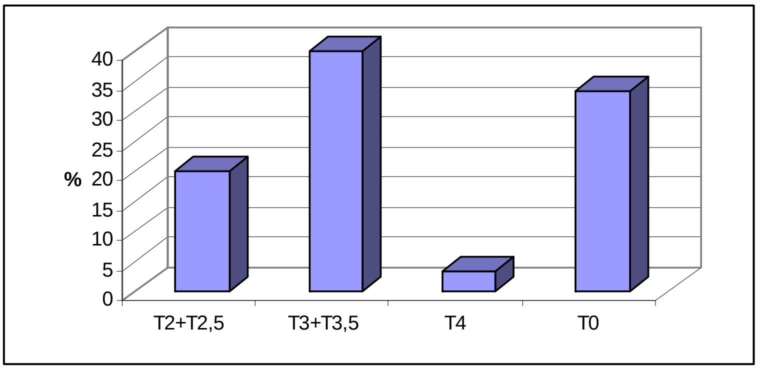

Fig. 11. Temperature indices spectrum

Soil pH spectrum (fig. 12) reveals that most of cormophytes species indentified on these sterile deposits tolerate varied values of this indicator. Prevail the euriionics species (43,33%), and significant proportion presents the acido-neutrophilous species (23,43%), followed by the low acido-neutrophilous species (20%) and by the acidophilous species (16,66%).

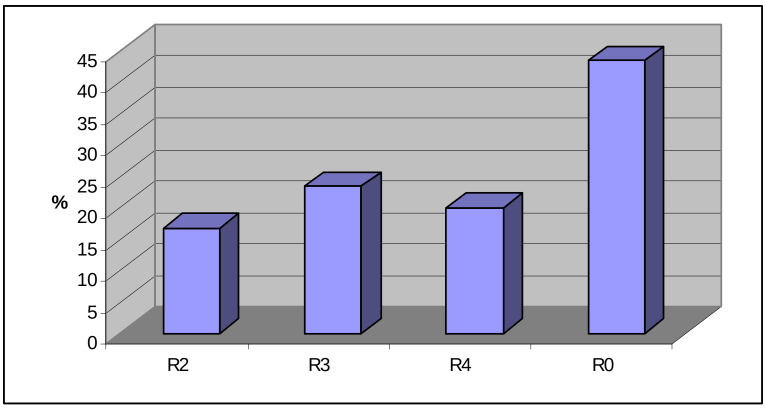

Fig. 12. Soil pH spectrum

The vegetation around the pond is ruderal entirelly, installed along of acces roads to the pond. It is obvioulsy that high concentrations of heavy metals in soil is lower, many species being presented: *Daucus carota*, *Cichorium intybus, Trifolium pratense, Taraxacum officinale, Galium verum, Tussilgo farfara, Achillea millefolium, Campanula patula, Rumex acetosella, Galium pseudoaristatum, Eupatorium cannabinum, Equisetum arvense, Melilotus albus, Cirsium arvense, Lythrum salicaria, Ranunculus repens, Festuca giganthea, Dactylis glomerata, Lotus corniculatus, Abutilon theophrasti, Convolvulus arvensis, Galium molugo, Salix viminalis, Erigeron canadensis, Matricaria recutita, Artemisia vulgaris, Centaurea austriaca, Chrysanthemum leucanthemum, Lactuca saligna, Salix alba, Plantago lanceolata, Trifolium medium, Inula britannica, Linaria vulgaris, Lathyrus tuberosus, Thypha latifola, Silene alba, Prunus spinosa, Populus nigra.*

A low number of leguminous species of which roots could establish symbiotic relationships with settling nitrogen bacteria were notices and thus the soil structure could not be improved.

Starting from the case study presented above, we consider that the ecological reconstruction by trees planting is not enough and on long term proves incapacity for covering the degraded surface with a continuous vegetation layer. Cover in vegetation of ponds should consider beyond of cover with a continuous fertile soil layer and immediatelly cover with vegetation resisting to extreme conditions of dry and high level of contaminants.The studies and rehabilitation should be also oriented to improval of microbiota (fungus, microorganisms) of which develop is directlly conditioned by the vegetation layer.

CONCLUSIONS

Investigations of flora and vegetal associations on tailing ponds realized during 2007-year count above 52 vascular plant identified species.

The cormophyte flora was analyzing from bioformes, floristic elements, and caryological and species ecological requests perspectives.

The phytocoenological characterization shows that in this stage, we can't talk about a real vegetal association. It is the first level in the installation proces of primary vegetation. For this reason we can not include this vegetal layer in the phytocoenological classification. The phytocoenological characterization shows that this vegetal layer in poor in species, perfectly natural situation if we take into account the very restrictive statinal conditions.

The study analyzed the flora and vegetation presented on investigated tailings pond and near areas, showed the floristic differences which appear on the differents pond's sides depending on ecological particularity, especially the insolation and humidity level.

On N-W pond's side the situation is more good, because a lower sunstrokes on these sides and a lower dehydration level allows the developing of a larger numer of species. On this side the structure of Raunkiaer's life forms showed that the hemicryptophytes prevail with 50%, demonstrates the tendency of colonization by perennial herbaceous species.

The eurasiatic and circumpolar elements, which prevails in the floristic spectrum, represents the "native" species background and also the main source of colonizer species, and a hope that the mining ponds would be cover with a "native" vegetal layer.

But, on the East side where is a higher level of dehydration, prevail the alien species and cosmopolites with a great resistance to lower humidity level.

The diploidy index (DI=D/P x100) has a value of 37,5% respectively, 33,33% reflected general restrictive ecological conditions and also, the pressure generated by human activities.

Humidity indices spectrum reveals the presence and preponderance of mesophytes species and xeromesophytes, followed by mesohydrophylous and euryhygrous. Temperature indices spectrum demonstrates the prevalance of mesothermophylous, followed by eurythermic species and microthermophylous species.

The presences of these all tipes of species is reletad with the different ecological conditions during the vegetation period.

Soil pH spectrum reveals that most of cormophytes species indentified on these sterile deposits tolerate varied values of this indicator. Prevail the euriionics species and significant proportion presents the acido-neutrophilous species, followed by the low acido-neutrophilous species and by the acidophilous species. The significantly percentage of low-acidophylous species and acidophylous species demonstrated the great level of soil acidity.

Finally, we can conclude that the tailings ponds under preservation still remain threats for environment, due their physically and chemically instability. One of the most important problem must be solved concerns avoiding of soil mobility. In this end, biological rehabilitation of pond should be considers in all ecosystem's elements: trees layer, grassy layer and microbiota of soil. Simbiotic relationships settled between all these contribute not only to stop the mobility of soil but also to improving the soil structure.

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