RESEARCH CONCERNING THE VALORISING POTENTIAL OF MINE STERILE FROM SURFACE CARBONIFEROUS EXPLOITATIONS IN THE ESTABLISHMENT OF AGRICULTURAL LANDS

CERCETĂRI PRIVIND POTENŢIALUL DE VALORIFICARE A STERILULUI MINER DIN EXPLOATĂRILE CARBONIFERE DE SUPRAFAŢĂ ÎN CONSTRUCŢIA DE TERENURI AGRICOLE

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Abstract: Mine sterile from surface carboniferous exploitations in the Motru River Basin (County of Gorj) and Huznicioara (County of Mehedinti) have mineral and physical and chemical features that make them a potential soil source. Literature, as well as research we have carried out, point out the possibility of valorising mine sterile within local ecological reconstruction works. Mine sterile can also be used in ash, floating sand, waste dump, etc. covering works. It is also important in the establishment of agricultural lands.

Rezumat: Sterilul minier provenit din exploatariile carbonifere de suprafață din Bazinul Motru, județul Gorj și Huznicioara județul Mehedință, prezintă însușiri mineralogice și fizico-chimice propice pentru a fi caracterizat ca o resursă potențială de sol. Literatura de specialitate precum și cercetările întreprinse susțin posibilitatea de valorificare a sterilului miner în cadrul unor amenajări de reconstrucție ecologică locală. De asemenea, sterilul miner poate fi utilizat în lucrări de copertare a hălderilor de cenusașă, nisip de flotațiune, deponii și a. De real interes este și potențialul de valorificare a sterilului miner în construcția de terenuri agricole.

Key words: waste dump, mine sterile, ecological impact, waste dump management, ecological reconstruction, improving works, establishing agricultural land

Cuvinte cheie: haldă, steril miner, impact ecologic, amenajare haldă, reconstrucție ecologică, lucrări ameliorative, construcția de terenuri agricole

INTRODUCTION

Agriculture is the economic activity that supplies the main food resources for humans, and earth agro-ecosystems are the field production technologies are displayed in order to achieve biomass useful to humans.

The size and spread of human developments (urban, industrial, communication infrastructure, etc.) steadily affect productive agricultural lands with varied soil types, of which quite frequently some are fertile soils, belonging to high quality classes.

Demographic growth worldwide has an increasing and important pressure on earth ecosystems. All these specific trends of human society result in new trends in establishing agricultural lands and in valorising less proper soil resources, weakly productive, and affected by different limiting factors. Most often, specific agro-pedo-ameliorative works associated with proper technological works, are enough in the improvement and establishment of productive agricultural lands.

There are nevertheless situations when establishing agricultural lands supposes using proper substrata coming from different potential soil resources or from material that can be improved in order to become cultivable.

We can say that in the future it is not soil, in a soil science sense, but cultivation technology that will count, and the substratum on which agricultural crops will be established
shall have to meet certain criteria to allow a high degree of mechanisation and irrigation, all the rest of features making it cultivable being supported by performing technologies of the future.

**MATERIAL AND METHOD**

Research we have carried out aimed at assessing from a qualitative point of view the mine sterile of the waste dump in Valea Mănăstirii (County of Gorj) in order to use it as a soil resource in establishing agricultural lands.

To do so we made studies and research concerning mineral composition, the value of the main agro-chemical and soil indices, and fertility potential of mine sterile resulted from surface carboniferous exploitations.

We used as analytical method X-ray diffraction, spectro-photometry in atomic absorption, colourimetric spectro-photometry, etc.

Laboratory analyses were completed with experiments on vegetation plates as well as with field measurements.

**RESULTS AND DISCUSSIONS**

Both in Romania and worldwide, there is the problem of rational, sustainable use of existing soil resources already part of the productive agricultural circuit and of improving through agro-pedo-ameliorative works some soil categories affected by limiting factors.

On the ground of studies and documentation, there are situations worldwide in which they approach the problem of expanding agricultural areas destined to agriculture through the ‘establishment’ of agricultural lands. This is possible through the management of a fertile substratum that can be improved on land playing the role of support.

Our research aimed at assessing qualitatively the mine sterile from surface carboniferous exploitations and the possibility of valorizing it in the establishment of agricultural lands. We focused mainly on the waste dumps in Valea Mănăstirii (County of Gorj) and Huznicioara (County of Mehedinți).

First, we analysed the quality of the sterile stored in the waste dump in order to assess its fertile potential with a view to future cultivation.

From a mineral point of view, X-ray diffraction analysis of the sterile samples points out the presence of the following minerals: quartz (SiO₂), moskovite (K,O·3Al₂O₃·6SiO₂·2H₂O), feldspath represented by mixed crystals from the isomorphous series (anortite CaO·Al₂O₃·2SiO₂ and albite Na₂O·Al₂O₃·6SiO₂), hydroaluminosilicates (chlorite and caolinite), pyroxens, calcite and dolomite.

The presence of these minerals is uneven, if we take into account the provenance of sterile from depths that vary between soil level – after previous uncovering – and 200-300 m.

The main soil and agro-chemical indices we monitored (texture, density, apparent density, pH, humus, phosphorus and potassium content, carbonates and bicarbonates, electric conductivity) also show favourable values, taking into account the provenance of this material, comparable to those of a medium value agricultural land. The values of indices are presented in Table 1.

Measurements and field research pointed out the establishment, on mine sterile waste dumps, of varied spontaneous vegetation. We could see a wide range of species, some of which with high forage value (melilotus, dactilis, phleum, medicago, trifolium sp., etc.), which shows the fact that the mine sterile, because of its composition and features, is not vegetation selective or restrictive, allowing the development of a wide range of plant species.

Agricultural crops established by the natives in the area on the managed side of the waste dump by levelling, crops with a variable level of development and production depending on the fertilisers applied and particularly on the hydric deficit shows that there are possibilities
of cultivating mine sterile. Advanced technology could allow the establishment of superior crops with high performances.

Table 1

Soil and agro-chemical parameters of the mine sterile in Valea Mănăstirii, Romania

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Parameter</th>
<th>MU</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Granulometric analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Texture: Coarse sand ($\Theta = 2-0.2$ mm*)</td>
<td>%</td>
<td>14.1</td>
</tr>
<tr>
<td>2</td>
<td>Fine sand ($\Theta = 0.2-0.02$ mm)</td>
<td>%</td>
<td>46.7</td>
</tr>
<tr>
<td>3</td>
<td>Dust ($\Theta = 0.02-0.002$ mm)</td>
<td>%</td>
<td>26.2</td>
</tr>
<tr>
<td>4</td>
<td>Clay ($\Theta &lt; 0.002$ mm)</td>
<td>%</td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td>Physical features</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Density</td>
<td>g/cm$^3$</td>
<td>2.68</td>
</tr>
<tr>
<td>2</td>
<td>Apparent density</td>
<td>g/cm$^3$</td>
<td>1.51</td>
</tr>
<tr>
<td></td>
<td>Agro-chemical features</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>pH</td>
<td></td>
<td>6.64</td>
</tr>
<tr>
<td>2</td>
<td>Humus</td>
<td>%</td>
<td>0.89</td>
</tr>
<tr>
<td>3</td>
<td>Phosphorus content</td>
<td>ppm</td>
<td>4.07</td>
</tr>
<tr>
<td>4</td>
<td>Potassium content</td>
<td>ppm</td>
<td>79.85</td>
</tr>
<tr>
<td>5</td>
<td>Carbonates and bicarbonates</td>
<td>%</td>
<td>0.190</td>
</tr>
<tr>
<td>6</td>
<td>Electric conductivity</td>
<td>m.e./100 g soil</td>
<td>31</td>
</tr>
</tbody>
</table>

Our main concern was to manage the waste dump locally in order to recover area ecology and landscape with the possibility of developing local agricultural systems with improving role and later on as a source for the maintaining of social development for the population affected by the presence of the waste dump.

Another trend resulted from our documentation and research was to valorise the material in the management of special ecological works, particularly in covering ash waste dumps, floating sand waste dumps, city waste dumps, degraded lands, and any other works involving the covering with a superficial layer of soil.

It is important to use this material in the management in vast works such as establishing agricultural lands in areas where there are such lands, where they are not enough, or where they do not have the proper features to allow the establishment of agricultural crops.

In our opinion, on the ground of what we have already presented, it is possible to valorise mine sterile as a soil resource in the establishment of agricultural lands in areas where it is a must.

Literature and our own research show that this material has favourable mineral and physical and chemical features. These features give it a medium natural fertility as well as a storing capacity of some improving factors that are used in increasing productive capacity (amendments, mineral and organic fertilizers). These initial improving features recommend it for the kind of management we have mentioned above.

Results we obtained were corroborated (completed) with observations concerning spontaneous vegetation settled on the waste dumps as well as with the vegetation state and degree of development of crops established by the natives on the leveled portion of the waste dump.

For the establishment of agricultural lands we can use material of the waste dump type that has proper features for cultivation, by ‘posing’ it on the surface of a land used as a support in a layer 30-50 cm thick, as shown in Table 2.

There are worldwide, for example in the Arab United Emirates situations in which most cultivated areas have been established through such establishment procedures involving
native resources.

In order to achieve such agricultural lands, it is necessary to do a series of leveling, agro-pedo-ameliorative works, to prepare the support land on which the mine sterile is to be spread.

Then, the mine sterile is to be transported and set on the land area previously prepared and leveled evenly. Homogenizing the material thus set is done simultaneously.

The substratum thus set is, due to the mechanical works, in an aerated state, which asks for superficial works that prepare the establishment of the agricultural crops to be done first.

It is recommended that the first crops have an ameliorative, fixing, and enriching (organic matter and nutrients) role. In this respect, legume and green manure crops are most recommendable.

Agricultural systems developed later on in such environments should be performing, with high economic profitability so that investments in the vast agricultural land establishment can be recuperated.

CONCLUSIONS

Certain worldwide situations ask for the establishment of agricultural lands with a view to obtaining food resources for the humans steadily growing.

The mine sterile from surface carboniferous exploitations in the Motru River Basin (County of Gorj) and Huznicioara (County of Mehedinti) show mineral and physical and chemical features proper to become a potential soil resource with possibilities of being valorised in the establishment of agricultural lands.

We recommend local management of waste dumps to reconstruct ecology and landscape in affected areas.

In certain conditions, mine sterile can be valorised in the special ecological management, in covering areas affected by human activities that really need it.

Mine sterile is also a potential soil resource that can be valorised successfully in the establishment of agricultural lands in areas where it is strictly necessary.

LITERATURE

Table 2

Succession of works in the establishment of agricultural lands through the use of mine sterile as fertile substratum

<table>
<thead>
<tr>
<th>Preparation of the support</th>
<th>Establishment of agricultural land</th>
<th>Exploitation works</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levelling works</td>
<td>Transportation and setting of mine sterile on the support</td>
<td>Organic and mineral fertilising</td>
</tr>
<tr>
<td>Agro-pedo-ameliorative works</td>
<td>Spreading and levelling of the mine sterile</td>
<td>Soil works</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irrigation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Special crop rotation for the fixing of soil and improving of fertility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Agricultural crops destined to production</td>
</tr>
</tbody>
</table>
