# IMPACT OF OPEN PIT GRAVEL EXTRACTION FROM SEBES, ALBA COUNTY, ON SOIL FERTILITY

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***Abstract***
*Exploitation of mineral aggregates as sedimentary type has a great expansion at national level and at the level of the Alba Iulia County; due to growing industrialization thus aggregate resources are critical to modern society. Aggregated resources are used in almost every element of the newly built environment, whether for roads, bridges and transportation infrastructure, either for private development. Natural aggregate (crushed stone, sand, and gravel) is used as a construction material in various sectors, especially in this period, when, in Alba County, are developing a series of infrastructure projects, such as the construction of highways and railways. Sand and gravel pits are located in almost every city of Alba County, especially on the terrace of the rivers Mures, Tarnava and Sebes. In this period the demand for aggregate will continue to grow, due to the increasing number of infrastructure projects in the coming years. Investments in transport infrastructure that were started in the city of Sebes require a large amounts of mineral aggregates, therefore deemed appropriate location of that exploitation of mineral aggregates in the locality Lancram, area rich in resources, in order to secure the raw materials necessary, but also to reduce their transport costs from other areas. The present work want to be a study conducted for the identification and quantification of soil and groundwater impacts generated by the exploitation of mineral aggregates from the upper terrace of the rivers Mures in Sebes municipality area.*

***Key words****: gravel extraction, open pit, soil fertility, mineral aggregate*

## INTRODUCTION

The level of construction activity is inextricably linked with a given country's concept of a development process. Such a concept is based on a number of human activities, and these depend in part on the kinds of infrastructure already built. The construction method that best meet society's current expectations incorporate the use of aggregates; these materials all stem from a nearly universal resource and give rise to relatively simple production processes. Moreover, they are easy to transport and allow a rapid implementation [1].

Aggregate extraction in pits and quarries can take place both above and below the water table. Aggregate extraction above the water table usually has no significant impact on the local groundwater system or local wells [2].

Pits that extract sand or gravel from below the water table use equipment that digs or dredges the wet aggregate from a pond that forms and expands as the sand or gravel is removed. This allows most of the water to stay in the ground and usually maintains the water table. Possible effects on groundwater include local changes to groundwater flow and temperature near the ponds [2].

Rock quarries that remove bedrock below the water table can only operate if the water table is lowered artificially – called "dewatering." This allows the quarry floor to stay dry. The drop in the water table can affect the groundwater flow in a limited area beyond the quarry, called the "zone of influence." Quarries may also affect the temperature of the local groundwater. Water wells and natural features such as wetlands within the affected area must be carefully studied to predict how they may be affected and what steps should be taken to protect them [2].

Soil pollution is represented by any activity that causes an imbalance in the normal functioning of soil as a medium of life, in different natural and man-made ecosystems. Degradation is manifested by physical, chemical, biological soil. Adversely affect fertility, productive capacity, in terms of quality and quantity. Man, proving and this particularly inventive, assault the nature in various ways: chemical use, biological resource exploitation, land-use change, exploitation of deposits for useful minerals, accumulation of waste dumps, waste, sludge and residues, activities leading to soil erosion, waste management [3].

Quarry exploitation causes significant environmental problems as a consequence of soil removal and drastic changes in the original drainage network and topography [4].

Gravel extraction causes changes in deepwater and groundwater quality as well as in the elevation of the groundwater table and its variation. Gravel extraction increases the pollution risk of groundwater and may cause difficulties in the treatment of the water abstracted from a groundwater intake. Post extraction maintenance is recommended. Under an exposed gravel surface the retention was much weaker. The deepwater studies show that the risk of groundwater contamination is clearly higher at gravel extraction sites than in natural groundwater areas. Fecal coliform bacteria were observed more in gravel extraction areas than in natural groundwater areas. In some places nitrate was observed in groundwater; this may be a result of dumping of wastes in gravel pits. A serious factor that caused changes in groundwater quality was the seepage of surface water and especially of bog water into the groundwater area as a result of carelessness in gravel extraction [6].

Irrigation is becoming a common practice in restoration works. Usually, support irrigation is implemented during summer droughts to ensure plant growth on recently restored slopes. In the case of stony substrates used for restoration in semi-arid areas, the response of vegetation to irrigation is a topic of particular interest, because conditions combine adverse topography, shallow and dry soils, and the need to increase plan cover under unfavorable hydrological situations [5].

Gravel pits site is located outside city limits Sebes, Lancram area, and an area on the left upper terrace of the river Mures.

**Deposit geology**

From the geomorphologic point of view, area is located in the south eastern Transylvanian Basin, basin formed during the geo-tectonic movements Laramie phase, following the collapse of the foundation of the Carpathian Mountains and evolved against a rigid, since Paleocene. During Neocene, it works as a basin subsidence area that allows the accumulation of thick sedimentary series with a relatively monotonous constitution. Bedrock consists of Neocene deposits (clay marl, sand turned into sandstone).

Quaternary Period contributes by submitting alluvial deposits with vertical graded bedding from under boulders and gravel, and clay powder to the upper terrace deposits. The deposit is available in tabular form on the terrace of the Mures River, covering virtually the entire perimeter of the area being covered with topsoil.

Mineralogical, aggregates are composed of fragments of gneisses, micaceous shale, sandstone, limestone, quartzite, igneous rocks, as follows:

*Table nr. 1*

Mineralogical composition of aggregates

| Rock type | | % |
|---|---|---|
| Crystalline rocks | quartzite | 10 |
| | gneisses | 15 |
| | crystalline schist | 35 |
| Eruptive rocks | granite, andesite | 35 |
| Sedimentary rocks | sandstones, limestones | 15 |

Mining method that applies is topsoil stripping and storing it (figure 1), digging with excavator with transverse slices. A slice width is about 15 m, a depth between 4-6 m, with keeping a pillar of 1 m above the water table level. Mineral aggregates are loaded in dump and transported to the sorting station or directly to beneficiaries. Many times the maximum operating depth is not kept intercepting the groundwater level. In other cases the environmental permit is required to carry fishing lakes with exploitation of mineral aggregates. In many cases, only extract mineral aggregates and fishing lakes are no longer completed, leaving only the holes, which are sometimes stored in household waste and construction.

Figure 1 - Land prepared for excavation

Figure 2 - Land rehabilitated

These quarries, especially those that intercept the water table, affect the groundwater hydrological regime of the soil, affect neighboring soil parcels and increase the risk of groundwater pollution.

Sequence required for environmental restoration work in operating perimeters that not intercept the groundwater is: leveling base of the aggregate quarries, operation in sloping the sides, spreading topsoil and compaction on the bottom and slopes (mechanical and manual), grassing (figure 2), and monitoring soil stabilization.

## MATERIAL AND METHODS

Our research was carried out in the field and in the laboratory, in order to identify and to establish the soil properties and also, to identify the type of soils from the research area. Soil samples were collected from forth locations in the outside city limits Sebes, Lancram area. Soil pH was determinate by potential method, in water extract 1:2.5 ratio. Humus content from the soil samples was analyzed after Tiurin method [7]. Mobile potassium content was determinate in ammonium-acetate lactate solution and the values were measured with and atomic absorption spectrophotometer at wave length 766 nm. Mobile phosphorus content was determinate by Egner-Rhiem-Domingo method and the sample values were measured by a spectra-photo-colorimeter at 660 nm wave length. Content of total calcium carbonates was measured by Scheibler method. The soil types from the research areas were established according to the Romanian Soil System Taxonomy [8] and after the Methodology for Pedological Studies [9] and were verified after the Soil Atlas of Europe [10].

## RESULTS AND DISCUSSIONS

The soil types presented bellow, are the most representatives for each location because they occupy the largest surface, and according to the observations that were made in the field.

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In terms of soil, land form of this area is characterized by: cambic chernozem, the parent rock consists of salty carbonates deposits and groundwater at depths greater than 5m.

*Table 2*

Particole size analysis of Cambic chernozem from Lancram.

| Horizons | Ap | Am | AB | Bv | Cca |
|---|---|---|---|---|---|
| Depth of pedogenetic horizon(cm) | 10-20 | 30-40 | 50-60 | 75-80 | 95-105 |
| Coarse sand (2-0,2 mm) | 6,68 | 6,71 | 7,81 | 4,09 | 6,72 |
| Fine sand (0,2 -0,02 mm) | 42.10 | 43.05 | 40.98 | 42.91 | 47.96 |
| Dust 1+2 (0,02-0,002 mm) | 18.45 | 17.11 | 18.48 | 19.01 | 20.01 |
| Clay (0,002 mm) | 32.77 | 33.13 | 32.73 | 35.99 | 25.31 |

*Table 3*

Chemical characteristics of Cambic chernozem from Lancram.

| Horizons | Ap | Am | AB | Bv | Cca |
|---|---|---|---|---|---|
| Depth of pedogenetic horizon(cm) | 10-20 | 30-40 | 50-60 | 75-80 | 95-105 |
| pH( in $H_20$) | 6.30 | 6.70 | 7.10 | 7.30 | 7.70 |
| Humus (%) | 2.15 | 2.18 | 1.88 | 1.86 | 0.78 |
| $CaCO_3$ (%) | - | - | - | - | 7.8 |
| P(mg kg $^{-1}$) | 31.50 | 35.00 | 27.50 | 26.50 | 22.00 |
| K(mg kg $^{-1}$) | 132 | 109 | 103 | 98 | 57 |

In some of the plots were carried out environmental works by covering with a layer of soil, about 50 cm thick, surfaces impacted by operation. It was collected eight soil samples whose values helps to determine land class quality after soil restoration. The values are listed in the table below.

*Table 4*

Chemical characteristics of soil after soil restoration.

| Sample point | Depth of sample collection (cm) | pH( in $H_2O$) | Humus (%) | P (mg kg $^{-1}$) | K (mg kg $^{-1}$) |
|---|---|---|---|---|---|
| 1 | 0-20 | 7,1 | 1,68 | 29,0 | 104 |
| | 20-40 | 7,3 | 1,55 | 31,5 | 98 |
| 2 | 0-20 | 7,1 | 1,67 | 28,5 | 111 |
| | 20-40 | 7,2 | 1,52 | 26,5 | 95 |
| 3 | 0-20 | 7,1 | 1,58 | 25,5 | 107 |
| | 20-40 | 7,3 | 1,51 | 23,5 | 108 |
| 4 | 0-20 | 7,2 | 1,46 | 25,5 | 102 |
| | 20-40 | 7,3 | 1,48 | 25,0 | 95 |

## CONCLUSIONS

As a result of soil analysis performed it can be concluded that the organic humus content greatly decreased because of soil horizons were mixed in the stripping-greening process. In addition soil was compacted greatly from the work of greening. Surrounding land slope stability causes big problems, making it impossible to access farm machinery on a portion of at least 5 m from the edge of the slope (figure 3).

In areas where aggregates exploitation is above groundwater, after bottom excavation greening, capillary water rise to the surface of the soil profile, this phenomenon leading to the loss of large amounts of water through evaporation. This can also lead to soil salinization phenomenon.

Figure 3 - Surrounding land slope

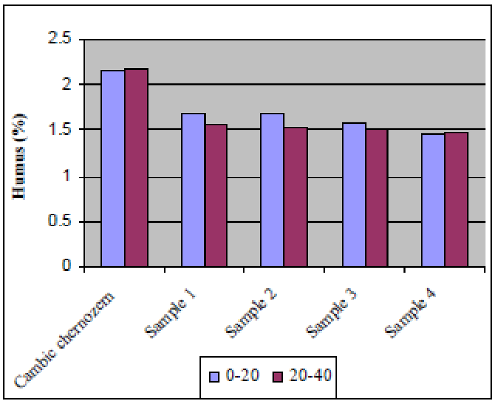


Figure 4 - Variation of humus content

Groundwater pollution from open pits, especially if the work of extracting the mineral aggregates are below the water table may lead to migration of pollutants into groundwater and can affect water quality while this is used by other users of the surrounding area.

This trend of land use in the extraction of mineral aggregates in order to continue and the next period, the affected areas so far are estimated at about 0.2 square kilometers, and the surfacing of land that will be affected by 2020 will be about 1 square kilometer.

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