PROPOSITIONS OF THE PhD THESIS

# Study on the environmental impacts and the utilization possibilities of power plant slag cones through the example of a sample area in Salgótarján town

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## *I. Introduction*

One of the significant agglomerations on the heavy industrial axle in North Hungary is Nógrádi basin, in the heart of which – along Tarján rivulet – the centre of the small region, i.e. Salgótarján town is located. The town had been one of the determining industrial regions of the country where – on the basis of the brown coal resources – power plants and a series of plants for the heavy industry (steel factory, floated glass factory, blown glass factory) had been constructed since the end of the 1800s (Perczel et al., 2003). Large numbers of these factories were closed in the 1990s or continued production at a significantly reduced capacity and product range. However, the prints of the „golden age" - which proceeded for several decades - did not disappear in the transformation period. In the surroundings of the town, the abandoned sites of mines and the cones of wastes (slag, fly ash) originating from the power plants - for the disposal of which several methods were applied: on one hand slag coming from the plants was spread over or on the other hand it was piled up in cones – can be found at several locations, however in almost each case no appropriate technical protection was applied. In addition to their disturbing landscape appearance it is possible that these cones contain contaminants of different quality and quantity – depending on their physical and chemical properties and - as a consequence - they mean a real danger to the natural and man made components and the living organisms in their surroundings. In my thesis I studied the influences of the deposited fly ash on the environment and health in a sample region of Salgótartján, and made suggestions for the utilization of the deposited substance on the basis of the results of my research.

## *II. The aim*

Of the above mentioned environment endangering influences, in my PhD thesis I examined wastes remaining after burning coal in coal fired power plants. The aim of my work was to examine the impact of materials - deposited on the selected sample area - on the environment and health and to find possibilities for their utilization respectively. In my thesis I was looking for answers to several questions, i.e.:

1. What types of morphologic changes have occurred in the slag cones since their deposition and to what extent they influence the spread of contamination?
2. What are the geochemical composition and the structure of the tested slag fly ash?
3. What physical properties characterize the tested fly ash which are important in the course of road construction?
4. Are the slag cones containing contaminations and if yes what is their type and quantity? What is their mobility, i.e. how dangerous are they to the soil; the underground waters; the surface waters of the surrounding areas and the health of people living nearby?
5. What is the activity concentration of the deposited slag fly ash and what is its relation to the activity concentration of slag fly ash examined in other regions of Hungary?
6. What are the ecological demands and the nature protection value of flora settled on the slag cones?
7. Considering the results of my research, what are the utilization possibilities of the power plant slag fly ash in the region?

My initial assumptions have been the followings:

**1.** In the deposited slag cones certain materials - dangerous to the environment and health - can be found which pollute their surroundings due to erosion caused by the precipitation and the wind.

**2.** Flora on the slag cones settled spontaneously and is reflecting the vegetation of the neighbouring areas.

**3.** For the utilization of the deposited slag there are more possibilities in the region, however the realization of not all of them is reasonable from the aspect of environment protection and the policy of town planning.

### *III. Testing methods*

Testing of the role played by the examined slag cones in the contamination of the surrounding areas and in the changes of the health of people living in the surroundings belongs to the scope of several other disciplines in addition to geography. Thus, for my

research I had to study certain details of chemical (analytic chemical), physical (mainly nuclear physical), biological (botanical, ecological) and in some cases technical (engineering) works; acquire measuring methods as well as work up the historical sources of the industry in archives, libraries and research institutes. In the course of my work I found that the interviews with local people and the questionnaire surveys were very important methods and in many cases the most useful information was provided by them.

Throughout in my thesis I made efforts to use the approach of a geographer, and utilized the results and methods of other disciplines only as much as it was absolutely required for the completion of the measurements and the evaluation of the collected data.

## *IV. Results*

The results of my tests and scientific statements can be summarized as follows:

1. I stated that the ***development of the present form of the slag cones*** depends mainly on their principal shapes, age, and resistance of the forming slag material and the transformation activity of the external forces. The largest transformation of the slag cones is caused by *bad furrows, slips and slides*. Due to these processes, in the course of the several decades since their deposition, the stockpiles have significantly eroded and still are undergoing erosion. The erosion less reduced the height of the cones; the more characteristic process was the washing out, ablation and material collection at the bottom of the cones. With the spontaneous settling of vegetation, grooving and thus repiling of the material reduced also. The spread of vegetation started from the lower portion of the cones on those surfaces which became less sloping after the land slides. On these areas the significance of grooving and of material movement has greatly decreased while material erosion is proceeding in the grooves - and through deflation on the upper areas which have not conquered by the vegetation yet.

2. ***By the results of the geochemical tests of the slag fly ash,*** the composition of the grains in the selected slag samples showed similar picture - irrespective of the site of sampling. I was able to classify the grains into two main morphological types. Within a single grain several different phases could be separated. Concerning the geochemical composition of the tested fly ash, it well correlated with the composition of several other domestic slag fly ashes.

3. Studying the ***physical properties*** referring to fly ash, I based my work on the data of a survey made in the 80'-ies. I compared these with requirements required in connection with the roadbed materials and admixtures used in road construction and qualified the tested material on this basis. On the basis of all these, most properties of the Salgótarján fly ash are suitable for utilization later.

4. ***Through my component analytical tests*** I presented that the deposited slag fly ash contained several different contaminations also. The applied testing method was suitable for the evaluation of metals – I analyzed ten of them in each tested sample. I compared them with the effective limit values and stated that in most of the samples the concentration of metals was over the allowed value. I tested potassium and calcium separately as these components play an important role in the process of soil formation and the formation of soil quality. My results presented that their quantity is adequate for soil formation.

5. Comparing my results received after the ***activity concentration*** measurement of the tested samples with data found in the literature it was possible to state that the activity concentration of slag fly ash coming from the Power Plant of Salgótarján was between the values of the Hungarian averages (100-200 Bq/kg), i.e. it was high on a world scale.

6. On the two opposite exposed sides of the slag cones (North-Western and South-Eastern), on the lowland between the two piles and along the lake located at the edge of the deposit area ***I determined plant species settled spontaneously and classified them into ecological and naturality value classes.*** After their evaluation it was possible to state that vegetation rich in different species was characteristic to the slag cones and their surroundings; however this flora was mixed and not uniform and reflected the vegetation of the surrounding areas. At the same time it was possible to reveal some sort of uniqueness that could be explained by the extreme conditions of the living place (e.g. water supply). I experienced large differences between the differently exposed sides of the cones and their height levels – both in the composition of the species and the development of the plant cover, its mass relations and ecological values.

7. In my opinion – considering the ***utilization possibilities*** of the tested slag deposit, the results of my research and the capacities of the area there are two reasonable ways of utilization. One possibility is the utilization as an admixture in road construction while the other one is to maintain the piles at their original sites, arrange the landscape around them, construct the infrastructure and possibly form a destination site for tourism.

Thus, in the course of my research I succeeded in achieving my goals and got answer to my questions raised in the Introduction. The results supported my assumptions. As far as my possibilities allowed I completed the scientific and partly technical measurements concerning the utilization of the studied area and the deposited fly ash, and worked up the literature, however I did not cover the economical and town planning aspects provided by the possibilities of utilization. However I think it is likely that in the course of working out the plans in the future these factors will be emphasized at least as much as the conditions of environment protection and engineering. In spite of this I hope that with my work – even if partially only – I contributed to the expertise treatment of the slag cones, their utilization and thus the formation of a more comfortable environment.

## *V.List of my own reports used as a basis for the propositions*


- Angyal Zs. (2007): Landforms and vegetation development on spoil-tip surfaces near Salgótarján (NE Hungary). – Geomorfologia Fisica e Dinamica Quaternaria, 2007/1. pp. 155-159.

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**Abstracts**


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- Angyal Zs. (2004): Salgótarján melletti salakmeddők kúpjainak felszínfejlődése és a növényzet szukcessziója. – IX. Országos Felsőoktatatási Környezettudományi Diákkonferencia Absztrakt kötete. Eötvös Loránd Tudományegyetem, Budapest, pp. 200.

- Szabó M. – Karátson D. – Angyal Zs. (2004): A Salgótarján melletti salakmeddők kúpjainak felszínfejlődése és a növényzet szukcessziója. – II. Magyar Földrajzi Konferencia Absztrakt kötete. Szegedi Tudományegyetem TTK Természeti Földrajzi és Geoinformatikai Tanszéke, Szeged pp. 14.

- Angyal Zs. – Szabó M. – Karátson D. (2004): Tájidegen elemek: a Salgótarján környéki salakkúpok. – I. Magyar Tájökológiai Konferencia Absztrakt kötete, SzIE, Környezet- és Tájgazdálkodási Intézet, Tájökológiai Tanszék, Gödöllő pp. 24.

- Angyal Zs. (2005): Unfitting landscape elements: the spoil cones of the town of Salgótarján. – Environment-Research, Protection and Management Absztrakt kötete, Universitatea Babes-Bolyai, Cluj-Napoca pp. 19.

- Angyal Zs (2006): Széntüzelésű erőművekből származó salakmeddők szemcseeloszlás-vizsgálata és ennek hatása a szennyezés terjedésére. – II. Magyar Tájökológiai Konferencia Absztrakt kötete, Debreceni Egyetem, Tájvédelmi és Környezetföldrajzi Tanszék, Debrecen pp. 99.

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