Research on the negative effects of the "Valea Arsului" tailings dumps on the environment

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Abstract. As a result of the exploitation of coal in the mines from the Jiu Valley, significant quantities of tailings result from the mining works, but also from the coal preparation processes. They are stored in piles of different sizes, placed on the ground horizontally or between mountains, piles called tailings dumps. For the construction of tailings dumps the first requirement was the removal of the vegetal layer from the soil surface, a requirement that was often not observed so that the environment was affected. This paper aims to show how the environment around the Vulcan coal mine was affected in 2020..

1 Introduction

In a corner of the country hidden among the mountains, crossed by fast and foamy waters, is the largest depression of the Southern Carpathians, namely the Petroșani Depression or the Jiu Valley basin. Wrapped in a circle of mountains with spectacular dimensions, this depression holds some of the most important deposits in the country, namely coal or "black gold", a resource that turned this area into the most important coal area in our country.

The Petroșani Depression or Jiu Valley is located in the central part of the Southern Carpathians being surrounded by some of the most beautiful mountain ranges in the country, with heights exceeding 2000 meters altitude, namely 2519 meters in Parângul Mare peak and 2509 meters in Peleaga peak. This depression is located at a northern latitude of 45 ° 25 'and an eastern longitude of 23 ° 22'. The depression has the shape of an asymmetrical triangle, with a width on the east side of 9.6 km, on the west side of 2 km and a length of 45.6 km.[1]

The Jiu Valley region occupies an area of 137.6 km2 of the total area of Romania. The Jiu Valley Basin is located on the banks of the two waters, namely the West Jiu and the East Jiu, in the southeast of Hunedoara County.

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Through this area at the intersection of Transylvania with Banat and Wallachia, nature and people dug passages, built roads, thus managing to connect the interior of the depression with the rest of the country.

In this geographical area where wealth meets and combines with poverty, sobriety with exuberance, happiness with despair, life with death, despair and despair with the hope of a better future, the visitor encounters the life and toil of people who sometimes gave their lives for to extract coal from the depths of the mountains.

The main activity of the Jiu Valley since the interwar period is mining, and if in the past the area experienced a good development due to mining, now this area is considered disadvantaged due to the closure of mining.[2]

Mining activities produce a series of pollutants that affect all components of the environment. Soil, one of the most important components of the environment is also the most affected by this industry, because the quantities of sterile material resulting from the preparation of coal are deposited on the soil surface in dumps, thus making changes in relief and occupying large areas of which may not be used for other purposes.

Sterile material deposited in dumps changes the appearance of the land by creating landscape pollution, and rainwater or surface water that intersects them changes the properties of the land on which they are deposited, thus causing landslides, mudslides or environmental pollution with harmful substances.

As a result of the exploitation of coal in the mines from the Jiu Valley, significant quantities of tailings result from the mining works, but also from the coal preparation processes. They are stored in piles of different sizes, placed on the ground horizontally or between mountains, piles called tailings dumps. For the construction of tailings dumps the first requirement was the removal of the vegetal layer from the soil surface, a requirement that was often not observed so that the environment was affected. This paper aims to show how the environment around the Vulcan coal mine was affected in 2020.

“Valea Arsului” tailings dump is located in the town of Vulcan in the Jiu Valley and was built for the storage of waste rocks resulting from the mining works at the Vulcan mine. The dump is located in “Valea Arsului” and is formed by car transport, storage and leveling of sterile material obtained with bulldozers or tractors.

During periods of heavy rainfall, inside the tailings dump are presents erosion phenomena and water accumulations in its southern part, and the presence of the lake formed near it is another unfavorable factor on the environment, because the accumulated water saturates the rocks at the base of the dump, thus causing landslides and mudslides.

The total length of the dump is about 450 meters, and its width is about 250 meters at the top and about 100 meters at the bottom

2. Materials and Methods

Tailings dumps due to their content of metal ions and flotation agents bring serious effects to soil quality by affecting fertility for many years, surface water or groundwater and air through wind erosion and deposition.

This paper was realised during 2020 and is based on studies on air, soil and water quality near the tailings dump.

To determine air quality, we used a module called the DSM501A module which is a sensor that can be used to determine suspended particles larger than 1um.

In the graph shown in figure number 1 and figure number 2, we can observe the fluctuations of the suspended particles around the tailings dump. These particles are determined by the transport, storage and arrangement of the tailings in the dump.

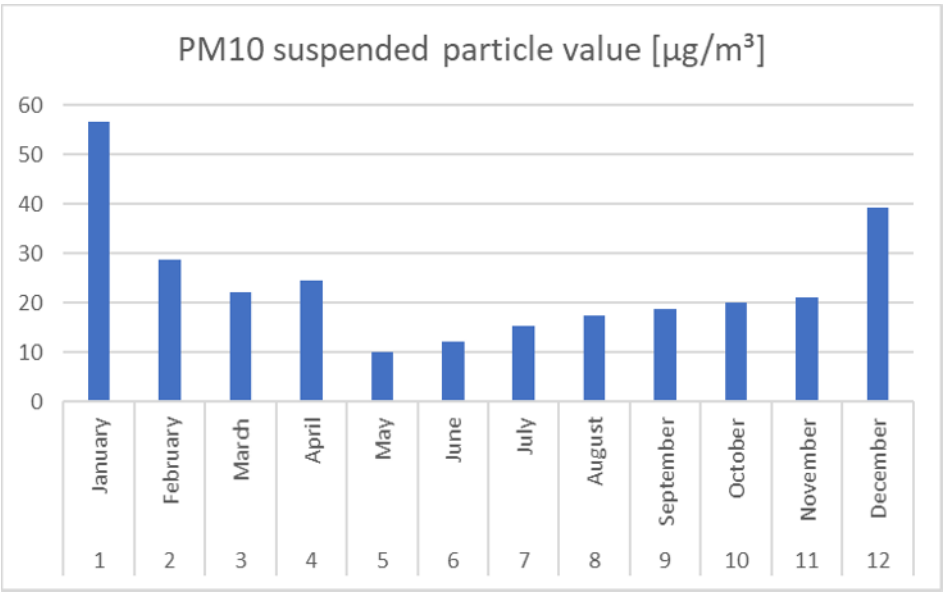

Fig. no. 1. PM 10 suspended particle value [µg/m³].

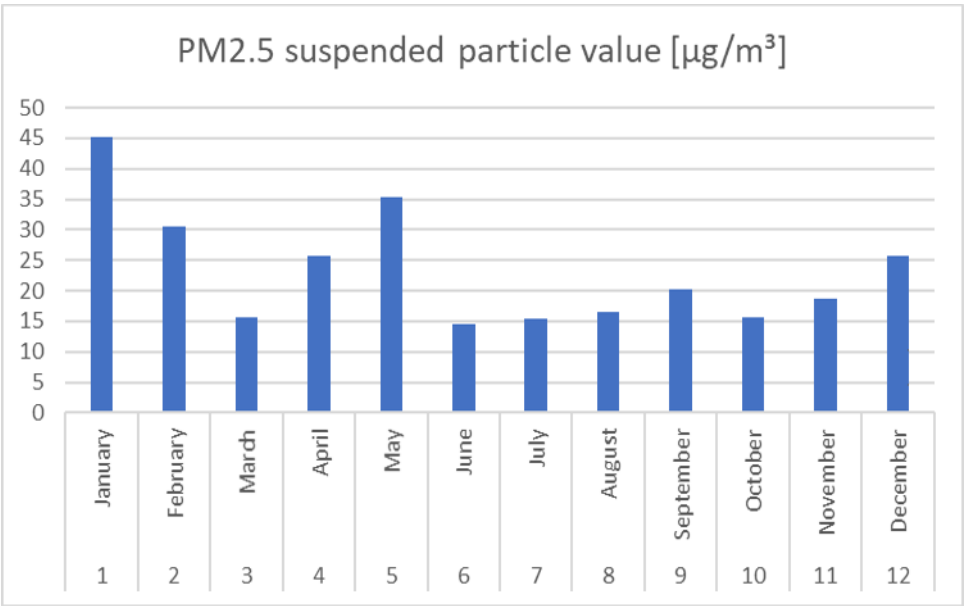

Fig. no. 2. PM 2.5 suspended particle value [µg/m³].

As we could see in the previous figure the monthly values of suspended particles it changes depending on the months of the year, so we can see that the winter months have much higher amounts of particulate matter than the summer months. The measurements made near the dump show us that although there are days that exceed the limit values imposed by law in total, they fall within the normal limits, not affecting in a very serious way the living things and the plants around the dump.

To determine the water quality in the tailings dump area, the analysis were performed using measuring instruments, namely sensors for determining water quality and sensors for determining water pH.

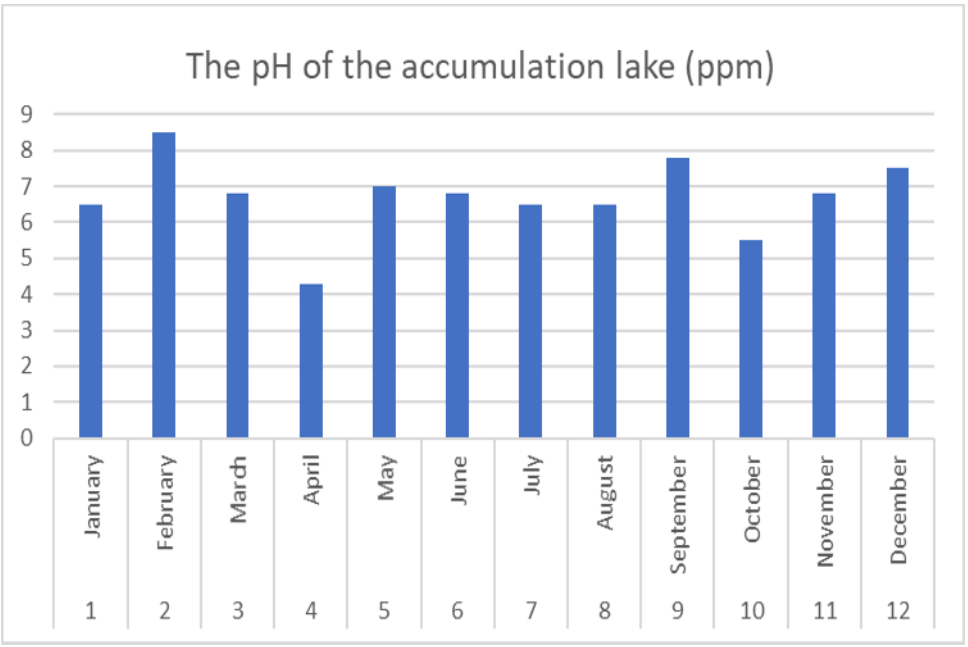

Fig. no. 3. The pH of the accumulation lake (ppm)

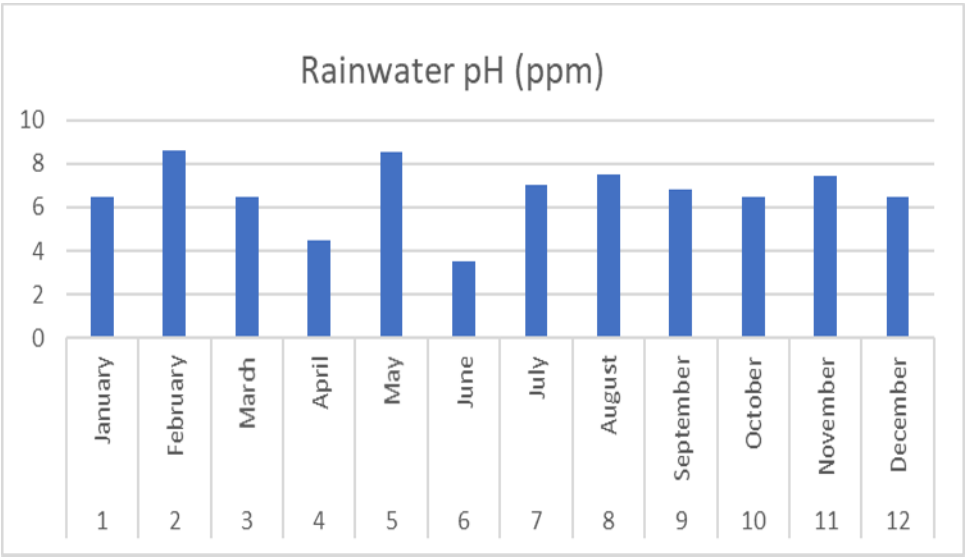

Fig. no. 4 The pH of the rainwater (ppm)

The normal pH range in surface water systems is between 6.5 ppm and 8.5 ppm. The pH of a pure water has values close to 7 ppm. As can be seen in the images above, the water in the accumulation lake near the tailings dump is not pure, its pH being between values 4.5 ppm and 8.9 ppm, which means that the quality of its waters is poor and cannot be considered drinkable.

So are the accumulations of rainwater that wash the perimeter of the tailings dump, bringing with them pollutants that integrate into the environment. And the pH of these

waters is between the values 3.5 ppm and 8 ppm which frames them in impure and non-potable waters.

To determine the soil quality we used a new multifunctional device to determine the soil pH, namely an Optimus AT RZ89. It achieves pH values between 3.5 and 9 ppm, being easy to use and recording data with great accuracy. The importance of studying the soil pH is to determine the effect on plant growth and development.

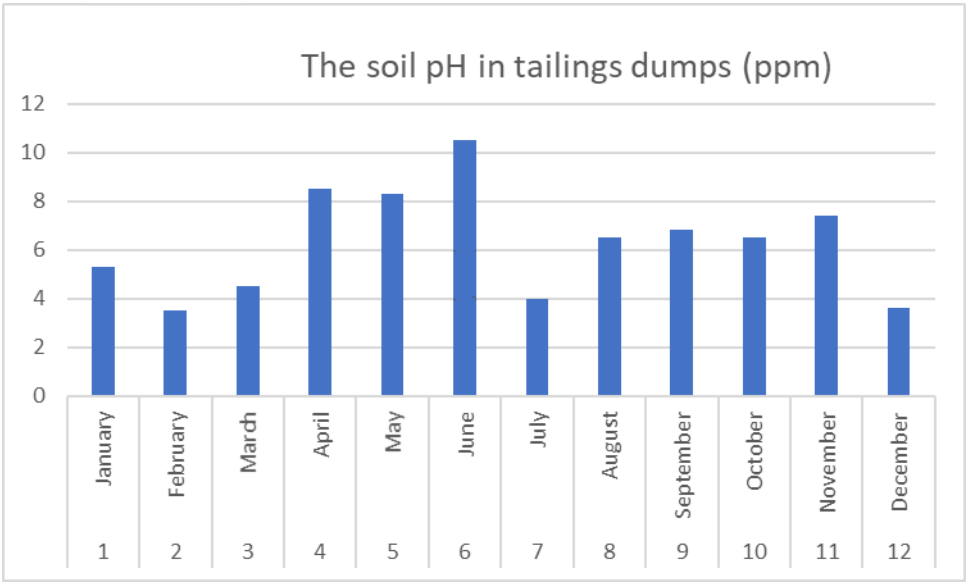

Fig. no. 5 The pH of the soil in tailings dumps (ppm)

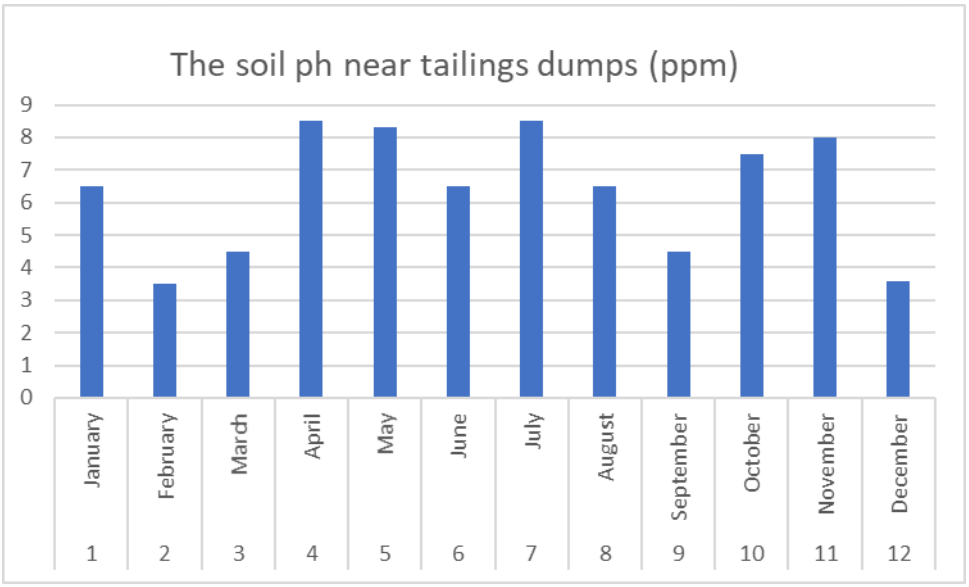

Fig. no. 6 The pH of the soil near the tailings dumps (ppm)

As we can see in the graphs above, the pH of the soil has values between 2.5 ppm and 8.5 ppm that frame the soil in the dumps in an acid soil where garden plants cannot be grown. With the help of rainwater that transported pollutants and outside the perimeter of

the dumps, the pH of the nearby soils is one with values between 3.5 ppm and 8.9 ppm, which transforms it into a soil with acidic and basic portions. Plants could be grown on the surface of this soil with the help of adjacent substances.

Conclusions

Mining activity, regardless of how it is carried out, always produces long-term negative effects on the environment, and one of the areas in Romania where the environment has suffered from anthropogenic activities is that of Jiu Valley (Petroșani Depression), the area where the main activity mining has been and continues to be mining.

As we can see, the areas around the perimeter of the coal dumps are not in a very marked state of degradation, but the pollution generated by the mining operations has produced and produces negative effects on the environment. Thus, the water around this deposit cannot be potable, the soil is not indicated for growing vegetables or plants, and pollution with suspended particles can endanger human health if the limit values are exceeded.

This work was carried out following observations and measurements in the field, and a first step towards reducing the polluting elements in the perimeter of the dumps would be the use of new technologies for transport, storage and placement of sterile material.

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