MONITORING THE LEVEL OF AIR POLLUTION WITH SUSPENDED PARTICLES IN THE AREA AROUND THE LUPENI MINING EXPLOITATION

Tataru A. C., University of Petrosani, *Petrosani, ROMANIA*

ABSTRACT: Air pollution is a major environmental problem that can have negative effects on flora and fauna, as well as human health. An important problem of air pollution is the presence of suspended particles in the atmosphere. Suspended particles are a complex mixture of very small particles and liquid droplets. These suspension particles can be from natural sources from volcanic eruptions, rock erosion, sandstorms and pollen dispersal or anthropogenic from industrial, military, public heating system, thermal power plants, road traffic. Suspended particles smaller than 10 micrometers have significant effects on human health because they pass through the nose and throat and enter the alveoli of the lungs causing inflammation and poisoning. In order to determine the level of air pollution from the neighboring Lupeni Mines area, we made a series of measurements to determine the level of air pollution with particule matter pM10 and pM 2.5.

KEY WORDS: pollution, particles, air.

1. INTRODUCTION

Air pollution is a major environmental problem that can have negative effects on flora and fauna, as well as on human health.

Air pollution can be caused by changes in the normal proportions of the natural constituents of the atmosphere, or due to the introduction into the atmosphere of foreign compounds, which prove to be toxic or dangerous.

Atmospheric pollutants are mainly found in the following forms: gases, solid and liquid particles and aerosols.

In the atmosphere, the air layers are in a continuous movement both vertically and horizontally, a phenomenon that contributes to the dissemination of pollutants according to certain better or less well-known laws.

Turbulence and atmospheric circulation play the main role in the dispersion of pollutants, but some peculirities of their spread, as well as the elimination of pollutants come from the interference of the phenomena of molecular diffusion and aerosol sedimentation.

Due to the different diffusion capacity of different pollutant gases as well as the various molecular weights of different aerosols, pollutants in the atmosphere show different condensation tendencies.

Air is not a chemically inert environment, and a series of chemical reactions occur in the atmosphere due to the following factors:

- free oxygen from the atmosphere that favors oxidation reactions
- solar radiation that favors photochemical reactions:
- water vapor that favors hydrolysis reactions;
- high temperatures that accelerate the development of reactions:
- continuous contact on appreciable surfaces of the atmosphere with the soil, water, vegetation, which is the place of additional chemical reactions.

The simultaneous presence in the atmosphere of several pollutants can lead to the occurrence of synergism, antagonism or anergism, leading to the summation of effects, their annihilation or the lack of any mutual influence.

2. AIR POLLUTION WITH SUSPENDED PARTICLES

An important problem of air pollution is the presence of suspension particles in the atmosphere. Suspended particles are a complex mixture of very small particles and liquid droplets. These suspension particles can be from natural sources from volcanic eruptions, rock erosion, sandstorms and pollen dispersal or anthropogenic from industrial, population heating system, thermal power plants, road traffic.

Solid particles in the atmosphere produced as a result of human activity are largely due to the process of incomplete combustion of fuels, especially coal and wood. In addition, other responsible activities are: automobile engines, extractive industry, construction materials industry, metallurgical and steel industry. Depending on their size, they can be classified into three categories:

- sedimentable powders, with an average diameter of approx. 20 microns that are located at altitudes of 3000 m and are deposited on the ground next to the emission sources:
- semi-fine powders, which are very little or not at all sedimentable, with a diameter between 0.1-2.5 microns are brought to the ground due to precipitation or due to electrostatic forces that cause them to join together;
- non-sedimentable powders, with inframicroscopic dimensions.

Suspension particles smaller than 10 micrometers have significant effects on human health because they pass through the nose and throat and enter the alveoli of the lungs causing inflammation and poisoning.

3. RESULTS AND DISCUSSIONS

Air pollution can be caused by many factors. An important source of air pollution is industry. The Jiu Valley is an industrial area where coal is extracted. The waste resulting from coal mining and processing is an important source of air pollution with suspended particles.

The Jiu Valley is an intramontane depression located on the Jiu River. It is known for its natural riches, exploited by the Romanian state through coal mines. The surrounding mountains are in the Retezat-Godeanu group of the Southern Carpathians. The main cities in this area are Petrosani, Vulcan, Petrila, Aninoasa, Lupeni, Uricani.

In popular speech, the notion of "Jiu Valley" refers to the Petrosani Depression in the south of Hunedoara County

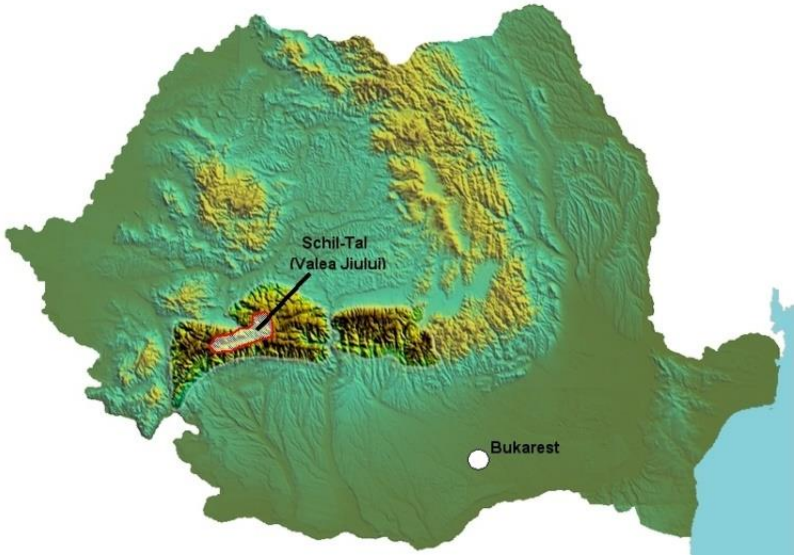

Figure 1. Jiu Valley

The Lupeni Mining Exploitation is part of the mining operations in the Jiu Valley. This operation currently has a tailings dump with three branches. Currently, only one of the 3 branches is still active, the other two being remodeled and an attempt was made to green them, only that currently a large part of the surface of the dumps is still without vegetation. The lack of vegetation leads to air pollution with significant amounts of suspended particlesIn this paper we propose to present results obtained as a result of air quality monitoring, by determining the amount of suspended particles in the area adjacent to the Lupeni Mine.

To determine the level of air pollution with suspended particles, we performed measurements using the TROTEC PC200. This is a particle counter that allows, through 6 channels of particle size, the determination of 0.3 to 10 μm of suspended particles.

Figure 2. TROTEC PC200

The measurements of the level of suspended particles were carried out in the period 20.03.2022 - 10.04.2022, in the Locality of Lupeni, towns in the Jiu Valley.

The measurements were made in an isolated area, without road traffic. The monitoring point of the level of pollution with suspended particles is shown in figure 3.

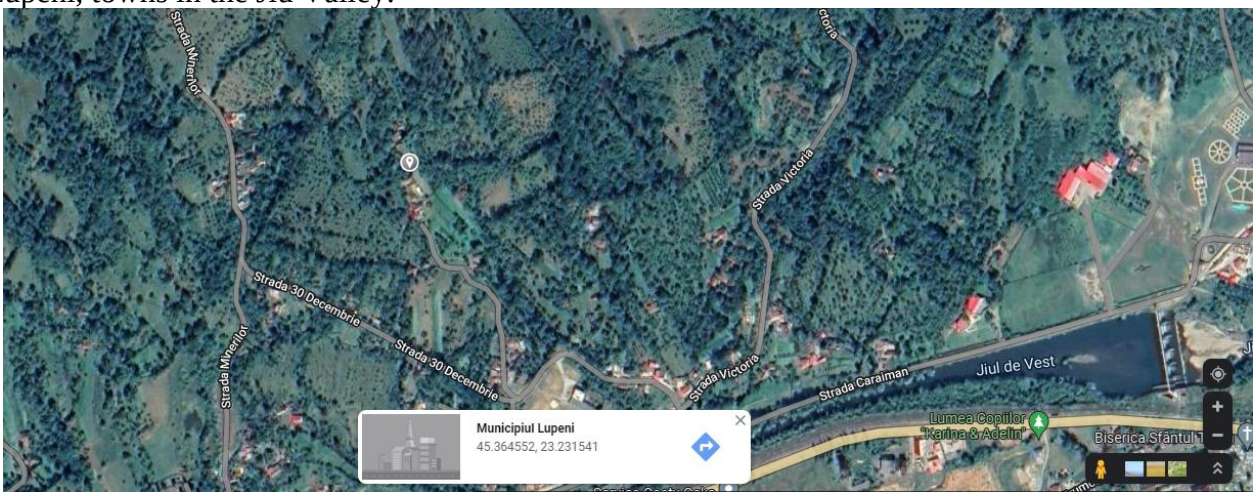

Figure 3. Points for monitoring the level of pollution with suspended particles

Following the measurements performed, higher values of the level of suspended particles can be observed in the period 29.03.2022 - 03.04.2022. These values are supposed to be higher due to a cloud of Saharan dust that has reached over Romania.

The Saharian cloud is assumed to have arrived over the town of Lupeni on 31.03.2022. The values have suffered increases since 29.03.2022, which shows us that there was also another source of pollution.

Following the analysis of the weather conditions during that period, we were able to observe the presence of the wind which led to

the entrainment of particles from the surface of the tailings dumps of the Lupeni Mine.

The results obtained after monitoring the level of air pollution with suspended particles are presented in table 1.

Table 1 The pM concentration values recorded during the monitoring period

No.	0.3um	0.5um	1.0um	2.5um	5.0um	10um	Date
1	5553	1162	140	28	8	2	3/20/2022
2	4510	861	98	13	3	3	3/21/2022
3	4337	1065	160	31	3	2	3/22/2022
4	5967	1735	277	46	9	8	3/23/2022
5	4384	1146	97	12	2	2	3/24/2022
6	4820	1073	151	25	3	3	3/25/2022
7	5286	1047	144	16	4	4	3/26/2022
8	4693	984	130	23	10	5	3/27/2022
9	4196	970	130	23	7	3	3/28/2022
10	31817	12127	2834	1042	352	259	3/29/2022
11	63682	25399	6311	2430	822	514	3/30/2022
12	217399	80093	20441	9277	3766	2175	3/31/2022
13	51197	73471	21553	10693	5082	3708	4/1/2022
14	86505	51567	11755	5994	2575	1825	4/2/2022
15	59576	28413	7376	4069	1819	1417	4/3/2022
16	131707	57052	15073	7036	2810	1760	4/4/2022
17	43696	18743	4626	1882	645	446	4/5/2022
18	19087	7685	2064	846	323	216	4/6/2022
19	19066	7446	1935	803	308	214	4/7/2022
20	60771	24895	6670	2769	1009	721	4/8/2022
21	68020	21851	5116	2827	1146	817	4/9/2022
22	41597	15687	4039	1730	704	419	4/10/2022

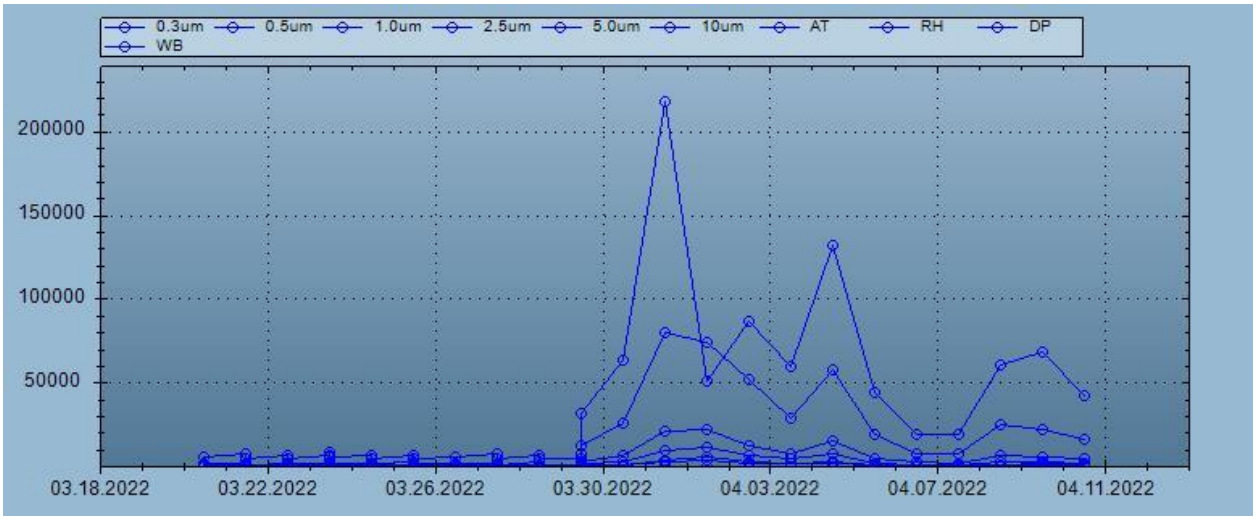

Figure 4. Values of the level of air pollution with suspended particles recorded during 20.03.2022-10.04.2022

After the passage of the Saharan dust cloud, the values did not decrease to the initial limits registered between 20.03.2022-29.03.2022. During 04.04.2022-10.04.2022 the registered

values were higher than at the beginning but lower than during the Saharan cloud.
The recorded values may also vary due to weather conditions. On days with stronger wind were recorded higher values has the level of suspended particles. This can be seen in the values recorded on 08.04.2022
The area adjacent to the Lupeni Mining Exploitation is an area where, depending on the weather commissions, it can represent a more polluted area. Problems with higher levels of particulate air pollution are only present during periods of strong wind and low humidity.

4. CONCLUSION

An important problem of air pollution is the presence of suspension particles in the atmosphere.
Air pollution with suspended particles can have negative effects on human health and the environment.
Weather conditions can influence the value of the level of suspended particles recorded. During the windy period the values are higher. The presence of the Saharan cloud over Romania gave us a much higher value compared to those recorded between 20.03.2022-29.03.2022.
The area adjacent to the Lupeni Mining Exploitation is an area where, depending on the weather commissions, it can represent a more polluted area.
Problems with higher levels of particulate air pollution are only present during periods of strong wind and low humidity.

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