THE CURRENT STUDY REGARDING AIR POLLUTION WITH SETTLED POWDERS IN THE INFLUENCE AREA OF MINING EXPLOITATION ROȘIUȚA FROM COUNTY GORJ

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Abstract
In county Gorj the mining industry is represented by the surface mines which contribute significantly to the economical development of the area. Surface mining exploits are polluting the environmental factors through the industrial activities that take place, as well as through the huge quantities of waste that are produced. The Roșiuța surface mining exploitation site is located in the south-west of county Gorj. In this study will be presented the current research about the air pollution in the influence area of the surface mining exploitation Roșiuța form county Gorj. The most significant sources of atmosphere pollution in the area of the Roșiuța Quarry are dumping excavators, the conveyors, the distribution nods, the coal deposit, the waste dump and the access routes. For the monitoring of the settled powders eight sampling points were established from which seven were placed in the influence area of the coal deposit. The determination of the settled powders content has been conducted accordingly to the 10195/75 standard. The air purity, determination of the settled powders.
The results obtained after the measurements conducted regarding the settled powders during the years of studies 2013-2014 have shown that during the year 2014 the frequency of allowed limit exceeding (53.3%)was higher than in 2013 (47.3%). The lower values were obtained during the winter season and this is explained by an interruption of the excavating, transport and storage activities for a period of time. The large concentrations of settled powders during the summer-autumn seasons, represented by the huge number of exceedings, can be caused by the meteorological conditions in this seasons, when there is less rainfall and the economical agent doesn't apply the necessary measures to reduce the powders emissions in such situations.

Keywords: lignite, pollutants, environment, mining, coal, excavators

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1. INTRODUCTION

The negative impact of the mining activities over the surrounding environment is a direct one which is strictly relied to the useful mineral ores extraction activity, and there is also a collateral one, which is relied on the processing activity and on the use of mining products. The lignite deposits from Romania are quartered in regions in which mostly youngest geological formations are developing, that are made of soft rocks, cohesive and non-cohesive , like marls, clay and sand (Popa and Fodor, 2001; Fodor, 2008). In the lignite quarries from Oltenia, depending on the types of equipment that are used in the technological chain, the exploitation process takes place in continuous and discontinuous flux. The discontinuous technological flux which is based on the use of excavators with intermittent action combined with auto transport, is used in micro-quarries. The Roșiuța mining perimeter is located in the north-west part of Oltenia and in the south-west of county Gorj. At north it adjoins the Roșiuța II mining perimeter, at south the Plostina mining perimeter, at west the North Jilt perimeter as well as the Runcurelu village and at west the Roșiuța town. The Roșiuța perimeter is located in the north-east of the Motru mining basin, on the left shore of Roșiuța creek. Morphologically speaking, the landform in the Roșiuța mining perimeter is typically hilly, and the terrain is very rough, being part of the sub-Carpathian region from between Jiu and Danube with level differences of 200m. The Roșiuța mining field was given for exploitation in year 1969 for an underground activity of lignite extraction at a

capacity of 1000 thousand tons per year. Geomorphologic speaking, the Roșiuța mining perimeter is located in Motru perimeter, and it is stretched between the Motru and Jiu Valleys. The production capacity which is established by the conditions for the extend of the exploitation licence is 3000 thousand tons per year, and the activity duration is 2011-2017. Today, the quarry's activity is conducted in eight steps of excavation, seven dumping excavators Es Rc 1400 are used. The steps I-IV are excavated in tailings and steps V-VIII are excavate in mining. From all the particles that were submitted to be in the air of the influenced areas, the characteristic pollutants are the coal and tailings dusts, other pollutants are not taken in consideration, because all the working equipments are electrically operated. (Dumitrescu and Lazar,2001; Fodor and Baican,2001; Căpățînă,2012; Căpățînă et al,2009; Gămăneci et al,2013; Căpățină,2011) The air quality in the area is affected mostly by the technological process. (Căpățînă and Șchiopu,2014) from the quarry, the dump and the coal deposit.

The most significant atmospherically pollution sources in Roșiuța Quarry are the dumping excavators, the conveyors, the distribution nods, the coal deposit, the waste dump and the access routes. In Roșiuța Area, the coal deposit is the largest source of pollution with powders from all the other activities of the quarry. The biggest concentrations of powders were measured here.

2. MATERIALS AND METHODS

For the monitoring of the settled powders, eight sampling points were established from which seven were placed in the influence area of the coal deposit, and they are presented in figure 1.

The eight monitoring locations for settled powders in the influence area of Roșiuța quarry are placed in the following way towards the coal deposit and the national road Targu Jiu-Drobeta Turnu Severin.

P1-located towards the north of the quarry and at its western limit;

P2-located towards the north-west of the deposit, at about 150m of its northern limit, on the left side of DN;

P3- towards the west of the deposit, on the right side of DN, at 50m of the deposit;

P4-located towards the west of the deposit, on the left side of DN, at about 30m of the deposit;

P5-located towards the west of the deposit, on the right side of DN, at about 50m of the deposit;

P6-located towards the south-west of the deposit, on the right side of DN, at about 100m of the deposit;

P7-on the left side of DN, towards the south-west of the deposit, at about 150m of it;

P8-located on the left side of DN, towards the south of the deposit, at about 200m of it.

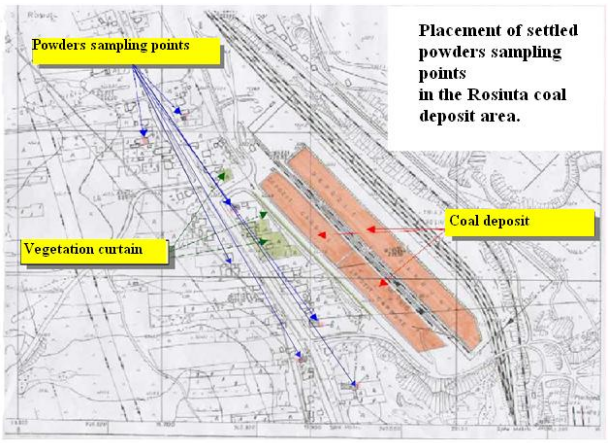

Figure 1 Settled powders monitoring locations in the area of Roșiuța coal deposit.

We need to mention that all the sampling points are placed inside some local households.

Point P1 has been established in order to highlight the pollution produced by the activities taken in the quarry, but especially in the administrative incidence of it. The point is placed on a sideway road to the left which ensures the access to the administrative headquarters. All the other sampling points highlight the air pollution with settled powders that are produced by activities conducted in the area of the coal deposits. The determination of the settled powders content has been conducted

accordingly to the 10195/75 standard. The air purity, determination of the settled powders.
This standard sets the method of determining the settled powders from the atmosphere, which consist of the dust that settle due to the action of gravity, as well as the one engaged by rainfalls. The method consists in collecting the powders from the atmosphere in pots with common surface in a determined period of time and the gravimetric determination of them.
The drying, cooling and weighting operations are repeated until the constant mass.

3. RESULTS AND DISCUSSION

The content of settled powders is expressed in g/m^2/month and is calculated with the ratio:

$$P_{sed} = \frac{(m - 0{,}0177 \cdot V)}{S} \cdot \frac{30}{n} \quad \left[g / m^2 / month\right] \quad (1)$$

where:
m - the mass of the settled powders from the sample, [g];
0.0177- quantity of $CuSO_4$+H_2O added, [g];
V- the volume of the collecting recipient, in [l];
S - the surface of sedimentation,[m];
n - the numbers of days for exposure

Under this standard, the maximum allowable amount of settled powders in the air protected areas is 17g/m^2/month.

The result interpretation for the settled powders has been made accordingly to the stipulations in standards 12574/87 "Air from protected areas. Quality conditions".
From the whole set of diverse activities conducted in the Roșiuța Quarry, the storage and auto transport one of the coal represents the major source of pollution in the area's air, in conditions that these activities take place in the near vicinity of Roșiuța town.
In this regard, this area has been monitored right from the beginning, so here are more settled powders sampling points, in order to bring up a clearer image of the impact's size, impact that has been produced by this activity on the environment, and especially on human settlement.
The results with concentrations of settled powders recorded during two years of studies are presented in table 1.

Table 1. Concentrations of settled powders in the air of Roșiuța area.

Year	Sampling point	Month											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2013	P1	13,79	8,88	8,23	6,97	7,12	10,23	7,63	8,04	4,61	-	8,16	13,59
	P2	-	23,28	9,12	10,68	22,17	23,37	21,24	19,26	20,11	21,13	12,80	11,32
	P3	15,46	12,00	16,79	38,41	27,50	22,39	14,59	19,41	19,15	24,11	17,82	25,04
	P4	25,41	23,54	14,27	-	20,13	14,75	28,64	15,83	18,30	21,12	18,94	16,46
	P5	24,49	17,26	16,95	32,69	21,68	21,42	15,46	18,19	21,27	16,77	20,43	18,36
	P6	15,77	14,13	17,57	29,31	19,00	24,81	23,57	22,96	25,11	27,42	9,61	8,59
	P7	10,62	6,02	11,28	10,51	11,95	22,83	12,43	14,33	29,86	13,36	6,78	13,44
	P8	17,40	4,32	-	14,00	6,35	11,33	4,52	4,36	17,13	-	9,62	10,91
2014	P1	9,74	12,06	11,62	7,26	5,59	8,35	14,32	7,78	9,54	12,39	6,68	9,50
	P2	23,02	17,42	22,48	24,96	27,16	-	11,45	26,09	18,88	20,17	25,00	17,04
	P3	-	12,72	23,70	18,42	25,09	16,31	18,62	25,09	25,79	19,85	25,24	17,15
	P4	17,92	-	7,24	17,82	16,57	20,84	18,24	21,08	33,21	30,09	30,96	16,75
	P5	-	21,20	10,81	15,66	17,94	18,69	19,86	9,60	30,77	32,14	25,44	16,17
	P6	16,79	13,35	19,39	28,47	11,21	19,21	20,97	19,82	28,39	18,10	36,94	16,86
	P7	12,82	12,65	10,29	14,91	10,20	17,87	15,76	22,67	13,92	20,15	42,11	18,02
	P8	8,98	5,85	30,58	8,87	5,36	14,71	7,75	8,29	7,63	20,91	13,39	12,19

These values represent the settled powders concentration recorded during 2013 and 2014.
In order to highlight the settled powders pollution degree of the air in the influence are of the activities that take place in the Roșiuța Quarry, an analysis of each point will be conducted.
So, in point P1, placed in a way that highlights the activities that take place in the quarry as well as in the headquarters, during the two years of analysis presented in figure 2 value exceeded the maximum allowed limit.

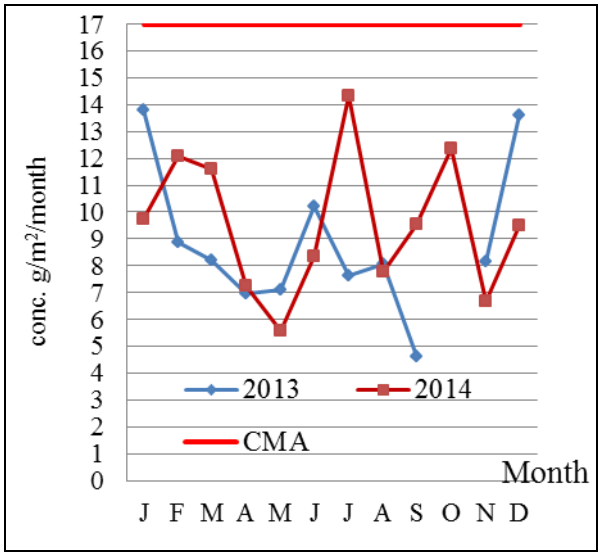

Figure 2 Variation of settled powders concentrations P1-area of Roșiuța Quarry

In year 2013, the concentration with the highest value has been recorded at the end of January and February, which was about 80% of the maximum allowed, and the smallest one has been measured in September and it was about a quarter of the limit. In year 2014, large concentrations of settled powders were measured in July, value which was 84% of the allowed limit. The concentration with the lowest value has been recorded in May, and it represented about one third of the limit. In the next point, P2, placed in the north-west of the coal deposit, which is considered the biggest source of air pollution with settled powers, have been recorded limit exceedings whose frequency had different percentages during the two years of studies. So, in year 2013 from out of a total of 11 conducted measurements, 7 were above the allowed limit, which means an exceeding frequency of 63.6%.The highest values of settled powders concentrations have been recorded in February and May, and those were somewhere about 37.5% above the allowed limit. The concentration with the lowest value has been measured in March and it was just over half of the allowed limit. During 2014 the frequency of exceedings was even higher, from out of a total of 11 conducted measurements, 10 have been above the allowed limit, meaning 90.9%.
The highest value of settled powders concentration has been recorded in May and it was almost 60% above the allowed limit. The only period of the year when the level of settled powders was below the allowed limit was in July, the value was 85% of the maximum allowed concentration. The next sampling point, P3, also had a high percentage of settled powders concentrations that was above the allowed limit during the two years.
So, in year 2013, from out of a total of 12 conducted measurements, 66.7% where higher than the allowed limit. From those, the highest concentration has been recorded in April, and it was 126% above the allowed limit. The concentration with the lowest value has been recorded in February, and it represented about 71% of the allowed limit.
During 2014 there was an even higher exceeding frequency, from out of a total of 11 conducted measurements 9 were above the allowed limit which means a exceeding frequency of 81.8%.Months May, August, September and November were the periods with the highest concentrations, and the values were equal or very close, which were above the limit with about 50%.The period with the lowest value was February whose concentration was about 75% of the allowed limit. The measure point P4 is one of the closest to the coal deposit. The exceeding frequency recorded in this area was 63.7% in 2013 and 72.8% in 2014.
From all the values that were above the allowed limit during 2013, the one recorded in July represented the highest concentration, 68.5% above the limit. The lowest level of

settled powders has been recorded during March and June, and the values were about 83% of the allowed limit.
In 2014 the highest value of settled powders concentrations has been recorded in September, and it exceeded the limit with over 95%.
The concentration with the lowest value has been recorded in March and it represented 42.6% of the maximum allowed.
Concerning the next sampling point, P5, the frequency of exceedings that are represented in figure 3 was higher in 2013 than in 2014. Year 2013 had an exceeding frequency of 75% and 2014 of 63.6%, which meant that 9 respectively 7 of the total measurements conducted were above the limit.

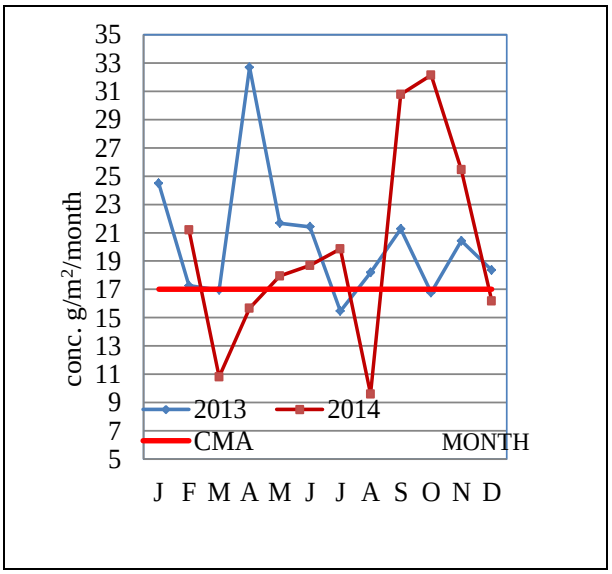

Figure 3 Variation of settled powders concentrations P5-area of Roșiuța Quarry

In the first year of study, settled powders concentrations with the highest values were measured in April and they exceeded the allowed limit with over 92%. The periods of 2013 when the settled powders concentration was below the limit had close values, lowest one being recorded in July and it was around 91% of the limit.
In the next year the concentration with the highest value has been measured at the end of October, and it exceeded the limit with 89.5%. Month August of this year was the period in which the lowest concentration of settled powders has been recorded, more than half of the allowed limit.
Sampling and measuring point P6, located to the south-west of the deposit, had the same exceeding frequency in the two years of study, of 66.6% which is represented in figure 4 meaning that 8 from 12 conducted measurements were above the allowed limit.
During year 2013 the settled powders concentration with the highest value has been recorded in April, and the lowest one in December, whose value represented 50% of the allowed limit.

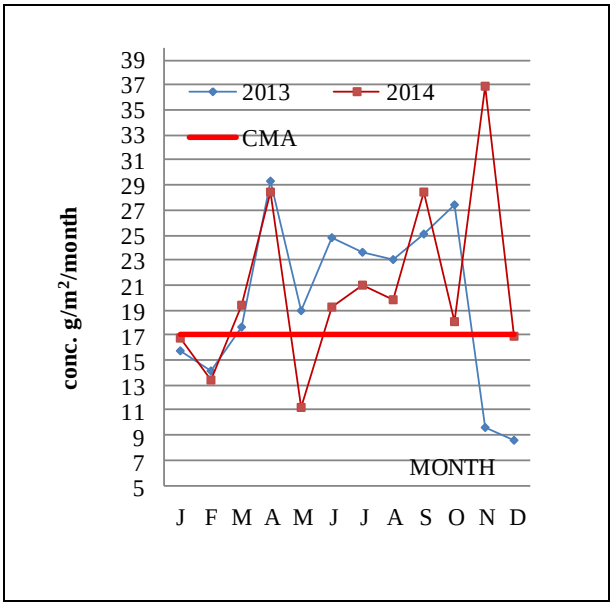

Figure 4. Variation of settled powders concentrations P6-area of Roșiuța Quarry

During year 2014 the period in which the highest settled powders concentration has been recorded in this location was November, whose value exceeded the allowed limit almost 2.2 times, and the lowest value has been recorded in May and it represented around 66% of the allowed limit.
In the next sampling point, P7, the exceeding frequency in the two years had different values which are represented in figure 5, If during 2013, from out of a total of 12 conducted measurements, 2 have been above the limit, meaning 16.7%, in year 2014 the number of exceedings was 41.7%, which meant that 5 of the 12 values were higher than the limit In year 2013 the settled powders concentration with

the highest value has been recorded in September, and it exceeded the limit with 75.6%. The lowest quantity has been recorded in February and it represented 35.4% of the allowed limit.
The concentration with the highest value in the next year had an even higher level, it was recorded in November. Its value has been almost two times and a half higher than the allowed limit. Considering the minimum concentrations, these were recorded in March and May, their level has been 60% of the allowed limit.
Last sampling point, P8, located to the south of the coal deposit at a distance of about 200 m, had a much lower exceeding frequency. If in the case of year 2013 from out of 10 conducted measurements two were above the allowed limit, which meet a frequency of 20%, in 2014 the exceeding frequency represented 16.7%, meaning that 2 of 12 values were above the limit.

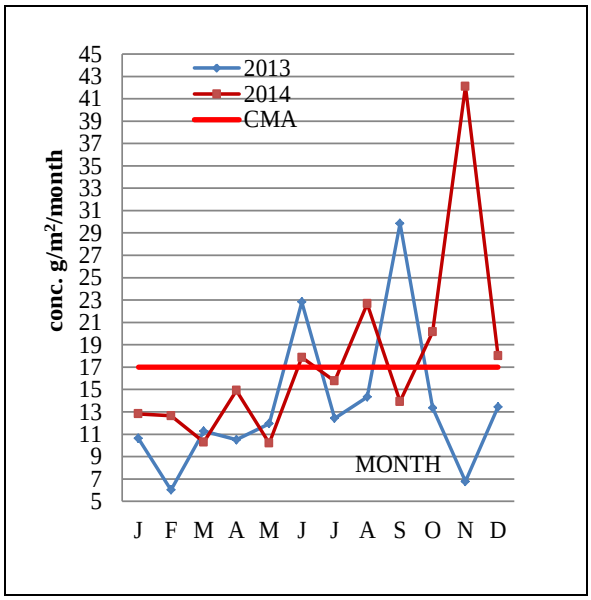

Figure 5 Variation of settled powders concentrations P8-area of Roșiuța Quarry

During year 2013, concentrations with values above the limit have been recorded in January and September, but these had reduced levels of settled powders, of 2.3% respectively 0.8%. The concentration with the lowest value was a little bit above one third of the allowed limit and it has been recorded in May. In year 2014 the highest level of settled powders has been recorded in March, and it was above the limit with about 80%. And the lowest one had been recorded in May and it represented 31.5% of the allowed limit.
After making a comparative analysis of the results obtained from the measurements conducted regarding the settled powders during the two years of study, there can be seen some similarities, but especially some differences, that took place due to more or less objective causes, proof that the atmosphere is the most unpredictable and unstable vector of pollutants spreading.
Applying the proximity principle, it is considered that the largest contribution to the pollution of an area can be attributed to the closest source, or in this case to the coal deposit, and the activities that take place in its area (coal dumping from the quarry to the deposit, loading in vehicles or wagons, auto transport), this represents the source that is the closest to the sampling points.
Referring to the exceedings recorded during the two years of study, these have been more numerous in 2014 (53.3%), than in 2013 (47.3%), considering that the number of conducted measurements each year has been almost equal (91 in 2013 and 92 in 2014). The exception is sampling point (P1) where all the values have been under the allowed limit, because it wasn't under the incidence of the coal deposit activities.The lowest values were obtained mostly in the winter season, meaning at the beginning and also at the end of the year, this can be can be attributed to the fact that during this period the excavation, transport and storing activities of the mining mass are interrupted for a period of time, the activity being resumed in the middle of January and it comes back to normal in February.
In another order of thoughts, the huge concentrations of settled powders from the autumn season, represented by the big number of exceedings, may happed due to the meteorological conditions of this period, when the numbers of rainfalls is lower, and the economical agent does not apply the required

measures that are needed to reduce the emissions of powders in such situations.
While the activity of coal exploitation through excavating has a great impact it self on the ground and also on the underground water, the transport and coal storing activities got a significant impact on the air in the area through emissions of powders and noise.

4. CONCLUSIONS

Based on the measurements conducted regarding the settled powders content in the air from the influence area of Roșiuța Quarry and their interpretation accordingly to the stipulations that are in force, multiple conclusions can be submitted. The daily coal exploit is constituting a source of pollution during its whole lifetime, starting from the moment of land stripping activities and ending in the moment when the new created surfaces are returned to the economical circuit. Through the complex activities that take place, a lignite exploitation quarry is a source of pollution to all the environmental factors : land, air, water, biodiversity, human settlements and constructions. The impact produced on the environment factors is manifested differently, depending on the activities undertaken in each quarry and its technical equipment. The air quality in the area of a quarry exploitation is mostly affected by the coal transport and storage activities.
The damage to the air quality in the area of Roșiuța Quarry is highlighted by the large number of allowed limit exceedings , recorded in the monitoring locations of this activity. The number of maximum concentration exceedings recorded during the two years of study has been higher in 2014 than in 2013.
During 2013, the settled powders concentrations had values that went from exceeding the limit with 126% to values that were 25% of the limit. In year 2014, the level of settled powders has been more pronounced, the highest value has been 147% above the allowed limit and the lowest one has been 31.5% of the limit.
High concentrations of settled powders have been recorded in points located in the near proximity of the coal deposit.
Smaller quantities of settled powders, as well as lower number of exceedings, have been recorded during the cold season rather than in the other seasons, but this aspect is attributed to fewer activities undertaken in his period, rather than to other causes.
Higher concentrations that were recorded in summer and autumn seasons are owed, not just to less favourable weather conditions (fewer rainfalls), but also to the lack of anti-pollution measures that should have been taken by the economical agent.

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