

## THE STUDY OF THE AIR POLLUTION BY A SURFACE MINING EXPLOITATION FROM ROMANIA

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### ABSTRACT

*In Romania, the activity of surface extraction of the lignite unfolds in 18 big quarries, equipped with technologies in continuous flux, that have a designed maximum total capacity of production of 40 million t/year.*

*The paper presents the study of the air pollution by a surface mining exploitation from Romania.*

*For the gaseous indicators:  $SO_2$ ,  $NO_2$ ,  $NH_3$ , there have not been registered exceedings of allowable concentration maxims.*

*The air quality is affected by the suspension and sedimentary powders resulted from the extraction activity, transportation and coal deposition.*

**Keywords:** mining exploitation, air pollution.

### INTRODUCTION

In the exploitation and valorification of the coal resources, the perturbation of the environment starts with the extraction of these resources by the mining industry units, through [1]:

- The elimination from the agricultural circuit and the deforestation of some plots; the opening of new access roads;
- The construction of concrete mixers, silos, dwellings, huts and storehouses;
- The concentration of the means of transportation and the arrangement of the parking or garagement lots for them;
- The deposition of liquid fuels, materials, scrap-iron and wastes; the installation of transformers and electric networks;
- The assembling of conveyor belts; discovery and excavation in quarries;

- Well digging, coastal galleries, oblique planes and other mining works; sterile heap and sometimes self-inflammable coals; the water evacuation from the mining works;

- Controlled collapse of the surface soil over the subterranean excavations;

- The altering of the geomorphology and the water flows;

- The starting or reactivation of the landslides;

- The encouragement of erosion and soil degradation; the pollution of the surface and subterranean waters etc.

After the extraction and, eventually, mechanical preparation, the coals are transported to the users, at small or great distances, with conveyor dump track belts, train sets and fluvial or maritime ships. Both the loading and discharge balusters and during the transportation roads the environment is deteriorated because of [1, 6]:

- The dispersal of powder at handling;
- Loss of some different sizes fractions under the effect of air currents, water from the precipitations and the forces that interfere during transportation;
- Oxidation and sometimes self-inflammation in contact with the air;
- Emiting of some gases initially contained (methane) or resulted from the aeration (carbon oxides and of sulphur).

The surface mining exploitation has a varied and complex influence over the environment thus [1]:

- The temporary or definite occupation of some land area that affects in some cases the hydrogeology and of the relief surrounding the exploitations;
- The partial or total degradation of the soils and landscape;
- The change of the hydrographic conditions;
- The further change of the environment and the degradation of the health conditions of the inhabitants of the industrial regions;
- The reincorporation within the economic circuit of the degraded lands.

The mining activity exercised through the surface exploitation is characterized thus by the following series of important sources of influence of the environment [1, 4]:

- The actual surface exploitation may modify the geomorphological structure and makes impossible for a long period of time the cultivation of the occupied lands, also exercising the indirect influence over the neighbouring areas through the perturbation of the hydrologic balance;
- The sterile heaps that occupy important surfaces and do not allow their exploitation influence the adjacent lands through geometric, hydrologic and often chemical changes;
- The mining constructions and installations that often constitute the cause of the hydrographic changes of the surrounding lands and are sometimes pollution sources of the atmosphere and waters.

The most serious effect of the mining exploitation up to date is the elimination from the economic circuit of great land areas and the reduction of the production capacity of some limittrophe lands through the disorder of the hydrologic regime [4, 5].

The paper presents the study of the air pollution by a great surface mining exploitation.

## EXPERIMENTAL

The establishment of the sampling points was realised in conformity with the norms stipulated by STAS 10331/1992 [2, 8]. The establishment of the sampling points was realized in conformity with the norms stipulated by STAS 10331/1992 in different points located at the surface exploitation. The gases were spectrophotometric ally analysed,  $\text{NO}_2$  at the wavelength of  $\lambda = 550$  nm, in conformity with STAS 1032975,  $\text{SO}_2$  at the wavelength of  $\lambda = 548$  nm, in conformity with STAS 10194-89 and  $\text{NH}_3$  at the wavelength of  $\lambda = 450$  nm, in conformity with STAS 10812-76 [2, 8].

### The determination of suspension powders

The reference method for the sampling and measurement of the  $\text{PM}_{10}$  fraction is described in the European Norm EN 12341/1999 which specifies the performances of the sampling instruments for the  $\text{PM}_{10}$  fraction in view of the harmonizing of measurements systems, according to the provisions of the Directives of the European Union Council 96/62/EC for the evaluation and management of the environmental air quality.

The measuring principle is based on the filtering selection of the  $\text{PM}_{10}$  fraction, which is separated from the air-floated particles followed by a gravimetric determination. In this case it was used a Low Volume System of the LVS- $\text{PM}_{10}$  type (Fig. 1).

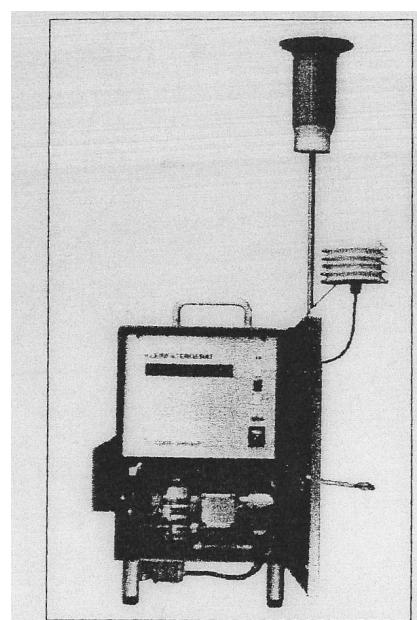


Fig. 1. System of powders sampling.

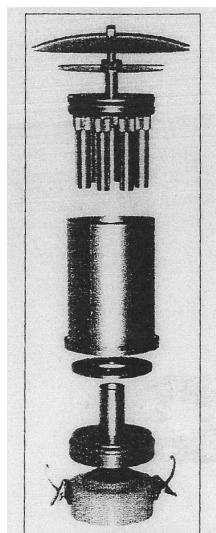


Fig. 2. Head of sampling powders.

The method of reference measurement uses an aspiration system of  $PM_{10}$  directly coupled to a filter substrate and a control device of the aspiration flow rate, followed by a gravimetric determination of the  $PM_{10}$  mass collected on the filter. The sampling flow rate was adjusted to  $2m^3/h$  (Fig. 2).

Inside the aspiration compartment, the air flow is accelerated by an impactor with 8 impact nozzles and then directed by a pipe towards the impact surface. Thereafter, the air stream is directed to a line towards the filter support. This support is adjusted for the insertion of a circular filter with the diameter of 47 mm.

Before sampling, the filters are conditioned for 24 hours by drying in an exicator with calcium dichloride dryer. They are weighted and then exposed for sampling for another 24 hours. After sampling, the filters are again conditioned for 24 hours by drying and weighted. The difference between the filter mass after exposure and the filter mass before exposure represents the quantity of air-floated powders, the  $PM_{10}$  fraction.

## RESULTS AND DISCUSSION

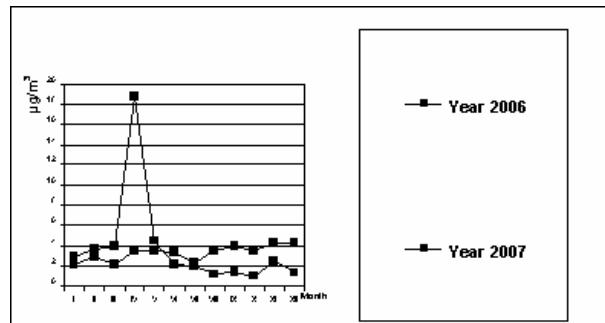
The impact brought over the air is produced by [6, 7]:

- The pollution with the gaseous noxes and suspension particles resulted following transportation and the operation of heaping of the sterile material;

- the emissions of noxes and volatile hydrocarbures produced by the engines with internal combustion of the used equipment;

- the acoustic emissions with different origins, fixed or mobiles, produced by the technological equipment or by the means of transportation.

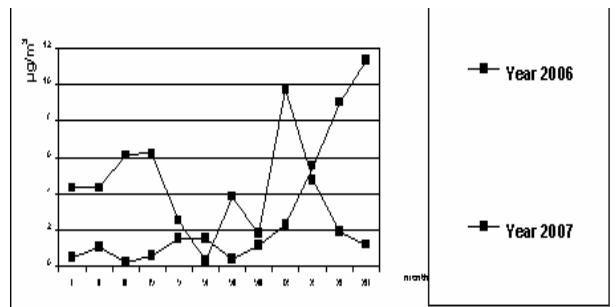
For the sulphur dioxide, STAS 12574/87 stipulated a maximum admissible concentration for samples of short length (30 minutes) of  $750 \text{ mg m}^{-3}$ . The monthly medium results for the years 2006 and 2007 are presented in the graphic from the Fig. 3.

Fig. 3. The  $SO_2$  variation in the surface exploitation.

The maximum was registered in April ( $18.7 \text{ mg m}^{-3}$ ), and the minimum in October ( $1.0 \text{ mg m}^{-3}$ ). The same situation may be observed at the level of the year 2007 in the sense that there were not registered exceedings this time. The monthly medium values obtained varied between  $2.1 \text{ mg m}^{-3}$ , registered in January and March and  $4.3 \text{ mg m}^{-3}$  registered in November.

For the dioxide azotat STAS 12574/87 stipulates a maximum admissible concentration for samples of short duration of  $300 \text{ mg m}^{-3}$ .

And in the case of the indicator  $NO_2$  both the daily values obtained and the monthly means are situated under the maximum admissible concentration, represented in Fig. 4. In the year 2006 the average monthly values varied between  $0.3 \text{ mg m}^{-3}$  in June and  $9.7 \text{ mg m}^{-3}$  registered in September, the annual mean being  $3.9 \text{ mg m}^{-3}$ .

Fig. 4. The variation  $NO_2$  variation in the surface exploiting area.

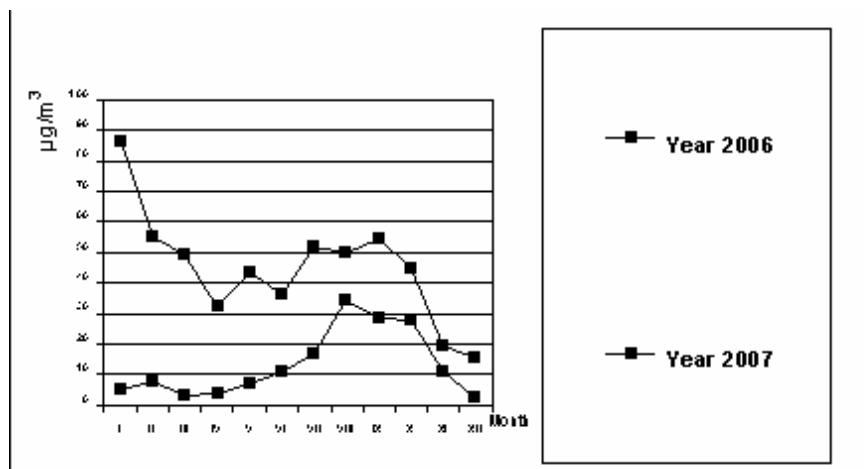


Fig. 5. The variation  $\text{NH}_3$  in the surface exploitation area.

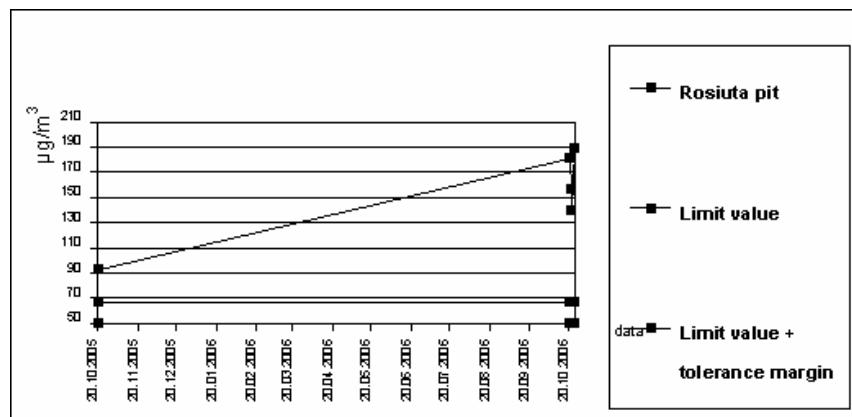


Fig. 6. The variation of suspension powders ( $\text{PM}_{10}$ ) in the surface exploitation area.

For the year 2007 the variation of the average monthly values was slightly marked than in 2006, the minimum being registered in mars ( $0,2 \text{ mg m}^{-3}$ ) and the maximum in december ( $11,3 \text{ mg m}^{-3}$ ).

The average annual value was of  $2,6 \text{ mg m}^{-3}$ .

For the indicator ammonia, STAS 12574/87 stipulated a maximum admissible concentration of  $300 \text{ mg m}^{-3}$  in the surrounding air for samples of short duration. The average monthly values for 2006 and 2007 are presented in Fig. 5.

And in this case also both the daily values obtained and the monthly means are situated under the maximum admissible concentration.

In the year 2007 the average monthly values are bigger than those in the year 2006, the minimum

value registered in april ( $0,0 \text{ mg m}^{-3}$ ) and the maximum in january ( $89,0 \text{ mg m}^{-3}$ ), the average annual value being of  $44,4 \text{ mg m}^{-3}$ .

For the year 2007 there were registered average monthly values that varied from  $2,3 \text{ mg m}^{-3}$  in decembre to  $34,3 \text{ mg m}^{-3}$  in august, the annual mean being of  $12,3 \text{ mg m}^{-3}$ .

The  $\text{PM}_{10}$  content is calculated with the relation:

$$\text{PM}_{10} = \frac{m_1 - m_2}{v} \text{ mg/m}^3$$

During the year 2006 there were done a number of five measurements regarding the air pollution in suspension powders, the fraction  $\text{PM}_{10}$ , presented in Fig. 6.

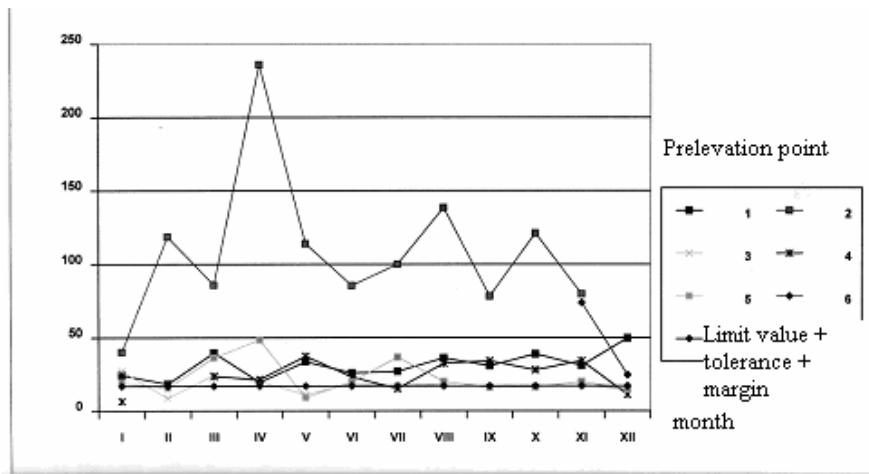


Fig. 7. The variation of sedimentary powders in the area surface exploiting area.

The direction of the Minister of the Waters and the Protection of the Environment nr. 592/2002 stipulated a margin value of  $50 \text{ mg m}^{-3}$  plus a margin of tolerance of  $16,67 \text{ mg m}^{-3}$  applicable to the values registered in the year 2007.

The lowest value obtained was of  $91,72 \text{ mg m}^{-3}$ , representing 1.4 over the limit value plus a tolerance margin and the greatest value was of  $188,76 \text{ mg m}^{-3}$ , which represents a exceeding with 2.8 over the limit value plus the margin of tolerance.

In the year 2006, from the total of 58 measurements effectuated regarding the pollution with sedimentary powders, in the 47 cases there were registered exceedings of the CMA, this representing 81% from the total measurements presented in the Fig. 7.

In the pre-elevation points 1 and 2, in every case there were registered exceedings. This is explained by the fact that the point 1 is in the proximity of the delivery-reception vault of the coal, and the point 2 is in the close vicinity of the the cole storehouse where there takes place the deposition with the assistance of the deposition-loading machine or of the automatic means with the classic equipment.

In the point 2 there were registered the greatest values for sedimentary powders, the means being of  $108,87 \text{ g m}^{-2} \text{ month}^{-1}$ , and the maximum being of  $235,88 \text{ g m}^{-2} \text{ month}^{-1}$  and it was registered in april. In these two points of pre-elevation the frequency of exceedings was of 100%.

In the point 3, located in the south part against the coal storehouse and at a distance of approximately

200 meters, from the total of the 10 measurements effectuated in the year 2007, 7 exceeded C.M.A., which represents 70%. The minimum was of  $8.71 \text{ g/m}^2/\text{month}$  and it was registered in february, and the maximum of  $27,29 \text{ g m}^{-2} \text{ month}^{-1}$  and it was registered in january.

In the point 4, situated near the north-west against the storehouse, the frequency of exceedings was of 72,7 %, this one representing 8 measurements from the total of 11 made during 2007.

In the point 5, situated between south and west against the storehouse from the total of 12 measurements in 7 cases the CMA was exceeded which represents 58.3 %.

In the point 6, situated at the west end of the storehouse and in the proximity of the acces road of the automatic means, the frequency of the exceedings was of 100 %.

There may be ascertained a growing of suspension powders concentrations in the following points of work:

- excavation area;
- at deversation on the conveyor belt;
- at the deversation from a belt on another;
- in the stations of coal smashing;
- during the line of auto transportation;
- at the platforms of coal loading in the train waggon.

The potential impact over the air is maintained over the entire period of deposition, manifesting it self through a areal pollution with sedimentary or in suspension powders [6].

Besides the modification of the physico-chemical features of the air, there may be signal out also some modifications its circulation, due to the relief changes and the reduction of the wooded areas.

## CONCLUSIONS

The lignite extraction from the Mining Exploitation of Quarry affects the quality of the areal air.

For the gazeous indicators,  $\text{SO}_2$ ,  $\text{NO}_2$ ,  $\text{NH}_3$  there have not been registered exceedings of the maximum admissible concentrations.

The quality of the environment from the influence area of the surface exploitation is affected by the powder dust resulted from the extraction activity, transportation and storing of the coal as well as from the noise produced by the specific equipment of this activity.

In the case of the gazeous indicators  $\text{SO}_2$ ,  $\text{NO}_2$ ,  $\text{NH}_3$  there have not been registered exceedings of the maximum admissible concentrations.

The quality of the air is affected by the suspension and sedimentary powders resulted from the extraction activity, transportation and deposition of the coal.

The adoption of some modern technologies, efficient and clean may reduce the negative impact that the mines have over the environment.

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