ATMOSPHERE AND SOIL POLLUTION SOURCES IN MONO-INDUSTRIAL AREAS AND THEIR ENVIRONMENTAL IMPACT

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Abstract: *The mining industry induces major influences on the environment, which appears in every stage of the technological processes. Besides the solid wastes, the mining industry also generates gaseous and liquid wastes, in significant amounts. Opencast mining deeply affects all the environmental factors (soil, water, air) and involves high expenses for affected surface land restoration in order to put it back in the economical circuit. The mining mass from waste dumps consists in a heterogenous mixture of rocks with different strengths, granulometry and physical and mechanical properties. This leads to the growing of vegetation in these areas only after their coverage with a vegetal soil layer and their reintroducing in the agricultural circuit. If the waste dumps are storing wastes issued from rocks conraining metalic sulphides, the rainfalls are generating chemical and bacterian solubilisation of these sulphides and the resulting solutions are tricklering in the ground and underground waters, affecting the local hidrographic network. As a consequence of mining operations, the vegetation is also affected through deforestation, landslides and dust settling on leafs, resulting a dramatic decrease of the agricultural production in the region. When the mineral deposit is mined out by underground workings, the stress and strain state in the rock massif is modified, generating the surrounding rock stability decrease and their displacement on a certain distance, according to their loosening capacity and their capacity of filling the resulting cave. Sometimes, the movement of the surrounding rocks can affect the surface ground, producing its degradation and that of the facilities built up in the influence area. For a significantly long period, the coal will maintain his role of safe energetically fuel, for many countries being the only available fuel to provide the growing electricity demand. Coal-based thermo-electrical power plants can affect the environment, even by impacting the ecological balance in their proximity, through their complex influences exerted on all the environmental factors (water, air, soil, flora and fauna), so that the energy-generating sector is considered a major pollution source. Mintia thermo-electric plant is the third electricity generating capacity in Romania, with an installed capacity of 1260 MW and a yearly output exceeding 4 million MWh. For thermal and electric power generation, it yearly consumes 2.3-3 million tons of coal, over 500 t fuel oil and 8000 m3 natural gas. As it concerns the Paroşeni power plant, his airborne emissions are lower. SO2 quantity released is of 8,800 t/year, the NOx is of 1,400 t/year, the airborne dust reaching only 1,400 t/year.*

Key words**:** *pollution, atmosphere, soil, mono-industrial areas*

INTRODUCTION

Due to his specific character, the entire mining activity induces various adverse effects on the environment, such as:

- landscape degradation as a consequence of relief alteration in the mined out area;
- large surface land reclamation for exploitation activity, waste dump storage and raw mineral disposal;
- surface land deformation as a result of waste dumps sliding;
- adverse influences on regional atmosphere, flora and fauna;
- surface water pollution due to tailing ponds;

- underground water unbalance;
- soil pollution;
- phonic environmental pollution induced by equipment use and blasting operations.

Most of the time, to the above-mentionned, the presence of a thermo-electric power station is added, whose location was selected in such a manner that it is nearby the coalfield. After the burning process of coal or other fossil fuecl, through the stacks airborne dust particles and noxious gasses are released with negative environmental effect.

MATERIAL AND METHODS

Opencast mining deeply affects all the environmental factors (soil, water, air) and involves high expenses for affected surface land restoration in order to put it back in the economical circuit.

The mining mass from waste dumps consists in a heterogenous mixture of rocks with different strengths, granulometry and physical and mechanical properties. This leads to the growing of vegetation in these areas only after their coverage with a vegetal soil layer and their reintroducing in the agricultural circuit. If the waste dumps are storing wastes issued from rocks conraining metalic sulphides, the rainfalls are generating chemical and bacterian solubilisation of these sulphides and the resulting solutions are tricklering in the ground and underground waters, affecting the local hidrographic network.

The exploitation operations carried out in a quarry can induce the degradation of intercepted aquiferous systems, in order to minimize the mine workings flooding hazard, various technologies are employed to dry the aquiferous layers. This have lead, for example, in Rovinari coalfield to the complete drying out of all drinking water wells located upstream the quarry, with serious repercussions on the forestly and agricultural activities in the whole region.

Between the romanian quarries having adverse environmental effects, it is well-known the Gurasada bentonite quarry, where the landscape was severely deformed due to unadequate operated excavations. The slope undercaving unleashed a series of slidings and the dump rock have covered the working faces in the bentonite seams. In the sliding were taken over also the existing social buildings and other facilities within the quarry. The quarry's waste dump, developed on a bank of Mures river, had blocked the floodable zone, the river's water overflowed the agricultural land which was entirely flooded.

Further, the airborne dust particles issues from bentonite processing is spread by the airflow on a high surface, polluting the air in residential areas.

As a consequence of mining operations, the vegetation is also affected through deforestation, landslides and dust settling on leafs, resulting a dramatic decrease of the agricultural production in the region.

When the mineral deposit is mined out by underground workings, the stress and strain state in the rock massif is modified, generating the surrounding rock stability decrease and their displacement on a certain distance, according to their loosening capacity and their capacity of filling the resulting cave. Sometimes, the movement of the surrounding rocks can affect the surface ground, producing its degradation and that of the facilities built up in the influence area.

Basicaly, the magnitude of surface land degradation depends on the following factors: the size of the cavity developed by mining, the mining depth, the mining method and employed technology, pressure supporting systems and geomechanical rock characteristics.

The land surface displacement is the result of stresses redistribution in the rock massif under the influence of underground cavities generated by mining operations.

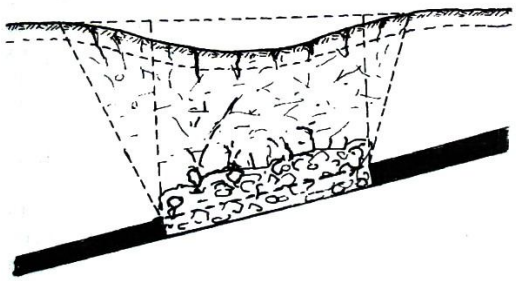

Figure 1: Continuous subsidence above a working face.

The most frequent subsidences are the continuous ones, where the subsidence tub profile developes with the increasing of the exploited surface area. This kind of subsidence is specific for thin, horizontal or slightly inclined seams and veins, located in weak rocks, generally occuring in coal seams and sulphur deposit exploitation [4, 5].

Continuous subsidences are characterized by the following five paramaters: vertical depth, subsidence tub's curvature and slope, compressive and tensile horizontal deformations.

According to the depth of the deposit, in the covering rock massif three deformation regions are developing: the irregular subsidence area; the regular subsidence are; the rock bending after hedding area. When the depth at which the deposit is located do not exceed 100-150 m, the third area misses [4].

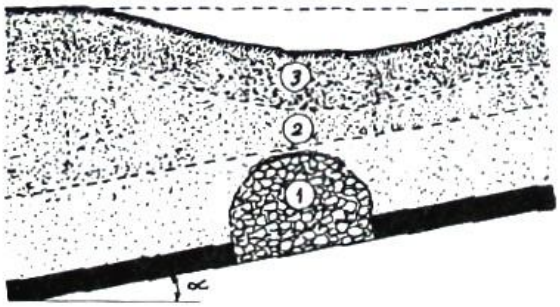

Figure 2: Rock massif displacement and subsidence under the influence of underground mining.

Coal and natural gas remain the most important fuels for electricity generation throughout the projection period, together accounting for 80 percent of total increment in world electric power generation from 2004 to 2030 in the reference case (see Figure 3) [3].

For a significantly long period, the coal will maintain his role of safe energetically fuel, for many countries being the only available fuel to provide the growing electricity demand.

Coal-based thermo-electrical power plants can affect the environment, even by impacting the ecological balance in their proximity, through their complex influences exerted on all the environmental factors (water, air, soil, flora and fauna), so that the energy-generating sector is considered a major pollution source.

Gas and other air pollutants are released through stacks, and their diffusion occurs not immediately after leaving the chimney. Burned gasses released in atmosphere by the thermo-

electrical power plants include significant quantities of pollutants noxious gases (sulphur oxides, nitrogen oxides, carbon monoxide and dioxide) and flying ash particles.

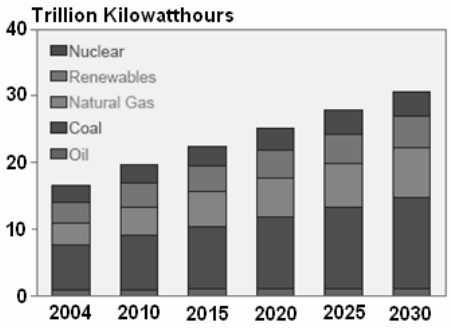

Figure 3: World energy generation by fuel [2, 3].

RESULTS AND DISCUSSIONS

The size of the affected surface by deformation phenomena is comprised between 13.5 hectares at Berbeşti colliery and 30 hectares at Dragoteşti colliery, being 6-8 times higher than the mined out surface.

In Motru coal basin, for example, the vertical deformations occurred after mining the lignite seams were often comprised in the range 1.0-3.5 m. at the limit, subsidence values of 5.0-6.0 m were encountered. In Petroşani coal basin the deformations registered after exploitation of seams no. 3 and no.5 have reached a maximum value of 16.4 m, at Lonea colliery [6]. Consequently of the mining in Deva deposit, a subsidence cone developed, having a cross-sectional area of 5 hectares and a depth of about 200 m. Similar were encountered in other mining regions in Romania.

A unique situation is met the case of salt deposit exploitation in Ocnele Mari, where after kinetic room dissolution, the basic negative effect consisted in the dissolution of the pillars between the rooms and the complete joining of the rooms. Furthermore, the dissolution process developed in an uncontrolled manner, resulting in a cavern of 10.5 hectares of surface, with a volume of 2.5 million m^3 of brines. This phenomenon have lead in time to the following consequences on the surface ground: subsidence, fractures, local impregnations with salt brine as a consequence of wells tightness loss and accidental leakages [1].

In 2001, after land sliding around a well, in the hydrographic basin a turnover of more than 2 million m^3 of brine occurred, severely affecting the environment and damaging 62 estates. In 2004, another well crumbled, nearby the first one, leading to a turnover of more than 600,000 m^3 of brine and affecting 159 estates.

At present, the thermo-electrical power plants with significant atmospherically pollutants are those located in mining basins or nearby, such as those from Mintia, Paroşeni, Turceni, Rovinari, Craiova.

Mintia thermo-electric plant is the third electricity generating capacity in Romania, with an installed capacity of 1260 MW and a yearly output exceeding 4 million MWh.

For thermal and electric power generation, it yearly consumes 2.3-3 million tons of coal, over 500 t fuel oil and 8000 m^3 natural gas.

The levels of pollutant emissions are highlighted in table 1.

For a yearly consumption of 3 million tons of coal it is obtained about 1 million tons of slag and ash, which is stored in place, near by the power plant [7].

Table 1

Pollutant emissions per year

Pollutant	**Quantity,** 10^3 tons
CO_2	3800-4200
SO_2	35-65
NO_x	16-17
Dust	8
Ash	900

The stored ash can be taken over spread by air currents, polluting with dust the air and soil on large surfaces. The spreading of hard coal ash is much more in tense than that of lignite ash, as a consequence of its lower granulation and specific density. In order to supress this phenomena, the freely exposed surfaces are covered with sodium silicate or bituminous solutions.

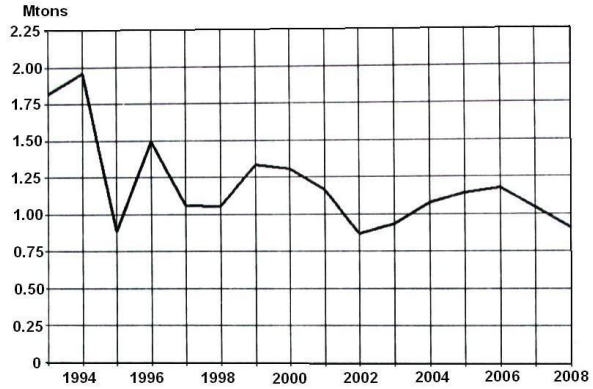

Figure 4: Slag and ash quantities stored nearby the power plant.

As it concerns the Paroşeni power plant, his airborne emissions are lower. SO_2 quantity released is of 8,800 t/year, the NO_x is of 1,400 t/year, the airborne dust reaching only 1,400 t/year.

At the national borders, the SO_2emission levels generated by the major thermo-electric power plants are 0.39 μg/m^3 for Mintia power plant, 1.07 μg/m^3 for that located in Craiova and 0.71 μg/m^3 for the Rovinari one, all these values do not exceeding the maximum allowable limits required for compliance by European standards.

Another important pollution factor is the noise level generated by the equipments operating in the coal warehouse and other sector of any thermo-electrical power station.

CONCLUSIONS

The extraction of mineral deposits in Romania, significantly affected in time all the environmental factors; consequently nowadays the issue of environmental protection, rehabilitation and restoration is very seriously approached.

At present various actions are undertaken in order to minimize the adverse effects induced by mining operations, for landscape restoration, increasing of interest for tourisme in the former mining regions and opening new ways of employing less pollutant energy sources.

The quality coal burned out in the thermo-electric power station boilers directly influences the environmental pollution. In order to diminish the impact of solid and gasseous pollutants further actions directed to modernization of energetic capacities are required.

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