

## GREENING OF SLAG AND ASH DEPOSITS

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### ABSTRACT

*In the last years the need to develop national and international policies aimed at protecting the environment, so as not to compromise the quality of life, future generations and all living species on this planet, was stressed.*

*Romania due to the developed industrial activities, especially those in the energy sector, is one of the countries affected by all these negative effects on the environment. The energy industry is the main consumer of fossil fuels, especially coal, which is considered to be the most polluting of them.*

*The result of burning coal is ash. In order to preserve the quality of the environment, measures must be taken to green the slag and ash deposits.*

**Keywords:** Green, Coal, Slag, Ash, Environment.

### 1.INTRODUCTION

The basic fuel used in the combustion process at 1035 t / h boilers is lignite coal, extracted from the coal basin of Oltenia, and for the maintenance and stabilization of the flame, fuel oil and natural gas are used. At each steam boiler of 1035 t / h, the slag resulting from the combustion of the coal is crushed and transported hydraulically in a dilution of 1:10 through channels, at the Bagger pump station afferent to the boiler. Lignite contains 24-32% ash at the initial mass. Of this amount of ash, about 5% is separated in the hearth of the boiler in the form of slag and ash, which falls in to the funnel of the hearth, from where it is evacuated by means of a scraper conveyor (Kratzer).

### 2.EVACUATION OF SLAG

The Kratzer discharges slag and ash onto a 30 mm mesh sieve, where fine particles are separated from coarse slag particles. The coarse particles are sent to a crusher, after

which, with the help of water ejectors, the slag is discharged to the sludge pump station (Bagger). The role of the slag evacuation installation is to cool the slag that falls hot from the hearth funnel, into a water bath and to evacuate it. This installation ensures, by the immersion socket in the water bath, the sealing of the hearth at the bottom. The water level in the bathroom is maintained with the help of an overflow. The water bath of the slag drain is constantly supplied with washing water, so that the temperature in the Kratzer does not exceed 6000<sup>0</sup>C. Falling in the water bath, the heat of the slag is absorbed by the cooling water. The cooling process usually takes place so quickly that large lumps of slag turn into small, friable particles. The slag particles are transported from the water bath by means of scrapers, caught on a caliber chain. For crushing the slag up to the size of 30 mm, two crushers with a roller and crushing jaws are provided, with a flow rate of 10-20 t / h. After the crushing process, the crushed slag is

discharged into an intermediate hopper and then into the slag channels.

The slag and ash is taken up by the ejectors which transport it with the help of the hydraulic pressure to the exhaust channel. The fly ash, which leaves the hearth with the flue gases, is partially retained and collected in the funnels under the air preheaters, the funnels of the electrofilters and the chimney funnel, from where it is evacuated by free fall, through large diameter pipes (400 mm or 600 mm) mounted with high inclination. From the funnels under the air preheaters, the ash is driven by free fall through pipes to a height of +0 m, where it is mixed with the washing water in a basin and then discharged to the sludge pump station. The ash from the funnels of the electrofilters is evacuated with the help of counterweight weights, led to the water-ash mixers (teapots) and then through the canals to the bagger pump station. Bagger pump stations ensure the evacuation of slag and ash from the plant. The Bagger pumping station serves two boilers and has three pumping lines, one of which is in operation, one in reserve and one in repair. A line of Bagger pumps comprises two series centrifugal pumps.

In order to align with the European norms of environment and energy efficiency, it is necessary in addition to the technological rehabilitation of coal-fired power plants, respectively the construction of flue gas desulphurization installations and the replacement of current evacuation, transport and storage of coal in the boilers of the energy groups, with non-polluting installations [7]. The current system of evacuation, transport and storage of slag and ash has a number of drawbacks, including:

- requires large amounts of water to transport the mixture, which leads to high operating costs;
- excess water in the warehouse affects safety, respectively local and general stability of the deposit;
- a series of harmful substances contained in slag and ash are dissolved in water and some of them seep into the soil.

In conclusion, the cause of all these inconveniences is the drainage technology,

respectively the excess water. The infiltrations from the landfill affect the groundwater and the subsoil due to the lack of tightness and inadequate drainage of its tank. Driven by the wind on the dry surface of the storage compartments, affect all environmental factors: water, vegetation, living organisms, soil, human settlements.

### 3. IDENTIFYING POTENTIAL SOURCES OF POLLUTION AND ASSESSING THE IMPACT ON THE ENVIRONMENT

#### 3.1. Air pollution and protection:

For the implementation of the European Union Directive 2001/80 / EC, the Romanian Government issued GD541 / 2001 regarding the limitation of emissions into the atmosphere from large power plants over 50 MW (emissions of solids, SO<sub>2</sub> and NO<sub>x</sub>).

These limits are mandatory for any new unit to be implemented [1].

For the units in operation, it is foreseen that by 2012 the required limits will be reached through a gradual program, so that, through the implementation of important investments, the level of emissions provided in the new regulation will be met [4].

The compliance with the norms for dust will be achieved as a result of an extensive program for the rehabilitation of electrofilters of all energy boilers.



Figure 1 Air pollution

### **3.2. Water pollution and protection:**

Reducing the impact of the activity on surface and groundwater as well as complying with the provisions of Water Law 107/1996, GD 188/2002 for the approval of some norms regarding the conditions of discharge of wastewater in the aquatic environment, Law 404/2003 for the approval of GEO 107/2002 on the establishment of the National Administration “Romanian Waters” will be done by:

- quantitative and qualitative monitoring of captured and discharged waters;
- reduction of water consumption and implicitly reduction of wastewater discharges produced and / or discharged;
- optimization of water pretreatment and treatment processes;
- improving the performance of fuel oil separators;
- recirculation of slag / ash hydrotransport waters;
- increasing the degree of water recirculation in cooling circuits;
- elaboration of the intervention plan in case of accidental pollution;

### **3.3. Soil and subsoil pollution and protection:**

Among the environmental factors, the soil has a major importance, being a place of accumulation of polluting elements.

The reduction of the impact of the activity on the soil is done by:

- soil quality monitoring;
  - reduction of sedimentary dust emissions;
  - prevention of leaks of reagents and hydrocarbons in the discharge / storage areas;
  - prevention of fluid losses, suspensions, sludge transported on pipes;
  - elimination of infiltrations or exfiltrations from landfills;
  - the optimal use of the land surfaces occupied by the landfills by reducing the quantities of waste produced and their capitalization;
  - decontamination of accidentally polluted soil.
- Soil pollution can be: direct, due to the deposition of solid or semi-solid residues from the development of technological processes; indirect, due to pollutants emitted into the atmosphere, carried by the wind, which are deposited on the ground and are washed away by precipitation, infiltrating underground.

### **3.4. Waste management:**

From the activity carried out within this complex, the following types of waste result:

- mining waste;
- nuclear waste.

At the level of the European Union, environmental protection is a field of major interest, the *acquis communautaire* being in a continuous dynamic of change and development aiming at:

- integration of environmental objectives in the policies of the economic sectors;
- actions at local and regional level to promote sustainable development;
- promoting preventive and precautionary techniques and tools.

The completion of the legislative framework with normative acts regarding the environmental protection, imposed a reconsideration of the approach to the activity in the thermal power plant [2].

Basic policy Rovinari Energy Complex considers the production and supply of electricity and heat in conditions of high efficiency and with the least impact on the environment.

The environmental strategy for the implementation of this policy is an integral part of the overall development strategy of the complex and aims to reduce the negative impact of energy installations on the environment at the lowest possible costs and in compliance with national and international regulations.

In the current economic context, marked by the increasing recognition of the interdependencies between environment and development, we are witnessing the increase of the society's exigencies regarding the environmental protection, exigencies materialized in more and more severe regulations.

The main activities carried out by Rovinari Energy Complex, lignite extraction, production and supply of electricity are carried out in conditions of high efficiency and with the least impact on the environment, respecting the National Energy Strategy for sustainable development of the energy sector.

## **4. GREENING OF SLAG AND ASH DEPOSITS**

### **4.1. Ecological rehabilitation of lands**

In the design of the ecological and territorial rehabilitation works of the affected areas, a series of real and verified exigencies are taken into account:

- of the population that actually lives in the territory;
- of the territory, regarded as a subject capable of expressing its attractions and repulsions towards its use;
- of traditions, seen as a verified relationship between local culture and territory.

The financing of these ecological rehabilitation works was done only from own sources.

### **4.2. Agricultural cultivation**

Electricity is a non-polluting form of energy, but its production, most of the time, is based on the processes of burning primary energy resources.

The burning of fossil fuels in thermal power plants generates a large volume of pollutants which can have considerable effects on the environment. These effects are even greater in developing countries, whose power plants are equipped with non-performing equipment. In Romania, the burning of lower fuels has generated and continues to generate huge entities of ash, which are stored in dumps. These deposits of surface remove from the economic circuit large areas of land, which are permanently lost for future generations [3]. Ash dumps are also important sources of ash environmental pollution.

The soils located on the Cicani dump, belong to the class of undeveloped, truncated or cleared soils. From this class, the anthropogenic protosol type was individualized from a pedogenetic point of view. The subtypes are varied depending on the piling process and the particle size composition.

The ash distributed on the soils developed around the Rovinari Thermal Power Plant can have a negative effect on plant growth, including on the root system of the vine due to

the phytotoxic potential of some chemical elements existing in the ash component [5].

Heavy metals in ash can have an adverse effect on activity the root system, even in those conditions in which the chemical composition of the plants has not been modified.

The soil content of heavy metals registers values above the maximum limits permissible at Ni (89.0 mg / kg), Mn (928.5 mg / kg), Cr (180 mg / kg).

The tailings dump has a defective aerohydric regime; due to the presence of areas with a high content of moderate and high gravel, most of the root of the vine grows to depths over 60 cm to find the necessary water and nutrients.

The rendering activity in the economic circuit started in Oltenia since 1969, when the first experimental lot sown with wheat was established and in the following year with corn. Between 1981 - 1983, on the outer dump of the Tismana I quarry and between 1984 - 1985 on the Cicani dump, experiments were carried out on the viability of four crops: wheat, corn, potato and clover. Between 1993 and 1994, the experiments on the Balta Unchiasului dump were resumed, this time using six types of cultivated plants: potato, corn, oats, peas, barley. The obtained results showed an increase in production in direct proportion to the solidification process of the clays.

### **4.3. Recultivation of vines - fruit trees**

The tailings dumps offer conditions for early or extra-mature fruit tree varieties. The results obtained on the plantation made on the Cicani dump highlighted the good behavior of the apple, plum, cherry and cherry. Vine plantations have shown that good results can be obtained through proper soil preparation, consisting of basic and annual fertilization.



Figure 2 Recultivation of fruit trees

#### 4.4. Forestry cultivation

Predominantly for the stabilization of the dump slopes, starting with 1990, acacia afforestations were made at the Garla and Rovinari Est quarries, as well as pine afforestations at the Tismana I quarry.

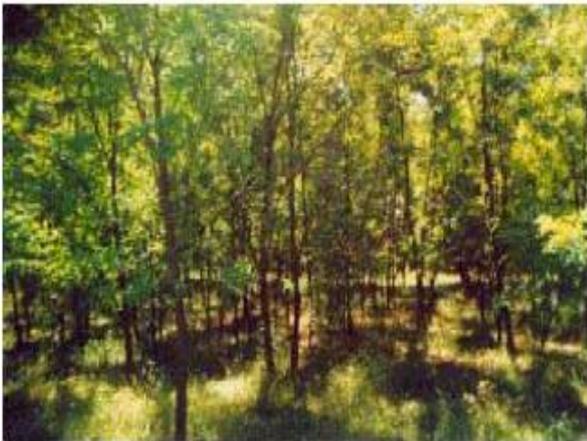


Figure 3 Forestry cultivation

#### CONCLUSION

Large installations for the production of electricity and heat represent a large and continuous source of pollution of the environment through ash particles and flue gases released into the atmosphere. They influence natural environmental factors air, water, soil, flora and fauna. That is why most of the regulations on environmental protection concern the energy sector and as a result they must be known and respected both by the designers of thermal energy equipment and by the personnel from the operation of thermal power plants.

Reducing ash deposits and sludge in steam boilers is an effective method of reducing fuel consumption in steam generators.

The ashes of the thermal power plant resulting from the burning of coal as well as the other noxious substances resulting from  $\text{NO}_x$ ,  $\text{SO}_2$  can be said to have the most harmful effects on human health, producing various diseases, as well as on the soil, buildings, environment. [6] Due to the pollution caused by these pollutants resulting from the burning of coal, we are currently trying to reduce pollution by adopting new technologies capable of minimizing their harmful effects.

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