SULPHUR REMOVAL IN COAL-FIRED POWER PLANTS. PART I: SULPHUR EMISSIONS ASSESMENT METHODOOGY

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ABSTRACT: Environmental regulation regarding electricity generation in coal-fired power plants have become increasingly more demanding both quantitatively and qualitatively. Implementation of sulphur removal systems has become a compulsory condition for continuation of operation. This paper presents the general considerations on sulphur emissions assessment and for various sulphur removal methods.

Key-Words: - power plant, lignite, emissions, sulphur oxides.

1.INTRODUCERE

In an increasingly globalized economy, a country's energy strategy is realized in the context of evolutions and changes taking place worldwide. At the moment there are two trends we have to deal with: increasing energy demand and minimizing environmental pollution [1].

For this reason, energy consumption must be monitored in correlation with the annual pollutant emissions recorded worldwide, with disastrous effects on the environment: air, water and soil pollution, global warming through greenhouse effects, acid rain, ozone depletion, climate change .

Most of the annual pollutant emissions into the atmosphere are due to fossil fuels used as a primary form of energy. For this reason, energy consumption must be monitored in correlation with the annual pollutant emissions recorded worldwide, with disastrous effects on the environment: air, water and soil pollution, global warming through greenhouse effects, acid rain, ozone depletion, climate change.

As thermal power plants and especially those operating with conventional fuels (lignite, brown coal, coal) have a significant share of sources of pollutants worldwide (dust, CO2, SO2, NOx, etc.) in the environment, it was considered it is normal to set emission limit values for the flue gases [2].

In this context, the responsibilities and measures to prevent and combat environmental pollution lie with all states and world public opinion.

Significant in this sense is the legislative framework created by the transposition of community regulations, which conditions the future operation of large combustion plants - IMA (with thermal power > 50 MW), belonging to thermal power plants [3].

2.OPERATIONAL METHODOLOGY FOR EVALUATION OF GASES AND DUST EMISSIONS

Most of the large thermal power plants in our country date back to the period when the dispersion of flue gases through high chimneys was considered as an efficient and sufficient means to protect the quality

of life and the environment. The height of the chimneys was calculated in such a way that the emissions of gases and dust did not exceed the regulations in force at that time [4].

The dispersion of pollutant emissions on large areas of land meant, in fact, the reduction of concentrations per unit area, not their quantitative reduction at the exit to the basket. The pollution phenomenon produced by thermal power plants was accentuated by the poor quality of coal, combustion equipment and flue gas purification equipment. In this way, for every kilowatt of electricity produced, the Romanian thermal power plants emitted in the atmosphere double quantities of flue gases loaded with carbon dioxide, nitrogen oxides and sulfur and various powders (heavy metals, flying ash, etc.).

Chimneys are the "high sources" of environmental pollution while the ash dumps are the "low sources". High sources release large amounts of gaseous pollutants, metal dust and fly ash into the atmosphere. Pollutants of this kind are dispersed over long distances, depending on the height of the chimney, the velocity of the gases at the exit of the chimney, the direction and intensity of air currents [5]. The major effect of low sources, represented by ash dumps, on the environment is the material deposited in such deposits, namely, ash. Both sources act together, their influence on the environment cumulating.

The emission of a thermal power plant chimney is not homogeneous but is composed of solid particles and gaseous components, and during the turbulent diffusion from the atmosphere, in the presence of humidity, the sedimentation processes will overlap with the reaction ones. Emissions from high sources are continuous and relatively uniform as opposed to those from low sources, which occur intermittently. These emissions, due to their complex character, cause the pollution of the surrounding atmosphere with flue gases and various particles [6].

The high height of the evacuation chimneys has as a consequence the dispersion of pollutants over long and even very long distances (20-25 km) from the thermal power plant, the pollution being in this case spatial. Spatial pollution, caused by flue gases, has the effect of increasing the concentration of CO_2 and SO_2 in the atmosphere [7]. Spatial pollution produced by coal-fired power plants can become cross-border pollution in the first instance. The immediate result of space pollution is the alteration of air quality and water properties. At ground level, the effects of this type of pollution are not immediate, as this component of the environment has the ability to store various pollutants and counteract their action. Also, the concentration of different pollutants can change over time, which can become higher due to accumulation or, conversely, lower when leaching is higher than the accumulation of various pollutants in the upper part of the soil [8].

The pollution produced by thermal power plants can be classified according to the manifestation of the polluting agents on the quality status of the soils. From this point of view, the pollution can be: physical or chemical. Physical pollution of soils consists in all those actions that determine the modification of one or more physical properties: granulometry, density, porosity, skeletal material content. Chemical pollution can cause: changes in the reaction of the substrate, the content of organic matter, trace elements, salts, etc.

Physical pollution generated by coal-fired power plants is the most serious form of soil

pollution, the effects of this type of pollution can be total or partial [9]. The total effect of physical pollution on soils materializes by destroying them with the construction of power plants and ash dumps. The soils related to the construction of dumps are permanently lost for the society, the removal of the lands from the agricultural circuit coming in total contradiction with the sustainable development of the economy of each country. Of course, in the current economic stage, the construction of ash dumps is a necessary evil and therefore, for them, will be destined only those land areas unsuitable for agricultural production. The partial effects consist in the transformation of the natural soil cover into anthropogenic protosols. Such soils occur inside thermal power plants and around ash dumps.

Another form of physical pollution is the modification of the textural composition of soils loaded with ash particles. Also, inside many thermal power plants, the land is unjustifiably occupied by large quantities of materials that can be used. Physical pollution has a smaller range than chemical pollution, but its effects are much larger and more immediate.

Soil chemical pollution is caused by both high and low sources. Thus, emissions from high sources can cause soils to acidify and load them with heavy metals and ash. Low sources, due to infiltrations through the foundation of the dumps and through their side walls, can cause alkalization and wilting of the surrounding soils [10]. Consequently, the two sources have an antagonistic action on the reaction of the soils, while the high sources cause the decrease of the reaction, the low ones determine the increase of this characteristic. The action of thermal power plants can also be classified from the point of view of the impact produced by pollutants on the different compartments of the environment. From this point of view, the impact that coal-fired power plants have can be: aesthetic impact, climate impact, impact on groundwater and surface water, impact on soil, vegetation, human health.

The identification and evaluation of the potential impact (positive or negative), due to thermal power plants operating on fossil fuels, on biotic and abiotic environmental factors, as well as human communities, is done by measuring and determining emissions of dust and gaseous pollutants.

In general, the measurement of noxious emissions is complementary to the determination of functional parameters, being an indicator of the correctness in the operation of combustion plants [11].

The measurement techniques (investigation) can be continuous, respectively discontinuous depending on the purpose of the measurements. In the case of continuous measurements, the time dependence of the measured values is recorded. For discontinuous measurements, average values are determined, representative of the time interval in which the measurement was performed.

The measurement methods were materialized by designing and building a wide range of devices, which are made in series production in industrialized countries, such as Germany, USA, France, Japan, etc. in direct correlation with the rigor imposed by law, regarding the maximum allowed level of emissions, on the one hand, respectively with the stage of development of clean (clean) combustion technologies and flue gas cleaning, on the other hand [1].

At a complex combustion plant, the measuring devices are chosen for the concentrations of the noxious substances to

be investigated. Continuous monitoring of flue gas pollutants from solid fuel power plants is necessary to maintain control over those emission regimes.

In order to continuously investigate the level of emissions, modern power plants are equipped with the most advanced measuring devices, and the data collected are processed in order to prepare the "daily and annual emissions log".

The half - hourly, daily average and monthly average emission values are recorded in the data logs [11]. Any large combustion plant must have a unit for measuring and recording emissions, which is under the direct control of the bodies which supervise the protection of the environment.

3.CONCLUSIONS

Desulfurization is a necessity imposed by international regulations in all large combustion plants. Regardless of the type of desulphurization method and installation, a first stage in its implementation is the evaluation of the current level of emissions. Depending on this parameter, the most suitable desulphurization method is chosen (pre-combustion, during combustion or post-combustion). The choice of desulphurization method also takes into account technical and economic considerations, such as the cost of fuel and the operating regime of the thermal power plant.

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