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Measurements of Emission of Gases SO_2, NO_x, CO and CO_2 from the Burning Process in the Furnaces of Power Plant "Kosova B"

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Abstract The main source of the release of acidifying substances in the environment is the emission of gases that contain dioxide sulphur (SO_2), nitrogen oxides (NO_x), ammonia (NH_3) and others. These gases are produced during the combustion of combustibles in the sector of the production of electricity, in chemical industry, in metallurgy. The emission, quantity and characteristics of smoke gases emitted after combustion in the furnaces of the Power Plant, depend on the composition of sulphur in lignite itself, whereas the concentration of SO_2 is related to the composition of sulphur in lignite to be burned. Whereas related to nitrogen oxides NO_x, it greatly depends on the technological process of combustion in furnace. After the combustion process in the furnace of Power Plant "Kosova B" the emitted smoke gases will contain CO_2 as a product of combustion, which is one of the main causers of the global warming of our planet. The purpose of these measurements is to set the emission of these toxic gases SO_2, NO_x, in gas channels in the Power Plant "Kosova B", and CO2.

***Key words**: gases, pollution, emission, combustion*

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Introduction

In this study were presented the results of measurements of gases O_2, CO, CO_2, NO, NO_2, SO_2, NO_x and H_2 after the measures of gas channels in power plant "Kosova B".

Around 97% of the electric energy generated in Kosovo is obtained from the combustion of lignite in the power plants A and B, whereas only 3% of annual production comes from water flows *(Agolli, 1983)***.** Kosovo Energy Corporation is a large polluter of environment, especially in the wide region of Prishtina. The pollution is caused by ash particles and emitted gases such as carbon monoxide (CO), sulfur dioxide (SO_2), nitric gases (NO_X).

In the narrow meaning of word, air may be considered polluted when it contains substances which are foreign for its natural composition. However, today in this state of global pollution it is almost impossible to discuss about such ideal air (especially in areas populated by humans), therefore air will be considered polluted if it contains substances that are concentrated to the extent of causing damages to the health of humans and their living environment *(Rozhaja, Jablanovič, 1984)*.

The purpose of this study is to determine the level of gas emission in the gas channels of power plant "Kosova B" before they are emitted in the atmosphere, in particular gases that cause acid rain.

Therefore, the main purpose of this study is to determine the concentration of gases such as SO_2 and NO_X and measures to be taken in accordance with scientific achievements for the prevention of environment pollution by these gases.

Materials and Methods

The measurement of concentration of these gases was done in the operating unit of power plant "Kosova B_1". The measurement instrument testo 350-XL Abgas-Anlyesgerät Flye Gas is German made. The methodology for the gas measurement with Testo 350-XL Abgas-Anlyesgerät Flye Gas Analyzer (O_2, CO, CO_2, NO, NO_2, SO_2, NO_X, H_2, ^0C) is simple. The German instrument testo 350-XL Abgas consists of sensors and analyzers of respective gases. The gas probe absorbs the gases from the place designed for taking gas samples in channels. The assembled pump absorbs the gases from the gas channel and transmits them to the sensors and analyzers mounted in Testo 350-XL instrument. After the time necessary for the instrument to provide the results, the measurement results will be displayed in the monitor with the possibility of printing them in paper. Testo 350-XL Abgas instrument will signalize (with a red lamp) that the measurement is complete and it will be ready for showing the concentration of gases in channel and the temperature of gases.

The measurements of emitted gases were made in six locations in the two gas channels where probes are placed. The placement of probe for the absorption of gases was done before and after the air heaters and before the absorbing ventilators. There are two parallel lines in power plant "Kosova B" that are symmetrical. The results of measurements made on 11.06.2008 are presented in Table 1 whereas the repeated measurements made on 12.06.2008 are presented in Table 2.

The performances of operating units of B_1 of power plant "Kosova B" during the time of measurements are presented in table 3.

Figure 1. Instrument for measurements of emissions of gases

Table 1. Results of measurements in gas channels 11.06.2008, 11:15

Parameters Gases	Unit	Before air heater 1	Before air heater 2	After air heater 1	After air heater 2	Before absorbing ventilator 1	Before absorbing ventilator 2
O_2	%	5.3	5.47	6.55	6.27	8.47	8.2
CO	ppm	73	70	69	75	58	66
CO_2	%vol	13.7	13.7	12.68	12.2	11.12	13.35
NO	ppm	393	487	353	350	321	321
NO_2	ppm	0.1	1.2	12.3	14	8.6	7.3
SO_2	ppm	0.00	0.00	2	11	0.00	1
NO_X	ppm	471	363	374	362	329	326
H_2	ppm	32	31	28	27	24	25
Temp	^{0}C	327	327	199	201	166	174

Table 2. Results of measurements in gas channels 12.06.2008, 11:30

Parameters Gases	Unit	Before air heater 1	Before air heater 2	After air heater 1	After air heater 2	Before absorbing ventilator 1	Before absorbing ventilator 2
O_2	%	5.91	6.18	6.23	6.71	8.55	8.92
CO	Ppm	78	69	72	76	57	71
CO_2	%Vol	14.6	14.3	13.15	13.51	12.70	14.15
NO	ppm	421	497	531	541	421	423
NO_2	ppm	0.4	1.5	11.7	16	8.5	7.7
SO_2	ppm	0.00	0.00	3.25	11	0.00	2
NO_x	ppm	375	355	379	362	337	333
H_2	ppm	33	32	28	27	24	25
Temp.	^{0}C	327	327	199	201	166	174

Table 3. Main parameters of Unit B1 during the measurements

Date	11-06-08	12-06-08	Average value
Time h	11^{30}	11^{15}	
Power MW	289	285	287.2
Ash %	14.7	15.2	15.62
Cal. Value J/kg	7943	8321	8002.6
Q_{coal} t/h	366	368	365
Q_{ash} t/h	53.8	55.93	56.98
Q_{gas} Nm3/h	1380 10^3	1368 10^3	1381 10^3

Discussion and Conclusion

Based on the obtained results presented in tabular form we can conclude that SO_2 has a lower concentration than expected in channel 2 after the air heater 2. SO_2 is 11 ppm and after heater 1 we found the value 2 ppm, whereas in other measured channels the instrument recorded the value 0.00.

Whereas in the repeated measurement the values did not change significantly as it can be seen in table 2. After the measurements and analysis of measurement results and after obtaining these values of SO_2, we consulted the literature and came to the conclusion that in the fireplace of the furnace occurred the phenomenon of natural removal of sulphur. The natural desulfurization because the lignite used as combustible in the furnace contains high composition of $CaCO_3$ and $MgCO_3$. In the fireplace there will be a quick reaction between CaO, SO_2 and O_2 thus producing $CaSO_4$. This reaction occurs at the temperature above 750^{0}C. Under this temperature the reaction practically ceases and as a result the natural desulfurization does not take place (Gill, 1984).

This fact that is very favourable for power plant "Kosova B" is explained with the high presence of CaO in fly ash (-35%), which is a crucial factor in the so-called desulfurization process. The values obtained after the measurements in the gas channels for NO, NO_2 and NO_X are presented in table 1, whereas the repeated measurements in table 2. The obtained value of 487 ppm is the highest value

obtained in the gas channel before the air heater 1, whereas the lowest value is 321 ppm obtained in both sides of the channels before the absorbing ventilator.

These values do not exceed the maximal concentration permitted (MCP) which is NO_X mg/Nm^3 dry 6% O2 of 500 mg/Nm^3. For NO_2 the instrument recorded a value from 1.2 to 12.3 ppm. whereas for the value of NO_X the instrument testo 350-XL Abgas does not record the values that exceed the MCP of 500 mg/Nm^3, since this values varies from 471 to 326 ppm. For CO the testo 350-XL Abgas instrument used for the measurement, recorded the value from 75 to 68 ppm. whereas for O2 5.47% before the air heater, which is lower than it should be (6%), whereas after the air heaters reaches the value of 8.2% which shows the passage of fresh air in the fitting of air heater and this amount reaches up to approximately 100.000 Nm^3/h. Testo 350-XL Abgas-Analysegerat Flye Gas instrument also measures H_2 where the obtained value of H_2 was 32 ppm before the air heater which gradually decreased to 24 ppm before the absorbing ventilator. In the repeated measurements the values were approximately the same.

In line 2 before the heater the instrument showed a value from 11 ppm for SO_2 whereas before the heater shows the value 0.00. This phenomenon occurred because of the presence of a gas channel connected to the absorbing ventilator which serves to form the sub pressure in the ash system where the concentration of SO_2 is supposed to originate from the ash process.

The main measures for the minimization of the emission of NO_X are the reduction of combustion temperature and reduction of the percentage of excessive air in the furnace (Gjurgjeala, 2007).

The emission of NO_X is caused by the projection of air combustion system and by optimizing the operation parameters.

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