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DECREASING THE SO_2 EMISSION FROM POWER PLANTS BY APPLICATION OF MODIFIED TECHNOLOGICAL PROCESSES OF FUEL COMBUSTION

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ABSTRACT

Since the energy is a basic condition of civilized life and economy development, many more attention must be dedicated to the impact of its production onto life environment. Power plants, used for production of technological steam, electric and thermal energy, represent today dominant sources of pollutants emission in the atmosphere.

In this work analysed is the possibility of decreasing the SO_2 emission, as well as other pollutants from power plants, by the application of modified technological processes of fuel combustion (the substitution of coals with high sulphur content, gas combustion, the combustion bed modification and application of other technological measures). By applying cited measures, it is possible importantly decrease SO_2 and dust emission. SO_2 emission can be decreased under permitted value limits and therefore the removing of sulphur from waste chimney gases, by use of certain technologies, is not necessary.

Key words: energy, fuel, fuel combustion, substitution of fuel, decreasing the SO_2 and dust emission

1. INTRODUCTION

Justified need for electric and heat energy encounters severe directives and standards of emission limits and of life environment protection. Therefore the suitable technical – technological measures must be found and applied to decrease the emission into atmosphere. Today accessible are information about various technologies of coal combustion. Sulphur content of the Central Bosnia coals is extremely high and it represents main cause of high SO_2 emission. Therefore the application of primary technological proceedings and measures (without the installation of technical systems for cleaning waste chimney gases), besides finding for the environment appropriate alternative energy sources, represents most acceptable solution for decreasing the SO_2 emission from economical, technological and ecological standpoint [1,2].

In this work analysed is the possibility of decreasing the SO_2 emission, as well as other pollutants from power plants, by the application of modified technological processes of fuel combustion (the substitution of coals with high sulphur content, gas burning, the combustion bed modification and application of other technological measures). By applying cited measures, it is possible importantly decrease SO_2 and dust emission. SO_2 emission can be decreased under permitted value limits and therefore the removing of sulphur from waste chimney gases, by use of certain technologies, is not necessary.

2. CONTROL AND RECOMMENDATIONS FOR REDUCING THE POLLUTANT EMISSIONS INTO THE ATMOSPHERE NEAR THE COAL COMBUSTION BED

It is known that coal combustion beds utmost contribute to the pollutants emission in the air, if the precautions are not applied for the emission reduction of gas pollutant (SO_x, NO_x, and so on) and of the dust.

In the case of coal dust combustion and addition of gas (coke-oven, blast furnace or other gaseous fuel) in the combustion bed, cited is application of double – block burner where foreseen is multi-step combusting, with high degree combustion of fuel and low pollutant emission. The construction of burner enables dosing of coal dust helped by the air current and optimal spreading in the combustion bed, as well as dosing the mixture of gas and air, along with an intensive curling in the combustion bed.

The combustion concept of coals with increased content of sulphur and nitrogen should consider corresponding recommendations for decreasing the emission of gaseous pollutants: SO_x and NO_x into the atmosphere. Most acceptable solutions for decreasing emission of primary gaseous pollutants are optimizing the technological process and the fuel the fuel combustion system. For simultaneous decreasing of SO_x and NO_x emission applied are so called primary measures, as the proceedings in combustion bed along with addition of additives for the process of hot desulphuration. At the same time modification and reconstruction of combustion bed are being effectuated to reduce emission of SO_x and NO_x [3].

Direct desulphuration with addition of additives in the form of fine dust into the flame is a frequent method and, combined with system modification, by it achieved is a simultaneous decrease of SO_x and NO_x emission. As an additive most often used is calcium carbonate ($CaCO_3$) and calcium hydroxide ($Ca(OH)_2$). The temperature level in combustion bed enables the process of calcinations or alternatively of dehydrating of additive particles, by which the particles of basic oxide CaO arise. Gaseous components SO_2 and SO_3 have an affinity to bind with CaO in a temperature range from 800^o to 1100 ^{o}C, what was confirmed by the results of numerous researches.

Processing and improvement of coals, before being used in combustion beds, have a particular importance for the aspect of decreasing the moisture quantity, ash and sulphur, if available are corresponding technologies. The elaborations of new technologies of coal gasification and liquation are realised in developed industrial countries of the world.

3. SO_2 EMISSION FROM THERMO-ENERGETIC FACILITIES OF IRONWORK ZENICA

It is possible in the integral ironworks to apply the option of coal substitution with gaseous fuels (coke – oven and blast furnace gas). Previewed is that the coke – oven gas be desulphurised (extraction of H_2S). The pollutants emission control measurement has been performed at one power plant in Ironwork Zenica in the year 2006 and the results are shown in table 1.

Table 1. Measurement of pollutant emission

Pollutant / O_2	Measurement unit	Measurement number			Measurement number		
		1	2	3	1	2	3
	%	8,97	8,89	8,86	9,24	9,32	9,25
CO	ppm	20	24	23	20	22	20
	mg/Nm^3	25	30	29	25	28	25
NOx	ppm	137	136	141	136	129	136
	mg/Nm^3	281	279	289	279	264	279
SO_2	ppm	1355	1366	1372	1357	1328	1316
	mg/Nm^3	3871	3903	3920	3877	3794	3760
Particles	mg/Nm^3	92			92		

Measured values of CO, NO_x and SO_2 were re-calculated to 6 %O_2 and the results are shown in table 2.

Table 2. Values of CO, NO_x, SO_2 emissions re-calculated to 6 % O_2.

Pollutant / Recalculation factor	Measurement unit	Measurement number			Measurement number			Boundary limits of emission according to Regulation of the B&H Federation	Boundary limits according to IPPC
		1	2	3	1	2	3		
		1,247	1,239	1,236	1,276	1,284	1,277		
CO	ppm	25	30	28	26	28	26	120	40 – 120
	mg/Nm^3	31	37	36	32	35	32	150	50 – 150
NOx	ppm	171	168	174	173	166	174	320	50 - 100
	mg/Nm^3	350	345	357	356	340	356	650	100 – 200
SO_2	ppm	1.690	1.692	1695	1.731	1.705	1.680	421	35 - 90
	mg/Nm^3	4.827	4.834	4843	4.945	4.873	4.800	1200	100 -250
Particles	mg/Nm^3	92			92			50	5 - 25

Based on obtained results it can be concluded that SO_2 emissions importantly overcome permitted boundary limit prescribed by the Regulation on Boundary Limits of Emission into the Air from Facilities for Combustion [4] and IPPC EU Directive [5]. Because of that effectuated was the reconstruction of boiler facilities aiming to assure the conditions of using the gaseous fuels, to achieve a decrease of SO_2 emission under permitted boundary limits. At the same time performed was the automatic regulation of boiler work, so that automatic leading the electric and heat energy production process is enabled by the means of a computer. Main parameter, by which the technological process is leaded, is O_2 content in chimney gas. By effectuated reconstruction assured are the conditions for maximal substitution of coal by gaseous fuels, which results with decreased SO_2 and other pollutants emission. SO_2 emission is decreased under permitted boundary values.
In table 3. given are the data of expected SO_2 emissions after effectuation of foreseen technological measures for decreasing the emission (substitution of coal by gaseous fuel, injection of lime powder, modification of combustion bed etc.).

Table 3. Expected SO_2 emission after implementation of foreseen measures for decreasing the emission

No	Parameter	Unit	Total
1.	**Basic state (without planned measures)**		
1.1.	Total production of SO_2	t	6.423,45
1.2.	Production of SO_2 per unit	t/h	0,7434
1.3.	SO_2 Emission (with 10% bind into the ash)	mg/Nm^3	2.638,69
2.	State according to realised foreseen measures		
2.1.	*Decreasing the coal consumption in winter period from 22 to 15 t/h:*	t/h	8,5
	- SO_2 total production	t	40.507,72
	- Production of SO_2 per unit	t/h	0,52
	- SO_2 Emission	mg/Nm^3	1.890,14
2.2.	*Lime powder injection* - Emission of SO_2 supposed is decreasing of 10 %	mg/Nm^3	189,04
	- Emission of SO_2 after injecting the lime powder	mg/Nm^3	1.701,12
2.3.	*Substitution of coal by earth gas in winter period up to maximum of coal consumption 10 t/h:*		
	- Coal consumption	t/h	7
	- Total SO_2 emission	mg/Nm^3	1.469,24

2.4.	*Desulphuration of coke oven gas*		
	- State without coke-oven gas desulphuration (with previous measures)	mg/Nm^3	1.469,24
	- SO_2 from coke-oven gas	t	807,44
	- SO_2 from coke-oven gas	mg/Nm^3	331,70
	- SO_2 emission after desulphuration of coke-oven gas	mg/Nm^3	1.137,54
2.5.	Further substitution of coal consumption by earth gas in winter period	Coal consumption to be reduced to 5 t/h and earth gas consumption to be increased from 2000 to 4000 m^3/h	

4. CONCLUSION

Based on obtained results, it can be concluded that by implementation of technical – technological measures (reconstruction and modification of combustion bed, substitution of coal by gaseous fuel, injection of lime powder etc.) the emission of SO_2 into the atmosphere is importantly decreased, without using technical systems for desulphuration of waste chimney gases. SO_2 emission is decreased under permitted boundary limits (<1200 mg/Nm^3).

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