STUDY ON FLUE GAS DESULFURIZATION IN 330 MW POWER UNITS

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ABSTRACT. This paper presents a case study on the operation of the flue gas desulfurization plant at the 330 MW power plants of the Oltenia Energy Complex. The efficiency of the wet flue gas desulfurization plant at the 1035 t/h steam boiler, which operates with lignite from the Oltenia Mining Basin, is analyzed.

KEY WORDS. SO2, limestone, gypsum, specific heat, flue gas analyzer.

1. INTRODUCTION

Technological process of flue gas desulfurization.

The boilers of the 330 MW power plants of the Oltenia Energy Complex operate with lignite, originating from surface mining operations in Gorj County. The combustion of coal results in polluting substances (sulfur oxides, nitrogen oxides, carbon oxides, ash) that have harmful effects on the environment and human health. In order to comply with environmental protection regulations, the 330 MW power plants were equipped with modern flue gas decontamination technologies. In order to comply with the maximum limit for SO2 emissions of 200 mg/Nm3 of exhaust gases, wet flue gas desulfurization technology is used.

The flue gases are taken from the boiler flue gas fans discharge through a channel that bypasses the chimney and introduced into the absorber with two auxiliary fans necessary to compensate for the additional pressure loss introduced by the new gas and absorber channels. For certain special operating situations there is the possibility of directing the flue gases directly to the boiler chimney and bypassing the desulphurisation plant.

The limestone used to reduce the SO2 content from 4000-6000 mg/Nm3 to below 200 mg/Nm3 is unloaded, stored and prepared by crushing in the limestone farm. Then, before being introduced into the absorber, it is ground in ball mills, mixed with water, passed through a hydrocyclone and stored in tanks as a solution. The lime solution washes the flue gases in countercurrent and is recirculated to the absorber by means of recirculation pumps, from the desulfurization process resulting in gypsum. The gypsum solution is discharged from the absorber with a gypsum concentration of 16%, passes through a hydrocyclone after which the gypsum concentration becomes 55% and then, depending on the density and pH values, is recirculated to the absorber via a recirculation tank or is discharged either directly to the gypsum dryer or to the Bagger pump station after being stored in transfer tanks. After the dryer, the gypsum with a moisture content of 10% is stored in the gypsum storage. To carry out the desulfurization process, oxidation with atmospheric oxygen supplied by blowers and process water supplied by the treatment plant is required. The limestone and gypsum storage are common to the four boilers. There is one absorber and two auxiliary flue gas fans for each boiler. One mill can supply limestone for two absorbers, with one limestone solution tank for each absorber. All four tanks are connected by a level equalization pipe.

2. EXPERIMENTAL RESULTS

Figure no. 1 shows the diagram of the wet desulfurization installation of energy group no. 5 at the Rovinari thermal power plant.

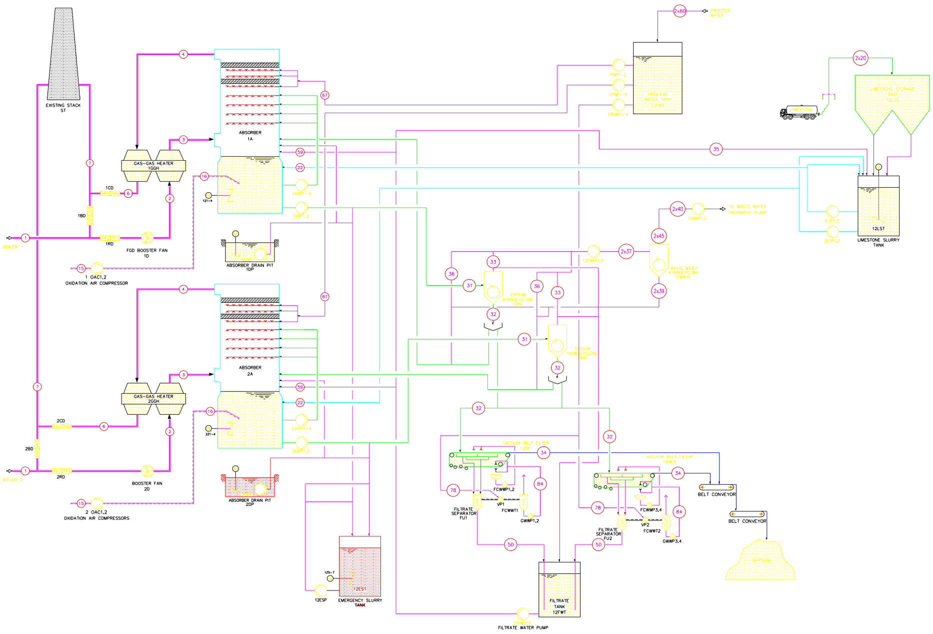

Figure 1 Scheme of the wet flue gas desulfurization plant

For the experimental measurements, the following were used:
-flue gas analyzers type TESTO 340, with 4 sensors: O2, CO, NO, SO2, compact sampling probe of 180 mm, Tmax 500 0 C, ambient temperature sensor, differential pressure sensors;
-Panametrics ultrasonic flowmeter;
-digital thermometers, accuracy class 0.5;
-chromel-alumel thermocouples of different lengths;
-Pitot tube;
-infrared thermometer;
Measurement points used:
-flue gas inlet desulphurization plant:
- flow rate (dynamic pressure);
- temperature;
- static pressure;
- analysis: O2, CO2, CO, SO2, NOx;
- humidity;
-flue gas outlet desulphurization plant:
- flow rate (dynamic pressure);
- temperature;
- static pressure;
- analysis: O2, CO2, CO, SO2, NOx;
- humidity;
- oxidation air suction blower:
- temperature;
- barometric pressure;
- humidity;
- gypsum:
- temperature;
- flow rate;
- process water:
- flow rate;
- temperature;
- limestone:

- temperature

The results of the measurements carried out for the steam boiler of the power group no. 5, with a power of 330 MW, table no. 1.

The results of the measurements carried out for the desulfurization plant are presented in table no. 2.

Table no.1 Steam boiler parameters

Nr. crt.	Name	U.M.	Measured values
1.	Live steam flow	t/h	934,9
2.	Injection water flow into intermediate steam	t/h	11,37
3.	Average live steam pressure	bar	184,8
4.	Average cold intermediate steam pressure	bar	49,2
5.	Average hot intermediate steam pressure	bar	41,7
6.	Feed water pressure	bar	254,3
7.	Average live steam temperature	°C	537,1
8.	Feed water temperature	°C	259,4
9.	Average cold intermediate steam temp.	°C	345,6
10.	Average hot intermediate steam temp.	°C	530,9
11.	Lower calorific value of coal	kcal/kg	1989
12.	Coal elemental analysis - C^i - H^i - S - O^i	% % % %	22,78 2,12 1,05 9,25
13.	Coal elemental analysis - Wt^i - N^i - A^i	% % %	0,62 40,82 22,64
14.	Gaseous fuel flow	Nmc/h	0

Table no.2 Desulfurization plant parameters

Nr. Crt.	Name	U.M.	Measured values
Oxidation air			
1.	Ambient air temperature	°C	23,8
2.	Ambient air relative humidity	%	42,4
3.	Barometric pressure	mbar	996,0
Flue gas entering the system			
4.	Flue gas analysis at the desulfurization plant inlet : - O_{2i} - CO2i - CO_i - SO_{2i} (la 6% O_2) - NO_{xi} (la 6% O_2,)	% % % mg/Nm^3 mg/Nm^3	10,02 11,35 0,0031 5783 148 508

5.	Flue gas temperature at system inlet	°C	154,2
6.	Volume humidity at system inlet	%	17,32
7.	Static relative flue gas pressure at system inlet	mbar	-2,81
8.	Dynamic flue gas pressure at system inlet	mmH_2O	-
Gaze de ardere ieşire instalaţie			
9.	Analysis of flue gas at the desulfurization plant outlet: - O_{2e} - CO2e - COe - SO_{2e} (la 6% O_2, uscat) - NO_{xe} (la 6% O_2, uscat)	 % % % mg/Nm^3 mg/Nm	10,02 11,24 0,0027 145,6 514
10.	Flue gas temperature at system outlet	°C	65,8
11.	Volumetric humidity at system outlet	%	23,2
12.	Relative static pressure at system outlet	mbar	-7,7
13.	Dynamic pressure at system outlet	mmH_2O	-
Process water			
14.	Process water flow line 34	m^3/h	73,6
15.	Process water flow line 56	m^3/h	65,1
16.	Process water temperature	°C	34,2
Lime solution			
17.	Variation start-end tank level 3	mm	0
18.	Variation start-end tank level	mm	0,02
19.	Variation start-end tank level 5	mm	0,0033
20.	Variation start-end tank level 6	mm	0,0041
Gypsum solution			
21.	pH of solution in absorber	__-	5,61
22.	Density of gypsum solution	Kg/l	1,1086
23.	End-beginning variation of transfer reservoir level 2	mm	0,334
24.	End-beginning variation of transfer reservoir level 3	mm	0,891
25.	Temperature of gypsum solution in transfer reservoir	°C	66,4
Gypsum			
26.	Gypsum temperature discharged from the dryer	°C	33
27.	Volume of gypsum discharged (according to the geometry of the deposit made during the measurements)	m^3	12,8

3. CONCLUSIONS

The role of the desulphurisation plant is not an energy one (energy production, drying, melting, etc., which would involve fuel consumption or recovery of a quantity of heat). Its role is to reduce the amount of sulphur dioxide in the flue gases so that the emission falls within the legal limits. The only identifiable causes of the high consumption of process water would be the physical and chemical processes taking place in the absorber or the existence of an undetectable loss of water in the channel. From the analysis of the operation and in other periods of time it appears that this high water consumption was not caused by an abnormal operation, existing at the time of the test, but is a permanent characteristic of the desulphurisation plant of block no. 5. Regarding the limestone consumption, taking into account the flue gas flow rate, the SO2 concentration at the inlet and the limestone consumption, a specific limestone consumption of 1.6487 kgCaCO3/kgSO2 results.

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