MODERN TECHNOLOGIES TO REDUCE SULPHUR OXIDE EMISSIONS

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ABSTRACT. This paper presents modern technologies to reduce pollutant emissions of sulfur oxides, which can be applied to energy groups operating on fossil fuels. The experimental measurements were carried out for the 330 MW energy groups at the Turceni thermal power plant.

KEY WORDS. Desulfurization, limestone, sulfur oxides, absorber.

1. INTRODUCTION

Currently, in the energy systems of the European Union states, measures are being taken to reduce pollution due to the production of electricity by burning fossil fuels. Until the use of coal for electricity production is abandoned, energy groups will use technologies to reduce polluting emissions. To reduce sulphur oxide emissions to 330 MW energy groups, wet flue gas desulphurisation technology is used. The system for reducing SO2 from flue gases within the limits provided by the norms, related to an energy block, consists of three main parts:

- limestone household
- absorption plant
- gypsum household

The limestone required for the desulphurisation process is transported by car, weighed and unloaded at an unloading station.

The unloading station is equipped with 4 picking hoppers with a capacity of 52 m3, under which 2 belt conveyors will be placed – one in operation and the other in reserve.

Through these conveyors, the limestone first crushed in the quarry and brought to the plant at a grain size of 75 – 170mm, will be taken to a closed warehouse, with a storage capacity of 12 days.

The limestone has dimensions between 0 – 30 mm after crushing. The flue gases from the combustion of lignite in the boiler will be purified in a tower-type absorber by counter-washing with limestone solution with a mass concentration of 30%. The flue gases from the combustion of lignite in the boiler will be purified in a tower-type absorber by counter-washing with limestone solution with a mass concentration of 30%.

Figure The Turceni thermal power plant.

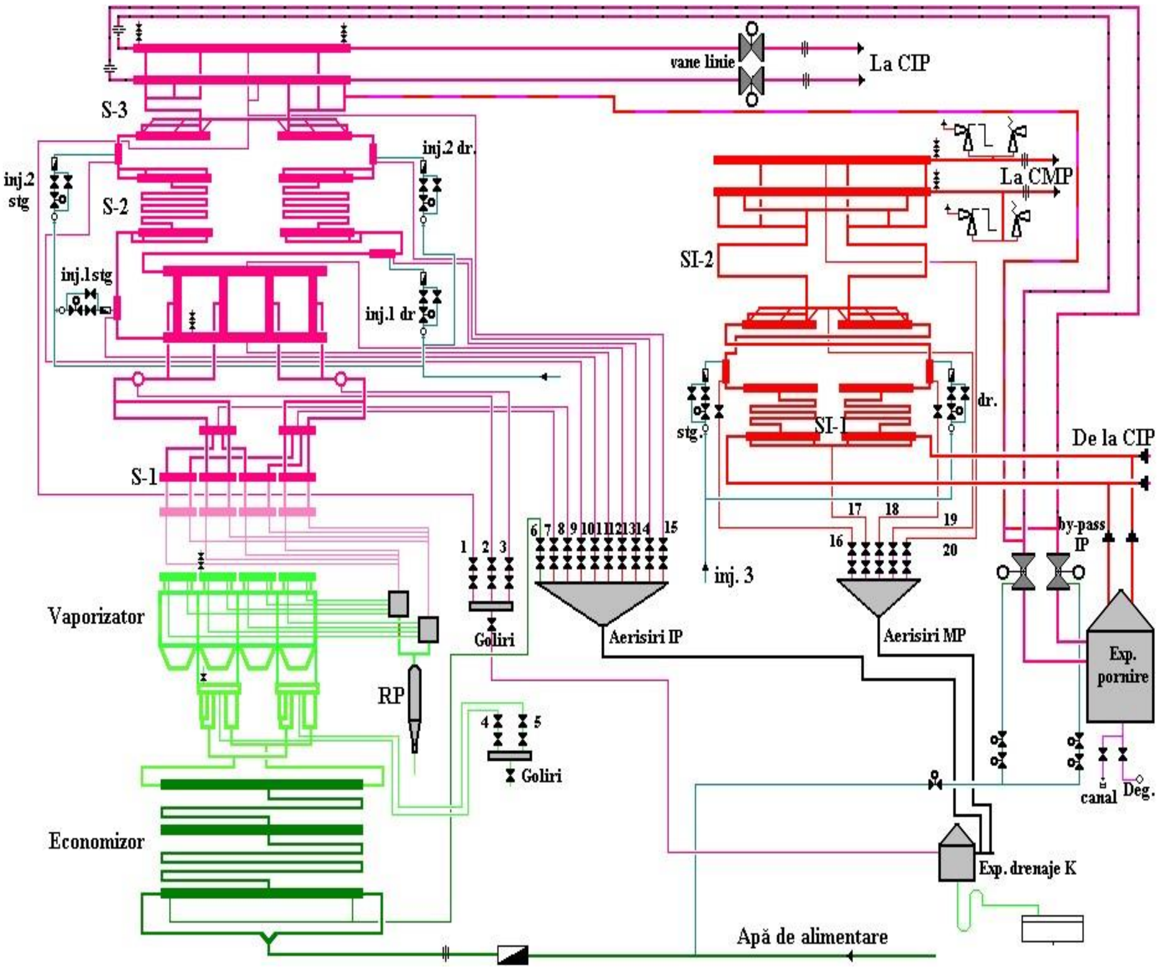

Figure 2. Thermal scheme of the 1035 t/h steam boiler

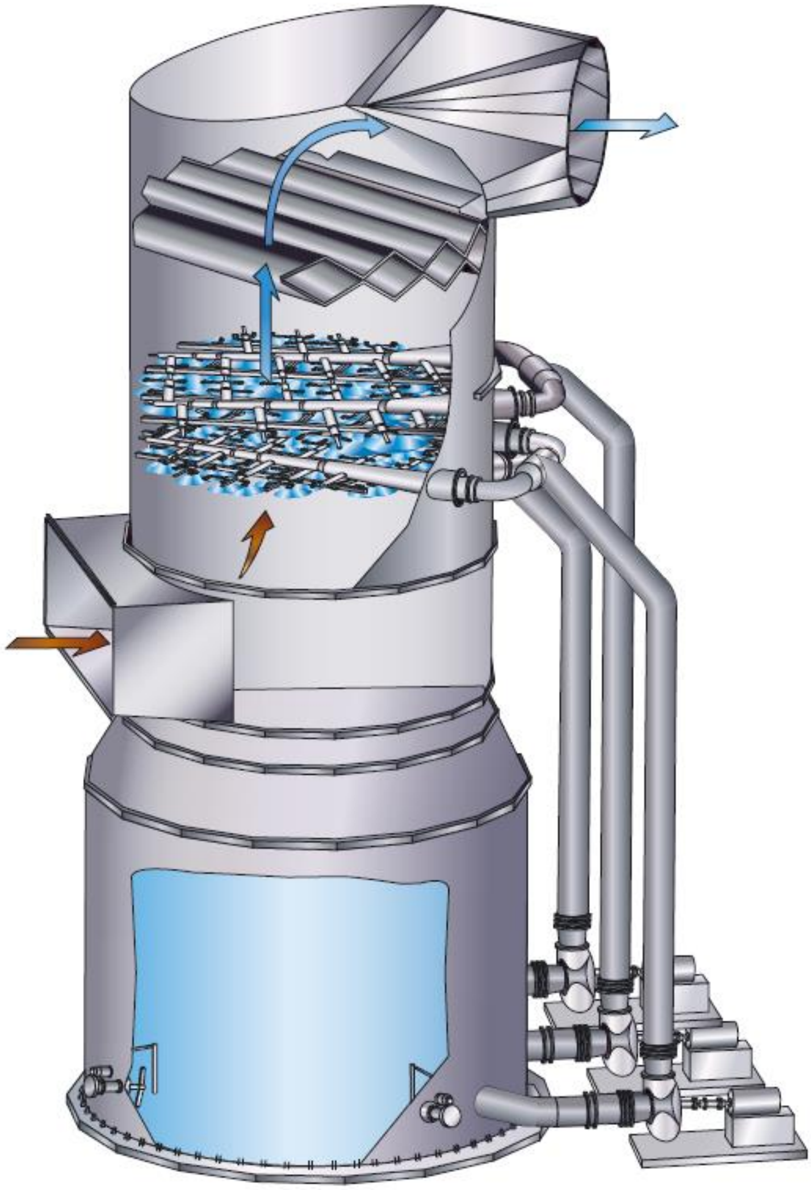

Figure 3. Spray Tower Absorber

Table no.1

Nr crt	Size	Symbol	U.M.	Values
ENTRIES				
1	Heat Flue Gas Inlet Desulfurization Plant	$Q_{ga\ i}$	kJ/h	1.082.402.641
2	Heat introduced with oxidation air	$Q_{aer\ ox}$	kJ/h	701.132
3	Heat entered with process water	$Q_{apa\ i}$	kJ/h	18.589.115

4	Heat entered with limescale and water from limescale solution	$Q_{sol\ c}$	kJ/h	205.972
5	Amount of mechanical powers of pumps and blowers in operation	$\sum P_m$	kJ/h	8.681.146
TOTAL ENTRIES			kJ/h	1.110.580.006
IEŞIRI				
8	Heat flue gas outlet desulfurization plant	$Q_{ga\ e}$	kJ/h	1.119.402.370
9	Heat accumulated in transfer tanks	$Q_{sol\ g}$	kJ/h	901.224
10	Heat embedded in the gypsum discharged to the landfill	Q_{gips}	kJ/h	317.074
TOTAL OUTINGS			kJ/h	1.120.320.668
Balance sheet non-closing (difference between inputs and outputs)		ΔQ	kJ/h	-37.918.027
			%	-3,29

Figure 1 shows the Turceni thermal power plant. Figure 2 shows the thermal diagram of the steam boiler of 1035 t/h. Figure 3 shows the spray tower absorber. Table no.1 presents the results of the calculation of the thermo-energy balance of the desulphurization plant.

2. EXPERIMENTAL RESULTS

Heat flue gas at inlet

$Q_{ga\ i} = V_{gu\ i} + I_{gau\ i} + V_{H2O\ i} / v_{H2O} \times i_{H2O\ i}$ (kj/h)

Heat air oxidation

$Q_{aer\ ox} = D_{aer\ ox} \times I_{1+x}$ (kj/kg)

Process water heat entering the plant

$Q_{apa\ i} = V_{apa} \times \rho_{apa\ i} \times c_{apa} \times t_{apa\ i}$ (kj/kg)

Exhaust gas heat at the outlet

$Q_{ga\ e} = V_{ga\ e} \times I_{gau\ e} + V_{H2Oe} / v_{H2O} \times i_{H2O}$ (kj/kg)

Heat gypsum formed and discharged to the warehouse

$Q_{gips}=1/100\times((100-u_{gips})\times V_{gips}\times\rho_{gips}\times c_{gips}+u_{gips}\times V_{gips}\times\rho_{apagips}\times c_{apa})\times t_{gips}$ (kj/kg)

Limescale heat solution

$Q_{sol\ c}=1/100\times(x_{calcar}\times V_{sol\ c}\times\rho_{calcar}\times c_{CaCo}{}^{3}+(100-x_{calcar})\times V_{solc}\times p_{apasol}\times c_{apa})\times t_{solc}$ (kj/kg)

3. CONCLUSIONS

From a thermoenergetic point of view, we can emphasize the fact that, within the balance sheet, the heat contained in the combustion gases entering / and leaving the installation is predominant. The other quantities of heat are much smaller, almost negligible compared to that of the flue gases.

The efficiency of the desulphurization plants is above the project value of 96%.

The process water consumption exceeds the guaranteed value of 130 t/h.

The limestone consumption is below the guaranteed value of 12.7 t/h; for an inlet SO2 flow rate of about 8000 kg/h, the limestone consumption is 12,1 – 1,.4 t/h.

The SO2 content of the flue gas in the chimney is below the guaranteed value of 200 mg/Nm3.

The desulphurisation plant is not characterised by energy efficiency but by the efficiency of reducing sulphur dioxide.

The wet flue gas reduction technology is the most advanced technology applied to energy groups in thermoelectric power plants in Romania.

REFERENCES

1.Racoceanu., C. THE ROLE OF FOSSIL FUELS IN THE CURRENT ENERGY CRISIS, Annals of the” Contantin Brancusi “ University of Târgu Jiu, Engineering Series, vol. 3(2022) , pag.63-66, ISSN: 1842-4856.

2. Racoceanu., C. STUDY ON BENSON STEAM GENERATOR WET FLUE GAS DESULPHURIZATION, Annals of the” Contantin Brancusi “ University of Târgu Jiu, Engineering Series, vol. 3(2022) , pag.67-70, ISSN: 1842-4856

3. Racoceanu., C. REDUCTION OF GREENHOUSE GAS EMISSIONS, Annals of the” Contantin Brancusi “ University of Târgu Jiu, Engineering Series, vol. 3(2021) , pag.17-20, ISSN: 1842-4856

4. Racoceanu., C. REDUCTION OF NITROGEN OXIDE EMISSIONS BY ORGANIZING COMBUSTION, Annals of the” Contantin Brancusi “ University of Târgu Jiu, Engineering Series, vol. 3(2021) , pag.51-54, ISSN: 1842-4856 .

5. Racoceanu., C**.** *STUDY ON THE PERSPECTIVES OF COAL BURNING IN CLASSIC THEROELECTRIC POWER PLANTS IN ROMANIA,* Annals of the “Constantin Brâncuși” University of Târgu-Jiu. Engineering Series, **4** (2019), 96-99 [ISSN: 1842-4856].

6. Racoceanu., C. *STUDY CONCERNING THE APPLICATION OF THE NONPOLLUTING ASH EXHAUST TECHNOLOGY TO THE BENSON STEAM GENERATORS,* Annals of the “Constantin Brâncuși” University of Târgu-Jiu. Engineering Series, **4** (2019), 100-104 [ISSN: 1842-4856].3

7. Cristinel Racoceanu**,** *STUDY ON INFLUENCE OF NOISE DISPERSION ON AIR QUALITY IN THE AREA OF ROVINARI THERMAL POWER PLANT***,** Annals of the „Constantin Brâncuşi”, University of Târgu-Jiu, Engineering Series, no.4 /2018, pag 13-16, ISSN1842-4856.

8. Cristinel Racoceanu, STUDY ON THE REDUCTION OF POLLUTING

EMISSIONS THROUGH COMBUSTION BIOMASS IN THE THERMAL BOILERS**,** Annals of the „Constantin Brâncuşi", University of Târgu-Jiu, Engineering Series, no.4 /2018, pag 17-20, ISSN1842-4856.

9. Racoceanu Cristinel**,** Hațiegan Cornel, *POLLUTION EMISSIONS RESULTING FROM COAL BURNING*, Annals of the „Constantin Brancusi" University of Targu Jiu, Engineering Series, No. 1/2018, pag. 57 -61 , ISSN 1842 – 4856.

10. Racoceanu, C., Popescu C. *ANALYSIS OF THE IMPACT OF ENERGY COMPLEXES ON THE ENVIRONMENT* – second edition, SITECH Craiova Publishing House, 2024.

11. Racoceanu, C. *AUDIT STUDY OF THERMOELECTRIC POWER PLANTS* **-** second edition, SITECH Craiova Publishing House, 2024.

12. Racoceanu C., Căpăţînă C., *EMISSIONS OF POWER STATIONS.* Publishing House Matrix Rom, Bucureşti, 2005.

13. Schiopu Emil Catalin**;** Popescu Luminita Georgeta; Popa Roxana Gabriela, *DETERMINATION OF POWDER IMISSIONS DEPOSITED FROM ROVINARI AREA WHICH COME FROM THE ACTIVITIES OF DEPOSING THE COAL AND PREVENTION MEASURE***,** 14th International Multidisciplinary Scientific Geoconference, ISBN: 978-619-7105-17-9, ISSN: 1314-2704, 2014.

14. Emil Cătălin Şchiopu, Roxana Gabriela Popa, Ramona Violeta Mitran, Gămăneci Gheorghe, *MONITORING OF GASES IMMISSION AND PARTICLES IN SUSPENSION IN THE ROVINARI AREA*, The 13th International Multidisciplinary GeoConference SGEM 2013,16-22 June, 2013, Albena Co., Bulgaria, Conference Proceedings volume 1, Ecology and Environmental Protection, pag. 715-721, ISBN 978-619-7105-04-9.

15. Popescu Cristinel - *ASPECTS REGARDING THE DIAGNOSTICATION OF THE MEDIUM VOLTAGE AFFERENT TO THE COLLECTOR BARS OF THE POWER SUPPLY SYSTEM OF OWN SERVICE CONSUMERS OF AN ENERGY GROUP WITH THE POWER OF 330 MW*. Annals of the ,,Constantin Brâncuși University of Târgu Jiu, Engineering Series, No. 2/2017,pp.92-95.

16 .Șchiopu Emil Cătălin, *MONITORING NOISE IN THE INDUSTRIAL AREA OF ROVINARI*, Annals of the „Constantin Brâncuşi", University of Târgu-Jiu, Engineering Series, ISSN 1842-4856, No. 2/2016, pag. 17-20.

17. Cazalbaşu Violeta Ramona, *THE IMPACT OF THE WIND POWER STATIONS ON THE AVIFAUNEI THE SITES OF COMMUNITY IMPORTANCE*, Annals of the .„Constantin Brancusi" University of Targu Jiu, Engineering Series , ISSN 1842-4856, No. 4/2018, pag 55-60.

18. Cazalbaşu Violeta Ramona, *ACTUAL STUDY OF SOUND POLLUTION PRODUCED BY ROSIUȚA MINORITY EXPLOITATION*, Annals of the „Constantin Brancusi" University of Targu Jiu, Engineering Series, ISSN 1842-4856, No. 1/2019, pag 43-46.