

The Alternative concept - external steam-gas heat exchanger (DaGaVo)

Tomas Zizka¹

¹Technical University of Liberec, Faculty of Mechanical Engineering, Studenstka 1402/2, 461 17 Liberec, CZ

Abstract. In Waste to Energy plants ((WtE)) is treatment of municipal solid waste a complex process that places strictly demands on design and operation of technology. As part of the general renovation of the WtE plant in Prague Malesice was installed an alternative concept for flue gas heating in front of Selective Catalytic Reduction System (SCR) DeNOx. This concept replaced the original flue gas heating with natural gas burners with steam heating using an external steam-gas heat exchanger (DaGAVo). This alternative concept aims to reduce natural gas consumption, reduce secondary emissions and increase the energy efficiency of the installation.

1 Introduction – Waste to Energy Prague – Malesice

The Company Pražské služby a.s. according to a 10-year contract with the City of Prague shall to thermally treated of approx. 260 000 t/a of residual waste. The current approved capacity of the plant is 330 000 t/a. The plant is located on west industrial part of city Prague as you can see in Figure 1 and is operated by Pražské služby a.s.. The plant is equipped with four combustion lines.



Fig. 1. The WtE plant in Prague – Malesice.

*Corresponding author: tomas.zizka1@tul.cz

1.1 Project description

WtE Prague – Malešice - GOLEM

Pražské služby a.s. signed on 9 November 2017 the contract for work designated “GENERAL RENEWAL AND ECOLOGIZATION MALEŠICE - THERMIC TREATMENT OF WASTE” called “Project GOLEM”. The primary purpose of the project was to renovate the technology and related equipment after 20 years in operation. The execution of renovation follows the basic objective of ensuring the safe and reliable operation of the WTE Prague at least until 2045, while achieving higher annual utilization. [1]

Alternative concept

As a part of general renovation was an Alternative concept that shall improve the ecologization and make the energy management of the WTE Prague more efficient to an even greater extent than it was originally agreed in the Basic concept and achieve a significant decrease in operating costs. The Alternative concept distinguishes itself from the boiler concept by virtue of additional super heater surfaces in the fourth boiler path and of an external steam-gas heat exchanger (DaGAVo) positioned upstream of the SCR system to reheat the flue gases as you can see in Figure 2.

Due to the additional heating surfaces in the boiler, the steam temperature increases to 320° C, 15 bar(a). This steam is taken from the boiler into an external steam-gas heat exchanger positioned upstream of the SCR in order to increase the operating temperature of the flue gases in the ceramic catalysts (SCR DeDiox/DeNOx) from 235°C to 275-280°C. The steam parameters suited for supplying steam to the existing turbine are achieved by means of spray cooling downstream of the heat exchanger.

Position of external steam-gas heat exchanger in the flue gas path you can see in Figure 3.

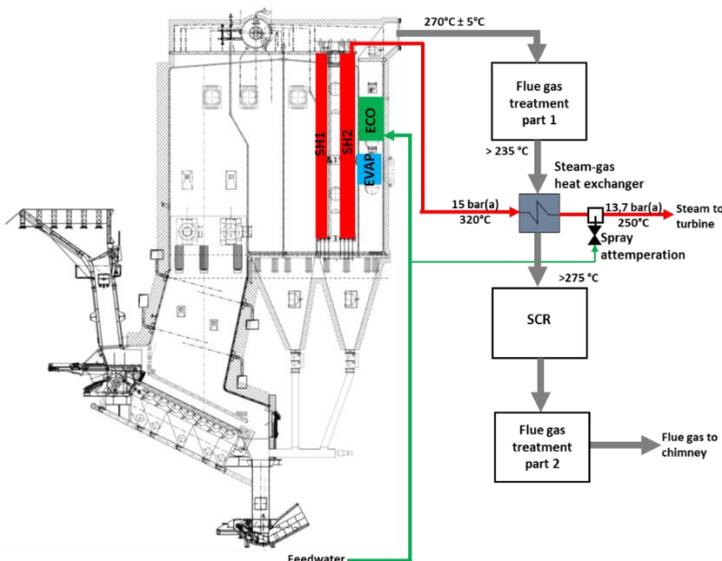


Fig. 2. Steam boiler with heat displacement system (MARTIN).

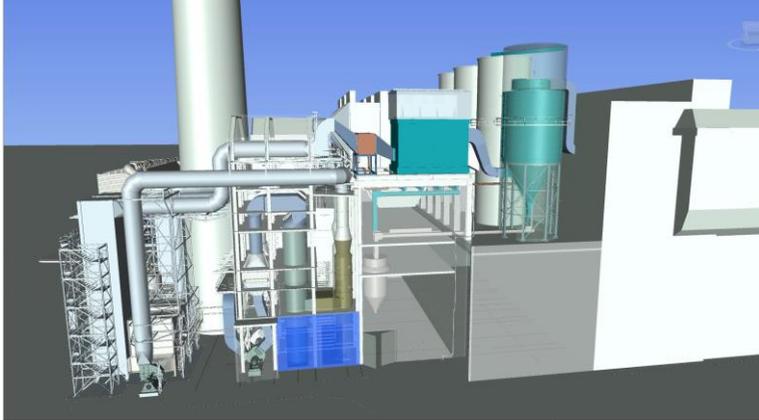


Fig. 3. Position of external steam-gas heat exchanger in FGT system.

Own natural gas consumption

WtE plant use the natural gas for the burners in 4 boilers and also in flue gas cleaning system for increasing flue gas temperature. In the boilers are burners used to put in the operation after shut down or for stabilization of the burning process (wet waste etc.) [4]. With installation the honeycomb catalyst in 2007 for reducing PCDD/PCDF emissions also was installed in flue gas cleaning part of the technology additional natural gas burners for regularly monthly 8 hours' regeneration process with the temperature 290°C. Ceramic catalysts were installed in the purification of raw flue gases immediately after dedusting. From an energy point of view, this location is more suitable, which is in line with the information in reference [3].

In 2010 we added the ammonia water dosing and started to use it as a Selective Catalytic Reduction System (SCR) with reducing NO_x emissions from the flue gases. For ammonia water dosing we need permanent operation of the burners due to the flue gas temperature. It had to negative influence to operation costs. For this reason, we gradually optimized the SCR System to keep balance between costs for the natural gas and the NO_x emission. Currently we operate the plant with average 110-120 mg.Nm⁻³ NO_x emission, the limit is 200 mg.Nm⁻³. Annual consumption natural gas from 2009 to 2021 you can see on the Figure 4 bellow. You can see the reduction in consumption since 2019 due to the gradual replacement of flue gas heaters with flue gas heater (DaGaVo) on Figure 4.

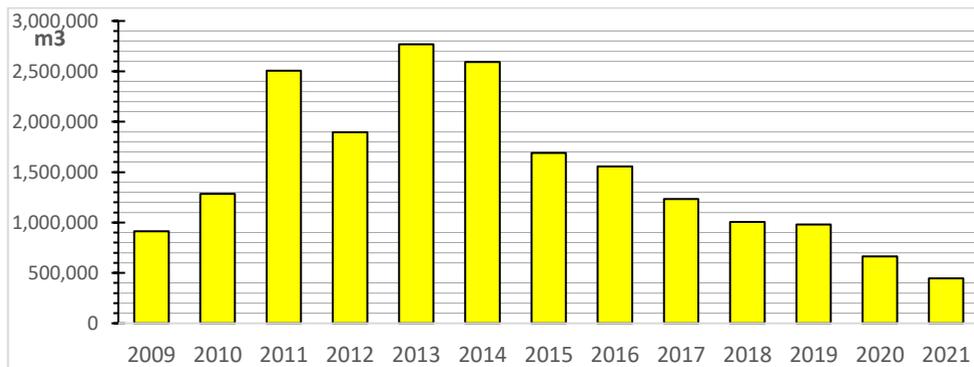


Fig. 4. Annually natural gas consumption.

2 Conclusion

The goal of the measures facilitate was considerably reducing the operating hours of the burner used to heat up the flue gas upstream of the SCR system and significantly lowering the associated natural gas consumption. After 3 years in operation with the Alternative concept we could decide to remove and store the natural gas burners for SCR System. The considerably reducing is done with combination of the high work availability. December 2021 was our historically first month, when we did not have to start a natural gas burner for a whole month.

The results of replacing natural gas burners with a steam exchanger clearly show that natural gas consumption are significantly reduced in 2021 to less than 30% of long-term average annual consumption. The Alternative concept proved to be operationally reliable and economical after 3 years in operation.

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