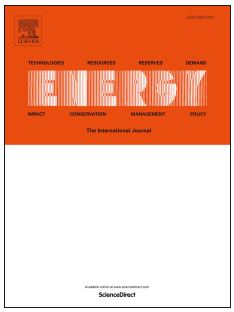
Accepted Manuscript



Thermo-ecological evaluation of an integrated MILD oxy-fuel combustion power plant with CO_2 capture, utilisation, and storage – A case study in Poland

Paweł Gładysz, Wojciech Stanek, Lucyna Czarnowska, Sławomir Sładek, Andrzej Szlęk

PII: S0360-5442(17)31991-6

DOI: 10.1016/j.energy.2017.11.133

Reference: EGY 11921

To appear in: *Energy*

Received Date: 14 January 2017

Revised Date: 22 November 2017

Accepted Date: 23 November 2017

Please cite this article as: Gładysz Paweł, Stanek W, Czarnowska L, Sładek Sł, Szlęk A, Thermo-ecological evaluation of an integrated MILD oxy-fuel combustion power plant with CO_2 capture, utilisation, and storage – A case study in Poland, *Energy* (2018), doi: 10.1016/j.energy.2017.11.133.

Thermo-ecological evaluation of an integrated MILD oxy-fuel combustion power plant with CO_2 capture, utilisation, and storage – a case study in Poland

Paweł Gładysz[1*], Wojciech Stanek[2], Lucyna Czarnowska[3], Sławomir Sładek[4], Andrzej Szlęk[5]

[1]*Institute of Thermal Technology, Silesian University of Technology, Gliwice, Poland,* pawel.gladysz@polsl.pl

[2]*Institute of Thermal Technology, Silesian University of Technology, Gliwice, Poland,* wojciech.stanek@polsl.pl

[3]*Institute of Thermal Technology, Silesian University of Technology, Gliwice, Poland,* lucyna.czarnowska@polsl.pl

[4]*Institute of Thermal Technology, Silesian University of Technology, Gliwice, Poland,* slawomir.sladek@polsl.pl

[5]*Institute of Thermal Technology, Silesian University of Technology, Gliwice, Poland,* andrzej.szlek@polsl.pl

Abstract

This study investigated the environmental benefits of a new boiler design for a fossil fuel-based power plant with CO_2 capture, utilisation, and storage (CCUS) through thermo-ecological cost (TEC) analysis. MILD oxy-fuel combustion (MOFC) combines the advantages of the moderate and intense low-oxygen dilution (MILD) combustion and oxy-fuel combustion (OFC) to achieve efficient and environmentally justified CO_2 capture from fossil fuel-based power generation. The advantages of MOFC application are: (i) it increases the efficiency of the coal-fired boiler, (ii) it increases the purity of the CO_2 in the flue gases, (iii) it reduces the oxygen consumption of the boiler by using lower oxidiser excess, and (iv) it reduces the energy consumption associated with CO_2 recirculation. Therefore, using MOFC decreases the penalty of the overall net energy efficiency associated with the CO_2 capture from coal-fired power plants.

The environmental analysis in this study considered the TEC, which measures the depletion of non-renewable natural resources by estimating the cumulative exergy consumed by the production processes. Moreover, the additional exergy consumption that compensates for the negative impact of harmful emissions has also been considered. The data for the new boiler design were obtained by CFD modelling, while the other technological modules of the

[*]Corresponding author