

Impact of natural gas composition variation on the performance of PACT Pilot-Plant Micro Gas Turbine

K.C. Omehia*; K. Finney; M. Akram; M.E. Diego; K. Hughes; L. Ma; M. Pourkashanian
University of Sheffield, Energy 2050
M: 07821544850; E: komehia1@sheffield.ac.uk

Background

Across Europe, the increased demand in natural gas is leading to a growing requirement for the import of natural gas from other countries which have varying compositions in natural gas compositions and hence in gas quality.

Aim: The aim of this project is to investigate the effect of fuel flexibility on the performance of a gas-fired power plant while reducing the green house gas emissions from the power plant using CO₂ capture technologies.

Natural Gas Composition

Some of the most important countries that supply natural gas to the United Kingdom are considered. These are Russia, the Netherlands, North African countries such as Libya and LNG from Norway and Nigeria [1, 2].

Table 1. Different natural gas compositions for different countries [1, 2].

Compositions	Russia	Netherlands	Libya	Norway	Nigeria
Methane, %	97.64	87.81	81.39	91.80	91.30
Ethane, %	0.99	7.63	12.44	5.70	4.60
Propane, %	0.32	1.32	3.51	1.30	2.60
Butane, %	0.10	0.24	0.64	0.40	1.40
Nitrogen, %	0.84	9.96	2.02	0.80	0.10
Carbon dioxide, %	0.09	2.00	0.00	0.00	0.00
LHV, MJ/kg	49.10	40.80	47.70	48.90	49.30

Variations in the natural gas composition changes the kinetic reaction between the fuel and high temperature compressed air in the combustor. The impact of the combustion characteristics on the turbine is investigated and the indirect effect on the compressor is also investigated. The impact on the composition on the exhaust flue gas will be investigated as well to see the effect of each gas composition on CO₂ capture.

The methodology in this project involves an experimental and process modelling campaign being carried out.

Experiment

The experimental campaign will be conducted using a Turbec T100 series 3 Micro gas turbine available in the PACT Core Facility in Sheffield, United Kingdom.

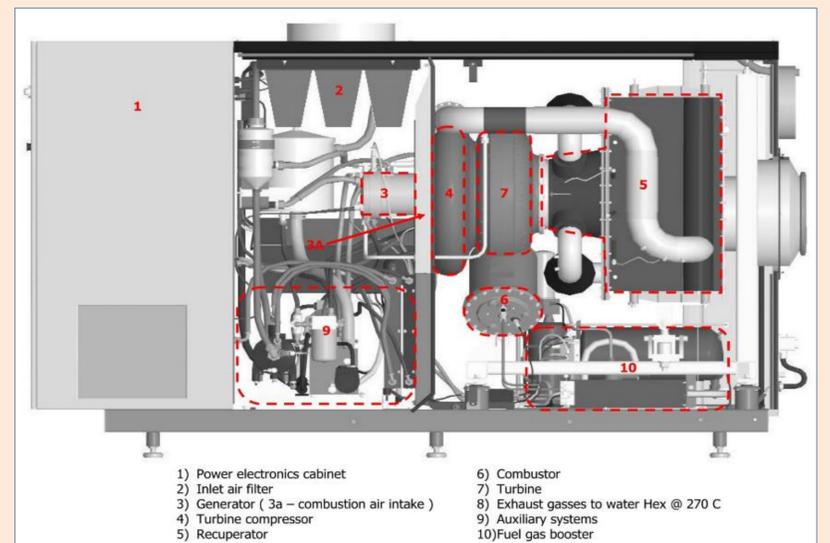


Figure 1. Main components of the Turbec T100 series 3.

Process Modelling

A flowsheet model of a micro gas turbine with its characteristic map is used in the process modelling. The chic maps are used to improved the accuracy of the process model.

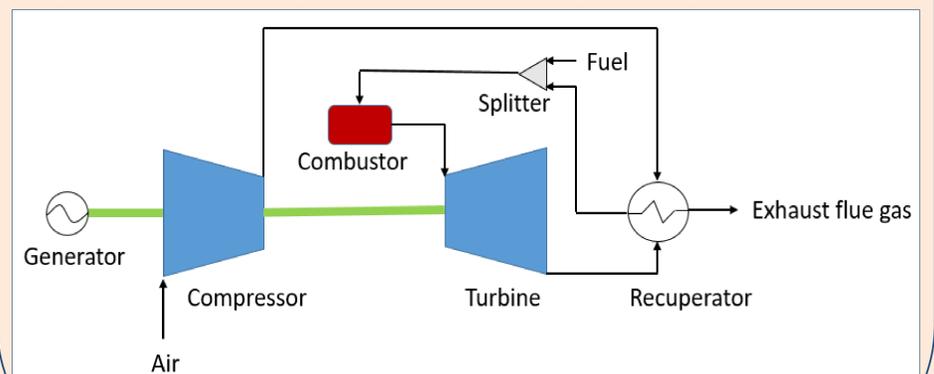


Figure 2. Configuration of the Baseline MGT Model.

Current and Future Work

- 1) Investigate effect of fuel flexibility in gas-fired power plants.
- 2) Flowsheet modelling of the CO₂ capture plant which uses MEA and is readily available at the PACT core facility.
- 3) Investigate the economic viability of the different natural gas compositions and establish the compositions with maximum economic viability.

References

1. Ferrera, IP Co-ordinator Massimo, IP CRF, and CRF Subproject SPA. "Deliverable Report INGAS." *Month 500.B2*: 12.
2. Schori, Salome, and Rolf Frischknecht. "Life Cycle Inventory of Natural Gas Supply." *Middle East 75.800* (2007): 461.