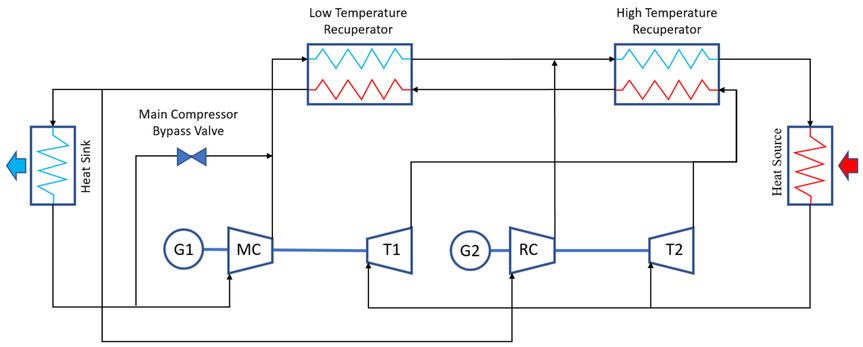
Investigation of Recompression Supercrtical CO2 cycle

Jaroslaw Milewski
Piotr Lis
Łukasz Szabłowski
Arkadiusz Szczęśniak
Olaf Dybiński
Marcin Wołowicz

Warsaw University of Technology
Poland

ABSTRACT

The paper contains off-design simulations of super critical CO2 recompression cycle with various system control strategies. The closed cycle is controlled by varying the bypass valve of the main compressor and turbine inlet temperature to achieve the target system power and rotational shaft speed. Performance maps were generated based on the off-design simulation. The maps can be used to estimate the control parameters dependencies and develop an efficient system controller. Other more complex strategies not considered in this study may also be used, such as turbine wastegate or compressor inlet pressure and temperature control.



RESULTS AND DISCUSSION

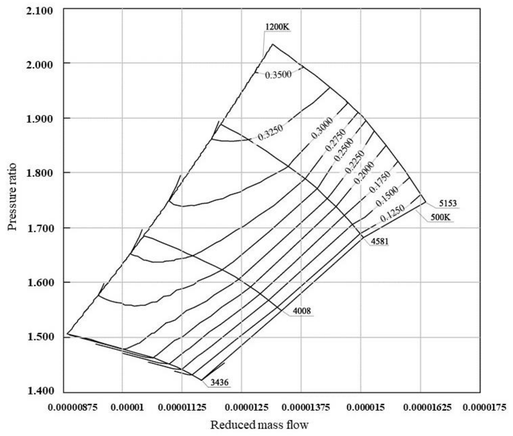
The presented simulation results indicate that the analyzed sCO2 recompression cycle possesses high operational and control flexibility while at the same time maintaining stable thermal efficiency. The system can operate across a very wide range of parameter change.

There are two main operating modes considered: grid parallel and island mode. Each of them needs different system control strategy.

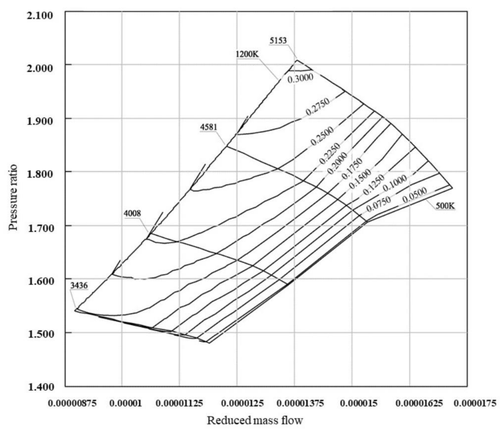
In general, it should be underlined that in the case of a system with an sCO2 recompression cycle there is a possibility of changing the system power output by changing not only the bypass valve position but also the TIT at variable rotational speeds of the compressor-turbine unit. This is accompanied by different system efficiencies. So, there is a need to formulate an appropriate control concept (logic) and approach for technical realization.

Island Mode Performance map vs main compressor bypass valve position

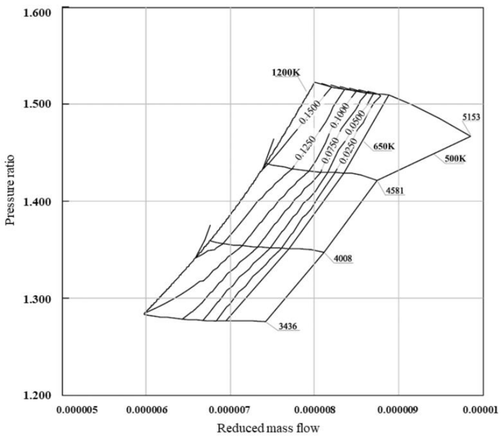
Bypass Valve Closed



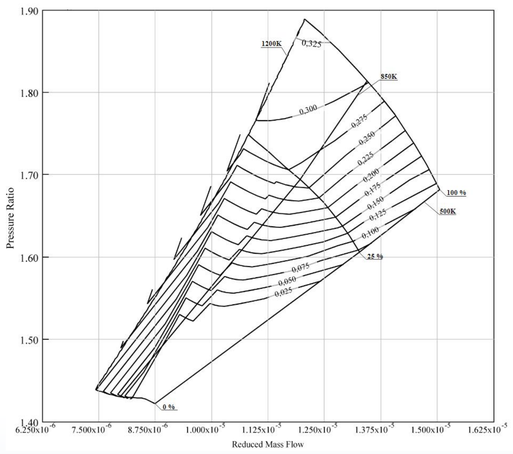
Bypass Valve 25% Open



Bypass Valve 100% Open

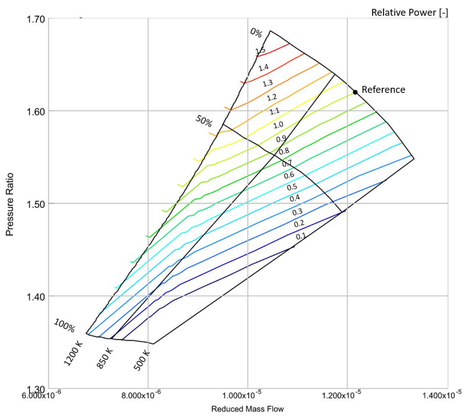


Grid Mode Performance Map



Power Output Sensitivity

System Relative Power Map



System Power Map