Technologies for waste heat recovery in offshore applications

Pierobon, Leonardo; Nguyen, Tuong-Van

Publication date: 2012

Document Version: Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Technologies for waste heat recovery in offshore applications

Leonardo Pierobon\textsuperscript{1,*}, Tuong-Van Nguyen\textsuperscript{1}

\textsuperscript{1} Technical University of Denmark, Department of Mechanical Engineering, Nils Koppels Allé, Building 403, 2800 Kgs. Lyngby, Denmark
*Corresponding author, Tel.: +45 4525 4129, Fax: +45 4588 4325, Email: lpier@mek.dtu.dk

1 Motivation and background

With increasing incentives for reducing CO\textsubscript{2} emissions, energy optimization on offshore platforms becomes a focus area. The waste heat recovery from the SGT-500 SIEMENS gas turbine utilized on the Draugen platform (Kristiansund) is investigated. Three possible technologies are considered: the air bottoming cycle (ABC), the organic Rankine cycle (ORC) and the steam Rankine cycle (SRC). Thermal efficiency, compactness, weight and investment cost are the major constraints.

Net power: 19.1 MW
Net power ABC: 2.1 MW
Thermal efficiency: 35.8 %

**Air bottoming cycle**

Pros:
- Simple layout (open cycle)
- No condenser is needed
- No intermediate loop
- Low hazard and environmental-friendly fluid

Cons:
- Low thermal efficiency
- Wide WHRU exchange area
- High turbine outlet temperature

**Organic Rankine cycle**

Pros:
- High thermal efficiency (up to 44.3%)
- Compactness
- No moisture at turbine outlet (“dry” fluid)
- Flexibility in the working fluid selection

Cons:
- Intermediate loop
- High fire hazard
- New technology

Fluid: cyclohexane
Net power: 25.7 MW
Thermal efficiency: 44.3 %

Net power: 23.7 MW
Net power ORC: 6.7 MW
Thermal efficiency: 44.3 %

**Steam Rankine cycle**

Pros:
- Low maximum (10 bar) and high minimum pressures (0.1 bar)
- No intermediate loop
- Established technology
- Low hazard and environmental-friendly fluid

Cons:
- Low thermal efficiency
- Moisture at steam turbine outlet (5%)
- Need for make-up water

Net power: 21.4 MW
Net power SRC: 4.4 MW
Thermal efficiency: 40.1 %

2 Results and discussion

The combination of the SGT-500 and ORC presents the highest system performance (44.3%) with cyclohexane (case a). When a low fire hazard is required carbon dioxide is the preferable media (case b). The ABC exhibits the lowest overall efficiency (35.8%) due to the high outlet ABC turbine temperature (220°C). If a SRC is utilized problems related to moisture content after the expansion are encountered; combined cycle efficiency is 40.2%.

3 Acknowledgements

Funding from the Norwegian Research Council through Petromaks led by Teknova with project n\textsuperscript{o}203404/E30 is acknowledged.