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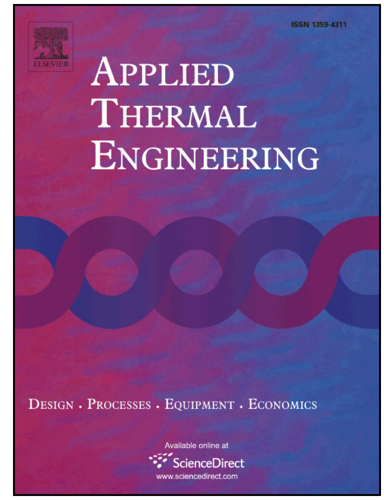

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Waltteri Salmi, Juha Vanttola, Mia Elg, Maunu Kuosa, Risto Lahdelma

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Using waste heat of ship as energy source for an absorption refrigeration system

Waltteri Salmi[a], Juha Vanttola[a], Mia Elg[b], Maunu Kuosa[a], Risto Lahdelma[a]

[a]Aalto University, School of Engineering, Department of Energy Technology, P.O. Box 14400, FI-00076 Aalto, Finland

[b]Deltamarin Ltd, Postikatu 2, 20250 Turku, Finland.

waltteri.salmi@aalto.fi, juha.vanttola@aalto.fi, Mia.Elg@deltamarin.com, mabkuosa@hotmail.com, risto.lahdelma@aalto.fi

Abstract

This work presents a steady-state thermodynamic model for absorption refrigeration cycles with water-LiBr and ammonia-water working pairs for purpose of application on a ship. The coefficient of performance was studied with different generator and evaporator temperatures in ISO and tropical conditions. Absorption refrigeration systems were examined using exhaust gases, jacket water, and scavenge air as energy sources. Optimal generator temperatures for different refrigerant temperatures were found using different waste heat sources and for the absorption cycle itself. Critical temperature values, (where the refrigeration power drops to zero) were defined. All of these values were used in order to evaluate the cooling power and energy production possibilities in a bulk carrier. The process data of exhaust gases and cooling water flows in two different climate conditions (ISO and tropical) and operation profiles of a B. Delta37 bulk carrier were used as initial data in the study. With the case ship data, a theoretical potential of saving of 70% of the electricity used in accommodation (AC use) compressor in ISO conditions and 61% in tropical conditions was recognized. Those estimates enable between 47 and 95 tons of annual fuel savings, respectively. Moreover, jacket water heat recovery with a water-LiBr system has the potential to provide 2.2–4.0 times more cooling power than required during sea-time operations in ISO conditions, depending on the main engine load.

Keywords: ship, absorption refrigeration, ammonia, lithium bromide, waste heat recovery.

Nomenclature

c_p	specific heat capacity (kJ/[kgK])
E_{tot}	total energy production or demand (MWh)
h	enthalpy (kJ/kg)
$\dot{m}$	mass flow rate (kg/s)
$\dot{n}$	molar flow (mol/s)
P	compressor power (W)