Abstract

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Thermodynamic, environmental and economic analysis of absorption air conditioning unit for emissions reduction onboard passenger ships

In this paper, the waste heat of exhaust gases and jacket cooling water in marine diesel engines are analyzed to operate the absorption refrigeration unit (ARU). Thermo-economic and environmental analysis of the absorption refrigeration cycle operated with the two heat sources that use lithium bromide as an absorbent is carried out. The analysis is performed using Engineering Equation Solver (EES) software package where the thermodynamic properties of the steam and the LiBr-water mixtures are provided. The used EES code is verified by published experimental data. As a case study, high speed passenger vessel operating in the Red Sea area has been investigated. The results show that a considerable specific economic benefit could be achieved from ARU jacket cooling water operated over that gained from main engine exhaust gases. Environmentally, applying ARU machine during cruise will reduce the annual fuel consumption for the diesel generators by 156 ton with a reduction percentage of 23%. This will reduce the exhaust gas emissions by 6.3% from the applied main engine emissions. In addition, this will result in reducing NOx, SOx, and CO2 emissions with cost-effectiveness of 4.99 $/kg, 13.18 $/kg, and 0.08 $/kg, respectively.