








# A novel approach to heat integration development and multi-objective optimization for a marine diesel engine: Towards a framework of waste-to-electric power, dual-stage coolant, and distilled water

Tao Hai <sup>a b c</sup>  , Pradeep Kumar Singh <sup>d</sup>, Husham Jawad ahmed Al-Qaysi <sup>e</sup>, Babak Farhang <sup>f</sup>  , Nasser M.Abd El-Salam <sup>g</sup>, Walid El-Shafai <sup>h</sup>

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## Abstract

Heat integration is a well-admitted technology to reuse the waste of different engines in different arrangements, relying on the principal needs. Considering the heat capacity of the flow released from the engine of a ship during maritime travel, heat integration is a promising tool to maintain the marine environment, along with processing some energy-related needs of the ship. This is a technology that is being developed based on which this study presents a new structure. In this regard, an innovative combined cooling and power (CCP) scheme using a dual-stage coolant production technology (bi-evaporator) for air-conditioning and freezing purposes is arranged and integrated into the engine. The proposed technology, which can provide one of the basic needs of a ship during maritime travel, i.e., freezing, has not been studied and optimized for a ship in previous studies. In addition, the arranged structure uses a multi-effect desalination coupled with the engine for cascade heat integration. First, the most suitable working fluid of the designed CCP was investigated using a comparative study. Afterward, based on the selected working fluid, the entire process was simulated and scrutinized in the engineering equation solver (EES) software from the viewpoints of thermodynamics, environment, economics, and sustainability. Eventually, this structure is optimized using a NSGA-II optimization method in the MATLAB environment. Here, the most suitable working fluid determined by the TOPSIS approach is R236ea, and the optimal unit cost of products and sustainability index are found as 0.7326 \$/GJ and 1.335, respectively.