Thermoeconomic Diagnosis of an Energy System for Ship Propulsion

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A thermoeconomic diagnosis of an energy system for ship propulsion is performed. We consider a Thermo Efficiency System (TES), for a Post-Panamax class ship where the waste heat from the main engine is utilised with a waste heat recovery system consisting of a power turbine expander and a single pressure level steam cycle. In complex energy systems, such as the TES, it may be difficult to identify operation anomalies as the effects of an intrinsic malfunction in one component spreads through the whole energy system and induces malfunctions in other components. Exergy and thermoeconomic analyses are used to investigate the system with the goal of more efficient use of energy resources and in a cost-effective manner. Moreover, the respective analyses identify the components that the thermoeconomic diagnosis is focused on. The thermoeconomic diagnosis is done with the characteristic curve method, which enables the identification of the causes of malfunctions. Components with intrinsic and induced malfunctions are clearly identified in two test cases imposed on the TES. In the first case the causes of malfunctions are identified to be in the turbocharger compressor and the power turbine and in the second case they are identified to be in the steam turbine. The relative indicator for the components with intrinsic malfunctions are approximately two orders of magnitude larger compared to the components with induced malfunctions. The method can thus be concluded to be a promising option for the diagnosis of malfunction in a TES.

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