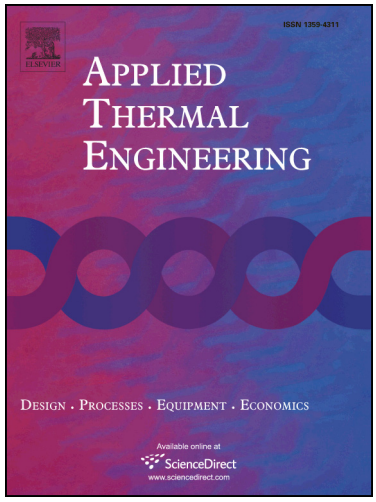

Research Paper

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THERMODYNAMIC ANALYSIS OF AN ABSORPTION REFRIGERATION SYSTEM USED TO COOL DOWN THE INTAKE AIR IN AN INTERNAL COMBUSTION ENGINE

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Abstract

This paper deals with the thermodynamic analysis of an Absorption Refrigeration Cycle used to cool down the temperature of the intake air in an Internal Combustion Engine using as a heat source the exhaust gas of the engine. The solution of ammonia-water has been selected due to the stability for a wide range of operating temperatures and pressures and the low freezing point. The effects of operating temperatures, pressures, concentrations of strong and weak solutions in the Absorption Refrigeration Cycle were examined to achieve proper heat rejection to the ambient. Potential of increasing Internal Combustion Engine efficiency and reduce pollutant emissions was estimated by means of theoretical models and experimental tests. In order to provide boundary conditions for the absorption refrigeration cycle and to simulate its effect on engine performance, a 0D thermodynamic model was used to reproduce the engine performance when the intake air is cooled. Furthermore, a detailed experimental work was carried out to validate the results in real engine operation. Theoretical results show how the absorption refrigeration system decreases the intake air flow temperature down to a temperature around 5 °C and even lower by using the bottoming waste heat energy available in the exhaust gases in a wide range of engine operating conditions. In addition, the theoretical analysis estimates the potential of the strategy for increasing the engine indicated efficiency in levels up to 4% also at the operating conditions under evaluation. Finally, this predicted benefit in engine indicated efficiency has been experimentally confirmed by direct testing.

Keywords

Absorption Refrigeration Cycle, Diesel engine, Waste Heat Recovery, alternative solutions, ammonia-water

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