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Experimental performance analysis of an automotive heat pump system for electric vehicles using HFC134a as refrigerant

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The use of electric vehicles has become popular due to their high energy efficiency and zero emission. However, comfort heating of passenger compartments in IC vehicles is performed by waste heat from IC engine, while electric vehicles (EV) employ electrical resistance for this aim due to having no waste heat source with sufficient capacity. Because providing heat from electrical resistance causes extra energy consumption, the use of air-source heat pumps for the comfort heating of EVs is getting importance to reduce total energy consumption in EVs. In this study, a bench-top automotive air conditioning system using HFC134a as refrigerant was set up and equipped with some auxiliary components to operate it as a heat pump. The system had instruments to measure refrigerant and air stream temperatures at critical points, refrigerant mass flow rate, refrigerant pressures, compressor speed and torque. The temperatures of the air streams entering the indoor and outdoor units was kept at two different values, namely 0°C and 10°C, and the compressor speed was changed between 800 to 2800 rpm with intervals of 400 rpm for each air stream temperature. The experimental data was acquired by a data aquisition system anddetermined that the automotive heat pump system provided sufficient heating capacity and conditioned air stream temperature at test conditions. It was observed that heating capacity and conditioned air stream temperature increased while COP_h decreased on increasing the compressor speed.

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Impact of sailing strategies on fuel consumption and the powernet system

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The engine stop-start system was a major advance to face the challenges of fuel saving of ICE vehicles. This technology requires significant changes of the electrical system like electrical energy management and cycle resistant starter batteries to ensure a reliable restart and sufficient energy supply during vehicle standstill. Latest developments are focusing vehicle sailing with engine off. This allows expanding engine off period as well as reduction of driving resistance during vehicle deceleration. An engine stop while sailing reduces fuel consumption significantly, but it also leads to considerably higher load on the electrical system. This investigation analyses the impact on fuel consumption and the electrical system by vehicle measurements and simulations. Basis is a state-of-the-art C-segment vehicle with DCT, enhanced stop-start and engine idle sailing. The enhanced stop-start system turns off the engine shortly before vehicle stop. The sailing function declutches the engine in situations without driver torque request while the engine remains in idle. Enhanced stop-start and sailing idle are evaluated by vehicle measurements under real world driving conditions. The battery as the most important electrical component is additionally validated on a component test bench. A powernet simulation is set up and calibrated based on experimental data of vehicle and component tests. An engine off sailing algorithm is implemented in the vehicle simulation environment. The effects on powernet voltage stability, energy balance and cranking ability are evaluated and compared to the estimated fuel consumption reduction. Starting from simulation analysis this study defines requirements for prospective automotive electrical systems to further reduce fuel consumption and emissions.

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