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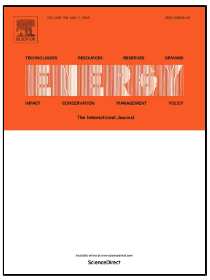

Potential of Predictive Control for Improvement of Seasonal Coefficient of Performance of Air Source Heat Pump in Central European Climate Zone

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Potential of Predictive Control for Improvement of Seasonal Coefficient of Performance of Air Source Heat Pump in Central European Climate Zone

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Abstract

This paper compares different operation models of the air-to-water heat pump (HP). Detail focus of this study aims at a potential to increase seasonal coefficient of performance (SCOP) by utilising the predictive control. The considered predictive control uses an outdoor air temperature forecast for the upcoming 48 h. The predictive control operates the heat pump so that it runs, preferably, during the periods of the day with the highest air temperature. For a detailed assessment, a model of the heat supply system with a heat pump supplemented by a heat accumulator has been developed. The mathematical model involves detailed algorithm for time-dependent quantification of the heat demand for the considered model building. Dataset of real operation tests of the HP helps correctly evaluate the coefficient of performance (COP). An original algorithm of predictive control has been developed and tested for different operating parameters and different capacities of the heat accumulator. A long-term record of air temperatures from the last ten years is employed to evaluate the model. The mathematical model allows for a complex parametrical study to evaluate the relations of SCOP - accumulator capacity, SCOP - method of heat pump control.

Nomenclature

MPC	*model predictive control*
PCM	*phase change material*
EHPA	*European Heat Pump Association*
T_{min}	*minimal daily temperature (°C)*
T_{max}	*maximal daily temperature (°C)*
T_{out}	*actual outdoor temperature (°C)*
T_{in}	*actual indoor temperature (°C)*
T_{av}	*average outdoor temperature in 24 hour interval (°C)*
T_e	*standardized outdoor temperature (°C)*
T_i	*standardized indoor temperature (°C)*
T_{w2}	*temperature of heating water (°C)*
$T_{w2,n}$	*temperature of heating water for standardized outdoor temperature (°C)*
ΔT_{aw}	*difference between actual outdoor and actual heating water temperatures (°C)*
$\dot{Q}_l$	*actual heat loss of a building (W)*
$\dot{Q}_{l,n}$	*heat loss of a building for standardized temperatures (W)*
$\dot{Q}_{l,av}$	*average heat loss of a building in 24 hour interval (W)*
Q_{24}	*total heat loss in 24 hour interval (Wh)*
$\dot{Q}_{HP}$	*output power of a heat pump (W)*
P_{HP}	*input power (electric) of a heat pump (W)*
P_{24}	*energy input to heat pump in 24 hour interval (Wh)*
k_{HP}	*ratio of nominal heat pump output power and heat loss of a building*
COP_τ	*coefficient of performance for average temperature of period chosen by predictive control*