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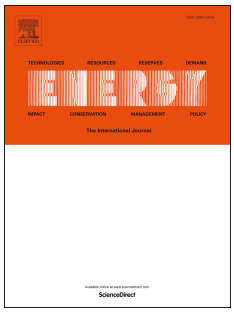

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Demis Pandelidis, Aleksandra Cichoń, Anna Pacak, Sergey Anisimov, Paweł Drąg

PII: S0360-5442(18)31887-5

DOI: 10.1016/j.energy.2018.09.123

Reference: EGY 13817

To appear in: *Energy*

Received Date: 13 April 2018

Revised Date: 20 August 2018

Accepted Date: 18 September 2018

Please cite this article as: Pandelidis D, Cichoń A, Pacak A, Anisimov S, Drąg Paweł, Counter-flow indirect evaporative cooler for heat recovery in the temperate climate, *Energy* (2018), doi: https://doi.org/10.1016/j.energy.2018.09.123.

COUNTER-FLOW INDIRECT EVAPORATIVE COOLER FOR HEAT RECOVERY IN THE TEMPERATE CLIMATE

DEMIS PANDELIDIS*[a], ALEKSANDRA CICHOŃ*, ANNA PACAK*, SERGEY ANISIMOV*, PAWEŁ DRĄG**

*Department of Environmental Engineering, Wroclaw University of Science and Technology, 27 Wyspiański st., 50-370, Wroclaw, Republic of Poland

** Department of Control Systems and Mechatronics, Wroclaw University of Science and Technology, 27 Wyspiański st., 50-370, Wroclaw, Republic of Poland

[a] address all correspondence to demis.pandelidis@pwr.edu.pl

Keywords:
indirect evaporative cooling, heat recovery, counter-flow heat and mass exchanger

Abstract:
Following paper focuses on the application of a counter-flow indirect evaporative cooler as a heat recovery device in air conditioning systems in temperate climate (climate where temperature in summer does not exceed 32°C and humidity ratio does not exceed 15 g/kg, which is typical for Central and Eastern Europe). The purpose of the study is to show the potential of retrofitting conventionally used recuperator exchangers by changing them into indirect evaporative coolers (IEC). Study was performed with original ε-NTU-model. Proposed analysis discussed the critical operational aspects of the IEC unit operating as a heat recovery device, including detail discussion about the heat and mass transfer process with and without condensation in the product air channel and investigation of the influence of different parameters on the exchanger performance. Achieved results are additionally compared with the conventional recuperation process, which is commonly used in temperate climates, in order to show the energy savings which can be obtained by simple modification of such devices. It was found that the counter-flow indirect evaporative cooler is suitable for these climate conditions and it allows to significantly increase the temperature drop during heat recovery process in compare with the commonly used recuperators. In addition, several important operational aspects where analyzed, including analysis of pressure drops inside IEC unit and potential of water recovery from the condensation inside the unit.

Highlights:
- Indirect evaporative cooling for heat recovery in temperate climate is presented.
- The analysis is based on the numerical simulations.
- Model included operation with and without condensation in product channel.
- Exchanger was compared with typical recuperator.
- Performance of the unit was investigated for different factors.

NOMENCLATURE

c_g	J/(kg·K)	Specific heat capacity of water vapor
c_p	J/(kg·K)	Specific heat capacity of moist air
c_w	J/(kg·K)	Specific heat capacity of water
D_h	-	Hydraulic diameter of airflow passage
EER	-	Energy Efficiency Rating