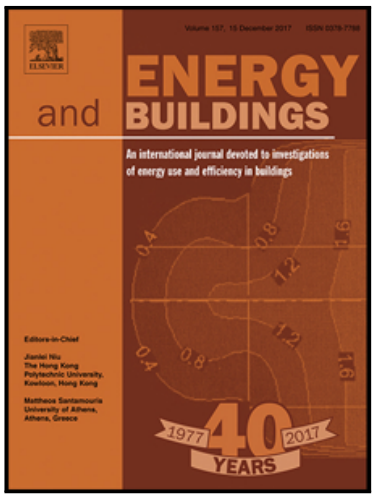
Accepted Manuscript



Performance analysis of heat and energy recovery ventilators using exergy analysis and nonequilibrium thermodynamics

Magnus Aa. Gjennestad, Eskil Aursand, Elisa Magnanelli, Jon Pharoah

PII: S0378-7788(17)34156-7
DOI: 10.1016/j.enbuild.2018.04.013
Reference: ENB 8486

To appear in: *Energy & Buildings*

Received date: 23 December 2017
Revised date: 12 March 2018
Accepted date: 10 April 2018

Please cite this article as: Magnus Aa. Gjennestad, Eskil Aursand, Elisa Magnanelli, Jon Pharoah, Performance analysis of heat and energy recovery ventilators using exergy analysis and nonequilibrium thermodynamics, *Energy & Buildings* (2018), doi: 10.1016/j.enbuild.2018.04.013

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

Performance analysis of heat and energy recovery ventilators using exergy analysis and nonequilibrium thermodynamics

Magnus Aa. Gjennestad[a], Eskil Aursand[b], Elisa Magnanelli[c,*], Jon Pharoah[d]

[a]*Department of Physics, NTNU - Norwegian University of Science and Technology NO-7491 Trondheim, Norway*
[b]*Department of Energy and Process Engineering, NTNU - Norwegian University of Science and Technology NO-7491 Trondheim, Norway*
[c]*Department of Chemistry, NTNU - Norwegian University of Science and Technology NO-7491 Trondheim, Norway*
[d]*Department of Mechanical and Materials Engineering, Queen's University K7L 3N6 Kingston, Canada*

Abstract

The increased attention to energy savings has contributed to more widespread use of energy recovery systems for building ventilation. We investigate the efficiency of such systems under different outdoor conditions using exergy analysis and nonequilibrium thermodynamics. This analysis makes it possible to assess performance in terms of loss of work potential, to account for the different quality of energy and to localize and compare the different sources of loss in the system. It also enables the use exergy efficiency as a single performance parameter, in contrast to the several indicators that are commonly used. These more common indicators are difficult to compare and relate to each other. Further, since there is no obvious optimal trade-off between them, it is challenging to combine them and develop a global performance indicator that allows for a sensible comparison of different technical solutions and different types of recovery devices.

We illustrate the concepts by applying the analysis to a heat recovery ventilator (HRV) and to a structurally similar membrane energy recovery ventilator (MERV) which can exchange both heat and moisture. We show how the exergy efficiency can be used to identify the range of operating conditions for which the recovery ventilator is not beneficial as the energy cost is greater than the energy recovery. This is not trivial using traditional performance parameters, yet it is a natural outcome of exergy analysis. In addition, we identify the mechanism by which work potential is lost, which can help the eventual optimization of both the recovery process and the auxiliary systems present in ventilation systems.

Keywords: exergy efficiency, energy efficiency, recovery ventilator, ventilation systems, nonequilibrium thermodynamics

Download English Version:

https://daneshyari.com/en/article/6727876

Download Persian Version:

https://daneshyari.com/article/6727876

Daneshyari.com