Notes: literature

============================================================

FN Thomson Reuters Web of Science™

VR 1.0

enthalpy exchanger, heat, moistur;

2011-2015

PT J

AU Al-Waked, Rafat

Nasif, Mohammad Shakir

Morrison, Graham

Behnia, Masud

TI CFD simulation of air to air enthalpy heat exchanger: Variable membrane

moisture resistance

SO APPLIED THERMAL ENGINEERING

VL 84

BP 301

EP 309

DI 10.1016/j.applthermaleng.2015.03.067

PD JUN 5 2015

PY 2015

AB Conjugate heat and mass transfer processes across membrane heat

exchangers of variable mass transportation resistance were investigated

numerically. One half of flow channel for the hot stream and another for

the adjacent cold stream were simulated. Effects of channel height,

Reynolds number and flow direction on heat exchanger thermal

effectiveness and energy recovered were studied. The validated CFD model

showed that values of moisture resistance decrease with the increase in

flow rates and/or the decrease in vapour mass fractions on both sides of

the membrane. Furthermore, total hydraulic diameter effects on the

thermal efficiency within membrane heat exchangers were found strong.

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PT J

AU Li, Zhen-Xing

Zhong, Ting-Shu

Niu, Jian-Lei

Xiao, Fu

Zhang, Li-Zhi

TI Conjugate heat and mass transfer in a total heat exchanger with

cross-corrugated triangular ducts and one-step made asymmetric membranes SO INTERNATIONAL JOURNAL OF HEAT AND MASS TRANSFER VL 84 BP 390 EP 400 DI 10.1016/j.ijheatmasstransfer.2015.01.032

PD MAY 2015

PY 2015

AB Membrane-based total heat exchanger is a device to recover both sensible

heat and moisture from exhaust air stream from a building. Heat and mass

transfer intensification has been undertaken by using a structure of

cross-corrugated triangular ducts. To further intensify moisture

transfer, recently developed membranes-one step made asymmetric

membranes, are used as the exchanger materials. Conjugate heat and mass

transfer under transitional flow regime in this total heat exchanger are

investigated. Contrary to the traditional methods of assuming a uniform

temperature (concentration) or a uniform heat flux (mass flux) boundary

condition, in this study, the real boundary conditions on the exchanger

surfaces are obtained by the numerical solution of the coupled equations

that govern the transfer of momentum, energy and moisture in the two air

streams and in the membrane materials. The naturally formed heat and

mass boundary conditions are then used to calculate the local and mean

Nusselt and Sherwood numbers along the exchanger ducts, in the heat and

mass developing regions. The data are compared with those results under

uniform temperature (concentration) and uniform heat flux (mass flux)

boundary conditions, for cross-corrugated triangular ducts with typical

duct apex angles of 60 degrees and 90 degrees. (C) 2015 Elsevier Ltd.

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PT J

AU Yang, Bo

Yuan, Weixing

Gao, Feng

Guo, Binghan

TI A review of membrane-based air dehumidification SO INDOOR AND BUILT ENVIRONMENT VL 24 IS 1 BP 11 EP 26 DI 10.1177/1420326X13500294 PD FEB 2015 PY 2015 AB Air dehumidification plays an important role in improving air quality

and maintaining thermal comfort. Increasing attention is paid to the

membrane-based technology, which is based on water vapour transmembrane

transport driven by mass transfer potential, together with sensible heat

transfer under temperature difference. Membrane-based air

dehumidification has been applied in heating, ventilation and air

conditioning, compressed air dehumidification and environmental control

in space vehicle, and some other engineering fields. This paper

summarizes recent research results in these fields, including

fundamental principles, membrane materials, membrane module structures,

operation conditions and theory models. In the end, two methods of

membrane-based dehumidification performance evaluation are introduced

from perspective of energy and exergy, respectively.

PT J

AU Nie, Jinzhe

Yang, Jianrong

Fang, Lei

Kong, Xiangrui

TI Experimental evaluation of enthalpy efficiency and gas-phase contaminant

transfer in an enthalpy recovery unit with polymer membrane foils SO SCIENCE AND TECHNOLOGY FOR THE BUILT ENVIRONMENT VL 21 IS 2 BP 150 EP 159 DI 10.1080/10789669.2014.967165 PD 2015 PY 2015 AB Experimental studies were conducted in a laboratory setting to

investigate the enthalpy efficiency and gas-phase contaminant transfer

in a polymer membrane enthalpy recovery unit. One commercially available

polymer membrane enthalpy recovery unit was used as a reference unit.

Simulated indoor air and outdoor air by twin chambers was connected to

the unit. Three chemical gases were dosed to the indoor exhaust air to

mimic indoor air contaminants. Based on the measurements of temperature,

humidity ratio, and contaminant concentrations of the indoor exhaust air

and outdoor air supply upstream and downstream of the unit, the

temperature efficiencies, humidity efficiencies, enthalpy efficiencies,

and contaminant transfer ratios were calculated. The results showed that

over 60% of enthalpy recovery efficiency could be achieved and that the

contaminant transfer ratios were in the range of 5.4% to 9.0%. The

enthalpy efficiency in cold-dry climate conditions was slightly higher

than in hot-humid climate conditions. The contaminant transfer ratio

were independent of any hygrothermal difference between indoor and

outdoor air and was unrelated to its molecule size or water solubility.

The conclusion indicated that the polymer membrane enthalpy recovery

unit may be a viable choice for energy recovery in ventilation systems.

PT J

AU Zhong, Qiu

Yang, Liping

Tao, Ye

Luo, Caiyun

Xu, Zijun

Xi, Tonggeng

TI An optimized crossflow plate-fin membrane-based total heat exchanger SO ENERGY AND BUILDINGS VL 86 BP 550 EP 556 DI 10.1016/j.enbuild.2014.10.036 PD JAN 2015 PY 2015 AB In this paper, a test rig was constructed to measure the sensibility and

enthalpy effectiveness of a plate-fin total heat exchanger (PFFHE).

Combined with finite element method, the influence of airflow

distribution was analyzed, and an improved PFTHE was subsequently

introduced. Utilizing the test rig, the study measured the sensibility

and enthalpy effectiveness of the improved PFTHEs with air deflectors

and different air spreader plates. Results show that the sensibility and

enthalpy effectiveness of the PFTHE are optimized at 17.4% and 7.8%

airflow rates, respectively. (C) 2014 Elsevier B.V. All rights reserved.

PT J

AU Liang, Caihang

TI Research on a Refrigeration Dehumidification System with Membrane-Based

Total Heat Recovery

SO HEAT TRANSFER ENGINEERING

VL 35

IS 11-12

SI SI

BP 1043

EP 1049

DI 10.1080/01457632.2013.863072

PD JUL 24 2014

PY 2014

AB An independent air dehumidification system is helpful to improve indoor

air quality and decrease energy consumption by heating, ventilation, and

air conditioning (HVAC). A refrigeration dehumidification system with

membrane-based total heat recovery is the key equipment to realize this

goal. The system comprises two subsystems: a membrane total heat

recovery and a direct expansion refrigeration system. The total heat

exchanger has a membrane core where the incoming fresh air exchanges

moisture and temperature simultaneously with the exhaust air. In this

manner, the total heat or enthalpy from the exhaust air is recovered.

Then the fresh air flows through a cooling coil where it is dehumidified

below the dewpoint. Finally, the cold and dry air is supplied to

indoors. A prototype of practical application is designed and

fabricated. Experiments are conducted under variable operating

conditions in the psychrometric calorimeter chamber. The effects of

varying operating conditions like temperature and air humidity on the

air dehumidification rate, cooling power, coefficient of performance,

and compressor power are evaluated with indoor exhaust air dry bulb 27

degrees C, wet bulb 19 degrees C, and fresh air flow rate 200m(3)/h. In

comparison with a conventional refrigeration dehumidification system,

the coefficient of performance and air dehumidification rate of the

prototype are 2.3times and 3times higher, respectively. The performance

of the prototype is rather robust under a hot and humid environment.

PT J

AU Huizing, Ryan

Merida, Walter

Ko, Frank

TI Impregnated electrospun nanofibrous membranes for water vapour transport

applications

SO JOURNAL OF MEMBRANE SCIENCE

VL 461

BP 146

EP 160

DI 10.1016/j.memsci.2014.03.019

PD JUL 1 2014

PY 2014

AB Membranes with high water vapour permeance and selectivity find many end

uses including protective clothing, dehydration, and humidification. One

application for water vapour transport membranes is in energy recovery

ventilators (ERVs) for buildings. These devices improve building energy

efficiency by transporting heat and moisture between incoming and

outgoing air streams in building ventilation systems, effectively

'recycling' the energy used to condition the indoor air. Membranes for

these devices must have high vapour permeance, and selectivity for water

vapour over other gases and contaminants that may be present in the

exhaust indoor air. Due to the high rates of water vapour transport

required in these gas to gas devices, boundary layer and internal

resistances within the membrane contribute significantly to performance.

Commercially available membranes suffer from high water vapour transport

resistance in the microporous substrate support layer. In this study we

report the fabrication of novel impregnated electrospun nanofibrous

membranes (IENM) for water vapour transport applications. Electrospun

nanofibre layers are impregnated with a polyether-polyurethane solution

and cured to create continuous thin impregnated fibre loaded film layers

which are bound to a non-woven support layer. These membranes have high

water vapour permeance and selectivity while eliminating the requirement

for a microporous support layer which has high vapour transport

resistance. Here we report initial studies on how controllable factors

in the membrane fabrication (namely fibre loading and impregnated

solution polymer solids concentration) affect structural and permeation

properties of IENMs created. Membranes with adequate permeance and

selectivity are demonstrated and direction for optimization is

identified. We find that the nanofibre loading has a significant impact

on water vapour permeability as the membrane thickness decreases. Future

work will study how modifications to the geometric and structural

properties of the fibres affect the membrane performance. (C) 2014

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PT J

AU Woods, Jason

TI Membrane processes for heating, ventilation, and air conditioning SO RENEWABLE & SUSTAINABLE ENERGY REVIEWS VL 33 BP 290 EP 304 DI 10.1016/j.rser.2014.01.092 PD MAY 2014 PY 2014 AB This article reviews literature on using membranes in heating,

ventilation, and air conditioning (HVAC) applications. Membranes enable

the separation of one species from another, and membranes allowing the

selective permeation of water vapor can be used to condition air in

buildings, potentially more efficiently than conventional HVAC

equipment. After a brief background on membrane technology, this review

focuses on the following processes: vacuum membrane dehumidification;

membrane energy recovery ventilation; liquid desiccant dehumidification;

liquid desiccant regeneration; evaporative cooling; and humidification.

It highlights the design, modeling, and experimental research on these

topics, and suggests areas for further research. (C) 2014 Published by

Elsevier Ltd.

PT J

AU Dvorak, V.

Novotny, P.

Vit, T.

TI Testing of materials for heat and moisture transport SO Advanced Materials Research VL 896 BP 650 EP 5 DI 10.4028/www.scientific.net/AMR.896.650

PD 2014

PY 2014

AB The article deals with testing materials for using in enthalpy

exchangers. The purpose of the enthalpy heat exchangers is to transport

the heat and moisture together. Such heat exchangers are used in heat

and ventilation air conditioning units. There are several methods how to

test transport of moisture through material used in textile industry.

However, these methods are not suitable for testing of materials, which

are considered to be in heat exchangers. Methods for testing of moisture

transport are usually based on free convection around membrane, which

separates spaces with air of low humidity and air saturated with water.

The free convection does not occur in heat exchangers and moisture

varies in wide range. Therefore we developed and tested a devise to

simulate moisture transport in enthalpy heat exchangers with plates,

where co-current and countercurrent occur. With the help of this device,

we could compare materials and evaluate the influence of the surface

structure, which affect the boundary layers and heat and mass transport,

when the flow is tangential to the material surface. We could also

investigate the effect of flow velocity and humidity. The methods of

evaluation are discussed and some results are presented.

PT S

AU Fang, Lei

Yuan, Shu

Nie, Jinzhe

BE Li, A

Zhu, Y

Li, Y

TI Experimental Evaluation of a Total Heat Recovery Unit with Polymer

Membrane Foils

SO PROCEEDINGS OF THE 8TH INTERNATIONAL SYMPOSIUM ON HEATING, VENTILATION

AND AIR CONDITIONING, VOL 2: HVAC&R COMPONENT AND ENERGY SYSTEM SE Lecture Notes in Electrical Engineering VL 262 BP 235 EP 242 DI 10.1007/978-3-642-39581-9\_23 PD 2014 PY 2014 AB A laboratory experimental study was conducted to investigate the energy

performance of a total heat recovery unit using a polymer membranes heat

exchanger. The study was conducted in twin climate chambers. One of the

chambers simulated outdoor climate conditions and the other simulated

the climate condition indoors. The airflows taken from the two chambers

were connected into the total heat recovery unit and exchange heat in a

polymer membrane foil heat exchanger installed inside the unit. The

temperature and humidity of the air upstream and downstream of the heat

exchanger were measured. Based on the measured temperature and humidity

values, the temperature, humidity, and enthalpy efficiencies of the

total heat recovery unit were calculated. The experiment was conducted

in different combinations of outdoor climate conditions simulating warm

and humid outdoor climates and air-conditioned indoor climate. The test

was also conducted in isothermal conditions to observe the moisture

transfer performance of the polymer membrane heat exchanger. The results

of the experiment shows that total heat recovery equipment tested can

recover up to 60 % of the total heat from the ventilation air. Around 87

% of the recovered total heat is latent heat that comes from the

moisture transfer.

CT 8th International Symposium on Heating, Ventilation, and Air

Conditioning (ISHVAC)

CY OCT 19-21, 2013

CL Xian, PEOPLES R CHINA

SP Xian Univ Architecture & Technol; Tsinghua Univ; Univ Hong Kong TC 1 ZB 0

PT J

AU Nasif, Mohammad Shakir

Al-Waked, Rafat

Behnia, Masud

Morrison, Graham

TI Air to air fixed plate enthalpy heat exchanger, performance variation

and energy analysis

SO JOURNAL OF MECHANICAL SCIENCE AND TECHNOLOGY VL 27 IS 11 BP 3541 EP 3551 DI 10.1007/s12206-013-0872-6 PD NOV 2013 PY 2013 AB The thermal performance of a Z shape enthalpy heat exchanger utilising

70 gsm Kraft paper as the heat and moisture transfer surface has been

investigated. Effects of different inlet air humidity ratio conditions

on the heat exchanger effectiveness and on the energy recovered by the

heat exchanger have been the main focus of this investigation. A typical

air conditioning cooling coil which incorporates an enthalpy heat

exchanger has been modelled for tropical climate. Under test conditions,

results have shown that latent effectiveness and the moisture resistance

coefficient have strong dependency on the inlet air humidity ratio.

Moreover, the latent effectiveness has been found to be strongly

dependent on the moisture resistance coefficient rather than the

convective mass transfer coefficient. Finally, annual energy analysis

for Singapore weather conditions have also shown that energy recovered

under variable inlet air conditions is 15% less than that recovered

under constant inlet air conditions for the same heat exchanger.

PT J

AU Zaw, Khin

Safizadeh, M. Reza

Luther, Joachim

Ng, Kim Choon

TI Analysis of a membrane based air-dehumidification unit for air

conditioning in tropical climates

SO APPLIED THERMAL ENGINEERING

VL 59

IS 1-2

BP 370

EP 379

DI 10.1016/j.applthermaleng.2013.05.029

PD SEP 25 2013

PY 2013

AB The dehumidification potential of a cross-flow membrane based

air-dehumidification unit is analysed for tropical climatic conditions.

The process of dehumidification is driven by the gradient of the

concentration of water vapour between the incoming ambient air and the

relatively dry exhaust air from a building. Electric energy is used for

air transport only. This paper reports on experiments, physical

modelling and computer simulations performed for the analysis of a

laboratory-type dehumidification unit in Singapore. Experimentally

moisture reductions between 4 g and 8 g of moisture per kg of moist air

have been achieved for high humidity ambient air conditions (16 g/kg and

20 g/kg, respectively). Membrane dehumidification units may be used as

stand-alone dehumidification units or as pre-dehumidification devices in

the context of more complex air-conditioning systems in tropical

climates. (C) 2013 Elsevier Ltd. All rights reserved.

RI Ng, Kim Choon/A-9421-2014; Ng, Kim Choon/

OI Ng, Kim Choon/0000-0003-3930-4127

PT P

AU ISHIMARU Y

TOGAWA H

TAKADA M

TOKIZAKI S

TERAI M

TI Total enthalpy heat exchanger used for ventilator, has partition plate

with porous resin base material layer, layer with porous hydrophilic

moisture-permeable resin film, and another layer having non-hole-shaped

hydrophilic resin film

PN JP2013015286-A

AE MITSUBISHI ELECTRIC CORP

AB

NOVELTY - Total enthalpy heat exchanger has partition plate with

three-layered structure having layer (A) with porous resin base material

(11), layer (B) with porous hydrophilic moisture-permeable resin film

(10) laminated on layer (A), and layer (C) laminated on layer (B) having

air permeability. Layer (C) contains non-hole-shaped hydrophilic

moisture-permeable resin film (9) and has corrugated shape on surface,

and gas-shielding property. Heat exchanger distributes 2 types of gases

across partition plate, and heat-exchanges sensible heat and latent heat

of each gas through partition plate.

USE - Total enthalpy heat exchanger is used for ventilator.

ADVANTAGE - The heat exchanger can also be used under cold environment.

DETAILED DESCRIPTION - An INDEPENDENT CLAIM is included for manufacture

of partition plate.

DESCRIPTION Of DRAWING(S) - The drawing shows a schematic view of the

partition plate used for heat exchanger.Non-hole-shaped hydrophilic

moisture-permeable resin film (9)Porous hydrophilic moisture-permeable

resin film (10)Porous resin base material (11)

PT J

AU Huang, Si-Min

Zhang, Li-Zhi

Tang, Kai

Pei, Li-Xia

TI Fluid flow and heat mass transfer in membrane parallel-plates channels

used for liquid desiccant air dehumidification SO INTERNATIONAL JOURNAL OF HEAT AND MASS TRANSFER VL 55 IS 9-10 BP 2571 EP 2580 DI 10.1016/j.ijheatmasstransfer.2012.01.003

PD APR 2012

PY 2012

AB Fluid flow and convective heat mass transfer in membrane-formed

parallel-plates channels are investigated. The membrane-formed channels

are used for liquid desiccant air dehumidification. The liquid desiccant

and the air stream are separated by the semi-permeable membrane to

prevent liquid droplets from crossing over. The two streams, in a

cross-flow arrangement, exchange heat and moisture through the membrane,

which only selectively permits the transport of water vapor and heat.

The two flows are assumed hydrodynamically fully developed while

developing thermally and in concentration. Different from traditional

method of assuming a uniform temperature (concentration) or a uniform

heat flux (mass flux) boundary condition, the real boundary conditions

on membrane surfaces are numerically obtained by simultaneous solution

of momentum, energy and concentration equations for the two fluids.

Equations are then coupled on membrane surfaces. The naturally formed

boundary conditions are then used to calculate the local and mean

Nusselt and Sherwood numbers along the channels. Experimental work is

performed to validate the results. The different features of the

channels in comparison to traditional metal-formed parallel-plates

channels are disclosed. (C) 2012 Elsevier Ltd. All rights reserved.

PT B

AU Khin, Zaw

Ng, Kim Choon

GP ASME

TI THEORETICAL AND EXPERIMENTAL ANALYSES OF ENERGY EFFICIENT AIR

DEHUMIDIFICATION SYSTEMS FOR TROPICAL CLIMATES USING MEMBRANE TECHNOLOGY SO PROCEEDINGS OF THE ASME INTERNATIONAL MECHANICAL ENGINEERING CONGRESS

AND EXPOSITION, 2011, VOL 4, PTS A AND B BP 39 EP 46 PD 2012 PY 2012 AB This paper presents the analytical and experimental analysis of a

membrane based air-dehumidification system for handling the latent loads

efficiently. This is important for tropical countries like Singapore

where the humidity content of ambient air is high and therefore, air

conditioning systems need to handle large latent load. A detailed COMSOL

simulation model was set-up in order to simulate the water diffusion

through the membrane. Experimental results from a real size membrane

dehumidification unit are used to validate the mathematical model. Our

investigations show that the moisture content of ambient air may be

reduced by more than 5 g per kg of air if the dehumidification process

is driven by the gradient between the water content of ambient air and

the water content of exhaust air form air-conditioned spaces. With the

exception of low electricity requirement for air transport, there is no

electric energy consumption in the system. Therefore, the membrane

system discussed in this paper is an efficient and alternative way of

air dehumidification for air conditioning applications, potentially

reducing the electricity consumption of air conditioning system in

tropics.

CT ASME International Mechanical Engineering Congress and Exposition

(IMECE)

CY NOV 11-17, 2011

CL Denver, CO

SP Amer Soc Mech Engn

RI Ng, Kim Choon/A-9421-2014

PT S

AU Li, Li

Zhang, Qingling

Li, Yaping

BE Chu, MJ

Li, XG

Lu, JZ

Hou, XM

Wang, X

TI Application of an Air-Air Energy Exchanger in a Building HVAC System in

Xiamen

SO PROGRESS IN CIVIL ENGINEERING, PTS 1-4 SE Applied Mechanics and Materials VL 170-173 BP 2474 EP 2477 DI 10.4028/www.scientific.net/AMM.170-173.2474

PD 2012

PY 2012

AB An air-air energy exchanger (AAEE) has been introduced in the literature

as a novel energy recovery system that transfers heat and moisture

between the ventilation and exhaust air. In this paper, the application

of an AAEE in a HVAC system is investigated. The paper discusses the

dependency of AAEE performance on ventilation air and indoor and outdoor

air conditions,it describes how to control the AAEE in different

operating conditions (summer and winter). The suited meteorological

conditions of the AAEE in buildings are given. Based on the humidity and

temperature data of the typical meteorological year in Xiamen, the

temperature distribution statistics throughout the year is studied and

the air enthalpy difference is calculated. Combining with the demand of

the indoor air conditioning parameters, the applicable hours of

different types of AAEE, such as total heat and sensible heat, in Xiamen

are analyzed. It is shown that the lower we intend to get the

temperature and relative humidity, the more space there will be for the

AAEE to work in summer. In winter, for the sensible heat AAEE, the

higher indoor temperature we design, the more hours it works, the

greater space we will have for heat recovery. But for the total heat

AAEE, it will be used longer as the indoor temperature and relative

humidity are designed higher. The study results show that the AAEE can

be energy-saving and reduce indoor air pollution of modern buildings,

improve indoor work and living environment. The result can provide basic

principle and referenced data for product improvement and

air-conditioning system design.

CT 2nd International Conference on Civil Engineering, Architecture and

Building Materials (CEABM 2012)

CY MAY 25-27, 2012

CL Yantai, PEOPLES R CHINA

SP Yantai Univ, Sch Civil Engn; Guizhou Univ, Coll Civil & Architecture

Engn; Hainan Soc Theoret & Appl Mech

PT J

AU MIN, J. C.

SU, M.

WANG, L. N.

TI EXPERIMENTAL AND THEORETICAL INVESTIGATIONS OF MEMBRANE-BASED ENERGY

RECOVERY VENTILATOR PERFORMANCE

SO International Journal of Air-Conditioning and Refrigeration VL 20 IS 1 BP 58 EP 66 PD 2012 PY 2012 AB Experimental and theoretical studies were conducted to investigate the

performance of a membrane-based energy recovery ventilator, which is an

air-to-air heat exchanger with a water vapor permeable core. Tests were

done on a commercially available membrane-based energy recovery

ventilator, during which the supply and exhaust air states were recorded

continuously over a long period of time. The test results show that as

time passes the sensible effectiveness decreases very slightly from 56%

to 55%, while the latent effectiveness increases appreciably from 28% to

39%. As a resultant of sensible and latent effectiveness, the enthalpy

effectiveness provides an intermediate value between them and increases

from 39% to 43%. The reason that the effectiveness changes with time is

that the air relative humidity changes with time, which alters the

moisture content at the membrane surface. Calculations were then

implemented to predict the performance of the membrane-based energy

recovery ventilator based on the model we developed previously and the

calculation results were compared with the experimental data. The

comparison suggests that the calculated effectiveness agrees well with

the measured one, supporting the reasonability of the model.

Calculations were also made to investigate the effects of various

membrane parameters on latent and enthalpy effectiveness and

latent-to-sensible heat ratio.

PT J

AU Kim, Nae-Hyun

AU 이을종

송길섭

이정표

TI HEAT AND MOISTURE TRANSFER CHARACTERISTICS OF A PLATE-TYPE ENTHALPY

EXCHANGER MADE OF PAPER

SO International Journal of Air-Conditioning and Refrigeration VL 19 IS 1 BP 85 EP 92 PD 2011 PY 2011 AB In this study, heat and moisture transfer data of an enthalpy exchanger

were obtained varying the indoor and outdoor condition systematically.

At the same time, equilibrium water content ratios of the membrane were

measured. It is shown that equilibrium water content ratio of the

membrane increases with the increase of relative humidity. The effect of

temperature on equilibrium water content ratio, however, is rather

complex. It decreases with the increase of temperature to a certain

value, and then increases with further increase of temperature. Moisture

transfer effectiveness of the enthalpy exchanger is also affected by

relative humidity and temperature. Heat transfer effectiveness, however,

is independent of relative humidity and temperature. Moisture transfer

effectiveness of the enthalpy exchanger was successfully correlated by

equilibrium water content ratio of the membrane.

PT J

AU Nasif, M.

AL-Waked, R.

Morrison, G.

Behnia, M.

TI Membrane heat exchanger in HVAC energy recovery systems, systems energy

analysis

SO ENERGY AND BUILDINGS

VL 42

IS 10

BP 1833

EP 1840

DI 10.1016/j.enbuild.2010.05.020

PD OCT 2010

PY 2010

AB The thermal performance of an enthalpy/membrane heat exchanger is

experimentally investigated. The heat exchanger utilizes a 60gsm Kraft

paper as the heat and moisture transfer surface for HVAC energy

recovery. The heat exchanger sensible. latent and total effectiveness

have been determined through temperature and moisture content

measurements. The annual energy consumption of an air conditioner

coupled with an enthalpy/membrane heat exchanger is also studied and

compared with a conventional air conditioning cycle using in-house

modified HPRate software. The heat exchanger effectiveness are used as

thermal performance indicators and incorporated in the modified

software. Energy analysis showed that an air conditioning system coupled

with a membrane heat exchanger consumes less energy than a conventional

air conditioning system in hot and humid climates where the latent load

is high. It has been shown that in humid climate a saving of up to 8% in

annual energy consumption can be achieved when membrane heat exchanger

is used instead of a conventional HVAC system. (C) 2010 Elsevier B.V.

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EF