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Fwd: i-TREC 2018 submission 295

imansyah@eng.ui.ac.id <imansyah@eng.ui.ac.id> Sat, May 6, 2023 at 7:28 PM
To: artawina@gmail.com

-------- Pesan Asli --------

Judul: i-TREC 2018 submission 295
Tanggal: 2018-08-03 10:28
Pengirim: "i-TREC 2018" <itrec2018@easychair.org>
Penerima: Imansyah Ibnu Hakim <imansyah@eng.ui.ac.id>

Dear authors,

We received your paper:

Authors : Imansyah Ibnu Hakim, Nandy Putra, Adam Prihananda Marda, Muhammad Alvin Alvaro and Adi Winarta
Title : Experimental Study on Utilization of Heat Pipe Heat Exchanger for Improving Efficiency of Clean Room Air System in Hospitals
Number : 295

The paper was submitted by a conference chair.

Thank you for submitting to i-TREC 2018.

Best regards,
EasyChair for i-TREC 2018.

Bagian 1.asc
1K

Gmail **Adi Winarta <artawina@gmail.com>**

Fwd: i-TREC 2018 notification for paper 295

imansyah@eng.ui.ac.id <imansyah@eng.ui.ac.id> Sat, May 6, 2023 at 7:28 PM
To: artawina@gmail.com

-------- Pesan Asli --------

Judul: i-TREC 2018 notification for paper 295
Tanggal: 2018-08-29 20:12
Pengirim: "i-TREC 2018" <itrec2018@easychair.org>
Penerima: Imansyah Ibnu Hakim <imansyah@eng.ui.ac.id>

Dear Prof. / DR. / Mr./Mrs. Imansyah Ibnu Hakim,
Congratulations!!
Your conference paper submission entitled Experimental Study on Utilization of Heat Pipe Heat Exchanger for Improving Efficiency of Clean Room Air System in Hospitals, has been accepted for the 3rd International Tropical Renewable Energy Conference, which will take place September 6-8, 2018, in Discovery Kartika Plaza Hotel, Bali, Indonesia.
Please reflect the reviewers' comments into your final manuscript and submit it in MS Word file format via Easy Chair by August 31, 2018. Papers submitted after the deadline will not be accepted.
After peer-reviewed, accepted and presented papers will published in one of the special issues of the following proceedings or journals :
1. E3S which is indexed by SCOPUS, THOMSON REUTERS, and many more.
2. International Journal of Technology (indexed in SCOPUS, Q2) only for selected papers.
Below are items for your consideration for presenting a paper at the 3rd International Tropical Renewable Energy Conference, Bali:
1. Request your Support Letter for Visa Application/Letter of Invitation early to ensure that all paperwork is completed and approved on time. Please complete the form and submit the completed form to i-trec@ui.ac.id.
2. Registering as the presenting author -- At least one of the authors must register as the presenting author and the required registration fee must be paid before July 31, 2018.
3. The conference registration form can be downloaded at https://i-

trec.ui.ac.id/wp-content/uploads/sites/158/2018/04/Registration-Form.docx.
4. The registration form and the payment proof must be emailed to i-trec@ui.ac.id.
5. The registration fee received by the 3rd i-TREC is not refundable.
6. Note that one author can be the presenting author on a maximum of 2 papers. Presenting authors must clearly mark in their registration for the conference of which paper(s) they will be presenting.

Kind regards,
Eny Kusrini, Ph.D.
The 3rd i-TREC 2018 General Chair
TREC Faculty of Engineering
Universitas Indonesia
Website: https://i-trec.ui.ac.id

----------------------- REVIEW 1 ---------------------
PAPER: 295
TITLE: Experimental Study on Utilization of Heat Pipe Heat Exchanger for Improving Efficiency of Clean Room Air System in Hospitals
AUTHORS: Imansyah Ibnu Hakim, Nandy Putra, Adam Prihananda Marda, Muhammad Alvin Alvaro and Adi Winarta

Overall evaluation: 2 (accept)

----------- Overall evaluation -----------
1. In accordance with the format
   - Please repair some pages, there is a blank pages on page 2 (before Fig. 2) and page 5 (before fig.5). It should not be good in page arrangement.
   - Some errors on writing point or comma in writing of unit/scale
   - Please write the scale of oC with a similar form

2. Overall, the methods could be well understood
   - Equation (1) is not explained with description
   - In relation to the number of notations, it should be added with nomenclature or given a description on the experimental set up.
   - Please add each measure parameters on the experimental set up
   - Figure of "Experimental set up" is not clear

3. Results and discussions

- Table (1) should be re-type and Table (1) is not mentioned in the discussion of sub title 3.3.1.
- Equation (1) should be mentioned in sub title "Temperature Differential at Evaporator". Please fix the sentences

----------------------- REVIEW 2 ---------------------
PAPER: 295
TITLE: Experimental Study on Utilization of Heat Pipe Heat Exchanger for Improving Efficiency of Clean Room Air System in Hospitals
AUTHORS: Imansyah Ibnu Hakim, Nandy Putra, Adam Prihananda Marda, Muhammad Alvin Alvaro and Adi Winarta

Overall evaluation: 2 (accept)

----------- Overall evaluation -----------
1.The title should be justified.
2. The first paragraph after a section or subsection should not be indented.
3. The captions should be centred above the tables and flush left beneath the figures.
4. In Abtract please write completely this abbreviations: HVAC, HPHE.
5. In introdusction author stated that : "The HPHE used in this study consisted of 12 heat pipes per module, in which heat pipe was arranged staggered.". Why use 12 heat pipes per module? and why heat pipe was arranged staggered? Please explain.
6. And about this sentence "Different from the previous study, in this one the ducting schematic was attempted to adjust to standard conditions in the hospital by using two outlets on right and left the side of the chamber. ", please give some comparison result that this research better than pravious study.

Bagian 1.asc
5K

Experimental Study on Utilization of Heat Pipe Heat Exchanger for Improving Efficiency of Clean Room Air System in Hospitals

Nandy Putra[1,*], *Imansyah* Ibnu Hakim[1], *Adi* Winarta[1], *Adam* Prihananda Marda[1], Muhammad *Alvin* Alvaro[1]

[1] Applied Heat Transfer Research Group, Department of Mechanical Engineering, University of Indonesia, Kampus UI, Depok 16424, Indonesia

Abstract. HVAC system in hospital's clean room is required to continue working for 24 hours to provide the ideal air quality for the activities therein. This causes a huge amount of energy consumption in hospital buildings itself. This study aims to determine the effectiveness and heat recovery of HPHE. The HPHE used in this study consisted of 12 heat pipes per module, in which the line was arranged staggered. The number of the module is varied 3 times, which are 1, 2, and 3 modules. The heat pipe is made of copper and contains working fluid in the form of water with 50% filling ratio. HPHE equipped with fins to expand the contact surface with airflow. Each variation of the number of modules is tested on the HVAC system model of the clean room. In the evaporator inlet, air flowing to the variation of temperature: 28, 30, 35, and 40° C, and at speeds of 1.5, 2.0, 2.5 m/s. The use of HPHE can recover heat as much as 1654.72 kJ/h. The highest effectiveness of this HPHE is 48.729%, was obtained when using three modules, air temperature inlet evaporator (Te, i) = 35 °C, and airspeed of inlet 1.5 m/s.

1. Introduction

Hospitals are health service institutions that provide a full range of personal health services (promotive, preventive, curative and rehabilitative), and provide inpatient, outpatient, and emergency care services [1]. Due to the many functions of the hospital, there are few room types according to its function. The existing rooms in the hospital include the inpatient room, emergency room, laboratory room, pharmacy room, isolation room, and operating room.

Facilities and infrastructure in the hospital have an important role for the hospital to keep performing its functions. These facilities and infrastructure include buildings, air systems, mechanical and electrical systems, and medical equipment. The air-conditioning system for the clean room should continue to operate for 24 hours in order to keep functioning properly. Hospital rooms such as operating rooms, for example, have special specifications set in international standards.

The operating room has certain specifications regarding the value of temperature, relative humidity, and air change within it. Under the ASHRAE standard [2], the temperature inside the operating room should be in the range 20-24° C, the relative humidity of air at 30-60%, and the change of air within it by 15-20 times per hour. The Heating Ventilation & Air Conditioning (HVAC) system in the operating room is required to continue working for 24 hours to provide this specification. The use of this continuous HVAC system results in the enormous energy demand in hospitals. Energy Consumption Index for hospitals by the Indonesian National Standard (SNI) 05-3052-1992 is 380 kWh/m². Based on the results of the survey and energy audit conducted by BPPT and JICA on buildings in Jakarta, the intensity of energy use in buildings the hospital reached 239 kWh/m² per year [3]. The HVAC system is the largest energy consumption in hospitals with a percentage of up to 60%.

Since a large amount of energy is used in the HVAC system for the operating room, a special method needs to be done to make savings. One of them is to use heat pipes as a heat recovery system. Heat Pipe Heat Exchangers (HPHE) have great potential for commercial and industrial applications, particularly in the HVAC [4]. This heat exchanger system virtually does not have cross-leakage between hot and cold airflow. Another advantage is that HPHE systems do not require input power to operate, are compact and passive, economical, reliable, have few components, and the design can be adjusted as needed [4].

First HPHE research in the air system of a hospital surgery room was conducted by Noie-Baghban et al. (Noie-Baghban and Majideian, 2000). They achieved 0.16 for the HPHE effectiveness. The reason for their relatively poor result was the shortcoming of fins. YH Yau [6] simulates the use of a double heat pipe heat exchanger in the operating room in order to decrease energy consumption. The model of an empirical transient system simulation program was made to estimate the energy consumption of the operating room per year. Their results stated that the use of HPHE is highly recommended as an effective tool in controlling moisture and as an energy saver to keep the condition of the room according to the standard specification. Heat pipe heat exchangers used in air conditioning systems (AC) as secondary heat recovery are also examined by Haito Wang et al [7]. This study also compares two systems, but with different configurations. The first system uses two HPHEs by laying before and after cooling coil, while the second system uses only one HPHE which is placed after the cooling coil. Experimental analysis shows that the average heat recovery efficiency of the system in winter is 21.08%, while in summer it is 39.2%. They stated that the use of two HPHEs is more effective. Govinda Mahajan et al [8] conducted a study on the use of oscillating heat pipe (OHP) as heat recovery in HVAC systems. The goal is to utilize thermal energy wasted to pre-heat or pre-cool the air as a step to reduce the load on

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the HVAC system. The results show that the full OHP can work in the air to air convection mode for heat recovery under typical HVAC system operating conditions. Winarta et al. also performed experimental test of thermal performance of Oscillating Heat Pipe for heat recovery design [13].

Putra et al. [5] conducted an experimental study to investigate the thermal performance of HPHE the operating room air conditioning system. HPHE consists of several tubular heat pipes with water as the working fluid and arranged staggered to 6 lines. Experiments were conducted to determine the effect of incoming air temperature, the number of lines used, and also the air velocity of entry. Experimental results stated that the greater the air temperature, the greater the effectiveness of HPHE. It was found that with a decrease in air temperature coming into the evaporator of 2.4 ° C, its effectiveness value is 0.15. This result was obtained when using 6 HPHE lines, 1 m/s air velocity, and air intake temperature of evaporator 45° C. When air velocity doubled to 2 m/s, the system achieved the greatest heat recovery value of 1404.29 kJ/hour. Based on the previous result, still a potensial method to save energy.

Specifically at the clean room, the use of HPHE are the potential method to reduce the energy consumption used in HVAC system. To continue/continuing our previous research, a further development of HPHE application on a clean room needs to be design and test. To obtain a more effective and efficient HPHE system. The HPHE used in this study consisted of 12 heat pipes per module, in which heat pipe was arranged staggered. The number of modules is varied 3 times, 1, 2, and 3 modules. HPHE equipped with the fin to expand the contact surface with airflow. Each of these module configurations is tested on a clean room HVAC system model. In the evaporator inlet air flowing to the variation of temperature: 28, 30, 35, 40° C, and at speeds of 1.5, 2.0, 2.5 m/s. In this study, the ducting schematic design was manufactured following the standard (ASHRAE) of clean room at the hospital using two outlets on the right and left side of the room simulator. Moreover, the refrigeration for the ducting system using mini air-cooled chiller system. This system is widely used in the actual application. The purpose of this study was to obtain the effectiveness and heat recovery of HPHE applications in clean room.

Methodology

2.1. Heat Pipe Heat Exchanger Design Modul

Three HPHE modul were constructed with tubular heat pipes in a staggered arrangement. Each module consists of 12 heat pipes and wavy fins. The heat pipe was made from 10 mm tubular copper tubbing with a total length of 720 mm. DI Water was choseen as the working fluid for the heat pipe with 50% filling ratio. The evaporator, adiabatic and condenser was considered about 150 mm, 380 mm, 190 mm respectively. The part of HPHE module which is considered as an evaporator section is placed in fresh-supply air ducting, while the condenser section is placed in return-exhaust air ducting. Wavy fin material is aluminum with thickness 0,105 mm. The length of the wavy fin is 100 mm and the width is 63.3 mm. There are 90 wavy fins mounted on the evaporator and 95 mounted on the condenser part. The distance between the wavy fins is 2 mm.

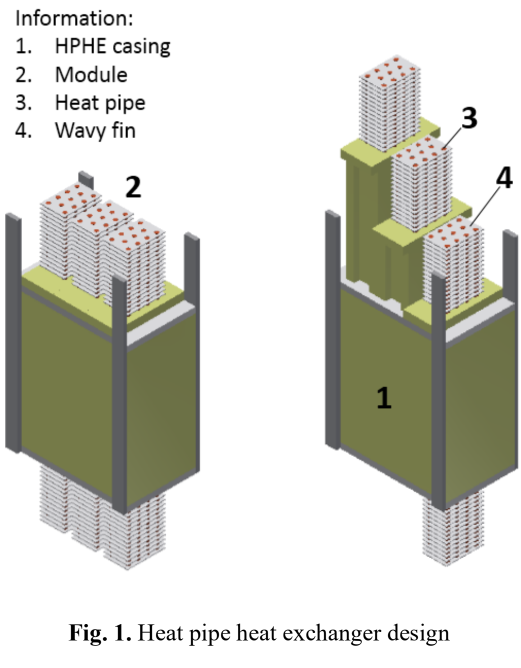

Fig. 1. Heat pipe heat exchanger design

2.2. Experimental Setup

Figure 2 provide a schematic of the test rig for the ducting system. The ducting also equiped with 3 axial fan and a cooling coils with fins. Mini air cooled chiler was built from 200 m^3 water container. The water inside the container is cooled with refrigerant system using R22 as primary refrigerant. Proper insulation were used to reduce the heat loss from water container and chiller water piping system to the ducting cooling coil. The secondary refrigerant (water) is circulated through the ducting cooling coil and water container using water pump. The temperature measurement was conducted with type-K thermocouple with DAQ system (NI 9214, NI 9213 and cDAQ 9174). The moisture data of airflow was measured with relative humidity (RH) sensor by ®Phidget and recorded to PC using data logger. Two thermocouple and two RH sensors are placed at fresh-supply and return-exhaust air inside the ducting system. The Kimo AMI-300 hotwire sensor is used to measure the speed of the airflow on the ducting to match the specified value. Mass flow rate of the chilled water was regulatead by rotameter. The picture of experimental setup is provided at figure 3.

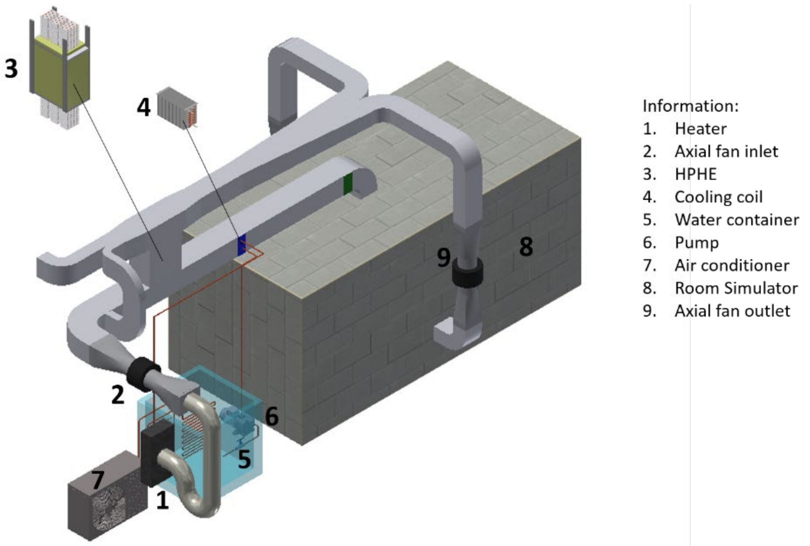

Fig. 2. Experimental ducting system

Fig. 3. Experimental rig at the laboratory

2.3. The experimental Method

Fig. 4. shows a schematic of the test rig. Room simulator volume was approximately 310 × 150 × 150 cm^3.The experimental rig consist of inlet and outlet side, HPHE, ducting cooling coil, room simulator, temperature and relative humidity measurement system which connected to ducting system. Fig. 4 also shown the HPHE placement inside the ducting and the directions of air flow. The cooling coil was placed after the HPHE module. Axial fan blow the fresh air to the ducting system with three variations (1.5, 2.0, and 2.5 m/s). Fresh air is heated by a heating element system with PID controller. So that the inlet temperature can be varied by 28, 30, 35 and 40 °C respectively. The number of HPHE modules used inside the ducting also varies to 1, 2, and 3 modules.

Refrigeration system for room simulator using mini air-cooled chiller system. This can produce 5 – 7 °C chilled water to the ducting cooling coil. Temperature 25-26°C can be generated inside room simulator using this system. If the water mass flow rate can be set constantly (4 LPM at this research), then the amount of energy recovered by HPHE for refrigeration can calculated easily.

The thermal performance of the HPHE can be defined by its effectiveness and heat recovery values. Abd El-Baky et al [9, Noie Baghban, Incropera] stated the effectiveness of HPHE by the equation below;

$$\varepsilon = \frac{T_{e,in} - T_{e,out}}{T_{e,in} - T_{c,in}} \quad (1)$$

Heat recovery is a Q actual obtained by the relation below;

$$Q_{act} = \dot{m}_h C_{ph}(Te,in - Te,out) \quad (2)$$

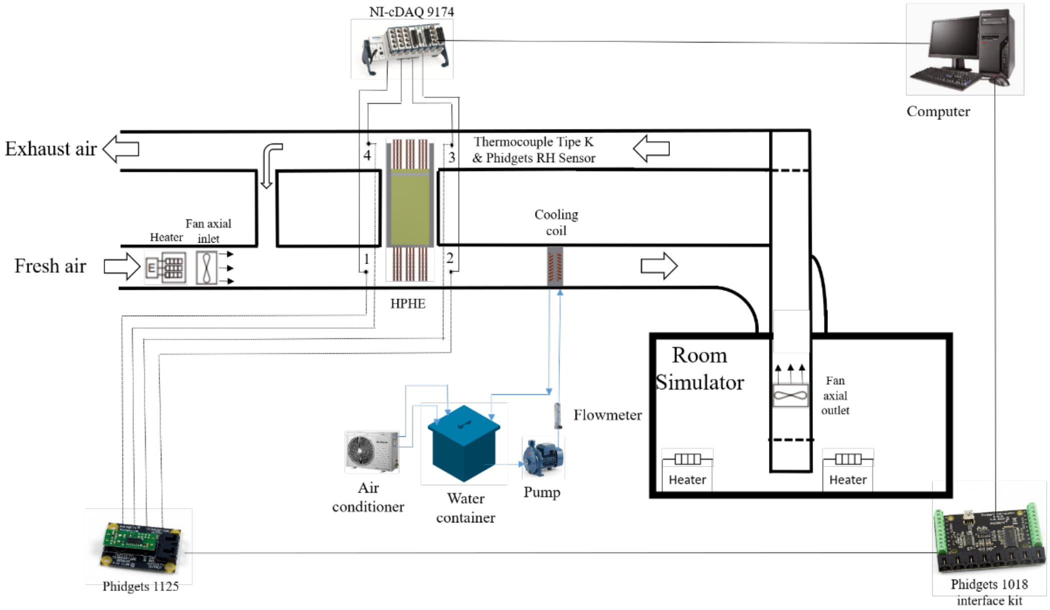

Fig. 4. Experimental setup

3. Results and Discussion

3.1. Effect on temperature and Relative Humidity

Fig. 5 shows the result for $T_{e,i}$ = 40 °C, $V_{e,i}$ = 1.5 m/s and using 3 modules of HPHE for both evaporator and condenser (inlet and outlet temperature). The graph shown clearly that HPHE can reduce the incoming air temperature ($T_{e,o}$) up to 5.432 °C. The evaporator sections HPHE absorbs the sensible heat of the incoming air and reduce the temperature significantly. From this graph we can conclude that HPHE has successfully precooling the fresh supply air. Meanwhile, there is an increase of air temperature which pass through the condenser sections of HPHE. The average temperature increase at the condenser outlet ($T_{c,o}$) was 2.320 °C. Or, we can conclude not all the energy absorp at the evaporator sections were successfully release at the condenser section of HPHE.

Fig. 6. shows the relative humidity at the same positions of temperature measurement at Fig.5. The relative humidity of air passes through the HPHE evaporator has increased of 37.31%. The increase of relative humidity is due to the decrease of air temperature inlet ($T_{e,i}$) after the precooling process at HPHE evaporator. While on the HPHE condenser, the relative humidity of condenser inlet decreases from 50.806% to 46.015%.

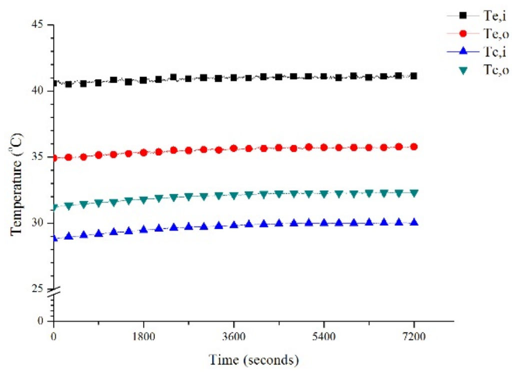

Fig. 5. Temperature profile at Te,i = 40°C, Ve,i = 1.5 m/s, 3 modul

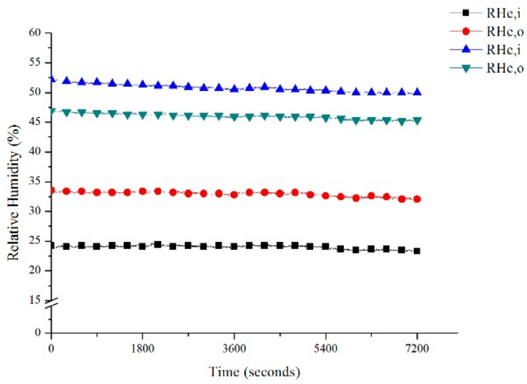

Fig. 6. Relative humidity profile at Te,i = 40°C, Ve,i = 1.5 m/s, 3 modul

Fig. 7. shows the relative humidity profiles referring to the HPHE evaporator inlet temperature. The average relative humidity in the room/ambient is approximately 50% include in the graph to find out how much change occurs when the experimental tool is run. In all variations of Te,i, RHe,i fall lower than 50% except at a temperature of 28°C. RHe,o is always greater than RHe,i in all variations of Te,i because the air decreases the vapor saturation pressure when it passes through the HPHE evaporator. This process is called sensible precooling process by the evaporator. The change from RHe,o to RHc,i is caused because the air temperature is lowered by cooling coil. Then RHc,o is smaller than RHc,i due to the addition of heat by the HPHE condenser into the air. The addition of this heat causes the addition of temperature and ultimately increases the vapor saturation pressure.

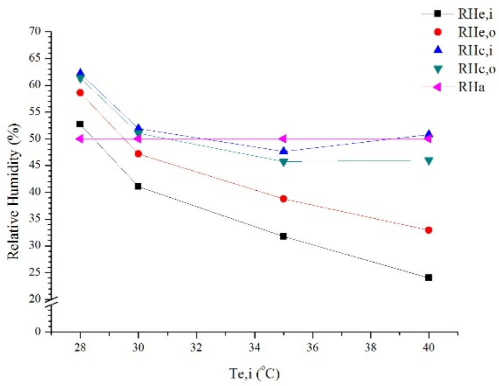

Fig. 7. Relative humidity profile with 3 modules and Ve,i = 1.5 m/s relative to Te,i

3.2 Effect of Temperature precooling at evaporator section

Fig. 8. shows the temperature drop of fresh air due to precooling effect by the evaporator section of HPHE (ΔTe = Te,i - Te,o). The temperature drop is increasing (ΔT_e) with more number of modules used. The larger $T_{e,i}$ will also enlarge ΔT_e as more heat can be absorbed by the HPHE evaporator. The largest ΔTe occurred in the 3-module test with Te, i = 40 °C and Ve, i = 1.5 m/s, while the smallest in the test 1-module with Te,i = 28 °C and Ve,i = 1.5 m/s.

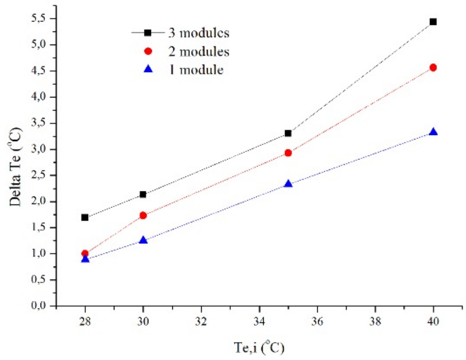

Fig. 8. ΔT HPHE evaporator profile with Ve,i = 1.5 m/s relative to the number of modules and $T_{e,i}$

3.3 Effect of Effectiveness and Heat Recovery

Fig. 9. illustrates the calculated effectiveness of HPHE for 3 modules based on the variation of inlet temperature of evaporator (Te,i) and air velocity (Ve,i). Raising the inlet temperature ($T_{e,i}$) at all air velocity not directly increase the effectiveness of HPHE. Increasing the air velocity at 2.0 and 2.5 m/s result in lowering the effectiveness. The value of effectiveness also decreases even though the inlet temperature has been raised from 30°C to 36°C. The greatest effectiveness was obtained at 1.5 m/s^2 of air velocity and 32.0°C of temperature inlet. Although, at this air velocity (1.5 m/s) the effectiveness effect due to the temperature variation are nearly constant. It is considered that the effect of air velocity is the most superior effect for the HPHE effectiveness. This result indicating that the heat transfer process was achieved with lower air velocity.

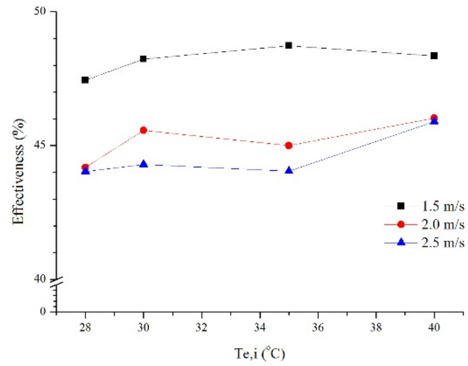

Fig. 9. HPHE effectiveness profile with 3 modules relative to Ve,i and Te,i

The calculated result of heat recovery for 3 modules and variation of air velocity with temperature inlet ($V_{e,i}$ and $T_{e,i}$) are indicated at **Fig.9**. It is found that the heat recovery is increased with increasing the inlet temperature or fresh air velocity. This happened because of the HPHE temperature change due to precooling is increase with raising the inlet temperature and air velocity. Based on the calculation of formula (2) then the resulting heat recovery will be greater. The highest value of heat recovery is 459,645 W or 1654,720 J/kg·K. It was achieved at temperatur inlet 40 °C ($T_{e,i}$) and air velocity 2.5 m/s ($V_{e,i}$).

3.4 Analysis of Heat Recovery Amount

Table 1. shows the HPHE effectiveness and heat recovery calculations for variations of module number, fresh air velocity and temperature of inlet fresh air. Based on that table, the capacity of HPHE to recover the heat increased the use more modules. The contact time between the air and HPHE becomes shorter with the increasing of air velocity. Lowering the air velocity will result in greater HPHE effectiveness. Increasing the inlet air temperature will increase the effectiveness of HPHE due to the larger amount of sensible heat to be absorbed by HPHE.

The highest heat recovery occurred in the 3-modules test with Te, i = 40°C and Ve, i = 2.5 m/s, and the smallest heat recovery occurred in the 1-module test with Te, i = 28°C and Ve, i = 1.5 m/s. This characteristic is consistent with the results of a study conducted by Nandy Putra et al [10]. In this study, the largest heat recovery value is 1654,72 kJ/hour.

Table 1. Effectiveness and heat recovery of HPHE

Te,i (°C)	3 modules			2 modules			1 module		
	1.5 m/s	2 m/s	2.5 m/s	1.5 m/s	2 m/s	2.5 m/s	1.5 m/s	2 m/s	2.5 m/s
	Effectiveness (%)								
28	47.443	44.185	44.030	41.098	39.361	38.384	36.003	34.776	34.483
30	48.233	45.566	44.299	41.143	38.790	37.664	35.425	33.682	33.312
35	48.729	44.995	44.048	40.839	40.226	38.397	35.264	33.379	32.416
40	48.344	46.024	45.890	41.642	39.710	38.538	35.071	33.843	33.075
	Heat Recovery (W)								
28	96.104	92.278	110.550	56.893	74.886	93.164	50.602	72.670	97.856
30	121.205	129.353	154.074	98.531	130.467	171.131	70.994	96.041	126.790
35	187.639	214.142	273.956	166.551	208.424	221.093	132.243	167.433	206.900
40	308.785	358.891	459.645	259.536	308.103	350.306	188.772	247.576	312.008

The HPHE can save energy consumption up to 459,645 W or 1654,72 kJ/hr in this experiment. This savings can occur under optimal conditions with 3 modules, Te,i = 40 °C, and Ve,i = 2.5 m/s. For real application, where Te,i is smaller than that, the saving that can be done is between 100-300 W. Energy saving efforts at the hospital are also analyzed and taken into account in the research of M. Ahmadzadehtalatapeh et al [11] and A. Teke et al [12].

4. Conclusion

From this research, the HPHE effectiveness value increases with the increasing used of modules and the amount of air temperature inlet evaporator, but decreases as the airspeed increases. The HPHE Heat Recovery Value increases with the increasing used of modules, the amount of air temperature inlet evaporator, and the air velocity. The greatest HPHE effectiveness is 48.729% was obtained when using three modules, air temperature inlet evaporator (Te,i) = 35 °C, and air speed of inlet 1.5 m/s. The smallest HPHE effectiveness is 32.416% was obtained when using one module, air temperature inlet evaporator (Te,i) = 35 °C, and air speed inlet 2.5 m/s. The largest heat recovery is 459,645 W or 1654,72 kJ/h, obtained when using three modules, air temperature inlet evaporator (Te,i) = 40 °C, and air speed inlet 2.5 m/s. The smallest heat recovery is 50.602 W or 182.169 kJ/h, obtained when using one module, air temperature inlet evaporator (Te,i) = 28 °C, and air speed of inlet 1.5 m/s. The thermal comfort conditions (temperature and relative humidity) have conformed to the ASHRAE standard for Te,i = 28°C and 30°C.

5. Acknowledgment

The author would like to thank DRPM UI for funding this research through the PITTA 2018 scheme with contract number 234/UN2.R3.1/PPM.00/2018. Also, to Mr. Iwan Chandra as a CEO of PT. Aicool Indonesia for manufacturing the HPHE module.

References

[1] Law of the Republic of Indonesia Number 44 Year 2009 About Hospital.
[2] ASHRAE, *HVAC Design Manual for Hospitals and Clinics*. 2013. Second Edition: p. 28.
[3] B2TE-BPPT, *Energy Efficiency and Elasticity Planning 2012.* Jakarta: BPPT Press, 2012.
[4] Srimuang, W. and P. Amatachaya, *A review of the applications of heat pipe heat exchangers for heat recovery.* Renewable and Sustainable Energy Reviews, 2012. 16 (6): p. 4303-4315.
[5] N. Putra, T. Anggoro, A. Winarta, *Experimental Study of Heat Pipe Heat Exchangers in Hospital HVAC System for Energy Conservation.* International Journal on Advanced Science, Engineering and Information Technology, 2017. 7 (3).
[6] Yau, Y.H., *The use of a double heat pipe heat exchanger system for reducing energy consumption of treating ventilation water in an operating theater-A full year energy consumption model simulation.* Energy and Buildings, 2008. 40 (5): p.917-925.
[7] Wang, H., et al., *A study of secondary heat recovery efficiency of heat pipe heat exchanger air conditioning system.* Energy and Building, 2016. 133: p. 206-216.
[8] Govinda Mahajan, H.C., Scott M Thomson, Harrison Rupp, Kevin Muse, *Oscillating Heat Pipe For Waste Heat Recovery in HVAC System.* ASME 2015, 2015. Proceeding of ASME 2015 International Mechanical Engineering Congress and Exposition.
[9] Abd El-Baky, M.A. and M.M. Mohamed, *Heat pipe heat exchanger for heat recovery in air conditioning.* Applied Thermal Engineering, 2007. 27 (4): p. 795-801.
[10] Muhammaddiyah, S., A. Winarta, N. Putra, Experimental Study of Multi-Fin Heat Pipe Heat Exchanger for Energy Efficiency in Operating Room Air Systems. International Journal of Technology (2018) 2: 422-429.
[11] Ahmadzadehtalatapeh, M., Yau, Y.H., *The application of heat pipe heat exchangers to improve the air quality and reduce the energy consumption of the air conditioning systems in a hospital ward-a full year model simulation.* Energy and Buildings, 2011. 43 (9):2344-2355.

[12] Teke, A., Timur, O., *Assessing the energy efficiency improvement potentials of HVAC systems considering economic and environmental aspects at the hospitals*. Renew. Sustain. Energy Rev. 2014, 7, 3282-3303.
[13] A. Winarta, N. Putra, and F. Bakhtiar, "Thermal Performance of Oscillating Heat Pipe with Ethanol/Methanol for Heat Recovery Application Design," *International Journal on Advanced Science, Engineering and Information Technology,* vol. 7, pp. 1268-1274, 2017.

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Adi Winarta <artawina@gmail.com>

Fwd: i-TREC 2018 submission 295 update

imansyah@eng.ui.ac.id <imansyah@eng.ui.ac.id> Sat, May 6, 2023 at 7:31 PM
To: artawina@gmail.com

-------- Pesan Asli --------

Judul: i-TREC 2018 submission 295 update
Tanggal: 2018-09-24 07:55
Pengirim: "i-TREC 2018" <itrec2018@easychair.org>
Penerima: Imansyah Ibnu Hakim <imansyah@eng.ui.ac.id>

Dear authors,

we acknowledge that we received new files for your i-TREC 2018 submission. The information about this update is shown below.

Number: 295
Authors: Imansyah Ibnu Hakim, Nandy Putra, Adam Prihananda Marda, Muhammad Alvin Alvaro and Adi Winarta
Title: Experimental Study on Utilization of Heat Pipe Heat Exchanger for Improving Efficiency of Clean Room Air System in Hospitals
Uploaded by: Imansyah Ibnu Hakim <imansyah@eng.ui.ac.id>
Updates:
Copyright Transfer Form, version 1 (97014 bytes)

To access the new version of your submission you should log in to the i-TREC 2018 EasyChair page.

Bagian 1.asc
1K

Gmail **Adi Winarta <artawina@gmail.com>**

Fwd: Publication for E3S for your paper in i-TREC 2018

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imansyah@eng.ui.ac.id <imansyah@eng.ui.ac.id> Sat, May 6, 2023 at 7:32 PM
To: artawina@gmail.com

-------- Pesan Asli --------

Judul: Publication for E3S for your paper in i-TREC 2018
Tanggal: 2018-11-21 09:18
Pengirim: "i-TREC 2018" <itrec2018@easychair.org>
Penerima: Imansyah Ibnu Hakim <imansyah@eng.ui.ac.id>

Dear Imansyah Ibnu Hakim,

We are glad to inform you that your papers titled Experimental Study on Utilization of Heat Pipe Heat Exchanger for Improving Efficiency of Clean Room Air System in Hospitals have been submitted to E3S for further publication process.

We will keep informing you the latest updates on the publication progress.

Regards,
Eny Kusrini, Ph.D.

Bagian 1.asc
1K

Gmail

Adi Winarta <artawina@gmail.com>

Fwd: Update on 3S Publication of your paper 295

1 message

imansyah@eng.ui.ac.id <imansyah@eng.ui.ac.id> Sat, May 6, 2023 at 7:32 PM
To: artawina@gmail.com

-------- Pesan Asli --------

Judul: Update on 3S Publication of your paper 295
Tanggal: 2018-11-27 06:22
Pengirim: "i-TREC 2018" <itrec2018@easychair.org>
Penerima: Imansyah Ibnu Hakim <imansyah@eng.ui.ac.id>

Dear Prof./Dr./Mr./Ms. Ibnu Hakim

Greetings from the 3rd i-TREC committee.

We would like to inform you that the proceedings of the 3rd i-TREC 2018 have been available online at the following link

https://www.e3s-conferences.org/articles/e3sconf/abs/2018/42/contents/contents.html

We thank you for your excellent contribution to the 3rd i-TREC 2018. We are looking forward to seeing you again in the 4th i-TREC 2019.

Warmest Regards,
Eny Kusrini, Ph.D.

Bagian 1.asc
1K