LEMBAR
HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW*
KARYA ILMIAH : PROSIDING

Judul Artikel	: Cooling Effect of Capilary Tube in Refrigerator
Nama Penulis	: **HartoTanujaya**, RichardChristianChandra
Jumlah Penulis	: 2 (dua)
Status Pengusul	: Penulis Pertama
Identitas Prosiding	: a. Judul Prosiding: 1st International Conference on Engineering of Tarumanagara (ICET) b. ISBN/ISSN : ISBN 978-979-99723-9-2 c. Thn Terbit, Tempat : Jakarta, October 2-3, 2013 d. Alamat Repository PT/Web Prosiding : https://lintar.untar.ac.id/dokportofolio/forumilmiah/837e06c579978de4e83822e655104ed4.pdf e. Terindex di : -

Kategori Publikasi *Prosiding* Ilmiah (beri (√) pada kategori yang tepat)

- [√] *Prosiding* Internasional
- [ ] *Prosiding* Nasional
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Kontribusi Pengusul; (nilai akhir *peer* x bobot penulis pertama) = **13,95 x 60% = 8,37**				**8,37**
Komentar/Usulan *Peer Review*: (Terlampir hal. 2)	1. Tentang kelengkapan dan kesesuaian unsur: 2. Tentang ruang lingkup dan kedalaman pembahasan; 3. Kecukupan dan kemutakhiran data/informasi dan metodologi; 4. Kelengkapan unsur dan kualitas penerbit: 5. Indikasi Plagiasi: 6. Kesesuaian Bidang Ilmu: *Terlampir*			

Jakarta, 18.12. 2019
Penilai I

(Prof. Dr. Ir. Agustinus Purna Irawan)
NIDN/NIP : 0328087102 / 10398021
Jabatan/Pangkat/Bidang Ilmu: Professor/IVC/Teknik Mesin
Unit Kerja: Fakultas Teknik – Universitas Tarumanagara

KOMENTAR *PEER REVIEW*	1. Tentang kelengkapan dan kesesuaian unsur: Artikel dengan judul **Cooling Effect of Capilary Tube in Refrigerator**, ditulis secara benar sesuai dengan standar penulisan artikel ilmiah yang memuat pendahuluan, metode/peralatan yang digunakan, pengambilan data dan data, analisa dan kesimpulan. 2. Tentang ruang lingkup dan kedalaman pembahasan: Artikel tersebut membahas mengenai mesin pendingin dengan menggunakan pengekspansi pipa kapiler, dibahas secara spesifik dan mudah dipahami. 3. Kecukupan dan kemutakhiran data/informasi dan metodologi; Metodologi terstruktur dan jelas, data dan referensi yang diambil up to date. 4. Kelengkapan unsur dan kualitas penerbit: Kepanitiaan, reviewer makalah dan penyelenggara seminar jelas dan terdokumentasi. Artikel didalam prosiding ber ISBN/ISSN dan dapat dibaca melalui daring. 5. Indikasi Plagiasi: Artikel dengan judul **Cooling Effect of Capilary Tube in Refrigerator** yang dipresentasikan di **1st International Conference on Engineering of Tarumanagara (ICET)**, pada tanggal October 2-3, 2013 di Jakarta dan diselenggarakan oleh Fakultas Teknik, Universitas Tarumanagara, dapat dibaca secara daring https://lint ar.untar.ac.id/dokportofolio/forumilmiah/837e06c579978de4e83822e655104ed4.pdf dan tidak ditemukan indikasi plagiasi dengan tingkat kesamaan menggunakan software **Turnitin sebesar 19 %.** 6. Kesesuaian Bidang Ilmu: Artikel tersebut membahas tentang mesin pendingin dan ada Linieritas keilmuan dengan pengusul.

Jakarta, 18.12. 2019
Penilai I

(Prof. Dr. Ir. Agustinus Purna Irawan)
NIDN/NIP : 0328087102 / 10398021
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Hasil Penilaian *Peer Review*

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Kelengkapan dan kesesuaian unsur isi *prosiding* (10%)	1.5			1,395
Ruang lingkup dan kedalaman pembahasan (30%)	4.5			4,185
Kecukupan & kemutahiran data/informasi dan metodologi (30%)	4.5			4,275
Kelengkapan unsur & kualitas penerbit (30%)	4.5			4,275
Total = 100%	15			14,13
Kontribusi Pengusul; (nilai akhir *peer* x penulis pertama = 14,13 x 60% = 8,478				8,478

Komentar/Usulan *Peer Review*:	1. Tentang kelengkapan dan kesesuaian unsur: 2. Tentang ruang lingkup dan kedalaman pembahasan; 3. Kecukupan dan kemutakhiran data/informasi dan metodologi; 4. Kelengkapan unsur dan kualitas penerbit: 5. Indikasi Plagiasi: 6. Kesesuaian Bidang Ilmu: *Terlampir*

Jakarta, 14 - 11 - 2019
Penilai

(Dr. Ir. M. Sobron Yamin L., M.Sc.)
NIDN/NIP : 0114056705 / 10311009
Jabatan/Pangkat/Bidang Ilmu: Lektor Kepala/IV/Teknik Mesin
Unit Kerja: Fakultas Teknik – Universitas Tarumanagara

KOMENTAR *PEER REVIEW*	1. Tentang kelengkapan dan kesesuaian unsur: Artikel **Cooling Effect of Capilary Tube in Refrigerator**, sesuai dengan kaidah penulisan artikel ilmiah yang meliputi pendahuluan, metode/alat, data dan analisa serta kesimpulan. 2. Tentang ruang lingkup dan kedalaman pembahasan: Ruang lingkup pembahasan artikel tersebut tentang mesin pendingin atau refrigerator dengan menggunakan pengekspansi pipa kapiler, dengan kedalaman pembahasan yang spesifik. 3. Kecukupan dan kemutakhiran data/informasi dan metodologi; Data yang diambil dan digunakan untuk analisa dan referensi tergolong baru dan mutakhir, dengan susunan metodologi yang baik. 4. Kelengkapan unsur dan kualitas penerbit: Penerbit dan penyelenggara seminar bergerak dalam dunia pendidikan dan sering mengadakan acara seminar/konferensi berskala nasional/internasional. Editor/ketua panitia dan reviewer untuk makalah tersusun jelas. Prosiding ber ISBN/ISSN dan dapat dilihat secara online. 5. Indikasi Plagiasi: Artikel Cooling Effect of Capilary Tube in Refrigerator yang dipresentasikan pada tanggal 2-3 October 2013 di 1st International Conference on Engineering of Tarumanagara (ICET) di Jakarta dan diselenggarakan oleh Fakultas Teknik, Universitas Tarumanagara, dapat dibaca melalui daring di https://lintar.untar.ac.id/dokportofolio/forumilmiah/837e06c579978de4e83822e655104ed4.pdf tidak ditemukan indikasi plagiasi. 6. Kesesuaian Bidang Ilmu: Artikel Cooling Effect of Capilary Tube in Refrigerator dengan pembahasan tentang mesin pendingin refrigerator sesuai dan linier dengan bidang ilmu pengusul.

Jakarta, 14-11- 2019
Penilai II

(Dr. Ir. M. Sobron Yamin L., M.Sc.)
NIDN/NIP : 0114056705 / 10311009
Jabatan/Pangkat/Bidang Ilmu: Lektor Kepala/IV/Teknik Mesin
Unit Kerja: Fakultas Teknik – Universitas Tarumanagara

International Conference on Engineering of Tarumanagara (ICET 2013)
Faculty of Engineering, Tarumanagara University, Jakarta-Indonesia, 2-3 October 2013

COOLING EFFECT OF CAPILLARY TUBE IN REFRIGERATOR

Harto Tanujaya, Richard Christian Chandra
Department of Mechanical Engineering, Faculty of Engineering,
Tarumanagara University, Jakarta
e-mail: harto@yahoo.com, harto@fmesin.untar.ac.id

Abstract

Capillary tube is one of the metering device in the refrigeration such as a small refrigerator. In this research, the capillary tube is made of a copper tube with internal diameter of 0.0065 m and the length of 0.25 m. Performance of the refrigerator can be influenced by length and dimension of the capillary tube. Precooling of the capillary tube is expected increase the performance of the refrigerator. Refrigerant 22 is used in the experiment. The highest coefficient of performance (COP) of the refrigerator are investigated at position 7 , and 7 ,,.

Keywords: Refrigerant 22, refrigeration effect, COP, capillary tube

INTRODUCTION

Refrigeration system is used in many applications such as domestic refrigeration, commercial refrigeration, industrial refrigeration and marine refrigeration. Generally, system refrigeration has 4 basic components, evaporator, condenser, expansion, and compressor. Expansion is used achere on the refrigeration system. Expansion valve usually is used at the big scale refrigeration and the capillary tube is used for the small scale and simple refrigeration.

Generally, capillary tube made of a copper material that is usual for refrigerant 22 with diameter of 0.5 to 2 mm, depend on the load of system refrigeration. The length of the capillary tube is also varied. Using capillary tube in the system of refrigeration has some benefit such as the shape of the expansion is very simple and also the cost to operate inexpensive compared with expansion valve.

Precooling of the capillary tube is expected increase of the performance of the refrigerator. Many researchers did the experiment about the replacement of the capillary tube in right place to increase and get more efficient of the performance of refrigerator. Akintunde (2007) did the research about capillary tube with difference shape as helical and serpentine shape using R-134a refrigerant. His results show the performance of the refrigerator is not influenced with the various pitch of the helical capillary tube. It is different with the serpentine capillary tube which is influenced with pitch.

Performance of the helical and serpentine capillaries tubes are influenced by its diameter and high, respectively. The results are indicated that the shape and dimension of the capillary tube can affect of the performance. This research investigate the effect of precooling of capillary tube in refrigerator using R 22 refrigerant.

MATERIAL AND METHOD

Vapour compression refrigeration system is a refrigeration simplest cycle. The basic principle of refrigeration is liquid or refrigerant absorb heat when changed from liquid to gas and gases give off heat when changed from gas to liquid. This phenomena is occurred when the gasses compressed and condensed. Vapour compression refrigeration system has four basic components; compressor, evaporator, condenser, and expansion. This research use capillary tube expansion. Compressor is used to compress the vapour refrigerant to increase the pressure of refrigerant in order can be decreased rapidly by

International Conference on Engineering of Tarumanagara (ICET 2013)
Faculty of Engineering, Tarumanagara University, Jakarta-Indonesia, 2-3 October 2013

expansion tube. Evaporator and condenser are used to evaporate and condense the refrigerant in the system with absorb and release the heat from environment, respectively. A installation diagram of the refrigeration system is shown in figure 1.

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ICET 2013

PROCEEDINGS

1st International Conference on Engineering of Tarumanagara

"Urban Engineering for Future Generation"

Jakarta, 2-3 October 2013

Faculty of Engineering
Tarumanagara University
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ME-23	Agus Halim, Didi Widya Utama, Jemmy Septiawan	Application For Rough Estimation Of Cutting Force
ME-24	Sobron Lubis, Rosehan, Denny Handoko	Effect of Rake Angle in the Turning Process on the Surface Roughness of Workpiece AISI 4340 Steel
ME-25	Muhammad Ade Irfan	The Split Of Engineering Development To Support Engineering, Procurement, Construction, And Commissioning Of Onshore Oil And Gas Receiving Facility (Case Study On Epcc Orf Bukit Tua)
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ME-29	Richard Jonathan Salli, Agustinus Purna Irawan, Danardono A.S.	Design Of Fifo Pick And Deposit System
ME-30	Steven Darmawan, Ahmad Indra Siswantara, Budiarso	Reynolds Numbers Effects On Velocity Distribution In Combustion Chamber Inlet Of A Proto X-2 Bioenergy Micro Gas Turbine
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ME-32	Harto Tanujaya	Cooling Effect of Capillary Tube for Refrigerator
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ME-34	Azridjal Aziz, Herisiswanto, Afdhal Kurniawan Mainil	Energy Efficient Cold Storage As Hybrid Refrigeration Machine Using Heating Effect From Condenser With Hydrocarbon Refrigerant Substituted For R-22
UE-01	Priyendiswara	To Promote Jakarta City as one of an excited Tourist Destination in Asia towards the Asian Economic Community (AEC)
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UE-04	Adiwan Aritenang	The Lineage of ICT Development: The Case Of Batam Island

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Parallel Session Schedule

Day/Date	Time	Room No	Paper ID
Wednesday 2 October 2013	13.00-15.00	1	AE-01, AE-06, UE-04, CE-06, CE-19
	13.00-15.00	2	IE-02, IE-04, IE-05, IE-06, IE-07
	13.00-15.00	3	IE-19, IE-21, IE-22, IE-23, ME-07
	13.00-15.00	4	ME-10, ME-11, ME-18, ME-20, ME-27, ME-34
	15.00-15.30		*Coffee Break*
	15.30-17.30	1	CE-07, CE-09, CE-11, CE-14, CE-18, CE-21
	15.30-17.30	2	EE-01, EE-02, EE-03, EE-04, EE-06, EE-08
	15.30-17.30	3	IE-10, IE-11, IE-12, IE-13, IE-16
	15.30-17.30	4	ME-12, ME-13, ME-17, ME-19, ME-26, ME-33
Thursday 3 October 2013	09.00-12.00	1	AE-02, AE-04, AE-07, AE-08, AE-09, AE-12, AE-14
	09.00-12.00	2	AE-13, AE-15, CE-03, CE-16, CE-20
	09.00-12.00	3	ME-01, ME-16, ME-22, ME-24, ME-29, ME-30, ME-31, ME-32
	09.00-12.00	4	IE-08, IE-14, IE-15, IE-17, IE-24, UE-01, UE-02, UE-03

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e-mail: hart_tan18@yahoo.com, harto@tarumanagara.ac.id

Abstract

Capillary tube is one of the throttling device in the refrigeration such as a small refrigerator. In this research, the capillary tube is made of a copper tube with internal diameter of 0.0063 m and the length of 0.248 m. Performance of the refrigerator can be influenced by shape and dimension of the capillary tube. Precooling around the capillary tube is expected increase the performance of the refrigerator. Refrigerant 22 is used in the experiment. The highest and lowest of the Coefficient of Performance (COP) of the refrigerator are investigated at position F_{11} and F_{33}.

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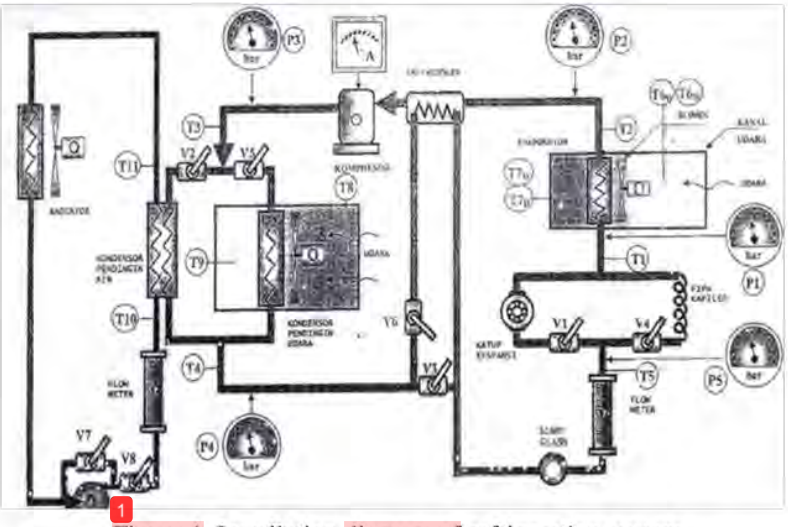

Figure 1. Installation diagram of refrigeration system

The experimental method is used in this research, the temperature of capillary tube is set below the environment temperature of – 70 ^{0}C. Diameter of the suction and discharge pipes of refrigerant are ½ in with the length 0.3 and 0.8 m, respectively. The inner diameter of the capillary tube is 0.0063 m with the length of 0.248 m. Single cylinder reciprocating compressor type AJ 4461A is used in this research with maximum power of ½ Hp and 300 rpm. The diameter, length, high, and width of the condenser are 3/8 in, 0.294 m, 0.27 m, and 0.143m, respectively. Capacity of the condenser is 1200 m^3/h with the amount of the pipe of 30. The high of evaporator is 0.28 m with diameter of pipe ½ in.

Variable area flowmeter is used to measure the discharge flow of the refrigerant with capacity maximum of 0 – 140 litre/h. Conversion table of the discharge flow using the flowmeter is shown at table 1.

Table 1. Conversion table of Refrigerant 22

Density R-22 (kg/m^3)	Coefficient Conversion
750	0,850
800	0,880
850	0,910
900	0,940
950	0,970
1000	1,000
1050	1,028
1100	1,056
1150	1,084
1200	1,111
1250	1,139
1300	1,166

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Flowrate of the air which are blow into the evaporator and condenser are variated. Velocity of the air are variated with three stage of each evaporator and condenser. Description of each stage is $F_{11}, F_{12}, F_{13}, F_{21}, F_{22}, F_{23}, F_{31}, F_{32}, F_{33}$.

F_{11} : fan velocity 1 in evaporator and fan velocity 1 in condenser
F_{12} : fan velocity 1 in evaporator and fan velocity 2 in condenser
F_{13} : fan velocity 1 in evaporator and fan velocity 3 in condenser
F_{21} : fan velocity 2 in evaporator and fan velocity 1 in condenser
F_{22} : fan velocity 2 in evaporator and fan velocity 2 in condenser
F_{23} : fan velocity 2 in evaporator and fan velocity 3 in condenser
F_{31} : fan velocity 3 in evaporator and fan velocity 1 in condenser
F_{32} : fan velocity 3 in evaporator and fan velocity 2 in condenser
F_{33} : fan velocity 3 in evaporator and fan velocity 3 in condenser

RESULTS AND DISCUSSION

In this experiment, we investigate the efficiency of refrigerator using extreme condition of temperature of capillary tube. Temperature and pressure of each condition are record and evaluation. Results of the experimental can be shown at the tabel 2.

Table 2. Results

	Compression Work (W) – kJ/m^3	Compression Power (P) - kW	Refrigeration Effect (q_e) – kJ/m^3	Q_e kW	Q_c kW	$Q_{cap\ tube}$ kW	COP
F_{11}	22	0,4748	242	5,2224	-4,5965	1,1006	10,99
F_{12}	24	0,5179	242	5,2224	-4,7260	1,0143	10,08
F_{13}	26	0,5611	242	5,2224	-4,7692	1,0143	9,31
F_{21}	34	0,7337	242	5,2224	-4,8555	1,1006	7,12
F_{22}	41	0,8848	242	5,2224	-5,0281	1,079	5,90
F_{23}	41	0,8848	231	4,9850	-5,0066	0,8632	5,63
F_{31}	50	1,079	234	5,0497	-5,2224	0,9064	4,68
F_{32}	50	1,079	240	5,1792	-5,1792	1,079	4,8
F_{33}	53	1,1437	241	5,2008	-5,2439	1,1006	4,55

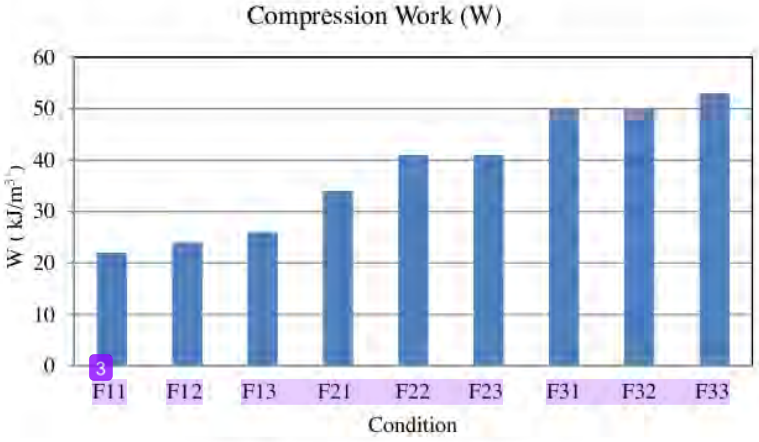

Figure 2. Compression Work

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Figure 2 show the graph of work (compressor). The graph shows that position at F_{33} has a biggest work of compressor of 53 kJ/m^3 compared with position of F_{11} 22 kJ/m^3 which has a lowest work of compressor.

Figure 3 show the compression power of the refrigerator. Compression power is influenced by compression work in the system. This indicates that the compression work will be increased as the result of increasingly the compression power. The power of the lowest and highest of compression power are 0.4748 kW and 1.1437 kW, which are shown at the position of F_{11} and F_{33} respectively.

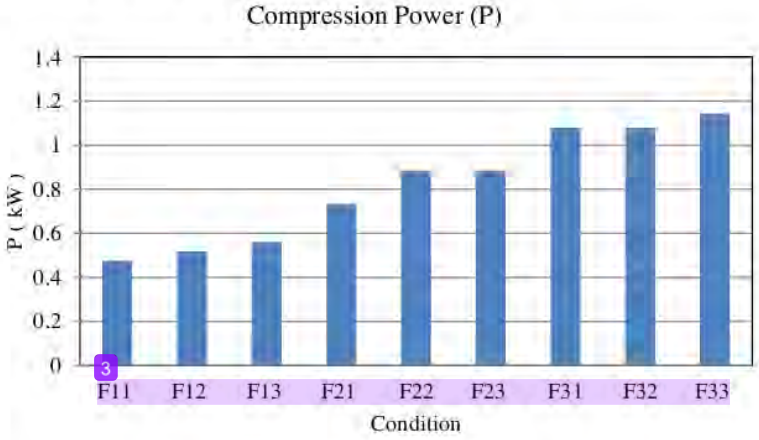

Figure 3. Compression Power

Figure 4 show the refrigeration effect of the refrigerator. Refrigeration effect is one of parameter to calculate the efficiency of refrigerator. Positions of F_{11}, F_{12}, F_{13}, F_{21}, and F_{22} have almost similar refrigeration effect of 5.22 kW.

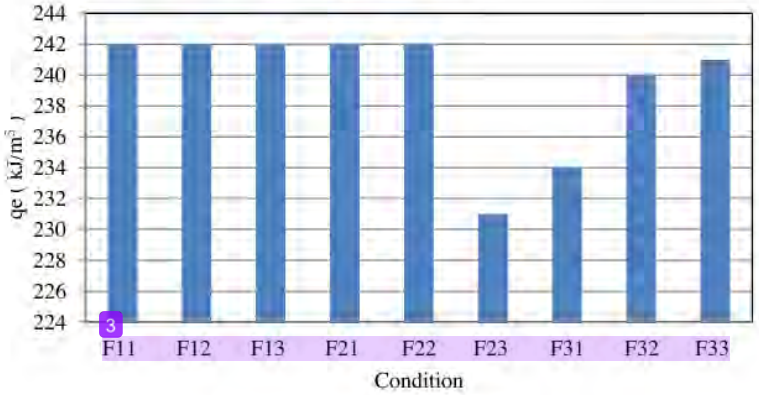

Figure 4. Refrigeration Effect

Figure 5 shows the coefficient of performance (COP) of the refrigerator. The graph show that the lowest and highest COP investigated at the position F_{33} and F_{11}. COP at F_{11}

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and F_{33} are 10.99 and 4.55, respectively. This indicates that the refrigerator at the position of F_{11} has maximum efficiency.

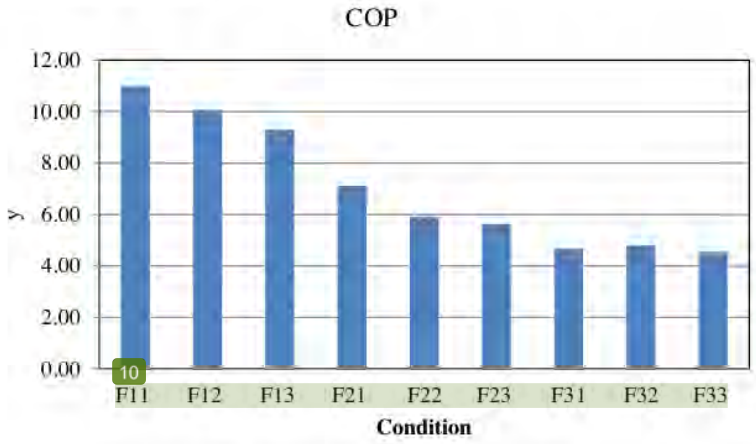

Figure 5. Coefficient of Performance

CONCLUSIONS

Compression power increases as the velocity of the fan at evaporator and condenser increases. Refrigeration effect has a maximum limitation value for conditioning at low fan rotation of evaporator and condenser. The highest and lowest of Coefficient of performance (COP) are investigated position F_{11} and F_{33} of 10.99 and 4.55, respectively. This indicates that the conditioning of capillary tube will increase the performance of the refrigerator at lower fan rotation of the evaporator and condenser.

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