STUDI EKSPERIMENTAL DAN ANALISIS PERPINDAHAN PANAS KONVEKSI ALAMIAH PADA SUATU RONGGA DENGAN VARIASI DERAJAT KEVAKUMAN

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JUDUL

STUDI EKSPERIMENTAL DAN ANALISIS PERPINDAHAN PANAS KONVEKSI ALAMIAH PADA SUATU RONGGA DENGAN VARIASI DERAJAT KEVAKUMAN

Tesis disusun untuk memenuhi salah satu syarat memperoleh gelar
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ABSTRAK

Dalam dunia industri, material isolasi sering digunakan untuk mempertahankan temperatur zat pada keadaan dingin atau panas. Disamping mahal dan tebal ukuran penggunaan material isolasi terkadang dipandang kurang praktis. Untuk menggantikan fungsi material isolasi sering digunakan rongga udara bertekanan rendah atau vakum. Membuat derajat kevakuman 100 % pada rongga udara tidaklah mudah. Biasanya masih adanya udara di dalam rongga akan mengakibatkan terjadinya perpindahan panas konveksi alami (natural convection) antara kedua permukaan pembentuk rongga tersebut. Koeffisien perpindahan panas konveksi (h) pada suatu rongga selain dipengaruhi oleh perbedaan temperatur juga dipengaruhi oleh geometri rongga, orientasi dari rongga dan sifat-sifat yang dimiliki oleh fluida , antara lain : tekanan, temperatur, massa jenis, konduktifitas dan viskositas.

Permasalahan yang timbul dalam penelitian ini adalah bagaimanakah pengaruh variasi derajat kevakuman dan ratio rongga terhadap laju perpindahan Panas konveksi alamiah pada suatu rongga.

Tujuan penelitian ini adalah untuk mendapatkan harga tekanan Vakum yang sesuai sebagai isolator dalam suatu rongga . Sedangkan manfaat dalam studi ini adalah untuk menghambat laju perpindahan panas antara sistem terhadap media sekelilingnya.

Dari penelitian ini diperoleh hasil bahwa dengan derajat kevakuman –60 cm Hg dan $\frac{L}{\delta} = 5.96$ diperoleh harga laju perpindahan Panas konveksi alamiah lebih rendah dibandingkan dengan derajat kevakuman –20 cm Hg dan – 40 cm Hg. Ini memberikan arti bahwa derajat kevakuman –60 cm Hg mempunyai hambatan termal lebih besar (isolator) dibandingkan dengan derajat kevakuman – 20 cm Hg dan –40 cm Hg.

Kata kunci : *Derajat Kevakuman, rongga, laju perpindahan panas konveksi alamiah, aspek ratio rongga*

AN EXPERIMENTAL STUDY AND ANALYSIS OF NATURAL CONVECTION HEAT TRANSFER IN A CAVITY WITH VACUUM PRESSURE VARIATION

By : Mulyono
Under the supervision : Dr. Ir. H. Djatmiko Ichsani M. Eng.

ABSTRACT

This paper reports on a study aimed at finding the appropriate degree of vacuum pressure which effectively works as insulator.

In the world of industry, insulation materials are often utilized to maintain the temperature, either low or high. However, since the insulation materials often need to be thick, thus, costly, they are frequently deemed impractical. Therefore, in the attempt to replace the insulation materials, a cavity with low vacuum pressure is opted for. Yet, to attain a total (100%) air-free cavity is not an easy task. Such, the cavity usually still bears some amount of air pressure which results in natural heat convection through the two surfaces making up the cavity. The transfer coefficient of natural heat convection (h) is influenced by some factors, such as, the temperature difference, geometry of the cavity, cavity orientation, and characteristics of the fluid, for instance, its pressure, temperature, conductivity, specific gravity (density), and viscosity.

The purpose of the study is to find answers to the following question: "How do vacuum pressure variation and cavity ratio affect the rate of natural heat convection through the a cavity?" Pertinent to the question, the study was aimed to find the appropriate value of the vacuum pressure which can function well as an insulator. This study is significant in the attempt to lower down the rate of heat transfer taking place in a system vis-à-vis the surrounding media.

The study found out that the degree of emptiness of -60 cm Hg and $\frac{L}{\delta}$=5.96, results in a lower rate of heat transfer compared with -20 cm Hg and -40 cm Hg. This means that the vacuum pressure of -60 cm Hg bears a bigger thermal resistance than the -20 cm Hg and -40 cm Hg do.

Key words: *vacuum pressure, cavity, heat transfer rate of natural convection, aspects of cavity ratio*

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Hormat ,

Mulyono

DAFTAR ISI

DAFTAR LAMBANG

Notasi		Keterangan	Satuan
H=L	:	Tinggi tabung	mm
D_1	:	Diameter tabung dalam	mm
D_2	:	Diameter tabung luar	mm
$r_{w1\text{-}in}$	:	Jari-jari tabung dalam bagian permukaan dalam	mm
$r_{w1\text{-}out}$	:	Jari-jari tabung dalam bagian permukaan luar	mm
$r_{w2\text{-}in}$	:	Jari-jari tabung luar bagian permukaan dalam	mm
$r_{w2\text{-}out}$	:	Jari-jari tabung luar bagian permukaan luar	mm
$T_{w1\text{-}in}$	:	Temp. tabung dalam bagian permukaan dalam	^0C
$T_{w1\text{-}out}$	:	Temp. tabung dalam bagian permukaan luar	^0C
$T_{w2\text{-}in}$	:	Temp. tabung luar bagian permukaan dalam	^0C
$T_{w2\text{-}out}$	:	Temp.tabung luar bagian permukaan luar	^0C
R	:	Tahanan Termal	$W/^0k$
k_{w1}	:	Konduktifitas panas bahan tabung dalam	$W/m\text{-}^0k$
k_{w2}	:	Konduktifitas panas bahan tabung luar	$W/m\text{-}^0k$
h_{udara}	:	Koefisien perpindahan panas konveksi udara	$W/m^2\text{-}^0k$
q	:	Laju perpindahan panas	W
θ	:	Sudut kemiringan	0
δ_{lt}	:	Tebal lapisan batas termal	mm
δ	:	Diameter karakteristik (tebal rongga)	mm
g	:	Percepatan gravitasi	m/s^2
β	:	Koefisien ekspansi volume	$1/^0C$
υ	:	Viscositas kinematis	m^2/s
T_∞	:	Temperatur aliran bebas	^0C
Pr	:	Bilangan Prandtl	-
Nu	:	Bilangan Nusselt	-

Notasi		Keterangan	Satuan
Gr	:	Bilangan Grashoft	-
Ra	:	Bilangan Rayleigh	-
Cp	:	Kapasitas panas jenis tekanan konstan	J/kg-^{0}k
α	:	Difusitas termal	m^2/s
μ	:	Viscositas dinamis	Kg/m-s
ρ	:	Massa jenis fluida	Kg/m^3
P	:	Tekanan vakum	torr
T	:	Temperatur	^0C
ρ_∞	:	Massa jenis aliran bebas	Kg/m^3
k_{udara}	:	Konduktifitas udara	W/m-^{0}k
T_{es}	:	Temperatur es	^0C

DAFTAR GAMBAR

BAB I

PENDAHULUAN

1.1. Latar Belakang

Dalam perkembangan teknologi sekarang ini, untuk mengangkut dan menyimpan zat-zat cair kriogenik yang bersuhu rendah (sampai kira-kira –250 ^{0} C), misalnya hidrogen cair untuk waktu yang lama, telah dikembangkannya *Superisolator (superinsolation).* Superisolator yang paling effectif terdiri dari lapisan-lapisan rangkap yang terbuat dari bahan yang berdaya refleksi tinggi dengan isolator-isolator sebagai pengantara. Keseluruhan sistem ini *dihampakan* agar konduksi melalui udara menjadi minimum.

Dalam dunia industri , material isolasi digunakan untuk mempertahankan temperatur zat pada keadaan dingin atau panas. Disamping mahal dan tebal ukuran penggunaan material isoalsi terkadang dipandang kurang praktis. Untuk menggantikannya fungsi material isolasi sering digunakan rongga udara bertekanan rendah atau vakum. Membuat derajat kevakuman 100 % pada rongga udara tidaklah mudah, biasanya masih adanya udara didalam rongga yang mengakibatkan terjadinya perpindahan panas konveksi alami (natural convection) antara kedua permukaan pembentuk rongga tersebut.

Laju perpindahan panas pada suatu rongga dihitung berdasarkan hukum newton pendinginan. Sedangkan koefisien perpindahan panas konveksi (h) pada rongga dipengaruhi oleh : perbedaan temperatur dari kedua dinding pembatas, selain itu juga merupakan fungsi dari geometri rongga , orientasi dari rongga dan sifat-sifat yang dimiliki fluida . Besarnya laju perpindahan panas antara dua

permukaan yang membentuk rongga sangat dipengaruhi pula oleh kondisi sifat-sifat (properties) , yaitu ; tekanan, temperatur, massa jenis, konduktivitas, viskositas dan sebagainya dari fluida yang berada di dalam rongga tersebut.

Untuk mengurangi laju perpindahan panas pada suatu rongga (cavity), *cara penghampaan* (pemvakuman) merupakan suatu metode yang sangat populer didalam kehidupan sehari-hari. Cara ini sering digunakan pada thermos, pelat-pelat absorber pada pemanas matahari, sebagai isolasi untuk mengurangi kehilangan panas pada reaktor nuklir, pendinginan pada tangki sampah radioaktif, ventilasi ruangan dan seterusnya.

1.2. Rumusan Masalah

Kondisi gas yang berada pada suatu rongga akan mempunyai konsekuensi terhadap kondisi fisik zat/fluida yang ada didalamnya. Ini mempunyai korelasi besar terhadap fenomena koefisien perpindahan panas konveksi alamiah antar gas/zat dalam rongga dengan sekelilingnya. Maka dengan ini dapat kita rumuskan masalah sebagai berikut :

1. Bagaimanakah pengaruh derajat kevakuman dan aspek ratio rongga terhadap laju perpindahan panas konveksi alamiah pada suatu rongga (tabung anulus).
2. Bagaimanakah hubungan antara variasi derajat Kevakuman dengan bilangan Nusselt, bilangan Rayleigh dan aspek ratio rongga .

1.3. Batasan Masalah

Untuk mengetahui phenomena pada permasalahan tersebut di atas akan dilakukan suatu penelitian perpindahan panas konveksi alamiah yang terjadi di dalam suatu rongga yang dibentuk oleh dua silinder dengan diameter yang berbeda. Oleh karena itu batasan permasalahan pada penelitian ini adalah :

1. Ukuran tabung anulus (cincin) :

   Tinggi (H) : 300 mm = 0.300 m

   Diameter Pipa/tabung dalam(D_1) tetap : 50.8 mm/0.0508 m (2 in)

   Variasi diameter tabung luar (D_2): 76.2 mm/0.07612 m (3 in), 88.9 mm/ 0.0889 m (3.5 in), 101.6 mm/0.1016 m (4 in).
2. Variasi tekanan vacuum (vacuum rendah) dalam tabung adalah : -20 cm Hg (P abs : -560 torr), -40 cm Hg (P abs : -360 torr) , -60 cm Hg (Pabs : -160 torr),
3. Tabung /pipa dalam berisi es dan tabung luar berisikan udara murni.
4. Kondisi operational berlangsung dalam kondisi tunak.
5. Perpindahan panas diasumsikan hanya berlangsung secara konveksi alamiah dan mengabaikan efek radiasi.
6. Bahan tabung adalah baja carbon chrom (ST-45)
7. Tabung luar diberikan perlakuan panas dengan variasi temperatur : 35 ° C, 45 ° C, 55 ° C dan 65 ° C

1.4. Tujuan Penelitian

Tujuan dari penelitian ini adalah :

1. Untuk mendapatkan harga tekanan kevakuman yang sesuai sebagai Insulator dalam suatu rongga
2. Untuk mendapatkan sejauhmana hubungan/korelasi variasi derajat kevakuman terhadap bilangan Nusselt, bilangan Rayleigh dan aspek ratio rongga.

1.5. Manfaat Penelitian

Manfaat yang diharapkan dari hasil penelitian ini adalah :

1. Untuk meningkatkan daya tahan penyimpanan bahan, misalnya : ikan, obat dan bahan-bahan lain yang tidak tahan pada kondisi tekanan atmosfir/lingkungan.
2. Sebagai masukan dalam perancangan alat penukar kalor khususnya dalam ruangan yang vacuum/hampa.
3. Menambah wacana keilmuan dalam bidang perpindahan panas pada umumnya, dan alat penukar kalor pada khususnya.

BAB II

TINJAUAN PUSTAKA

2.1. Penelitian yang telah dilakukan

Xundan Shi, dkk (2003), melakukan penelitian tentang perpindahan panas konveksi alamiah secara aliran laminar dan kondisi tunak (steady state) pada suatu rongga berbentuk bujur sangkar yang dilengkapi sirip tipis dengan analisa sistem komputasi. Dari hasil analisa diperoleh hubungan bilangan Nusselt rata-rata sebagi berikut :

$$\overline{Nu} = \left(0.1213\ Sp^2 - 0.1202\ Sp + 0.1807\right) Ra^{0.2979}\ Lp^{0.0656} \ldots untuk\ Ra = 10^4 - 10^5$$

$$\overline{Nu} = \left(0.0163\ Sp^2 - 0.0129\ Sp + 0.1598\right) Ra^{0.2979}\ Lp^{0.0656} \ldots untuk\ Ra = 10^6 - 10^7$$

dimana

Sp : besaran non dimensional dari perbandingan letak sirip terhadap lebar rongga.

Lp : besaran non dimensional dari perbandingan panjang sirip terhadap lebar rongga

Wang dkk (2000), melakukan penelitian perpindahan panas konveksi alamiah pada suatu bujur sangkar yang membentuk sudut dalam ruangan tertutup (enclosure). Variasi sudut (θ) yang diberikan adalah 0^0, 30^0, 45^0, 60^0dan 90^0. Dari hasil eksperimen didapatkan hubungan bilangan Nusselt sebagai berikut

$$Nu_{l.m} = 0.5360\ \left(Ra_l \cos\theta\right)^{0.25}$$

Campo dkk (2000), melakukan penelitian perpindahan panas konveksi bebas pada rongga (cavities) yang berbentuk segi empat. Rongga segi empat diisi

campuran antara helium dan nitrogen. Sedangkan variasi campuran helium dan nitrogen adalah 70 % He + 30 % Ni dan 60 % He + 40 % Ni. Rongga berbentuk segi empat, bagian dinding atas dan bawah di isolasi sedangkan bagian vertical di berikan perlakuan temperatur yang berbeda.

Dalam penelitian ini mempunyai tujuan untuk mendapatkan hubungan properties campuran yaitu : massa jenis campuran ($\rho_{m)}$, kapasitas panas jenis tekanan konstan campuran ($Cp_{-m)}$, Kerapatan dinamik campuran ($\mu_{m)}$, konduktifitas panas campuran (k_m) terhadap koeffisien perpindahan panas konveksi rata-rata maksimum ($\overline{h_m}$) dan diperoleh hubungan sebagai berikut :

$$\overline{h_m} = B \sqrt[3]{\frac{k_m^{\,2}\ \rho_m^{\,2}\ Cp_m}{\mu_m}}$$

Penelitian ini menghasilkan Koefisien perpindahan panas konveksi rata-rata maksimum campuran (He dan Ni) sebagai berikut :

Suhu (^{0} k)	$\overline{h_m}$ max (w/m^2 - ^{0}k)
200	68.4
1000	33

Oronzio Manca (2002), melakukan penelitian tentang perpindahan panas konveksi bebas di antara dua plat yang dipanaskan dan posisi kedua plat yang membentuk sudut. Sedangkan variasi perlakuan yang diberikan adalah :

Variasi jarak antara dua plat (b) : 20-32.3 mm

Variasi sudut (posisi) plat (θ) : 0 – 88 ^{0}

Tinggi susunan saluran (t) : 409 mm

Lebar plat (w) : 450 mm

Dalam penelitian ini, menghasilkan hubungan bilangan Nusselt (Nu) dengan bilangan Rayleigh (Ra) adalah sebagai berikut :

$$Nu_x = a\left(Ra_x \, Cos\,\theta\right)^b$$

Dimana : harga $Ra_x = 20 - 8.0 \,.10^5$

JumlahLajur Plat	Koefisien/Konstanta		
	a	b	R^2
4	0.806	0.231	0.974
6	0.650	0.228	0.953
8	0.622	0.244	0.946

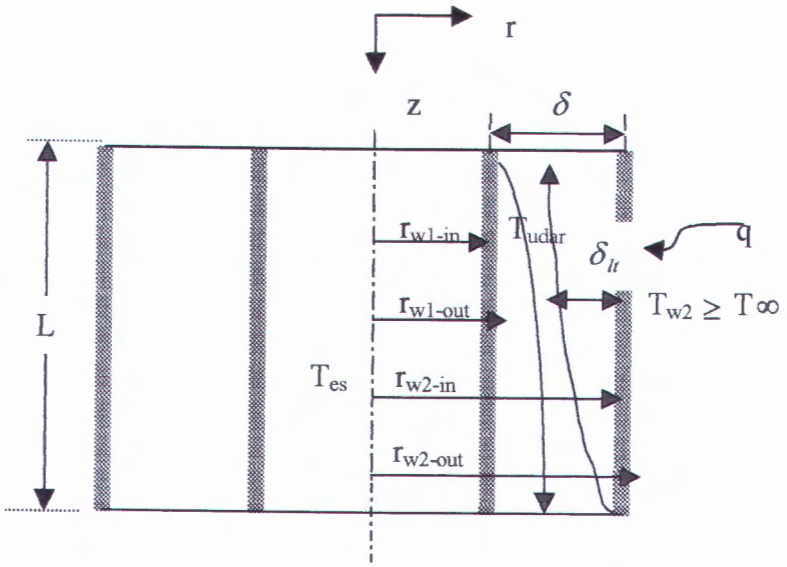
Dari paparan penelitian yang telah dilakukan diatas, dapat diambil suatu pelajaran bagi peneliti untuk melakukan suatu kajian terhadap laju perpindahan panas konveksi alamiah pada suatu tabung anulus , yang diberikan perlakuan berupa : variasi derajat kevakuman, variasi kemiringan benda uji, variasi pembebanan temperatur permukaan dan variasi diameter tabung luar yang berbeda.

2.2. Tinjauan Teori

2.2.1. Mencari koefisien perpindahan panas konveksi alamiah pada tabung anulus

Mencari koefisien perpindahan panas konveksi alamiah, tidak lepas dengan pemahaman tentang lapisan batas termal. Lapisan batas termal (thermal boundary layer) didefinisikan sebagai daerah didalamnya terdapat gradien suhu

dalam aliran tersebut. Gradien suhu tersebut diakibatkan oleh proses pertukaran kalor antara fluida dan dinding atau sebaliknya.



Gambar : 2-1

Lapisan batas termal pada tabung anulus

Seperti pada gambar 2-1, temperatur dinding tabung luar bagian dalam ($r_{w2\text{-}in}$) lebih besar dari pada temperatur udara (T_{udara}) sehingga lapisan batas termal akan terbentuk jika ada pergerakan molekul untuk membawa energi dalam suatu rongga/celah.

Berdasarkan gambar diatas maka dapat dibuat kesetimbangan energi/neraca energi pada muka atur sebagai berikut :

$$q = q\big|_{konduksi-wall2} = q\big|_{konveksi\ udara} = q\big|_{konduksi-wall1} = q\big|_{konveksi-es},$$

atau

$$q = \frac{(T_{w2-out} - T_{w2-in})}{\left(\frac{\ln\left(r_{w2-out}/r_{w2-in}\right)}{2.\pi.L.k_{w2}}\right)} = \frac{(T_{w2-in} - T_{w1-out})}{\left(\frac{1}{2.\pi.L\,r_{w2-in}.h_{w2-in} + 2.\pi\,L.r_{w1-out}.h_{w1-out}}\right)}$$

$$= \frac{(T_{w1-out} - T_{w1-in})}{\left(\frac{\ln\left(r_{w1-out}/r_{w1-in}\right)}{2.\pi.L.k_{w1}}\right)} = h_{es}\,2\pi L r_{w1-in}\,\frac{(T_{w1-in} - T_{es})}{\frac{1}{2.\pi.L.r_{w1-in}.h_{w1-in}}}$$

..... (2-1)

Untuk menghitung koefisien perpindahan panas dari **dinding tabung luar** ke **temperatur udara (h $_{udara}$)** pada permukaan tabung luar bagian dalam adalah sebagai berikut :

Kesetimbangan Energi :

$$\frac{(T_{w2-out} - T_{w2-in})}{\frac{\ln\left(r_{w2-out}/r_{w2-in}\right)}{2\,\pi\,k_{w2}\,L}} = \frac{(T_{w2-in} - T_{udara})}{\frac{1}{2\,\pi\,h_{udara}\,L\,(r_{w2-in})}} \quad \text{..... (2-2).}$$

Sehingga didapatkan koeffisien perpindahan panas konveksi udara (h $_{udara}$) sebagai berikut :

$$h_{udara-lokal} = \frac{k_{w2}\,(T_{w2-out} - T_{w2-in})}{\ln\left(r_{w2-out}/r_{w2-in}\right)}\,x\,\frac{1}{r_{w2-in}.(T_{w2-in} - T_{udara})} \quad \text{....(2-3)}$$

Untuk menghitung Koeffisien perpindahan panas konveksi **dari dinding tabung dalam ke temperatur es (h_{es}) .**

Kesetimbangan energi :

$$\frac{\left(T_{w1-out} - T_{w1-in}\right)}{\dfrac{\ln\left(r_{w1-out} / r_{w1-in}\right)}{2\,\pi\,k_{w1}\,L}} = \frac{\left(T_{w1-in} - T_{es}\right)}{\dfrac{1}{2\,\pi\,h_{es}\,L\,\left(r_{w1-in}\right)}} \qquad \text{.............................} \quad (2\text{-}4).$$

Sehingga diperoleh koeffisien perpindahan panas konveksi es (h_{es}), sebagai berikut :

$$h_{esl} = \frac{k_{w1}\,\left(T_{w1-out} - T_{w1-in}\right)}{\ln\left(r_{w1-out} / r_{w1-in}\right)}\; x \;\frac{1}{r_{w1-in}\,.\left(T_{w1-in} - T_{es}\right)} \qquad \text{........} \quad (2\text{-}5)$$

Menghitung bilangan Nuselt pada udara adalah sebagai berikut :

$$Nu = \frac{h_{uadara.}\,.\left(r_{w2-in} - r_{w1-out}\right)}{k_{udara}} = \frac{h_{udara}\;\delta}{k_{udara}} \qquad \text{........................} \quad (2\text{-}6)$$

2.2.2. Laju Perpindahan Panas Total dalam Tabung Annulus

Berdasarkan pada gambar 2-1, sebelum untuk mendapatkan laju perpindahan panas total maka di cari lebih dahulu " Tahanan Termal" pada bidang tersebut, yaitu didapatkan :

$$R = \frac{\ln\left(r_{w2-out} / r_{w2-in}\right)}{2\,.\,\pi\,k_{w2}\,L} + \frac{1}{2.\,\pi\,h_{w2-in}\,L\,\left(r_{w2-in}\right) + 2.\pi\,L\,.h_{w1-out}\,r_{w1-out}} + \frac{\ln\left(r_{w1-out} / r_{w1-in}\right)}{2.\pi\,.k_{w1}\,L}$$

$$\text{..} \quad (2\text{-}7)$$

dimana :

L	: tinggi tabung (m)
r_{w2-out}	: jari-jari tabung luar bagian permukaan luar (m)
$r_{w2-in} = r_2$	: jari-jari tabung luar bagian permukaan dalam (m)
r_{w1-out}	: jari-jari tabung dalam bagian permukaan luar (m)
$r_{w1-in} = r_1$	: jari-jari tabung dalam bagian permukaan dalam (m)

$T_{w2\text{-}out}$: temperatur tabung luar bagian permukaan luar (^{o}k)

$T_{w2\text{-}in}$: temperatur tabung luar bagian permukaan dalam (^{o}k)

$T_{w1\text{-}out}$: temperatur tabung dalam bagian permukaan luar (^{o}k)

$T_{w1\text{-}in}$: temperatur tabung dalam bagian permukaan dalam (^{o}k)

k_{w2} : konduktifitas panas bahan tabung luar (W/m-^{o}k)

k_{w1} : konduktifitas panas bahan tabung dalam (W/m-^{o}k)

Sedangkan persamaan perpindahan panas total (q_{total}) adalah sebagai berikut :

$$q_{total} = \frac{(T_{w2-out} - T_{w1-in})}{R}$$, dimana R = Tahanan termal ..... (2-8)

substitusikan persamaan (2-7) ke persamaan (2-8) , diperoleh persamaan perpindahan panas total sebagai berikut :

$$q_{total} = \frac{(T_{w2-out} - T_{w1-in})}{\frac{\ln\left(r_{w2-out}/r_{w2-in}\right)}{2\,.\,\pi\,k_{w2}\,L} + \frac{1}{2.\,\pi\,h_{uw2-in}\,L\,(r_{w2-in}) + 2\pi\,.h_{w1-out}\,.L\,.r_{w1-ou}t} + \frac{\ln\left(r_{w1-out}/r_{w1-in}\right)}{2.\pi\,.k_{w1}\,L}}$$

..... (2-9)

2.3. Perpindahan panas Konveksi Bebas/Alamiah

Konveksi dalam ilmu perpindahan panas digunakan untuk menunjukkan model perpindahan panas yang terjadi antara permukaan dan fluida yang bergerak pada kondisi temperatur yang berbeda. Perpindahan panas konveksi dibedakan menjadi dua macam, yaitu: konveksi paksa (forced convection) dan konveksi alamiah (natural convection). Konveksi paksa terjadi bila aliran fluida disebabkan oleh gaya luar, misalnya: fan, pompa, blower dll. Sedangkan konveksi alamiah gerakan fluida disebabkan akibat adanya gaya apung (bouyancy force). Gaya

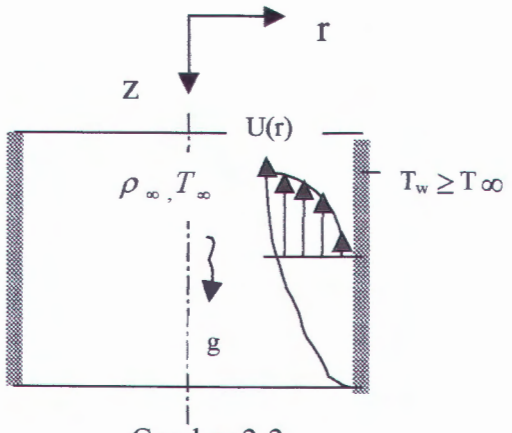
apung yang menyebabkan aliran konveksi bebas adalah gaya badan (body force) (Holman, 1988).

Konveksi alamiah yang umum terjadi dan paling sering digunakan adalah konveksi bebas yang terjadi pada bidang vertikal/dinding, tapi pada kesempatan ini akan dilakukan pada suatu silinder berongga yang dindingnya dipanaskan atau lebih tinggi suhunya dibandingkan dengan fluida didalamnya (misalnya udara).

Gambar dibawah menunjukkan fenomena lapisan batas yang terjadi pada permukaan dalam silinder. Sedangkan untuk memudahkan analisa untuk lapisan batas hidrodinamik dan lapisan batas termal digambarkan berimpit.

Kecepatan aliran fluida dalam konveksi bebas adalah berharga nol pada permukaan, bertambah cepat dalam lapisan batas yang tipis dan menjadi nol lagi pada lapisan batas kondisi bebas. Dalam menganalisa proses yang terjadi pada sistem perpindahan panas konveksi untuk memudahkan analisa digunakan pendekatan persamaan pengendali (governing equation) dengan ketentuan sebagai berikut :

1. Suhu dinding tabung luar ---> $T_w >= T_\infty$
2. Arah gaya body searah gaya gravitasi; sesuai arah z.
3. Aliran dalam kondisi tunak 2 dimensi (r, z).
4. Fluida incompresibel



Gambar 2-2:

Lapisan batas termal untuk konveksi Bebas

Persamaan Kontinuitas :

$$\frac{1}{r}(\rho r V_r) + \frac{\partial}{\partial z}(r.\rho V_z) = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}10)$$

Persamaan Momentum :

Arah z :

$$\rho\left[v_r\frac{\partial v_z}{\partial r} + v_z\frac{\partial v_z}{\partial z}\right] = -\frac{\partial p}{\partial z} - \left[\frac{1}{r}(r.\tau_{rz}) + \frac{\partial \tau_{zz}}{\partial z}\right] - \rho.g_z \text{ , atau :}$$

$$\rho\left[v_r\frac{\partial v_z}{\partial r} + v_z\frac{\partial v_z}{\partial z}\right] = \frac{\partial}{\partial z}\left[\tau_{zz} - p\right] + \frac{1}{r}(r\,\tau_{rz}) - \rho.g \quad \ldots\ldots\ldots\ldots \quad (2\text{-}11)$$

Dimana :

ρg = gaya body $\neq 0$

$$\tau_{zz} = 2\mu\frac{\partial v_z}{\partial z} - \frac{2}{3}\mu\left[\frac{\partial v_r}{\partial r} + \frac{\partial v_z}{\partial z}\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}12)$$

$$\tau_{rz} = \tau_{zr} = \mu\left[\frac{\partial v_z}{\partial r} + \frac{\partial v_r}{\partial z}\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}13)$$

karena $v_z \succ\succ v_r$ maka $\frac{\partial v_z}{\partial r} \succ \frac{\partial v_r}{\partial z}; \frac{\partial v_r}{\partial r}; \frac{\partial v_z}{\partial z}$

Jadi persamaan (2-11) dan (2-12) menjadi :

1. $\tau_{zz} \approx 0$

2. $\tau_{rz} = \tau_{zr} = \mu\left[\frac{\partial v_z}{\partial r}\right]$

Maka persamaan momentum arah z menjadi :

$$\rho\left[v_r\frac{\partial v_z}{\partial r} + v_z\frac{\partial v_z}{\partial z}\right] = -\frac{\partial p}{\partial z} + \frac{\partial}{\partial r}\left[\mu\frac{\partial v_z}{\partial r}\right] - \rho.g_z \quad \ldots\ldots\ldots \quad (2\text{-}14)$$

untuk μ = konstan, maka persamaan menjadi :

$$\left[v_r\frac{\partial v_z}{\partial r} + v_z\frac{\partial v_z}{\partial z}\right] = -\frac{1}{\rho}\frac{\partial p}{\partial z} + \frac{\partial}{\partial r}\left[\frac{\mu}{\rho}\frac{\partial v_z}{\partial r}\right] - .g \quad \ldots\ldots\ldots\ldots \quad (2\text{-}15)$$

atau

$$\left[v_r\frac{\partial v_z}{\partial r} + v_z\frac{\partial v_z}{\partial z}\right] = -\frac{1}{\rho}\frac{\partial p}{\partial z} + \upsilon\frac{\partial^2 v_z}{\partial r^2} - .g \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}16)$$

Syarat batas :

$V_r = V_Z = 0$

$\left.\frac{\partial p}{\partial z}\right|_{bl} = \left.\frac{\partial p}{\partial z}\right|_{qr}$ dimana : b.l = boundary layer

q.r = quiescent region

maka persamaan (2-16) menjadi :

$$[0 + 0] = -\frac{1}{\rho_\infty}\frac{\partial p}{\partial z} + 0 - .g \;\; ; \;\; \rho = \rho_\infty$$

$$\frac{\partial p}{\partial z} = .- g\,\rho_\infty \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}17)$$

Persamaan Lapisan batas menjadi :

$$\left[v_r\frac{\partial v_z}{\partial r} + v_z\frac{\partial v_z}{\partial z}\right] = -\frac{1}{\rho}\left(-\rho_\infty g\right) + \upsilon\frac{\partial^2 v_z}{\partial r^2} - .g \text{ , atau}$$

$$\left[v_r \frac{\partial v_z}{\partial r} + v_z \frac{\partial v_z}{\partial z} \right] = \frac{g}{\rho} \left(\rho_\infty - \rho \right) + \upsilon \frac{\partial^2 v_z}{\partial r^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}18)$$

dimana :

$$\frac{g}{\rho} \left(\rho_\infty - \rho \right) = \text{gaya apung} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}19)$$

Bila, $\beta = -\frac{1}{\rho}\left(\frac{\partial p}{\partial T}\right) \approx -\frac{1}{\rho}\left(\frac{\rho_\infty - \rho}{T_\infty - T}\right)$ disebut Koeffisien Ekspansi volumetris panas

Sehingga :

$$\rho_\infty - \rho = \rho \beta \left(T - T_\infty \right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}20)$$

Persamaan (2-20) disubstitusikan ke persamaan (2-18) menjadi :

$$\left[v_r \frac{\partial v_z}{\partial r} + v_z \frac{\partial v_z}{\partial z} \right] = \frac{g}{\rho} \rho \beta \left(T - T_\infty \right) + \upsilon \frac{\partial^2 v_z}{\partial r^2} \quad \text{, atau :}$$

$$\left[v_r \frac{\partial v_z}{\partial r} + v_z \frac{\partial v_z}{\partial z} \right] = g \beta \left(T - T_\infty \right) + \upsilon \frac{\partial^2 v_z}{\partial r^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}21)$$

Kondisi batas :

$$r = r_{w2-in} \quad maka \quad v_z = 0$$

$$r = r_{w1-out} \quad maka \quad v_z = 0$$

Persamaan energi :

$$\left[v_r \frac{\partial T}{\partial r} + v_z \frac{\partial T}{\partial z} \right] = \alpha \frac{\partial^2 T}{\partial r^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}22)$$

Kondisi batas :

$$T = T_{w2-in} \quad pada \; r = r_{w2-in}$$

$$T = T_{w2-in} \quad pada \quad r = r_{wi-out}$$

Pertimbangan Kesamaan (similarity consideration) :

Parameter tanpa dimensi yang digunakan adalah ;

$$v_r^* = \frac{v_r}{(v_r)_0} \qquad v_z^* = \frac{v_z}{(v_z)_0} \qquad T^* = \frac{T - T_\infty}{T_s - T_\infty} \qquad r^* = \frac{r}{\delta}$$

$$z^* = \frac{z}{\delta} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}23)$$

dimana :

T_s = temperatur permukaan

$T\infty$ = temperatur aliran bebas

$(v_r)_o = (v_z)_o$ = kecepatan acuan sembarang

$$= \sqrt{g\ \beta\ \delta\ (T - T\infty)}$$

Masukkan persamaan (2-23) ke persamaan (2-21) dan (2-22) didapat :

Persamaan Momentum arah z :

$$\left[v_r^* \frac{\partial v_z^*}{\partial r^*} + v_z^* \frac{\partial v_z^*}{\partial z^*} \right] = g\ \beta \left(\frac{T - T}{(v_z)_o^2{}_\infty} \right) \delta\ T^* + \left(\frac{\upsilon}{(v_r)_o\ \delta} \right) \frac{\partial^2 v_z^*}{\partial r^{2^*}} \quad \ldots\ldots \quad (2\text{-}24)$$

Persamaan Energi :

$$\left[v_r^* \frac{\partial T^*}{\partial r^*} + v_z^* \frac{\partial T^*}{\partial z^*} \right] = \left(\frac{\alpha}{(v_z)_o\ \delta} \right) \frac{\partial^2 T^*}{\partial r^{2^*}} \quad \ldots\ldots\ldots\ldots \quad (2\text{-}25)$$

Dari persamaan (2-24) dan persamaan (2-25) terdapat dua parameter yang mempunyai nilai sama yaitu :

$$\left(\frac{\alpha}{(v_z)_o\ \delta} \right) ; \left(\frac{g\ \beta\ (T_s - T_\infty)\ \delta^2\ (v_z)_o}{(v_z)_o^2\ \upsilon} \right) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}26)$$

atau ;

$$\left(\frac{k}{(v_z)_o\ \rho\ c_p\ \delta}\right);\left(\frac{g\ \beta\ (T_s - T_\infty)\ \delta^3}{(v_z)_o^2\ \delta\ \upsilon}\right) \quad \ldots\ldots\ldots\ldots\ldots \quad (2\text{-}27)$$

maka :

$$\left(\frac{\mu\ c_p}{k}\right).\left(\frac{g\ \beta\ (T_s - T_\infty)\ \delta^3}{\upsilon^2}\right) = p_r\ G_{r_\delta} \quad \ldots\ldots\ldots\ldots\ldots \quad (2\text{-}28)$$

dimana :

$G_{r\text{-}}\delta$ = bilangan grashoft

g = gaya gravitasi (9.81 m/s^2)

g' = g . cos θ = gaya gravitasi bila benda uji berposisi miring

δ = diameter karakteristik (mm)

β = koeffisien ekspansi volumetris panas (1/k, untuk gas ideal = 1/T)

υ = viscositas kinematis fluida (m^2/s)

T_s = temperatur permukaan (^0C atau ^0k)

$T\infty$ = temperatur fluida dekat permukaan (^0C atau ^0k)

Bilangan Grashoft merupakan perbandingan antara gaya apung (bouyancy force) dengan gaya viscous (viscouse force) dalam aliran fluida bebas , yang mempunyai peranan yang sama seperti halnya bilangan Reynolds (Re) pada aliran fluida paksa. Sedangkan bilangan Prandtl (Pr) merupakan perbandingan antara momentum suatu aliran terhadap diffusitas termalnya, yang dinyatakan sebagai berikut :

$$P_r = \frac{C_p\ \mu}{k} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}29)$$

dimana :

Cp : kapasitas panas jenis tekanan konstan fluida (J/kg-^{o}k)

k : koeffisien konduktifitas panas (W/m-°k)

μ : viscositas dinamik fluida (kg/m-s)

Untuk menentukan tipe aliran laminer atau turbulen pada konveksi bebas dinyatakan dalam bilangan Rayleigh (Ra) yang mempunyai kondisi kritis aliran yang terjadi adalah $Ra_{D,c} \sim 10^9$. Bilangan Rayleigh diperoleh dari hasil perkalian antara bilangan Prandtl (Pr) dengan Grashoft (Gr) , yang dinyatakan sebagai berikut :

$$Ra_\delta = \frac{g\ \beta\ \delta^3\ (T_s - T_\infty)}{\alpha\ \upsilon} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}30)$$

dimana :

α : difusitas panas fluida (m^2/s)

Bilangan tanpa dimensi yang lain adalah bilangan Nusselt (Nu). Dalam persamaan (2-26), (2-27) dan (2-28) bilangan Nusselt merupakan suatu fungsi yang dinyatakan sebagai berikut :

$$Nu_\delta = \frac{h\ \delta}{k} = f(Gr\text{-}\delta, Pr) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}31)$$

dimana :

h : koeffisien konveksi fluida (W/m^2-°K)

Dalam praktek perekayasaan harga bilangan Nusselt untuk aliran didalam saluran biasanya ditentukan dari persamaan-persamaan empiris yang didasarkan pada hasil eksperiment yang telah dilakukan .

Jadi korelasi empiris dalam penelitian ini adalah :

$$Nu = C\ (Gr\,\delta\ .\ Pr)^m . \left(\frac{L}{\delta}\right)^n \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}32)$$

Dimana : C : konstanta

m, n : konstanta eksponential

Gr-δ : bilangan grashoft

Pr : bilangan Prandtl

$\left(\frac{L}{\delta}\right)$: aspek ratio rongga

Lapisan batas termal yang terjadi pada permukaan dinding yang dipanaskan terbentuk mulai dari bagian bawah dinding kemudian berkembang sampai bagian atas dinding, atau sebaliknya untuk dinding yang didinginkan . Sesuai dengan gerakan fluida pada konveksi bebas/alamiah pada dinding atau silinder vertikal tertutup, yang salah satu dinding dipanaskan dan dinding lainnya didinginkan , seperti pada gambar 2-2.

Sedangkan untuk menentukan tebal lapisan batas yang berkembang sampai batas dinding dari permukaan vertikal yang tertutup , menurut Nailor (1999) dinyatakan sebagai berikut :

$$\delta_{lt} = \frac{\delta}{(Gr_{\delta})^{0.25}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2\text{-}33)$$

Dimana :

δ_{lt} : *tebal lapisan batas(mm)*

δ : *diameter karakteristik (mm)*

Gr_{δ} : *bilangan Grashoft*

BAB III

METODOLOGI PENELITIAN

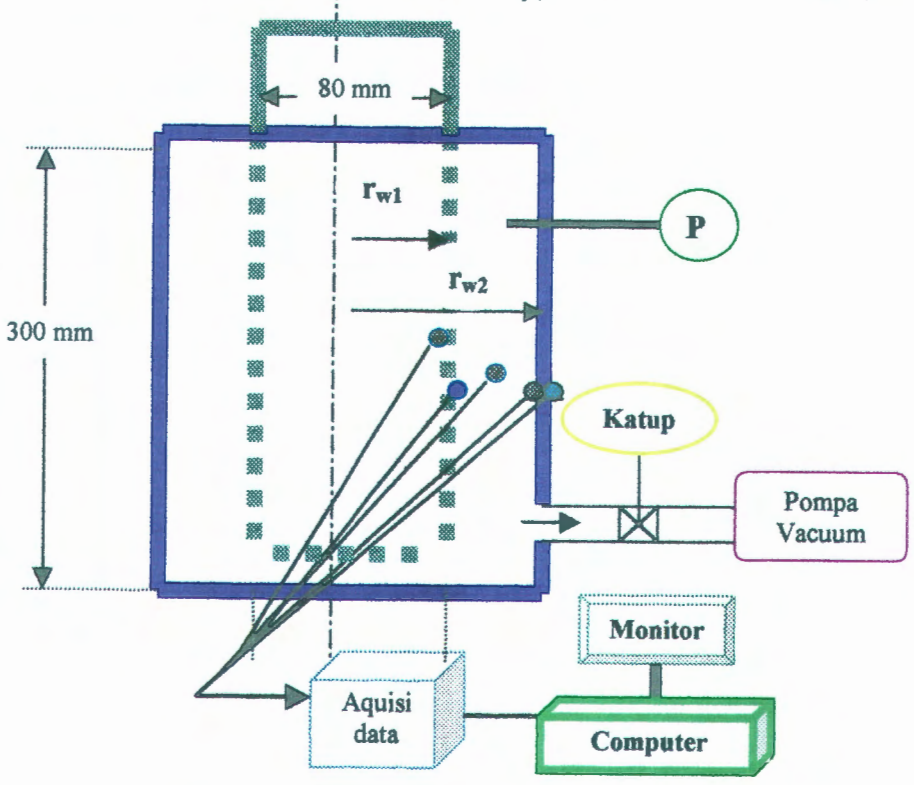
3.1. Variabel penelitian

Analisa proses perpindahan panas konveksi alamiah dalam tabung annulus yang diberikan perlakuan berupa variasi derajat kevakuman, dilakukan analisa dimensional dengan pendekatan "DALIL π BUCKINGHAM" atau Buckingham method, yang mana akan didapatkan suatu fungsi-fungsi tanpa dimensi. Berikut persamaan fungsi koeffisien perpindahan panas konveksi alamiah yang menyatakan hubungan antara variabel-variabel adalah sebagai berikut ;

$$h = f\{\delta, k, Cp, \mu, \rho, p, \beta g(T_s - T_f)\} \quad \text{..... (3-1)}$$

atau

$$f\{h, \delta, k, Cp, \mu, \rho, p, \beta g(T_s - T_f)\} = 0 \quad \text{..... (3-2)}$$



Gambar 3-1: Skema Eksperimen

Dengan menggunakan dimensi MLtT (massa, panjang, waktu dan temperatur) akan didapat grup parameter tanpa dimensi dari fungsi diatas, yaitu :

1. $\pi_1 = f\left(h, \delta^{a1}, k^{b1}, \mu^{c1}, p^{d1}, \rho^{e1}\right) \approx bilanganNusselt$ ..... (3-3)

2. $\pi_2 = f\left(Cp, \delta^{a2}, k^{b2}, \mu^{c2}, p^{d2}, \rho^{e2}\right) \approx$ ...bilangan Prandtl ... (3-4)

3. $\pi_3 = f\left(\beta g\left(T_s - T_f\right), \delta^{a3}, k^{b3}, \mu^{c3}, p^{d3}, \rho^{e3}\right) \approx bil.\ Grashoft$ (3-5)

4. $\pi_4 = \left(\frac{L}{\delta}\right) \approx aspek\ ratio\ \ rongga$ ..... (3-6)

sehingga didapatkan persamaan koeffisien perpindahan panas konveksi alamiah dalam bentuk variabel tanpa dimensi sebagai berikut :

$\pi_1 = f\left(\pi_2, \pi_3, \pi_4\right)$, atau :

$$Nu = f\left(\Pr, Gr_\delta, \frac{L}{\delta}\right) \quad \text{.....} \quad (3\text{-}7)$$

atau :

$$Nu = f\left(Ra_\delta, \frac{L}{\delta}\right) \quad \text{.....} \quad (3\text{-}8)$$

Dari analisa dimensi diperoleh koeffisien perpindahan panas (variabel tetap) konveksi alamiah sebagai fungsi dari *bilangan Rayleigh, aspek ratio rongga,* seperti diuraikan pada persamaan (3-8).

3.2. Peralatan Eksperimen

Eksperimen ini dilakukan untuk mendapatkan hubungan secara empiris antara koeffisien perpindahan panas konveksi alamiah (bilangan Nusselt) terhadap bilangan Prandtl, bilangan Grashoft dengan melakukan perlakuan berupa variasi derajat kevakuman (tekanan rendah) dan aspek ratio diameter tabung/rongga.

Peralatan yang digunakan dalam eksperimen ini adalah sebagai berikut :

1. Barometer vacuum , untuk menggukur tekanan vacuum
2. Thermometer biasa, untuk mengukur temperatur ruangan
3. Tabung anulus dari bahan baja carbon chrom , sebagai obyek penelitian.
4. Thermokopel/sensor Type lm-35 ; untuk mengukur temperatur dinding tabung.
5. Pompa vakum (yang digunakan untuk AC), untuk menvakumkan tabung anulus/rongga.
6. Acquisisi data, difungsikan untuk merekam input data dari sensor atau termokople, yang merubah input panas menjadi volt selanjutnya menjadi data temperatur.
7. Seperangkat komputer (PC), untuk menampilkan data hasil proses dari data aquisisi.
8. Katup, untuk membuka dan menutup aliran udara ke rongga .
9. Fluida kerja, tabung dalam berupa es dan tabung luar berupa udara.

Untuk mengukur temperatur pada sejumlah titik pada dinding tabung digunakan thermokopel type lm-35 yang dihubungkan dengan data aquisisi yang telah dikalibrasi, selanjutnya dihubungkan ke seperangkat komputer untuk membaca data temperatur.

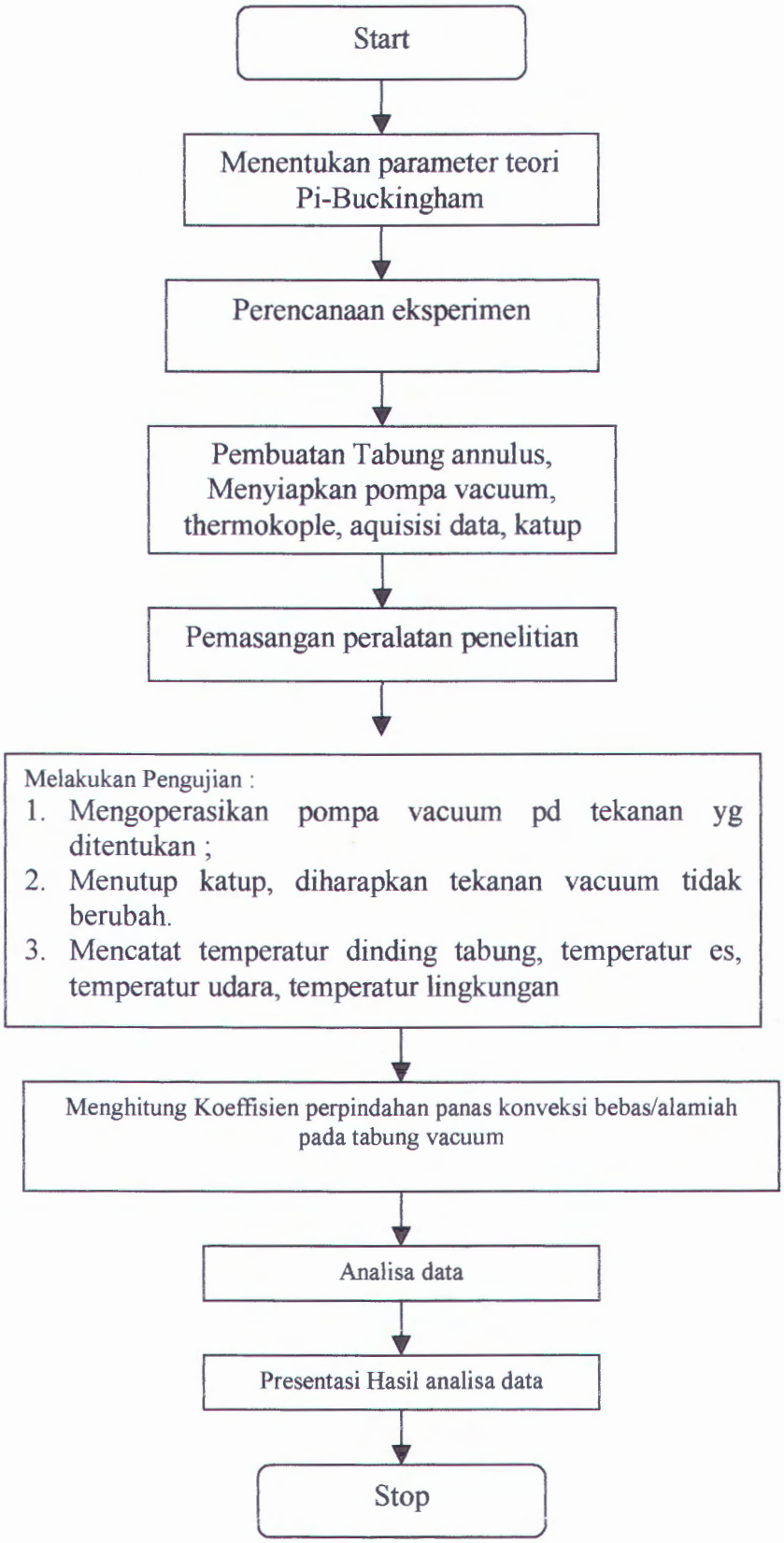
3.3. Prosedur Percobaan

Untuk melakukan penelitian dan pengambilan data, dilakukan langkah-langkah penelitian sebagai berikut :

1. Mempersiapkan tabung annulus, thermokople, barometer, es, pompa vacuum dan kompucter selanjutnya alat tersebut diset sedemikian rupa.
2. Operasikan pompa vakum hingga mencapai tekanan vakum yang telah ditentukan .
3. Bila tekanan vakum (tekanan yang direncanakan) telah tercapai, selanjutnya katup ditutup sedemikian rupa agar tidak berhubungan dengan lingkungan.
4. Mencatat seluruh data yaitu: temperatur dinding, tekanan vacuum, temperatur udara vacuum, temperatur es, temperatur lingkungan semuanya dicatat oleh data aquisisi yang dihubungkan ke kompucter .
5. Ulangi point (3), dengan tekanan vacuum yang lain dan seterusnya.

Diameter tabung dalam (D1) .... Es	Diameter tabung Luar (D2).. udara	Tekanan Vacuum Udara Absolut (Pabs)
50.8 mm/ 0.0508 m	76.2 mm/0.0762 m 88.90 mm/0.0889 m 101.6 mm/0.1016 m	560 torr/-20 cm Hg 360 torr/-40 cm Hg 160 torr/-60 cm Hg

3.4. Diagram Alir Prosedur Penelitian



3.5. Tempat dan Waktu Kegiatan/Penelitian

Tempat penelitian dilakukan di laboratorium Konvergi Energi/Perpindahan Panas Universitas Muhammadiyah Malang

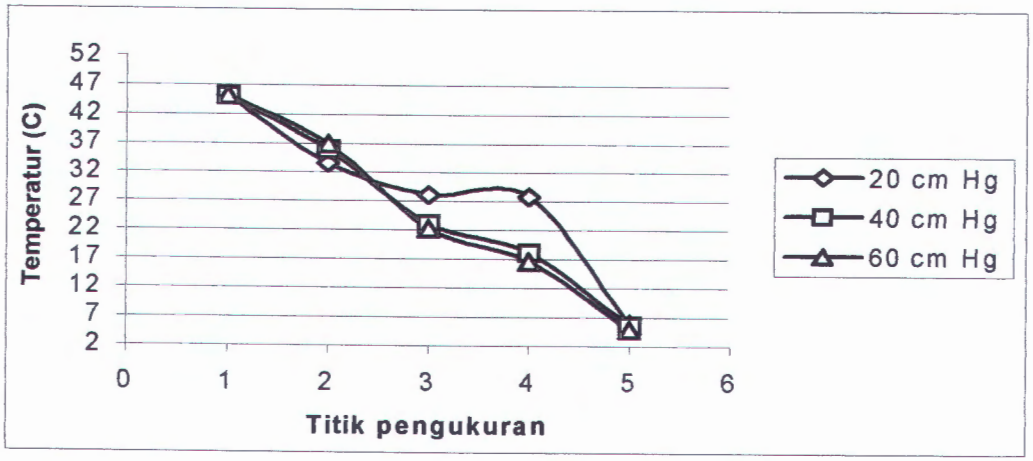
No	Jenis Kegiatan	Bulan Ke							
		1	2	3	4	5	6	7	8
1	Tahap persiapan	X	X						
2	Pelaksanaan Penelitian			X	X				
3	Analisa Data					X	X		
4	Penulisan laporan							X	X

BAB IV

PERHITUNGAN DAN PEMBAHASAN

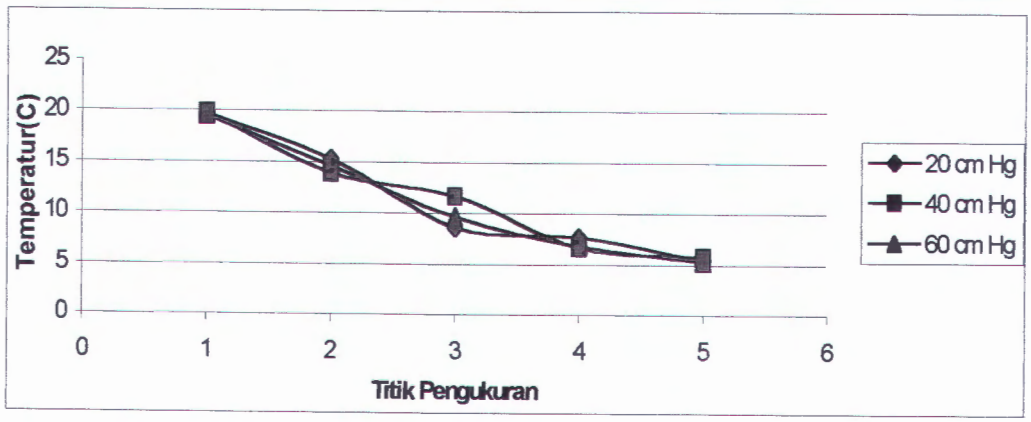
4.1. Data Penelitian

Gambar dibawah ini merupakan data hasil penelitian untuk distribusi temperatur ditiap-tiap titik pengukuran (dinding benda uji). Sedangkan distribusi temperaturnya adalah sebagai berikut :



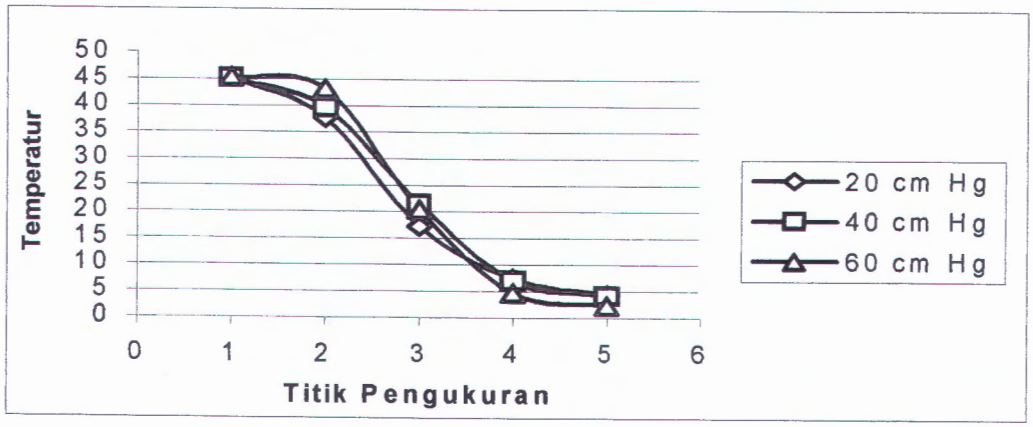
Gambar 4-1:

Distribusi Temperatur pada L/δ = 5.9 dan Temperatur Permukaan = 45 ^{0}C



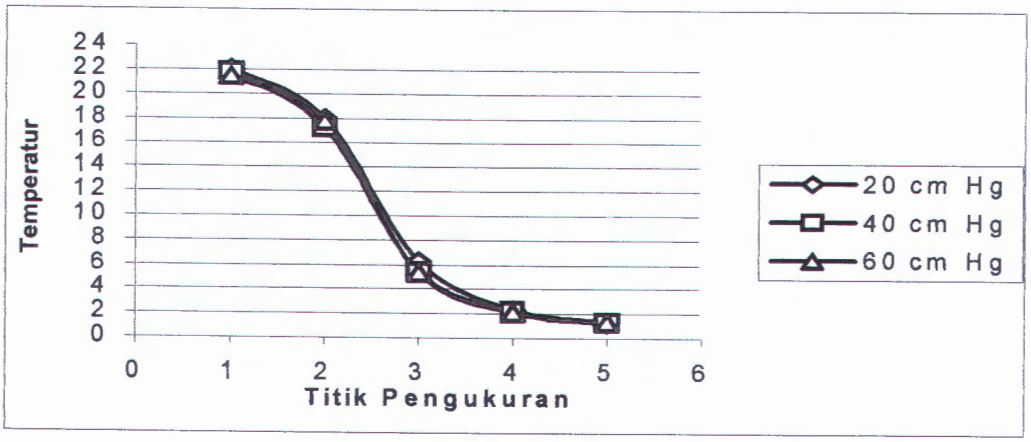
Gambar 4-2:

Distribusi Temperatur pada L/δ = 5.9 dan Temperatur Kondisi Standard



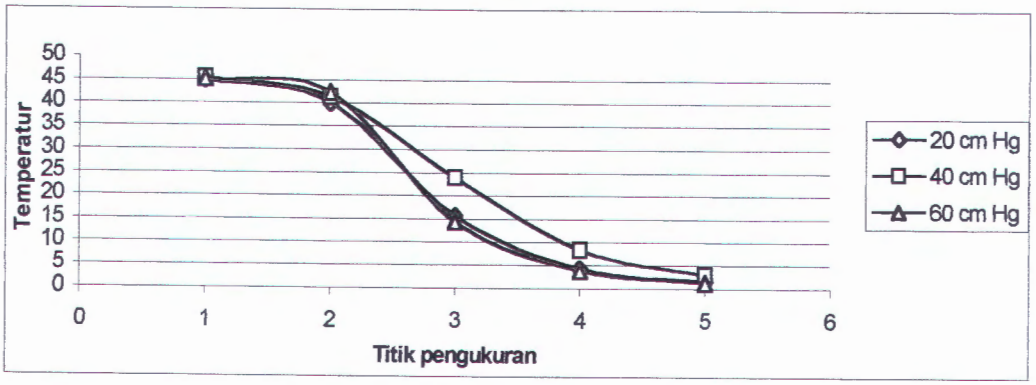
Gambar 4-3:

Distribusi Temperatur pada L/δ = 7.87 dan Temperatur Permukaan = 45^{0}C



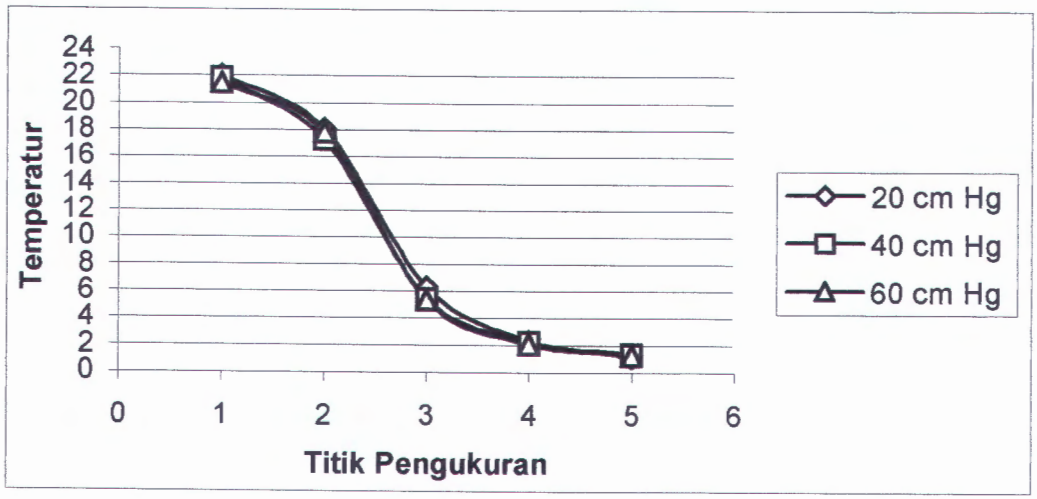
Gambar 4-4:

Distribusi Temperatur pada L/δ = 7.87 dan Temperatur Kondisi Standard



Gambar 4-5:

Distribusi Temperatur pada L/δ = 11.8 dan Temperatur Permukaan = 45^{0}C



Gambar 4-6:

Distribusi Temperatur pada L/δ = 11.8 dan Temperatur Kondisi Standard

Dalam penelitian ini dilakukan dengan tiga macam kondisi perbandingan antara tinggi tabung (L) dengan diameter karakteristik rongga (δ), yaitu : $\frac{L}{\delta} = 11$ (Diameter tabung luar : 3 "), $\frac{L}{\delta} = 7.87$ (Diameter tabung Luar : 3.5 ") dan $\frac{L}{\delta} = 5.90$ (Diameter tabung Luar : 4 ") . sedangkan Diameter Tabung dalam adalah tetap yaitu : 2 " (0.0508 m) . Pada pengujian ini diberikan perlakuan berupa :

1. Perubahan Posisi benda uji, yaitu : 30^0, 60^0 dan 90^0
2. Pemanasan permukaan benda uji, yaitu ; 35 ^{0} C, 45 ^{0} C, 55 ^{0} C dan 65 ^{0} C

Sedangkan pada gambar 4-1 sampai 4-6 adalah data distribusi temperatur dinding pada posisi 90 ^{0} , dengan temperatur permukaan ; 45 ^{0}C dan

Temperatur atmosfir (standard) pada $\frac{L}{\delta}$ yang berbeda. Absis (sumbu X) menunjukkan titik pengukuran , dimana :

- Titik 1 : menunjukkan temperatur dinding tabung luar bagian luar ($T_{w2\text{-}out}$),
- Titik 2 : menunjukkan temperatur dinding tabung luar bagian dalam ($_{Tw2\text{-}in}$),
- Titik 3 : menunjukkan temperatur free stream/udara pada rongga (T~),
- Titik 4 : menunjukkan temperatur dindin tabung dalam bagian luar ($T_{w1\text{-}out}$)
- Titik 5 : menunjukkan temperatur dinding tabung dalam bagian dalam ($T_{w1\text{-}in}$)

Gambar 4-1 sampai 4-6 memperlihatkan profil temperatur dari permukaan tabung luar (Tw2-out) ke temperatur dinding tabung dalam (Tw1-in) cenderung menurun. Hal ini disebabkan terjadinya perambatan pada ketebalan tabung luar secara konduksi sehingga mengakibatkan kehilangan panas (juga temperatur), begitu pada rongga yang berisi udara akan membentuk lapisan termal yang mengakibatkan penurunan temperatur dan akhirnya terjadi perambatan (konduksi) pada dinding tabung dalam yang juga mengakibatkan kehilangan panas (temperatur). Pada Gambar tersebut dapat disimpulkan dengan kenaikan tekanan vacuum, besarnya distribusi temperatur pada dinding luar kedinding tabung dalam cenderung menurun.

Sedangkan data hasil penelitian secara lengkap dapat dilihat pada ***lampiran I.***

4.2. Perhitungan Data Penelitian

4.2.1. Perhitungan Pada Tabung luar dengan Diameter 4 in atau 0.1016 m

atau $\frac{L}{\delta} = 5.9$

Misal data penelitian : 4", -20 cm Hg, 45 ^{0}C, 90 ^{0}

Diketahui :

- Diameter tabung dalam (D_1) = 2 in = 5.08 cm = 0.0508 m
- Tebal rongga/celah (δ) = (D_2-D_1) = (0.1016-0.0508) m
  = 0.0508 m
- Kemiringan benda uji (θ) = 90 ^{0}C
- Data Material tabung baja Karbon krom (ST-42) , sebagai berikut :
  1. ρ = 7865 kg/m^3
  2. Cp = 0.46 Kj/kg-^{0}C
  3. k_{mat} = 19 W/m-^{0}C
  4. α = 0.527 x 10^{-5} m^2/s
- Data distribusi temperatur :

1.	T_{atm}	=	27 ^{0}C	=	300	^{0}K
2.	$T_{w2\text{-}out}$	=	45.1463 ^{0}C	=	318.1463	^{0}K
3.	$T_{w2\text{-}in}$	=	35.4764 ^{0}C	=	308.4764	^{0}K
4.	$T_{\delta-lt}$	=	28.0508 ^{0}C	=	301.0508	^{0}K
5.	$T_{w1\text{-}out}$	=	17.8102 ^{0}C	=	290.8102	^{0}K
6.	$T_{w1\text{-}inj}$	=	5.8376 ^{0}C	=	278.8376	^{0}K

a. **Menghitung Temperatur Film dalam rongga** :

$$T_f = \frac{T_{w2-in} + T_{w1-out}}{2} = \frac{308.4764 + 290.8102}{2} = 299.6433\ ^0K$$

Dari temperatur film diatas dapat diperoleh properties udara dengan cara interpolasi , sehingga diperoleh nilai sebagai berikut :

$$\rho = \left\{\frac{(299.6433 - 250)(0.998 - 1.4128)}{(350 - 250)}\right\} + 1.4128 = 1.20688\ \frac{kg}{m^3}$$

untuk harga yang lainnya dihitung dengan model yang sama dan harga nilai yang lain seperti tabulasi berikut :

Temp. (K)	ρ (kg/m^3)	Cp (kj/kg-C)	μ (x 10^{-5}) (kg/m.s)	υ (x 10^{-6}) m^2/s	K (W/m-C)	α (x10^{-4}) (m^2/s)	Pr
250	1.4128	1.0053	1.599	11.31	0.02227	0.15675	0.722
299.6433	1.2068796	1.007137	1.835302	16.00129	0.026122	0.22702	0.70958
350	0.998	1.009	2.075	20.76	0.03003	0.2983	0.697

b. **Koeffisien Ekspansi Volume (β)** :

$$\beta = \frac{1}{T_f} = \frac{1}{299.6433} = 0.003337\ K^{-1} = 0.037534\ C^{-1}$$

c. **Gaya gravitasi (g') benda uji dengan kemiringan 90 ^{0} adalah :**

g' = 9.81 m/s^2 , jika benda uji dalam posisi tegak (90 ^{0})

$g' = g \cos\theta$ ---------> benda uji berposisi miring

d. Bilangan Grashoft (Gr_δ) :

$$Gr_\delta = \frac{g' \beta (T_{w2-in} - T_{w1-out}) \delta^3}{\upsilon^2}$$

$$= \frac{9.81 \frac{m}{s^2} \; 0.003337 \frac{1}{K} \; 0.0508^3 \; m^3 (308.4764 - 290.8102) K}{(16.0013 \; x.10^{-6})^2 \frac{m^4}{s^2}}$$

$$= 37017$$

e. Tebal Lapisan Batas Termal (δ_{lt}) :

$$\delta_{lt} = \frac{\delta}{(Gr_\delta)^{0.25}} = \frac{0.0508}{(37017)^{0.25}} = 0.001831 \; m$$

f. Bilangan Rayleigh (Ra) :

$$Ra = Gr_\delta \; x \; \Pr = 37017 \; x \; 0.7096 = 26267$$

g. **Mencari Bilangan Nusselt (Nu δ):**

Untuk mencari bilangan Nusselt dalam suatu rongga yang tertutup , dicari dengan menggunakan persamaan rongga tertutup secara umum (tidak berdasarkan hasil eksperimen) yang dinyatakan sebagai berikut :

$$Nu_\delta = C(Gr_\delta \; \Pr)^n \; (\frac{L}{\delta})^{-m}$$

Harga konstanta : C, n dan m didapat berdasarkan harga bilangan Rayleigh. Berdasarkan tabel 7-3 hal. 320 pada Holman , untuk harga Ra = 26267 diperoleh harga ; C = 0.197, n = 0.25 dan m = -0.11, sehingga persamaan untuk mencari Nusellt adalah sebagai berikut :

$$Nu_\delta = 0.197 \; (Gr_\delta \; \Pr)^{0.25} \; (\frac{L}{\delta})^{-0.11}$$

dimana : L = panjang benda uji (m)

δ = ketebalan rongga (m)

Dari persamaan Nusselt diatas, diperoleh harga Nu sebagai berikut :

$$Nu_{\delta} = 0.197\,(26267)^{0.25}\,(\frac{0.3}{0.0508})^{-0.11} = 1.9115$$

h. Mencari **'kooeffisien perpindahan panas konveksi alamiah udara** :

$$Nu = \frac{h\,\delta}{k_f}$$

$$h = \frac{Nu_{\delta}\,k_f}{\delta} = \frac{1.9115\,x\,0.026122}{0.0508} = 1.9658\,\frac{W}{m^2 - C}$$

i. **Laju Perpindahan Panas Konveksi pada Rongga (q) :**

$$q = 2\,\pi\,L\,h_{w2-in}\,(r_{w2-in\,t})\,(T_{w2-in} - T_{\infty t}) + 2.\pi.L.h_{w1-out}\,(r_{w1-out})(T_{\infty} - T_{w2-out})$$

$$= 2.3.14.0.3m\,.\,1.9658\,\frac{W}{m^2 - C}\,(0.0508)m\,[35.47 - 28.05]C +$$

$$2.3.14.0.3m.1.9658\frac{W}{m^2 - {}^{0}C}(0.0266)(28.05 - 17.81)C$$

$$= 2.2747\,W$$

j. **Tahanan Termal total ($R_{thermal}$)** :

$$R = \frac{\ln\left(r_{w2-out} / r_{w2-in}\right)}{2\,.\,\pi\,k_{w2}\,L} + \frac{1}{2.\,\pi\,h_{udara}\,L\,(r_{w2-in\,\,t})} + \frac{\ln\left(r_{w1-out} / r_{w1-in}\right)}{2.\pi.k_{w1}\,L}$$

$$+ \frac{1}{2.\pi.h_{udara}.L.(r_{w1-out})}$$

$$= \frac{\ln\left(\frac{0.052}{0.0508}\right)}{2.x3.14.x19x0.3} + \frac{1}{2x3.14x1.9658x\ 0.3\ (0.0508)}$$

$$+ \frac{\ln\left(\frac{0.0266}{0.0254}\right)}{2\ x\ 3.14\ x19x0.3} + \left(\frac{1}{2x3.14x1.9658x0.3x(0.0266)}\right)$$

$$= 16.123\ \frac{^0C}{W}$$

k. **Laju Perpindahan Panas Total (q_{total}) :**

$$q_{total} = \frac{(T_{w2-out} - T_{w1-in})}{R_{termal}} = \frac{(45.1463-5.8376)}{16.123} = 2.437W$$

l. **Prosentase Selisih antara Laju Perpindahan Panas Konveksi Alamiah rongga dengan Laju Perpindahan Panas Total (Δq) adalah :**

$$\Delta q = \left(\frac{q_{konveksi} - q_{total}}{q_{total}}\right) x100\% = \left(\frac{2.2747 - 2.4379}{2.4379}\right) x100\%$$

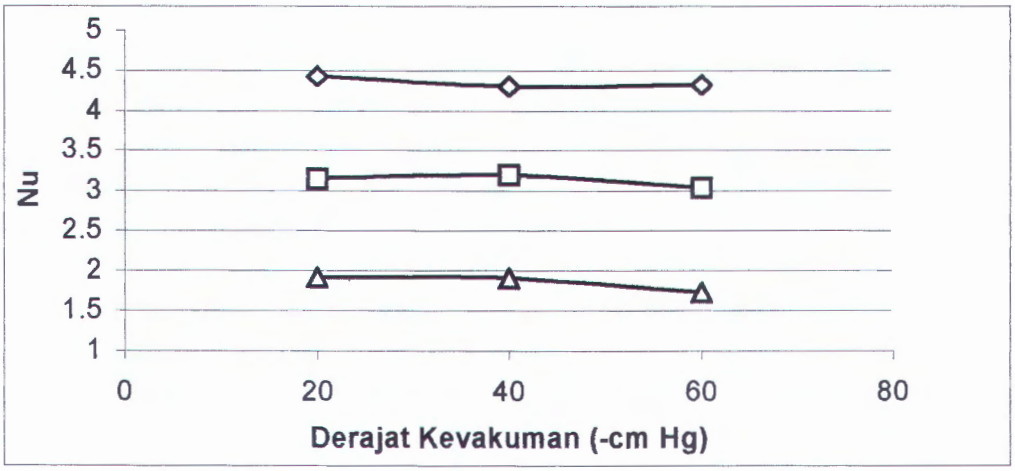
$$= -0.0669\ \%$$

Dengan cara yang sama untuk data percobaan yang lain , hasil dari perhitungan disusun dalam bentuk tabel pada lampiran : II

4.3. Pembahasan

4.3.1 Hubungan Derajat Kevakuman Terhadap Bilangan Nusselt dan Bilangan Rayleigh

Gambar 4-7 menunjukkan hubungan antara derajat /tingkat kevakuman terhadap Bilangan Nusselt dengan adanya variasi aspek ratio rongga ($\frac{L}{\delta}$) pada posisi benda uji : 90^0 dan temperatur permukaan : 45^0 C.



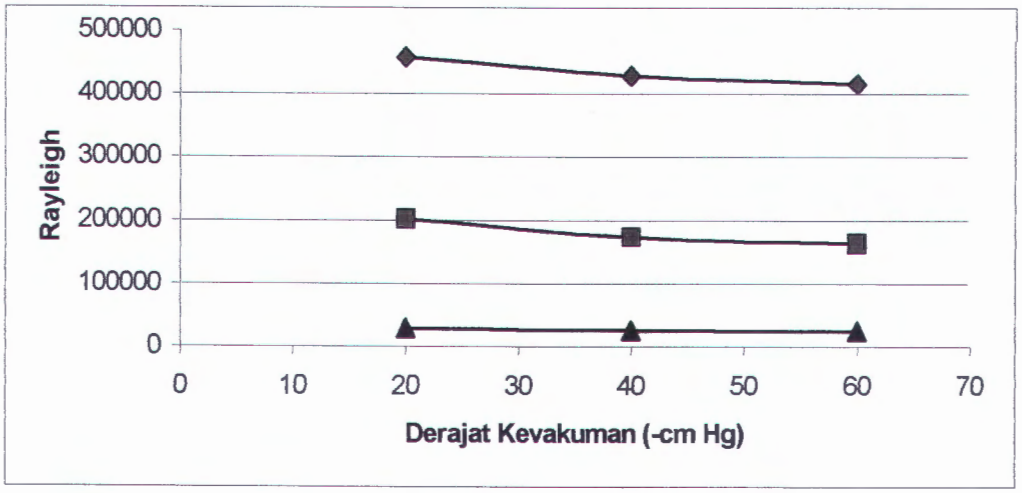
Gambar 4-7 :

Hubungan Derajat kevakuman terhadap Bilangan Nusselt Pada Posisi benda uji = 90^0 dan Temperatur Permukaan = $45\ ^0$C

Simbol : ✧ $\frac{L}{\delta} = 11.8$, □ $\frac{L}{\delta} = 7.87$, Δ $\frac{L}{\delta} = 5.9$

Dari grafik diatas, dapat dijelaskan bahwa tingkat/derajat kevakumanan semakin besar maka harga bilanan Nusselt semakin menurun. Hal ini disebabkan karena dengan semakin besar derajat kevakuman akan memberikan harga kerapatan jenis udara dalam rongga semakin besar. Dengan kerapatan jenis semakin besar akan memberikan arti bahwa kecepatan pergerakan fluida atau molekul membawa energi semakin lambat , sehingga akan mempengaruhi selisih

kerapatan jenis free stream dengan kerapatan jenis mula-mula ($\rho_\infty - \rho$) . Untuk aspek ratio rongga ($\frac{L}{\delta}$ = 11.8) yang besar atau rongga tipis mempunyai harga lbilangan Nusselt lebih besar, karena kecepatan pergerakan molekul membawa energi lebih cepat dibandingkan dengan aspek ratio ($\frac{L}{\delta}$) 7.87 dan 5.9. Akibat dari pergerakan molekul membawa energi lebih cepat maka akan memberikan selisih kerapatan antara kerapatan free stream dengan kerapatan mula-mula akan semakin kecil sehingga gaya apung yang timbul adalah semakin kecil akibatnya bilangan nusselt akan semakin besar. Karena bilangan nusselt merupakan fungsi dari bilangan Grasshoft. Dari gambar 4-7, dengan derajat kevakuman yang berbeda , aspek ratio rongga ($\frac{L}{\delta}$ **= 5.90)** mepmpunyai harga bilangan Nusselt lebih kecil dibandingkan dengan aspek ratio rongga yang lain (7.87 atau 11.8).



Gambar 4-8 :

Hubungan Derajat kevakuman Terhadap Bilangan Rayleigh Pada Posisi Benda Uji = 90 ^{0} dan Temperatur Permukaan = 45 ^{0}C

Simbol : ✧ $\frac{L}{\delta}$ = 11.8 , □ $\frac{L}{\delta}$ = 7.87, Δ $\frac{L}{\delta}$ = 5.9

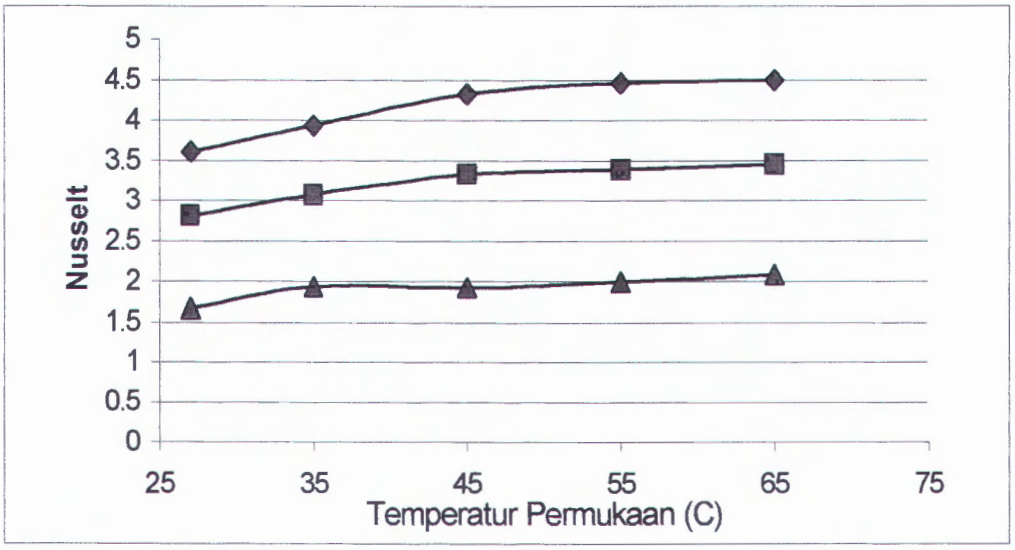
Gambar 4-8 , merupakan grafik hubungan derajat kevakuman terhadap Bilangan Rayleigh pada posisi benda uji = 90 ^{0} dengan temperatur permukaan 45 ^{0}C. Dari gambar dijelaskan bahwa semakin besar tingkat kevakuman pada yang terjadi di rongga , harga bilangan Nusselt cenderung turun. Bagi aspek ratio rongga semakin kecil ($\frac{L}{\delta}$=**5.9)** atau rongga besar mempunyai bilangan Rayleigh yang paling kecil. Hal ini disebabkan bila tekanan kevakuman dinaikkan maka kerapatan jenis molekul akan naik , sehingga kecepatan pergerakan molekul/fluida /udara dalam rongga menjadi sangat kecil . Kecepatan fluida bergerak dipengaruhi oleh perbedaan kerapatan jenis molekul free stream dengan kerapatan jenis molekul yang ada di dinding. Terjadinya perbedaan kerapatan disebabkan oleh adanya energi/pemanasan dari permukaan dinding ($T_{w2\text{-}in}$) sehingga akan mengakibatkan timbulnya momentum molekul dalam rongga. Untuk aspek ratio rongga semakin besar ($\frac{L}{\delta}$) atau ketebalan rongga adalah tipis, maka harga bilangan Rayleigh semakin besar, hal ini terjadi karena dengan rongga/celah yang tipis kecepatan pergerakan molekul membawa energi lebih cepat dibandingkan dengan aspek ratio 7.87 dan 5.9. Akibatnya, lapisan batas termal (gradient suhu) pada aspek ratio rongga 11.8 lebih cepat terbentuk dibandingkan dengan aspek ratio 7.87 dan 5.9. Sehingga perbedaan temperatur free stream dengan temperatur dinding tabung dalam sisi luar ($T\infty - T_{w1-out}$) adalah kecil. Akibat perbedaan temperatur antar dinding dalam rongga yang kecil sehingga harga bilangan grashoft menjadi besar, sehingga bilangan Rayleigh juga menjadi besar . Karena bilangan Rayleigh merupakan fungsi dari bilangan grashof dan Prandtl.

4.3.2. Hubungan Variasi Temperatur Permukaan Terhadap Bilangan Nusselt dan Rayleigh.

Gambar 4-9 : menunjukkan hubungan antara variasi temperatur permukaan terhadap Bilangan Nusselt pada posisi benda uji = 90^{0} dengan tekanan vakum = - 60 cm Hg (160 torr).

Dari gambar 4-9, dapat disampaikan bahwa semakin besar temperatur pada aspek ratio $(\frac{L}{\delta})$ yang berbeda akan diperoleh harga bilangan Nusselt semakin naik. Untuk aspek ratio yang besar (rongga tipis) mempunyai bilangan Nusselt lebih besar dibandingkan dengan aspek ratio 7.87 dan 5.9. Hal ini disebabkan karena pada aspek ratio rongga 11.8 timbulnya perbedaan antara temperatur free stream dengan temperatur dinding dalam bagian luar adalah kecil karena dengan pada aspek ratio rongga 11.8 kecepatan pergerakan molekul membawa energi lebih cepat dibandingkan dengan aspek ratio rongga 7.87 dan 5.9. Sehingga aspek ratio rongga 11.8 mempunyai bilangan Grashof lebih besar dibandingkan dengan aspek ratio 7.87 dan 5.9. Sedangkan besar-kecilnya bilangan Grashof merupakan fungsi dari temperatur. Akibatnya semakin besar temperatur yang masuk maka bilangan Grashof semakin besar sehingga harga bilangan Nusselt juga akan semakin besar. Untuk aspek ratio rongga kecil (ketebalan rongga besar) mempunyai bilangan nusselt juga kecil karena kecepatan pergerakan molekul dalam rongga lebih lambat dibandingkan dengan aspek ratio rongga 11.8 dan 7.87. Maka dapat disimpulkan bahwa dengan semakin besar temperatur permukaan maka harga bilangan Nusselt semakin besar pula, karena

bilangan Nuselt merupakan fungsi bilangan Rayleigh. Sedangkan bilangan Rayleigh merupakan fungsi bilangan Grashof.



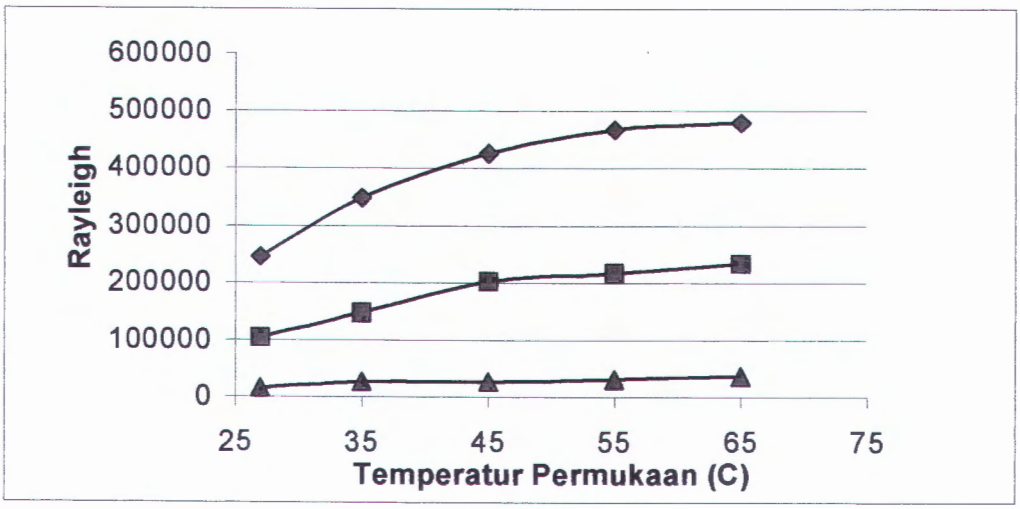
Gambar 4-9 :

Hubungan Temperatur Permukaan Terhadap Bilangan Nusselt Pada Posisi Benda Uji = 90 ^{0} dan Tekanan Vakum = -60 cm Hg

Simbol : ✧ $\frac{L}{\delta} = 11.8$, □ $\frac{L}{\delta} = 7.87$, Δ $\frac{L}{\delta} = 5.9$

Gambar 4-10 , merupakan hubungan antara temperatur terhadap Bilangan Rayleigh pada posisi benda uji : 90 ^{0} dengan Tekanan vakum : -60 cm Hg (160 torr). Dari gambar tersebut dapat disampaikan, bahwa semakin besar temperatur permukaan pada aspek ratio rongga yang berbeda diperoleh bilangan Rayleigh semakin besar. Hal ini disebabkan karena aspek ratio rongga besar (tebal rongga tipis), terbentuknya lapisan termal (gradient suhu) lebih cepat, akibatnya perbedaan temperatur antara free stream temperatur dan dinding ($T_{w2-in} - T_\infty$) menjadi kecil , sehingga akan diperoleh bilangan Rayleigh lebih besar dibandingkan dengan aspek ratio rongga 7.87 dan 5.9. Sedangkan besar kecilnya

harga Rayleigh dipengaruhi oleh bilangan Grashof dan bilangan grashof merupakan fungsi dari perbedaan temperatur ($T_{w2-in} - T_{\infty}$).



Gambar 4-10 :

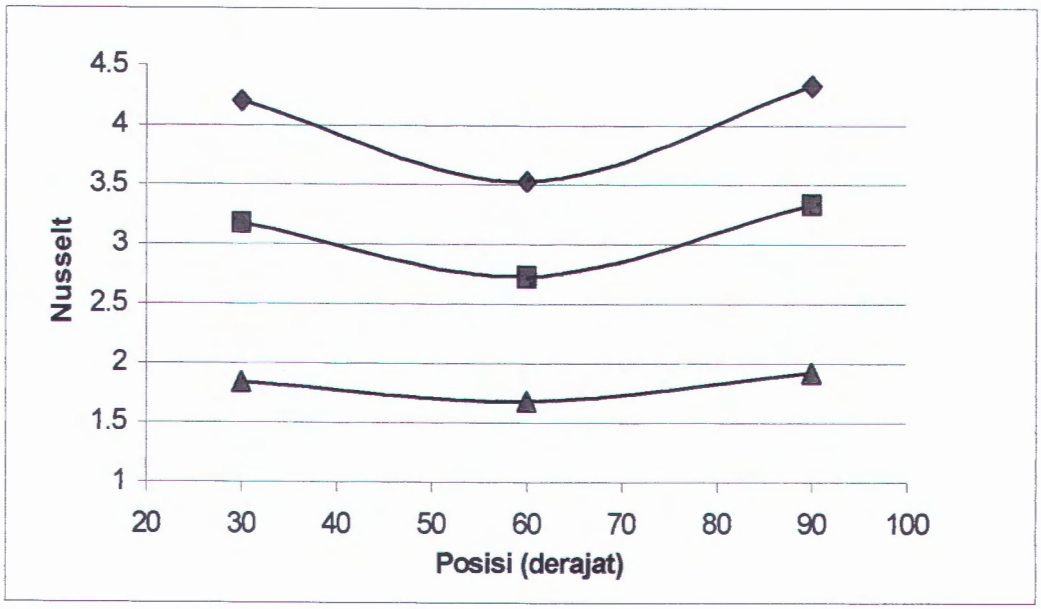
Hubungan Temperatur Permukaan Terhadap Bilangan Rayleigh Pada Posisi Benda Uji = 90 ^{0} dan Tekanan Vakum = -60 cm Hg

Simbol : ✧ $\frac{L}{\delta} = 11.8$, □ $\frac{L}{\delta} = 7.87$, Δ $\frac{L}{\delta} = 5.9$

4.3.3. Hubungan Variasi Posisi terhadap Bilangan Nusselt dan Rayleigh.

Gambar 4-11 merupakan Hubungan antara variasi Posisi terhadap Bilangan nusselt pada Tekanan vakum : -60 cm Hg (160 torr) dengan temperatur permukaan : 45 ^{0}C. Dari gambar tersebut dapat disampaikan bahwa semakin besar posisi , harga bilangan Nusselt adalah fluktuatif untuk aspek ratio rongga yang berbeda. Hal ini disebabkan, karena perbedaan kerapatan jenis molekul/fluida yang menyebabkan gaya apung pada rongga semakin tidak merata, sehingga berakibat terhadap kecepatan pergerakan molekul/fluida pada rongga, dan ini juga mempunyai efek bahwa timbulnya gradient suhu juga tidak merata pula. Melihat pada gambar tersebut dapat disimpulkan bahwa posisi yang memberikan

bilangan Nusselt yang rendah adalah dengan posisi benda uji 60^0 dan pada aspek ratio rongga $(\frac{L}{\delta})$: 5.90 . Karena pada posisi benda uji 60^0 kecepatan pergerakan molekul membawa energi lebih kecil dibandingkan dengan posisi benda uji 30^0 dan 90^0. Akibatnya bilangan Nusselt yang dihasilkan lebih rendah.



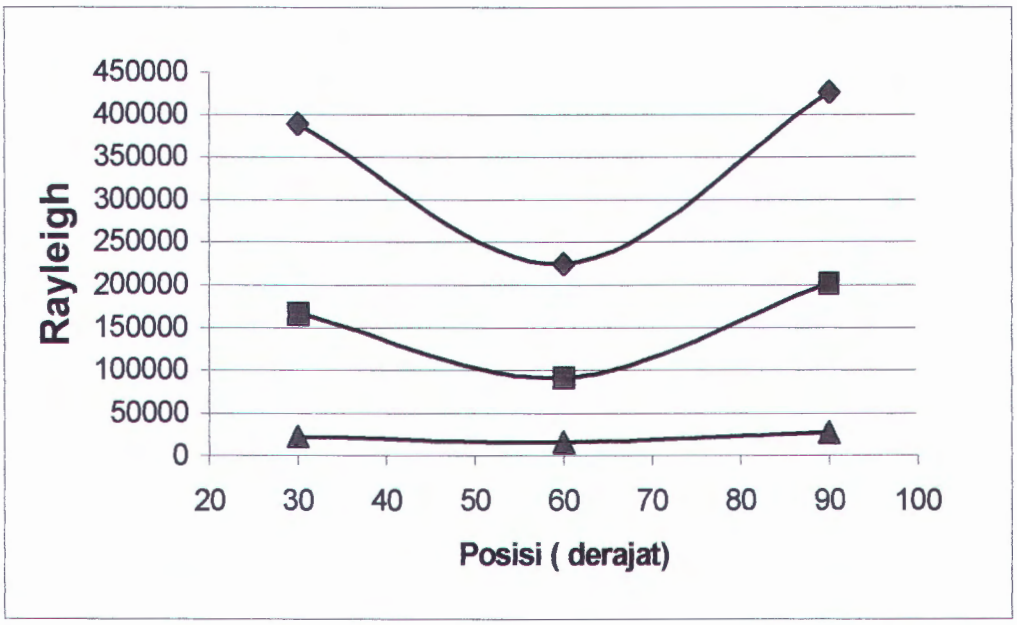
Gambar 4-11 :

Hubungan Posisi Benda Uji Terhadap Bilangan Nusselt Pada Tekanan Vakum = -60 cm Hg dan Temperatur Permukaan = $45\ ^0$C

Simbol : ✧ $\frac{L}{\delta} = 11.8$, □ $\frac{L}{\delta} = 7.87$, Δ $\frac{L}{\delta} = 5.9$

Gambar 4-12, menunjukkan Hubungan antara Posisi benda uji terhadap Bilangan Rayleigh pada aspek ratio rongga yang berbeda. Dari gambar tersebut dapat disampaikan bahwa semakin besar posisi benda uji, diperoleh harga Bilangan Rayleigh kecenderungan fluktuatif. Hal ini disebabkan karena tidak meratanya temperatur dalam rongga, sehingga akan mempengaruhi besar kecilnya

kecepatan aliran fluida, dan perbedaan kerapatan jenis fluida/molekul dalam rongga. Akibat perbedaan kerapatan jenis ini, akan menyebabkan besar kecilnya harga gaya apung dan gaya bodi. Gaya apung yang terjadi akan menentukan gradient temperatur pada rongga, dan ini mempunyai korelasi terhadap terbentuknya lapisan batas termal. Dari gambar diatas posisi benda uji 60^{0} mempunyai harga bilangan Rayleigh lebih kecil bila dibandingkan dengan posisi benda uji 30^{0} maupun 90^{0}. Hal ini terjadi karena pada posisi 60 derajat kecepatan pergerakan fluida untuk membawa energi lebih kecil dibandingkan dengan posisi benda uji 30 derajat dan 90 derajat.



Gambar 4-12 :

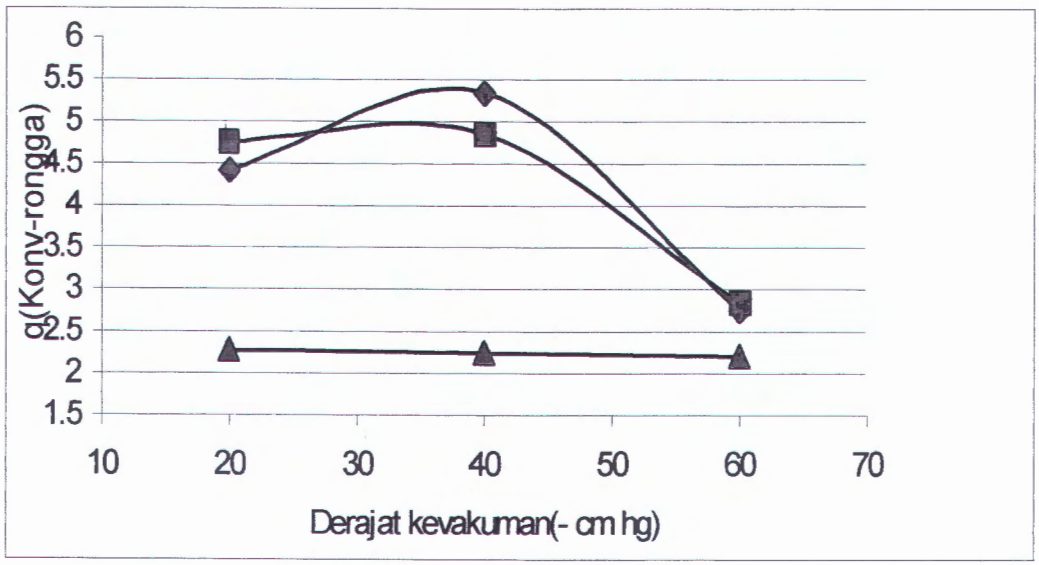
Hubungan Posisi Benda Uji Terhadap Bilangan Rayleigh Pada Tekanan Vakum = -60 cm Hg dan Temperatur Permukaan = 45^{0}C

Simbol : ✧ $\frac{L}{\delta} = 11.8$, □ $\frac{L}{\delta} = 7.87$, Δ $\frac{L}{\delta} = 5.9$

Perlu diketahui bahwa besar kecilnya harga Rayleigh di pengaruhi oleh bilangan Grashof dan Prandtl. Sedangkan bilangan Grashof merupakan fungsi dari percepatan gravitasi dan temperatur.

4.3.4. Hubungan Derajat Kevakuman terhadap Laju Perpindahan Panas Konveksi Alamiah Pada Rongga.

Dari gambar 4-13 menunjukkan hubungan antara derajat kevakuman terhadap Laju perpindahan panas Konveksi Alamiah di rongga dengan adanya aspek ratio rongga ($\frac{L}{\delta}$) yang berbeda.



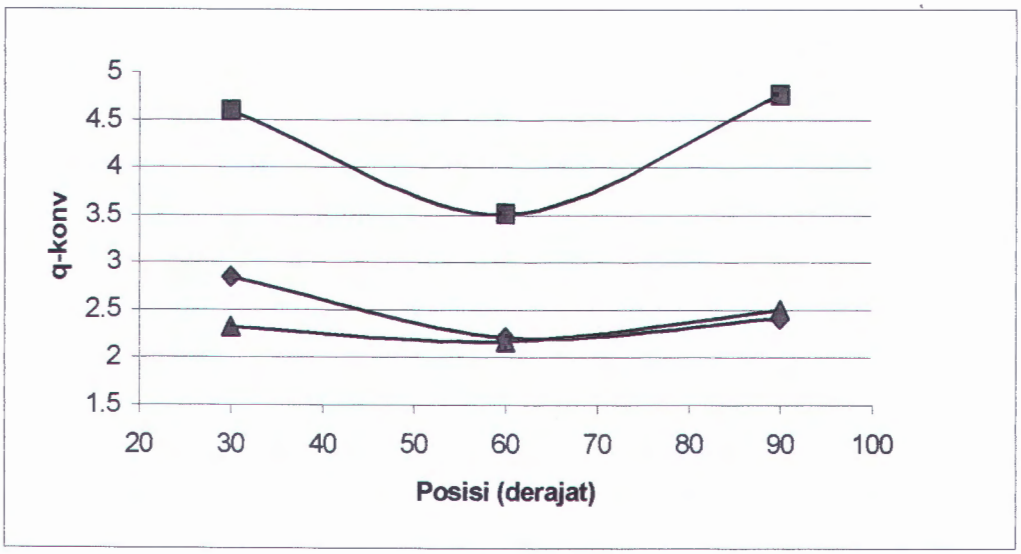
Gambar 4-13 :

Hubungan Derajat Kevakuman Terhadap Laju Perpindahan Panas Konveksi Alamiah di Rongga Pada Posisi Benda uji = 90 ^{0} dan Temperatur Permukaan = 45 ^{0}C

Simbol : ✧ $\frac{L}{\delta}$ = 11.8 , □ $\frac{L}{\delta}$ = 7.87, Δ $\frac{L}{\delta}$ = 5.9

Dari gambar 4-13 menunjukkan bahwa semakin besar derajat kevakuman akan memberikan harga laju perpindahan panas konveksi pada rongga semakin kecil. Hal ini terjadi karena dengan besarnya kevakuman akan memberikan hambatan termal pada rongga menjadi besar. Selain itu pula *perbedaan kerapatan jenis* pada udara ($\rho_\infty - \rho$) dalam rongga menjadi besar , sehingga pergerakan udara dalam rongga menjadi kecil akibatnya gaya apung yang terjadi juga kecil. Dengan gaya apung yang bergerak secara konveksi menjadi kecil , juga akan berdampak pada gaya bodi semakin kecil pula akibatnya akan mempengaruhi besarnya harga driving force (δT). Sedangkan aspek ratio rongga yang mempunyai laju perpindahaan panas konveksi alamiah kecil dengan derajat kevakuman yang berbeda adalah $(\frac{L}{\delta})$= 5.9.

Gambar 4-14, menunjukkan hubungan anatara posisi benda uji terhadap laju perpindahan panas konveksi alamiah rongga dengan aspek ratio rongga yang berbeda pada kondisi tekanan vakum rongga = -60 cm Hg (160 torr) dan temperatur permukaan = 45 ^{0}C. Dari gambar dibawah dapat disampaikan bahwa semakin besar posisi benda uji , besarnya laju perpindahan panas konveksi alamiah pada rongga berfluktuasi dengan aspek ratio rongga yang berbeda. Sedangkan posisi yang mempeunyai laju perpindahan panas konveksi alamiah yang rendah adalah posisi 60^0. Hal ini disebabkan karena pada posisi 60 derajat, mempunyai hambatan termal yang lebih besar karena effek pergerakaan udara dalam rongga terganggu oleh bodi dinding dalam, sehingga mengakibatkan distribusi temperatur pada rongga menjadi tidak merata



Gambar 4-14 :

Hubungan Posisi Benda Uji Terhadap Laju Perpindahan Panas Konveksi Alamiah di Rongga Pada Tekanan Vakum = -60 cm Hg dan Temperatur Permukaan = 45 ^{0}C

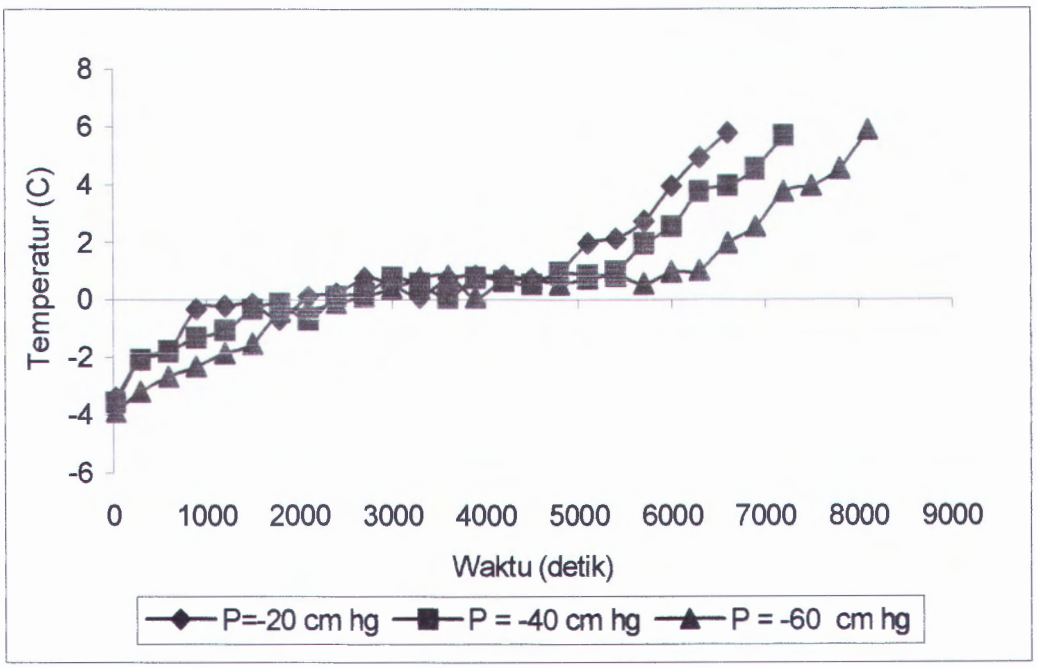
Simbol : ✧ $\frac{L}{\delta}$ = 11.8 , □ $\frac{L}{\delta}$ = 7.87, Δ $\frac{L}{\delta}$ = 5.9

4.4 Validasi Eksperimen

Untuk memberikan satu argumentasi terhadap pengaruh derajat kevakuman dalam rongga , validasi yang digunakan adalah mengamati temperatur yang terjadi selama es mencair (waktu yang dibutuhkan). Sedangkan berat es yang dicairkan adalah 300 gram. Gambar dibawah ini menjelaskan seberapa besar waktu yang dibutuhkan untuk es bisa mencair, dan sekaligus juga memberikan informasi besarnya temperatur es.

Dalam validasi eksperimen ini benda yang diuji adalah aspek ratio rongga $(\frac{L}{\delta})$ = 5.9 , sedangkan benda uji ini mendapatkan perlakuan berupa derajat

kevakuman yang berbeda yaitu –20 cm Hg (560 torr), -40 cm Hg (360 torr) dan –60 cm Hg (160 torr) serta diberikan perlakuan temperatur permukaan pada tabung luar sebesar : 45 ^{0}C .



Gambar 4-15 :

Validasi Eksperimen

Hubungan Waktu Terhadap Temperatur Es mencair Pada L/δ = 5.9 dan Temperatur Permukaan = 45 ^{0}C

Dari gambar 4-15 : diperoleh bahwa Tekanan Kevakuman = -60 cm Hg, mempunyai waktu yang lebih lama untuk es bisa mencair, bila dibandingkan dengan tekanan kevakuman –20 cm Hg (560 torr) dan –40 cm Hg (360 torr), hal ini disebabkan semakin besar derajat/tekanan kevakuman , maka hambatan termal yang terjadi dalam rongga semakin besar , sehingga aliran panas menuju ruang es menjadi kecil (temperatur kecil). Selain itu, dengan derajat kevakuman yang besar

akan mengakibatkan perubahan kerapatan jenis menjadi besar dan kecepatan aliran fluida (udara) dalam rongga menjadi lambat akibatnya gaya apung udara yang terjadi dalam rongga menjadi lemah, begitu juga gaya apung yang mengakibatkan arus konveksi disebut gaya bodi menjadi kecil pula. Akhirnya Gaya bodi ini akan menentukan besarnya temperatur free strem udara dalam rongga.

BAB V

KESIMPULAN DAN SARAN

5.1. Kesimpulan

Dari hasil penelitian yang telah dilakukan dapat disimpulkan sebagai berikut :

1. Suatu rongga yang diberi perlakuan variasi derajat kevakuman akan mampu memberikan kontribusi sebagai isulator.
2. Dari penelitian ini, derajat kevakuman –60 cm Hg mempunyai laju perpindahan panas konveksi alamiah lebih rendah dibandingkan dengan derajat kevakuman –20 cm Hg dan –40 cm Hg. Artinya derajat kevakuman –60 cm Hg mempunyai harga hambatan termal lebih besar (cocok sebagai isolator) khusunya dalam proses penyimpanan.
3. Aspek ratio rongga $(L/\delta) = 5.90$ mempunyai harga Bilangan Nusselt yang lebih kecil dibandingkan dengan aspek ratio rongga $(L/\delta) = 7.87$ dan $(L/\delta) = 11.8$. Hal ini dikarenakan, pada aspek ratio rongga 5.90, kecepatan pergerakan molekul membawa energi lebih rendah. Pada celah yang kecil (aspek ratio yang besar = 11.8), kecepatan alairan udara di dalam rongga relatif lebih besar. Bilangan Nusselt berbanding langsung dengan bilangan Reynolds. Untuk kecepatan yang tinggi akan diperoleh bilangan Reynolds yang tinggi pula, akibatnya bilangan Nusselt juga tinggi. Akhirnya harga koefisien perpindahan panas konveksi alamiah (h) pada celah yang kecil akan

tinggi. Sehingga perpindahan panas konveksi pada celah yang kecil akan mempunyai nilai yang besar

4. Untuk posisi benda uji (θ) = 60 ^{0} dengan aspek ratio rongga (L/δ) = 5.90 harga laju perpindahan panas konveksi alamiah adalah lebih kecil dibandingkan dengan posisi benda uji (θ) = 30^0 . Karena pada posisi benda uji (θ) = 60 ^{0} mempunyai efektivitas gravitasi lebih kecil bila dibandingkan dengan posisi benda uji (θ) = 30^0 . Sedangkan untuk harga posisi benda uji (θ) = 90^0 akan digunakan persamaan lainnya (tidak g' = g cos θ).
5. Dari hasil uji validasi eksperimen, dapat disampaikan bahwa semakin besar derajat kevakuman (-60 cm Hg) maka akan memberikan waktu mencair es *lebih lama*, dibandingkan dengan derajat kevakuman yang lebih rendah (-20 cm Hg atau –40 cm Hg). Hal ini terjadi karena pada tekanan kevakuman –60 cm Hg mempunyai hambatan termal lebih besar sehingga perbedaan temperatur free stream dengan temperatur dinding tabung dalam sisi luar adalah kecil sehingga waktu yang dibutuhkan untuk es mencair lebih lama.

5.2. Saran

Ada beberapa saran yang dapat kami sampaikan kaitannya penelitian ini, demi perkembangan ilmu pengetahuan dimasa yang akan datang, yaitu :

1. Perlu adanya penggunaan "alat temperatur kontrol" yang lebih baik (sensitif dan tepat), yang difungsikan untuk mengendalikan temperatur permukaan tabung .
2. Perlu dilakukan penelitian dengan menggunakan termokopel atau sejenisnya, untuk komparasi dari sensor LM-35.

3. Perlu dilakukan penelitian pada rongga, yang didalamya diberikan rusuk atau baffle.
4. Perlu dilakukan penelitian pada tabung yang mempunyai ketebalan lebih dari 1,2 mm atau tabung yang terbuat dari plastik atau resin.

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LAMPIRAN

SAMPL	ING DAT	(Derajat	Celcius)				Data : 4", -20, 30, 35 C									
NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	5	10.18	**10.18**	16.839	8.863	**12.851**	15.51	19.498	**17.504**	33.78	33.718	**33.749**	35.325	35.008	**35.1665**	28.361
2	15	6.192	**6.192**	16.839	6.647	**11.743**	15.953	23.043	**19.498**	37.667	17.776	**27.7215**	34.996	35.008	**35.002**	22.6
3	45	9.737	**9.737**	22.6	9.306	**15.953**	19.941	19.055	**19.498**	37.224	26.639	**31.9315**	35.008	34.998	**35.003**	24.816
4	115	7.965	**7.965**	20.827	4.875	**12.851**	15.51	21.271	**18.3905**	37.667	17.776	**27.7215**	35.451	35.008	**35.2295**	27.918
5	145	6.192	**6.192**	22.157	8.863	**15.51**	20.364	24.816	**22.6**	36.337	19.549	**27.943**	35.451	35.008	**35.2295**	28.361
			8.0532			**13.782**			**19.498**			**29.8133**			**35.1261**	
							Data : 4", -20, 30, 45 C									
NO	WAKTU	SENSOR	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	7.533	**7.533**	23.043	8.42	**15.7315**	19.498	27.918	**23.708**	46.086	32.349	**39.2175**	40.325	51.404	**45.8645**	27.475
2	25	2.659	**2.659**	25.259	10.192	**17.7255**	23.043	27.918	**25.4805**	46.086	38.996	**42.541**	39.439	51.404	**45.4215**	24.816
3	30	5.761	**5.761**	23.043	9.749	**16.396**	23.436	26.145	**24.8155**	46.529	33.235	**39.882**	47.859	40.769	**44.314**	27.475
4	40	1.329	**1.329**	20.827	9.306	**15.0665**	20.827	29.247	**25.037**	42.541	38.996	**40.7685**	50.075	40.325	**45.2**	22.157
5	50	2.659	**2.659**	27.031	9.306	**18.1685**	20.827	27.918	**24.3725**	46.086	32.349	**39.2175**	47.859	42.541	**45.2**	24.373
			3.9882			**16.618**			**24.683**			**40.3253**			**45.2**	
							Data : 4", -20, 30, 55 C									
NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	35	3.102	**3.102**	27.918	11.078	**19.498**	28.804	27.031	**27.9175**	45.2	46.086	**45.643**	56.032	54.722	**55.377**	21.714
2	45	5.761	**5.761**	24.816	15.067	**19.9415**	24.373	27.918	**26.1455**	54.063	42.541	**48.302**	54.949	56.002	**55.4755**	27.031
3	140	7.976	**7.976**	27.918	14.624	**21.271**	29.247	31.906	**30.5765**	43.427	38.553	**40.99**	56.278	55.278	**55.778**	26.588
4	145	5.761	**5.761**	30.576	14.624	**22.6**	27.918	28.361	**28.1395**	53.176	48.302	**50.739**	56.722	54.278	**55.5**	22.157
5	150	4.875	**4.875**	25.259	11.965	**18.612**	28.361	31.906	**30.1335**	49.631	42.541	**46.086**	53.722	56.722	**55.222**	22.6
			5.495			**20.385**			**28.583**			**46.352**			**55.4705**	
							Data : 4", -20, 30, 65 C									
NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	35	7.09	**7.09**	35.008	20.384	**27.696**	35.008	38.996	**37.002**	63.812	53.176	**58.494**	64.357	66.914	**65.6355**	23.043
2	65	3.988	**3.988**	28.361	19.498	**23.9295**	35.451	31.463	**33.457**	65.584	45.643	**55.6135**	66.471	64.722	**65.5965**	23.043
3	145	7.09	**7.09**	27.918	16.396	**22.157**	35.008	32.792	**33.9**	56.278	56.722	**56.5**	63.812	66.357	**65.0845**	22.6
4	165	7.09	**7.09**	28.361	19.498	**23.9295**	35.008	35.451	**35.2295**	56.278	55.835	**56.0565**	67.357	63.812	**65.5845**	27.918
5	180	4.875	**4.875**	28.361	19.498	**23.9295**	35.451	33.235	**34.343**	56.278	56.722	**56.5**	66.243	63.812	**65.0275**	27.918
			6.0266			**24.328**			**34.786**			**56.6328**			**65.3857**	

Data : 4", -20, 30

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	20	7.431	**7.431**	15.953	1.773	**8.863**	6.204	11.522	**8.863**	13.737	14.812	**14.2745**	15.51	15.51	**15.51**	27.031
2	60	5.216	**5.216**	7.976	4.431	**6.2035**	8.863	8.42	**8.6415**	14.18	13.491	**13.8355**	20.384	19.941	**20.1625**	27.031
3	85	4.216	**4.216**	6.647	6.647	**6.647**	8.863	8.42	**8.6415**	14.18	13.18	**13.68**	15.953	20.384	**18.1685**	27.031
4	230	4.431	**4.431**	8.42	2.216	**5.318**	6.204	10.192	**8.198**	15.953	13.032	**14.4925**	20.384	15.953	**18.1685**	27.918
5	240	5.431	**5.431**	6.204	6.647	**6.4255**	8.42	9.749	**9.0845**	14.18	13.91	**14.045**	20.384	20.384	**20.384**	27.031
			5.345			**6.6914**			**8.6857**			**14.0655**			**18.4787**	

Data : 4", -20, 60, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	20	4.875	**4.875**	34.173	17.725	**25.949**	19.498	24.816	**22.157**	28.804	34.173	**31.4885**	35.008	41.212	**38.11**	26.588
2	95	14.18	**14.18**	34.173	18.169	**26.171**	20.384	23.043	**21.7135**	35.451	34.173	**34.812**	35.008	35.451	**35.2295**	24.373
3	200	14.18	**14.18**	19.549	20.827	**20.188**	15.953	20.827	**18.39**	38.996	19.549	**29.2725**	35.008	35.008	**35.008**	22.6
4	210	6.647	**6.647**	17.776	17.282	**17.529**	21.271	20.827	**21.049**	30.576	17.776	**24.176**	33.678	38.996	**36.337**	27.475
5	220	3.102	**3.102**	19.549	21.714	**20.6315**	17.725	21.271	**19.498**	30.133	19.549	**24.841**	35.008	33.678	**34.343**	22.6
			8.5968			**22.094**			**20.562**			**28.918**			**35.8055**	

Data : 4", -20, 60, 45 C

NO	WAKTU	SENSOR	Tw1-in	SENSOR2	SENSOR3	Tw2-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	35	3.102	**3.102**	24.373	9.306	**16.8395**	24.816	27.918	**26.367**	44.314	38.996	**41.655**	47.859	42.541	**45.2**	22.157
2	50	6.204	**6.204**	24.816	9.749	**17.2825**	24.816	26.145	**25.4805**	38.11	38.996	**38.553**	48.745	42.098	**45.4215**	24.816
3	60	0.443	**0.443**	27.475	10.635	**19.055**	19.055	28.804	**23.9295**	42.541	38.996	**40.7685**	42.541	49.188	**45.8645**	27.031
4	65	3.102	**3.102**	21.714	14.624	**18.169**	19.055	29.247	**24.151**	42.098	32.349	**37.2235**	42.098	49.631	**45.8645**	26.588
5	75	0.886	**0.886**	24.816	13.294	**19.055**	20.827	28.361	**24.594**	42.098	31.906	**37.002**	47.859	42.098	**44.9785**	22.6
			2.7474			**18.08**			**24.904**			**39.0404**			**45.4658**	

Data : 4", -20, 60, 55 C

NO	WAKTU	SENSOR	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	30	5.761	**5.761**	30.133	12.408	**21.2705**	23.043	34.122	**28.5825**	55.392	46.973	**51.1825**	53.278	56.722	**55**	21.714
2	45	7.976	**7.976**	30.576	13.737	**22.1565**	23.043	27.918	**25.4805**	55.835	44.314	**50.0745**	53.722	56.722	**55.222**	22.157
3	55	3.545	**3.545**	30.133	13.294	**21.7135**	28.804	27.918	**28.361**	55.392	38.553	**46.9725**	56.722	53.278	**55**	26.588
4	70	7.976	**7.976**	28.361	11.522	**19.9415**	24.373	31.906	**28.1395**	44.757	42.098	**43.4275**	53.722	56.722	**55.222**	27.475
5	225	7.976	**7.976**	30.133	14.18	**22.1565**	27.918	31.463	**29.6905**	44.757	46.086	**45.4215**	56.722	53.733	**55.2275**	24.816
			6.6468			**21.448**			**28.051**			**47.4157**			**55.1343**	

							Data : 4", -20, 60, 65 C									
NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	110	4.875	**4.875**	28.361	19.498	**23.9295**	35.451	38.11	**36.7805**	56.722	55.835	**56.2785**	65.278	65.584	**65.431**	27.918
2	145	6.204	**6.204**	31.906	19.498	**25.702**	31.463	31.906	**31.6845**	56.722	54.949	**55.8355**	63.278	67.357	**65.3175**	22.6
3	120	6.647	**6.647**	27.918	20.384	**24.151**	36.337	31.02	**33.6785**	65.584	55.835	**60.7095**	63.212	67.357	**65.2845**	27.918
4	210	6.647	**6.647**	27.918	17.725	**22.8215**	29.69	38.996	**34.343**	63.812	55.835	**59.8235**	67.357	63.112	**65.2345**	28.361
5	225	7.09	**7.09**	33.678	19.498	**26.588**	29.247	32.349	**30.798**	56.278	45.643	**50.9605**	62.278	67.357	**64.8175**	28.361
			6.2926			**24.638**			**33.457**			**56.7215**			**65.217**	
							Data : 4", -20, 60									
NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	60	6.431	**6.431**	7.976	6.647	**7.3115**	15.953	10.192	**13.0725**	16.396	12.364	**14.38**	19.498	19.941	**19.7195**	27.031
2	80	4.216	**4.216**	7.976	3.102	**5.539**	6.204	10.192	**8.198**	15.953	12.1	**14.0265**	19.498	19.941	**19.7195**	27.475
3	100	5.102	**5.102**	9.749	3.102	**6.4255**	8.42	11.522	**9.971**	14.18	12.357	**13.2685**	16.396	20.827	**18.6115**	27.475
4	110	4.102	**4.102**	9.749	2.216	**5.9825**	5.318	11.522	**8.42**	16.396	12.632	**14.514**	17.725	21.271	**19.498**	27.475
5	195	6.647	**6.647**	14.18	6.647	**10.4135**	5.761	10.192	**7.9765**	14.18	13.261	**13.7205**	17.282	19.055	**18.1685**	27.031
			5.2996			**7.1344**			**9.5276**			**13.9819**			**19.1434**	
							Data : 4", -20, 90, 35 C									
NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	55	1.329	**1.329**	21.271	9.306	**15.2885**	17.282	22.6	**19.941**	35.451	27.918	**31.6845**	36.463	34.882	**35.6725**	21.271
2	70	4.431	**4.431**	21.271	4.875	**13.073**	17.725	20.827	**19.276**	28.361	33.678	**31.0195**	33.463	36.382	**34.9225**	21.271
3	85	0.443	**0.443**	22.157	14.18	**18.1685**	17.282	23.043	**20.1625**	38.553	27.031	**32.792**	38.996	31.906	**35.451**	20.827
4	100	1.773	**1.773**	23.043	17.725	**20.384**	20.827	21.271	**21.049**	33.678	33.678	**33.678**	35.008	35.008	**35.008**	25.259
5	230	0.443	**0.443**	21.271	4.875	**13.073**	21.271	23.043	**22.157**	33.678	31.906	**32.792**	35.451	35.451	**35.451**	24.816
			1.6838			**15.997**			**20.517**			**32.3932**			**35.301**	
							Data : 4", -20, 90, 45 C									
NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	5	10.18	**10.18**	34.173	30.133	**32.153**	28.361	27.918	**28.1395**	40.769	34.173	**37.471**	44.631	45.643	**45.137**	23.043
2	30	4.863	**4.863**	17.776	28.361	**23.0685**	28.361	27.918	**28.1395**	49.631	17.776	**33.7035**	44.631	46.086	**45.3585**	28.361
3	45	4.42	**4.42**	34.173	23.929	**29.051**	28.361	28.361	**28.361**	42.098	34.173	**38.1355**	43.541	46.586	**45.0635**	27.918
4	90	3.533	**3.533**	26.639	27.918	**27.2785**	23.043	31.906	**27.4745**	42.541	26.639	**34.59**	46.086	44.075	**45.0805**	26.588
5	165	6.192	**6.192**	26.639	28.361	**27.5**	27.918	28.361	**28.1395**	40.325	26.639	**33.482**	44.098	46.086	**45.092**	24.373
			5.8376			**27.81**			**28.051**			**35.4764**			**45.1463**	

							Data : 4", -20, 90, 55 C										
NO	WAKTU	SENSOR1	**Tw1-in**	SENSOR2	SENSOR3	**Tw1-out**	SENSOR4	SENSOR5	**T~**	SENSOR6	SENSOR7	**Tw2-in**	SENSOR8	SENSOR9	**Tw2-out**	SENSOR10
1	25	9.294	**9.294**	27.918	15.067	**21.4925**	27.031	28.361	**27.696**	42.541	19.549	**31.045**	54.267	56.278	**55.2725**	22.6
2	40	7.965	**7.965**	28.361	17.282	**22.8215**	33.678	27.918	**30.798**	42.541	19.549	**31.045**	54.294	56.722	**55.508**	22.157
3	55	11.067	**11.067**	28.361	16.396	**22.3785**	32.792	28.361	**30.5765**	41.655	34.173	**37.914**	54.278	56.722	**55.5**	27.475
4	70	10.18	**10.18**	30.133	14.18	**22.1565**	27.031	27.918	**27.4745**	41.655	34.173	**37.914**	56.722	54.278	**55.5**	22.157
5	110	10.18	**10.18**	27.918	13.737	**20.8275**	27.918	28.361	**28.1395**	49.188	19.549	**34.3685**	55.835	54.722	**55.2785**	27.475
			9.7372			**21.935**			**28.937**			**34.4573**			**55.4118**	
							Data : 4", -20, 90, 65 C										
NO	WAKTU	SENSOR1	**Tw1-in**	SENSOR2	SENSOR3	**Tw1-out**	SENSOR4	SENSOR5	**T~**	SENSOR6	SENSOR7	**Tw2-in**	SENSOR8	SENSOR9	**Tw2-out**	SENSOR10
1	80	5.318	**5.318**	28.361	19.498	**23.9295**	37.224	35.894	**36.559**	52.733	53.176	**52.9545**	63.506	66.471	**64.9885**	22.6
2	85	7.09	**7.09**	31.906	15.51	**23.708**	36.78	28.804	**32.792**	52.733	56.435	**54.584**	66.471	63.62	**65.0455**	22.6
3	110	4.875	**4.875**	28.361	19.498	**23.9295**	36.78	35.008	**35.894**	63.812	56.456	**60.134**	64.278	65.584	**64.931**	25.702
4	145	6.204	**6.204**	31.906	19.498	**25.702**	29.247	27.918	**28.5825**	52.733	56.432	**54.5825**	65.278	64.557	**64.9175**	22.6
5	175	3.102	**3.102**	28.361	20.827	**24.594**	36.337	28.361	**32.349**	56.278	56.345	**56.3115**	65.578	64.357	**64.9675**	27.475
			5.3178			**24.373**			**33.235**			**55.7133**			**64.97**	
							Data : 4", -20, 90										
NO	WAKTU	SENSOR1	**Tw1-in**	SENSOR2	SENSOR3	**Tw1-out**	SENSOR4	SENSOR5	**T~**	SENSOR6	SENSOR7	**Tw2-in**	SENSOR8	SENSOR9	**Tw2-out**	SENSOR10
1	10	6.431	**6.431**	8.863	7.09	**7.9765**	5.761	8.863	**7.312**	15.953	13.737	**14.845**	21.271	20.827	**21.049**	27.918
2	70	3.545	**3.545**	7.976	3.545	**5.7605**	8.42	10.192	**9.306**	11.965	16.396	**14.1805**	17.725	16.396	**17.0605**	27.031
3	80	5.431	**5.431**	8.863	7.09	**7.9765**	7.533	9.749	**8.641**	15.953	17.725	**16.839**	17.282	17.725	**17.5035**	27.475
4	165	6.545	**6.545**	14.624	2.216	**8.42**	7.533	11.522	**9.5275**	13.294	16.396	**14.845**	21.271	17.725	**19.498**	27.031
5	185	5.545	**5.545**	14.18	2.659	**8.4195**	5.761	10.635	**8.198**	13.737	17.725	**15.731**	16.839	19.941	**18.39**	27.031
			5.4994			**7.7106**			**8.5969**			**15.2881**			**18.7002**	

SAMPL	ING DATA SUHU				Data : 4", -40, 30, 35 C											
NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	2.659	**2.659**	16.839	14.18	**15.5095**	19.055	20.384	**19.7195**	31.02	26.639	**28.8295**	35.463	35.451	**35.457**	22.6
2	35	0.443	**0.443**	15.067	5.761	**10.414**	19.055	17.725	**18.39**	25.702	17.776	**21.739**	35.351	34.804	**35.0775**	27.031
3	50	1.773	**1.773**	17.282	3.988	**10.635**	21.271	19.055	**20.163**	28.361	17.776	**23.0685**	35.451	34.69	**35.0705**	22.6
4	60	3.545	**3.545**	15.953	15.953	**15.953**	21.271	18.169	**19.72**	30.133	36.831	**33.482**	35.951	34.804	**35.3775**	27.475
5	75	3.545	**3.545**	16.839	14.18	**15.5095**	21.271	18.169	**19.72**	28.361	27.082	**27.7215**	35.451	35.394	**35.4225**	26.588
			2.393			**13.6042**			**19.543**			**26.968**			**35.281**	
							Data : 4", -40, 30, 45 C									
NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	25	1.329	**1.329**	21.714	10.635	**16.1745**	26.588	28.361	**27.4745**	49.631	17.333	**33.482**	44.984	45.643	**45.3135**	22.6
2	60	3.102	**3.102**	25.702	11.078	**18.39**	24.816	24.816	**24.816**	49.188	17.776	**33.482**	44.463	45.643	**45.053**	24.373
3	115	7.09	**7.09**	23.043	9.306	**16.1745**	20.827	29.247	**25.037**	42.541	26.639	**34.59**	44.847	46.086	**45.4665**	26.588
4	30	2.659	**2.659**	26.588	9.306	**17.947**	21.714	30.133	**25.9235**	42.541	19.549	**31.045**	45.871	45.043	**45.457**	26.588
5	110	3.302	**3.302**	20.827	14.624	**17.7255**	20.827	29.247	**25.037**	38.996	17.333	**28.1645**	44.847	45.643	**45.245**	22.157
			3.496			**17.2823**			**25.658**			**32.153**			**45.307**	
							Data :4", -40, 30, 55 C									
NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	20	3.545	**3.545**	24.373	13.737	**19.055**	31.906	29.247	**30.5765**	56.278	26.639	**41.4585**	54.278	55.584	**54.931**	22.157
2	205	3.102	**3.102**	31.906	15.953	**23.9295**	25.259	28.361	**26.81**	49.188	34.173	**41.6805**	56.722	53.722	**55.222**	22.6
3	70	10.635	**10.635**	28.361	11.965	**20.163**	31.463	28.804	**30.1335**	58.494	26.639	**42.5665**	54.278	56.722	**55.5**	24.373
4	95	3.545	**3.545**	31.02	14.18	**22.6**	28.361	35.451	**31.906**	56.722	26.639	**41.6805**	54.278	56.722	**55.5**	24.373
5	170	3.545	**3.545**	31.02	13.737	**22.3785**	27.918	28.361	**28.1395**	47.416	34.173	**40.7945**	55.722	54.722	**55.222**	22.6
			4.874			**21.6252**			**29.513**			**41.636**			**55.275**	
							Data : 4", -40, 30, 65 C									
NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	30	1.329	**1.329**	35.894	14.18	**25.037**	37.224	31.02	**34.122**	59.824	65.435	**62.6295**	66.722	63.369	**65.0455**	27.031
2	50	3.102	**3.102**	31.906	16.839	**24.3725**	35.451	38.996	**37.2235**	59.824	64.345	**62.0845**	64.369	65.71	**65.0395**	27.475
3	70	0.443	**0.443**	36.337	18.612	**27.4745**	35.451	40.769	**38.11**	59.824	61.345	**60.5845**	65.812	64.447	**65.1295**	21.714
4	170	1.329	**1.329**	35.451	18.612	**27.0315**	38.11	35.008	**36.559**	59.824	59.824	**59.824**	64.369	65.902	**65.1355**	24.373
5	200	7.09	**7.09**	29.247	19.498	**24.3725**	30.576	33.678	**32.127**	60.234	62.123	**61.1785**	65.561	64.902	**65.2315**	24.816
			2.659			**25.6576**			**35.628**			**61.26**			**65.116**	

Data : 4", -40, 30

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	25	4.431	**4.431**	9.749	1.329	**5.539**	5.761	10.635	**8.198**	16.839	16.839	**16.839**	22.157	17.725	**19.941**	27.475
2	30	3.102	**3.102**	7.976	1.329	**4.6525**	8.42	10.192	**9.306**	15.953	15.953	**15.953**	20.384	22.157	**21.2705**	27.475
3	35	4.431	**4.431**	9.749	4.431	**7.09**	7.533	10.192	**8.8625**	16.839	16.839	**16.839**	19.498	20.384	**19.941**	27.031
4	70	4.431	**4.431**	7.976	3.545	**5.7605**	14.18	12.408	**13.294**	14.18	14.18	**14.18**	21.271	19.498	**20.3845**	27.031
5	75	3.102	**3.102**	9.306	3.102	**6.204**	6.647	8.42	**7.5335**	13.737	13.737	**13.737**	21.271	20.827	**21.049**	27.918
			3.899			**5.8492**			**9.4388**			**15.51**			**20.517**	

Data : 4", -40, 60, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	0.443	**0.443**	17.282	7.976	**12.629**	16.396	23.486	**19.941**	34.173	33.235	**33.704**	35.552	34.529	**35.0405**	27.918
2	30	2.216	**2.216**	20.827	14.18	**17.5035**	21.271	20.827	**21.049**	34.173	33.235	**33.704**	35.008	35.541	**35.2745**	21.714
3	50	1.329	**1.329**	17.725	4.875	**11.3**	19.498	19.055	**19.2765**	33.235	34.173	**33.704**	35.708	35.098	**35.403**	22.6
4	140	2.216	**2.216**	17.282	6.647	**11.9645**	16.839	22.6	**19.7195**	34.173	27.082	**30.6275**	35.008	36.541	**35.7745**	22.6
5	180	1.773	**1.773**	17.282	4.875	**11.0785**	19.498	21.271	**20.3845**	34.173	26.639	**30.406**	35.808	34.541	**35.1745**	22.6
			1.595			**12.8951**			**20.074**			**32.429**			**35.333**	

Data : 4", -40, 60, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	30	3.102	**3.102**	19.498	10.192	**14.845**	20.384	27.918	**24.151**	42.541	26.639	**34.59**	44.188	45.643	**44.9155**	27.918
2	50	0.443	**0.443**	25.259	13.294	**19.2765**	24.816	28.361	**26.5885**	45.086	34.173	**39.6295**	44.541	45.643	**45.092**	21.714
3	80	1.329	**1.329**	25.259	9.749	**17.504**	19.941	27.918	**23.9295**	45.086	19.549	**32.3175**	44.733	45.643	**45.188**	21.714
4	95	1.329	**1.329**	21.271	13.294	**17.2825**	20.827	28.361	**24.594**	39.882	34.173	**37.0275**	44.631	45.643	**45.137**	24.816
5	130	0.886	**0.886**	24.816	11.522	**18.169**	20.827	24.816	**22.8215**	42.541	27.082	**34.8115**	44.655	45.643	**45.149**	28.361
			1.418			**17.4154**			**24.417**			**35.675**			**45.096**	

Data : 4", -40, 60, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	3.545	**3.545**	30.133	14.18	**22.1565**	28.361	27.918	**28.1395**	52.733	17.776	**35.2545**	54.722	55.722	**55.222**	22.6
2	45	3.102	**3.102**	28.361	15.067	**21.714**	31.906	27.918	**29.912**	60.267	19.549	**39.908**	56.278	55.278	**55.778**	22.6
3	70	1.329	**1.329**	28.361	13.737	**21.049**	32.792	34.565	**33.6785**	52.733	36.388	**44.5605**	56.278	54.506	**55.392**	24.373
4	85	3.102	**3.102**	27.918	15.51	**21.714**	28.361	31.463	**29.912**	62.039	27.082	**44.5605**	54.278	56.278	**55.278**	27.918
5	115	1.329	**1.329**	31.906	16.396	**24.151**	27.918	35.008	**31.463**	50.075	26.639	**38.357**	54.278	56.278	**55.278**	24.816
			2.481			**22.1569**			**30.621**			**40.528**			**55.39**	

Data : 4", -40, 60, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	0.443	**0.443**	35.451	17.725	**26.588**	39.882	35.008	**37.445**	63.369	56.278	**59.8235**	63.812	66.596	**65.204**	22.6
2	75	1.329	**1.329**	37.224	19.498	**28.361**	38.996	42.541	**40.7685**	56.278	63.812	**60.045**	65.561	64.669	**65.115**	22.157
3	80	1.329	**1.329**	37.224	19.498	**28.361**	39.882	42.098	**40.99**	56.278	56.278	**56.278**	64.812	65.902	**65.357**	22.157
4	110	3.545	**3.545**	37.224	19.498	**28.361**	38.996	35.451	**37.2235**	58.051	56.278	**57.1645**	64.902	65.369	**65.1355**	24.373
5	120	7.09	**7.09**	35.451	17.725	**26.588**	38.553	38.996	**38.7745**	63.369	56.278	**59.8235**	65.459	65.039	**65.249**	27.475
			2.747			**27.6518**			**39.04**			**58.627**			**65.212**	

Data : 4", -40, 60

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	40	4.863	**4.863**	5.761	6.204	**5.9825**	5.761	11.522	**8.6415**	13.294	14.18	**13.737**	20.827	17.725	**19.276**	27.475
2	45	3.963	**3.963**	7.976	3.102	**5.539**	9.749	11.522	**10.6355**	15.51	14.18	**14.845**	19.498	17.282	**18.39**	27.918
3	95	4.363	**4.363**	15.953	7.09	**11.5215**	6.204	9.749	**7.9765**	15.953	15.953	**15.953**	16.839	17.725	**17.282**	27.475
4	100	4.761	**4.761**	5.761	4.875	**5.318**	5.318	11.965	**8.6415**	16.396	13.737	**15.0665**	20.827	21.714	**21.2705**	27.475
5	120	7.725	**7.725**	15.953	1.329	**8.641**	5.318	11.965	**8.6415**	14.18	16.396	**15.288**	20.827	17.725	**19.276**	27.475
			5.135			**7.4004**			**8.9073**			**14.978**			**19.099**	

Data : 4", -40, 90, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	1.773	**1.773**	16.839	6.204	**11.5215**	17.725	21.271	**19.498**	35.451	27.082	**31.2665**	34.541	35.894	**35.2175**	22.6
2	30	15.51	**15.51**	17.282	9.306	**13.294**	20.827	20.827	**20.827**	31.906	26.639	**29.2725**	35.908	34.314	**35.111**	27.031
3	50	0.886	**0.886**	21.271	18.612	**19.9415**	17.282	21.271	**19.2765**	39.439	26.639	**33.039**	35.008	35.008	**35.008**	27.475
4	160	1.329	**1.329**	20.384	11.078	**15.731**	19.498	21.714	**20.606**	28.804	17.776	**23.29**	35.451	35.008	**35.2295**	26.588
5	175	1.773	**1.773**	19.941	14.18	**17.0605**	19.941	22.157	**21.049**	35.451	26.639	**31.045**	34.463	35.808	**35.1355**	27.031
			4.254			**15.5097**			**20.251**			**29.583**			**35.14**	

Data : 4", -40, 90, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	9.294	**9.294**	20.827	6.204	**13.5155**	21.271	21.271	**21.271**	41.655	17.776	**29.7155**	44.565	45.2	**44.8825**	24.816
2	55	7.09	**7.09**	21.714	15.067	**18.3905**	16.396	21.271	**18.8335**	40.769	19.549	**30.159**	46.541	43.541	**45.041**	27.475
3	210	8.408	**8.408**	20.827	4.875	**12.851**	17.282	23.486	**20.384**	32.792	17.776	**25.284**	45.451	45.2	**45.3255**	27.918
4	240	0.443	**0.443**	17.725	18.612	**18.1685**	17.282	20.827	**19.0545**	41.212	17.776	**29.494**	44.541	46.086	**45.3135**	21.714
5	245	2.659	**2.659**	20.827	15.067	**17.947**	20.827	21.271	**21.049**	35.008	34.173	**34.5905**	44.541	45.2	**44.8705**	21.714
			5.579			**16.1745**			**20.118**			**29.849**			**45.087**	

Data : 4", -40, 90, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	5	2.659	**2.659**	28.361	13.737	**21.049**	24.373	27.918	**26.1455**	58.937	27.082	**43.0095**	56.722	53.722	**55.222**	22.157
2	30	4.431	**4.431**	28.804	14.18	**21.492**	25.259	26.145	**25.702**	56.722	34.173	**45.4475**	53.722	56.278	**55**	22.6
3	50	3.545	**3.545**	27.918	14.18	**21.049**	31.02	28.361	**29.6905**	57.608	26.639	**42.1235**	54.278	56.278	**55.278**	25.702
4	100	4.431	**4.431**	27.918	17.725	**22.8215**	28.361	28.361	**28.361**	56.278	36.831	**46.5545**	53.722	56.722	**55.222**	27.918
5	165	4.875	**4.875**	24.373	13.737	**19.055**	27.918	27.918	**27.918**	46.086	27.082	**36.584**	54.278	56.278	**55.278**	25.702
			3.988			**21.0933**			**27.563**			**42.744**			**55.2**	

Data : 4", -40, 90, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	40	10.635	**10.635**	27.918	17.725	**22.8215**	28.804	38.996	**33.9**	56.278	34.173	**45.2255**	63.812	67.357	**65.5845**	22.6
2	85	6.647	**6.647**	28.361	17.282	**22.8215**	27.918	35.451	**31.6845**	56.722	26.639	**41.6805**	63.812	67.357	**65.5845**	22.157
3	150	8.42	**8.42**	35.451	23.043	**29.247**	31.906	38.996	**35.451**	56.278	36.831	**46.5545**	66.471	63.812	**65.1415**	26.588
4	215	6.647	**6.647**	28.361	21.271	**24.816**	29.247	38.996	**34.1215**	63.812	17.776	**40.794**	65.584	64.914	**65.249**	28.361
5	240	6.647	**6.647**	27.031	17.725	**22.378**	35.894	38.996	**37.445**	56.722	27.082	**41.902**	64.357	65.584	**64.9705**	22.6
			7.799			**24.4168**			**34.52**			**43.231**			**65.306**	

Data : 4", -40, 90

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	5.863	**5.863**	7.09	7.09	**7.09**	13.18	11.965	**12.5725**	13.737	13.737	**13.737**	22.157	22.157	**22.157**	27.918
2	20	5.963	**5.963**	7.533	6.204	**6.8685**	7.976	11.078	**9.527**	12.851	13.737	**13.294**	20.827	21.271	**21.049**	27.918
3	60	4.363	**4.363**	5.318	3.988	**4.653**	13.953	10.192	**12.0725**	14.624	15.953	**15.2885**	19.498	17.725	**18.6115**	27.031
4	110	5.761	**5.761**	7.533	7.09	**7.3115**	14.18	10.635	**12.4075**	13.294	13.737	**13.5155**	17.282	17.725	**17.5035**	27.918
5	145	6.725	**6.725**	7.976	7.09	**7.533**	13.18	10.192	**11.686**	14.18	13.294	**13.737**	20.827	19.055	**19.941**	27.475
			5.735			**6.6912**			**11.653**			**13.914**			**19.852**	

Data : 4", -60, 30, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	6.635	**6.635**	17.725	17.725	**17.725**	13.737	21.271	**17.5**	27.918	27.082	**27.5**	35.008	35.451	**35.2295**	28.361
2	65	4.863	**4.863**	20.827	18.612	**19.7195**	11.965	21.271	**16.62**	24.373	19.549	**21.961**	35.451	35.008	**35.2295**	22.6
3	70	4.863	**4.863**	20.827	8.42	**14.6235**	9.749	19.055	**14.4**	30.133	28.804	**29.4685**	35.008	35.008	**35.008**	27.918
4	175	6.635	**6.635**	20.827	4.875	**12.851**	14.18	14.18	**14.18**	29.69	28.804	**29.247**	35.451	35.008	**35.2295**	27.475
5	205	3.533	**3.533**	17.725	17.725	**17.725**	12.408	12.408	**12.41**	30.576	26.639	**28.6075**	34.998	35.008	**35.003**	22.6
			5.306			**16.529**			**15.02**			**27.357**			**35.1399**	

Data : 4", -60, 30, 45 C

NO	WAKTU	SENSOR	Tw1-in	SENSOR	SENSOR	Tw1-out	SENSOR	SENSOR	T~	SENSOR	SENSOR	Tw2-in	SENSOR8	SENSOR	Tw2-out	SENSOR1
1	15	3.976	**3.976**	23.043	8.42	**15.7315**	22.6	20.827	**21.71**	39.882	35.945	**37.9135**	45.541	44.314	**44.9275**	22.6
2	30	6.192	**6.192**	23.043	9.749	**16.396**	24.373	19.941	**22.16**	42.098	26.639	**34.3685**	45.541	44.314	**44.9275**	27.475
3	105	6.192	**6.192**	28.361	13.294	**20.8275**	29.247	27.918	**28.58**	42.088	26.639	**34.3635**	44.631	45.643	**45.137**	24.816
4	130	4.863	**4.863**	23.043	14.18	**18.6115**	27.918	24.373	**26.15**	41.212	27.082	**34.147**	44.176	45.643	**44.9095**	24.373
5	185	6.192	**6.192**	22.6	11.522	**17.061**	24.373	24.816	**24.59**	42.631	27.082	**34.8565**	45.643	45.643	**45.643**	27.918
			5.483			**17.726**			**24.64**			**35.13**			**45.1089**	

Data : 4", -60, 30, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	5	3.976	**3.976**	24.373	12.408	**18.391**	27.918	28.361	**28.14**	45.643	35.549	**40.596**	54.278	56.722	**55.5**	27.918
2	45	5.749	**5.749**	28.361	12.408	**20.385**	27.918	27.918	**27.92**	56.278	26.639	**41.459**	56.278	54.278	**55.278**	27.475
3	60	3.533	**3.533**	24.373	13.737	**19.055**	31.906	28.361	**30.13**	45.2	35.549	**40.375**	56.722	54.278	**55.5**	28.361
4	85	4.42	**4.42**	24.373	16.396	**20.385**	27.918	31.906	**29.91**	56.722	34.173	**45.448**	56.722	53.722	**55.222**	28.804
5	100	6.635	**6.635**	25.259	16.839	**21.049**	28.361	27.918	**28.14**	49.188	26.639	**37.914**	54.278	56.278	**55.278**	27.918
			4.863			**19.853**			**28.85**			**41.158**			**55.3556**	

Data : 4", -60, 30, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	5	3.102	**3.102**	30.133	15.067	**22.6**	37.224	35.451	**36.34**	64.698	46.529	**55.6135**	63.812	65.584	**64.698**	24.373
2	30	2.659	**2.659**	29.69	18.169	**23.9295**	27.918	34.122	**31.02**	56.722	56.278	**56.5**	65.584	64.357	**64.9705**	23.043
3	85	3.102	**3.102**	30.133	13.294	**21.7135**	29.69	35.008	**32.35**	56.278	44.757	**50.5175**	64.357	65.584	**64.9705**	22.6
4	95	3.545	**3.545**	35.008	17.725	**26.3665**	35.451	34.122	**34.79**	52.733	45.2	**48.9665**	65.584	64.357	**64.9705**	24.816
5	205	1.329	**1.329**	35.894	17.725	**26.8095**	33.678	35.008	**34.34**	51.847	49.188	**50.5175**	65.584	64.912	**65.248**	22.157
			2.747			**24.284**			**33.77**			**52.423**			**64.9715**	

Data : 4", -60, 30

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	70	1.102	**1.102**	6.647	3.545	**5.096**	14.18	12.408	**13.29**	14.18	14.18	**14.18**	21.271	19.498	**20.3845**	27.031
2	75	0.345	**0.345**	9.306	3.102	**6.204**	6.647	8.42	**7.534**	13.737	13.737	**13.737**	21.271	20.827	**21.049**	27.918
3	100	0.345	**0.345**	6.647	5.318	**5.9825**	3.988	10.635	**7.312**	13.737	13.737	**13.737**	21.271	20.827	**21.049**	27.475
4	160	0.345	**0.345**	8.863	1.329	**5.096**	5.761	9.749	**7.755**	13.737	13.737	**13.737**	21.271	19.498	**20.3845**	27.031
5	210	2.09	**2.09**	7.976	3.545	**5.7605**	14.18	10.192	**12.19**	13.737	13.737	**13.737**	20.384	21.271	**20.8275**	27.475
			0.845			**5.6278**			**9.616**			**13.826**			**20.7389**	

Data : 4", -60, 60, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SOR10
1	10	6.635	**6.635**	19.055	4.431	**11.743**	16.396	23.486	**19.94**	34.173	33.235	**33.704**	35.008	35.541	**35.2745**	27.918
2	20	4.42	**4.42**	19.055	15.067	**17.061**	17.725	23.486	**20.61**	34.173	34.173	**34.173**	35.008	35.086	**35.047**	26.588
3	30	6.635	**6.635**	21.271	9.306	**15.2885**	21.271	20.827	**21.05**	34.173	33.235	**33.704**	35.008	35.086	**35.047**	21.714
4	35	6.192	**6.192**	22.157	4.875	**13.516**	20.384	23.043	**21.71**	34.173	33.235	**33.704**	35.832	34.667	**35.2495**	22.6
5	190	6.635	**6.635**	18.169	9.306	**13.7375**	15.953	19.055	**17.5**	30.133	34.173	**32.153**	35.451	35.094	**35.2725**	24.373
			6.103			**14.269**			**20.16**			**33.488**			**35.1781**	

Data : 4", -60, 60, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	6.192	**6.192**	25.702	10.635	**18.1685**	19.055	24.816	**21.94**	42.541	26.639	**34.59**	44.541	46.086	**45.3135**	27.918
2	155	3.09	**3.09**	25.259	9.306	**17.2825**	17.725	23.043	**20.38**	31.906	19.549	**25.7275**	46.086	44.541	**45.3135**	23.486
3	160	6.635	**6.635**	20.384	13.294	**16.839**	17.282	20.827	**19.05**	39.862	35.945	**37.9135**	44.098	46.086	**45.092**	27.918
4	225	3.976	**3.976**	19.941	11.078	**15.5095**	21.271	24.816	**23.04**	35.451	34.173	**34.812**	44.098	46.086	**45.092**	27.918
5	245	6.635	**6.635**	21.271	12.408	**16.8395**	21.271	24.373	**22.82**	39.439	27.082	**33.2605**	44.098	46.086	**45.092**	27.475
			5.306			**16.928**			**21.45**			**33.261**			**45.1806**	

Data : 4", -60, 60, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	3.976	**3.976**	27.918	11.965	**19.9415**	29.247	28.361	**28.8**	56.722	37.718	**47.22**	54.249	56.722	**55.4855**	28.361
2	50	2.647	**2.647**	24.373	15.067	**19.72**	26.588	28.361	**27.47**	56.278	34.173	**45.2255**	56.722	54.222	**55.472**	22.157
3	55	4.863	**4.863**	28.361	14.18	**21.2705**	28.361	31.906	**30.13**	50.075	34.173	**42.124**	54.278	56.722	**55.5**	24.373
4	65	4.42	**4.42**	27.918	14.18	**21.049**	32.792	31.906	**32.35**	61.153	27.082	**44.1175**	56.722	54.039	**55.3805**	22.157
5	70	3.533	**3.533**	28.361	15.953	**22.157**	27.918	31.906	**29.91**	52.733	34.173	**43.453**	54.278	56.278	**55.278**	22.6
			3.888			**20.828**			**29.73**			**44.428**			**55.4232**	

Data : 4", -60, 60, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	5	1.329	**1.329**	35.451	17.282	**26.3665**	30.576	38.11	**34.34**	65.584	45.643	**55.6135**	63.812	67.357	**65.5845**	28.361
14	70	2.216	**2.216**	35.451	14.18	**24.8155**	35.451	38.996	**37.22**	56.278	55.835	**56.0565**	65.584	64.357	**64.9705**	27.918
17	85	3.988	**3.988**	35.451	15.51	**25.4805**	35.451	39.439	**37.45**	66.027	56.278	**61.1525**	64.698	65.243	**64.9705**	28.361
36	180	2.659	**2.659**	30.133	18.612	**24.3725**	29.69	40.769	**35.23**	63.812	49.188	**56.5**	65.584	64.812	**65.198**	23.043
39	195	0.443	**0.443**	30.133	17.725	**23.929**	36.337	33.235	**34.79**	67.357	46.529	**56.943**	65.243	65.357	**65.3**	26.588
			2.127			**24.993**			**35.81**			**57.253**			**65.2047**	

Data : 4", -60, 60

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	20	4.875	**4.875**	7.976	3.102	**5.539**	6.204	11.965	**9.085**	14.18	16.396	**15.288**	21.271	20.384	**20.8275**	27.031
2	30	3.102	**3.102**	7.976	3.102	**5.539**	6.204	12.408	**9.306**	16.396	14.624	**15.51**	17.725	17.725	**17.725**	27.031
3	60	4.875	**4.875**	14.18	3.102	**8.641**	7.533	10.192	**8.863**	14.18	15.51	**14.845**	17.282	17.725	**17.5035**	27.475
4	75	3.102	**3.102**	9.749	5.318	**7.5335**	7.533	12.408	**9.971**	15.51	13.737	**14.6235**	21.714	17.725	**19.7195**	27.475
5	105	3.102	**3.102**	5.761	3.988	**4.8745**	7.533	11.965	**9.749**	16.839	13.737	**15.288**	19.498	21.271	**20.3845**	27.475
			3.811			**6.4254**			**9.395**			**15.111**			**19.232**	

Data : 4", -60, 90, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	55	1.773	**1.773**	13.737	8.42	**11.0785**	15.067	17.725	**16.4**	35.451	27.082	**31.2665**	35.451	35.463	**35.457**	28.361
2	95	0.443	**0.443**	17.725	3.102	**10.4135**	13.737	17.282	**15.51**	36.78	17.776	**27.278**	35.463	35.008	**35.2355**	28.361
3	135	0.886	**0.886**	17.282	9.749	**13.5155**	15.953	15.953	**15.95**	29.69	27.082	**28.386**	35.008	35.463	**35.2355**	26.588
4	215	0.886	**0.886**	15.51	17.725	**16.6175**	19.498	21.271	**20.38**	35.894	19.549	**27.7215**	35.008	35.463	**35.2355**	21.714
5	235	0.886	**0.886**	17.282	7.976	**12.629**	18.612	16.839	**17.73**	31.906	34.173	**33.0395**	35.451	35.451	**35.451**	22.6
			0.975			**12.851**			**17.19**			**29.538**			**35.3229**	

Data : 4", -60, 90, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	205	4.09	**4.09**	17.282	16.396	**16.839**	24.816	24.816	**24.82**	50.075	27.082	**38.5785**	46.086	44.008	**45.047**	24.373
2	230	5.42	**5.42**	22.157	17.725	**19.941**	23.486	22.6	**23.04**	49.631	19.549	**34.59**	44.859	45.2	**45.0295**	23.043
3	240	4.442	**4.442**	18.169	16.839	**17.504**	19.498	24.373	**21.94**	42.098	36.831	**39.4645**	44.631	45.598	**45.1145**	27.918
4	245	4.763	**4.763**	23.043	17.725	**20.384**	19.941	27.031	**23.49**	50.075	27.082	**38.5785**	44.541	46.086	**45.3135**	28.361
5	250	5.42	**5.42**	22.157	14.18	**18.1685**	24.373	22.157	**23.27**	38.996	27.082	**33.039**	45.518	44.541	**45.0295**	27.918
			4.827			**18.567**			**23.31**			**36.85**			**45.1068**	

Data : 4", -60, 90, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	3.09	**3.09**	24.373	15.067	**19.72**	31.906	31.906	**31.91**	49.188	17.776	**33.482**	56.278	54.494	**55.386**	23.486

2	25	4.42	**4.42**	27.918	12.408	**20.163**	31.02	27.918	**29.47**	56.278	19.549	**37.9135**	56.278	54.722	**55.5**	23.043
3	30	4.42	**4.42**	23.929	14.624	**19.2765**	27.918	31.906	**29.91**	45.643	26.639	**36.141**	54.722	56.078	**55.4**	24.373
4	100	4.863	**4.863**	27.918	14.18	**21.049**	28.361	32.792	**30.58**	46.086	34.173	**40.1295**	54.722	56.022	**55.372**	22.157
5	115	4.42	**4.42**	28.361	14.18	**21.2705**	31.02	34.122	**32.57**	45.643	26.639	**36.141**	54.722	56.022	**55.372**	22.6
			4.243			**20.296**			**30.89**			**36.761**			**55.406**	

Data : 4", -60, 90, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	25	3.545	**3.545**	35.008	21.271	**28.1395**	31.906	38.996	**35.45**	58.051	56.722	**57.3865**	64.278	65.584	**54.931**	22.157
2	30	1.773	**1.773**	35.451	20.827	**28.139**	35.451	31.463	**33.46**	70.902	46.086	**58.494**	64.357	65.686	**65.0215**	24.816
3	40	2.659	**2.659**	35.008	18.169	**26.5885**	35.451	31.463	**33.46**	70.902	56.722	**63.812**	65.243	64.878	**65.0605**	24.816
4	55	2.659	**2.659**	31.463	18.612	**25.0375**	41.212	31.463	**36.34**	56.278	56.722	**56.5**	64.278	65.857	**65.0675**	28.361
5	65	2.216	**2.216**	31.906	22.6	**27.253**	35.008	37.224	**36.12**	67.357	45.643	**56.5**	64.278	65.584	**64.931**	28.361
			2.57			**27.032**			**34.96**			**53.539**			**65.0023**	

Data : 4", -60, 90

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	225	5.318	**5.318**	7.533	5.318	**6.4255**	7.533	9.749	**8.641**	12.408	13.737	**13.0725**	21.271	17.282	**19.2765**	27.031
2	230	6.09	**6.09**	7.976	7.09	**7.533**	14.18	10.635	**12.41**	13.737	16.396	**15.0665**	21.271	21.271	**21.271**	27.475
3	240	5.102	**5.102**	11.078	3.102	**7.09**	7.533	11.965	**9.749**	13.737	17.725	**15.731**	20.827	18.169	**19.498**	27.031
4	245	5.204	**5.204**	6.204	6.204	**6.204**	5.318	12.408	**8.863**	14.18	13.737	**13.9585**	20.827	17.282	**19.0545**	26.588
5	250	4.875	**4.875**	8.863	4.875	**6.869**	6.204	11.078	**8.641**	13.737	16.839	**15.288**	17.282	19.498	**18.39**	27.031
			5.318			**6.8243**			**9.66**			**14.623**			**19.498**	

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Data : 3.5", -20, 30, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	65	2.659	**2.659**	3.545	3.102	**3.3235**	14.18	17.725	**15.9525**	28.996	31.906	**30.451**	35.451	35.451	**35.451**	24 373
2	75	1.329	**1.329**	3.102	3.545	**3.3235**	13.737	15.953	**14.845**	28.996	31.02	**30.008**	35.451	35.451	**35.451**	22 6
3	90	2.659	**2.659**	3.102	2.216	**2.659**	17.725	19.498	**18.6115**	33.427	31.906	**32.667**	35.235	35.008	**35.1215**	24.816
4	95	3.545	**3.545**	7.09	4.431	**5.7605**	15.51	15.953	**15.7315**	25.008	31.02	**28.014**	35.678	35.008	**35.343**	23.043
5	140	1.773	**1.773**	0	10.635	**5.3175**	16.839	19.498	**18.1685**	32.541	30.133	**31.337**	34.678	35.451	**35.0645**	28.361
			2.393			**4.0768**			**16.6618**			**30.495**			**35.2862**	

Data : 3.5", -20, 30, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	25	4.431	**4.431**	5.318	3.102	**4.21**	21.714	19.498	**20.606**	39.631	40.325	**39.978**	46.973	44.314	**45.6435**	27.475
2	40	3.988	**3.988**	3.102	3.988	**3.545**	20.827	20.384	**20.6055**	33.871	39.439	**36.655**	46.086	45.2	**45.643**	21.714
3	225	4.875	**4.875**	3.102	10.635	**6.8685**	19.498	19.941	**19.7195**	42.733	33.235	**37.984**	46.086	44.314	**45.2**	24.816
4	230	1.329	**1.329**	7.09	4.875	**5.9825**	19.498	19.498	**19.498**	32.541	41.212	**36.877**	45.859	44.541	**45.2**	22.6
5	235	7.09	**7.09**	6.647	6.204	**6.4255**	19.498	19.498	**19.498**	35.643	33.235	**34.439**	44.086	46.073	**45.0795**	21.714
			4.343			**5.4063**			**19.9854**			**37.187**			**45.3532**	

Data : 3.5", -20, 30, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	25	1.773	**1.773**	10.635	5.318	**7.9765**	23.929	27.031	**25.48**	46.278	49.631	**47.955**	56.278	53.176	**54.727**	27.918
2	35	0.886	**0.886**	3.988	7.533	**5.7605**	23.043	26.588	**24.8155**	42.733	49.631	**46.182**	56.278	54.063	**55.1705**	21.714
3	60	3.545	**3.545**	1.329	4.875	**3.102**	25.259	24.816	**25.0375**	46.722	42.541	**44.632**	56.722	53.176	**54.949**	26.145
4	80	0.886	**0.886**	6.204	8.42	**7.312**	22.157	28.361	**25.259**	46.278	41.212	**43.745**	56.722	54.949	**55.8355**	26.588
5	100	2.216	**2.216**	6.647	5.318	**5.9825**	20.827	24.373	**22.6**	46.278	49.631	**47.955**	56.722	54.506	**55.614**	24.816
			1.861			**6.0267**			**24.6384**			**46.094**			**55.2592**	

Data : 3.5", -20, 30, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	35	3.102	**3.102**	12.851	7.533	**10.192**	28.361	30.133	**29.247**	65.082	51.847	**58.465**	65.812	64.812	**65.312**	22.6
2	65	3.102	**3.102**	17.725	7.976	**12.851**	24.373	38.996	**31.6845**	48.686	56.278	**52.482**	65.812	64.698	**65.255**	27.031
3	155	3.545	**3.545**	18.612	7.533	**13.073**	30.576	38.553	**34.5645**	65.082	56.722	**60.902**	65.812	65.584	**65.698**	22.6
4	185	7.09	**7.09**	9.306	7.533	**8.4195**	28.361	38.996	**33.6785**	65.082	63.812	**64.447**	64.722	65.584	**65.153**	24.816
5	205	4.875	**4.875**	17.725	6.204	**11.965**	28.361	35.008	**31.6845**	64.639	56.722	**60.681**	64.722	65.357	**65.0395**	27.918
			4.343			**11.3**			**32.1718**			**59.395**			**65.2915**	

Data : 3.5", -20, 30

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	1.329	**1.329**	5.318	5.318	**5.318**	7.09	9.306	**8.198**	15.067	18.169	**16.618**	19.055	21.271	**20.163**	27.918
2	35	2.659	**2.659**	3.102	2.659	**2.8805**	6.204	10.635	**8.4195**	19.498	17.725	**18.612**	20.827	21.271	**21.049**	27.475
3	40	3.102	**3.102**	5.318	5.318	**5.318**	6.204	8.863	**7.5335**	18.612	18.169	**18.391**	21.271	23.043	**22.157**	27.475
4	45	0.886	**0.886**	4.875	3.545	**4.21**	4.875	8.42	**6.6475**	14.624	14.624	**14.624**	23.043	23.043	**23.043**	27.918
5	55	1.329	**1.329**	5.761	4.875	**5.318**	5.318	9.306	**7.312**	14.624	13.737	**14.181**	23.043	21.271	**22.157**	27.918
			1.861			**4.6089**			**7.6221**			**16.485**			**21.7138**	

Data : 3.5", -20, 60, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	30	2.659	**2.659**	3.545	5.318	**4.4315**	13.737	17.725	**15.731**	35.894	31.463	**33.679**	34.522	35.508	**35.015**	22.6
2	90	3.545	**3.545**	1.773	3.545	**2.659**	11.965	14.18	**13.0725**	33.235	29.69	**31.463**	36.996	33.906	**35.451**	24.816
3	100	2.659	**2.659**	3.545	3.102	**3.3235**	15.953	16.839	**16.396**	40.769	35.451	**38.11**	34.349	36.439	**35.394**	27.031
4	115	2.659	**2.659**	2.443	3.102	**2.7725**	14.18	15.953	**15.0665**	41.655	27.918	**34.787**	35.451	35.008	**35.2295**	26.588
5	120	1.329	**1.329**	4.875	1.773	**3.324**	11.965	14.624	**13.2945**	41.655	31.463	**36.559**	34.349	35.996	**35.1725**	27.918
			2.57			**3.3021**			**14.7121**			**34.919**			**35.2524**	

Data : 3.5", -20, 60, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	5	3.545	**3.545**	7.09	2.216	**4.653**	19.498	17.282	**18.39**	39.631	33.235	**36.433**	45.086	44.098	**44.592**	24.816
2	15	3.102	**3.102**	7.09	3.102	**5.096**	18.612	19.498	**19.055**	32.541	35.451	**33.996**	43.541	46.973	**45.257**	22.6
3	25	3.545	**3.545**	6.647	7.09	**6.8685**	16.396	15.953	**16.1745**	43.176	40.325	**41.751**	45.314	44.314	**44.814**	24.373
4	30	3.102	**3.102**	7.09	4.875	**5.9825**	19.941	19.055	**19.498**	39.631	35.451	**37.541**	45.643	45.098	**45.3705**	27.475
5	45	1.329	**1.329**	7.09	3.102	**5.096**	15.953	19.055	**17.504**	39.631	38.996	**39.314**	46.086	43.541	**44.8135**	27 918
			2.925			**5.5392**			**18.1243**			**37.807**			**44.9694**	

Data : 3.5", -20, 60, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	1.773	**1.773**	6.647	7.533	**7.09**	26.145	21.271	**23.708**	57.357	40.325	**48.841**	55.722	54.278	**55**	27.918
2	65	2.216	**2.216**	7.533	6.204	**6.8685**	23.929	26.145	**25.037**	46.722	42.098	**44.41**	56.278	54.949	**55.6135**	24.373
3	165	5.318	**5.318**	4.875	10.635	**7.755**	19.941	27.475	**23.708**	44.506	42.541	**43.524**	55.722	54.506	**55.114**	28.361
4	215	1.329	**1.329**	3.102	3.102	**3.102**	23.043	26.588	**24.8155**	53.812	42.098	**47.955**	55.722	54.506	**55.114**	24.816
5	220	1.773	**1.773**	6.204	7.09	**6.647**	19.941	26.588	**23.2645**	53.812	46.086	**49.949**	55.722	54.063	**54.8925**	22.6
			2.482			**6.2925**			**24.1066**			**46.936**			**55.1468**	

Data : 3.5", -20, 60, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	3.102	**3.102**	17.725	8.42	**13.073**	24.816	32.792	**28.804**	50.459	60.267	**55.363**	63.812	66.278	**65.045**	24.373
2	30	3.102	**3.102**	17.725	5.761	**11.743**	24.816	31.906	**28.361**	50.459	56.722	**53.591**	64.698	66.357	**65.5275**	28.361
3	155	3.102	**3.102**	17.725	7.976	**12.851**	30.576	28.804	**29.69**	50.902	56.278	**53.59**	64.357	65.722	**65.0395**	27.918
4	160	1.329	**1.329**	17.725	7.976	**12.851**	25.259	37.224	**31.2415**	48.686	60.267	**54.477**	64.357	65.722	**65.0395**	24.373
5	230	1.329	**1.329**	18.612	8.42	**13.516**	30.576	37.224	**33.9**	50.902	56.722	**53.812**	64.357	65.584	**64.9705**	24.373
			2.393			**12.807**			**30.3993**			**54.166**			**65.1244**	

Data : 3.5", -20, 60

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	5	2.659	**2.659**	1.773	5.318	**3.5455**	10.635	9.306	**9.9705**	19.498	15.51	**17.504**	22.6	25.259	**23.9295**	27.918
2	25	1.329	**1.329**	1.773	5.318	**3.5455**	3.102	8.863	**5.9825**	19.498	13.737	**16.618**	24.816	21.271	**23.0435**	27.918
3	40	3.545	**3.545**	2.659	1.773	**2.216**	7.09	8.863	**7.9765**	19.055	14.624	**16.84**	22.157	24.373	**23.265**	27.918
4	90	2.659	**2.659**	1.329	1.329	**1.329**	6.204	9.306	**7.755**	17.725	17.282	**17.504**	23.043	23.043	**23.043**	27.918
5	105	1.329	**1.329**	1.329	6.204	**3.7665**	6.204	9.306	**7.755**	17.725	17.282	**17.504**	22.157	24.816	**23.4865**	27.918
			2.304			**2.8805**			**7.8879**			**17.194**			**23.3535**	

Data : 3.5", -20, 90, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	40	6.647	**6.647**	3.102	3.988	**3.545**	17.725	14.18	**15.9525**	27.918	34.565	**31.242**	35.008	35.008	**35.008**	27.918
2	70	3.102	**3.102**	3.102	3.102	**3.102**	18.612	13.737	**16.1745**	28.361	35.451	**31.906**	35.451	35.451	**35.451**	27.031
3	105	2.216	**2.216**	3.545	7.09	**5.3175**	14.18	11.965	**13.0725**	27.918	27.918	**27.918**	35.008	35.451	**35.2295**	27.475
4	135	2.216	**2.216**	10.635	1.329	**5.982**	14.624	13.294	**13.959**	27.918	31.906	**29.912**	35.008	34.996	**35.002**	24.373
5	150	3.102	**3.102**	1.773	5.318	**3.5455**	18.612	15.51	**17.061**	31.906	27.918	**29.912**	34.882	35.451	**35.1665**	21.714
			3.457			**4.2984**			**15.2439**			**30.178**			**35.1714**	

Data : 3.5", -20, 90, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	3.545	**3.545**	7.09	6.204	**6.647**	15.51	15.953	**15.7315**	34.757	35.008	**34.883**	44.598	46.086	**45.342**	24.816
2	60	4.431	**4.431**	10.635	7.09	**8.8625**	17.725	19.941	**18.833**	32.541	40.769	**36.655**	46.529	44.086	**45.3075**	23.043
3	80	2.216	**2.216**	10.635	3.102	**6.8685**	15.51	15.51	**15.51**	41.404	41.212	**41.308**	46.086	44.086	**45.086**	27.918
4	215	4.431	**4.431**	6.204	7.09	**6.647**	17.725	19.498	**18.6115**	43.176	35.451	**39.314**	44.973	45.2	**45.0865**	26.588
5	245	7.09	**7.09**	10.635	3.988	**7.3115**	17.282	17.282	**17.282**	32.984	38.996	**35.99**	44.086	46.973	**45.5295**	22.6
			4.343			**7.2673**			**17.1936**			**37.63**			**45.2703**	

Data : 3.5", -20, 90, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	5	1.329	**1.329**	3.102	7.533	**5.3175**	22.6	26.588	**24.594**	53.812	40.769	**47.291**	54.008	56.322	**55.165**	22.157
2	70	1.773	**1.773**	1.329	14.18	**7.7545**	21.271	26.588	**23.9295**	59.129	49.631	**54.38**	54.278	56.278	**55.278**	28.361
3	90	2.659	**2.659**	6.647	10.635	**8.641**	19.055	21.271	**20.163**	46.722	40.325	**43.524**	56.722	54.278	**55.5**	27.918
4	110	2.216	**2.216**	6.647	4.875	**5.761**	23.043	21.271	**22.157**	46.278	42.098	**44.188**	56.722	54.278	**55.5**	27.918
5	160	0.886	**0.886**	3.102	7.976	**5.539**	23.929	21.271	**22.6**	46.722	42.098	**44.41**	56.278	54.722	**55.5**	24.373
			1.773			**6.6026**			**22.6887**			**46.758**			**55.3886**	

Data : 3.5", -20, 90, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	20	0.886	**0.886**	6.204	14.18	**10.192**	21.714	23.486	**22.6**	50.459	45.643	**48.051**	64.925	65.584	**65.2545**	28.361
2	65	4.875	**4.875**	8.42	7.976	**8.198**	27.918	28.361	**28.1395**	65.082	56.278	**60.68**	64.812	65.584	**65.198**	24.816
3	80	3.988	**3.988**	8.42	7.533	**7.9765**	21.714	27.918	**24.816**	50.902	56.722	**53.812**	64.812	65.584	**65.198**	22.6
4	175	6.204	**6.204**	9.749	7.976	**8.8625**	27.475	30.133	**28.804**	50.459	49.188	**49.824**	64.812	65.357	**65.0845**	27.475
5	185	7.09	**7.09**	5.318	7.533	**6.4255**	26.588	26.145	**26.3665**	50.459	49.188	**49.824**	64.812	65.8	**65.306**	22.6
			4.609			**8.3309**			**26.1452**			**52.438**			**65.2082**	

Data : 3.5", -20, 90

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	3.102	**3.102**	5.318	7.09	**6.204**	7.09	10.635	**8.8625**	20.384	19.498	**19.941**	23.043	24.373	**23.708**	27.918
2	40	3.545	**3.545**	3.988	3.102	**3.545**	4.875	7.09	**5.9825**	19.498	17.725	**18.612**	24.816	21.271	**23.0435**	27.918
3	70	2.216	**2.216**	3.988	3.102	**3.545**	5.318	8.42	**6.869**	17.725	18.612	**18.169**	24.816	20.827	**22.8215**	27.031
4	220	0.443	**0.443**	1.329	1.329	**1.329**	4.875	5.761	**5.318**	17.725	15.51	**16.618**	23.043	23.929	**23.486**	27.918
5	235	2.659	**2.659**	2.659	6.204	**4.4315**	7.533	5.761	**6.647**	17.725	15.51	**16.618**	23.486	24.816	**24.151**	27.918
			2.393			**3.8109**			**6.7358**			**17.991**			**23.442**	

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Data : 3.5", -40, 30, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	40	6.204	**6.204**	7.09	6.647	**6.8685**	17.725	15.51	**16.6175**	37.859	29.69	**33.7745**	35.008	35.451	**35.2295**	22.6
2	160	3.102	**3.102**	10.635	3.988	**7.3115**	15.51	17.282	**16.396**	32.098	35.894	**33.996**	34.996	35.008	**35.002**	27.475
3	185	5.761	**5.761**	7.09	7.09	**7.09**	17.725	14.624	**16.1745**	32.541	35.008	**33.7745**	35.008	35.008	**35.008**	22.6
4	230	1.329	**1.329**	7.09	7.09	**7.09**	18.612	15.067	**16.8395**	32.098	37.224	**34.661**	35.008	35.325	**35.1665**	27.918
5	240	5.761	**5.761**	7.533	4.875	**6.204**	18.612	17.282	**17.947**	26.337	35.894	**31.1155**	35.678	34.996	**35.337**	24.373
			4.4314			**6.9128**			**16.795**			**33.464**			**35.1486**	

Data : 3.5", -40, 30, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	65	1.773	**1.773**	3.102	10.635	**6.8685**	17.725	17.282	**17.5035**	39.188	37.224	**38.206**	44.541	45.541	**45.041**	28.804
2	85	6.863	**8.863**	7.09	6.204	**6.647**	21.271	17.282	**19.2765**	46.722	35.008	**40.865**	45.798	44.314	**45.056**	28.361
3	100	0.443	**0.443**	7.09	6.647	**6.8685**	19.055	18.612	**18.8335**	50.267	31.906	**41.0865**	45.098	45.2	**45.149**	22.6
4	180	2.216	**2.216**	3.102	2.659	**2.8805**	24.816	21.271	**23.0435**	52.039	42.541	**47.29**	45.086	46.086	**45.586**	22.6
5	230	1.329	**1.329**	6.204	5.318	**5.761**	23.929	27.918	**25.9235**	42.541	17.776	**30.1585**	45.098	45.2	**45.149**	26.588
			2.9248			**5.8051**			**20.916**			**39.521**			**45.1962**	

Data : 3.5", -40, 30, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	20	0.443	**0.443**	6.647	3.545	**5.096**	18.612	21.271	**19.9415**	46.722	49.631	**48.1765**	56.278	54.349	**55.3135**	27.475
2	25	1.329	**1.329**	4.875	3.102	**3.9885**	23.486	21.271	**22.3785**	46.278	42.098	**44.188**	56.722	54.349	**55.5355**	24.373
3	45	0.443	**0.443**	7.09	7.533	**7.3115**	24.816	21.271	**23.0435**	46.278	40.769	**43.5235**	56.722	54.063	**55.3925**	22.6
4	80	2.216	**2.216**	3.988	7.533	**5.7605**	22.6	21.714	**22.157**	46.722	46.086	**46.404**	56.722	53.62	**55.171**	22.6
5	110	0.443	**0.443**	5.318	10.635	**7.9765**	19.498	27.031	**23.2645**	53.812	42.098	**47.955**	56.278	54.506	**55.392**	27.918
			0.9748			**6.0266**			**22.157**			**46.049**			**55.3609**	

Data : 3.5", -40, 30, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	20	3.102	**3.102**	6.647	7.976	**7.3115**	29.69	31.02	**30.355**	56.914	56.722	**56.818**	63.812	67.357	**65.5845**	22.6
2	45	4.875	**4.875**	8.42	14.18	**11.3**	35.451	31.906	**33.6785**	74.639	48.302	**61.4705**	65.584	64.722	**65.153**	22.6
3	120	1.329	**1.329**	11.522	15.953	**13.7375**	31.906	27.918	**29.912**	67.992	49.188	**58.59**	65.357	65.357	**65.357**	27.475
4	200	1.773	**1.773**	5.761	8.863	**7.312**	28.361	28.361	**28.361**	60.459	56.722	**58.5905**	65.584	65.129	**65.3565**	22.6
5	245	2.659	**2.659**	5.761	7.976	**6.8685**	27.918	27.918	**27.918**	60.902	49.188	**55.045**	64.471	65.357	**64.914**	24.373
			2.7476			**9.3059**			**30.045**			**58.103**			**65.273**	

Data : 3.5", -40, 30

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	5	1.773	**1.773**	6.647	3.545	**5.096**	7.533	7.09	**7.3115**	19.941	18.169	**19.055**	23.043	20.827	**21.935**	27.475
2	30	2.659	**2.659**	3.102	0.886	**1.994**	14.18	7.09	**10.635**	15.51	14.624	**15.067**	19.498	24.373	**21.9355**	27.918
3	50	2.659	**2.659**	3.102	0.886	**1.994**	4.875	6.647	**5.761**	18.612	15.067	**16.8395**	21.271	20.827	**21.049**	27.918
4	85	1.329	**1.329**	2.659	2.659	**2.659**	15.067	10.635	**12.851**	16.839	15.067	**15.953**	19.498	20.827	**20.1625**	27.918
5	95	3.102	**3.102**	8.863	0.886	**4.8745**	6.204	7.976	**7.09**	17.282	18.169	**17.7255**	24.816	21.271	**23.0435**	27.475
			2.3044			**3.3235**			**8.7297**			**16.928**			**21.6251**	

Data : 3.5", -40, 60, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	35	5.318	**5.318**	7.09	4.102	**5.596**	15.067	15.51	**15.2885**	32.541	28.361	**30.451**	35.451	35.008	**35.2295**	28.361
2	125	3.545	**3.545**	4.431	6.204	**5.3175**	18.612	14.624	**16.618**	32.541	31.463	**32.002**	35.008	35.008	**35.008**	25.702
3	150	3.102	**3.102**	7.09	1.329	**4.2095**	15.953	17.282	**16.6175**	28.553	35.451	**32.002**	35.098	35.451	**35.2745**	24.816
4	170	3.545	**3.545**	10.635	6.204	**8.4195**	17.725	18.612	**18.1685**	32.541	35.451	**33.996**	35.008	35.008	**35.008**	24.373
5	205	3.102	**3.102**	4.875	3.545	**4.21**	17.725	17.725	**17.725**	36.973	31.463	**34.218**	34.965	35.008	**34.9865**	24.816
			3.7224			**5.5505**			**16.884**			**32.534**			**35.1013**	

Data : 3.5", -40, 60, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	65	6.204	**6.204**	11.078	3.102	**7.09**	22.157	18.612	**20.3845**	34.757	46.086	**40.4215**	48.745	42.541	**45.643**	27.918
2	50	7.09	**7.09**	3.102	6.204	**4.653**	21.271	19.055	**20.163**	46.722	38.553	**42.6375**	46.973	43.541	**45.257**	28.361
3	70	7.09	**7.09**	15.067	7.976	**11.5215**	23.486	21.271	**22.3785**	35.643	42.541	**39.092**	43.859	46.086	**44.9725**	22.6
4	85	3.988	**3.988**	11.078	6.204	**8.641**	22.157	23.043	**22.6**	43.176	36.337	**39.7565**	45.098	45.098	**45.098**	22.6
5	125	3.545	**3.545**	8.42	7.533	**7.9765**	20.827	18.169	**19.498**	34.757	42.541	**38.649**	46.086	44.541	**45.3135**	23.043
			5.5834			**7.9764**			**21.005**			**40.111**			**45.2568**	

Data : 3.5", -40, 60, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	0.886	**0.886**	7.09	5.761	**6.4255**	21.271	20.384	**20.8275**	46.278	42.541	**44.4095**	54.722	55.835	**55.2785**	27.918
2	25	1.773	**1.773**	4.875	3.102	**3.9885**	21.271	20.827	**21.049**	46.278	49.188	**47.733**	55.835	54.949	**55.392**	22.6
3	110	1.329	**1.329**	6.204	3.102	**4.653**	19.498	24.816	**22.157**	46.722	39.882	**43.302**	55.835	54.188	**55.0115**	27.918
4	120	2.659	**2.659**	6.204	5.313	**5.761**	24.373	21.271	**22.822**	46.722	42.541	**44.6315**	54.643	55.392	**55.0175**	24.816
5	185	0.886	**0.886**	7.09	4.875	**5.9825**	24.816	20.827	**22.8215**	46.278	39.882	**43.08**	56.278	54.206	**55.242**	24.816
			1.5066			**5.3621**			**21.935**			**44.631**			**55.1883**	

Data : 3.5". -40, 60, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	120	5.318	**5.318**	8.42	7.976	**8.198**	33.235	27.918	**30.5765**	57.992	67.357	**62.6745**	65.584	64.357	**64.9705**	28.361
2	175	5.318	**5.318**	7.976	5.761	**6.8685**	28.361	24.373	**26.367**	64.196	67.357	**65.7765**	65.584	64.357	**64.9705**	23.043
3	195	3.545	**3.545**	11.078	7.533	**9.3055**	27.918	29.69	**28.804**	57.992	63.812	**60.902**	64.812	65.912	**65.362**	24.816
4	205	7.09	**7.09**	11.078	5.761	**8.4195**	27.918	27.918	**27.918**	46.914	63.812	**55.363**	64.812	65.912	**65.362**	24.373
5	245	1.773	**1.773**	15.067	8.42	**11.7435**	33.678	30.133	**31.9055**	46.914	63.812	**55.363**	65.971	63.812	**64.8915**	22.6
			4.6088			**8.907**			**29.114**			**60.016**			**65.1113**	

Data : 3.5". -40, 60

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	50	1.329	**1.329**	5.318	0.886	**3.102**	5.761	7.09	**6.4255**	18.169	17.725	**17.947**	21.271	21.271	**21.271**	27.918
2	85	2.659	**2.659**	6.204	1.329	**3.7665**	6.204	8.863	**7.5335**	17.725	17.725	**17.725**	24.373	19.055	**21.714**	27.918
3	95	1.329	**1.329**	3.102	3.102	**3.102**	4.875	8.42	**6.6475**	19.498	17.282	**18.39**	21.271	22.157	**21.714**	27.918
4	170	2.659	**2.659**	3.102	1.773	**2.4375**	7.976	7.976	**7.976**	15.51	14.18	**14.845**	19.055	19.498	**19.2765**	27.918
5	175	0.443	**0.443**	3.102	1.329	**2.2155**	6.204	6.204	**6.204**	15.51	18.612	**17.061**	24.373	21.271	**22.822**	27.918
			1.6838			**2.9247**			**6.9573**			**17.194**			**21.3595**	

Data : 3.5". -40, 90, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	60	6.204	**6.204**	7.09	7.09	**7.09**	14.624	19.055	**16.8395**	26.78	35.008	**30.894**	35.008	35.678	**35.343**	23.486
2	80	3.545	**3.545**	10.635	6.204	**8.4195**	17.725	19.498	**18.6115**	28.553	35.451	**32.002**	35.008	35.235	**35.1215**	27.475
3	160	0.443	**0.443**	4.875	7.09	**5.9825**	17.725	17.282	**17.5035**	24.565	31.463	**28.014**	34.996	35.451	**35.2235**	23.043
4	190	4.875	**4.875**	6.647	5.318	**5.9825**	15.51	17.725	**16.6175**	31.655	35.451	**33.553**	35.008	35.02	**35.014**	27.918
5	220	5.318	**5.318**	10.635	6.204	**8.4195**	13.294	17.282	**15.288**	32.541	35.008	**33.7745**	35.451	34.906	**35.1785**	24.373
			4.077			**7.1788**			**16.972**			**31.648**			**35.1761**	

Data :3.5", -40, 90, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	35	3.545	**3.545**	6.647	6.204	**6.4255**	23.043	21.271	**22.157**	46.722	33.678	**40.2**	46.086	44.541	**45.3135**	26.588
2	15	3.545	**3.545**	4.875	6.204	**5.5395**	21.271	18.169	**19.72**	35.643	35.008	**35.3255**	45.541	44.541	**45.041**	23.043
3	50	1.773	**1.773**	7.09	7.533	**7.3115**	23.486	20.827	**22.1565**	46.722	34.122	**40.422**	45.541	44.541	**45.041**	24.816
4	55	4.875	**4.875**	6.647	5.318	**5.9825**	18.169	23.043	**20.606**	46.722	38.996	**42.859**	45.541	44.541	**45.041**	22.157
5	70	7.09	**7.09**	12.408	7.09	**9.749**	23.486	21.271	**22.3785**	35.643	42.541	**39.092**	45.541	44.655	**45.098**	22.6
			4.1656			**7.0016**			**21.404**			**39.58**			**45.1069**	

Data : 3.5", -40, 90, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	60	1.773	**1.773**	3.545	5.761	**4.653**	20.827	21.271	**21.049**	60.902	42.541	**51.7215**	55.835	54.278	**55.0565**	24.373
2	70	0.443	**0.443**	7.09	10.635	**8.8625**	21.714	24.816	**23.265**	47.165	48.745	**47.955**	55.835	54.278	**55.0565**	22.6
3	90	0.886	**0.886**	3.102	6.204	**4.653**	21.271	21.271	**21.271**	57.357	42.541	**49.949**	54.949	54.278	**54.6135**	27.475
4	125	3.545	**3.545**	4.431	7.533	**5.982**	20.827	21.271	**21.049**	47.165	40.325	**43.745**	56.278	54.278	**55.278**	27.918
5	140	2.659	**2.659**	7.09	8.42	**7.755**	18.169	19.055	**18.612**	60.902	42.098	**51.5**	53.722	56.722	**55.222**	22.6
			1.8612			**6.3811**			**21.049**			**48.974**			**55.0453**	

Data : 3.5", -40, 90, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	60	2.659	**2.659**	9.749	3.988	**6.8685**	27.918	28.361	**28.1395**	65.082	49.188	**57.135**	64.812	65.357	**65.0845**	28.361
2	110	2.659	**2.659**	5.761	3.988	**4.8745**	28.361	29.247	**28.804**	65.082	56.722	**60.902**	64.812	65.8	**65.306**	28.361
3	180	0.443	**0.443**	6.647	14.18	**10.4135**	26.145	24.373	**25.259**	49.573	59.38	**54.4765**	64.812	65.357	**65.0845**	23.043
4	190	1.773	**1.773**	9.749	7.533	**8.641**	28.361	28.361	**28.361**	65.082	56.722	**60.902**	64.812	65.129	**64.9705**	27.918
5	190	1.773	**1.773**	9.749	7.533	**8.641**	28.361	28.361	**28.361**	65.082	56.722	**60.902**	64.812	65.129	**64.9705**	27.918
			1.8614			**7.8877**			**27.785**			**58.864**			**65.0832**	

Data : 3.5", -40, 90

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	1.329	**1.329**	3.102	2.216	**2.659**	6.204	8.863	**7.5335**	19.498	18.612	**19.055**	23.486	20.827	**22.1565**	27.918
2	15	2.216	**2.216**	4.875	1.329	**3.102**	4.875	6.647	**5.761**	18.169	18.612	**18.3905**	23.486	19.055	**21.2705**	27.918
3	20	2.216	**2.216**	6.204	1.329	**3.7665**	5.318	5.318	**5.318**	18.169	15.953	**17.061**	23.929	23.043	**23.486**	27.918
4	55	1.329	**1.329**	5.318	0.443	**2.8805**	7.09	6.204	**6.647**	18.612	15.067	**16.8395**	19.055	23.043	**21.049**	27.918
5	110	1.329	**1.329**	0.443	5.318	**2.8805**	14.18	8.42	**11.3**	17.282	17.725	**17.5035**	20.827	23.486	**22.1565**	27.918
			1.6838			**3.0577**			**7.3119**			**17.77**			**22.0237**	

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Data : 3.5", -60, 30, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	45	1.773	**1.773**	5.318	2.659	**3.9885**	15.51	14.624	**15.067**	28.553	31.463	**30.008**	34.906	35.678	**35.292**	22.6
2	95	1.773	**1.773**	7.09	3.545	**5.3175**	15.067	18.169	**16.618**	27.224	29.247	**28.236**	35.235	35.008	**35.1215**	24.816
3	105	1.773	**1.773**	4.875	3.545	**4.21**	13.737	18.169	**15.953**	28.553	30.133	**29.343**	34.906	35.451	**35.1785**	24.816
4	160	1.329	**1.329**	7.533	2.216	**4.8745**	12.851	14.624	**13.738**	25.894	29.69	**27.792**	35.224	35.008	**35.116**	27.918
5	200	3.545	**3.545**	3.102	5.318	**4.21**	14.18	17.725	**15.953**	25.451	35.451	**30.451**	35.451	34.996	**35.2235**	24.816
			2.0386			**4.5201**			**15.466**			**29.166**			**35.1863**	

Data : 3.5", -60, 30, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	4.09	**4.09**	7.533	2.659	**5.096**	23.043	21.271	**22.157**	46.722	33.678	**40.2**	43.541	46.973	**45.257**	27.918
2	125	3.545	**3.545**	5.318	6.647	**5.9825**	23.043	23.043	**23.043**	46.278	36.337	**41.308**	46.086	44.098	**45.092**	27.031
3	135	1.773	**1.773**	5.761	2.216	**3.9885**	23.043	20.827	**21.935**	42.733	44.314	**43.524**	46.973	43.541	**45.257**	26.588
4	215	5.635	**5.635**	5.761	8.863	**7.312**	22.157	18.169	**20.163**	39.188	46.086	**42.637**	46.086	43.541	**44.8135**	24.373
5	235	3.102	**3.102**	5.761	4.875	**5.318**	18.612	21.271	**19.942**	42.733	42.541	**42.637**	44.541	45.439	**44.99**	27.918
			3.629			**5.5394**			**21.448**			**42.061**			**45.0819**	

Data : 3.5", -60, 30, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	1.773	**1.773**	3.102	2.659	**2.8805**	19.498	17.725	**18.612**	46.278	50.518	**48.398**	56.722	53.278	**55**	23.486
2	20	1.329	**1.329**	5.318	3.988	**4.653**	24.373	17.282	**20.828**	48.051	49.631	**48.841**	56.278	54.278	**55.278**	23.486
3	50	3.545	**3.545**	7.09	3.545	**5.3175**	21.271	21.271	**21.271**	46.722	49.631	**48.177**	54.722	55.722	**55.222**	24.373
4	110	1.329	**1.329**	3.988	4.431	**4.2095**	20.827	22.6	**21.714**	57.357	39.882	**48.62**	53.722	56.722	**55.222**	27.918
5	215	1.329	**1.329**	3.102	5.761	**4.4315**	20.827	19.498	**20.163**	46.722	42.541	**44.632**	53.278	56.722	**55**	22.6
			1.861			**4.2984**			**20.517**			**47.733**			**55.1444**	

Data : 3.5", -60, 30, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	65	2.216	**2.216**	6.647	3.102	**4.8745**	30.576	27.918	**29.247**	67.992	47.416	**57.704**	65.584	64.722	**65.153**	28.361
2	95	0.443	**0.443**	7.533	4.875	**6.204**	27.918	27.918	**27.918**	67.992	49.188	**58.59**	65.584	64.722	**65.153**	29.247
3	195	0.886	**0.886**	6.204	6.647	**6.4255**	28.361	27.918	**28.14**	56.914	56.722	**56.818**	65.812	64.812	**65.312**	24.373
4	215	2.216	**2.216**	6.204	6.647	**6.4255**	28.361	22.6	**25.481**	56.914	46.529	**51.722**	65.698	64.698	**65.198**	28.361
5	250	3.102	**3.102**	6.204	4.875	**5.5395**	26.145	27.918	**27.032**	60.902	56.722	**58.812**	64.255	66.471	**65.363**	28.804
			1.7726			**5.8938**			**27.563**			**56.729**			**65.2358**	

Data : 3.5", -60, 30

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	2.659	**2.659**	2.659	3.545	**3.102**	14.18	7.976	**11.078**	15.953	14.624	**15.289**	21.271	19.941	**20.606**	27.918
2	45	0.443	**0.443**	6.647	1.773	**4.21**	6.204	8.42	**7.312**	17.725	18.169	**17.947**	21.271	23.929	**22.6**	27.918
3	80	1.773	**1.773**	5.318	3.545	**4.4315**	6.647	7.533	**7.09**	19.498	14.624	**17.061**	23.929	21.271	**22.6**	27.918
4	165	1.329	**1.329**	3.988	2.216	**3.102**	6.204	10.635	**8.4195**	15.51	18.169	**16.84**	23.043	19.055	**21.049**	27.918
5	170	3.545	**3.545**	7.533	1.773	**4.653**	10.635	5.761	**8.198**	19.055	15.067	**17.061**	24.816	19.055	**21.9355**	23.043
			1.9498			**3.8997**			**8.4195**			**16.839**			**21.7581**	

Data : 3.5", -60, 60, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw1-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	95	1.329	**1.329**	7.533	1.329	**4.431**	17.725	17.725	**17.725**	32.098	29.69	**30.894**	34.349	35.451	**34.9**	27.918
2	120	2.659	**2.659**	5.318	6.647	**5.9825**	15.067	16.839	**15.953**	32.098	29.69	**30.894**	35.349	35.008	**35.1785**	27.918
3	140	2.216	**2.216**	5.318	2.216	**3.767**	17.725	17.725	**17.725**	28.553	29.69	**29.122**	34.906	35.451	**35.1785**	24.373
4	195	0.886	**0.886**	6.204	4.875	**5.5395**	15.953	18.169	**17.061**	30.325	31.463	**30.894**	35.451	35.451	**35.451**	28.361
5	215	2.659	**2.659**	5.318	5.318	**5.318**	17.282	18.612	**17.947**	30.325	29.247	**29.786**	35.008	35.349	**35.1785**	24.373
			1.9498			**5.0076**			**17.282**			**30.318**			**35.1773**	

Data : 3.5", -60, 60, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	20	1.329	**1.329**	7.533	1.329	**4.431**	19.055	21.271	**20.163**	42.733	42.541	**42.637**	46.086	44.541	**45.3135**	27.918
2	90	1.329	**1.329**	15.067	6.647	**10.857**	19.055	19.055	**19.055**	39.188	42.541	**40.865**	46.973	43.882	**45.4275**	24.816
3	180	1.329	**1.329**	7.533	5.761	**6.647**	23.929	22.6	**23.265**	40.961	45.2	**43.081**	44.098	46.086	**45.092**	23.486
4	240	1.329	**1.329**	8.42	5.318	**6.869**	22.157	19.055	**20.606**	46.278	36.78	**41.529**	44.098	46.086	**45.092**	27.918
5	245	3.545	**3.545**	6.204	5.318	**5.761**	23.043	21.271	**22.157**	40.075	42.541	**41.308**	44.745	46.086	**45.4155**	27.918
			1.7722			**6.913**			**21.049**			41.884			**45.2681**	

Data : 3.5", -60, 60, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	30	5.318	**5.318**	6.204	5.318	**5.761**	24.816	26.588	**25.702**	47.165	42.541	**44.853**	55.278	54.722	**55**	23.486
2	35	5.318	**5.318**	8.42	5.318	**6.869**	21.271	20.827	**21.049**	49.824	50.075	**49.95**	54.949	55.722	**55.3355**	23.043
3	75	7.533	**7.533**	14.18	7.09	**10.635**	20.384	21.714	**21.049**	48.051	42.098	**45.075**	54.278	55.722	**55**	28.361
4	120	5.318	**5.318**	5.318	5.318	**5.318**	25.702	22.6	**24.151**	46.722	49.631	**48.177**	54.722	56.278	**55.5**	27.918
5	125	5.318	**5.318**	6.647	5.318	**5.9825**	26.588	24.373	**25.481**	46.722	40.769	**43.746**	54.722	55.722	**55.222**	23.043
			5.761			**6.9131**			**23.486**			**46.36**			**55.2115**	

Data : 3.5", -60, 60, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	6.204	**6.204**	5.761	7.533	**6.647**	28.361	28.361	**28.361**	63.812	56.722	**60.267**	65.812	64.698	**65.255**	24.816
2	85	6.204	**6.204**	7.533	6.204	**6.8685**	28.361	27.918	**28.14**	64.698	56.722	**60.71**	64.698	65.812	**65.255**	24.373
3	180	1.329	**1.329**	3.988	3.102	**3.545**	25.259	24.816	**25.038**	64.698	56.722	**60.71**	64.698	65.812	**65.255**	28.361
4	235	6.204	**6.204**	5.318	7.09	**6.204**	26.145	27.918	**27.032**	63.812	56.278	**60.045**	64.812	65.812	**65.312**	27.918
5	250	0.443	**0.443**	11.078	3.545	**7.3115**	26.145	27.918	**27.032**	63.812	56.278	**60.045**	64.812	65.584	**65.198**	28.361
			4.0768			**6.1152**			**27.12**			**60.355**			**65.255**	

Data : 3.5", -60, 60

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	55	0.886	**0.886**	2.659	2.659	**2.659**	14.18	3.988	**9.084**	19.498	17.725	**18.612**	20.827	19.941	**20.384**	27.031
2	80	0	**0**	3.545	0.443	**1.994**	7.09	8.863	**7.9765**	20.384	19.055	**19.72**	20.827	21.271	**21.049**	27.475
3	90	1.329	**1.329**	3.102	3.988	**3.545**	4.875	7.976	**6.4255**	17.282	17.282	**17.282**	23.929	19.941	**21.935**	27.475
4	130	0.886	**0.886**	1.329	1.329	**1.329**	6.204	9.306	**7.755**	15.51	17.282	**16.396**	21.271	23.043	**22.157**	27.918
5	135	1.329	**1.329**	7.09	3.545	**5.3175**	1.329	7.976	**4.6525**	19.498	15.953	**17.726**	23.043	21.271	**22.157**	27.475
			0.886			**2.9689**			**7.1787**			**17.947**			**21.5364**	

Data : 3.5", -60, 90, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	30	2.659	**2.659**	1.329	1.329	**1.329**	14.624	16.839	**15.732**	27.541	27.918	**27.73**	35.451	34.349	**34.9**	23.043
2	35	1.773	**1.773**	5.318	5.318	**5.318**	17.725	16.839	**17.282**	27.098	28.804	**27.951**	34.463	35.008	**34.7355**	24.373
3	140	0.886	**0.886**	6.647	6.647	**6.647**	16.839	14.18	**15.51**	27.098	29.247	**28.173**	34.576	35.451	**35.0135**	27.918
4	155	0.443	**0.443**	4.875	4.875	**4.875**	17.725	15.953	**16.839**	27.098	28.361	**27.73**	35.02	35.008	**35.014**	28.361
5	200	1.773	**1.773**	0.886	0.886	**0.886**	15.067	16.839	**15.953**	27.541	36.337	**31.939**	35.451	35.349	**35.4**	23.043
			1.5068			**3.811**			**16.263**			**28.704**			**35.0126**	

Data : 3.5", -60, 90, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	90	3.102	**3.102**	3.102	0.443	**1.7725**	21.271	18.169	**19.72**	51.153	38.553	**44.853**	44.314	46.086	**45.2**	23.043
2	195	2.216	**2.216**	5.318	7.09	**6.204**	22.6	23.043	**22.822**	46.722	42.098	**44.41**	44.314	46.859	**45.5865**	27.475
3	200	1.329	**1.329**	3.102	3.988	**3.545**	21.271	20.827	**21.049**	42.733	38.553	**40.643**	46.086	44.098	**45.092**	24.816
4	205	1.773	**1.773**	14.18	3.102	**8.641**	21.271	18.612	**19.942**	40.961	42.541	**41.751**	46.086	44.325	**45.2055**	26.588
5	245	3.102	**3.102**	3.102	2.659	**2.8805**	18.169	18.169	**18.169**	40.961	46.973	**43.967**	46.086	44.859	**45.4725**	27.475
			2.3044			**4.6086**			**20.34**			**43.125**			**45.3113**	

Data : 3.5", -60, 90, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	1.329	**1.329**	5.318	6.204	**5.761**	19.941	20.827	**20.384**	57.357	50.518	**53.938**	53.176	56.722	**54.949**	24.373
2	25	3.102	**3.102**	7.533	6.204	**6.8685**	20.384	21.714	**21.049**	60.902	41.212	**51.057**	56.722	53.722	**55.222**	23.486
3	45	6.647	**6.647**	8.42	5.318	**6.869**	21.271	26.588	**23.93**	46.722	51.404	**49.063**	55.835	53.722	**54.7785**	28.361
4	65	5.318	**5.318**	14.18	1.329	**7.7545**	21.271	26.588	**23.93**	60.902	42.541	**51.722**	54.278	56.722	**55.5**	23.486
5	115	5.318	**5.318**	7.976	4.875	**6.4255**	24.816	21.714	**23.265**	53.369	50.518	**51.944**	56.722	54.278	**55.5**	24.816
			4.3428			**6.7357**			**22.511**			**51.545**			**55.1899**	

Data : 3.5", -60, 90, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	25	0	**0**	7.533	5.318	**6.4255**	29.247	31.906	**30.577**	54.004	56.278	**55.141**	65.584	64.902	**65.243**	28.361
2	75	1.329	**1.329**	6.204	7.09	**6.647**	28.361	30.133	**29.247**	64.196	56.722	**60.459**	65.584	64.278	**64.931**	22.6
3	135	1.773	**1.773**	6.204	5.318	**5.761**	32.792	27.918	**30.355**	62.867	58.494	**60.681**	64.722	65.584	**65.153**	23.043
4	230	1.773	**1.773**	6.204	5.318	**5.761**	31.906	27.918	**29.912**	64.639	58.494	**61.567**	64.267	66.357	**65.312**	28.804
5	245	2.216	**2.216**	5.318	5.318	**5.318**	27.918	28.361	**28.14**	65.082	56.722	**60.902**	63.847	67.357	**65.602**	23.486
			1.4182			**5.9825**			**29.646**			**59.75**			**65.2482**	

Data : 3.5", -60, 90

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	25	2.659	**2.659**	3.102	3.545	**3.3235**	7.976	7.533	**7.7545**	19.498	15.51	**17.504**	24.816	25.259	**25.0375**	27.475
2	85	1.329	**1.329**	3.545	3.102	**3.3235**	11.078	14.18	**12.629**	20.384	17.282	**18.833**	25.259	20.827	**23.043**	27.031
3	90	2.659	**2.659**	3.988	2.216	**3.102**	5.318	8.42	**6.869**	20.384	17.725	**19.055**	21.271	21.271	**21.271**	27.918
4	130	0.443	**0.443**	5.761	1.329	**3.545**	7.533	6.647	**7.09**	20.827	19.498	**20.163**	24.816	21.271	**23.0435**	27.475
5	160	0.886	**0.886**	1.773	1.329	**1.551**	7.533	15.953	**11.743**	19.941	17.725	**18.833**	20.827	19.941	**20.384**	27.475
			1.5952			**2.969**			**9.2171**			**18.877**			**22.5558**	

DATA SUHU

Data : 3", -20, 30, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	5	1.329	**1.329**	3.102	7.09	**5.096**	14.18	7.976	**11.078**	36.337	31.463	**33.9**	35.008	35.451	**35.2295**	27.918
2	70	0.886	**0.886**	2.216	1.329	**1.7725**	13.737	7.976	**10.857**	29.69	37.224	**33.457**	35.008	35.451	**35.2295**	27.918
3	80	1.773	**1.773**	3.545	7.09	**5.3175**	15.953	10.635	**13.294**	28.804	35.451	**32.1275**	35.451	34.224	**34.8375**	28.361
4	95	0.886	**0.886**	3.102	3.545	**3.3235**	14.18	11.522	**12.851**	36.337	31.02	**33.6785**	35.008	35.451	**35.2295**	28.361
5	115	1.773	**1.773**	2.216	1.329	**1.7725**	16.396	9.749	**13.073**	31.906	30.576	**31.241**	34.996	35.451	**35.2235**	27.918
			1.3294			**3.4564**			**12.23**			**32.8808**			**35.1499**	

Data : 3", -20, 30, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	1.773	**1.773**	7.09	7.09	**7.09**	21.271	12.851	**17.061**	38.553	37.224	**37.8885**	43.541	46.973	**45.257**	27.918
2	20	1.329	**1.329**	3.102	7.09	**5.096**	21.271	13.737	**17.504**	47.859	42.098	**44.9785**	46.416	44.098	**45.257**	28.361
3	50	0.443	**0.443**	6.204	6.647	**6.4255**	22.157	13.737	**17.947**	46.086	42.098	**44.092**	45.631	44.098	**44.8645**	28.361
4	70	1.329	**1.329**	1.329	3.102	**2.2155**	17.725	11.078	**14.402**	46.086	41.212	**43.649**	44.325	45.631	**44.978**	24.373
5	95	1.329	**1.329**	3.988	6.647	**5.3175**	17.725	11.078	**14.402**	42.541	42.541	**42.541**	45.098	45.404	**45.251**	27.918
			1.2406			**5.2289**			**16.263**			**42.6298**			**45.1215**	

Data : 3", -20, 30, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	2.659	**2.659**	14.624	7.976	**11.3**	24.373	32.349	**28.361**	53.722	52.722	**53.222**	54.949	56.278	**55.6135**	29.247
2	110	1.329	**1.329**	9.749	5.318	**7.5335**	27.031	33.235	**30.133**	53.722	52.278	**53**	54.949	56.278	**55.6135**	24.373
3	135	1.773	**1.773**	14.624	7.976	**11.3**	22.6	32.792	**27.696**	53.722	52.722	**53.222**	55.835	54.812	**55.3235**	24.373
4	215	1.329	**1.329**	14.18	5.761	**9.9705**	23.043	27.918	**25.481**	55.937	46.961	**51.449**	54.063	56.722	**55.3925**	27.918
5	230	0.443	**0.443**	17.725	7.976	**12.851**	27.918	27.918	**27.918**	44.416	52.278	**48.347**	53.176	56.722	**54.949**	29.247
			1.5066			**10.591**			**27.918**			**51.848**			**55.3784**	

Data : 3", -20, 30, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	3.863	**3.863**	17.725	7.976	**12.851**	28.361	31.906	**30.134**	58.278	65.584	**61.931**	66.608	64.278	**65.443**	27.918
2	25	3.863	**3.863**	9.749	5.761	**7.755**	24.816	31.906	**28.361**	58.278	63.812	**61.045**	65.722	64.278	**65**	24.373
3	40	3.863	**3.863**	14.624	7.976	**11.3**	27.918	35.894	**31.906**	62.267	56.722	**59.4945**	65.722	64.278	**65**	23.486
4	140	3.863	**3.863**	6.647	14.18	**10.414**	27.918	33.678	**30.798**	58.722	56.722	**57.722**	65.722	64.812	**65.267**	24.373
5	150	2.09	**2.09**	9.306	7.976	**8.641**	22.157	28.804	**25.481**	62.267	56.722	**59.4945**	65.722	64.812	**65.267**	28.361
			3.5084			**10.192**			**29.336**			**59.9374**			**65.1954**	

Data : 3", -20, 30

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	20	1.773	**1.773**	3.102	2.659	**2.8805**	5.761	3.102	**4.4315**	20.384	18.612	**19.498**	23.043	19.055	**21.049**	27.918
2	25	0.886	**0.886**	1.329	1.773	**1.551**	8.42	8.42	**8.42**	15.953	20.827	**18.39**	19.055	23.929	**21.492**	27.918
3	35	1.329	**1.329**	7.09	2.659	**4.8745**	7.976	2.659	**5.3175**	19.941	17.725	**18.833**	19.055	22.157	**20.606**	27.918
4	75	0.886	**0.886**	3.545	1.329	**2.437**	5.318	5.318	**5.318**	19.941	20.384	**20.1625**	19.498	23.929	**21.7135**	27.918
5	115	1.773	**1.773**	3.545	1.329	**2.437**	7.976	7.533	**7.7545**	19.941	16.396	**18.1685**	19.055	21.271	**20.163**	27.918
			1.3294			**2.836**			**6.2483**			**19.0104**			**21.0047**	

Data : 3", -20, 60, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	1.329	**1.329**	3.545	0.443	**1.994**	11.522	8.863	**10.193**	31.463	30.576	**31.0195**	35.451	35.224	**35.3375**	24.373
2	25	0.443	**0.443**	1.329	7.533	**4.431**	11.522	10.192	**10.857**	29.247	35.451	**32.349**	35.008	35.224	**35.116**	28.361
3	105	1.329	**1.329**	3.102	5.318	**4.21**	14.18	10.635	**12.408**	29.69	35.451	**32.5705**	35.008	35.008	**35.008**	28.361
4	145	0.886	**0.886**	8.863	3.102	**5.9825**	13.737	9.749	**11.743**	35.451	30.576	**33.0135**	35.224	35.451	**35.3375**	28.361
5	165	1.329	**1.329**	3.102	3.102	**3.102**	15.953	10.635	**13.294**	28.804	31.463	**30.1335**	34.667	35.008	**34.8375**	28.361
			1.0632			**3.9439**			**11.699**			**31.8172**			**35.1273**	

Data : 3", -20, 60, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	2.659	**2.659**	7.09	7.09	**7.09**	15.51	10.192	**12.851**	40.325	42.541	**41.433**	43.973	46.973	**45.473**	27.918
2	25	0.443	**0.443**	3.102	3.102	**3.102**	15.51	13.737	**14.624**	38.553	42.098	**40.3255**	44.086	45.973	**45.0295**	28.361
3	145	1.773	**1.773**	4.431	3.988	**4.2095**	18.612	10.192	**14.402**	42.098	42.541	**42.3195**	46.529	43.541	**45.035**	27.918
4	200	1.329	**1.329**	6.204	3.545	**4.8745**	17.282	10.192	**13.737**	40.325	39.439	**39.882**	42.541	47.416	**44.9785**	28.361
5	225	0.886	**0.886**	3.545	7.09	**5.3175**	17.282	11.078	**14.18**	38.553	42.541	**40.547**	45.086	45.302	**45.194**	27.918
			1.418			**4.9187**			**13.959**			**40.9014**			**45.142**	

Data : 3", -20, 60, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	25	1.329	**1.329**	9.306	14.18	**11.743**	22.157	28.361	**25.259**	53.722	53.722	**53.722**	55.835	54.176	**55.0055**	27.918
2	45	0.443	**0.443**	15.067	6.204	**10.636**	24.373	33.678	**29.026**	46.188	59.039	**52.6135**	53.176	56.278	**54.727**	28.361
3	70	0.886	**0.886**	4.875	14.18	**9.5275**	21.714	28.361	**25.038**	43.086	53.722	**48.404**	55.835	55.278	**55.5565**	29.247
4	110	0.886	**0.886**	9.306	5.761	**7.5335**	20.827	34.122	**27.475**	53.722	53.278	**53.5**	55.835	54.176	**55.0055**	28.361
5	125	0.886	**0.886**	14.624	5.761	**10.193**	24.816	27.918	**26.367**	53.722	53.722	**53.722**	55.835	54.176	**55.0055**	28.361
			0.886			**9.9264**			**26.633**			**52.3923**			**55.06**	

Data : 3", -20, 60, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	35	4.306	**4.306**	14.18	8.863	**11.522**	27.031	35.894	**31.463**	58.722	63.812	**61.267**	65.278	64.812	**65.045**	27.918
2	145	9.18	**0.443**	14.624	7.976	**11.3**	24.816	28.804	**26.81**	58.278	63.812	**61.045**	65.278	65.278	**65.278**	27.918
3	180	1.647	**1.647**	9.306	9.749	**9.5275**	25.702	28.804	**27.253**	58.722	56.722	**57.722**	65.722	64.812	**65.267**	24.373
4	215	1.204	**1.204**	9.306	5.761	**7.5335**	26.588	35.451	**31.02**	58.722	63.812	**61.267**	65.722	65.278	**65.5**	28.361
5	220	9.18	**9.18**	10.192	15.953	**13.073**	27.031	28.804	**27.918**	62.267	56.278	**59.2725**	65.722	65.278	**65.5**	24.373
			3.356			**10.591**			**28.893**			**60.1147**			**65.318**	

Data : 3", -20, 60

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	35	1.329	**1.329**	5.318	3.545	**4.4315**	8.42	6.647	**7.5335**	15.51	15.953	**15.7315**	19.498	21.271	**20.3845**	27.918
2	60	0.886	**0.443**	3.545	2.659	**3.102**	5.761	2.216	**3.9885**	15.51	16.396	**15.953**	20.827	19.498	**20.1625**	27.918
3	75	0.443	**0.443**	1.329	2.659	**1.994**	7.976	4.431	**6.2035**	17.282	19.498	**18.39**	18.612	20.827	**19.7195**	27.918
4	95	0.886	**0.886**	3.545	0.886	**2.2155**	14.18	2.659	**8.4195**	18.612	19.941	**19.2765**	23.929	23.929	**23.929**	27.918
5	150	1.773	**1.773**	3.545	0.443	**1.994**	11.522	7.09	**9.306**	14.624	17.282	**15.953**	20.827	23.043	**21.935**	27.918
			0.9748			**2.7474**			**7.0902**			**17.0608**			**21.2261**	

Data : 3", -20, 90, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSCR8	SENSOR9	Tw2-out	SENSOR10
1	5	0.886	**0.886**	3.545	3.545	**3.545**	15.953	10.192	**13.073**	32.098	33.678	**32.888**	35.008	35.008	**35.008**	24.373
2	65	1.773	**0.443**	3.545	6.204	**4.8745**	12.408	10.192	**11.3**	34.314	31.906	**33.11**	35.008	35.008	**35.008**	23.486
3	80	1.773	**1.773**	4.875	3.102	**3.9885**	15.067	10.635	**12.851**	28.553	32.541	**30.547**	34.922	35.008	**34.965**	24.373
4	190	0.443	**0.443**	6.204	3.102	**4.653**	11.522	11.522	**11.522**	31.655	35.451	**33.553**	35.451	35.008	**35.2295**	28.804
5	235	2.659	**2.659**	7.09	3.102	**5.096**	9.306	11.522	**10.414**	25.894	34.314	**30.104**	35.008	35.008	**35.008**	28.804
			1.2408			**4.4314**			**11.832**			**32.0404**			**35.0437**	

Data : 3", -20, 90, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	35	1.773	**1.773**	3.102	3.102	**3.102**	14.18	11.522	**12.851**	45.2	42.098	**43.649**	44.086	45.016	**44.551**	24.816
2	60	0.886	**0.443**	3.102	3.102	**3.102**	13.737	13.737	**13.737**	38.553	42.541	**40.547**	45.929	44.086	**45.0075**	28.361
3	95	1.773	**1.773**	7.09	5.318	**6.204**	13.737	13.737	**13.737**	36.78	45.541	**41.1605**	44.086	45.859	**44.9725**	27.918
4	100	2.659	**2.659**	4.875	6.204	**5.5395**	15.953	13.737	**14.845**	42.541	42.541	**42.541**	44.086	46.086	**45.086**	22.6
5	200	1.329	**1.329**	3.545	3.102	**3.3235**	14.18	11.522	**12.851**	42.098	42.541	**42.3195**	45.2	45.073	**45.1365**	22.6
			1.5954			**4.2542**			**13.604**			**42.0434**			**44.9507**	

Data : 3", -20, 90, 55 C

NO	WAKTU	SENSOR1	Tw1-out	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	0.886	**0.886**	14.624	9.306	**11.965**	24.816	27.918	**26.367**	53.278	53.722	**53.5**	55.835	54.278	**55.0565**	28.361
2	20	1.773	**0.443**	8.863	**14.18**	**11.522**	26.145	34.122	**30.134**	46.188	53.278	**49.733**	56.278	54.722	**55.5**	24.816
3	45	3.545	**3.545**	7.976	7.976	**7.976**	24.816	33.235	**29.026**	43.086	53.278	**48.182**	54.949	56.278	**55.6135**	22.6
4	50	0.886	**0.886**	5.761	9.749	**7.755**	26.588	28.361	**27.475**	42.643	53.722	**48.1825**	55.835	54.722	**55.2785**	24.373
5	165	2.659	**2.659**	15.953	14.18	**15.067**	20.827	32.792	**26.81**	53.278	47.961	**50.6195**	54.506	56.722	**55.614**	28.361
			1.6838			**10.857**			**27.962**			**50.0434**			**55.4125**	

Data : 3", -20, 90, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	80	2.725	**2.725**	14.624	6.647	**10.636**	22.157	35.008	**28.583**	58.278	63.812	**61.045**	66.608	64.267	**65.4375**	27.918
2	90	6.522	**0.443**	15.953	14.18	**15.067**	24.816	35.451	**30.134**	58.722	56.722	**57.722**	65.722	64.812	**65.267**	28.361
3	105	3.612	**3.612**	9.306	16.396	**12.851**	25.702	28.804	**27.253**	58.722	56.722	**57.722**	63.722	66.439	**65.0805**	27.918
4	150	2.976	**2.976**	9.749	14.624	**12.187**	21.714	28.361	**25.038**	48.529	65.584	**57.0565**	65.722	64.812	**65.267**	28.361
5	185	9.18	**9.18**	7.976	9.306	**8.641**	24.373	28.361	**26.367**	59.608	63.812	**61.71**	65.278	65.596	**65.437**	28.804
			3.7872			**11.876**			**27.475**			**59.0511**			**65.2978**	

Data : 3", -20, 90

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	1.773	**1.773**	2.216	1.329	**1.7725**	15.067	3.102	**9.0845**	15.51	21.271	**18.3905**	23.043	23.486	**23.2645**	27.918
2	30	0.886	**0.443**	2.216	3.102	**2.659**	7.976	3.102	**5.539**	17.725	21.714	**19.7195**	21.271	24.373	**22.822**	27.918
3	150	0.886	**0.886**	1.329	1.329	**1.329**	8.42	4.431	**6.4255**	15.953	16.396	**16.1745**	23.486	22.6	**23.043**	27.918
4	190	0.886	**0.886**	3.545	0.443	**1.994**	9.749	3.545	**6.647**	19.941	19.941	**19.941**	19.055	24.373	**21.714**	27.918
5	215	1.773	**1.773**	2.659	4.431	**3.545**	5.318	2.216	**3.767**	15.51	16.396	**15.953**	19.498	19.055	**19.2765**	27.918
			1.1522			**2.2599**			**6.2926**			**18.0357**			**22.024**	

DATA SUHU

Data : 3", -40, 30, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	180	1.329	**1.329**	2.659	7.09	**4.8745**	14.18	10.635	**12.408**	31.008	31.008	**31.01**	35.894	34.098	**34.996**	22.157
2	185	2.216	**2.216**	2.659	8.863	**5.761**	16.839	8.863	**12.851**	35.882	29.235	**32.56**	35.451	35.098	**35.2745**	27.475
3	190	2.226	**2.226**	3.545	3.102	**3.3235**	13.737	8.863	**11.3**	29.235	31.451	**30.34**	34.008	36.541	**35.2745**	28.361
4	215	2.416	**2.416**	3.102	7.09	**5.096**	14.18	9.749	**11.965**	31.451	35.439	**33.45**	34.098	36.098	**35.098**	27.918
5	240	2.216	**2.216**	7.09	5.318	**6.204**	16.839	11.965	**14.402**	31.008	28.792	**29.9**	35.098	34.996	**35.047**	24.373
			2.081			**5.0518**			**12.585**			**31.45**			**35.138**	

Data : 3", -40, 30, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	60	0.886	**0.886**	3.102	3.545	**3.3235**	14.624	10.635	**12.63**	42.098	40.325	**41.21**	44.098	46.086	**45.092**	28.361
2	75	1.773	**1.773**	7.09	7.09	**7.09**	14.624	14.18	**14.402**	36.78	44.314	**40.55**	44.302	45.541	**44.9215**	22.6
3	90	3.102	**3.102**	10.635	7.09	**8.8625**	17.725	13.294	**15.51**	42.541	42.098	**42.32**	43.302	46.086	**44.694**	28.361
4	125	0.886	**0.886**	3.988	2.216	**3.102**	14.624	10.635	**12.63**	42.098	41.212	**41.66**	46.586	43.541	**45.0635**	27.918
5	140	1.329	**1.329**	6.204	2.216	**4.21**	19.498	11.078	**15.288**	44.314	41.655	**42.98**	45.973	44.541	**45.257**	26.588
			1.595			**5.3176**			**14.092**			**41.74**			**45.0056**	

Data : 3", -40, 30, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	1.773	**1.773**	16.396	7.533	**11.9645**	24.816	33.678	**29.247**	47.188	52.278	**49.73**	54.949	55.733	**55.341**	28.361
2	20	1.329	**1.329**	16.396	8.42	**12.408**	24.816	27.918	**26.367**	54.722	52.722	**53.72**	54.176	56.722	**55.449**	27.918
3	85	0.443	**0.443**	14.624	5.318	**9.971**	26.588	28.361	**27.475**	54.722	46.961	**50.84**	53.176	56.722	**54.949**	24.373
4	145	0.443	**0.443**	14.624	5.318	**9.971**	25.702	33.235	**29.469**	47.188	52.278	**49.73**	54.063	56.278	**55.1705**	27.918
5	155	0.443	**0.443**	9.749	7.533	**8.641**	27.475	34.122	**30.799**	45.416	52.278	**48.85**	54.176	56.722	**55.449**	23.486
			0.886			**10.5911**			**28.671**			**50.58**			**55.2717**	

Data : 3", -40, 30, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	5	0.761	**0.761**	9.749	7.976	**8.8625**	20.827	28.804	**24.816**	56.278	56.278	**56.28**	65.722	64.812	**65.267**	24.816
2	10	2.976	**2.976**	11.522	15.067	**13.2945**	26.588	27.918	**27.253**	56.722	65.584	**61.15**	65.722	65.278	**65.5**	23.486
3	30	0.761	**0.761**	5.761	11.522	**8.6415**	27.475	29.69	**28.583**	49.188	63.812	**56.5**	65.722	64.812	**65.267**	24.373
4	130	1.647	**1.647**	14.624	5.761	**10.1925**	24.816	28.804	**26.81**	60.267	60.267	**60.27**	64.278	65.812	**65.045**	27.918
5	245	3.863	**3.863**	16.396	15.953	**16.1745**	21.714	31.463	**26.589**	56.278	63.812	**60.05**	65.278	65.278	**65.278**	27.918
			2.002			**11.4331**			**26.81**			**58.85**			**65.2714**	

Data : 3", -40, 30

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	20	1.773	**1.773**	5.318	0.886	**3.102**	7.533	3.988	**5.7605**	19.941	20.384	**20.16**	18.169	20.827	**19.498**	27.918
2	30	0.886	**0.886**	4.431	1.329	**2.88**	9.749	7.09	**8.4195**	19.055	20.827	**19.94**	23.043	23.043	**23.043**	27.918
3	35	0.443	**0.443**	3.102	2.216	**2.659**	7.976	6.204	**7.09**	19.498	20.827	**20.16**	19.055	21.271	**20.163**	27.918
4	50	1.773	**1.773**	6.204	0.886	**3.545**	11.078	2.659	**6.8685**	19.498	16.839	**18.17**	21.271	20.827	**21.049**	27.918
5	90	1.773	**1.773**	3.102	2.659	**2.8805**	8.42	3.102	**5.761**	18.169	20.827	**19.5**	18.612	19.055	**18.8335**	27.475
			1.33			**3.0133**			**6.7799**			**19.59**			**20.5173**	

Data : 3", -40, 60, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	25	0.443	**0.443**	6.647	3.102	**4.8745**	12.851	9.749	**11.3**	29.235	28.349	**28.79**	34.098	36.427	**35.2625**	27.918
2	30	0.443	**0.443**	2.216	6.647	**4.4315**	10.192	10.192	**10.192**	35.882	28.349	**32.12**	35.008	35.427	**35.2175**	27.918
3	135	0.886	**0.886**	10.192	6.647	**8.4195**	16.396	10.635	**13.516**	35.439	27.463	**31.45**	35.541	34.451	**34.996**	28.361
4	210	0.886	**0.886**	1.329	5.318	**3.3235**	9.306	11.522	**10.414**	31.451	35.882	**33.67**	34.541	35.541	**35.041**	24.373
5	240	0.886	**0.886**	3.102	3.102	**3.102**	13.737	10.635	**12.186**	28.349	33.224	**30.79**	35.996	34.541	**35.2685**	24.373
			0.709			**4.8302**			**11.522**			**31.36**			**35.1571**	

Data : 3", -40, 60, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	50	1.329	**1.329**	14.624	3.102	**8.863**	19.055	29.69	**24.373**	39.541	46.631	**43.09**	45.643	45.231	**45.437**	28.361
2	60	2.216	**2.216**	6.204	6.647	**6.4255**	19.055	27.918	**23.487**	43.086	39.541	**41.31**	45.2	45.221	**45.2105**	23.929
3	125	3.545	**3.545**	9.306	6.204	**7.755**	19.498	24.373	**21.936**	46.188	38.655	**42.42**	44.314	45.241	**44.7775**	28.361
4	140	5.761	**5.761**	15.953	3.988	**9.9705**	21.271	24.373	**22.822**	45.745	39.541	**42.64**	46.086	45.232	**45.659**	23.486
5	180	2.216	**2.216**	18.612	6.647	**12.6295**	23.486	23.486	**23.486**	44.859	39.098	**41.98**	44.098	45.2	**44.649**	28.361
			3.013			**9.1287**			**23.221**			**42.29**			**45.1466**	

Data : 3", -40, 60, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	35	2.659	**2.659**	5.761	3.102	**4.4315**	21.271	27.918	**24.595**	43.2	52.278	**47.74**	54.506	56.278	**55.392**	27.918
2	40	1.329	**1.329**	7.976	10.635	**9.3055**	24.816	33.678	**29.247**	43.643	48.733	**46.19**	53.176	56.722	**54.949**	28.804
3	45	2.216	**2.216**	7.976	6.204	**7.09**	20.827	27.918	**24.373**	42.757	57.153	**49.96**	53.176	56.722	**54.949**	28.804
4	185	0.886	**0.886**	14.624	3.102	**8.863**	19.941	27.031	**23.486**	54.722	52.278	**53.5**	53.176	56.722	**54.949**	24.373
5	190	1.329	**1.329**	7.976	5.318	**6.647**	20.827	34.565	**27.696**	43.643	58.039	**50.84**	53.176	56.722	**54.949**	27.918
			1.684			**7.2674**			**25.879**			**49.64**			**55.0376**	

Data : 3", -40, 60, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	20	0.443	**0.443**	16.396	14.624	**15.51**	27.918	39.439	**33.679**	60.267	56.278	**58.27**	65.494	64.722	**65.108**	22.157
2	30	0.443	**0.443**	18.612	8.863	**13.7375**	22.6	31.463	**27.032**	63.722	56.278	**60**	65.494	64.278	**64.886**	28.361
3	60	0.443	**0.443**	17.725	14.18	**15.9525**	23.043	35.451	**29.247**	60.267	56.278	**58.27**	65.494	64.278	**64.886**	27.475
4	90	0.443	**0.443**	15.067	9.749	**12.408**	27.918	35.451	**31.685**	56.278	63.722	**60**	65.937	65.278	**65.6075**	27.918
5	225	0.443	**0.443**	17.725	8.42	**13.0725**	24.373	35.451	**29.912**	56.278	63.369	**59.82**	64.278	65.812	**65.045**	26.588
			0.443			**14.1361**			**30.311**			**59.27**			**65.1065**	

Data : 3", -40, 60

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	20	0.886	**0.886**	2.216	1.773	**1.9945**	3.102	4.875	**3.9885**	19.498	17.282	**18.39**	18.169	20.827	**19.498**	27.918
2	60	1.773	**1.773**	6.204	1.329	**3.7665**	6.204	4.875	**5.5395**	18.612	20.384	**19.5**	18.612	20.827	**19.7195**	27.475
3	75	1.773	**1.773**	3.102	1.773	**2.4375**	7.976	3.102	**5.539**	15.51	20.827	**18.17**	19.055	23.043	**21.049**	27.918
4	90	0.443	**0.443**	3.102	1.773	**2.4375**	7.533	4.875	**6.204**	19.498	17.282	**18.39**	18.612	21.714	**20.163**	27.918
5	95	3.102	**3.102**	5.318	1.773	**3.5455**	8.42	1.773	**5.0965**	15.953	20.827	**18.39**	21.271	20.827	**21.049**	27.918
			1.595			**2.8363**			**5.2735**			**18.57**			**20.2957**	

Data : 3", -40, 90, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	70	0.886	**0.886**	7.09	1.773	**4.4315**	17.725	11.522	**14.624**	36.325	29.451	**32.89**	35.769	34.655	**35.212**	28.361
2	75	0.886	**0.886**	2.216	6.204	**4.21**	14.18	10.192	**12.186**	27.463	36.541	**32**	36.212	34.541	**35.3765**	23.043
3	220	1.773	**1.773**	1.329	2.216	**1.7725**	17.725	9.749	**13.737**	31.451	30.78	**31.12**	34.427	36.541	**35.484**	23.486
4	240	0.886	**0.886**	2.216	1.329	**1.7725**	12.851	12.851	**12.851**	29.235	30.78	**30.01**	34.451	36.541	**35.496**	26.588
5	245	2.216	**2.216**	6.647	2.659	**4.653**	9.306	10.635	**9.9705**	28.792	36.541	**32.67**	36.098	34.427	**35.2625**	22.6
			1.329			**3.3679**			**12.674**			**31.74**			**35.3662**	

Data : 3", -40, 90, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	45	3.102	**3.102**	16.396	7.09	**11.743**	19.498	29.247	**24.373**	35.553	39.098	**37.33**	45.2	44.631	**44.9155**	28.361
2	80	3.102	**3.102**	9.749	4.875	**7.312**	23.929	24.373	**24.151**	43.086	51.063	**47.07**	44.314	45.631	**44.9725**	23.486
3	90	3.102	**3.102**	9.306	7.09	**8.198**	19.055	27.918	**23.487**	43.086	39.984	**41.54**	45.2	49.631	**47.4155**	24.373
4	175	3.102	**3.102**	9.749	7.09	**8.4195**	23.043	28.361	**25.702**	35.553	48.404	**41.98**	46.086	44.098	**45.092**	28.361
5	220	2.216	**2.216**	6.647	5.318	**5.9825**	18.169	26.145	**22.157**	39.098	38.655	**38.88**	45.2	44.631	**44.9155**	27.918
			2.925			**8.331**			**23.974**			**41.36**			**45.4622**	

Data : 3", -40, 90, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	80	2.216	**2.216**	7.976	7.976	**7.976**	19.498	34.122	**26.81**	51.176	52.278	**51.73**	53.176	56.722	**54.949**	23.929
2	85	0.886	**0.886**	14.18	5.761	**9.9705**	19.941	27.918	**23.93**	41.871	52.278	**47.07**	54.176	56.278	**55.227**	28.361
3	160	5.318	**5.318**	14.18	7.976	**11.078**	20.827	34.565	**27.696**	41.871	52.278	**47.07**	53.176	57.608	**55.392**	27.918
4	215	2.659	**2.659**	8.863	5.761	**7.312**	23.043	27.918	**25.481**	52.949	48.733	**50.84**	54.404	56.722	**55.563**	27.918
5	230	1.329	**1.329**	3.102	5.318	**4.21**	23.929	34.122	**29.026**	51.176	52.278	**51.73**	53.176	56.722	**54.949**	23.486
			2.482			**8.1093**			**26.588**			**49.69**			**55.216**	

Data : 3", -40, 90, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	35	2.216	**2.216**	6.647	8.863	**7.755**	26.588	35.008	**30.798**	56.278	66.345	**61.31**	64.608	66.039	**65.3235**	27.918
2	50	0.886	**0.886**	14.624	11.522	**13.073**	24.816	40.769	**32.793**	61.596	51.278	**56.44**	64.608	65.267	**64.9375**	27.918
3	135	1.773	**1.773**	14.624	14.18	**14.402**	24.816	41.212	**33.014**	56.722	58.369	**57.55**	65.051	65.267	**65.159**	23.486
4	200	0.443	**0.443**	18.612	8.863	**13.7375**	27.918	32.349	**30.134**	56.278	65.459	**60.87**	65.937	64.722	**65.3295**	27.918
5	245	1.773	**1.773**	14.624	15.953	**15.2885**	22.6	31.463	**27.032**	49.188	65.459	**57.32**	65.278	65.267	**65.2725**	22.6
			1.418			**12.8512**			**30.754**			**58.7**			**65.2044**	

Data : 3", -40, 90

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	35	0.886	**0.886**	1.329	1.773	**1.551**	7.533	6.647	**7.09**	17.725	19.498	**18.61**	23.043	21.271	**22.157**	27.918
2	80	2.216	**2.216**	1.329	3.545	**2.437**	5.761	6.204	**5.9825**	17.725	15.953	**16.84**	23.043	20.827	**21.935**	27.918
3	170	0.886	**0.886**	3.545	0.443	**1.994**	8.42	3.102	**5.761**	17.282	20.384	**18.83**	23.043	23.043	**23.043**	27.804
4	125	0.886	**0.886**	3.545	2.659	**3.102**	6.204	3.545	**4.8745**	15.51	16.396	**15.95**	19.055	23.043	**21.049**	27.247
5	220	1.773	**1.773**	0.886	3.102	**1.994**	3.988	2.659	**3.3235**	15.067	16.839	**15.95**	23.043	19.055	**21.049**	27.918
			1.329			**2.2156**			**5.4063**			**17.24**			**21.8466**	

DATA SUHU

Data : 3", -60, 30, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	50	3.102	**3.102**	4.431	1.329	**2.88**	17.725	12.408	**15.067**	27.463	34.757	**31.11**	37.098	33.996	**35.547**	27.918
2	100	3.102	**3.102**	7.09	2.216	**4.653**	9.306	12.408	**10.857**	27.906	34.314	**31.11**	34.098	36.212	**35.155**	22.6
3	110	3.102	**3.102**	3.545	2.216	**2.8805**	13.737	10.192	**11.965**	28.349	26.337	**27.343**	34.541	36.655	**35.598**	24.373
4	115	3.102	**3.102**	2.216	5.318	**3.767**	12.851	10.635	**11.743**	31.008	34.314	**32.661**	35.541	35.069	**35.305**	28.361
5	120	1.773	**1.773**	7.09	1.329	**4.2095**	14.18	12.408	**13.294**	31.008	32.541	**31.775**	34.541	35.769	**35.155**	28.361
			2.8362			**3.678**			**12.585**			**30.8**			**35.352**	

Data : 3", -60, 30, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	25	0.886	**0.886**	4.875	3.102	**3.9885**	14.624	11.965	**13.295**	36.78	40.769	**38.775**	44.541	45.745	**45.143**	26.588
2	30	1.329	**1.329**	6.647	4.875	**5.761**	15.51	10.635	**13.073**	37.667	42.541	**40.104**	45.859	45.098	**45.479**	22.157
3	55	0.443	**0.443**	3.102	3.102	**3.102**	17.725	11.522	**14.624**	36.78	42.541	**39.661**	45.086	44.998	**45.042**	24.816
4	160	1.329	**1.329**	7.09	1.329	**4.2095**	14.624	11.078	**12.851**	37.667	41.655	**39.661**	44.098	46.086	**45.092**	27.918
5	215	1.773	**1.773**	7.09	2.216	**4.653**	17.282	10.192	**13.737**	36.78	40.325	**38.553**	46.086	44.541	**45.314**	23.043
			1.152			**4.3428**			**13.516**			**39.351**			**45.214**	

Data : 3", -60, 30, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	25	1.773	**1.773**	5.761	9.306	**7.5335**	28.361	37.224	**32.793**	43.529	59.039	**51.284**	54.176	56.278	**55.227**	28.804
2	80	1.329	**1.329**	7.976	6.647	**7.3115**	27.918	29.69	**28.804**	42.643	53.278	**47.961**	54.063	56.722	**55.393**	28.361
3	100	0.886	**0.886**	6.647	15.067	**10.857**	24.816	37.224	**31.02**	53.278	53.278	**53.278**	54.176	56.278	**55.227**	28.804
4	115	1.329	**1.329**	8.42	9.306	**8.863**	28.361	29.69	**29.026**	53.722	49.733	**51.728**	55.392	56.722	**56.057**	28.361
5	145	0.886	**0.886**	9.306	14.624	**11.965**	27.918	38.11	**33.014**	43.529	53.722	**48.626**	54.949	55.722	**55.336**	22.6
			1.2406			**9.306**			**30.931**			**50.575**			**55.448**	

Data : 3", -60, 30, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	20	0.443	**0.443**	7.976	15.067	**11.5215**	28.361	46.973	**37.667**	60.812	53.278	**57.045**	65.494	64.659	**65.077**	27.918
2	5	1.329	**1.329**	16.396	9.306	**12.851**	30.133	42.098	**36.116**	53.278	58.369	**55.824**	65.267	65.494	**65.381**	23.486
3	55	7.09	**7.09**	8.863	10.635	**9.749**	31.906	44.314	**38.11**	53.278	67.675	**60.477**	65.567	64.459	**65.013**	28.804
4	90	2.659	**2.659**	9.749	18.612	**14.1805**	25.259	35.451	**30.355**	53.722	53.051	**53.387**	64.267	66.357	**65.312**	23.486
5	65	8.863	**8.863**	15.953	12.851	**14.402**	25.259	36.78	**31.02**	60.357	61.675	**61.016**	65.267	64.829	**65.048**	28.361
			4.0768			**12.5408**			**34.653**			**57.55**			**65.166**	

Data : 3", -60, 30

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	5	1.329	**1.329**	1.329	1.773	**1.551**	7.533	3.102	**5.3175**	14.624	17.282	**15.953**	19.498	23.486	**21.492**	27.475
2	45	1.773	**1.773**	3.545	1.329	**2.437**	10.635	3.545	**7.09**	18.612	17.282	**17.947**	20.827	19.055	**19.941**	27.918
3	50	1.773	**1.773**	0.443	2.216	**1.3295**	6.204	5.318	**5.761**	15.51	16.396	**15.953**	23.043	19.055	**21.049**	27.918
4	60	1.329	**1.329**	1.773	1.773	**1.773**	6.647	3.545	**5.096**	18.612	20.384	**19.498**	22.6	19.055	**20.828**	27.918
5	125	0.886	**0.886**	1.329	2.216	**1.7725**	6.204	4.875	**5.5395**	15.51	16.839	**16.175**	21.271	20.827	**21.049**	27.475
			1.418			**1.7726**			**5.7608**			**17.105**			**20.872**	

Data : 3", -60, 60, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	0.886	**0.886**	1.329	1.773	**1.551**	14.624	13.294	**13.959**	27.02	25.894	**26.457**	35.541	34.655	**35.098**	22.157
2	25	0.443	**0.443**	7.09	2.659	**4.8745**	6.647	11.965	**9.306**	34.996	25.451	**30.224**	35.098	34.996	**35.047**	28.804
3	70	0.443	**0.443**	3.988	4.431	**4.2095**	9.306	12.408	**10.857**	27.463	24.565	**26.014**	35.098	34.882	**34.99**	28.361
4	75	2.659	**2.659**	4.875	3.102	**3.9885**	4.875	8.863	**6.869**	31.451	34.314	**32.883**	34.655	35.769	**35.212**	27.475
5	205	2.659	**2.659**	6.647	6.647	**6.647**	9.306	10.192	**9.749**	27.463	32.541	**30.002**	35.098	34.769	**34.934**	28.361
			1.418			**4.2541**			**10.148**			**29.116**			**35.056**	

Data : 3", -60, 60, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	35	0.443	**0.443**	7.09	5.318	**6.204**	14.18	11.078	**12.629**	42.098	41.212	**41.655**	46.086	44.314	**45.2**	22.6
2	60	3.545	**3.545**	3.545	1.329	**2.437**	15.51	13.737	**14.624**	38.553	42.098	**40.326**	44.086	46.973	**45.53**	24.373
3	165	0.443	**0.443**	7.09	6.204	**6.647**	14.18	10.192	**12.186**	35.894	42.098	**38.996**	45.541	44.314	**44.928**	24.373
4	220	0.443	**0.443**	3.102	3.102	**3.102**	15.953	11.522	**13.738**	36.78	42.541	**39.661**	44.973	45.098	**45.036**	27.918
5	250	1.773	**1.773**	10.635	2.659	**6.647**	17.282	11.078	**14.18**	42.098	42.541	**42.32**	43.098	46.973	**45.036**	28.361
			1.3294			**5.0074**			**13.471**			**40.591**			**45.146**	

Data : 3", -60, 60, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	25	0.443	**0.443**	9.749	4.875	**7.312**	24.373	37.224	**30.799**	42.643	60.812	**51.728**	54.176	56.38	**55.278**	23.043
2	50	1.329	**1.329**	11.522	14.624	**13.073**	28.361	29.69	**29.026**	53.722	53.722	**53.722**	54.631	55.267	**54.949**	28.804
3	60	1.329	**1.329**	9.749	8.863	**9.306**	27.475	30.576	**29.026**	53.722	53.722	**53.722**	55.631	54.38	**55.006**	23.486
4	90	0.886	**0.886**	15.953	6.204	**11.0785**	24.816	38.996	**31.906**	53.722	49.733	**51.728**	54.863	55.267	**55.065**	27.918
5	115	0.443	**0.443**	7.976	9.306	**8.641**	27.475	35.451	**31.463**	53.278	49.733	**51.506**	54.506	56.722	**55.614**	28.804
			0.886			**9.8821**			**30.444**			**52.481**			**55.182**	

Data : 3", -60, 60, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	15	2.659	**2.659**	7.976	8.863	**8.4195**	27.475	32.349	**29.912**	50.961	51.278	**51.12**	65.494	64.8	**65.147**	22.6
2	25	1.329	**1.329**	15.953	7.976	**11.9645**	24.816	42.541	**33.679**	56.722	51.722	**54.222**	64.494	65.657	**65.076**	28.804
3	75	1.329	**1.329**	9.749	5.761	**7.755**	27.475	41.655	**34.565**	56.722	58.369	**57.546**	65.278	65.243	**65.261**	24.816
4	95	3.545	**3.545**	9.749	9.749	**9.749**	27.475	35.008	**31.242**	61.153	51.722	**56.438**	64.722	65.243	**64.983**	28.361
5	140	0.886	**0.886**	15.953	9.749	**12.851**	22.157	34.122	**28.14**	62.039	65.902	**63.971**	65.722	64.357	**65.04**	27.918
			1.9496			**10.1478**			**31.507**			**56.659**			**65.101**	

Data : 3", -60, 60

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	35	0.886	**0.886**	0.443	1.773	**1.108**	4.875	3.102	**3.9885**	17.282	20.827	**19.055**	24.816	24.816	**24.816**	27.918
2	45	1.773	**1.773**	3.102	1.329	**2.2155**	7.533	2.659	**5.096**	17.282	15.953	**16.618**	19.498	21.271	**20.385**	27.918
3	95	1.329	**1.329**	2.659	2.659	**2.659**	6.647	7.09	**6.8685**	17.725	17.282	**17.504**	22.157	18.612	**20.385**	27.918
4	115	0.443	**0.443**	1.773	3.545	**2.659**	7.533	7.976	**7.7545**	17.282	19.498	**18.39**	23.043	21.271	**22.157**	27.918
5	120	1.773	**1.773**	3.102	1.329	**2.2155**	7.09	3.102	**5.096**	19.498	20.384	**19.941**	23.929	19.055	**21.492**	27.031
			1.2408			**2.1714**			**5.7607**			**18.301**			**21.847**	

Data : 3", -60, 90, 35 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	5	0.886	**0.886**	2.216	0.443	**1.3295**	15.067	10.192	**12.63**	27.02	32.541	**29.781**	35.098	34.769	**34.934**	28.361
2	45	3.545	**3.545**	3.988	6.647	**5.3175**	9.306	13.294	**11.3**	35.882	25.008	**30.445**	35.541	34.655	**35.098**	27.918
3	70	2.659	**2.659**	1.329	1.329	**1.329**	16.396	11.078	**13.737**	28.792	26.337	**27.565**	35.098	35.541	**35.32**	28.361
4	100	1.773	**1.773**	6.647	3.102	**4.8745**	9.306	13.737	**11.522**	28.792	34.314	**31.553**	35.541	34.655	**35.098**	24.816
5	250	2.216	**2.216**	10.192	7.09	**8.641**	14.624	14.18	**14.402**	29.235	25.894	**27.565**	34.655	35.769	**35.212**	24.816
			2.2158			**4.2983**			**12.718**			**29.382**			**35.132**	

Data : 3", -60, 90, 45 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	10	0.886	**0.886**	4.875	3.102	**3.9885**	16.839	13.737	**15.288**	44.314	42.541	**43.428**	46.086	44.314	**45.2**	28.361
2	30	1.773	**1.773**	1.329	4.431	**2.88**	14.18	14.18	**14.18**	36.337	42.541	**39.439**	44.314	46.086	**45.2**	28.361
3	155	0.443	**0.443**	3.545	7.09	**5.3175**	13.737	12.408	**13.073**	42.098	42.541	**42.32**	44.314	46.416	**45.365**	28.361
4	175	2.659	**2.659**	3.102	4.875	**3.9885**	14.18	12.408	**13.294**	38.553	42.541	**40.547**	44.529	46.086	**45.308**	28.361
5	200	0.443	**0.443**	3.102	3.102	**3.102**	16.839	15.067	**15.953**	38.553	42.541	**40.547**	46.086	44.529	**45.308**	22.6
			1.2408			**3.8553**			**14.358**			**41.256**			**45.276**	

Data : 3", -60, 90, 55 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	40	1.773	**1.773**	8.863	6.647	**7.755**	24.373	36.337	**30.355**	53.278	53.278	**53.278**	54.949	55.722	**55.336**	28.804
2	50	0.443	**0.443**	14.624	17.725	**16.1745**	21.714	35.451	**28.583**	42.643	53.722	**48.183**	54.276	55.722	**54.999**	22.6
3	60	0.443	**0.443**	14.624	11.522	**13.073**	21.271	35.451	**28.361**	46.188	60.812	**53.5**	53.176	56.722	**54.949**	27.918
4	170	0.443	**0.443**	9.749	14.624	**12.1365**	24.816	35.451	**30.134**	42.2	59.039	**50.62**	54.62	55.608	**55.114**	24.373
5	190	1.773	**1.773**	15.953	9.306	**12.6295**	22.6	37.224	**29.912**	42.2	53.722	**47.961**	55.176	55.051	**55.114**	27.475
			0.975			**12.3637**			**29.469**			**50.708**			**55.102**	

Data : 3", -60, 90, 65 C

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	30	0.886	**0.886**	9.749	7.976	**8.8625**	24.373	43.427	**33.9**	56.278	51.278	**53.778**	65.494	64.812	**65.153**	22.6
2	45	1.773	**1.773**	7.976	8.42	**8.198**	21 714	38.996	**30.355**	56.722	51.722	**54.222**	65.722	64.698	**65.21**	28.361
3	60	0.886	**0.886**	8.863	9.306	**9.0845**	27 918	35.008	**31.463**	56.278	65.902	**61.09**	65.494	64.278	**64.886**	22.6
4	80	2.216	**2.216**	7.976	8.863	**8.4195**	28 361	42.541	**35.451**	61.596	65.902	**63.749**	65.494	65.022	**65.258**	27.918
5	165	1.329	**1.329**	8.863	14.624	**11.7435**	23 043	35.451	**29.247**	56.722	58.812	**57.767**	65.537	64.961	**65.249**	27.475
			1.418			**9.2616**			**32.083**			**58.121**			**65.151**	

Data : 3", -60, 90

NO	WAKTU	SENSOR1	Tw1-in	SENSOR2	SENSOR3	Tw1-out	SENSOR4	SENSOR5	T~	SENSOR6	SENSOR7	Tw2-in	SENSOR8	SENSOR9	Tw2-out	SENSOR10
1	60	1.773	**1.773**	2.659	0.443	**1.551**	5.318	3.102	**4.21**	19.941	16.839	**18.39**	21.271	19.498	**20.385**	27.918
2	65	0.886	**0.886**	1.773	3.102	**2.4375**	6.204	3.102	**4.653**	15.51	17.725	**16.618**	24.816	18.612	**21.714**	27.918
3	95	0.886	**0.886**	0.886	3.988	**2.437**	6.647	3.545	**5.096**	19.055	19.498	**19.277**	23.929	19.055	**21.492**	23.043
4	130	1.329	**1.329**	2.216	1.329	**1.7725**	6.204	5.318	**5.761**	17.725	17.725	**17.725**	19.498	20.827	**20.163**	27.475
5	235	1.329	**1.329**	0.886	3.102	**1.994**	10.635	3.102	**6.8685**	17.282	16.396	**16.839**	23.486	23.486	**23.486**	27.918
			1.2406			**2.0384**			**5.3177**			**17.77**			**21.448**	

LAMPIRAN – II

REKAPITULASI HASIL PERHITUNGAN

DATA : KONDISI STANDARD / PEMBEBANAN PANAS*

Tabung : 4" atau (L/dha) = 5.9*

D2	Pvac	Tenta	Heater	Tw2-out	Tw2-in	T~	Tw1-out	Tw1-in	dha(m)	L/dha	Tf(C)	Tf (K)	rho	Cp	Miu(x10^-5)	Viskin(x10^-6	Kf	Alfa(x10^-4)
4"	20	30	35	35.1261	29.8133	19.4981	13.7816	2.0532	0.0508	5.9055	21.79745	294.797	1.22698	1.007	1.812235862	15.54335903	0.025746	0.22016079
		30	45	45.2	40.3253	24.6827	18.6176	3.9882	0.0508	5.9055	29.47145	302.471	1.19515	1.0072	1.848764102	16.26855203	0.025342	0.231023337
		30	55	55.4705	46.352	28.5825	22.3845	5.495	0.0508	5.9055	34.36825	307.368	1.17484	1.0074	1.87207287	16.73129963	0.026722	0.237954758
		30	65	65.3857	56.6328	34.7863	24.3283	6.0266	0.0508	5.9055	40.48055	313.481	1.14948	1.0076	1.901167418	17.30891198	0.027196	0.246606719
		30	*stand*	*18.4787*	*14.0655*	*8.6857*	*6.6914*	*5.345*	0.0508	5.9055	10.37845	283.378	1.27435	1.0065	1.757881422	14.46426353	0.02486	0.203997196
		60	35	35.8055	28.918	20.5615	15.0937	2.5968	0.0508	5.9055	22.00585	295.006	1.22612	1.007	1.813227846	15.56305283	0.025762	0.220455781
		60	45	45.4658	39.0404	24.9044	16.0802	3.7474	0.0508	5.9055	27.5603	300.56	1.20308	1.0072	1.839667028	16.08794835	0.026193	0.228318105
		60	55	55.1343	47.4157	28.0508	21.4477	6.6468	0.0508	5.9055	34.4317	307.432	1.17457	1.0074	1.872374892	16.73729565	0.026727	0.238044571
		60	65	65.217	56.7215	33.4569	24.6384	6.2926	0.0508	5.9055	40.67995	313.68	1.14866	1.0077	1.902116562	17.32775528	0.027212	0.246888969
		60	*stand*	*19.1434*	*13.9819*	*9.5276*	*7.1344*	*5.2996*	0.0508	5.9055	10.55815	283.558	1.2736	1.0065	1.758736794	14.48124518	0.024874	0.204251561
		90	35	35.301	32.3932	20.5171	15.9974	3.6838	0.0508	5.9055	24.1953	297.195	1.21703	1.007	1.823649628	15.76995585	0.025932	0.223554947
		90	45	45.1463	35.4764	28.0508	17.8102	5.8376	0.0508	5.9055	26.6433	299.643	1.20688	1.0071	1.835302108	16.00129185	0.026122	0.227020091
		90	55	55.4118	40.4573	28.9369	21.9353	9.7372	0.0508	5.9055	31.1963	304.196	1.18799	1.0073	1.856974388	16.43155035	0.026476	0.233464863
		90	65	64.97	55.7133	33.2353	24.3726	5.3178	0.0508	5.9055	40.04295	313.043	1.1513	1.0076	1.899084442	17.26755878	0.027162	0.245987296
		90	*Stand*	*18.7002*	*15.2881*	*8.5969*	*7.7106*	*5.4994*	0.0508	5.9055	11.49935	284.499	1.2697	1.0066	1.763216906	14.57018858	0.024947	0.20558383
4"	40	30	35	35.281	26.9681	19.5425	13.6042	2.393	0.0508	5.9055	20.28615	293.286	1.23325	1.0069	1.805042074	15.40054118	0.025629	0.218021545
		30	45	45.307	32.1527	25.6576	17.2823	3.4964	0.0508	5.9055	24.7175	297.718	1.21487	1.0071	1.8261353	15.81930375	0.025973	0.224294121
		30	55	55.275	41.6361	29.5131	21.6252	4.8744	0.0508	5.9055	31.63065	304.631	1.18619	1.0073	1.859041894	16.47259643	0.026509	0.234079685
		30	65	65.1163	57.2602	35.6283	25.6576	2.6586	0.0508	5.9055	41.4589	314.459	1.14542	1.0077	1.905824364	17.40136605	0.027272	0.247991573
		30	*Stand*	*20.5172*	*15.5096*	*9.4388*	*5.8492*	*3.8994*	0.0508	5.9055	10.6794	283.679	1.2731	1.0065	1.759313944	14.4927033	0.024884	0.204423191
		60	35	35.3334	32.4291	20.0741	12.8951	1.5954	0.0508	5.9055	22.6621	295.662	1.22339	1.007	1.816351596	15.62506845	0.025813	0.221384703
		60	45	45.0963	35.6752	24.4169	17.4154	2.4178	0.0508	5.9055	26.5453	299.545	1.20729	1.0071	1.834835628	15.99203085	0.026115	0.226881372
		60	55	55.3896	40.5281	30.621	22.1569	3.4814	0.0508	5.9055	31.3425	304.343	1.18739	1.0073	1.8576703	16.44536625	0.026487	0.233671809
		60	65	65.2121	58.6269	39.0403	27.6518	4.7472	0.0508	5.9055	43.13935	316.139	1.13845	1.0077	1.913823306	17.56016858	0.027402	0.25037025
		60	*Stand*	*19.0989*	*14.9779*	*8.9073*	*7.4004*	*5.135*	0.0508	5.9055	11.18915	284.189	1.27098	1.0066	1.761740354	14.54087468	0.024923	0.205144742
		90	35	35.1403	29.5826	20.2513	15.5097	4.2542	0.0508	5.9055	22.54615	295.546	1.22387	1.007	1.815799674	15.61411118	0.025804	0.221220575
		90	45	45.0366	32.8486	20.1184	16.1745	5.5788	0.0508	5.9055	24.51155	297.512	1.21572	1.0071	1.825154978	15.79984148	0.025957	0.224002599
		90	55	55.2	42.7438	27.5634	21.0933	6.9882	0.0508	5.9055	31.91855	304.919	1.185	1.0073	1.860412298	16.40980298	0.026532	0.234487208
		90	65	65.306	58.2313	34.5204	24.4168	7.7992	0.0508	5.9055	41.32405	314.324	1.14598	1.0077	1.905182478	17.38862273	0.027262	0.247800693
		90	*stand*	*19.8524*	*13.9144*	*11.653*	*6.6912*	*5.735*	0.0508	5.9055	10.3028	283.303	1.27466	1.0065	1.757521328	14.4571146	0.024854	0.203890113
																		1

Tabung : 4" atau (L/dha) = 5.9

Pr	g'	Beta(1/k)	Gr	dha(lt)-m	Ra	Nu	h	qkonv	rw2-out	rw2-in	rw1-out	rw1-in	Rthermal	q total(W)	dq(%)
0.7108	8.496	0.003392	31338.75587	0.001909032	22275.60765	1.834307	1.8593142	2.0244864	0.052	0.0508	0.0266	0.0254	17.00790517	1.944560465	0.0411
0.70888	8.496	0.003306	37752.63553	0.001822204	26762.16897	1.920414	1.9916196	2.9724608	0.052	0.0508	0.0266	0.0254	15.92393026	2.58804198	0.14854
0.70766	8.496	0.003253	38781.09183	0.001810001	27443.74746	1.932526	2.0330921	3.3612173	0.052	0.0508	0.0266	0.0254	15.61319012	3.200851306	0.0501
0.70613	8.496	0.00319	47888.20277	0.001717025	33815.29004	2.036071	2.1800459	4.808175	0.052	0.0508	0.0266	0.0254	14.60728052	4.063665369	0.18321
0.71366	8.496	0.003529	17316.70285	0.002214203	12358.15828	1.583081	1.549435	0.7866661	0.052	0.0508	0.0266	0.0254	20.27128099	0.647896895	0.21418
0.71075	4.905	0.00339	15551.17112	0.002274537	11052.97213	1.539517	1.5614852	1.4569924	0.052	0.0508	0.0266	0.0254	20.12017449	1.650517495	-0.11725
0.70936	4.905	0.003327	23723.72528	0.002046624	16828.65998	1.710122	1.7635446	2.7379026	0.052	0.0508	0.0266	0.0254	17.89401857	2.331415933	0.17435
0.70764	4.905	0.003253	24235.9162	0.002035724	17150.35403	1.718236	1.8079836	3.240742	0.052	0.0508	0.0266	0.0254	17.47117078	2.775286248	0.16771
0.70608	4.905	0.003188	27380.73583	0.00197457	19332.9903	1.770473	1.8967459	4.18689	0.052	0.0508	0.0266	0.0254	16.68588909	3.531391086	0.18562
0.71361	4.905	0.003527	9255.891507	0.002589579	6605.101019	1.353582	1.3255568	0.617167	0.052	0.0508	0.0266	0.0254	23.57833298	0.587140745	0.05114
0.7102	9.81	0.003365	35661.52223	0.001848348	25326.85499	1.894131	1.9338294	2.1812342	0.052	0.0508	0.0266	0.0254	16.37916013	1.930330966	0.12998
0.70959	9.81	0.003337	37016.77983	0.001831193	26266.70626	1.911463	1.9658213	2.274751	0.052	0.0508	0.0266	0.0254	16.12384396	2.437923618	-0.06693
0.70845	9.81	0.003287	36253.25668	0.001840759	25683.65323	1.900767	1.9812598	2.4838425	0.052	0.0508	0.0266	0.0254	16.00358389	2.854023218	-0.1297
0.70624	9.81	0.003194	53977.53356	0.001666405	38121.0535	2.098002	2.2435511	4.8317978	0.052	0.0508	0.0266	0.0254	14.2133599	4.196910542	0.15127
0.71338	9.81	0.003515	20169.00522	0.002131388	14388.06738	1.644429	1.6151112	0.8629776	0.052	0.0508	0.0266	0.0254	19.4750616	0.677830975	0.27315
0.71118	8.496	0.00341	26747.63276	0.001986152	19022.34034	1.763318	1.7792158	1.751846	0.052	0.0508	0.0266	0.0254	17.74249289	1.853629036	-0.14099
0.71007	8.496	0.003359	27788.12288	0.001967292	19731.52978	1.779528	1.8196638	2.2192637	0.052	0.0508	0.0266	0.0254	17.36345896	2.407964916	-0.26194
0.70834	8.496	0.003283	33704.24175	0.001874617	23874.14139	1.866365	1.9478778	2.8358501	0.052	0.0508	0.0266	0.0254	16.26601182	3.098522279	-0.15073
0.70589	8.496	0.00318	46207.01261	0.001732434	32616.84981	2.017786	2.1664992	5.3812802	0.052	0.0508	0.0266	0.0254	14.69429855	4.250471691	0.10119
0.71358	8.496	0.003525	22572.73383	0.002072229	16107.4548	1.691497	1.6571028	0.8681062	0.052	0.0508	0.0266	0.0254	18.99905667	0.874664479	0.24007
0.71058	4.905	0.003382	21751.63117	0.002091514	15456.37142	1.674139	1.7013851	2.2267915	0.052	0.0508	0.0266	0.0254	18.52253913	1.821456538	0.23708
0.70961	4.905	0.003338	19158.71736	0.002158948	13595.28783	1.621294	1.6669143	2.5664521	0.052	0.0508	0.0266	0.0254	18.8912925	2.259162522	-0.08887
0.70841	4.905	0.003286	17940.22903	0.002194708	12709.11613	1.594202	1.6624253	2.824369	0.052	0.0508	0.0266	0.0254	18.94043996	2.740601596	-0.25571
0.70547	4.905	0.003163	25539.76878	0.002009229	18017.41713	1.739553	1.8766913	4.174385	0.052	0.0508	0.0266	0.0254	16.85681698	3.586970189	0.09873
0.71345	4.905	0.003519	10136.25554	0.002531421	7231.73901	1.384603	1.3586051	0.8315898	0.052	0.0508	0.0266	0.0254	23.02158505	0.606556845	0.18173
0.71061	9.81	0.003384	31397.41678	0.00190814	22311.42705	1.835044	1.8642587	2.2416499	0.052	0.0508	0.0266	0.0254	16.96462819	1.820617561	-0.01822
0.71012	9.81	0.003361	36091.36181	0.00184282	25629.27409	1.89976	1.941412	2.4978187	0.052	0.0508	0.0266	0.0254	16.31788487	2.421134867	-0.07453
0.70827	9.81	0.00328	41927.28352	0.001775046	29695.85229	1.971009	2.0588257	3.1134798	0.052	0.0508	0.0266	0.0254	15.42667086	3.12522387	-0.02238
0.70592	9.81	0.003181	57195.93254	0.001642451	40375.69486	2.128358	2.2843433	4.8775632	0.052	0.0508	0.0266	0.0254	13.97188057	4.115895473	0.28637
0.71367	9.81	0.00353	19610.36527	0.002146408	13995.41371	1.633093	1.5980375	0.861459	0.052	0.0508	0.0266	0.0254	19.6761145	0.717489218	0.03506
															2

Tabung : 4" atau (L/dha) = 5.9

D2	Pvac	Tenta	Heater	Tw2-out	Tw2-in	T~	Tw1-out	Tw1-in	dha(m)	L/dha	Tf(C)	Tf (K)	rho	Cp	Miu(x10^-5)	Viskin(x10^-6	Kf	Alfa(x10^-4)
4"	60	30	35	35.1399	27.3568	15.0224	13.5288	2.3058	0.0508	5.9055	20.4428	293.443	1.2326	1.0069	1.805787728	15.4153446	0.025641	0.218243283
		30	45	45.1089	35.1298	24.6386	17.7255	3.483	0.0508	5.9055	26.42765	299.428	1.20777	1.0071	1.834275614	15.98091293	0.026106	0.226714639
		30	55	55.3556	41.158	28.8485	19.8527	4.8626	0.0508	5.9055	30.50535	303.505	1.19086	1.0073	1.853685466	16.36625558	0.026422	0.232486823
		30	65	64.9715	59.423	33.7672	24.2838	5.7474	0.0508	5.9055	41.8534	314.853	1.14379	1.0077	1.907702184	17.4386463	0.027303	0.248549988
		30	*Stand*	*20.7389*	*13.8256*	*9.616*	*5.6278*	*0.8454*	0.0508	5.9055	9.7267	282.727	1.27705	1.0065	1.754779092	14.40267315	0.02481	0.203074644
		60	35	35.1781	33.4876	20.1626	14.2692	2.1034	0.0508	5.9055	23.8784	296.878	1.21835	1.007	1.822141184	15.7400088	0.025908	0.223106375
		60	45	45.1806	38.2607	21.4479	16.9278	4.3056	0.0508	5.9055	27.59425	300.594	1.20294	1.0072	1.83982863	16.09115663	0.026196	0.228366161
		60	55	55.4232	44.428	29.7346	20.8276	5.8878	0.0508	5.9055	32.6278	305.628	1.18206	1.0074	1.863788328	16.5668271	0.026587	0.235491151
		60	65	65.2047	57.2531	35.8054	24.9928	6.127	0.0508	5.9055	41.12295	314.123	1.14682	1.0077	1.904225242	17.36961878	0.027246	0.247516036
		60	*Stand*	*19.232*	*15.1109*	*9.3945*	*6.4254*	*3.8112*	0.0508	5.9055	10.76815	283.768	1.27273	1.0065	1.759736394	14.50109018	0.02489	0.204548816
		90	35	35.3229	29.5383	17.1937	12.8508	2.9748	0.0508	5.9055	21.19455	294.195	1.22948	1.0069	1.809366058	15.48638498	0.025699	0.219307386
		90	45	45.1068	36.8501	23.3091	18.5673	3.827	0.0508	5.9055	27.7087	300.709	1.20246	1.0072	1.840373412	16.10197215	0.026205	0.228528165
		90	55	55.406	42.7614	30.8869	20.2958	4.2426	0.0508	5.9055	31.5286	304.529	1.18662	1.0073	1.858556136	16.4629527	0.026501	0.233935233
		90	65	65.0023	58.5385	34.9637	27.0315	5.5704	0.0508	5.9055	42.785	315.785	1.13992	1.0077	1.9121366	17.5266825	0.027375	0.249868668
		90	*Stand*	*19.498*	*14.6233*	*9.6603*	*6.8243*	*5.3178*	0.0508	5.9055	10.7238	283.724	1.27291	1.0065	1.759525288	14.4968991	0.024887	0.204486039

Tabung : 4" atau (L/dha) = 5.9

Pr	g'	Beta(1/k)	Gr	dha(lt)-m	Ra	Nu	h	qkonv	rw2-out	rw2-in	rw1-out	rw1-in	Rthermal	q total(W)	dq(%)
0.71114	8.496	0.003408	27608.64493	0.001970482	19633.59243	1.777316	1.7941903	1.5922851	0.052	0.0508	0.0266	0.0254	17.60017541	1.865555271	-0.06095
0.70964	8.496	0.00334	31686.70948	0.00190377	22486.25435	1.838628	1.8897032	1.7772176	0.052	0.0508	0.0266	0.0254	16.74550115	2.485796013	-0.10722
0.70862	8.496	0.003295	36487.01195	0.001837804	25855.56004	1.903939	1.9805477	2.6314676	0.052	0.0508	0.0266	0.0254	16.00908976	3.154020669	-0.10088
0.70579	8.496	0.003176	51094.43459	0.00168943	36061.76983	2.069076	2.2240627	4.6805801	0.052	0.0508	0.0266	0.0254	14.33185356	4.132340575	0.30224
0.71382	8.496	0.003537	19460.76633	0.002150521	13891.45163	1.630052	1.5921626	1.0846421	0.052	0.0508	0.0266	0.0254	19.74581112	1.007479504	-0.13834
0.71028	4.905	0.003368	21002.39622	0.002109923	14917.59039	1.659355	1.6925265	2.2532944	0.052	0.0508	0.0266	0.0254	18.61587039	1.776693719	0.25333
0.70935	4.905	0.003327	22031.03326	0.002084851	15627.74511	1.67876	1.7313777	2.0583866	0.052	0.0508	0.0266	0.0254	18.21363686	2.244197593	0.14359
0.70809	4.905	0.003272	22614.5521	0.00207127	16013.20717	1.689018	1.7679305	2.0397966	0.052	0.0508	0.0266	0.0254	17.85134083	2.774883997	0.01783
0.70597	4.905	0.003183	27360.77045	0.00197493	19315.86294	1.770081	1.8987213	3.9411144	0.052	0.0508	0.0266	0.0254	16.6692476	3.544113173	0.17784
0.71356	4.905	0.003524	11699.57352	0.002442256	8348.323844	1.435207	1.4064125	0.7167888	0.052	0.0508	0.0266	0.0254	22.25250054	0.6926805	0.20054
0.71095	9.81	0.003399	38021.27799	0.001818976	27031.27939	1.925224	1.9479247	1.7874375	0.052	0.0508	0.0266	0.0254	16.26563723	1.988738562	0.12717
0.70932	9.81	0.003325	37697.16845	0.001822874	26739.46202	1.920007	1.980857	2.2406793	0.052	0.0508	0.0266	0.0254	16.00669762	2.578907965	-0.03144
0.70837	9.81	0.003284	43756.70717	0.001756194	30995.84458	1.992235	2.0786237	3.0552787	0.052	0.0508	0.0266	0.0254	15.28631561	3.347006649	-0.06977
0.70555	9.81	0.003167	52213.91701	0.001680301	36839.72495	2.080145	2.2418821	5.2945733	0.052	0.0508	0.0266	0.0254	14.22342733	4.178451413	0.16731
0.71357	9.81	0.003525	21026.31069	0.002109322	15003.72454	1.661745	1.6281806	0.7426451	0.052	0.0508	0.0266	0.0254	19.3242769	0.73380236	0.17397

Tabung : 3.5 " atau (L/dha) = 7.87

D2	Pvac	Tenta	Heater	Tw2-out	Tw2-in	T~	Tw1-out	Tw1-in	dha(m)	L/dha	Tf(C)	Tf (K)	rho	Cp	Miu(x10^-5)	Viskin(x10^-6	Kf	Alfa(x10^-4)
3.5"	20	30	35	35.2862	30.4953	16.6618	4.0768	2.393	0.0381	7.87402	17.28605	290.286	1.24569	1.0068	1.790761598	15.11703173	0.025396	0.213774904
		30	45	45.3532	37.1865	19.9854	5.4063	3.3426	0.0381	7.87402	21.2964	294.296	1.22906	1.0069	1.809850864	15.4960098	0.025707	0.219451554
		30	55	55.2592	46.0935	24.6384	6.0267	3.8612	0.0381	7.87402	26.0601	299.06	1.2093	1.0071	1.832526076	15.94617945	0.026077	0.226194572
		30	65	65.2915	59.3952	32.1718	11.2998	4.3428	0.0381	7.87402	35.3475	308.348	1.17077	1.0075	1.8767341	16.82383875	0.026798	0.239340886
		30	*stand*	*21.7138*	*16.4849*	*7.6221*	*4.6089*	*1.861*	0.0381	7.87402	10.5469	283.547	1.27365	1.0065	1.758683244	14.48018205	0.024873	0.204235637
		60	35	35.2524	34.9193	14.7121	3.3021	2.5702	0.0381	7.87402	19.1107	292.111	1.23812	1.0069	1.799446932	15.28946115	0.025538	0.216357696
		60	45	44.9694	37.8068	18.1243	5.5392	2.9246	0.0381	7.87402	21.673	294.673	1.2275	1.007	1.81164348	15.5315985	0.025737	0.219984632
		60	55	55.1468	46.9357	24.1066	6.2925	2.4818	0.0381	7.87402	26.6141	299.614	1.207	1.0071	1.835163116	15.99853245	0.02612	0.226978759
		60	65	65.1244	54.1664	30.3993	12.8065	2.3928	0.0381	7.87402	33.48645	306.486	1.17849	1.0074	1.867875502	16.64796953	0.026653	0.23670657
		60	*stand*	*23.3535*	*17.1936*	*7.8879*	*2.8805*	*2.3042*	0.0381	7.87402	10.03705	283.037	1.27576	1.0065	1.756256358	14.43200123	0.024834	0.203513944
		90	35	35.1714	30.1779	15.2439	4.2984	3.4566	0.0381	7.87402	17.23815	290.238	1.24589	1.0068	1.790533594	15.11250518	0.025392	0.213707101
		90	45	45.2703	37.6298	17.1936	7.2673	4.3426	0.0381	7.87402	22.44855	295.449	1.22428	1.007	1.815335098	15.60488798	0.025797	0.221082423
		90	55	55.3886	46.7584	22.6887	6.6026	4.7726	0.0381	7.87402	26.6805	299.681	1.20673	1.0071	1.83547918	16.00480725	0.026125	0.227072748
		90	65	65.2082	56.438	26.1452	8.3309	4.6086	0.0381	7.87402	32.38445	305.384	1.18307	1.0073	1.862629982	16.54383053	0.026568	0.235146689
		90	*Stand*	*23.442*	*17.9912*	*6.7358*	*3.8109*	*2.393*	0.0381	7.87402	10.90105	283.901	1.27218	1.0066	1.760368998	14.51364923	0.024901	0.204736936
3.5"	40	30	35	35.1486	33.4643	16.7949	6.9128	2.4314	0.0381	7.87402	20.18855	293.189	1.23365	1.0069	1.804577498	15.39131798	0.025621	0.217883393
		30	45	45.1962	39.5212	20.9161	5.8051	2.9248	0.0381	7.87402	22.66315	295.663	1.22339	1.007	1.816356594	15.62516768	0.025813	0.221386189
		30	55	55.3609	46.0494	22.157	6.0266	3.9748	0.0381	7.87402	26.038	299.038	1.20939	1.0071	1.83242088	15.944091	0.026075	0.226163289
		30	65	65.273	58.1028	30.0449	9.3059	4.7476	0.0381	7.87402	33.70435	306.704	1.17759	1.0074	1.868912706	16.66856108	0.02667	0.237015007
		30	*Stand*	*21.6251*	*16.928*	*8.7297*	*3.3235*	*2.3044*	0.0381	7.87402	10.12575	283.126	1.27539	1.0065	1.75667857	14.44038338	0.024841	0.203639499
		60	35	35.1013	32.5338	16.8835	5.5505	2.7224	0.0381	7.87402	19.04215	292.042	1.23841	1.0069	1.799120634	15.28298318	0.025532	0.216260663
		60	45	45.2568	40.1113	21.0048	7.9764	3.5834	0.0381	7.87402	24.04385	297.044	1.21766	1.007	1.822928726	15.75564383	0.025921	0.22334057
		60	55	55.1883	44.6312	21.9354	5.3621	4.5066	0.0381	7.87402	24.99665	297.997	1.21371	1.0071	1.827464054	15.84568343	0.025995	0.224689258
		60	65	65.1113	59.0158	29.1142	8.907	4.6088	0.0381	7.87402	33.9614	306.961	1.17652	1.0074	1.870136264	16.6928523	0.02669	0.237378862
		60	*Stand*	*21.3595*	*17.1936*	*6.9573*	*2.9247*	*1.6838*	0.0381	7.87402	10.05915	283.059	1.27567	1.0065	1.756361554	14.43408968	0.024835	0.203545227
		90	35	35.1761	31.6475	16.972	7.1788	2.077	0.0381	7.87402	19.41315	292.413	1.23687	1.0069	1.800886594	15.31804268	0.025561	0.216785814
		90	45	45.1069	39.5797	21.4036	7.0016	3.1656	0.0381	7.87402	23.29065	296.291	1.22079	1.007	1.819343494	15.68446643	0.025862	0.222274415
		90	55	55.0453	48.9741	21.0492	6.3811	31.8612	0.0381	7.87402	27.6776	300.678	1.20259	1.0072	1.840225376	16.0990332	0.026203	0.228484143
		90	65	65.0832	58.8635	27.7849	7.8877	4.8614	0.0381	7.87402	33.3756	306.376	1.17895	1.0074	1.867347856	16.6374942	0.026645	0.236549632
		90	*stand*	*22.0237*	*17.7699*	*7.3119*	*3.0577*	*1.6838*	0.0381	7.87402	10.4138	283.414	1.2742	1.0065	1.758049688	14.4676041	0.024863	0.204047234

Tabung : 3.5 " atau (L/dha) = 7.87

Pr	g'	Beta	Gr	dha(lt)-m	Ra	Nu	h	qkonv	rw2-out	rw2-in	rw1-out	rw1-in	Rthermal	q total(W)	dq(%)
0.71193	8.496	0.003445	187127.8257	0.001831852	133221.6299	2.999358	1.9992727	3.3679857	0.04565	0.04445	0.0266	0.0254	14.09756612	2.33325382	0.44347
0.71093	8.496	0.003398	211310.6288	0.00177703	150226.199	3.090801	2.0854714	4.0698644	0.04565	0.04445	0.0266	0.0254	13.54180011	3.102290659	0.31189
0.70973	8.496	0.003344	247572.4534	0.001708045	175710.8291	3.214284	2.1999762	5.4808637	0.04565	0.04445	0.0266	0.0254	12.87088311	3.993354579	0.3725
0.70741	8.496	0.003243	258941.9093	0.00168898	183178.9052	3.247906	2.2844261	6.3824315	0.04565	0.04445	0.0266	0.0254	12.4191607	4.907634378	0.30051
0.71361	8.496	0.003527	93861.32316	0.002176724	66980.68622	2.525643	1.6488434	0.665047	0.04565	0.04445	0.0266	0.0254	16.95526522	1.17089292	-0.43202
0.71147	4.905	0.003423	125604.5929	0.002023828	89364.19174	2.71441	1.8194238	2.778846	0.04565	0.04445	0.0266	0.0254	15.42670255	2.118547362	0.31168
0.71083	4.905	0.003394	123142.4949	0.002033869	87533.59515	2.700401	1.8241265	3.0729578	0.04565	0.04445	0.0266	0.0254	15.38861117	2.732202375	0.12472
0.7096	4.905	0.003338	143773.648	0.001956614	102021.2738	2.805804	1.923563	4.5868579	0.04565	0.04445	0.0266	0.0254	14.62679144	3.600584601	0.27392
0.70788	4.905	0.003263	132086.8537	0.001998527	93501.42904	2.745296	1.9205075	4.5226809	0.04565	0.04445	0.0266	0.0254	14.64902629	4.282305101	0.05613
0.71374	4.905	0.003533	65864.476	0.002378276	47010.15968	2.311706	1.5067756	1.0099639	0.04565	0.04445	0.0266	0.0254	18.49248181	1.138262577	-0.11271
0.71194	9.81	0.003445	211822.6483	0.001775955	150805.1142	3.093774	2.0619057	3.0209907	0.04565	0.04445	0.0266	0.0254	13.68912463	2.316788024	0.30396
0.71064	9.81	0.003385	228969.8443	0.001741728	162714.6407	3.153126	2.1349233	2.8367082	0.04565	0.04445	0.0266	0.0254	13.243218	3.090464871	-0.08211
0.70958	9.81	0.003337	283813.3604	0.001650695	201388.2488	3.325777	2.2804887	4.9104769	0.04565	0.04445	0.0266	0.0254	12.43947823	4.068980954	0.20681
0.70815	9.81	0.003275	312272.721	0.001611727	221137.1414	3.404474	2.3740028	5.6610236	0.04565	0.04445	0.0266	0.0254	11.97513919	5.060450576	0.11868
0.71352	9.81	0.003522	128649.7982	0.002011744	91794.81352	2.732682	1.7859781	0.6992494	0.04565	0.04445	0.0266	0.0254	15.703395	1.340410784	-0.47833
0.7112	8.496	0.003411	179630.4117	0.001850674	127753.663	2.968096	1.9959809	2.8801026	0.04565	0.04445	0.0266	0.0254	14.11974145	2.317124582	0.13947
0.71058	8.496	0.003382	219472.5408	0.001760273	155953.7226	3.119849	2.1137559	4.587127	0.04565	0.04445	0.0266	0.0254	13.36931335	3.161822817	0.35225
0.70974	8.496	0.003344	247383.649	0.001708371	175578.1947	3.213677	2.1994163	4.8737443	0.04565	0.04445	0.0266	0.0254	12.87399395	3.991465291	0.18978
0.70782	8.496	0.00326	269070.1411	0.001672856	190454.28	3.279686	2.2958027	6.7713597	0.04565	0.04445	0.0266	0.0254	12.36084758	4.896541245	0.3016
0.71372	8.496	0.003532	108276.7469	0.002100348	77279.12414	2.617581	1.7066189	1.0193959	0.04565	0.04445	0.0266	0.0254	16.40332059	1.177852978	0.04853
0.71149	4.905	0.003424	107311.7293	0.002105054	76351.16462	2.609688	1.7488655	2.8317928	0.04565	0.04445	0.0266	0.0254	16.02281029	2.02080031	0.31287
0.71024	4.905	0.003367	118221.9225	0.00205471	83965.82442	2.672454	1.8181529	3.5127199	0.04565	0.04445	0.0266	0.0254	15.43703037	2.699573623	0.17455
0.71	4.905	0.003356	142374.2845	0.001961404	101085.8612	2.79935	1.9099166	4.2355	0.04565	0.04445	0.0266	0.0254	14.72664547	3.441496578	0.23118
0.70776	4.905	0.003258	158921.6527	0.001908223	112478.3333	2.875093	2.0140896	5.7305315	0.04565	0.04445	0.0266	0.0254	13.99864874	4.322024297	0.2605
0.71374	4.905	0.003533	65636.95672	0.002380334	46847.40725	2.309702	1.5055738	0.8583826	0.04565	0.04445	0.0266	0.0254	18.50672395	1.063164937	-0.23558
0.7114	9.81	0.00342	193486.8175	0.001816612	137645.8859	3.023956	2.0287696	3.4069951	0.04565	0.04445	0.0266	0.0254	13.90206956	2.380875729	0.11703
0.71043	9.81	0.003375	242500.2786	0.001716908	172278.8273	3.198472	2.1711125	4.7647969	0.04565	0.04445	0.0266	0.0254	13.03333259	3.218002742	0.30066
0.70933	9.81	0.003326	296538.7808	0.001632693	210344.0313	3.362151	2.312258	4.9387172	0.04565	0.04445	0.0266	0.0254	12.27751709	1.888337832	1.40423
0.70791	9.81	0.003264	326120.407	0.001594338	230862.6255	3.441304	2.4066319	7.0029245	0.04565	0.04445	0.0266	0.0254	11.82161331	5.094211629	0.25826
0.71365	9.81	0.003528	134557.3203	0.00198929	96026.36739	2.763645	1.8034714	1.5372472	0.04565	0.04445	0.0266	0.0254	15.55739462	1.307410431	-0.21447

Tabung : 3.5 " atau (L/dha) = 7.87

D2	Pvac	Tenta	Heater	Tw2-out	Tw2-in	T~	Tw1-out	Tw1-in	dha(m)	L/dha	Tf(C)	Tf (K)	rho	Cp	Miu(x10^-5)	Viskin(x10^-6	Kf	Alfa(x10^-4)
3.5"	60	30	35	35.1863	29.1659	15.4656	4.5201	2.0386	0.0381	7.87402	16.843	289.843	1.24753	1.0068	1.78865268	15.0751635	0.025362	0.213147767
		30	45	45.0819	42.061	21.4479	5.5394	3.629	0.0381	7.87402	23.8002	296.8	1.21867	1.007	1.821768952	15.7326189	0.025902	0.222995683
		30	55	55.1444	47.7333	20.5172	4.2984	3.861	0.0381	7.87402	26.01585	299.016	1.20948	1.0071	1.832315446	15.94199783	0.026074	0.226131936
		30	65	65.2358	57.7291	27.5633	5.8938	4.7726	0.0381	7.87402	31.81145	304.811	1.18544	1.0073	1.859902502	16.48968203	0.026523	0.234335607
		30	*Stand*	*21.7581*	*16.8394*	*8.4195*	*3.8997*	*1.9498*	0.0381	7.87402	10.36955	283.37	1.27438	1.0065	1.757839058	14.46342248	0.024859	0.203984598
3.5"	60	60	35	35.1773	30.3179	17.2822	5.0076	1.9498	0.0381	7.87402	17.66275	290.663	1.24413	1.0068	1.79255469	15.15262988	0.025425	0.214308123
		60	45	45.2681	41.8838	21.0491	6.913	2.7722	0.0381	7.87402	24.3984	297.398	1.21619	1.0071	1.824616384	15.7891488	0.025948	0.223842435
		60	55	55.2115	46.3598	23.4863	6.9131	4.761	0.0381	7.87402	26.63645	299.636	1.20691	1.0071	1.835269502	16.00064453	0.026122	0.227010395
		60	65	65.255	58.3554	27.1202	6.1152	5.0768	0.0381	7.87402	32.2353	305.235	1.18368	1.0073	1.861920028	16.52973585	0.026556	0.234935567
		60	*Stand*	*21.5364*	*17.9469*	*7.1787*	*2.9689*	*0.886*	0.0381	7.87402	10.4579	283.458	1.27402	1.0065	1.758259604	14.47177155	0.024866	0.204109657
		90	35	35.0126	28.7043	16.263	3.811	1.5068	0.0381	7.87402	16.25765	289.258	1.24996	1.0068	1.785866414	15.01984793	0.025316	0.212319204
		90	45	45.3113	43.1248	20.3402	4.6086	2.3044	0.0381	7.87402	23.8667	296.867	1.2184	1.007	1.822085492	15.73890315	0.025907	0.223089814
		90	55	55.1899	51.5445	22.5114	6.7357	4.3428	0.0381	7.87402	29.1401	302.14	1.19652	1.0072	1.847186876	16.23723945	0.026316	0.230554312
		90	65	65.2482	59.7498	29.646	7.9825	4.4182	0.0381	7.87402	33.86615	306.866	1.17692	1.0074	1.869682874	16.68385118	0 026683	0.237244035
		90	*Stand*	*22.5558*	*18.8774*	*9.2171*	*2.969*	*1.5952*	0.0381	7.87402	10.9232	283.923	1.27209	1.0066	1.760474432	14.5157424	0.024902	0.20476829

Tabung : 3.5 " atau (L/dha) = 7.87

Pr	g'	Beta	Gr	dha(lt)-m	Ra	Nu	h	qkonv	rw2-out	rw2-in	rw1-out	rw1-in	Rthermal	q total(W)	dq(%)
0.71204	8.496	0.00345	175810.7685	0.001860645	125184.1678	2.953058	1.9657459	2.6402838	0.04565	0.04445	0.0266	0.0254	14.32689611	2.313669321	0.24482
0.7103	8.496	0.003369	233600.0825	0.001733033	165926.1269	3.16857	2.1541034	4.2755601	0.04565	0.04445	0.0266	0.0254	13.13110155	3.156848636	0.45307
0.70975	8.496	0.003344	268564.4695	0.001673643	190612.5681	3.280368	2.2449105	4.7489495	0.04565	0.04445	0.0266	0.0254	12.62629856	4.06163372	0.19995
0.7083	8.496	0.003281	293872.6762	0.001636384	208149.1754	3.353346	2.3344362	6.3733438	0.04565	0.04445	0.0266	0.0254	12.16706456	4.969415564	0.36261
0.71366	8.496	0.003529	102569.5178	0.002128974	73199.51716	2.58233	1.6849177	1.235019	0.04565	0.04445	0.0266	0.0254	16.60619897	1.192825645	-0.14539
0.71183	4.905	0.00344	102883.5221	0.002127348	73236.02119	2.582652	1.7234915	2.6530552	0.04565	0.04445	0.0266	0.0254	16.24911411	2.04488071	0.38482
0.71015	4.905	0.003362	127956.8214	0.002014462	90868.58792	2.725763	1.8563888	3.1707826	0.04565	0.04445	0.0266	0.0254	15.13249375	2.808254918	0.25086
0.70959	4.905	0.003337	139493.8366	0.001971452	98983.5553	2.784681	1.9092084	4.2370967	0.04565	0.04445	0.0266	0.0254	14.73186659	3.424583008	0.23679
0.70819	4.905	0.003276	169923.0071	0.001876558	120337.974	2.924053	2.0381082	5.4479097	0.04565	0.04445	0.0266	0.0254	13.84135573	4.347709947	0.31806
0.71364	4.905	0.003528	68444.0663	0.002355543	48844.11719	2.333929	1.5232615	0.8127036	0.04565	0.04445	0.0266	0.0254	18.29939303	1.128474587	-0.23934
0.71219	9.81	0.003457	206971.4694	0.001786271	147402.0975	3.076172	2.0440307	2.6595144	0.04565	0.04445	0.0266	0.0254	13.80313851	2.427404461	0.40355
0.71028	9.81	0.003369	284169.1687	0.001650178	201840.622	3.327643	2.2626976	4.1855268	0.04565	0.04445	0.0266	0.0254	12.53216476	3.431721559	0.38846
0.70896	9.81	0.00331	305192.9441	0.001620994	216371.108	3.385981	2.3387324	4.5399925	0.04565	0.04445	0.0266	0.0254	12.14591063	4.186355519	0.17972
0.70778	9.81	0.003259	328819.7159	0.001591056	232733.1571	3.448254	2.4149372	6.4098314	0.04565	0.04445	0.0266	0.0254	11.78319753	5.162435733	0.35652
0.71352	9.81	0.003522	144274.9892	0.001954912	102942.9749	2.81212	1.8380222	1.027004	0.04565	0.04445	0.0266	0.0254	15.27719641	1.372018755	0.12043

Tabung : 3" atau (L/dha) = 11.8

D2	Pvac	Tenta	Heater	Tw2-out	Tw2-in	T~	Tw1-out	Tw1-in	dha(m)	L/dha	Tf(C)	Tf (K)	rho	Cp	Miu(x10^-5)	Viskin(x10^-6	Kf	Alfa(x10^-4)
3"	20	30	35	35.1499	32.8808	12.2304	3.4564	1.3294	0.0254	11.811	18.1686	291.169	1.24203	1.0068	1.794962536	15.2004327	0.025465	0.215024153
		30	45	45.1215	42.6298	16.263	5.2289	2.2406	0.0254	11.811	23.92935	296.929	1.21814	1.007	1.822383706	15.74482353	0.025912	0.223178495
		30	55	55.3784	51.848	27.9177	8.5909	2.5066	0.0254	11.811	30.21945	303.219	1.19205	1.0073	1.852324582	16.33923803	0.0264	0.232082131
		30	65	65.1954	59.9374	29.3358	9.192	3.5084	0.0254	11.811	34.5647	307.565	1.17402	1.0074	1.873007972	16.74986415	0.026737	0.238232833
		30	*stand*	*21.0047*	*19.0104*	*6.2483*	*2.836*	*1.3294*	0.0254	11.811	10.9232	283.923	1.27209	1.0066	1.760474432	14.5157424	0.024902	0.20476829
		60	35	35.1273	31.8172	11.6988	3.9439	1.0632	0.0254	11.811	17.88055	290.881	1.24323	1.0068	1.793591418	15.17321193	0.025442	0.214616419
		60	45	45.142	40.9014	13.9587	4.9187	1.418	0.0254	11.811	22.91005	295.91	1.22237	1.007	1.817531838	15.64849973	0.025833	0.221735676
		60	55	55.06	52.3923	26.6327	9.9264	2.886	0.0254	11.811	31.15935	304.159	1.18815	1.0073	1.856798506	16.42805858	0.026473	0.23341256
		60	65	65.318	59.1147	28.8925	10.591	3.356	0.0254	11.811	34.85285	307.853	1.17283	1.0074	1.874379566	16.77709433	0.026759	0.238640709
		60	*stand*	*21.2261*	*17.0608*	*7.0902*	*2.7474*	*0.9748*	0.0254	11.811	9.9041	282.904	1.27631	1.0065	1.755623516	14.41943745	0.024823	0.203325754
		90	35	35.0437	32.0404	11.8319	4.4314	1.2408	0.0254	11.811	18.2359	291.236	1.24175	1.0068	1.795282884	15.20679255	0.02547	0.215119416
		90	45	44.9507	42.0434	13.6042	5.2542	1.5954	0.0254	11.811	23.6488	296.649	1.2193	1.007	1.821048288	15.7183116	0.02589	0.222781376
		90	55	55.4125	50.0434	20.962	7.8568	2.6838	0.0254	11.811	28.9501	301.95	1.19731	1.0072	1.846282476	16.21928445	0.026301	0.230285367
		90	65	65.2978	59.0511	27.4747	11.8761	3.7872	0.0254	11.811	35.4636	308.464	1.17029	1.0075	1.877286736	16.8348102	0.026807	0.239505226
		90	*Stand*	*22.024*	*18.0357*	*6.2926*	*2.2599*	*1.1522*	0.0254	11.811	10.1478	283.148	1.2753	1.0065	1.756783528	14.4424671	0.024842	0.203670711
3"	40	30	35	35.138	31.4509	12.585	5.0518	2.0806	0.0254	11.811	18.25135	291.251	1.24169	1.0068	1.795356426	15.20825258	0.025471	0.215141286
		30	45	45.0056	41.7435	14.0917	6.3176	2.5952	0.0254	11.811	24.03055	297.031	1.21772	1.007	1.822865418	15.75438698	0.02592	0.223321744
		30	55	55.2717	50.5753	24.6711	9.5911	3.8862	0.0254	11.811	30.0832	303.083	1.19261	1.0073	1.851676032	16.3263624	0.026389	0.23188927
		30	65	65.2714	58.8486	26.8099	11.4331	4.0016	0.0254	11.811	35.14085	308.141	1.17163	1.0075	1.875750446	16.80431033	0.026782	0.239048373
		30	*Stand*	*20.5173*	*19.5865*	*6.7799*	*3.0133*	*1.3296*	0.0254	11.811	11.2999	284.3	1.27052	1.0066	1.762267524	14.55134055	0.024932	0.205301508
		60	35	35.1571	31.3623	11.5215	4.8302	1.7088	0.0254	11.811	18.09625	291.096	1.24233	1.0068	1.79461815	15.19359563	0.025459	0.214921742
		60	45	45.1466	42.2885	23.2205	5.1287	3.0134	0.0254	11.811	23.7086	296.709	1.21905	1.007	1.821332936	15.7239627	0.025895	0.222866023
		60	55	55.0376	49.6446	25.8792	9.2674	3.6838	0.0254	11.811	29.456	302.456	1.19521	1.0072	1.84869056	16.267092	0.026341	0.231001468
		60	65	65.1065	59.2737	30.3107	10.1361	4.443	0.0254	11.811	34.7049	307.705	1.17344	1.0074	1.873675324	16.76311305	0.026748	0.238431286
		60	*Stand*	*20.2957*	*18.5673*	*5.2735*	*2.8363*	*1.5954*	0.0254	11.811	10.7018	283.702	1.273	1.0065	1.759420568	14.4948201	0.024885	0.204454898
		90	35	35.3662	31.7359	12.6736	3.3679	1.3294	0.0254	11.811	17.5519	290.552	1.24459	1.0068	1.792027044	15.14215455	0.025417	0.214151214
		90	45	45.4622	41.358	23.9738	7.331	2.9248	0.0254	11.811	24.3445	297.345	1.21642	1.0071	1.82435982	15.78405525	0.025944	0.22376614
		90	55	55.216	49.6888	26.5883	8.1093	3.4816	0.0254	11.811	28.89905	301.899	1.19752	1.0072	1.846039478	16.21446023	0.026297	0.230213105
		90	65	65.2044	58.6972	30.7539	12.8512	4.4182	0.0254	11.811	35.7742	308.774	1.169	1.0075	1.878765192	16.8641619	0.026831	0.23994488
		90	*stand*	*21.8466*	*17.2379*	*5.4063*	*2.2156*	*1.3294*	0.0254	11.811	9.72675	282.727	1.27705	1.0065	1.75477933	14.40267788	0.02481	0.203074715

Tabung : 3" atau (L/dha) = 11.8

Pr	g'	Beta	Gr	dha(lt)-m	Ra	Nu	h	qkonv	rw2-out	rw2-in	rw1-out	rw1-in	Rthermal	q total(W)	dq(%)
0.71171	8.496	0.003434	487143.3926	0.001922868	346703.7766	4.042694	2.0264945	2.5927755	0.0393	0.0381	0.0266	0.0254	12.54604145	2.695710845	-0.03818
0.71027	8.496	0.003368	565925.1163	0.001852141	401958.3095	4.244869	2.1651937	3.4838186	0.0393	0.0381	0.0266	0.0254	11.78220701	3.639462451	-0.04277
0.7087	8.496	0.003298	595171.856	0.001828955	421795.4004	4.312888	2.2413287	6.3166579	0.0393	0.0381	0.0266	0.0254	11.4031109	4.636611927	0.36234
0.70761	8.496	0.003251	655002.9467	0.001785677	463485.8655	4.449145	2.341671	6.878427	0.0393	0.0381	0.0266	0.0254	10.94113408	5.638080986	0.21999
0.71352	8.496	0.003522	301130.2839	0.002168578	214862.2393	3.488735	1.7101969	0.8509718	0.0393	0.0381	0.0266	0.0254	14.75136234	1.333795452	-0.36199
0.71178	4.905	0.003438	267638.6341	0.002233451	190499.7902	3.385334	1.6954879	1.9173119	0.0393	0.0381	0.0266	0.0254	14.87393936	2.290186827	-0.16281
0.71052	4.905	0.003379	319314.594	0.002137022	226880.1996	3.536528	1.7983813	2.3706753	0.0393	0.0381	0.0266	0.0254	14.05852471	3.110141419	-0.23776
0.70846	4.905	0.003288	332657.121	0.002115264	235674.318	3.57031	1.8605509	4.5325614	0.0393	0.0381	0.0266	0.0254	13.60954973	3.833631606	0.18232
0.70754	4.905	0.003248	360086.9536	0.002073776	254774.7663	3.64055	1.9176942	5.1178541	0.0393	0.0381	0.0266	0.0254	13.22254919	4.686085801	0.09214
0.71377	4.905	0.003535	156472.1609	0.002554197	111685.7563	2.962288	1.4475186	0.916676	0.0393	0.0381	0.0266	0.0254	17.31538181	1.169555498	-0.21622
0.71169	9.81	0.003434	527218.5347	0.001885237	375216.6994	4.149518	2.0804691	2.245144	0.0393	0.0381	0.0266	0.0254	12.23669134	2.762421561	-0.18726
0.71034	9.81	0.003371	645544.3797	0.001792182	458554.5745	4.433468	2.2594931	2.7511822	0.0393	0.0381	0.0266	0.0254	11.31644012	3.831178316	-0.2819
0.70901	9.81	0.003312	683024.2306	0.001767074	484272.7002	4.514028	2.3371048	4.4662569	0.0393	0.0381	0.0266	0.0254	10.96129528	4.810444263	-0.07155
0.70738	9.81	0.003242	693987.5533	0.001760053	490915.7608	4.534369	2.392752	5.4425844	0.0393	0.0381	0.0266	0.0254	10.72083951	5.737479786	-0.0514
0.71371	9.81	0.003532	343522.8029	0.002098335	245176.7074	3.605767	1.7632961	1.0369147	0.0393	0.0381	0.0266	0.0254	14.32587743	1.456929958	-0.28829
0.71169	8.496	0.003433	436483.8522	0.001976386	310639.9542	3.825535	1.9181223	2.5677596	0.0393	0.0381	0.0266	0.0254	13.21973686	2.500609532	-0.15738
0.71024	8.496	0.003367	535207.7529	0.001878162	380127.2188	4.167361	2.1263031	2.8467564	0.0393	0.0381	0.0266	0.0254	11.9863289	3.53823096	-0.31874
0.70873	8.496	0.003299	565042.8373	0.001852863	400462.3581	4.239649	2.2023855	6.9630157	0.0393	0.0381	0.0266	0.0254	11.59374484	4.432174478	0.0927
0.70746	8.496	0.003245	606925.3995	0.001820036	429378.3488	4.338322	2.2871608	7.2506294	0.0393	0.0381	0.0266	0.0254	11.18707048	5.476840437	-0.06362
0.71343	8.496	0.003517	306640.3454	0.00215877	218764.8961	3.50447	1.719927	0.9830187	0.0393	0.0381	0.0266	0.0254	14.67142933	1.307827586	-0.27768
0.71173	4.905	0.003435	253889.0884	0.002263095	180699.4495	3.340928	1.6743487	1.4178624	0.0393	0.0381	0.0266	0.0254	15.05387451	2.221906393	-0.26472
0.71032	4.905	0.00337	325723.7096	0.002126431	231368.9937	3.553892	1.8115464	2.2136279	0.0393	0.0381	0.0266	0.0254	13.96087746	3.017947842	0.58358
0.70889	4.905	0.003306	324402.5785	0.002128593	229964.4463	3.548486	1.8399448	5.5827909	0.0393	0.0381	0.0266	0.0254	13.7550013	3.733463843	0.1938
0.70757	4.905	0.00325	365426.7448	0.002066158	258566.3813	3.65402	1.9239638	5.9171423	0.0393	0.0381	0.0266	0.0254	13.18148808	4.60217387	0.22987
0.71357	4.905	0.003525	169706.5987	0.002502874	121098.3098	3.022821	1.4807812	0.7803087	0.0393	0.0381	0.0266	0.0254	16.94040223	1.103887602	-0.52326
0.71186	9.81	0.003442	547633.2309	0.001867417	389839.3007	4.202201	2.1024923	2.4136786	0.0393	0.0381	0.0266	0.0254	12.11503014	2.809468866	0.0155
0.71016	9.81	0.003363	590726.8495	0.001832386	419512.8685	4.305172	2.1986828	2.4155336	0.0393	0.0381	0.0266	0.0254	11.61222154	3.663157809	0.45665
0.70903	9.81	0.003312	673709.4963	0.00177315	477677.0356	4.493646	2.3262019	6.7909202	0.0393	0.0381	0.0266	0.0254	11.00975516	4.698960081	0.33397
0.70731	9.81	0.003239	671415.0368	0.001774663	474896.1862	4.484996	2.3688266	6.8555387	0.0393	0.0381	0.0266	0.0254	10.82283874	5.616474702	0.10106
0.71382	9.81	0.003537	329414.8544	0.002120449	235142.3555	3.568294	1.7426758	0.842829	0.0393	0.0381	0.0266	0.0254	14.48802928	1.416148435	-0.42745

Tabung : 3" atau (L/dha) = 11.8

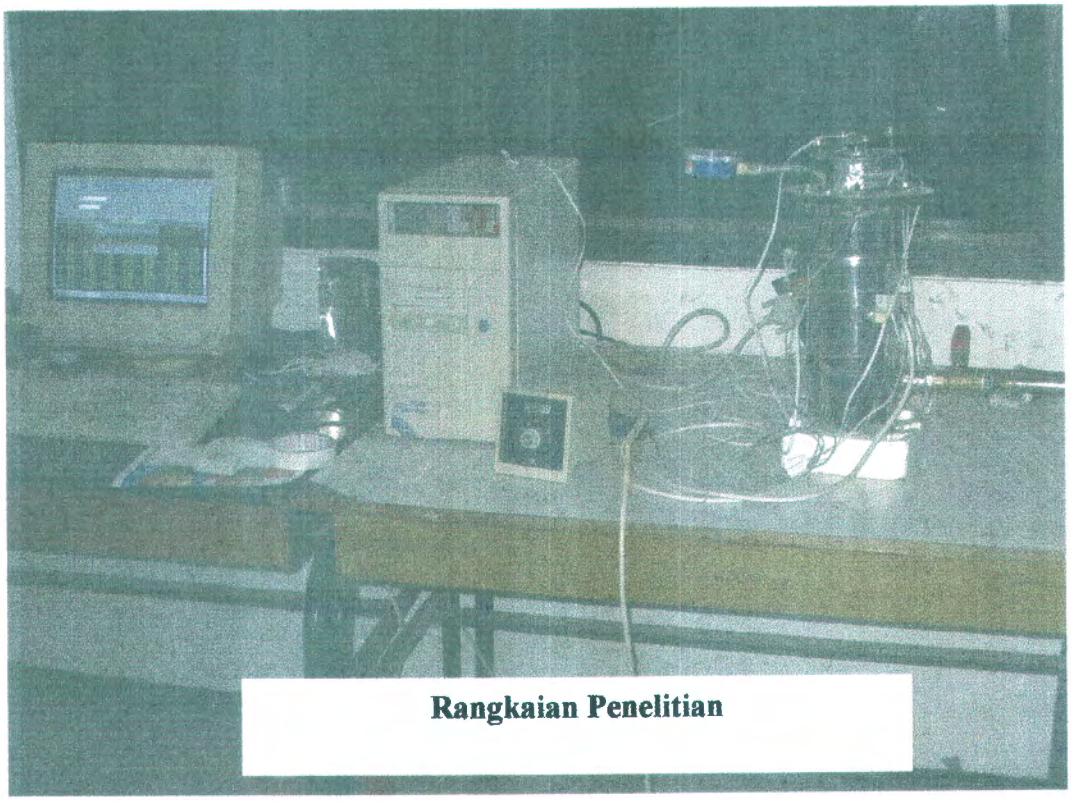
D2	Pvac	Tenta	Heater	Tw2-out	Tw2-in	T~	Tw1-out	Tw1-in	dha(m)	L/dha	Tf(C)	Tf (K)	rho	Cp	Miu(x10^-5)	Viskin(x10^-6	Kf	Alfa(x10^-4)
3"	60	30	35	35.352	30.7997	12.585	3.678	1.8362	0.0254	11.811	17.23885	290.239	1.24589	1.0068	1.790536926	15.11257133	0.025393	0.213708092
		30	45	45.2138	39.3505	13.5157	4.3428	2.152	0.0254	11.811	21.84665	294.847	1.22678	1.007	1.812470054	15.54800843	0.02575	0.220230433
		30	55	55.4478	50.5751	30.9312	9.306	3.2406	0.0254	11.811	29.94055	302.941	1.1932	1.0073	1.850997018	16.31288198	0.026378	0.231687349
		30	65	65.166	57.5495	34.6534	12.5408	4.0768	0.0254	11.811	35.04515	308.045	1.17203	1.0074	1.875294914	16.79526668	0.026774	0.23891291
		30	*Stand*	*20.8717*	*17.1051*	*5.7608*	*1.7726*	*1.418*	0.0254	11.811	9.43885	282.439	1.27824	1.0065	1.753408926	14.37547133	0.024787	0.202667192
		60	35	35.0561	29.1158	10.148	4.2541	1.418	0.0254	11.811	16.68495	289.685	1.24819	1.0068	1.787900362	15.06022778	0.02535	0.212924047
		60	45	45.1456	40.5913	13.4712	5.0074	2.3294	0.0254	11.811	22.79935	295.799	1.22282	1.007	1.817004906	15.63803858	0.025824	0.22157898
		60	55	55.1823	52.4809	30.4437	9.8821	3.886	0.0254	11.811	31.1815	304.182	1.18806	1.0073	1.85690394	16.43015175	0.026474	0.233443913
		60	65	65.101	56.659	31.5073	10.1478	4.9496	0.0254	11.811	33.4034	306.403	1.17884	1.0074	1.867480184	16.6401213	0.026647	0.236589013
		60	*Stand*	*21.8468*	*18.3013*	*5.7607*	*2.1714*	*1.2408*	0.0254	11.811	10.23635	283.236	1.27494	1.0065	1.757205026	14.45083508	0.024849	0.203796053
		90	35	35.1322	29.3815	12.718	4.2983	1.2158	0.0254	11.811	16.8399	289.84	1.24754	1.0068	1.788637924	15.07487055	0.025362	0.213143378
		90	45	45.276	41.256	14.3575	6.8553	2.2408	0.0254	11.811	24.05565	297.056	1.21761	1.007	1.822984894	15.75675893	0.025922	0.223357273
		90	55	55.1022	50.7082	29.4688	9.3637	3.975	0.0254	11.811	30.03595	303.036	1.19281	1.0073	1.851451122	16.32189728	0.026386	0.231822387
		90	65	65.1512	58.1212	32.0832	12.2616	4.418	0.0254	11.811	35.1914	308.191	1.17142	1.0075	1.875991064	16.8090873	0.026786	0.239119927
		90	*Stand*	*21.4478*	*17.7696*	*5.3177*	*2.0384*	*1.2406*	0.0254	11.811	9.904	282.904	1.27631	1.0065	1.75562304	14.419428	0.024823	0.203325612

Tabung : 3" atau (L/dha) = 11.8

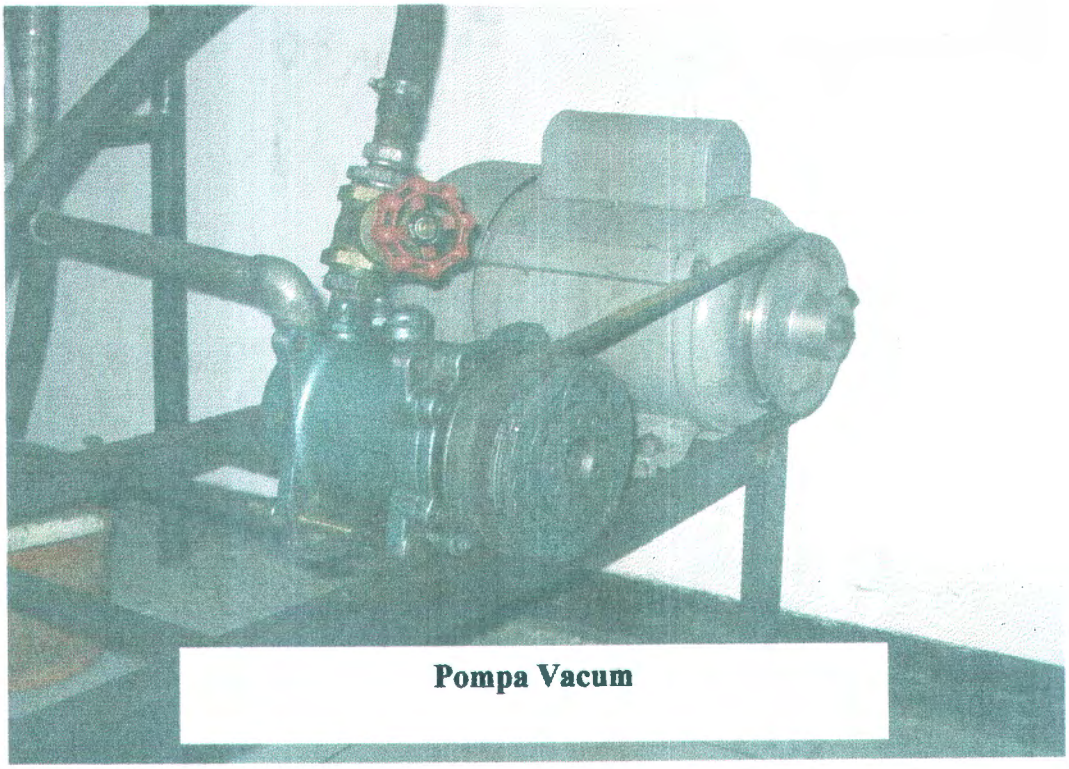
Pr	g'	Beta	Gr	dha(lt)-m	Ra	Nu	h	qkonv	rw2-out	rw2-in	rw1-out	rw1-in	Rthermal	q total(W)	dq(%)
0.71194	8.496	0.003445	455711.8027	0.0019552	324439.5918	3.955111	1.9769744	2.1070636	0.0393	0.0381	0.0266	0.0254	12.84471896	2.609305824	-0.01592
0.71079	8.496	0.003392	547045.5466	0.001867918	388833.5946	4.19862	2.1282458	2.4104446	0.0393	0.0381	0.0266	0.0254	11.97595558	3.59568802	-0.20829
0.70876	8.496	0.003301	570179.8177	0.001848676	404123.4201	4.2524	2.2080829	4.843023	0.0393	0.0381	0.0266	0.0254	11.56543473	4.514071562	0.54251
0.70749	8.496	0.003246	576917.7837	0.001843254	408162.82	4.26638	2.2486095	5.128431	0.0393	0.0381	0.0266	0.0254	11.36820261	5.373690291	0.34928
0.71389	8.496	0.003541	292583.61	0.002184244	208872.5974	3.464163	1.6902968	0.9446727	0.0393	0.0381	0.0266	0.0254	14.91770848	1.304067581	-0.24619
0.71208	4.905	0.003452	243316.7219	0.002287287	173260.6702	3.306	1.6497171	1.6337224	0.0393	0.0381	0.0266	0.0254	15.26935352	2.202981282	-0.35639
0.71055	4.905	0.003381	316316.5521	0.002142068	224758.7775	3.528231	1.793566	4.7791769	0.0393	0.0381	0.0266	0.0254	14.09459885	3.03777358	-0.2713
0.70845	4.905	0.003288	333588.8817	0.002113785	236332.5861	3.572801	1.8619696	4.4570072	0.0393	0.0381	0.0266	0.0254	13.59965398	3.771882733	0.48011
0.7079	4.905	0.003264	352517.87	0.002084819	249547.1006	3.62173	1.8997615	5.6600945	0.0393	0.0381	0.0266	0.0254	13.34149132	4.508596421	0.31241
0.71369	4.905	0.003531	175358.5498	0.002482458	125151.8034	3.047805	1.4908531	0.5262643	0.0393	0.0381	0.0266	0.0254	16.83015884	1.224349704	-0.36267
0.71204	9.81	0.00345	439753.7061	0.001920301	348724.2411	3.937753	1.9658979	2.8530233	0.0393	0.0381	0.0266	0.0254	12.91358534	2.626412348	-0.081
0.71024	9.81	0.003366	599868.181	0.001825365	426048.0299	4.327189	2.2080179	5.3359387	0.0393	0.0381	0.0266	0.0254	11.56575728	3.720915022	-0.35082
0.70874	9.81	0.0033	658631.4351	0.001783212	466799.1102	4.459616	2.3163305	6.2682706	0.0393	0.0381	0.0266	0.0254	11.05402409	4.625211558	0.46824
0.70745	9.81	0.003245	677300.8575	0.001770795	479157.9478	4.498239	2.3718161	6.1840595	0.0393	0.0381	0.0266	0.0254	10.80998109	5.618252196	0.22023
0.71377	9.81	0.003535	343943.2915	0.002097693	245497.7789	3.606947	1.7625298	0.8108199	0.0393	0.0381	0.0266	0.0254	14.33183546	1.409951995	-0.40223

LAMPIRAN – III

KOMPONEN EKSPERIMENTAL



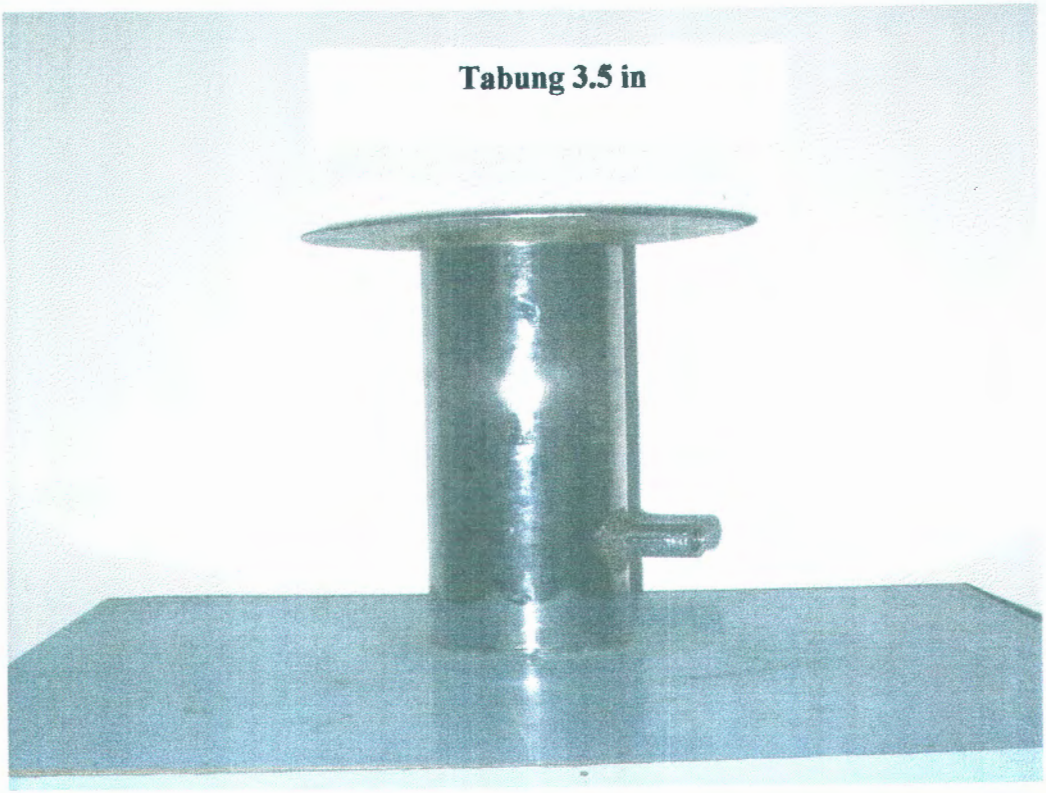
Rangkaian Penelitian



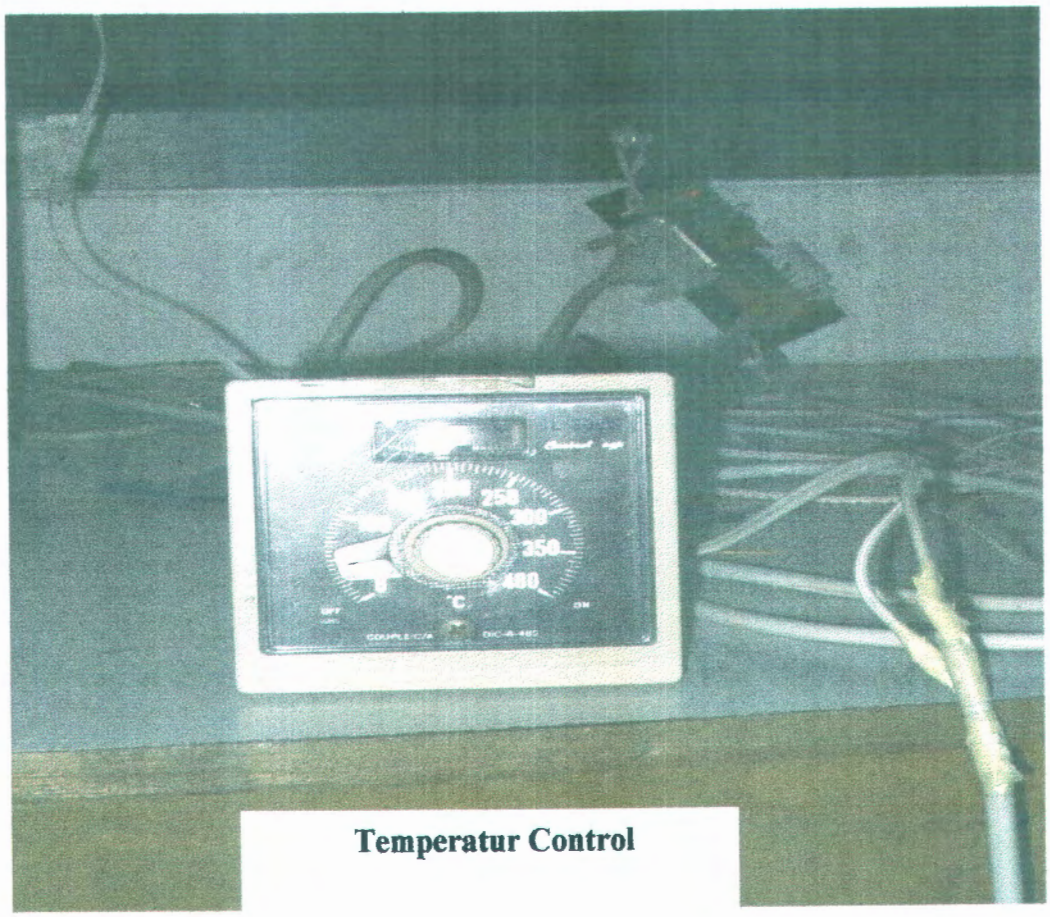
Pompa Vacum


Tabung 3 in


Tabung 4 in



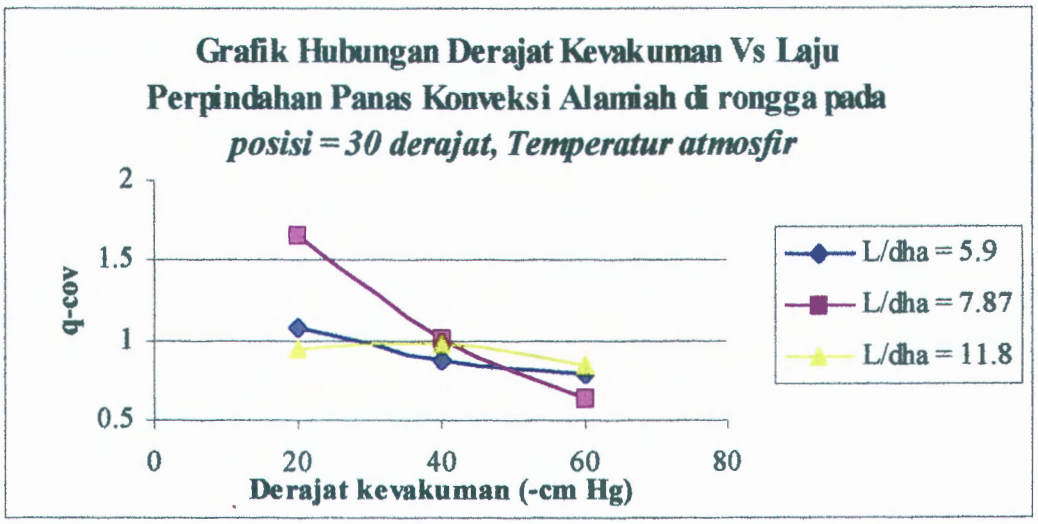
Tabung 3.5 in

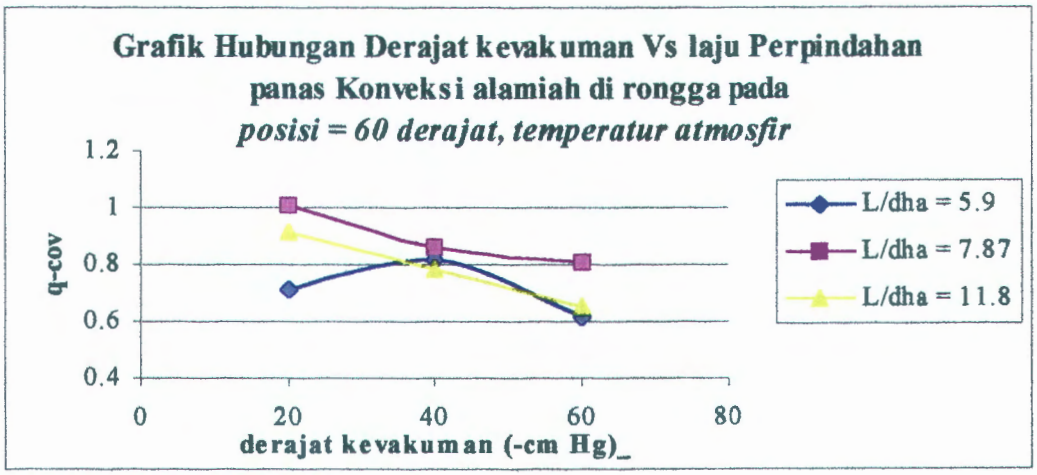


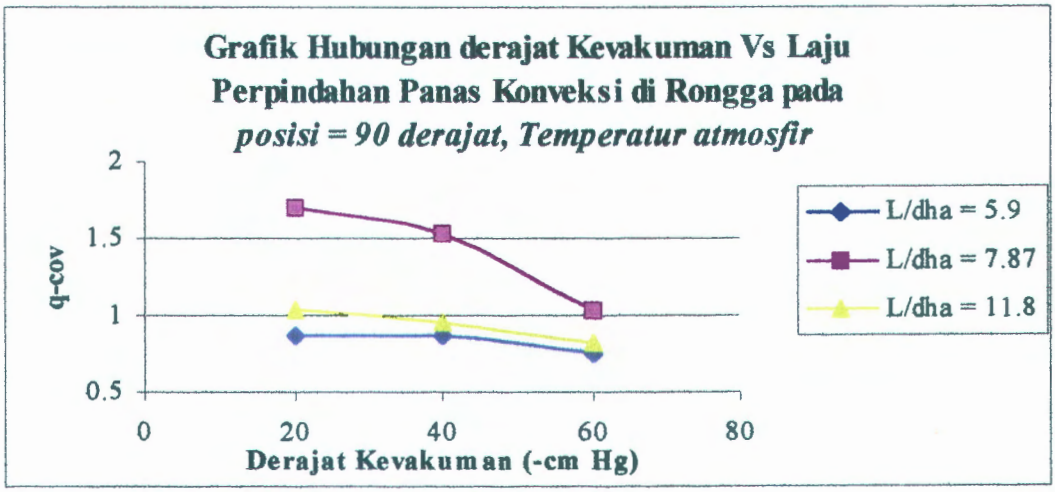
Temperatur Control

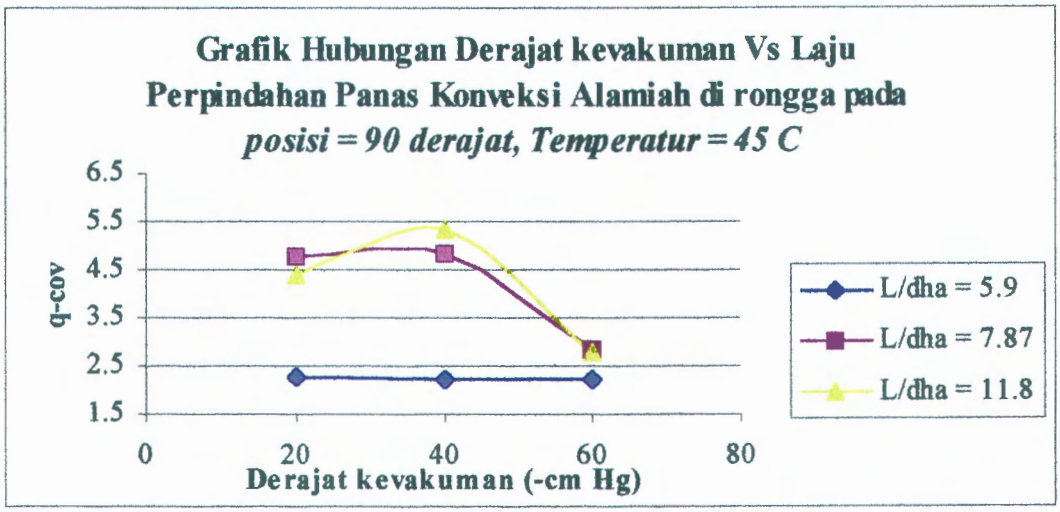
LAMPIRAN – IV

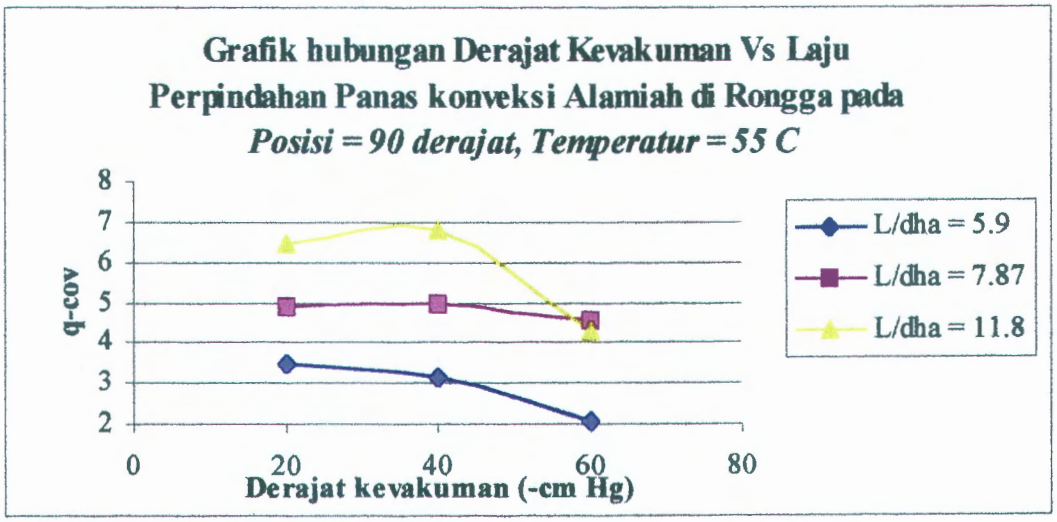
GRAFIK
HASIL PERHITUNGAN

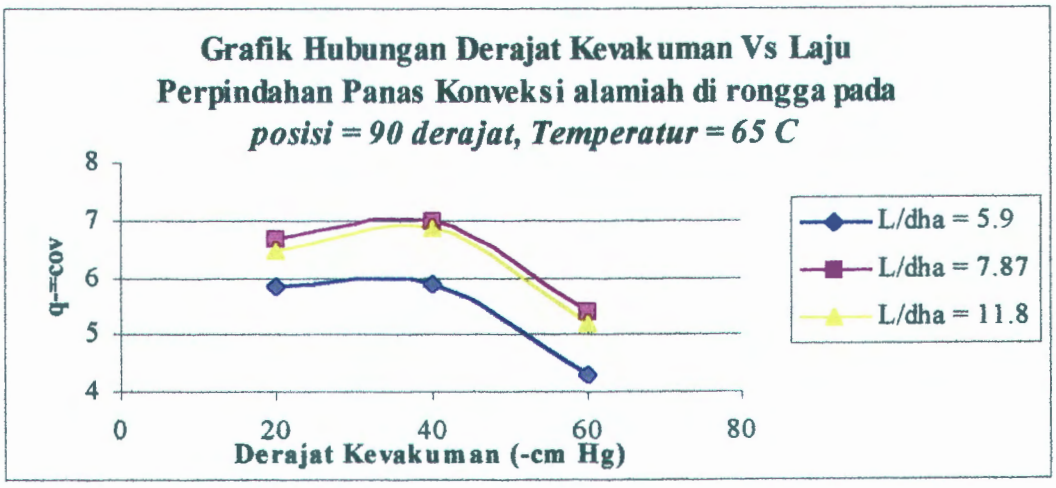

Grafik Hubungan Derajat Kevakuman Vs Laju Perpindahan Panas Konveksi Alamiah di rongga pada posisi = 30 derajat, Temperatur atmosfir
q-cov
2
1.5
1
0.5
0
20
40
60
80
Derajat kevakuman (-cm Hg)
L/dha = 5.9
L/dha = 7.87
L/dha = 11.8

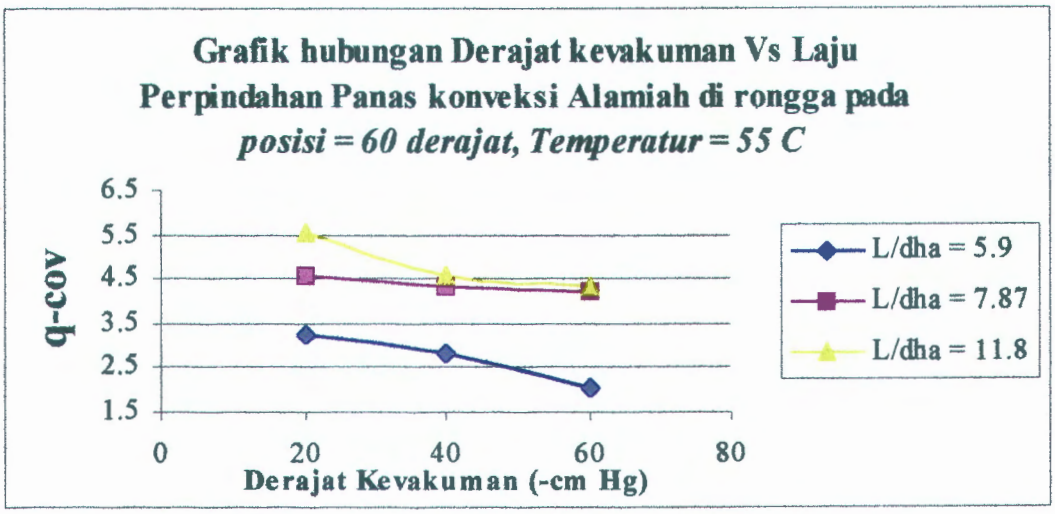

Grafik Hubungan Derajat kevakuman Vs laju Perpindahan panas Konveksi alamiah di rongga pada posisi = 60 derajat, temperatur atmosfir
q-cov
1.2
1
0.8
0.6
0.4
0
20
40
60
80
derajat kevakuman (-cm Hg)_
L/dha = 5.9
L/dha = 7.87
L/dha = 11.8

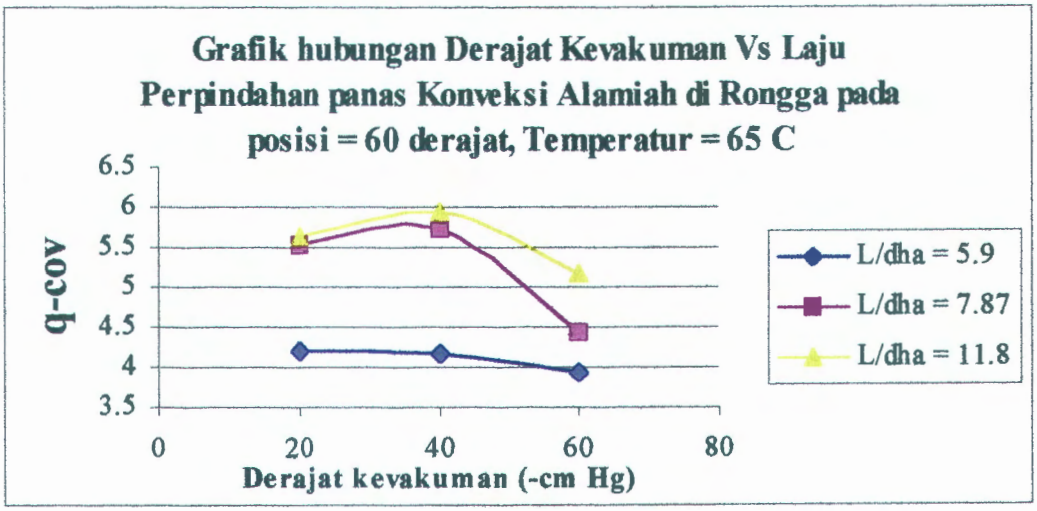

Grafik Hubungan derajat Kevakuman Vs Laju Perpindahan Panas Konveksi di Rongga pada posisi = 90 derajat, Temperatur atmosfir
q-cov
2
1.5
1
0.5
0
20
40
60
80
Derajat Kevakuman (-cm Hg)
L/dha = 5.9
L/dha = 7.87
L/dha = 11.8

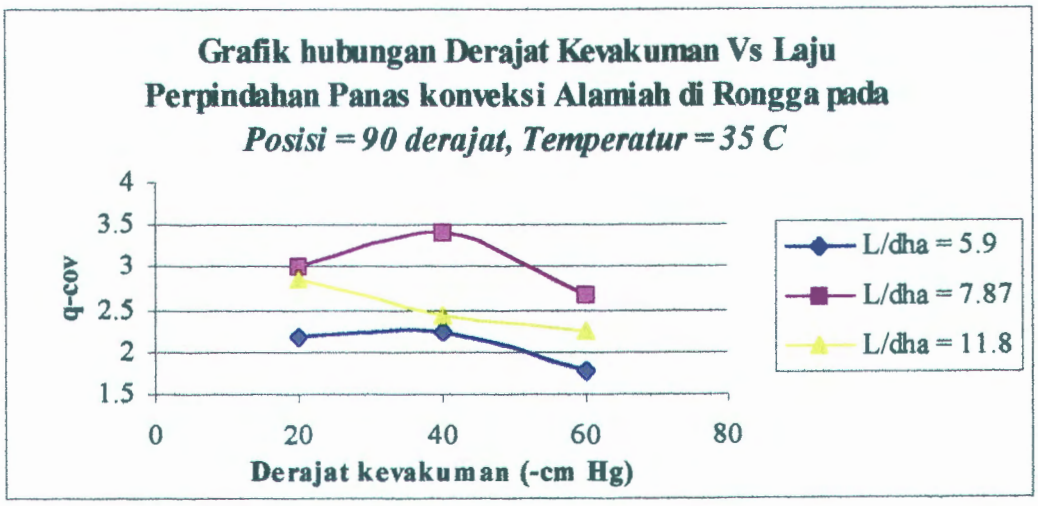

Grafik Hubungan Derajat kevakuman Vs Laju
Perpindahan Panas Konveksi Alamiah di rongga pada
posisi = 90 derajat, Temperatur = 45 C
6.5
5.5
4.5
3.5
2.5
1.5
0
20
40
60
80
Derajat kevakuman (-cm Hg)
L/dha = 5.9
L/dha = 7.87
L/dha = 11.8

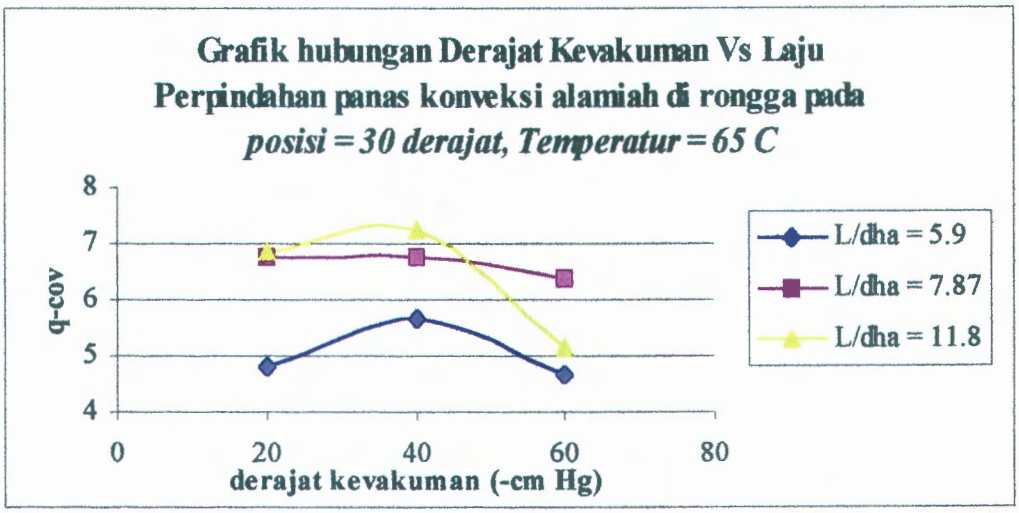

Grafik hubungan Derajat Kevakuman Vs Laju
Perpindahan Panas konveksi Alamiah di Rongga pada
Posisi = 90 derajat, Temperatur = 55 C
8
7
6
5
4
3
2
0
20
40
60
80
Derajat kevakuman (-cm Hg)
L/dha = 5.9
L/dha = 7.87
L/dha = 11.8

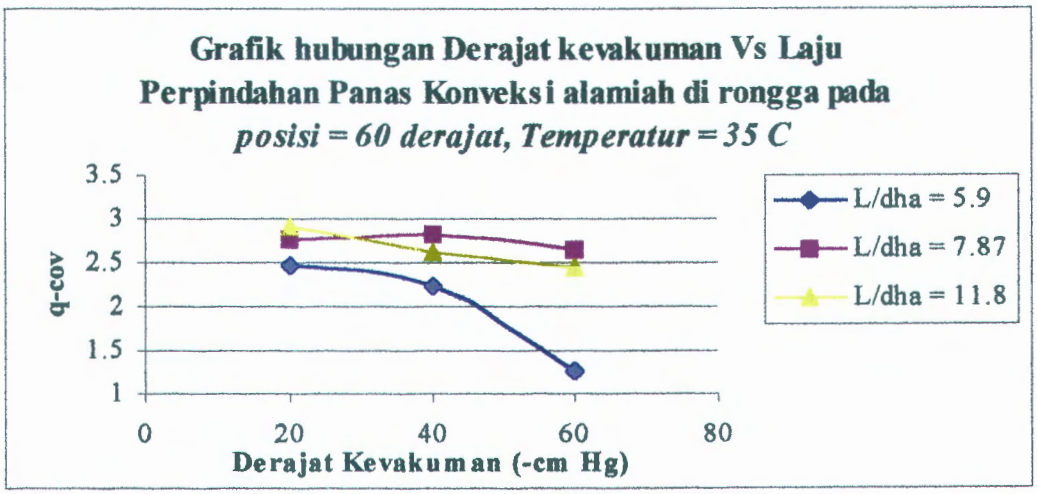

Grafik Hubungan Derajat Kevakuman Vs Laju
Perpindahan Panas Konveksi alamiah di rongga pada
posisi = 90 derajat, Temperatur = 65 C
8
7
6
5
4
0
20
40
60
80
Derajat Kevakuman (-cm Hg)
L/dha = 5.9
L/dha = 7.87
L/dha = 11.8

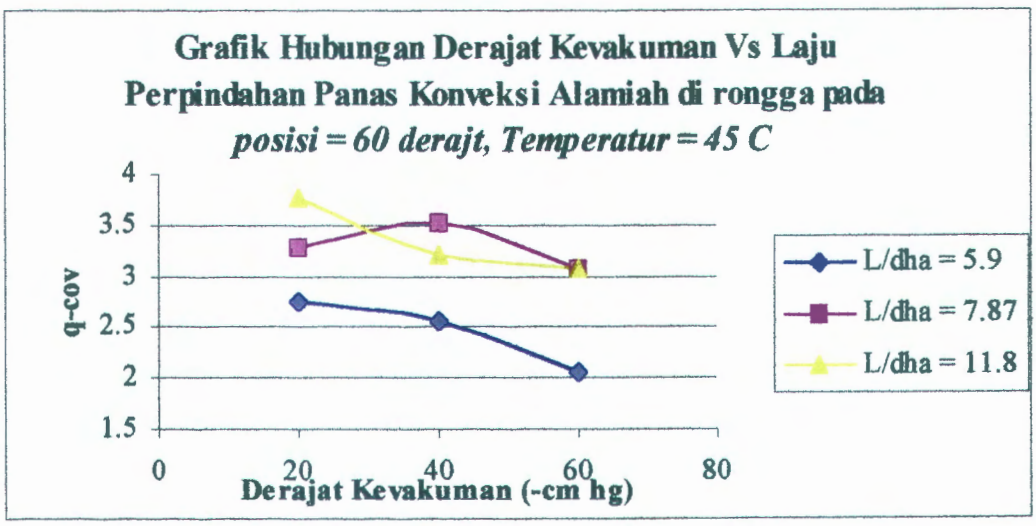

Grafik hubungan Derajat kevakuman Vs Laju
Perpindahan Panas konveksi Alamiah di rongga pada
posisi = 60 derajat, Temperatur = 55 C
q-cov
6.5
5.5
4.5
3.5
2.5
1.5
0
20
40
60
80
Derajat Kevakuman (-cm Hg)
L/dha = 5.9
L/dha = 7.87
L/dha = 11.8


Grafik hubungan Derajat Kevakuman Vs Laju
Perpindahan panas Konveksi Alamiah di Rongga pada
posisi = 60 derajat, Temperatur = 65 C
q-cov
6.5
6
5.5
5
4.5
4
3.5
0
20
40
60
80
Derajat kevakuman (-cm Hg)
L/dha = 5.9
L/dha = 7.87
L/dha = 11.8

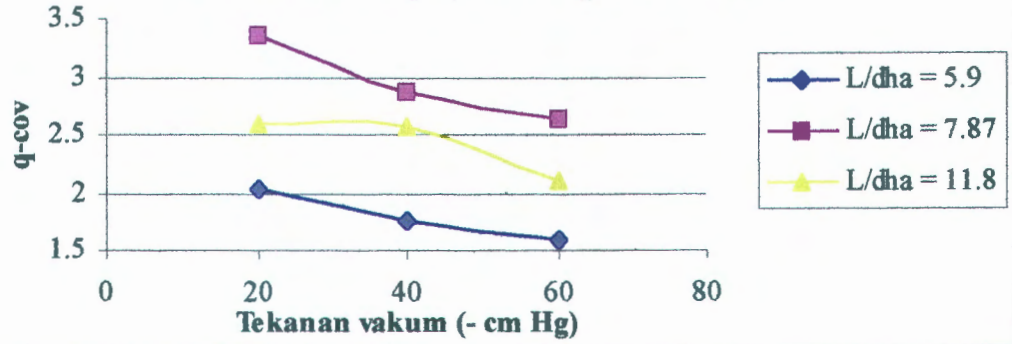

Grafik hubungan Derajat Kevakuman Vs Laju
Perpindahan Panas konveksi Alamiah di Rongga pada
Posisi = 90 derajat, Temperatur = 35 C
q-cov
4
3.5
3
2.5
2
1.5
0
20
40
60
80
Derajat kevakuman (-cm Hg)
L/dha = 5.9
L/dha = 7.87
L/dha = 11.8


Grafik hubungan Derajat Kevakuman Vs Laju
Perpindahan panas konveksi alamiah di rongga pada
posisi = 30 derajat, Temperatur = 65 C
q-cov
8
7
6
5
4
0
20
40
60
80
derajat kevakuman (-cm Hg)
L/dha = 5.9
L/dha = 7.87
L/dha = 11.8

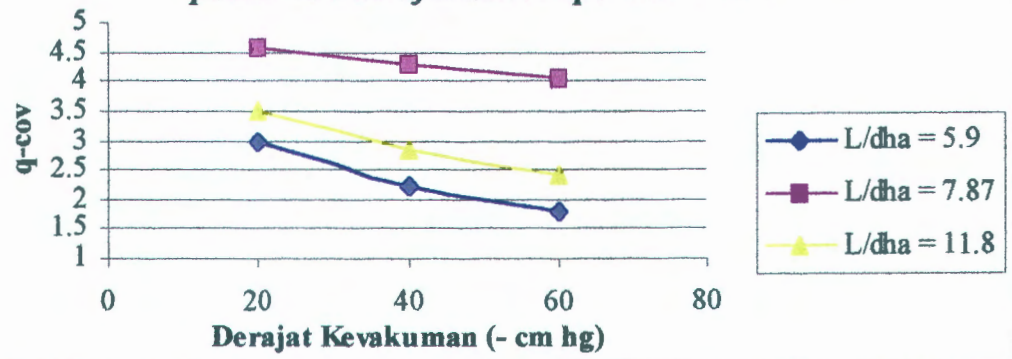

Grafik hubungan Derajat kevakuman Vs Laju
Perpindahan Panas Konveksi alamiah di rongga pada
posisi = 60 derajat, Temperatur = 35 C
q-cov
3.5
3
2.5
2
1.5
1
0
20
40
60
80
Derajat Kevakuman (-cm Hg)
L/dha = 5.9
L/dha = 7.87
L/dha = 11.8


Grafik Hubungan Derajat Kevakuman Vs Laju
Perpindahan Panas Konveksi Alamiah di rongga pada
posisi = 60 derajt, Temperatur = 45 C
q-cov
4
3.5
3
2.5
2
1.5
0
20
40
60
80
Derajat Kevakuman (-cm hg)
L/dha = 5.9
L/dha = 7.87
L/dha = 11.8

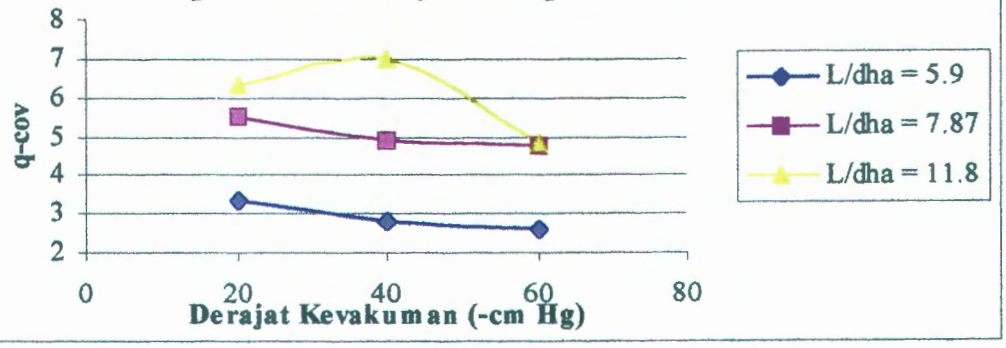
Grafik Hubungan Derajat Kevakuman terhadap Laju Perpindahan Panas Konveksi Alamiah pada *Posisi = 30 derajat dan Temperatur = 35 C*



Grafik : Hubungan Derajat Kevakuman Vs Laju Perpindahan Panas Konveksi Alamiah di rongga pada *posisi = 30 derajat dan temperatur = 45 C*



Grafik Hubungan derajat Kevakuman Vs laju Perpindahan panas konveksi alamiah di rongga pada *posisi = 30 derajat , Temperatur= 55 C*



LAMPIRAN – V

DATA VALIDASI EKSPERIMEN

DATA VALIDASI

WAKTU TERHADAP TEMPERATUR ES MENCAIR PADA $\frac{L}{\delta}$ =5.9

UNTUK POSISI = 90 ^{0} DAN TEMPERATUR PERMUKAAN = 45 ^{0}C

Waktu	P=-20 cm hg	P = -40 cm hg	P = -60 cm hg
30	-3.394	-3.594	-3.894
300	-2.107	-2.107	-3.207
600	-1.784	-1.784	-2.684
900	-0.325	-1.324	-2.324
1200	-0.225	-1.069	-1.869
1500	-0.137	-0.337	-1.537
1800	-0.694	-0.136	-0.425
2100	0.1089	-0.693	-0.337
2400	0.209	0.1091	-0.125
2700	0.749	0.2081	0.1087
3000	0.542	0.7482	0.409
3300	0.078	0.542	0.7480
3600	0.759	0.077	0.842
3900	0.842	0.749	0.079
4200	0.835	0.642	0.649
4500	0.735	0.535	0.742
4800	0.935	0.935	0.535
5100	1.976	0.835	0.735
5400	2.122	0.957	0.835
5700	2.737	1.933	0.557
6000	3.937	2.522	0.965
6300	4.922	3.737	1.022
6600	5.767	3.937	1.965
6900		4.522	2.522
7200		5.667	3.737
7500			3.937
7800			4.522
8100			5.867