

LAMPIRAN

Lampiran I.

Hasil DSC Paraffin wax

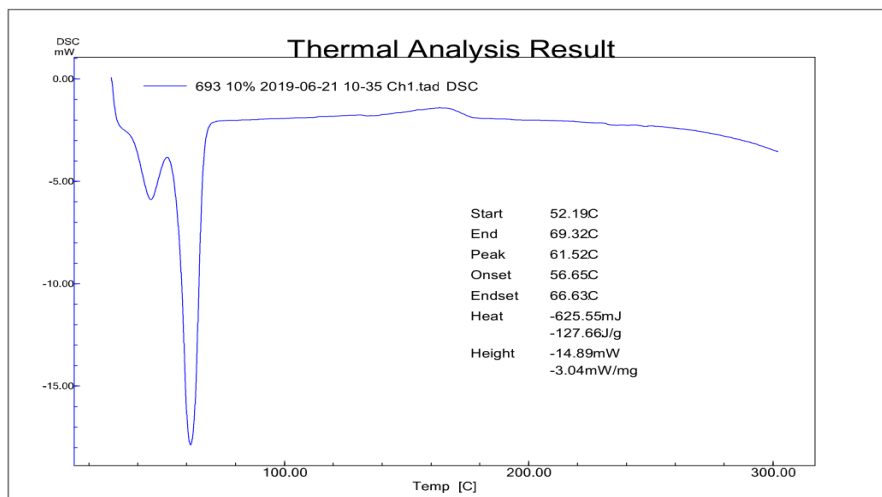
RDP/5.10.2/LPPT
Rev 0

2. 10%

[File Information]		[Temp Program]	
File Name:	693 10% 2019-06-21 10-35 Ch1.tad	Start Temp [°C]	30
Sample Name:	10%	Temp Rate [°C/min]	10
Lot No:	693	Hold Temp [°C]	300
Acquisition Date	2019/06/21	Hold Time [min]	0
Acquisition Time	10:35:54(+0700)	Gas	Nitrogen
Detector:	DSC-60		
Serial No:	C30935200137SA		
Operator:	Heri		
Atmosphere:	Nitrogen		
Flow Rate:	30[ml/min]		
Cell:	Aluminum Seal		
Sample Weight:	4.900[mg]		
Molecular Weight:	0.00		

[Analysis Result]

[DSC Peak]	1
Peak	
[°C]	61.52
Onset	
[°C]	56.65
Endset	
[°C]	66.63
Heat	
mJ	-625.55
J/g	-127.66
Height	
mW	-14.89
mW/mg	-3.04



Lampiran II

UDF densitas paraffin wax

```
#include "udf.h"
```

```
DEFINE_PROPERTY(density_udf,c,t)
```

```
{
```

```
real d;
```

```
real lf=C_LIQF(c,t);/*liquid fraction*/
```

```
if(lf==0)
```

```
d=865;
```

```
else if(lf==1)
```

```
d=810.8;
```

```
else
```

```
d=810.8*lf+(1-lf)*865;
```

```
return d;
```

```
}
```

Lampiran III

Profile debit aliran discharging secara kontinyu variasi 1,5 LPM

```
((massflowinlet transient 140 0)(time 300 301 600 601 900 901 1200 1201 1500
1501 1800 1801 2100 2101 2400 2401 2700 2701 3000 3001 3300 3301 3600 3601
3900 3901 4200 4201 4500 4501 4800 4801 5100 5101 5400 5401 5700 5701 6000
6001 6300 6301 6600 6601 6900 6901 7200 7201 7500 7501 7800 7801 8100 8101
8400 8401 8700 8701 9000 9001 9300 9301 9600 9601 9900 9901 10200 10201
10500 10501 10800 10801 11100 11101 11400 11401 11700 11701 12000 12001
12300 12301 12600 12601 12900 12901 13200 13201 13500 13501 13800 13801
14100 14101 14400 14401 14700 14701 15000 15001 15300 15301 15600 15601
15900 15901 16200 16201 16500 16501 16800 16801 17100 17101 17400 17401
17700 17701 18000 18001 18300 18301 18600 18601 18900 18901 19200 19201
19500 19501 19800 19801 20100 20101 20400 20401 20700 20701 21000
21001)(massflow 0.029735 0 0 0.029735 0.029735 0 0 0.029735 0.029735 0 0
0.029735 0.029735 0 0 0.029735 0.029735 0 0 0.029735 0.029735 0 0 0.029735
0.029735 0 0 0.029735 0.029735 0 0 0.029735 0.029735 0 0 0.029735 0.029735 0
0 0.029735 0.029735 0 0 0.029735 0.029735 0 0 0.029735 0.029735 0 0 0.029735
0.029735 0 0 0.029735 0.029735 0 0 0.029735 0.029735 0 0 0.029735 0.029735 0
0 0.029735 0.029735 0 0 0.029735 0.029735 0 0 0.029735 0.029735 0 0 0.029735
0.029735 0 0 0.029735 0.029735 0 0 0.029735 0.029735 0 0 0.029735 0.029735 0
0 0.029735 0.029735 0 0 0.029735 0.029735 0 0 0.029735 0.029735 0 0 0.029735
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0 0.029735 0.029735 0 0 0.029735 0.029735 0 0 0.029735 0.029735 0 0 0.029735
0.029735 0 0 0.029735 0.029735 0 0 0.029735 0.029735 0 0 0.029735 0.029735
0.029735 0 0 0.029735 0.029735 0 0))
```


Lampiran V

Profile temperatur inlet charging variasi 600 W

((massflowinlet transient 248 0)(time 5 60 120 180 240 300 360 420 480 540 600 660 720 780 840 900 960 1020 1080 1140 1200 1260 1320 1380 1440 1500 1560 1620 1680 1740 1800 1860 1920 1980 2040 2100 2160 2220 2280 2340 2400 2460 2520 2580 2640 2700 2760 2820 2880 2940 3000 3060 3120 3180 3240 3300 3360 3420 3480 3540 3600 3660 3720 3780 3840 3900 3960 4020 4080 4140 4200 4260 4320 4380 4440 4500 4560 4620 4680 4740 4800 4860 4920 4980 5040 5100 5160 5220 5280 5340 5400 5460 5520 5580 5640 5700 5760 5820 5880 5940 6000 6060 6120 6180 6240 6300 6360 6420 6480 6540 6600 6660 6720 6780 6840 6900 6960 7020 7080 7140 7200 7260 7320 7380 7440 7500 7560 7620 7680 7740 7800 7860 7920 7980 8040 8100 8160 8220 8280 8340 8400 8460 8520 8580 8640 8700 8760 8820 8880 8940 9000 9060 9120 9180 9240 9300 9360 9420 9480 9540 9600 9660 9720 9780 9840 9900 9960 10020 10080 10140 10200 10260 10320 10380 10440 10500 10560 10620 10680 10740 10800 10860 10920 10980 11040 11100 11160 11220 11280 11340 11400 11460 11520 11580 11640 11700 11760 11820 11880 11940 12000 12060 12120 12180 12240 12300 12360 12420 12480 12540 12600 12660 12720 12780 12840 12900 12960 13020 13080 13140 13200 13260 13320 13380 13440 13500 13560 13620 13680 13740 13800 13860 13920 13980 14040 14100 14160 14220 14280 14340 14400 14460 14520 14580 14640 14700 14760 14820)(temperature 297.627 299.337 301.963 303.810 305.366 306.728 307.895 308.770 309.548 310.229 310.812 311.396 311.979 312.368 312.660 313.049 313.438 313.633 313.924 314.119 314.411 314.605 314.897 314.994 315.189 315.480 315.675 315.967 316.064 316.161 316.356 316.453 316.647 316.842 316.939 317.231 317.328 317.523 317.620 317.814 317.912 318.009 318.106 318.301 318.398 318.592 318.787 318.981 319.176 319.370 319.370 319.565 319.565 319.662 319.857 319.954 320.148 320.246 320.440 320.635 320.829 321.024 321.121 321.218 321.510 321.607 321.704 321.899 322.191 322.385 322.482 322.580 322.677 322.871 323.066 323.163 323.163 323.358 323.552 323.649 323.747 323.941 324.136 324.233 324.427 324.525 324.622 324.719 325.011 325.108 325.108 325.303 325.497 325.594 325.789 325.789 326.081 326.178 326.372 326.567 326.761 326.956 327.150 327.248 327.345 327.442 327.637 327.734 327.831 327.928 328.026 328.123 328.317 328.220 328.512 328.706 328.901 328.998 329.193 329.387 329.582 329.679 329.873 330.068 330.262 330.360 330.651 330.749 330.943 331.040 331.235 331.332 331.527 331.721 331.916 332.013 332.013 332.207 332.305 332.402 332.499 332.694 332.791 332.888 332.985 333.083 333.180 333.277 333.374 333.666 333.763 333.958 334.055 334.250 334.347 334.444 334.541 334.639 334.639 334.736 334.930 335.028 335.125 335.125 335.319 335.417 335.514 335.611 335.806 335.903 336.000 336.195 336.389 336.486 336.584 336.778 336.875 336.973 337.167 337.264 337.362 337.556 337.556 337.751 337.848 337.945 338.042 338.140 338.140 338.237 338.334 338.334 338.431 339.112 339.404 339.696

340.279 340.474 340.571 340.765 340.765 340.960 341.252 341.252 341.446
341.543 341.738 341.932 342.030 342.224 342.516 342.613 342.808 342.905
343.002 343.099 343.099 343.294 343.294 343.586 343.586 343.780 343.877
344.169 344.169 344.364 344.558 344.655 344.850 344.947 345.142 345.044
345.239 345.433 345.628 345.822 345.920 346.114 346.211 346.309 346.406
346.600 346.698 346.892 347.087 347.087 347.184 347.670))

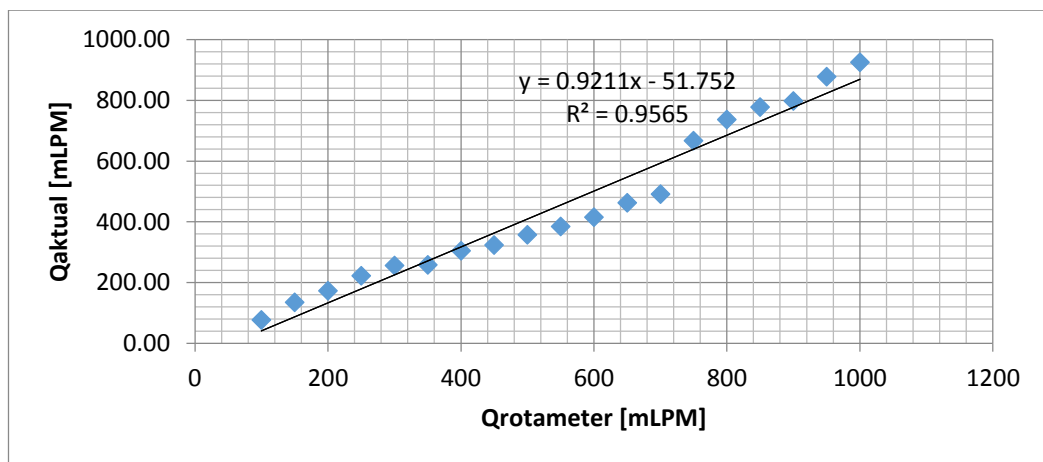
Lampiran VI

Profile temperatur inlet charging variasi 900 W

((massflowinlet transient 193 0)(time 5 60 120 180 240 300 360 420 480 540 600 660 720 780 840 900 960 1020 1080 1140 1200 1260 1320 1380 1440 1500 1560 1620 1680 1740 1800 1860 1920 1980 2040 2100 2160 2220 2280 2340 2400 2460 2520 2580 2640 2700 2760 2820 2880 2940 3000 3060 3120 3180 3240 3300 3360 3420 3480 3540 3600 3660 3720 3780 3840 3900 3960 4020 4080 4140 4200 4260 4320 4380 4440 4500 4560 4620 4680 4740 4800 4860 4920 4980 5040 5100 5160 5220 5280 5340 5400 5460 5520 5580 5640 5700 5760 5820 5880 5940 6000 6060 6120 6180 6240 6300 6360 6420 6480 6540 6600 6660 6720 6780 6840 6900 6960 7020 7080 7140 7200 7260 7320 7380 7440 7500 7560 7620 7680 7740 7800 7860 7920 7980 8040 8100 8160 8220 8280 8340 8400 8460 8520 8580 8640 8700 8760 8820 8880 8940 9000 9060 9120 9180 9240 9300 9360 9420 9480 9540 9600 9660 9720 9780 9840 9900 9960 10020 10080 10140 10200 10260 10320 10380 10440 10500 10560 10620 10680 10740 10800 10860 10920 10980 11040 11100 11160 11220 11280 11340 11400 11460 11520)(temperature 301.885 307.914 310.734 313.068 314.722 316.180 317.250 318.417 319.292 320.168 320.751 321.335 321.918 322.404 322.891 323.280 323.669 323.863 324.155 324.544 324.836 325.225 325.419 325.614 325.905 326.003 326.294 326.392 326.878 327.072 327.364 327.559 327.850 328.045 328.239 328.531 328.823 328.920 329.115 329.406 329.698 329.795 330.087 330.282 330.476 331.060 331.546 331.935 332.129 332.421 332.713 332.810 333.102 333.199 333.491 333.880 334.074 334.172 334.366 334.658 334.950 335.144 335.241 335.436 335.630 335.728 335.922 336.117 336.311 336.408 336.603 336.797 337.089 337.284 337.575 337.867 338.159 338.353 338.645 338.742 338.840 338.937 339.229 339.326 339.423 339.618 340.007 340.104 340.298 340.493 340.493 340.590 340.785 341.076 341.368 341.563 341.854 341.952 342.049 342.243 342.535 342.535 342.632 342.730 342.827 343.119 343.313 343.508 343.605 343.799 343.994 344.091 344.188 344.383 344.577 344.966 345.064 345.161 345.258 345.647 345.744 346.133 346.328 346.522 346.620 346.814 347.009 347.300 347.398 347.592 347.787 348.176 348.273 348.370 348.662 348.856 348.954 349.051 349.245 349.343 349.634 349.926 350.218 350.023 350.412 350.510 350.607 350.801 350.996 351.288 351.482 351.579 351.774 351.871 351.968 352.260 352.455 352.552 352.649 352.844 353.038 353.233 353.427 353.524 353.622 354.011 354.011 354.205 354.497 354.594 354.691 354.691 354.983 355.178 355.372 355.567 355.761 355.956 355.956 355.956 356.247 356.150 356.247 356.442 356.734 357.025 357.220 357.317 357.609 357.706 357.803 357.998 358.095))

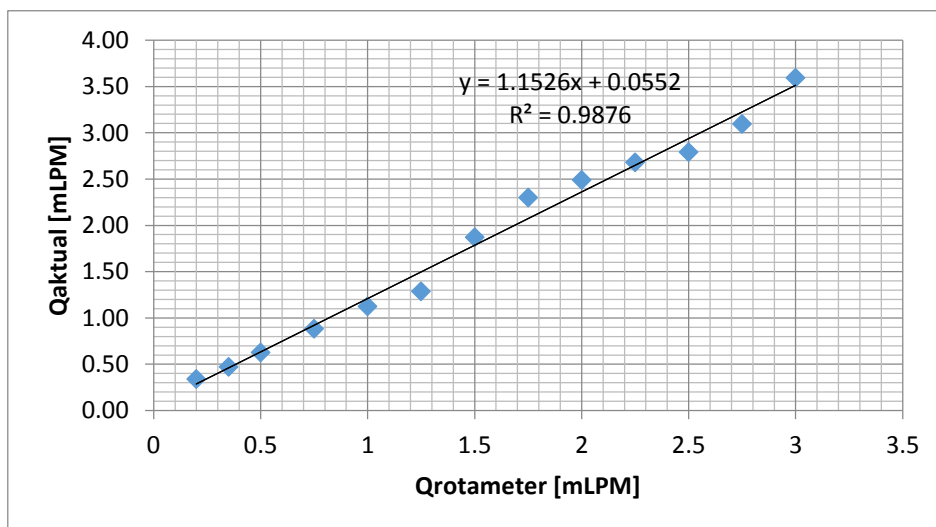
Lampiran VII. Hasil Kalibrasi pada Rotameter 0.1 mLPM - 1 LPM

No.	Rotameter	DC Power Supply		Debit Aktual		Suhu Air		mLPM	mLPM
		Voltase	Arus	Volume	Waktu	Awal	Akhir	Q rotameter	Q aktual
	[mLPM]	[Volt]	[Ampere]	[mL]	[detik]	[°C]	[°C]		
1	100	8,5	1,28	100	78,16	27	27	100	76,77
2	150	8,5	1,26	100	44,6	27	27	150	134,53
3	200	8,5	1,23	100	34,83	27	27	200	172,27
4	250	8,5	1,2	100	27	27	27	250	222,22
5	300	8,5	1,23	100	23,45	27	27	300	255,86
6	350	8,5	1,2	100	23,29	27	27	350	257,62
7	400	8,5	1,19	100	19,7	27	27	400	304,57
8	450	8,5	1,18	100	18,55	27	27	450	323,45
9	500	8,5	1,17	100	16,82	27	27	500	356,72
10	550	8,5	1,16	100	15,62	27	27	550	384,12
11	600	8,5	1,15	100	14,45	27	27	600	415,22
12	650	8,5	1,14	100	12,97	27	27	650	462,61
13	700	8,5	1,12	100	12,22	27	27	700	491,00
14	750	8,5	1,06	100	8,99	27	27	750	667,41
15	800	8,5	1,05	100	8,14	27	27	800	737,10
16	850	8,5	1,03	100	7,71	27	27	850	778,21
17	900	8,5	1,02	100	7,52	27	27	900	797,87
18	950	8,5	1,01	100	6,83	27	27	950	878,48
19	1000	8,5	0,99	100	6,48	27	27	1000	925,93



Lampiran VIII. Hasil Kalibrasi pada Rotameter 1 LPM – 3 LPM

No	Rotameter	DC Power Supply		Debit Aktual		Suhu Air		LPM
		Voltase	Arus	Volume	Waktu	Awal	Akhir	
	[LPM]	[Volt]	[Ampere]	[mL]	[detik]	[°C]	[°C]	Q rotameter
1	0,2	1,8	0,4	100	17,66	28	28	0,2
2	0,35	2,1	0,42	100	12,79	28	28	0,35
3	0,5	2,6	0,44	100	9,6	28	28	0,5
4	0,75	3,9	0,51	100	6,81	28	28	0,75
5	1	4,6	0,56	100	5,34	28	28	1
6	1,25	5,5	0,62	100	4,66	28	28	1,25
7	1,5	6,1	0,67	100	3,21	28	28	1,5
8	1,75	7	0,74	100	2,61	28	28	1,75
9	2	8	0,81	100	2,41	28	28	2
10	2,25	8,9	0,89	100	2,24	28	28	2,25
11	2,5	10,1	0,95	100	2,15	28	28	2,5
12	2,75	10,8	1	100	1,94	28	28	2,75
13	3	11,8	1,06	100	1,67	28	28	3



Lampiran IX

Data Sheet RT 60

Data sheet



RT60



RUBITHERM® RT is a pure PCM, this heat storage material utilising the processes of phase change between solid and liquid (melting and congealing) to store and release large quantities of thermal energy at nearly constant temperature. The RUBITHERM® phase change materials (PCM's) provide a very effective means for storing heat and cold, even when limited volumes and low differences in operating temperature are applicable.

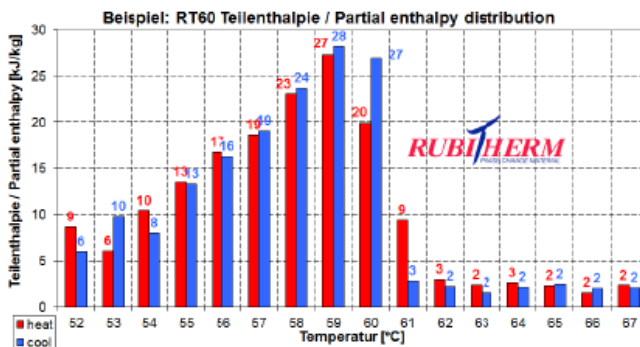
We look forward to discussing your particular questions, needs and interests with you.

Properties for RT-line:

- high thermal energy storage capacity
- heat storage and release take place at relatively constant temperatures
- no supercooling effect, chemically inert
- long life product, with stable performance through the phase change cycles
- melting temperature range between -9 °C and 100 °C available

The most important data:

	Typical Values	
Melting area	55-61	[°C]
	main peak: 60	
Congealing area	61-55	[°C]
	main peak: 61	
Heat storage capacity ± 7,5%	160	[kJ/kg]*
Combination of latent and sensible heat in a temperature range of 53°C to 68°C.	40	[Wh/kg]*
Specific heat capacity	2	[kJ/kg·K]
Density solid at 15 °C	0,88	[kg/l]
Density liquid at 80 °C	0,77	[kg/l]
Heat conductivity (both phases)	0,2	[W/(m·K)]
Volume expansion	12,5	[%]
Flash point	>200	[°C]
Max. operation temperature	80	[°C]



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 E-Mail: info@rubitherm.com
 Internet: www.rubitherm.com

The product information given is a non-binding planning aid, subject to technical changes without notice. Version: 06.08.2018

*Measured with 3-layer-calorimeter.