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LAMPIRAN

Lampiran 1 Hasil pengambilan data

Tabel 11. Hasil pengambilan data rangkaian *Heat pipe* dan fin tegangan 25V

Menit	T _{u, Before} PHE	T _{u, After} PHE	T _{U, Before} cooler	T _{U, After} cooler
0	27.769	27.234	27.500	27.500
5	26.565	26.606	26.520	24.919
10	24.937	24.927	25.151	20.905
15	24.024	23.839	24.282	19.744
20	23.369	23.199	23.765	19.315
25	22.969	22.782	23.350	19.174
30	22.624	22.411	22.928	19.016
35	22.293	22.186	22.663	18.897
40	22.210	22.037	22.466	18.891
45	22.188	22.075	22.396	18.833
50	22.189	22.002	22.268	18.743
55	22.232	22.041	22.335	18.691
60	22.321	22.030	22.511	18.791
65	22.861	23.048	23.048	20.609
70	23.900	24.406	24.406	23.574
75	464	25.106	25.106	24.675
80	933	25.531	25.531	25.232
85	336	25.855	25.855	25.574
90	671	26.073	26.073	25.744



Tabel 12. Hasil pengambilan data rangkaian *Heat pipe* dan fin tegangan 50V

Menit	T _{u, Before} PHE	T _{u, After} PHE	T _{U, Before} cooler	T _{U, After} cooler
0	28.300	28.000	28.300	28.000
5	26.991	26.747	26.747	24.177
10	27.587	26.639	26.639	21.538
15	27.855	26.774	26.774	21.132
20	28.024	26.901	26.901	21.231
25	28.136	26.994	26.994	21.287
30	28.235	27.058	27.058	21.328
35	28.264	27.106	27.106	21.394
40	28.413	27.099	27.099	21.410
45	28.440	27.085	27.085	21.441
50	28.509	27.077	27.077	21.456
55	28.531	27.088	27.088	21.499
60	28.755	27.159	27.159	21.499
65	28.272	27.103	27.103	21.609
70	28.489	26.560	26.560	22.641
75	28.947	26.496	26.496	24.912
80	29.053	26.915	26.915	25.923
85	29.041	27.148	27.148	26.448
90	28.989	27.288	27.288	26.689

Tabel 13. Hasil pengambilan data rangkaian *Heat pipe* dan fin tegangan 75V

Menit	T _{u, Before} PHE	T _{u, After} PHE	T _{U, Before} cooler	T _{U, After} cooler
0	29.000	29.000	29.749	29.345
5	29.059	27.807	27.807	24.902
10	32.510	29.441	29.441	23.288
15	34.096	30.619	30.619	23.181
20	34.975	31.407	31.407	23.583
25	35.626	31.950	31.950	23.925
30	36.013	32.312	32.312	24.199
35	36.300	32.527	32.527	24.320
40	36.325	32.706	32.706	24.413
45	36.454	32.865	32.865	24.608
50	36.471	32.922	32.922	24.789
55	36.452	32.992	32.992	24.824
60	36.528	32.998	32.998	24.869
65	35.327	29.437	29.437	25.915
70	34.325	28.434	28.434	26.815
75	33.729	28.419	28.419	27.272
80	33.094	28.392	28.392	27.497
85	32.511	28.329	28.329	27.532
90	31.944	28.231	28.231	27.516

Tabel 14. Hasil pengambilan data rangkaian *Heat pipe* dan fin tegangan 100V

Menit	T _{u, Before} PHE	T _{u, After} PHE	T _{U, Before} cooler	T _{U, After} cooler
0	29.500	29.500	29.500	29.500
5	31.978	29.409	29.409	25.013
10	38.954	33.354	33.354	25.082
15	42.255	35.894	35.894	26.583
20	44.089	37.718	37.718	27.540
25	45.154	38.826	38.826	28.331
30	45.799	39.592	39.592	28.918
35	46.228	40.091	40.091	29.271
40	46.472	40.351	40.351	29.483
45	46.793	40.512	40.512	29.590
50	46.963	40.642	40.642	29.663
55	46.988	40.762	40.762	29.785
60	47.001	40.777	40.777	29.885
65	43.619	34.448	34.448	28.816
70	39.917	30.644	30.644	28.632
75	38.630	30.056	30.056	28.668
80	37.472	29.772	29.772	28.619
85	36.420	29.546	29.546	28.561
90	35.441	29.362	29.362	28.440



Tabel 15. Hasil pengambilan data rangkaian *Heat pipe* tanpa *sink* tegangan 25V

Menit	T _{u, Before} PHE	T _{u, After} PHE	T _{U, Before} cooler	T _{U, After} cooler
0	27.500	27.500	27.500	27.500
5	26.595	26.525	26.741	25.048
10	25.390	25.268	25.483	21.553
15	24.652	24.479	24.804	20.231
20	24.278	24.227	24.270	19.785
25	24.093	24.085	23.984	19.713
30	24.059	23.998	23.769	19.580
35	24.010	23.975	23.650	19.579
40	23.984	23.943	23.597	19.530
45	23.975	23.944	23.585	19.523
50	23.974	23.932	23.566	19.507
55	23.984	23.945	23.581	19.461
60	24.004	23.962	23.600	19.535
65	24.026	24.178	24.178	20.587
70	25.299	25.613	25.613	24.032
75	25.922	26.416	26.416	25.583
80	26.420	26.907	26.907	26.416
85	26.765	27.193	27.193	26.865
90	27.059	27.423	27.423	27.085

Tabel 16. Hasil pengambilan data rangkaian *Heat pipe* Tanpa *sink* tegangan 50V

Menit	T _{u, Before} PHE	T _{u, After} PHE	T _{U, Before} cooler	T _{U, After} cooler
0	28.867	27.973	27.500	27.500
5	27.726	27.511	27.511	24.846
10	28.668	27.467	27.467	22.597
15	29.066	27.834	27.834	22.151
20	29.315	28.019	28.019	22.109
25	29.493	28.133	28.133	22.051
30	29.582	28.159	28.159	22.073
35	29.641	28.241	28.241	22.051
40	29.667	28.307	28.307	22.122
45	29.714	28.375	28.375	22.199
50	29.789	28.448	28.448	22.185
55	29.871	28.528	28.528	22.242
60	29.969	28.706	28.706	22.484
65	29.277	27.764	27.764	23.679
70	29.505	27.624	27.624	25.525
75	29.606	27.862	27.862	26.441
80	29.607	28.042	28.042	26.983
85	29.545	28.144	28.144	27.253
90	29.465	28.219	28.219	27.401



Tabel 17. Hasil pengambilan data rangkaian *Heat pipe* tanpa *sink* tegangan 75V

Menit	T _{u, Before} PHE	T _{u, After} PHE	T _{u, Before} cooler	T _{u, After} cooler
0	29.521	29.420	29.000	29.000
5	30.102	29.056	29.056	25.910
10	33.456	30.949	30.949	24.224
15	35.127	32.172	32.172	24.549
20	36.005	32.987	32.987	24.857
25	36.630	33.663	33.663	25.190
30	37.075	34.120	34.120	25.336
35	37.260	34.237	34.237	25.447
40	37.360	34.371	34.371	25.427
45	37.436	34.426	34.426	25.512
50	37.507	34.532	34.532	25.611
55	37.488	34.623	34.623	25.676
60	37.481	34.513	34.513	25.663
65	36.655	32.726	32.726	26.979
70	34.999	30.573	30.573	27.834
75	34.263	30.222	30.222	28.190
80	33.620	29.943	29.943	28.247
85	32.969	29.702	29.702	28.208
360	29.496	29.496	29.496	28.160

Tabel 18. Hasil pengambilan data rangkaian *Heat pipe* tanpa *sink* tegangan 100V

Menit	T _{u, Before} PHE	T _{u, After} PHE	T _{u, Before} cooler	T _{u, After} cooler
0	29.500	29.500	29.500	29.500
5	32.692	30.920	30.920	26.517
10	39.752	35.587	35.587	26.946
15	43.569	38.401	38.401	28.476
20	45.603	40.497	40.497	29.519
25	46.714	41.544	41.544	30.428
30	47.531	42.255	42.255	30.863
35	48.145	42.739	42.739	31.206
40	48.450	43.185	43.185	31.335
45	48.673	43.365	43.365	31.459
50	48.872	43.418	43.418	31.564
55	48.947	43.534	43.534	31.672
60	48.924	43.617	43.617	31.693
65	44.728	37.504	37.504	30.537
70	40.517	33.411	33.411	29.653
75	38.614	32.365	32.365	29.546
80	37.169	31.639	31.639	29.365
85	36.034	31.134	31.134	29.240
90	34.929	30.646	30.646	28.985



Tabel 19. Hasil pengambilan data rangkaian tanpa *passive heat exchanger*

Menit	25 V		50V		75V		100V	
	T _{U, Before} cooler	T _{U, After} cooler	T _{U, Before} cooler	T _{U, After} cooler	T _{U, Before} cooler	T _{U, After} cooler	T _{U, Before} cooler	T _{U, After} cooler
0	27.500	27.500	28.589	28.000	29.000	29.000	29.500	29.500
5	27.073	25.616	28.154	25.468	29.983	26.550	32.032	27.567
10	26.081	22.234	28.390	23.336	32.062	25.511	37.430	28.869
15	25.630	20.857	29.022	22.865	34.029	25.777	41.176	30.546
20	25.381	20.417	29.473	22.855	34.872	26.193	43.762	31.660
25	25.077	20.171	29.679	22.840	35.455	26.282	45.489	32.369
30	24.977	20.116	29.865	22.842	35.836	26.439	46.308	32.998
35	24.926	20.114	30.054	22.832	36.118	26.446	46.766	33.476
40	24.956	20.179	30.230	22.830	36.243	26.460	47.110	33.829
45	24.959	20.226	30.344	22.878	36.343	26.523	47.424	34.034
50	25.024	20.241	30.394	22.982	36.498	26.665	47.598	34.155
55	25.062	20.249	30.461	23.092	36.647	26.650	47.696	34.184
60	25.026	20.263	30.508	23.379	36.768	26.682	47.785	34.248
65	25.312	22.212	28.987	24.511	33.534	27.925	40.106	31.461
70	26.316	25.176	28.730	26.299	31.565	28.303	36.376	30.252
75	26.867	26.251	28.947	27.170	31.203	28.596	35.048	30.044
80	27.225	26.792	29.072	27.648	30.873	28.709	34.044	29.802
85	27.485	27.111	29.134	27.906	30.571	28.729	33.208	29.588
90	27.698	27.336	29.181	28.063	30.292	28.721	32.485	29.373



Tabel 20. Penyerapan dan pelepasan kalor dalam saluran

<i>Konfigurasi</i>	Voltage (V)	\dot{Q}_{PHE} (W)	\dot{Q}_c (W)	\dot{Q}_H (W)	Losses	Persentase losses (%)
<i>Hp & Sink</i>	25	6.21	93.34	94.24	-5.31	5.63
	50	39.51	140.85	184.05	3.69	2.01
	75	85.16	198.37	292.39	8.86	3.03
	100	145.24	259.23	421.96	17.49	4.14
HP	25	3.42	102.38	103.03	-2.77	2.69
	50	31.13	154.01	189.22	4.08	2.16
	75	71.38	214.85	295.56	9.33	3.16
	100	123.12	281.21	422.29	17.96	4.25
Tanpa PHE	25	0.72	119.37	117.42	1.95	1.59
	50	9.38	175.39	181.96	4.55	2.40
	75	51.13	243.13	304.60	10.34	3.40
	100	85.11	315.12	424.96	24.74	5.82



Lampiran 2 Referensi perhitungan

TABLE A-15

Properties of air at 1 atm pressure

Temp. $T, ^\circ\text{C}$	Density $\rho, \text{kg/m}^3$	Specific Heat $c_p, \text{J/kg}\cdot\text{K}$	Thermal Conductivity $k, \text{W/m}\cdot\text{K}$	Thermal Diffusivity $\alpha, \text{m}^2/\text{s}$	Dynamic Viscosity $\mu, \text{kg/m}\cdot\text{s}$	Kinematic Viscosity $\nu, \text{m}^2/\text{s}$	Prandtl Number Pr
-150	2.866	983	0.01171	4.158×10^{-6}	8.636×10^{-6}	3.013×10^{-6}	0.7246
-100	2.038	966	0.01582	8.036×10^{-6}	1.189×10^{-5}	5.837×10^{-6}	0.7263
-50	1.582	999	0.01979	1.252×10^{-5}	1.474×10^{-5}	9.319×10^{-6}	0.7440
-40	1.514	1002	0.02057	1.356×10^{-5}	1.527×10^{-5}	1.008×10^{-5}	0.7436
-30	1.451	1004	0.02134	1.465×10^{-5}	1.579×10^{-5}	1.087×10^{-5}	0.7425
-20	1.394	1005	0.02211	1.578×10^{-5}	1.630×10^{-5}	1.169×10^{-5}	0.7408
-10	1.341	1006	0.02288	1.696×10^{-5}	1.680×10^{-5}	1.252×10^{-5}	0.7387
0	1.292	1006	0.02364	1.818×10^{-5}	1.729×10^{-5}	1.338×10^{-5}	0.7362
5	1.269	1006	0.02401	1.880×10^{-5}	1.754×10^{-5}	1.382×10^{-5}	0.7350
10	1.246	1006	0.02439	1.944×10^{-5}	1.778×10^{-5}	1.426×10^{-5}	0.7336
15	1.225	1007	0.02476	2.009×10^{-5}	1.802×10^{-5}	1.470×10^{-5}	0.7323
20	1.204	1007	0.02514	2.074×10^{-5}	1.825×10^{-5}	1.516×10^{-5}	0.7309
25	1.184	1007	0.02551	2.141×10^{-5}	1.849×10^{-5}	1.562×10^{-5}	0.7296
30	1.164	1007	0.02588	2.208×10^{-5}	1.872×10^{-5}	1.608×10^{-5}	0.7282
35	1.145	1007	0.02625	2.277×10^{-5}	1.895×10^{-5}	1.655×10^{-5}	0.7268
40	1.127	1007	0.02662	2.346×10^{-5}	1.918×10^{-5}	1.702×10^{-5}	0.7255
45	1.109	1007	0.02699	2.416×10^{-5}	1.941×10^{-5}	1.750×10^{-5}	0.7241
50	1.092	1007	0.02735	2.487×10^{-5}	1.963×10^{-5}	1.798×10^{-5}	0.7228
60	1.059	1007	0.02808	2.632×10^{-5}	2.008×10^{-5}	1.896×10^{-5}	0.7202
70	1.028	1007	0.02881	2.780×10^{-5}	2.052×10^{-5}	1.995×10^{-5}	0.7177
80	0.9994	1008	0.02953	2.931×10^{-5}	2.096×10^{-5}	2.097×10^{-5}	0.7154
90	0.9718	1008	0.03024	3.086×10^{-5}	2.139×10^{-5}	2.201×10^{-5}	0.7132
100	0.9458	1009	0.03095	3.243×10^{-5}	2.181×10^{-5}	2.306×10^{-5}	0.7111
120	0.8977	1011	0.03235	3.565×10^{-5}	2.264×10^{-5}	2.522×10^{-5}	0.7073
140	0.8542	1013	0.03374	3.898×10^{-5}	2.345×10^{-5}	2.745×10^{-5}	0.7041
160	0.8148	1016	0.03511	4.241×10^{-5}	2.420×10^{-5}	2.975×10^{-5}	0.7014
180	0.7788	1019	0.03646	4.593×10^{-5}	2.504×10^{-5}	3.212×10^{-5}	0.6992
200	0.7459	1023	0.03779	4.954×10^{-5}	2.577×10^{-5}	3.455×10^{-5}	0.6974
250	0.6746	1033	0.04104	5.890×10^{-5}	2.760×10^{-5}	4.091×10^{-5}	0.6946
300	0.6158	1044	0.04418	6.871×10^{-5}	2.934×10^{-5}	4.765×10^{-5}	0.6935
350	0.5664	1056	0.04721	7.892×10^{-5}	3.101×10^{-5}	5.475×10^{-5}	0.6937
400	0.5243	1069	0.05015	8.951×10^{-5}	3.261×10^{-5}	6.219×10^{-5}	0.6948
450	0.4880	1081	0.05298	1.004×10^{-4}	3.415×10^{-5}	6.997×10^{-5}	0.6965
500	0.4565	1093	0.05572	1.117×10^{-4}	3.563×10^{-5}	7.806×10^{-5}	0.6986
600	0.4042	1115	0.06093	1.352×10^{-4}	3.846×10^{-5}	9.515×10^{-5}	0.7037
700	0.3627	1135	0.06581	1.598×10^{-4}	4.111×10^{-5}	1.133×10^{-4}	0.7092
800	0.3289	1153	0.07037	1.855×10^{-4}	4.362×10^{-5}	1.326×10^{-4}	0.7149
900	0.3008	1169	0.07465	2.122×10^{-4}	4.600×10^{-5}	1.529×10^{-4}	0.7206
1000	0.2772	1184	0.07868	2.398×10^{-4}	4.826×10^{-5}	1.741×10^{-4}	0.7260
1500	0.1990	1234	0.09599	3.908×10^{-4}	5.817×10^{-5}	2.922×10^{-4}	0.7478
2000	0.1553	1264	0.11113	5.664×10^{-4}	6.630×10^{-5}	4.270×10^{-4}	0.7539

Note: For ideal gases, the properties c_p , k , μ , and Pr are independent of pressure. The properties ρ , ν , and α at a pressure P (in atm) other than 1 atm are determined by multiplying the values of ρ at the given temperature by P and by dividing ν and α by P .

Source: Data generated from the EES software developed by S. A. Klein and F. L. Alvarado. Original sources: Keenan, Chao, Keyes, Gas Tables, Wiley, 1984; and Thermophysical Properties of Matter, Vol. 3: Thermal Conductivity, Y. S. Touloukian, P. E. Liley, S. C. Saxena, Vol. 11: Viscosity, Y. S. Touloukian, S. C. Saxena, and P. Hestermans, IFI/Plenum, NY, 1970, ISBN 0-306067020-8.

Gambar 46 Sifat Udara Pada Tekanan 1 atm (Cengel tabel A-15)



Lampiran 3 Dokumentasi penelitian

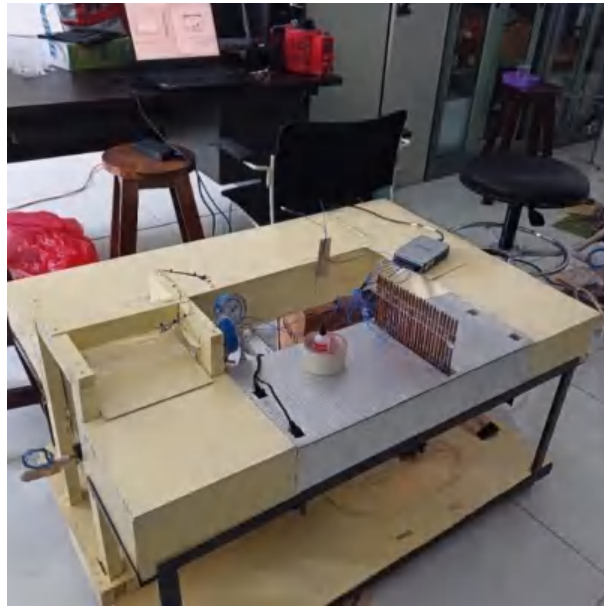


Gambar 47 Pemasangan termokopel pada modul labview



Gambar 48 Pemasangan PHE pada saluran udara





Gambar 49 Dokumentasi saat pengambilan data

