



LAMPIRAN 1

TABEL PERCOBAAN (PENGAMBILAN DATA) DEBIT AIR TERHADAP FREKUENSI

Penggunaan Frekuensi dan ketinggian :

Data Awal :

(Panjang x Lebar) = (60 x 30) cm

Hz	Tinggi (T) [cm]
30	1
32	1
34	1
36	2
38	2
40	2

Dimana $Q = \text{Volume (m}^3\text{/s)} / \text{Waktu (det)}$

Hasil Percobaan :

1. Hz = 30; Untuk t = 1 cm

No.	Waktu t (det)	Volume (m3)	Q (m3/s)
1	2.77	0.0018	0.000650
2	2.83	0.0018	0.000636
3	3.01	0.0018	0.000598
4	2.71	0.0018	0.000664
5	2.92	0.0018	0.000616
6	2.98	0.0018	0.000604
7	2.9	0.0018	0.000621
8	2.85	0.0018	0.000632
9	2.62	0.0018	0.000687
10	2.91	0.0018	0.000619
11	2.84	0.0018	0.000634
12	2.73	0.0018	0.000659
13	2.76	0.0018	0.000652
14	2.74	0.0018	0.000657
15	2.9	0.0018	0.000621
16	2.85	0.0018	0.000632
17	2.64	0.0018	0.000682
18	2.74	0.0018	0.000657
19	2.93	0.0018	0.000614
20	2.73	0.0018	0.000659
21	2.91	0.0018	0.000619
22	2.92	0.0018	0.000616
23	2.88	0.0018	0.000625
24	2.87	0.0018	0.000627
25	2.83	0.0018	0.000636
26	2.77	0.0018	0.000650
27	2.86	0.0018	0.000629
28	2.81	0.0018	0.000641
29	2.93	0.0018	0.000614
30	2.95	0.0018	0.000610
AVG			0.000635

2. Hz = 32; Untuk t = 1 cm

No.	Waktu t (det)	Volume (m3)	Q (m3/s)
1	2.77	0.0018	0.000650
2	2.91	0.0018	0.000619
3	2.64	0.0018	0.000682
4	2.85	0.0018	0.000632
5	2.72	0.0018	0.000662
6	2.73	0.0018	0.000659
7	2.81	0.0018	0.000641
8	2.88	0.0018	0.000625
9	2.64	0.0018	0.000682
10	2.71	0.0018	0.000664
11	2.63	0.0018	0.000684
12	2.72	0.0018	0.000662
13	2.83	0.0018	0.000636
14	2.75	0.0018	0.000655
15	2.8	0.0018	0.000643
16	2.79	0.0018	0.000645
17	2.73	0.0018	0.000659
18	2.77	0.0018	0.000650
19	2.7	0.0018	0.000667
20	2.81	0.0018	0.000641
21	2.83	0.0018	0.000636
22	2.8	0.0018	0.000643
23	2.71	0.0018	0.000664
24	2.74	0.0018	0.000657
25	2.73	0.0018	0.000659
26	2.77	0.0018	0.000650
27	2.78	0.0018	0.000647
28	2.76	0.0018	0.000652
29	2.71	0.0018	0.000664
30	2.7	0.0018	0.000667
AVG			0.000653

3. Hz = 34; Untuk t = 1 cm

No.	Waktu t (det)	Volume (m3)	Q (m3/s)
1	2.47	0.0018	0.000729
2	2.92	0.0018	0.000616
3	2.62	0.0018	0.000687
4	2.54	0.0018	0.000709
5	2.64	0.0018	0.000682
6	2.78	0.0018	0.000647
7	2.62	0.0018	0.000687
8	2.39	0.0018	0.000753
9	2.72	0.0018	0.000662
10	2.51	0.0018	0.000717
11	2.55	0.0018	0.000706
12	2.49	0.0018	0.000723
13	2.35	0.0018	0.000766
14	2.5	0.0018	0.000720
15	2.55	0.0018	0.000706
16	2.6	0.0018	0.000692
17	2.6	0.0018	0.000692
18	2.51	0.0018	0.000717
19	2.48	0.0018	0.000726
20	2.44	0.0018	0.000738
21	2.58	0.0018	0.000698
22	2.53	0.0018	0.000711
23	2.5	0.0018	0.000720
24	2.48	0.0018	0.000726
25	2.56	0.0018	0.000703
26	2.53	0.0018	0.000711
27	2.51	0.0018	0.000717
28	2.49	0.0018	0.000723
29	2.58	0.0018	0.000698
30	2.55	0.0018	0.000706
AVG			0.000706

4. Hz = 36; Untuk t = 2 cm

No.	Waktu t (det)	Volume (m3)	Q (m3/s)
1	4.79	0.0036	0.000752
2	4.55	0.0036	0.000791
3	4.92	0.0036	0.000732
4	4.52	0.0036	0.000796
5	4.55	0.0036	0.000791
6	4.4	0.0036	0.000818
7	4.83	0.0036	0.000745
8	4.75	0.0036	0.000758
9	4.63	0.0036	0.000778
10	4.44	0.0036	0.000811
11	4.65	0.0036	0.000774
12	4.66	0.0036	0.000773
13	4.55	0.0036	0.000791
14	4.53	0.0036	0.000795
15	4.51	0.0036	0.000798
16	4.7	0.0036	0.000766
17	4.64	0.0036	0.000776
18	4.67	0.0036	0.000771
19	4.59	0.0036	0.000784
20	4.68	0.0036	0.000769
21	4.75	0.0036	0.000758
22	4.65	0.0036	0.000774
23	4.82	0.0036	0.000747
24	4.5	0.0036	0.000800
25	4.64	0.0036	0.000776
26	4.61	0.0036	0.000781
27	4.69	0.0036	0.000768
28	4.7	0.0036	0.000766
29	4.76	0.0036	0.000756
30	4.67	0.0036	0.000771
AVG			0.000776

5. Hz = 38; Untuk t = 2 cm

No.	Waktu t (det)	Volume (m3)	Q (m3/s)
1	4.6	0.0036	0.000783
2	4.33	0.0036	0.000831
3	4.17	0.0036	0.000863
4	4.23	0.0036	0.000851
5	4.33	0.0036	0.000831
6	4.41	0.0036	0.000816
7	4.3	0.0036	0.000837
8	4.63	0.0036	0.000778
9	4.48	0.0036	0.000804
10	4.25	0.0036	0.000847
11	4.53	0.0036	0.000795
12	4.51	0.0036	0.000798
13	4.46	0.0036	0.000807
14	4.4	0.0036	0.000818
15	4.45	0.0036	0.000809
16	4.39	0.0036	0.000820
17	4.47	0.0036	0.000805
18	4.52	0.0036	0.000796
19	4.67	0.0036	0.000771
20	4.42	0.0036	0.000814
21	4.51	0.0036	0.000798
22	4.61	0.0036	0.000781
23	4.45	0.0036	0.000809
24	4.43	0.0036	0.000813
25	4.49	0.0036	0.000802
26	4.52	0.0036	0.000796
27	4.4	0.0036	0.000818
28	4.43	0.0036	0.000813
29	4.47	0.0036	0.000805
30	4.41	0.0036	0.000816
AVG			0.000811

6. Hz = 40; Untuk t = 2 cm

No.	Waktu t (det)	Volume (m3)	Q (m3/s)
1	4.24	0.0036	0.000849
2	4.36	0.0036	0.000826
3	4.47	0.0036	0.000805
4	4.32	0.0036	0.000833
5	4.16	0.0036	0.000865
6	4.27	0.0036	0.000843
7	4.11	0.0036	0.000876
8	4.1	0.0036	0.000878
9	4.23	0.0036	0.000851
10	4.05	0.0036	0.000889
11	4.04	0.0036	0.000891
12	4.12	0.0036	0.000874
13	4.18	0.0036	0.000861
14	4.13	0.0036	0.000872
15	4.08	0.0036	0.000882
16	4.23	0.0036	0.000851
17	4.09	0.0036	0.000880
18	4.21	0.0036	0.000855
19	4.19	0.0036	0.000859
20	4.09	0.0036	0.000880
21	4.04	0.0036	0.000891
22	4.14	0.0036	0.000870
23	4.07	0.0036	0.000885
24	4.15	0.0036	0.000867
25	4.13	0.0036	0.000872
26	4.08	0.0036	0.000882
27	4.02	0.0036	0.000896
28	4.05	0.0036	0.000889
29	4.14	0.0036	0.000870
30	4.06	0.0036	0.000887
AVG			0.000868

LAMPIRAN 2

DATA KECEPATAN KONVERSI DARI DEBIT

DIKETAHUI :

D1 (misal) =	2.8	cm		
=	0.028	m	0.028	m
=	0.014		0.014	
A1 =	0.000616	m ²		

1. Tabel kecepatan vs Q Hz = 30

No.	Q (m ³ /s)	V (m/s)
1	0.000650	1.054902
2	0.000636	1.032536
3	0.000598	0.970790
4	0.000664	1.078258
5	0.000616	1.000712
6	0.000604	0.980563
7	0.000621	1.007613
8	0.000632	1.025290
9	0.000687	1.115297
10	0.000619	1.004150
11	0.000634	1.028901
12	0.000659	1.070358
13	0.000652	1.058724
14	0.000657	1.066452
15	0.000621	1.007613
16	0.000632	1.025290
17	0.000682	1.106848
18	0.000657	1.066452
19	0.000614	0.997296
20	0.000659	1.070358
21	0.000619	1.004150
22	0.000616	1.000712
23	0.000625	1.014610
24	0.000627	1.018146
25	0.000636	1.032536
26	0.000650	1.054902
27	0.000629	1.021706
28	0.000641	0.000631
29	0.000614	0.997296
30	0.000610	0.990535
AVG		0.996788

2. Tabel kecepatan vs Q pada Hz = 32

No.	Q (m ³ /s)	V (m/s)
1	0.000650	1.054902
2	0.000619	1.004150
3	0.000682	1.106848
4	0.000632	1.025290
5	0.000662	1.074293
6	0.000659	1.070358
7	0.000641	1.039885
8	0.000625	1.014610
9	0.000682	1.106848
10	0.000664	1.078258
11	0.000684	1.111056
12	0.000662	1.074293
13	0.000636	1.032536
14	0.000655	1.062574
15	0.000643	1.043599
16	0.000645	1.047340
17	0.000659	1.070358
18	0.000650	1.054902
19	0.000667	1.082251
20	0.000641	1.039885
21	0.000636	1.032536
22	0.000643	1.043599
23	0.000664	1.078258
24	0.000657	1.066452
25	0.000659	1.070358
26	0.000650	1.054902
27	0.000647	1.051107
28	0.000652	1.058724
29	0.000664	1.078258
30	0.000667	1.082251
AVG		1.060356

3. Tabel kecepatan vs Q pada Hz = 34

No.	Q (m ³ /s)	V (m/s)
1	0.000729	1.183027
2	0.000616	1.000712
3	0.000687	1.115297
4	0.000709	1.150424
5	0.000682	1.106848
6	0.000647	1.051107
7	0.000687	1.115297
8	0.000753	1.222627
9	0.000662	1.074293
10	0.000717	1.164174
11	0.000706	1.145913
12	0.000723	1.173525
13	0.000766	1.243437
14	0.000720	1.168831
15	0.000706	1.145913
16	0.000692	1.123876
17	0.000692	1.123876
18	0.000717	1.164174
19	0.000726	1.178257
20	0.000738	1.197573
21	0.000698	1.132588
22	0.000711	1.154972
23	0.000720	1.168831
24	0.000726	1.178257
25	0.000703	1.141437
26	0.000711	1.154972
27	0.000717	1.164174
28	0.000723	1.173525
29	0.000698	1.132588
30	0.000706	1.145913
AVG		1.146548

4. Tabel kecepatan vs Q pada Hz = 36

No.	Q (m ³ /s)	V (m/s)
1	0.000752	1.220074
2	0.000791	1.284430
3	0.000732	1.187837
4	0.000796	1.292955
5	0.000791	1.284430
6	0.000818	1.328217
7	0.000745	1.209970
8	0.000758	1.230349
9	0.000778	1.262237
10	0.000811	1.316251
11	0.000774	1.256808
12	0.000773	1.254111
13	0.000791	1.284430
14	0.000795	1.290101
15	0.000798	1.295822
16	0.000766	1.243437
17	0.000776	1.259516
18	0.000771	1.251425
19	0.000784	1.273237
20	0.000769	1.248751
21	0.000758	1.230349
22	0.000774	1.256808
23	0.000747	1.212480
24	0.000800	1.298701
25	0.000776	1.259516
26	0.000781	1.267713
27	0.000768	1.246089
28	0.000766	1.243437
29	0.000756	1.227764
30	0.000771	1.251425
AVG		1.258956

5. Tabel kecepatan vs Q pada Hz = 38

No.	Q (m ³ /s)	V (m/s)
1	0.000783	1.270469
2	0.000831	1.349690
3	0.000863	1.401476
4	0.000851	1.381597
5	0.000831	1.349690
6	0.000816	1.325205
7	0.000837	1.359106
8	0.000778	1.262237
9	0.000804	1.304499
10	0.000847	1.375095
11	0.000795	1.290101
12	0.000798	1.295822
13	0.000807	1.310349
14	0.000818	1.328217
15	0.000809	1.313293
16	0.000820	1.331243
17	0.000805	1.307417
18	0.000796	1.292955
19	0.000771	1.251425
20	0.000814	1.322207
21	0.000798	1.295822
22	0.000781	1.267713
23	0.000809	1.313293
24	0.000813	1.319223
25	0.000802	1.301594
26	0.000796	1.292955
27	0.000818	1.328217
28	0.000813	1.319223
29	0.000805	1.307417
30	0.000816	1.325205
AVG		1.316425

6. Tabel kecepatan vs Q pada Hz = 40

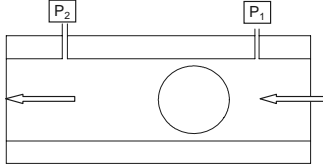
No.	Q (m ³ /s)	V (m/s)
1	0.000849	1.378339
2	0.000826	1.340403
3	0.000805	1.307417
4	0.000833	1.352814
5	0.000865	1.404845
6	0.000843	1.368655
7	0.000876	1.421936
8	0.000878	1.425404
9	0.000851	1.381597
10	0.000889	1.443001
11	0.000891	1.446573
12	0.000874	1.418484
13	0.000861	1.398123
14	0.000872	1.415050
15	0.000882	1.432391
16	0.000851	1.381597
17	0.000880	1.428889
18	0.000855	1.388161
19	0.000859	1.394787
20	0.000880	1.428889
21	0.000891	1.446573
22	0.000870	1.411632
23	0.000885	1.435911
24	0.000867	1.408230
25	0.000872	1.415050
26	0.000882	1.432391
27	0.000896	1.453770
28	0.000889	1.443001
29	0.000870	1.411632
30	0.000887	1.439447
AVG		1.408500

LAMPIRAN 3

TABEL PERCOBAAN (PENGAMBILAN DATA) PENGUKURAN TEKANAN THD. FREKUENSI

Penggunaan Frekuensi : 30 s.d 40 Hz

Alat bantu : Manometer U (raksa) dan Pressure Gauge



1. Hz = 30; dalam cmHg

No.	ΔP_1	mmHg	ΔP_2	Pa (N/m ²)
1	29.3	293	1	39063.346
2	29.2	292	1	38930.024
3	29	290	1	38663.38
4	29.3	293	1	39063.346
5	29.3	293	1	39063.346
6	29.5	295	1	39329.99
7	29.5	295	1	39329.99
8	29	290	1	38663.38
9	29	290	1	38663.38
10	29.3	293	1	39063.346
11	29	290	1	38663.38
12	29.4	294	1	39196.668
13	29.5	295	1	39329.99
14	29.3	293	1	39063.346
15	29.4	294	1	39196.668
16	29.2	292	1	38930.024
17	29.4	294	1	39196.668
18	29.4	294	1	39196.668
19	29.3	293	1	39063.346
20	29.5	295	1	39329.99
21	29.2	292	1	38930.024
22	29.2	292	1	38930.024
23	29.2	292	1	38930.024
24	29.3	293	1	39063.346
25	29.3	293	1	39063.346
26	29	290	1	38663.38
27	29.5	295	1	39329.99
28	29	290	1	38663.38
29	29.5	295	1	39329.99
30	29.3	293	1	39063.346
AVG				39032.23753

2. Hz = 32; dalam cmHg

No.	ΔP_1	mmHg	ΔP_2	Pa (N/m ²)
1	35.2	352	1	46929.344
2	35.2	352	1	46929.344
3	35	350	1	46662.7
4	35.3	353	1	47062.666
5	35.5	355	1	47329.31
6	35.3	353	1	47062.666
7	35	350	1	46662.7
8	35	350	1	46662.7
9	35.4	354	1	47195.988
10	35.2	352	1	46929.344
11	35.2	352	1	46929.344
12	35.4	354	1	47195.988
13	35.4	354	1	47195.988
14	35.4	354	1	47195.988
15	35.3	353	1	47062.666
16	35.2	352	1	46929.344
17	35.2	352	1	46929.344
18	35	350	1	46662.7
19	35	350	1	46662.7
20	35.5	355	1	47329.31
21	35.4	354	1	47195.988
22	35.2	352	1	46929.344
23	35.4	354	1	47195.988
24	35.3	353	1	47062.666
25	35.3	353	1	47062.666
26	35	350	1	46662.7
27	35.4	354	1	47195.988
28	35.4	354	1	47195.988
29	35.4	354	1	47195.988
30	35.2	352	1	46929.344
AVG				47004.89313

3. Hz = 34; dalam Psi

No.	ΔP_1	ΔP_2	Pa (N/m ²)
1	7	1	48263.32
2	7	1	48263.32
3	7	1	48263.32
4	7	1	48263.32
5	7	1	48263.32
6	7.5	1	51710.7
7	7	1	48263.32
8	7.5	1	51710.7
9	7.5	1	51710.7
10	7	1	48263.32
11	7	1	48263.32
12	7	1	48263.32
13	7	1	48263.32
14	7	1	48263.32
15	7	1	48263.32
16	7	1	48263.32
17	7	1	48263.32
18	7	1	48263.32
19	7.5	1	51710.7
20	7	1	48263.32
21	7	1	48263.32
22	7	1	48263.32
23	7	1	48263.32
24	7	1	48263.32
25	7	1	48263.32
26	7	1	48263.32
27	7.5	1	51710.7
28	7	1	48263.32
29	7	1	48263.32
30	7	1	48263.32
AVG			48837.88333

4. Hz = 36; dalam Psi

No.	ΔP_1	ΔP_2	Pa (N/m ²)
1	9.5	1	65500.22
2	9	1	62052.84
3	9.5	1	65500.22
4	9.5	1	65500.22
5	9.5	1	65500.22
6	9	1	62052.84
7	9	1	62052.84
8	9.5	1	65500.22
9	9	1	62052.84
10	9	1	62052.84
11	9	1	62052.84
12	9	1	62052.84
13	9	1	62052.84
14	9	1	62052.84
15	9.5	1	65500.22
16	9	1	62052.84
17	9.5	1	65500.22
18	9	1	62052.84
19	9.5	1	65500.22
20	9	1	62052.84
21	9.5	1	65500.22
22	9.5	1	65500.22
23	9.5	1	65500.22
24	9.5	1	65500.22
25	9	1	62052.84
26	9	1	62052.84
27	9	1	62052.84
28	9	1	62052.84
29	9	1	62052.84
30	9	1	62052.84
AVG			63431.792

5. Hz = 38; dalam Psi

No.	ΔP_1	ΔP_2	Pa (N/m ²)
1	10.5	1	72394.98
2	10	1	68947.6
3	10.5	1	72394.98
4	10.5	1	72394.98
5	10	1	68947.6
6	10	1	68947.6
7	10.5	1	72394.98
8	10	1	68947.6
9	10	1	68947.6
10	10.5	1	72394.98
11	10	1	68947.6
12	10	1	68947.6
13	10	1	68947.6
14	10	1	68947.6
15	10	1	68947.6
16	10	1	68947.6
17	10.5	1	72394.98
18	10	1	68947.6
19	10	1	68947.6
20	10.5	1	72394.98
21	10	1	68947.6
22	10	1	68947.6
23	10	1	68947.6
24	10	1	68947.6
25	10	1	68947.6
26	10	1	68947.6
27	10.5	1	72394.98
28	10	1	68947.6
29	10	1	68947.6
30	10	1	68947.6
AVG			69866.90133

6. Hz = 40; dalam Psi

No.	ΔP_1	ΔP_2	Pa (N/m ²)
1	12	1	82737.12
2	11.5	1	79289.74
3	12	1	82737.12
4	12	1	82737.12
5	12	1	82737.12
6	12	1	82737.12
7	12	1	82737.12
8	12	1	82737.12
9	12	1	82737.12
10	11.5	1	79289.74
11	12	1	82737.12
12	11.5	1	79289.74
13	11.5	1	79289.74
14	12	1	82737.12
15	12	1	82737.12
16	12	1	82737.12
17	12	1	82737.12
18	11.5	1	79289.74
19	12	1	82737.12
20	12	1	82737.12
21	12	1	82737.12
22	12	1	82737.12
23	11.5	1	79289.74
24	12	1	82737.12
25	12	1	82737.12
26	12	1	82737.12
27	12	1	82737.12
28	11.5	1	79289.74
29	11.5	1	79289.74
30	12	1	82737.12
AVG			81817.81867

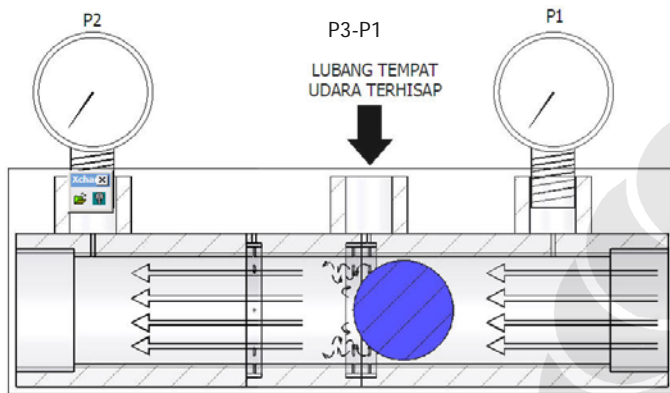
LAMPIRAN 4

RESUME HASIL SELURUH PERCOBAAN

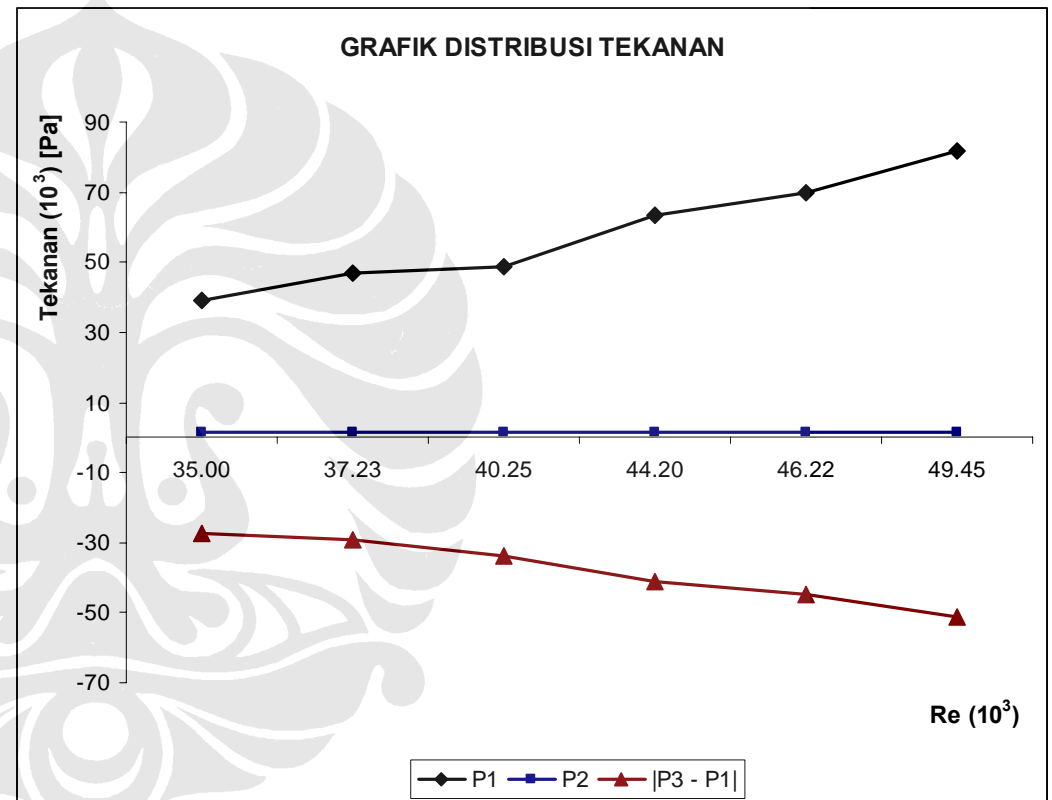
NO	FREKUENSI (Hz)	$P_1 (10^3) \text{ [Pa]}$	$P_2 (10^3) \text{ [Pa]}$	DEBIT (10^{-4}) [m^3/s]	KEC. Rata-rata \bar{U}_1 (m/s)	V_2 (m/s)	$P_3 - P_1 (10^3) \text{ [Pa]}$	Reynold No. (10^3)	DIAMETER RATA-RATA (μm)
1	30	39.03	1.33	6.35	0.997	7.236	-27.50	35.00	137.190
2	32	47.00	1.33	6.53	1.060	7.697	-29.06	37.23	103.996
3	34	48.84	1.33	7.06	1.147	8.323	-33.98	40.25	99.091
4	36	63.43	1.33	7.76	1.259	9.139	-40.97	44.20	95.966
5	38	69.87	1.33	8.11	1.316	9.556	-44.79	46.22	94.110
6	40	81.82	1.33	8.68	1.408	10.225	-51.28	49.45	86.069

LAMPIRAN 5

Ilustrasi distribusi tekanan berdasarkan bilangan Re.



NO	FREKUENSI (Hz)	Reynold No. (10^3)	P_1 (10^3) [Pa]	P_2 (10^3) [Pa]	$ P_3 - P_1 $ (10^3) [Pa]
1	30	35.00	39.03	1.33	-27.50
2	32	37.23	47.00	1.33	-29.06
3	34	40.25	48.84	1.33	-33.98
4	36	44.20	63.43	1.33	-40.97
5	38	46.22	69.87	1.33	-44.79
6	40	49.45	81.82	1.33	-51.28



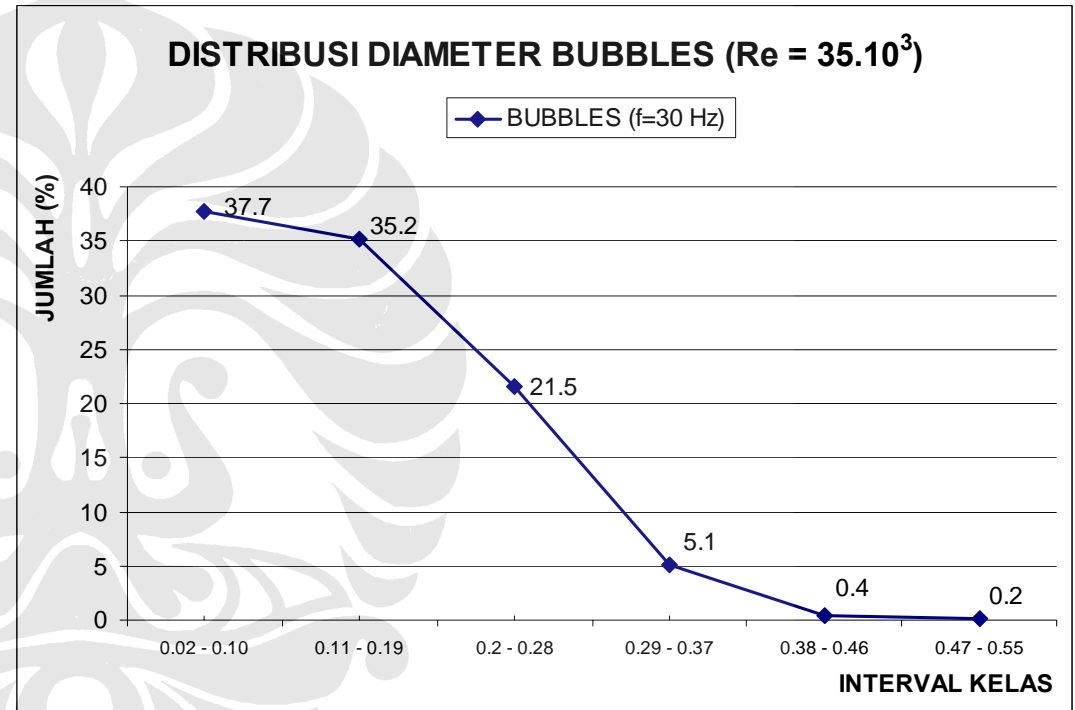
LAMPIRAN 6

DISTRIBUSI DIAMETER *BUBBLES* PADA $Re\ 35.10^3$

HASIL SORTIR SELURUH DATA

DATA TERBESAR 0.498405100
DATA TERKECIL 0.023033986
SELISIH 0.475371114
PEMBULATAN 0.48
DIBAGI 6 KELAS 0.08

KELAS	URUTAN KELAS	DIAMETER (mm)		JUMLAH	PERCENT
KELAS 1	0.02 - 0.10	0.02	0.10	207	37.7
KELAS 2	0.11 - 0.19	0.11	0.19	193	35.2
KELAS 3	0.2 - 0.28	0.2	0.28	118	21.5
KELAS 4	0.29 - 0.37	0.29	0.37	28	5.1
KELAS 5	0.38 - 0.46	0.38	0.46	2	0.4
KELAS 6	0.47 - 0.55	0.47	0.55	1	0.2
				549	100



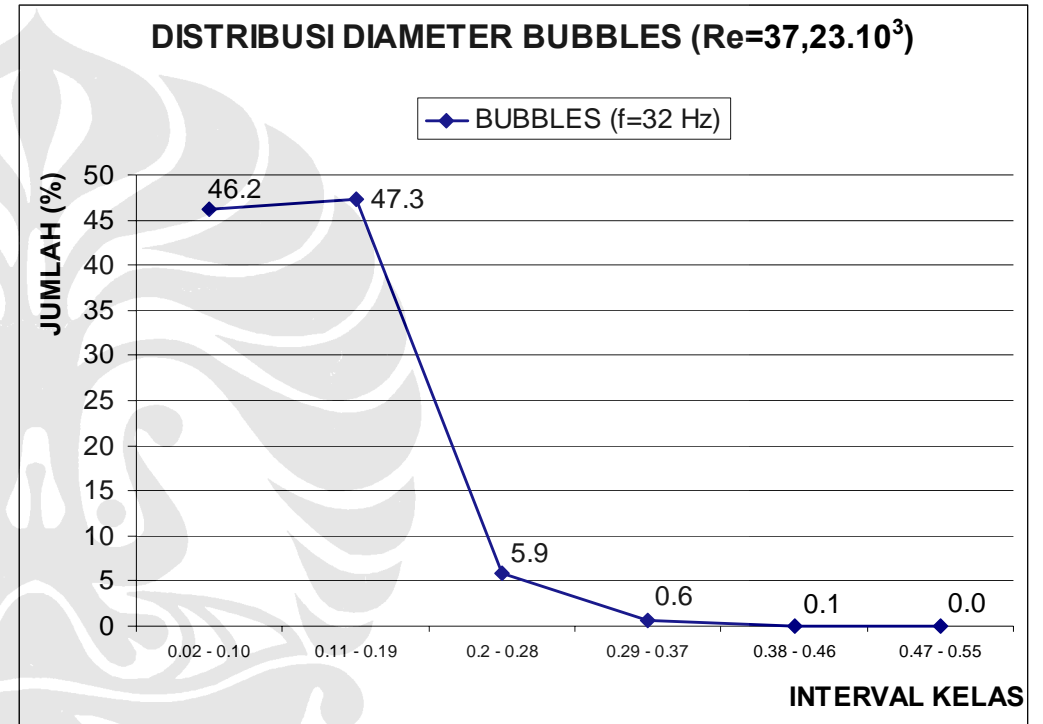
LAMPIRAN 7

DISTRIBUSI DIAMETER *BUBBLES* PADA $Re\ 37,23.10^3$

HASIL SORTIR SELURUH DATA

DATA TERBESAR 0.498405100
DATA TERKECIL 0.023033986
SELISIH 0.475371114
PEMBULATAN 0.48
DIBAGI 6 KELAS 0.08

KELAS	URUTAN KELAS	DIAMETER (mm)		JUMLAH	PERCENT
KELAS 1	0.02 - 0.10	0.02	0.10	207	37.7
KELAS 2	0.11 - 0.19	0.11	0.19	193	35.2
KELAS 3	0.2 - 0.28	0.2	0.28	118	21.5
KELAS 4	0.29 - 0.37	0.29	0.37	28	5.1
KELAS 5	0.38 - 0.46	0.38	0.46	2	0.4
KELAS 6	0.47 - 0.55	0.47	0.55	1	0.2
				549	100



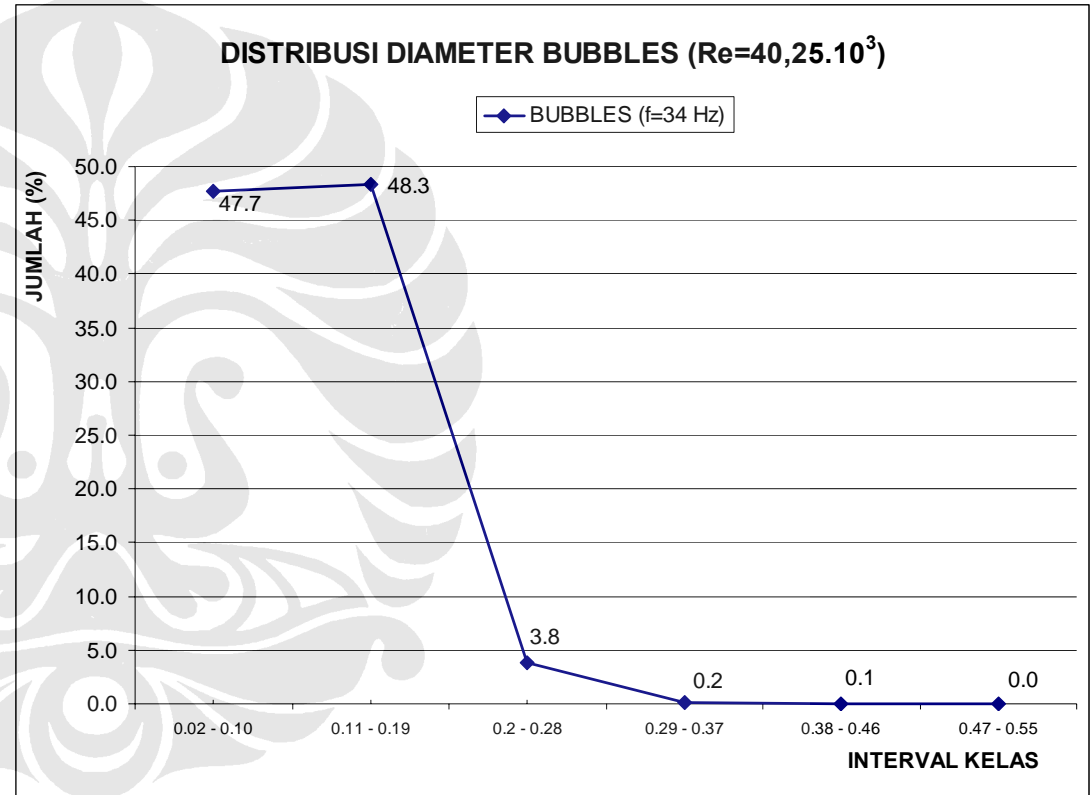
LAMPIRAN 8

DISTRIBUSI DIAMETER *BUBBLES* PADA $Re\ 40,25.10^3$

HASIL SORTIR SELURUH DATA

DATA TERBESAR 0.498405100
DATA TERKECIL 0.023033986
SELISIH 0.475371114
PEMBULATAN 0.48
DIBAGI 6 KELAS 0.08

KELAS	URUTAN KELAS	NILAI TERKECIL	NILAI TERBESAR	JUMLAH	PERCENT
KELAS 1	0.02 - 0.10	0.02	0.10	767	47.7
KELAS 2	0.11 - 0.19	0.11	0.19	777	48.3
KELAS 3	0.2 - 0.28	0.2	0.28	61	3.8
KELAS 4	0.29 - 0.37	0.29	0.37	3	0.2
KELAS 5	0.38 - 0.46	0.38	0.46	1	0.1
KELAS 6	0.47 - 0.55	0.47	0.55	0	0.0
				1609	100



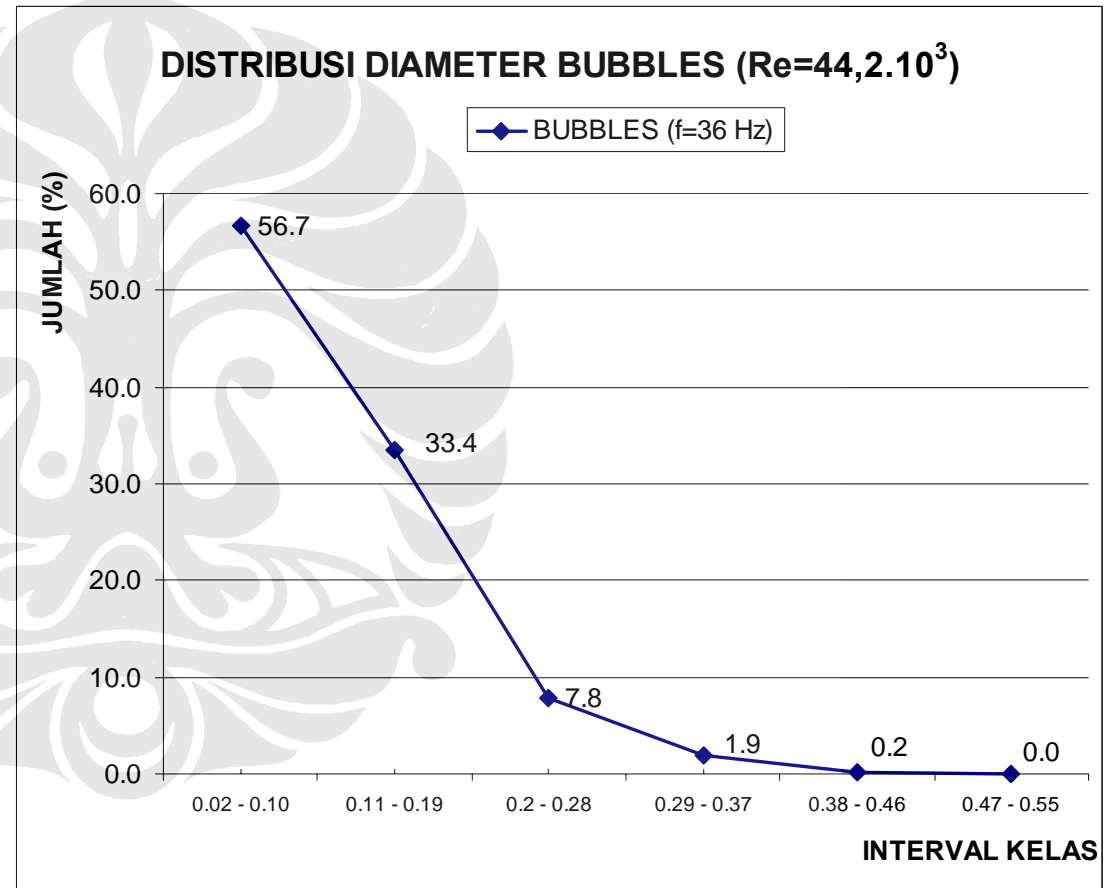
LAMPIRAN 9

DISTRIBUSI DIAMETER *BUBBLES* PADA $Re\ 44,2.10^3$

HASIL SORTIR SELURUH DATA

DATA TERBESAR 0.498405100
DATA TERKECIL 0.023033986
SELISIH 0.475371114
PEMBULATAN 0.48
DIBAGI 6 KELAS 0.08

KELAS	URUTAN KELAS	NILAI TERKECIL		JUMLAH	PERCENT
KELAS 1	0.02 - 0.10	0.02	0.10	702	56.7
KELAS 2	0.11 - 0.19	0.11	0.19	414	33.4
KELAS 3	0.2 - 0.28	0.2	0.28	97	7.8
KELAS 4	0.29 - 0.37	0.29	0.37	23	1.9
KELAS 5	0.38 - 0.46	0.38	0.46	2	0.2
KELAS 6	0.47 - 0.55	0.47	0.55	0	0.0
				1238	100



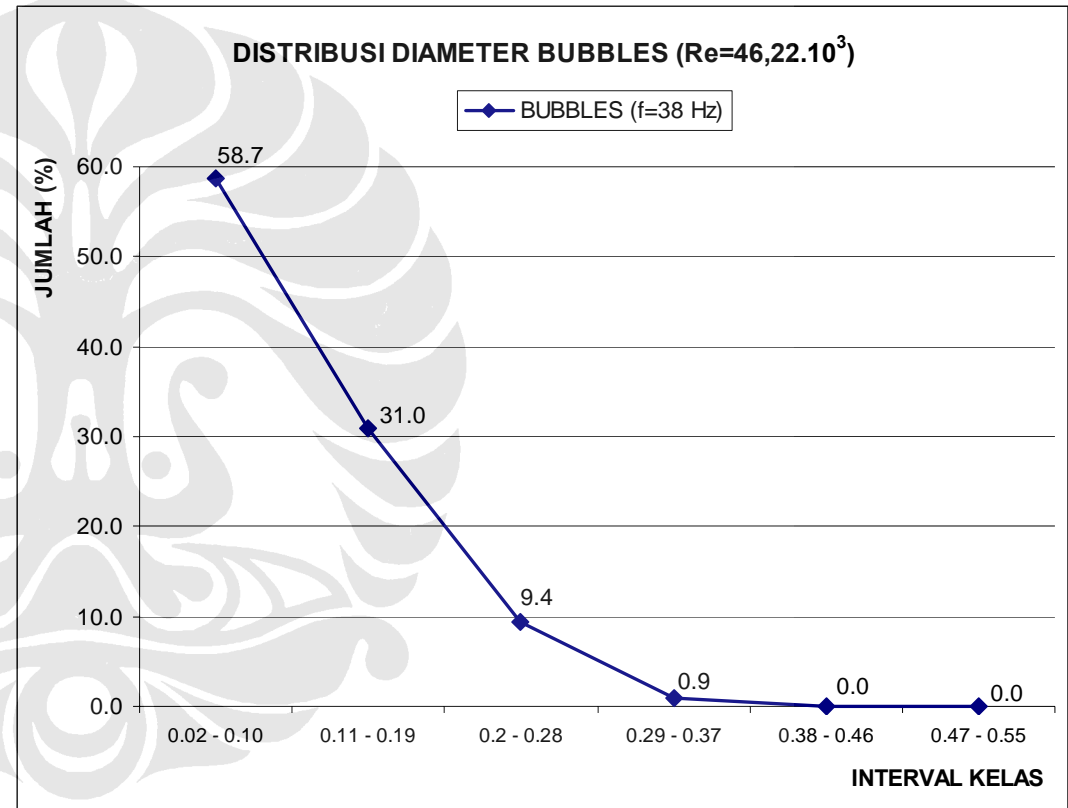
LAMPIRAN 10

DISTRIBUSI DIAMETER *BUBBLES* PADA $Re\ 46,22.10^3$

HASIL SORTIR SELURUH DATA

DATA TERBESAR 0.498405100
DATA TERKECIL 0.023033986
SELISIH 0.475371114
PEMBULATAN 0.48
DIBAGI 6 KELAS 0.08

KELAS	URUTAN KELAS	DIAMETER (mm)		JUMLAH	PERCENT
KELAS 1	0.02 - 0.10	0.02	0.10	921	58.7
KELAS 2	0.11 - 0.19	0.11	0.19	486	31.0
KELAS 3	0.2 - 0.28	0.2	0.28	148	9.4
KELAS 4	0.29 - 0.37	0.29	0.37	14	0.9
KELAS 5	0.38 - 0.46	0.38	0.46	0	0.0
KELAS 6	0.47 - 0.55	0.47	0.55	0	0.0
				1569	100

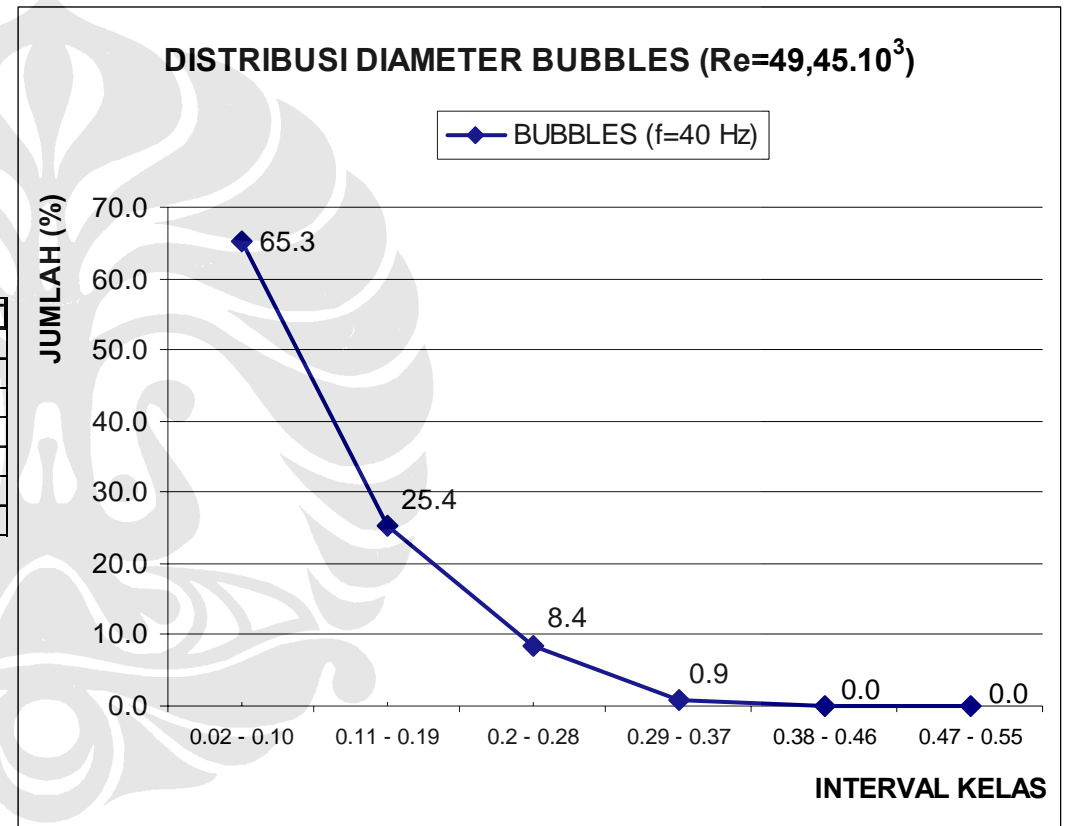


LAMPIRAN 11

DISTRIBUSI DIAMETER *BUBBLES* PADA $Re\ 49,45.10^3$

HASIL SORTIR SELURUH DATA	
DATA TERBESAR	0.498405100
DATA TERKECIL	0.023033986
SELISIH	0.475371114
PEMBULATAN	0.48
DIBAGI 6 KELAS	0.08

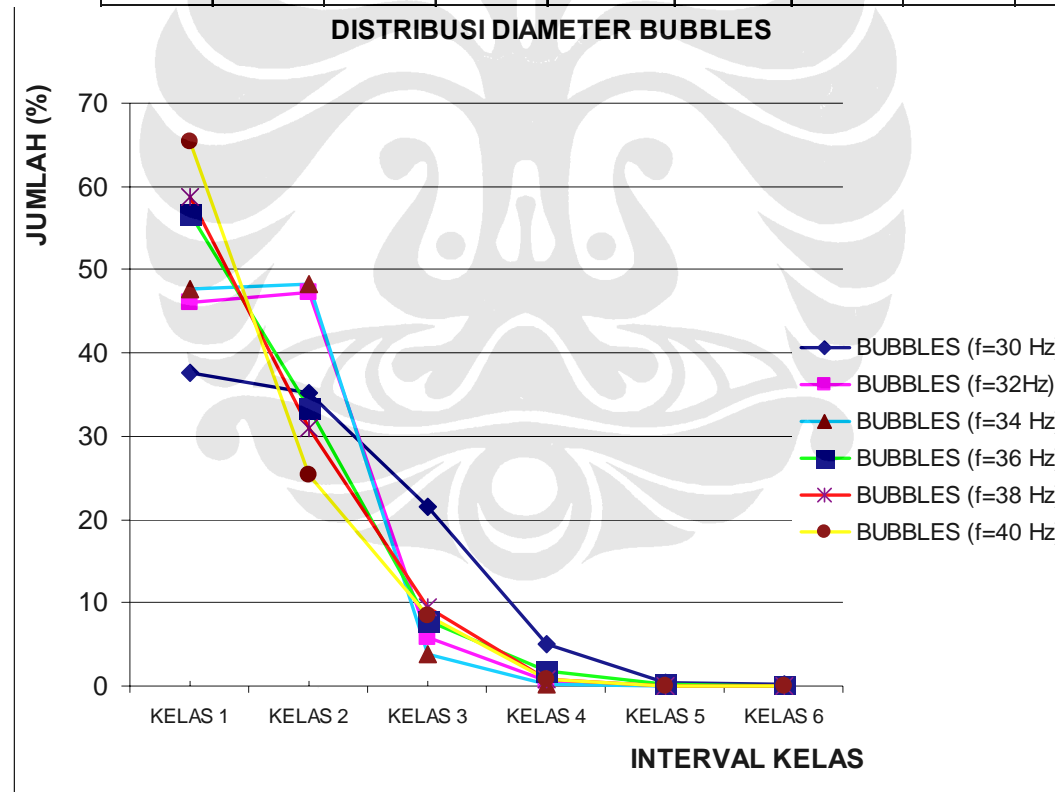
KELAS	URUTAN KELAS	DIAMETER (mm)		JUMLAH	PERCENT
KELAS 1	0.02 - 0.10	0.02	0.10	614	65.3
KELAS 2	0.11 - 0.19	0.11	0.19	239	25.4
KELAS 3	0.2 - 0.28	0.2	0.28	79	8.4
KELAS 4	0.29 - 0.37	0.29	0.37	8	0.9
KELAS 5	0.38 - 0.46	0.38	0.46	0	0.0
KELAS 6	0.47 - 0.55	0.47	0.55	0	0.0
				940	100



LAMPIRAN 12

GABUNGAN DISTRIBUSI DIAMETER *BUBBLES*

KELAS	INTERVAL KELAS	DIAMETER (mm)		Re = 35,00.10 ³		Re = 37,23.10 ³		Re = 40,25.10 ³		Re = 44,20.10 ³		Re = 46,22.10 ³		Re = 49,45.10 ³	
				JUMLAH	%	JUMLAH	%	DIAMETER	%	JUMLAH	%	JUMLAH	%	JUMLAH	PERCENT
KELAS 1	0.02 - 0.10	0.02	0.10	207	37.7	648	46.2	767	47.7	702	56.7	921	58.7	614	65.3
KELAS 2	0.11 - 0.19	0.11	0.19	193	35.2	664	47.3	777	48.3	414	33.4	486	31.0	239	25.4
KELAS 3	0.2 - 0.28	0.2	0.28	118	21.5	83	5.9	61	3.8	97	7.8	148	9.4	79	8.4
KELAS 4	0.29 - 0.37	0.29	0.37	28	5.1	8	0.6	3	0.2	23	1.9	14	0.9	8	0.9
KELAS 5	0.38 - 0.46	0.38	0.46	2	0.4	1	0.1	1	0.1	2	0.2	0	0.0	0	0.0
KELAS 6	0.47 - 0.55	0.47	0.55	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
				549	100	1404	100	1609	100	1238	100	1569	100	940	100



LAMPIRAN 13

**PERHITUNGAN PRESSURE DROP P₃-P₁ TEST SECTION
(BERDASARKAN KEMAMPUAN POMPA)**

Diketahui :		
ρ _{air}	=	1000 kg/m ³
Q	=	300 L/min
	=	5 L/s
Diameter Pipa	=	1.5 inch
	=	3.81 cm
	=	0.0381 m

5 dm³/s
0.005 m³/s

ASUMSI : D₁>D₂		
D ₁ (misal)	=	2.8 cm
	=	0.028 m
	=	0.014
A ₁	=	0.000616 m ²
Q ₁	=	A ₁ * V ₁
V ₁	=	$\frac{Q_1}{A_1} = \frac{0.005}{0.000616} = 8.116883$ m/s

$$\frac{Q_1}{A_1 \cdot V_1} = \frac{Q_3}{A_3 \cdot V_3}$$

MISAL :		
D ₃	=	2.6 cm
	=	0.026 m
	=	0.013
A ₃	=	0.000085 m ²
V ₃	=	$\frac{A_1 \cdot V_1}{A_3} = \frac{0.005}{8.49E-05} = 58.92256$ m/s

BERNOULI :

$$\frac{P_1}{\gamma_1} + \frac{V_1^2}{2 \cdot g} + z_1 = \frac{P_3}{\gamma_3} + \frac{V_3^2}{2 \cdot g} + z_3$$

$$\frac{P_1}{\rho_1 \cdot g} + \frac{V_1^2}{2 \cdot g} = \frac{P_3}{\rho_3 \cdot g} + \frac{V_3^2}{2 \cdot g}$$

$$\frac{V_1^2}{2 \cdot g} - \frac{V_3^2}{2 \cdot g} = \frac{P_3}{\rho_3 \cdot g} - \frac{P_1}{\rho_1 \cdot g}$$

$$\frac{V_1^2 - V_3^2}{2 \cdot g} = \frac{P_3 - P_1}{\rho \cdot g}$$

$$\frac{V_1^2 - V_3^2}{20} = \frac{P_3 - P_1}{1000 \cdot 10}$$

$$\frac{(V_1^2 - V_3^2) \cdot 10000}{20} = P_3 - P_1$$

V₁² = 65.88379153 m²/s²
V₃² = 3471.86795 m²/s²

P₃ - P₁ = -1702992 N/m² = -17.02992 bar

LAMPIRAN 14

PERHITUNGAN PRESSURE DROP $P_3 - P_1$ TEST SECTION

FREKUENSI INVERTER 30 Hz

Diketahui :

ρ_{air}	=	1000 kg/m ³
Q	=	0.000635 m ³ /s
	=	0.000635 m ³ /s
Diameter Pipa	=	1.5 inch
	=	3.81 cm
	=	0.0381 m

0.000635 m ³ /s (Debit hasil percobaan)
0.000635 m ³ /s

ASUMSI :

$D_1 > D_3$

D_1 (misal)	=	2.8 cm	
	=	0.028 m	0.028 m
	=	0.014	0.014
A_1	=	0.000616 m ²	
Q_1	=	$A_1 \cdot V_1$	
V_1	=	$\frac{Q_1}{A_1} = \frac{0.000635}{0.000616}$	= 1.031429391 m/s

Q_1	=	Q_3
$A_1 \cdot V_1$	=	$A_3 \cdot V_3$

MISAL :

D_3	=	2.6 cm	
	=	0.026 m	0.026 m
	=	0.013	0.013
A_3	=	0.00008 m ²	
V_3	=	$\frac{A_1 \cdot V_1}{A_3} = \frac{0.000635}{8.49E-05}$	= 7.487413358 m/s

BERNOULI :

$$\frac{P_1}{\gamma_1} + \frac{V_1^2}{2 \cdot g} + Z_1 = \frac{P_3}{\gamma_3} + \frac{V_3^2}{2 \cdot g} + Z_3$$

$$\frac{P_1}{\rho_1 \cdot g} + \frac{V_1^2}{2 \cdot g} = \frac{P_3}{\rho_3 \cdot g} + \frac{V_3^2}{2 \cdot g}$$

$$\frac{V_1^2}{2 \cdot g} - \frac{V_3^2}{2 \cdot g} = \frac{P_3}{\rho_3 \cdot g} - \frac{P_1}{\rho_1 \cdot g}$$

$$\frac{V_1^2 - V_3^2}{2 \cdot g} = \frac{P_3 - P_1}{\rho \cdot g}$$

$$\frac{V_1^2 - V_3^2}{20} = \frac{P_3 - P_1}{1000 \cdot 10}$$

$$\frac{(V_1^2 - V_3^2) \cdot 10000}{20} = P_3 - P_1$$

V_1^2	=	1.063846589 m ² /s ²
V_3^2	=	56.0613588 m ² /s ²

$$P_3 - P_1 = \underline{\underline{-27498.7561 \text{ Nm}^2}} = -0.275 \text{ bar}$$

LAMPIRAN 15

PERHITUNGAN PRESSURE DROP P₃-P₁ TEST SECTION

FREKUENSI INVERTER 32 Hz

Diketahui :

ρ_{air} = 1000 kg/m³
 Q = 0.000653179 m³/s
 = 0.000653179 m³/s
 Diameter Pipa = 1.5 inch
 = 3.81 cm
 = 0.0381 m

0.00065318 m³/s (Debit hasil percobaan)
 0.00065318 m³/s

ASUMSI :

D₁>D₃

D₁ (misal) = 2.8 cm
 = 0.028 m 0.028 m
 = 0.014 0.014
 A₁ = 0.000616 m²

Q₁ = A₁ * V₁
 V₁ = $\frac{Q_1}{A_1} = \frac{0.000653}{0.000616} = 1.0603561$ m/s

$\frac{Q_1}{A_1 \cdot V_1} = \frac{Q_3}{A_3 \cdot V_3}$

MISAL :

D₃ = 2.6 cm
 = 0.026 m 0.026 m
 = 0.013 0.013
 A₃ = 8.48571E-05 m²

V₃ = $\frac{A_1 \cdot V_1}{A_3} = \frac{0.000653}{8.49E-05} = 7.69739981$ m/s

BERNOULI :

$\frac{P_1}{\gamma_1} + \frac{V_1^2}{2 \cdot g} + z_1 = \frac{P_3}{\gamma_3} + \frac{V_3^2}{2 \cdot g} + z_3$

$\frac{P_1}{\rho_1 \cdot g} + \frac{V_1^2}{2 \cdot g} = \frac{P_3}{\rho_3 \cdot g} + \frac{V_3^2}{2 \cdot g}$

$\frac{V_1^2}{2 \cdot g} - \frac{V_3^2}{2 \cdot g} = \frac{P_3}{\rho_3 \cdot g} - \frac{P_1}{\rho_1 \cdot g}$

$\frac{V_1^2 - V_3^2}{2 \cdot g} = \frac{P_3 - P_1}{\rho \cdot g}$

$\frac{V_1^2 - V_3^2}{20} = \frac{P_3 - P_1}{1000 \cdot 10}$

$\frac{(V_1^2 - V_3^2) \cdot 10000}{20} = P_3 - P_1$

V₁² = 1.12435505 m²/s²
 V₃² = 59.24996379 m²/s²

P₃ - P₁ = -29062.8 N/m² = -0.29 bar

LAMPIRAN 16

PERHITUNGAN PRESSURE DROP P_3-P_1 TEST SECTION

FREKUENSI INVERTER 34 Hz

Diketahui :

ρ_{air} = 1000 kg/m³
 Q = 0.000706274 m³/s
 = 0.000706274 m³/s
 Diameter Pipa = 1.5 inch
 = 3.81 cm
 = 0.0381 m

0.00070627 m³/s (Debit hasil percobaan)
 0.00070627 m³/s

ASUMSI :

$D_1 > D_3$

D_1 (misal) = 2.8 cm
 = 0.028 m 0.028 m
 = 0.014 0.014
 A_1 = 0.000616 m²

$Q_1 = A_1 \cdot V_1$
 $V_1 = \frac{Q_1}{A_1} = \frac{0.000706}{0.000616} = 1.14654802 \text{ m/s}$

$Q_1 = Q_3$
 $A_1 \cdot V_1 = A_3 \cdot V_3$

MISAL :

D_3 = 2.6 cm
 = 0.026 m 0.026 m
 = 0.013 0.013
 A_3 = 8.48571E-05 m²
 $V_3 = \frac{A_1 \cdot V_1}{A_3} = \frac{0.000706}{8.49E-05} = 8.32308936 \text{ m/s}$

BERNOULI :

$$\frac{P_1}{\gamma_1} + \frac{V_1^2}{2 \cdot g} + z_1 = \frac{P_3}{\gamma_3} + \frac{V_3^2}{2 \cdot g} + z_3$$

$$\frac{P_1}{\rho_1 \cdot g} + \frac{V_1^2}{2 \cdot g} = \frac{P_3}{\rho_3 \cdot g} + \frac{V_3^2}{2 \cdot g}$$

$$\frac{V_1^2}{2 \cdot g} - \frac{V_3^2}{2 \cdot g} = \frac{P_3}{\rho_3 \cdot g} - \frac{P_1}{\rho_1 \cdot g}$$

$$\frac{V_1^2 - V_3^2}{2 \cdot g} = \frac{P_3 - P_1}{\rho \cdot g}$$

$$\frac{V_1^2 - V_3^2}{20} = \frac{P_3 - P_1}{1000 \cdot 10}$$

$$\frac{(V_1^2 - V_3^2) \cdot 10000}{20} = P_3 - P_1$$

$V_1^2 = 1.314572373 \text{ m}^2/\text{s}^2$
 $V_3^2 = 69.27381657 \text{ m}^2/\text{s}^2$

$P_3 - P_1 = \underline{\underline{-33979.62 \text{ N/m}^2}} = -0.34 \text{ bar}$

LAMPIRAN 17

PERHITUNGAN PRESSURE DROP P_3-P_1 TEST SECTION

FREKUENSI INVERTER 36 Hz

Diketahui :

ρ_{air} = 1000 kg/m³
 Q = 0.000775517 m³/s
 = 0.000775517 m³/s
 Diameter Pipa = 1.5 inch
 = 3.81 cm
 = 0.0381 m

0.000776 m³/s (Debit hasil percobaan)
 0.000776 m³/s

ASUMSI :

$D_1 > D_3$

D_1 (misal) = 2.8 cm
 = 0.028 m 0.028 m
 = 0.014 0.014
 A_1 = 0.000616 m²

$Q_1 = A_1 \cdot V_1$
 $V_1 = \frac{Q_1}{A_1} = \frac{0.000776}{0.000616} = 1.258956$ m/s

$Q_1 = Q_3$
 $A_1 \cdot V_1 = A_3 \cdot V_3$

MISAL :

D_3 = 2.6 cm
 = 0.026 m 0.026 m
 = 0.013 0.013
 A_3 = 8.48571E-05 m²
 $V_3 = \frac{A_1 \cdot V_1}{A_3} = \frac{0.000776}{8.49E-05} = 9.139085$ m/s

BERNOULI :

$$\frac{P_1}{\gamma_1} + \frac{V_1^2}{2 \cdot g} + z_1 = \frac{P_3}{\gamma_3} + \frac{V_3^2}{2 \cdot g} + z_3$$

$$\frac{P_1}{\rho_1 \cdot g} + \frac{V_1^2}{2 \cdot g} = \frac{P_3}{\rho_3 \cdot g} + \frac{V_3^2}{2 \cdot g}$$

$$\frac{V_1^2}{2 \cdot g} - \frac{V_3^2}{2 \cdot g} = \frac{P_3}{\rho_3 \cdot g} - \frac{P_1}{\rho_1 \cdot g}$$

$$\frac{V_1^2 - V_3^2}{2 \cdot g} = \frac{P_3 - P_1}{\rho \cdot g}$$

$$\frac{V_1^2 - V_3^2}{20} = \frac{P_3 - P_1}{1000 \cdot 10}$$

$$\frac{(V_1^2 - V_3^2) \cdot 10000}{20} = P_3 - P_1$$

$V_1^2 = 1.584969295$ m²/s²
 $V_3^2 = 83.52288126$ m²/s²

$P_3 - P_1 = \underline{\underline{-40968.96}} \text{ N/m}^2 = -0.41 \text{ bar}$

LAMPIRAN 18

PERHITUNGAN PRESSURE DROP P_3-P_1 TEST SECTION

FREKUENSI INVERTER 38 Hz

Diketahui :

ρ_{air} = 1000 kg/m³
 Q = **0.000810918** m³/s
 = **0.000810918** m³/s
 Diameter Pipa = 1.5 inch
 = 3.81 cm
 = 0.0381 m

0.000811 m³/s (Debit hasil percobaan)
0.000811 m³/s

ASUMSI :

$D_1 > D_3$

D_1 (misal) = 2.8 cm
 = 0.028 m 0.028 m
 = 0.014 0.014
 A_1 = 0.000616 m²

Q_1 = $A_1 \cdot V_1$
 V_1 = $\frac{Q_1}{A_1} = \frac{0.000811}{0.000616} = 1.316425$ m/s

$\frac{Q_1}{A_1 \cdot V_1} = \frac{Q_3}{A_3 \cdot V_3}$

MISAL :

D_3 = 2.6 cm
 = 0.026 m 0.026 m
 = 0.013 0.013
 A_3 = 8.48571E-05 m²
 V_3 = $\frac{A_1 \cdot V_1}{A_3} = \frac{0.000811}{8.49E-05} = 9.556272$ m/s

BERNOULI :

$$\frac{P_1}{\gamma_1} + \frac{V_1^2}{2 \cdot g} + Z_1 = \frac{P_3}{\gamma_3} + \frac{V_3^2}{2 \cdot g} + Z_3$$

$$\frac{P_1}{\rho_1 \cdot g} + \frac{V_1^2}{2 \cdot g} = \frac{P_3}{\rho_3 \cdot g} + \frac{V_3^2}{2 \cdot g}$$

$$\frac{V_1^2}{2 \cdot g} - \frac{V_3^2}{2 \cdot g} = \frac{P_3}{\rho_3 \cdot g} - \frac{P_1}{\rho_1 \cdot g}$$

$$\frac{V_1^2 - V_3^2}{2 \cdot g} = \frac{P_3 - P_1}{\rho \cdot g}$$

$$\frac{V_1^2 - V_3^2}{20} = \frac{P_3 - P_1}{1000 \cdot 10}$$

$$\frac{(V_1^2 - V_3^2) \cdot 10000}{20} = P_3 - P_1$$

V_1^2 = 1.732975198 m²/s²
 V_3^2 = 91.32232536 m²/s²

$P_3 - P_1 = \underline{\underline{-44794.68}} \text{ N/m}^2 = -0.448 \text{ bar}$

LAMPIRAN 19

**PERHITUNGAN PRESSURE DROP P_3-P_1 TEST SECTION
FREKUENSI INVERTER 40 Hz**

Diketahui :		0.000868 m³/s (Debit hasil percobaan) 0.000868 m³/s
ρ_{air}	= 1000 kg/m ³	
Q	= 0.000867636 m ³ /s	
Diameter Pipa	= 0.000867636 m ³ /s	
	= 1.5 inch = 3.81 cm = 0.0381 m	

ASUMSI :		$D_1 > D_3$
D_1 (misal)	= 2.8 cm	
	= 0.028 m	0.028 m
	= 0.014	0.014
A_1	= 0.000616 m ²	
Q_1	= $A_1 \cdot V_1$	
V_1	= $\frac{Q_1}{A_1} = \frac{0.000867636}{0.000616} = 1.4085$ m/s	
$\frac{Q_1}{A_1 \cdot V_1} = \frac{Q_3}{A_3 \cdot V_3}$		
MISAL :		
D_3	= 2.6 cm	
	= 0.026 m	0.026 m
	= 0.013	0.013
A_3	= 8.48571E-05 m ²	
V_3	= $\frac{A_1 \cdot V_1}{A_3} = \frac{0.000867636}{8.48571E-05} = 10.22466$ m/s	

BERNOULI :

$$\frac{P_1}{\gamma_1} + \frac{V_1^2}{2 \cdot g} + Z_1 = \frac{P_3}{\gamma_3} + \frac{V_3^2}{2 \cdot g} + Z_3$$

$$\frac{P_1}{\rho_1 \cdot g} + \frac{V_1^2}{2 \cdot g} = \frac{P_3}{\rho_3 \cdot g} + \frac{V_3^2}{2 \cdot g}$$

$$\frac{V_1^2}{2 \cdot g} - \frac{V_3^2}{2 \cdot g} = \frac{P_3}{\rho_3 \cdot g} - \frac{P_1}{\rho_1 \cdot g}$$

$$\frac{V_1^2 - V_3^2}{2 \cdot g} = \frac{P_3 - P_1}{\rho \cdot g}$$

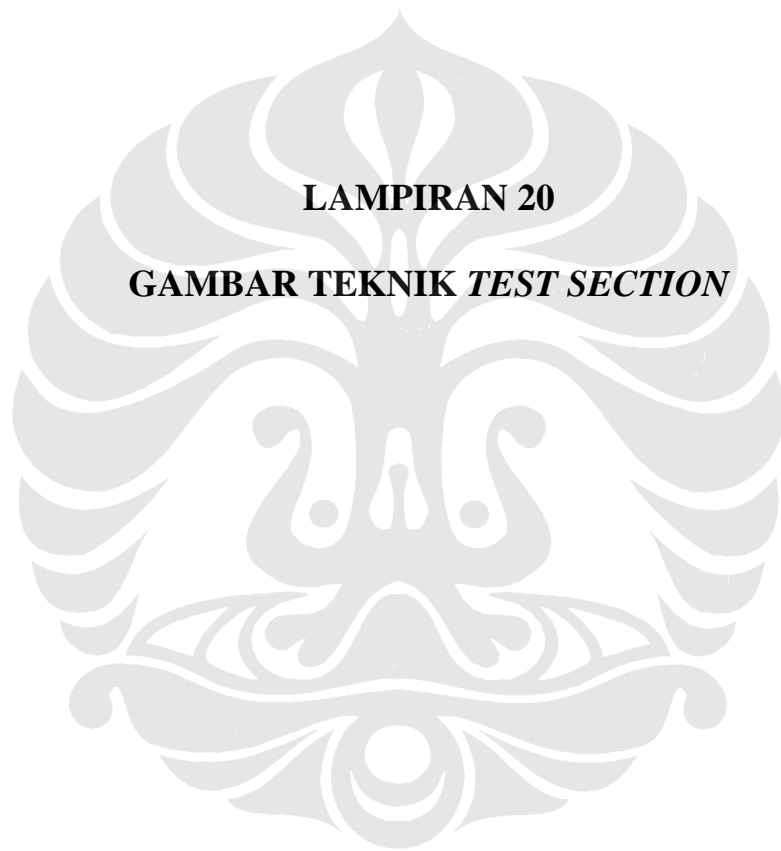
$$\frac{V_1^2 - V_3^2}{20} = \frac{P_3 - P_1}{1000 \cdot 10}$$

$$\frac{(V_1^2 - V_3^2) \cdot 10000}{20} = P_3 - P_1$$

$$V_1^2 = 1.9838715 \text{ m}^2/\text{s}^2$$

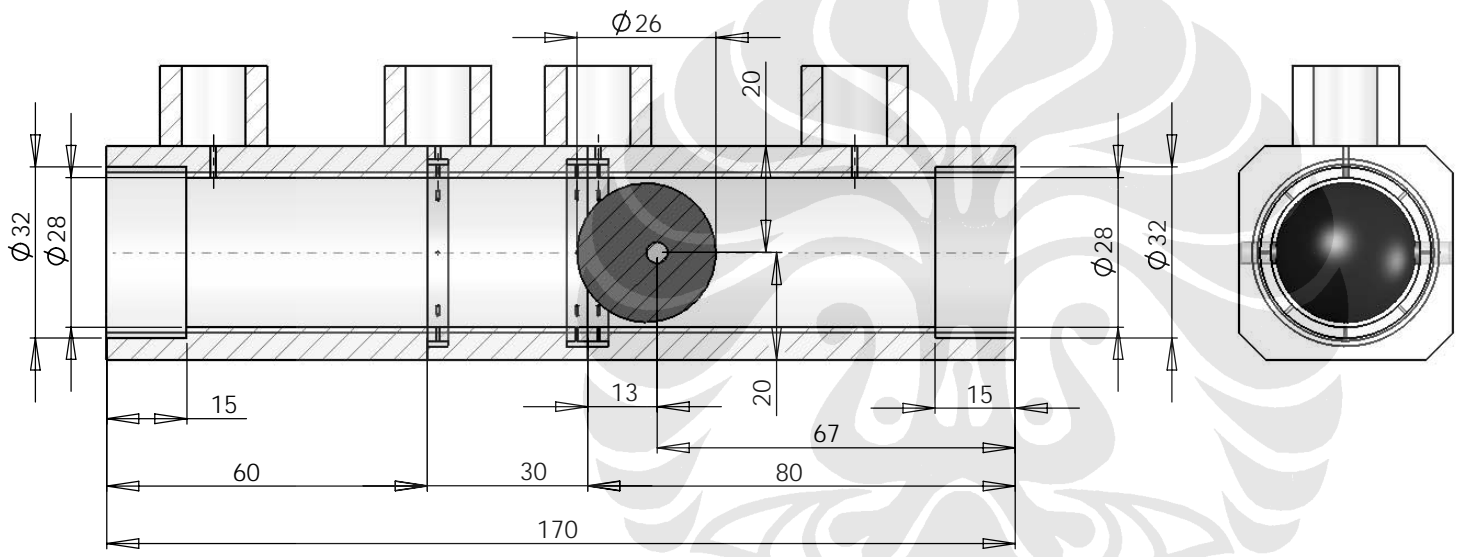
$$V_3^2 = 104.54377 \text{ m}^2/\text{s}^2$$

$$P_3 - P_1 = \underline{\underline{-51279.95 \text{ N/m}^2}} = -0.513 \text{ bar}$$



LAMPIRAN 20

GAMBAR TEKNIK *TEST SECTION*



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:		DEBUR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING		REVISION	
DRAWN: ADHI		SIGNATURE		DATE		TITLE: MBG ASSY			
CHK'D									
APPV'D									
MFG									
Micro-bubble generator..., Marttriadhi Laksana, FT UI, 2008				MATERIAL: ACRYLIC		DWG NO. MCR-005		A3	
				WEIGHT:		SCALE:1:2		SHEET 1 OF 1	

Micro-bubble generator..., Marttriadhi Laksana, FT UI, 2008

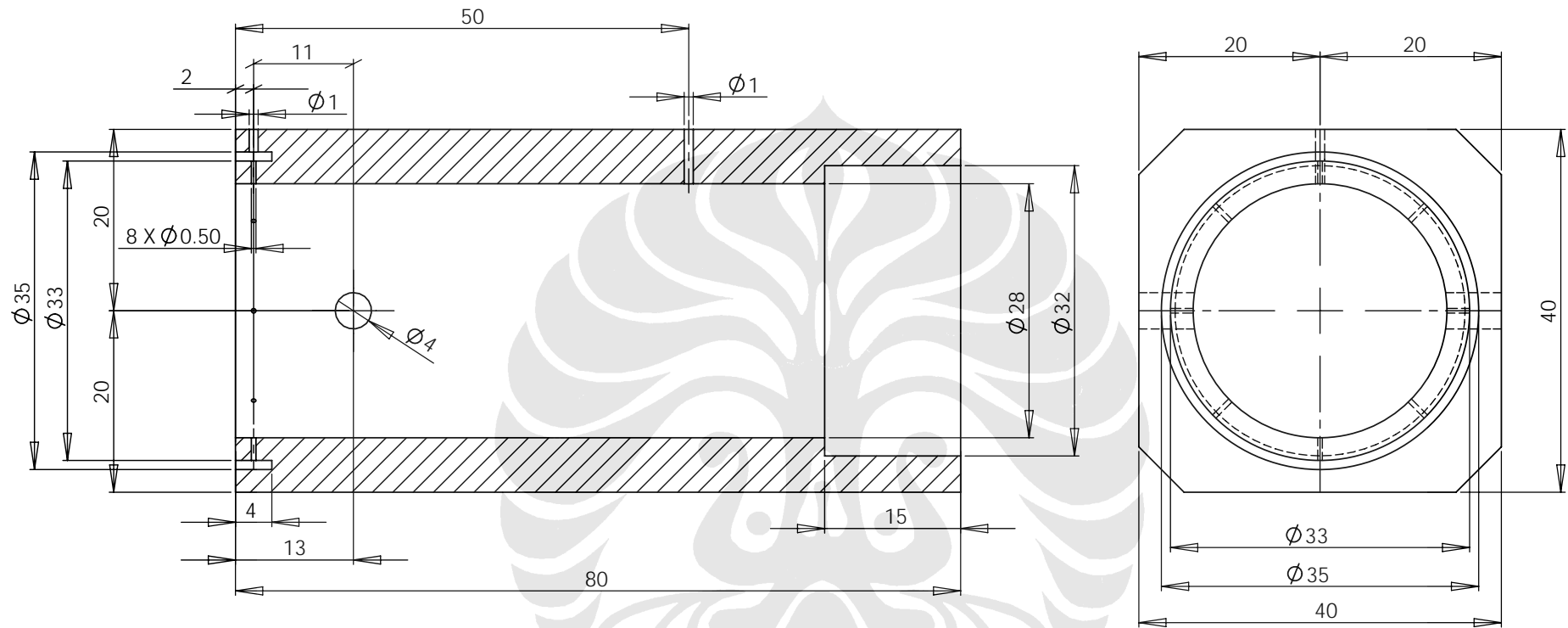
ACRYLIC

MCR-005

A3

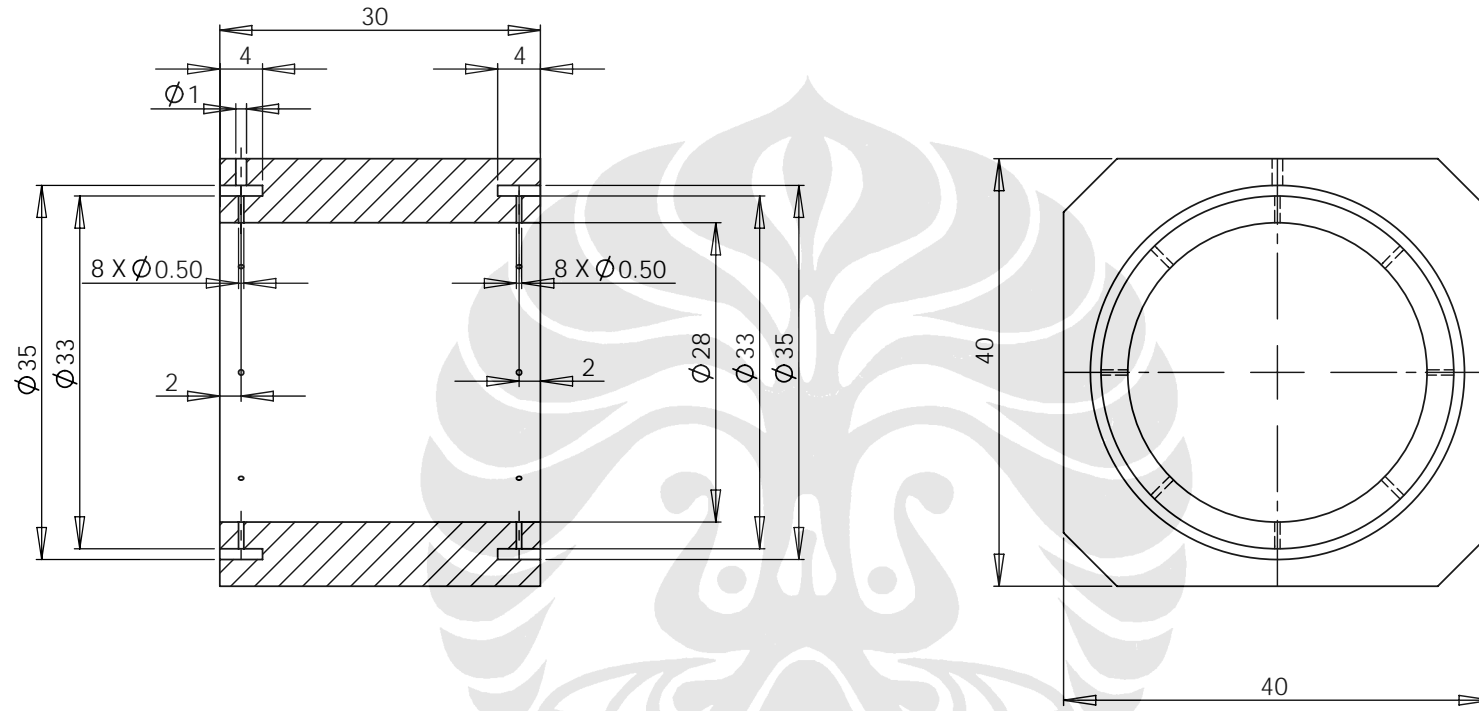
SCALE:1:2

SHEET 1 OF 1



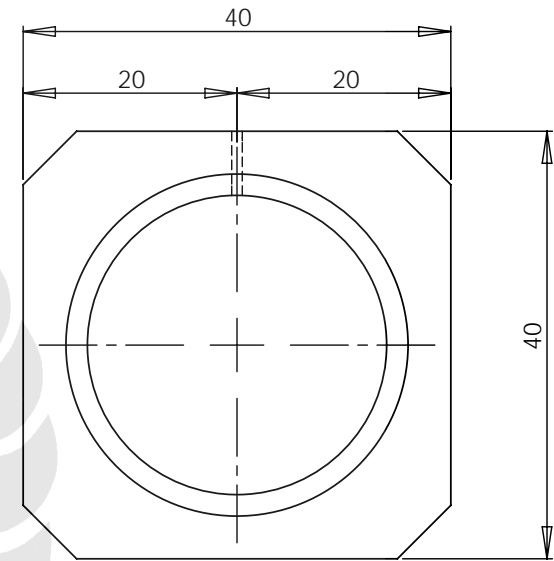
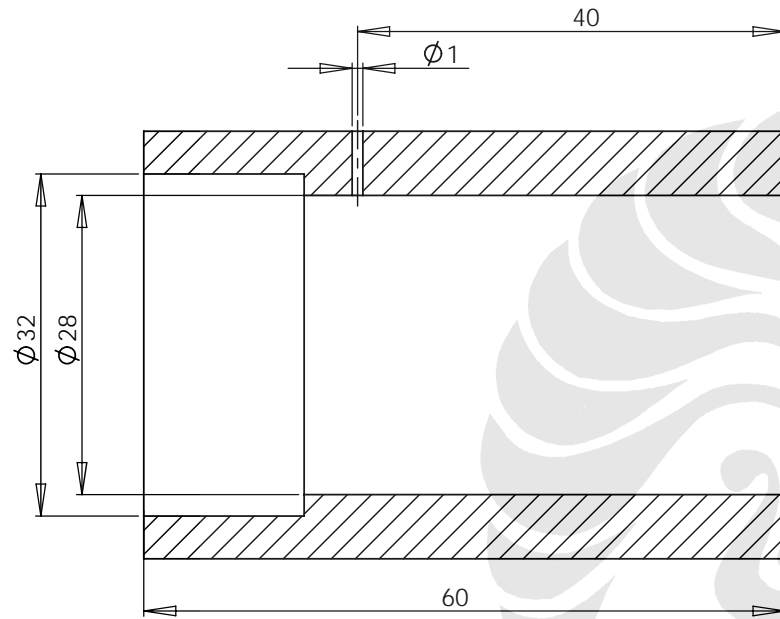
Micro-bubble generator..., Marttriadhi Laksana, FT UI, 2008

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:				FINISH:		DEBUR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING		REVISION	
DRAWN: ADHI				SIGNATURE		DATE		TITLE: Microbubbles Assy			
CHK'D											
APP'VD											
MFG											
MATERIAL: ACRYLIC						DWG NO. MICRO-001		A3			
WEIGHT:						SCALE: 2:1		SHEET 1 OF 1			



Micro-bubble generator..., Marttriadhi Laksana, FT UI, 2008

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:				FINISH:		DEBUR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING		REVISION	
DRAWN: ADHII				SIGNATURE		DATE		TITLE: SECOND PART			
CHK'D											
APP'VD											
MFG											
MATERIAL: ACRYLIC						DWG NO. MICRO-002		A3			
WEIGHT:						SCALE:2:1		SHEET 1 OF 1			



Micro-bubble generator..., Marttriadhi Laksana, FT UI, 2008

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:				FINISH:		DEBUR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING		REVISION	
DRAWN: ADHI				SIGNATURE		DATE		TITLE: THIRD PART			
CHK'D											
APP'VD											
MFG											
MATERIAL: ACRYLIC						DWG NO. MICRO-003		A3			
WEIGHT:						SCALE:2:1		SHEET 1 OF 1			