

DAFTAR PUSTAKA

- Awaluddin, dkk. 2014 . *Analisis Aliran Fluida Dua Fase (Udara-Air) melalui Belokan 45°*. Malang : Rekayasa Mesin Universitas Brawijaya.
- Cengel, Y.A. and Cimbala, J.M. (2006) *Fluid Mechanics: Fundamentals and Applications*. Mc-Graw-Hill, New York.
- Indra Ahmad, dkk. 2014 . *ANALISIS PENGARUH FAKTOR GESEK TERHADAP PRESSURE DROP PADA PIPA BAJA BERGELOMBANG DENGAN COMPUTATIONAL FLUID DYNAMICS (CFD)*. Jakarta : Universitas Gunadarma.
- Jalaluddin, dkk. 2019 . *Analisa Profil Aliran Fluida Cair dan Pressure Drop pada Pipa L menggunakan Metode Simulasi Computational Fluid Dynamic (CFD)*. Aceh : Universitas Malikussaleh.
- Kusumaningsih Haslinda, dkk . 2019. *POLA ALIRAN DUA FASE GAS-FLUIDA NON NEWTONIAN MELALUI BELOKAN PIPA*. Malang : Rekayasa Mesin Universitas Brawijaya.
- Lukman. 2011. *Eksperimental Karakteristik Pressure drop Pada Pipa Dan Variasi Elbow 90° Untuk Sistem Perpipaan*. Surabaya : Jurusan Teknik Mesin FT-UNESA.
- Mawarni, D. I., Sutarto, E., & Junaidi, M. (2023). Studi Eksperimental Karakteristik Pressure Drop Aliran Dua Fase Air–Udara pada Elbowmiter. *SIMETRIS*, 17(1), 42-45.
- Negara, Wendy Priana. 2014 . *Perbandingan Analisis Pressure drop Pada Pipa Lengkung 90° Standar Ansi B36.10 Dengan COSMOSfloWorks 2007*. Jakarta : Universitas Gunadarma.
- Saidj Faiza, dkk. 2014 . *Experimental investigation of air-water two-phase flow through vertical 90° bend*. Aljazair : Université des Sciences et de la Technologie Houari Boumedién.
- Spedding, Benard. 2006. *Gas–liquid two phase flow through a vertical 90° elbow bend*. Belfast : School of Aeronautical Engineering, Queen’s University.

Widayana. 2010. *STUDI EKSPERIMENTAL DAN NUMERIK ALIRAN DUA FASE MELEWATI ELBOW 30 DARI PIPA VERTIKAL MENUJU PIPA DENGAN SUDUT KEMIRINGAN 60*. Surabaya : Institut Teknologi Sepuluh November.

Wiryanta. 2010 .*STUDI EKSPERIMENTAL DAN NUMERIK KARAKTERISTIK ALIRAN DUA FASE AIR-UDARA MELEWATI ELBOW 75° DARI PIPA VERTIKAL MENUJU PIPA DENGAN SUDUT KEMIRINGAN 15°*. Surabaya : Institut Teknologi Sepuluh November.

Zainuddin, dkk. 2012 . *Analisa Pengaruh Variasi Sudut Sambungan Belokan Terhadap Head Losses Aliran Pipa*. Mataram : Universitas Mataram.

LAMPIRAN

Lampiran 1 Data Hasil Penelitian

QA1 = 0,001 m³/s

QU1	QU/QA	P1	P2	ΔP
m ³ /s	m ³ /s	paskal	paskal	paskal
0.00008	8.3%	13000	9000	4000
0.00017	16.7%	15000	10000	5000
0.00025	25.0%	17000	11000	6000
0.00033	33.3%	19000	12000	7000
0.00042	41.7%	23000	15000	8000

QA5 = 0,001667 m³/s

QU	QU/QA	P1	P2	ΔP
m ³ /s	m ³ /s	paskal	paskal	paskal
0.00008	5%	30000	22000	8000
0.00017	10%	33000	24000	9000
0.00025	15%	35000	25000	10000
0.00033	20%	38000	27000	11000
0.00042	25%	42000	29000	13000

QA2 = 0,001167 m³/s

QU1	QU/QA	P1	P2	ΔP
m ³ /s	m ³ /s	paskal	paskal	paskal
0.00008	7.1%	18000	13000	5000
0.00017	14.3%	20000	14000	6000
0.00025	21.4%	22000	15000	7000
0.00033	28.6%	25000	16000	9000
0.00042	35.7%	29000	19000	10000

QA 6= 0,001833 m³/s

QU	QU/QA	P1	P2	ΔP
m ³ /s	m ³ /s	paskal	paskal	paskal
0.00008	4.5%	35000	26000	9000
0.00017	9.1%	37000	27000	10000
0.00025	13.6%	40000	29000	11000
0.00033	18.2%	42000	30000	12000
0.00042	22.7%	47000	33000	14000

QA3 = 0,001333 m³/s

QU	QU/QA	P1	P2	ΔP
m ³ /s	m ³ /s	paskal	paskal	paskal
0.00008	6.3%	21000	15000	6000
0.00017	12.5%	24000	17000	7000
0.00025	18.8%	26000	18000	8000
0.00033	25.0%	31000	21000	10000
0.00042	31.3%	35000	24000	11000

QA7 = 0,002 m³/s

QU	QU/QA	P1	P2	ΔP
m ³ /s	m ³ /s	paskal	paskal	paskal
0.00008	4.2%	42000	32000	10000
0.00017	8.3%	45000	34000	11000
0.00025	12.5%	47000	35000	12000
0.00033	16.7%	50000	37000	13000
0.00042	20.8%	55000	40000	15000

QA4 = 0,0015 m³/s

QU	QU/QA	P1	P2	ΔP
m ³ /s	m ³ /s	paskal	paskal	paskal
0.00008	5.6%	26000	19000	7000
0.00017	11.1%	29000	21000	8000
0.00025	16.7%	32000	23000	9000
0.00033	22.2%	37000	26000	11000
0.00042	27.8%	40000	28000	12000

Lampiran 2 Data Hasil Perhitungan

QA1	0.001	m ³ /s		va	1.97453019	m/s		ma	0.99700	Kg/s		Ga	1968.607	Kg/m ² s				
No	QU	Q mix	vu	v mix	mu	m mix	Gu	G mix	x	α	ρ mix	β	μ	Re	S	φ	k	ΔH teori
	m ³ /s	m ³ /s	m/s	m/s	Kg/s	Kg/s	Kg/m ² s	Kg/m ² s	ü		Kg/m ³		Kg/ms			pengali 2 fase		paskal
1	0.000083	0.00108	0.164544	2.139	0.00010	0.99710	0.197	1968.804	0.00010	0.50000	920.400	0.077	0.000887	56390.894	1.041	1.083	1.900	4432
2	0.000167	0.00117	0.329088	2.304	0.00020	0.99720	0.395	1969.002	0.00020	0.50000	854.743	0.143	0.000883	56662.138	1.080	1.166	2.205	5965
3	0.000250	0.00125	0.493633	2.468	0.00030	0.99730	0.592	1969.199	0.00030	0.50000	797.840	0.200	0.000879	56933.382	1.118	1.250	2.469	7669
4	0.000333	0.00133	0.658177	2.633	0.00040	0.99740	0.790	1969.396	0.00040	0.50000	748.050	0.250	0.000874	57204.627	1.155	1.333	2.700	9542
5	0.000417	0.00142	0.822721	2.797	0.00050	0.99750	0.987	1969.594	0.00050	0.50000	704.118	0.294	0.00087	57475.871	1.190	1.416	2.904	11586

QA2	0.001167	m ³ /s		va	2.30361856	m/s		ma	1.16317	Kg/s		Ga	2296.708	Kg/m ² s				
No	QU	Q mix	vu	v mix	mu	m mix	Gu	G mix	x	α	ρ mix	β	μ	Re	S	φ	k	ΔH teori
	m ³ /s	m ³ /s	m/s	m/s	Kg/s	Kg/s	Kg/m ² s	Kg/m ² s	ü		Kg/m ³		Kg/ms			pengali 2 fase		
1	0.000083	0.00125	0.164544	2.468	0.00010	1.16327	0.197	2296.905	0.00009	0.50000	930.613	0.067	0.000887	65744.169	1.035	1.071	1.764	5479
2	0.000167	0.00133	0.329088	2.633	0.00020	1.16337	0.395	2297.103	0.00017	0.50000	872.525	0.125	0.000884	66015.413	1.069	1.143	1.984	7012
3	0.000250	0.00142	0.493633	2.797	0.00030	1.16347	0.592	2297.300	0.00026	0.50000	821.271	0.176	0.00088	66286.657	1.102	1.214	2.179	8692
4	0.000333	0.00150	0.658177	2.962	0.00040	1.16357	0.790	2297.498	0.00034	0.50000	775.711	0.222	0.000877	66557.901	1.134	1.285	2.645	11831
5	0.000417	0.00158	0.822721	3.126	0.00050	1.16367	0.987	2297.695	0.00043	0.50000	734.947	0.263	0.000873	66829.146	1.165	1.357	2.784	13875

QA3	0.001333	m ³ /s		va	2.63270692	m/s		ma	1.32934	Kg/s		Ga	2624.809	Kg/m ² s				
No	QU	Q mix	vu	v mix	mu	m mix	Gu	G mix	x	α	ρ mix	β	μ	Re	S	φ	k	ΔH teori
	m ³ /s	m ³ /s	m/s	m/s	Kg/s	Kg/s	Kg/m ² s	Kg/m ² s	ü		Kg/m ³		Kg/ms			pengali 2 fase		
1	0.000083	0.00142	0.164544	2.797	0.00010	1.32944	0.197	2625.006	0.00008	0.50000	938.424	0.059	0.000888	75097.444	1.031	1.062	1.634	6520
2	0.000167	0.00150	0.329088	2.962	0.00020	1.32954	0.395	2625.204	0.00015	0.50000	886.356	0.111	0.000885	75368.688	1.061	1.125	1.801	8053
3	0.000250	0.00158	0.493633	3.126	0.00030	1.32964	0.592	2625.401	0.00023	0.50000	839.768	0.158	0.000882	75639.932	1.090	1.187	1.949	9714
4	0.000333	0.00167	0.658177	3.291	0.00040	1.32974	0.790	2625.599	0.00030	0.50000	797.840	0.200	0.000879	75911.176	1.118	1.250	2.315	12781
5	0.000417	0.00175	0.822721	3.455	0.00050	1.32984	0.987	2625.796	0.00038	0.50000	759.905	0.238	0.000875	76182.421	1.146	1.312	2.425	14761

QA4	0.0015	m ³ /s		va	2.96179529	m/s		ma	1.49550	Kg/s		Ga	2952.91	Kg/m ² s				
No	QU	Q mix	vu	v mix	mu	m mix	Gu	G mix	x	α	ρ mix	β	μ	Re	S	φ	k	ΔH teori
	m ³ /s	m ³ /s	m/s	m/s	Kg/s	Kg/s	Kg/m ² s	Kg/m ² s	ü		Kg/m ³		Kg/ms			pengali 2 fase		
1	0.000083	0.00158	0.164544	3.126	0.00010	1.49560	0.197	2953.107	0.00007	0.50000	944.589	0.053	0.000888	84450.718	1.027	1.055	1.516	7557
2	0.000167	0.00167	0.329088	3.291	0.00020	1.49570	0.395	2953.305	0.00013	0.50000	897.420	0.100	0.000885	84721.963	1.054	1.111	1.646	9090
3	0.000250	0.00175	0.493633	3.455	0.00030	1.49580	0.592	2953.502	0.00020	0.50000	854.743	0.143	0.000883	84993.207	1.080	1.166	1.764	10737
4	0.000333	0.00183	0.658177	3.620	0.00040	1.49590	0.790	2953.700	0.00027	0.50000	815.945	0.182	0.00088	85264.451	1.106	1.222	2.058	13747
5	0.000417	0.00192	0.822721	3.785	0.00050	1.49600	0.987	2953.897	0.00033	0.50000	780.522	0.217	0.000877	85535.696	1.130	1.277	2.147	15678

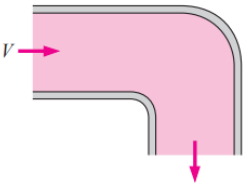
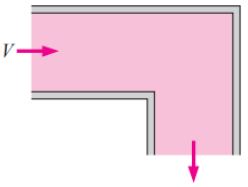
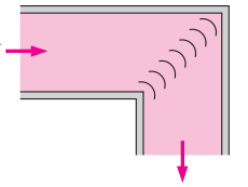
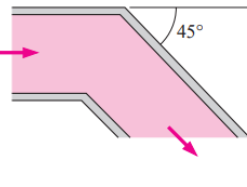
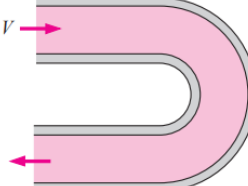
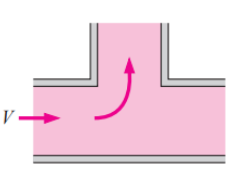
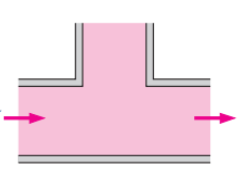
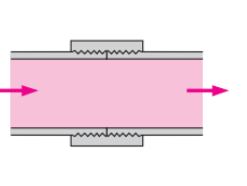
QA5	0.001667	m3/s		va	3.29088365	m/s		ma	1.66167	Kg/s		Ga	3281.011	Kg/m2s				
No	QU	Q mix	vu	v mix	mu	m mix	Gu	G mix	x	α	ρ mix	β	μ	Re	S	ϕ	k	ΔH teori
	m3/s	m3/s	m/s	m/s	Kg/s	Kg/s	Kg/m2s	Kg/m2s	ü		Kg/m3		Kg/ms			pengali 2 fase		
1	0.000083	0.00175	0.164544	3.455	0.00010	1.66177	0.197	3281.208	0.00006	0.50000	949.581	0.048	0.000888	93803.993	1.025	1.050	1.411	8591
2	0.000167	0.00183	0.329088	3.620	0.00020	1.66187	0.395	3281.406	0.00012	0.50000	906.473	0.091	0.000886	94075.238	1.049	1.100	1.515	10124
3	0.000250	0.00192	0.493633	3.785	0.00030	1.66197	0.592	3281.603	0.00018	0.50000	867.113	0.130	0.000883	94346.482	1.072	1.150	1.610	11760
4	0.000333	0.00200	0.658177	3.949	0.00040	1.66207	0.790	3281.801	0.00024	0.50000	831.033	0.167	0.000881	94617.726	1.095	1.200	1.698	13498
5	0.000417	0.00208	0.822721	4.114	0.00050	1.66217	0.987	3281.998	0.00030	0.50000	797.840	0.200	0.000879	94888.970	1.118	1.250	1.926	16615

QA6	0.001833	m3/s		va	3.61997202	m/s		ma	1.82784	Kg/s		Ga	3609.112	Kg/m2s				
No	QU	Q mix	vu	v mix	mu	m mix	Gu	G mix	x	α	ρ mix	β	μ	Re	S	ϕ	k	ΔH teori
	m3/s	m3/s	m/s	m/s	Kg/s	Kg/s	Kg/m2s	Kg/m2s	ü		Kg/m3		Kg/ms			pengali 2 fase		
1	0.000083	0.00192	0.164544	3.785	0.00010	1.82794	0.197	3609.310	0.00005	0.50000	953.704	0.043	0.000889	103157.268	1.022	1.045	1.318	9623
2	0.000167	0.00200	0.329088	3.949	0.00020	1.82804	0.395	3609.507	0.00011	0.50000	914.017	0.083	0.000886	103428.513	1.044	1.091	1.403	11157
3	0.000250	0.00208	0.493633	4.114	0.00030	1.82814	0.592	3609.704	0.00016	0.50000	877.504	0.120	0.000884	103699.757	1.066	1.136	1.482	12783
4	0.000333	0.00217	0.658177	4.278	0.00040	1.82824	0.790	3609.902	0.00022	0.50000	843.800	0.154	0.000882	103971.001	1.087	1.182	1.554	14502
5	0.000417	0.00225	0.822721	4.443	0.00050	1.82834	0.987	3610.099	0.00027	0.50000	812.593	0.185	0.00088	104242.245	1.108	1.227	1.746	17569

QA7	0.002	m3/s		va	3.94906038	m/s		ma	1.99400	Kg/s		Ga	3937.213	Kg/m2s				
No	QU	Q mix	vu	v mix	mu	m mix	Gu	G mix	x	α	ρ mix	β	μ	Re	S	ϕ	k	ΔH teori
	m3/s	m3/s	m/s	m/s	Kg/s	Kg/s	Kg/m2s	Kg/m2s	ü		Kg/m3		Kg/ms			pengali 2 fase		
1	0.000083	0.00208	0.164544	4.114	0.00010	1.99410	0.197	3937.411	0.00005	0.50000	957.168	0.040	0.000889	112510.543	1.021	1.042	1.235	10654
2	0.000167	0.00217	0.329088	4.278	0.00020	1.99420	0.395	3937.608	0.00010	0.50000	920.400	0.077	0.000887	112781.787	1.041	1.083	1.306	12187
3	0.000250	0.00225	0.493633	4.443	0.00030	1.99430	0.592	3937.806	0.00015	0.50000	886.356	0.111	0.000885	113053.032	1.061	1.125	1.372	13806
4	0.000333	0.00233	0.658177	4.607	0.00040	1.99440	0.790	3938.003	0.00020	0.50000	854.743	0.143	0.000883	113324.276	1.080	1.166	1.433	15509
5	0.000417	0.00242	0.822721	4.772	0.00050	1.99450	0.987	3938.200	0.00025	0.50000	825.310	0.172	0.000881	113595.520	1.099	1.208	1.596	18534

QA7	0.002	m3/s		va	3.94906038	m/s		ma	1.99400	Kg/s		Ga	3937.213	Kg/m2s				
No	QU	Q mix	vu	v mix	mu	m mix	Gu	G mix	x	α	ρ mix	β	μ	Re	S	ϕ	k	ΔH teori
	m3/s	m3/s	m/s	m/s	Kg/s	Kg/s	Kg/m2s	Kg/m2s	ü		Kg/m3		Kg/ms			pengali 2 fase		
1	0.000083	0.00208	0.164544	4.114	0.00010	1.99410	0.197	3937.411	0.00005	0.50000	957.168	0.040	0.000889	112510.543	1.021	1.042	1.235	10654
2	0.000167	0.00217	0.329088	4.278	0.00020	1.99420	0.395	3937.608	0.00010	0.50000	920.400	0.077	0.000887	112781.787	1.041	1.083	1.306	12187
3	0.000250	0.00225	0.493633	4.443	0.00030	1.99430	0.592	3937.806	0.00015	0.50000	886.356	0.111	0.000885	113053.032	1.061	1.125	1.372	13806
4	0.000333	0.00233	0.658177	4.607	0.00040	1.99440	0.790	3938.003	0.00020	0.50000	854.743	0.143	0.000883	113324.276	1.080	1.166	1.433	15509
5	0.000417	0.00242	0.822721	4.772	0.00050	1.99450	0.987	3938.200	0.00025	0.50000	825.310	0.172	0.000881	113595.520	1.099	1.208	1.596	18534

Lampiran 3 Nilai koefisien berdasarkan jenis belokan

TABLE 8-4 (CONCLUDED)											
<p><i>Bends and Branches</i> 90° smooth bend: Flanged: $K_L = 0.3$ Threaded: $K_L = 0.9$</p> 	<p>90° miter bend (without vanes): $K_L = 1.1$</p> 	<p>90° miter bend (with vanes): $K_L = 0.2$</p> 	<p>45° threaded elbow: $K_L = 0.4$</p> 								
<p>180° return bend: Flanged: $K_L = 0.2$ Threaded: $K_L = 1.5$</p> 	<p>Tee (branch flow): Flanged: $K_L = 1.0$ Threaded: $K_L = 2.0$</p> 	<p>Tee (line flow): Flanged: $K_L = 0.2$ Threaded: $K_L = 0.9$</p> 	<p>Threaded union: $K_L = 0.08$</p> 								
<p><i>Valves</i></p> <table border="0"> <tr> <td>Globe valve, fully open: $K_L = 10$</td> <td>Gate valve, fully open: $K_L = 0.2$</td> </tr> <tr> <td>Angle valve, fully open: $K_L = 5$</td> <td>closed: $K_L = 0.3$</td> </tr> <tr> <td>Ball valve, fully open: $K_L = 0.05$</td> <td>closed: $K_L = 2.1$</td> </tr> <tr> <td>Swing check valve: $K_L = 2$</td> <td>closed: $K_L = 17$</td> </tr> </table>				Globe valve, fully open: $K_L = 10$	Gate valve, fully open: $K_L = 0.2$	Angle valve, fully open: $K_L = 5$	closed: $K_L = 0.3$	Ball valve, fully open: $K_L = 0.05$	closed: $K_L = 2.1$	Swing check valve: $K_L = 2$	closed: $K_L = 17$
Globe valve, fully open: $K_L = 10$	Gate valve, fully open: $K_L = 0.2$										
Angle valve, fully open: $K_L = 5$	closed: $K_L = 0.3$										
Ball valve, fully open: $K_L = 0.05$	closed: $K_L = 2.1$										
Swing check valve: $K_L = 2$	closed: $K_L = 17$										

Lampiran 4 Dokumentasi



