

LAMPIRAN

Lampiran 1. Perhitungan Pengenceran Larutan Asam Sulfat

- a. Larutan H₂SO₄ 0,5 %

Diketahui:

$$M_1 = 96 \%$$

$$M_2 = 0,5 \%$$

$$V_2 = 250 \text{ ml} = 0,25 \text{ L}$$

Ditanya: V₁...?

Penyelesaian:

$$0,5 \% = 96 \% \times V_1 = 0,5 \times 0,25 \text{ L}$$

$$= 96 \% \times V_1 = 0,125 \text{ L}$$

$$V_1 = 0,0013 \text{ L}$$

$$V_1 = 1,30 \text{ ml}$$

- b. Larutan H₂SO₄ 1 %

Diketahui:

$$M_1 = 96 \%$$

$$M_2 = 1 \%$$

$$V_2 = 250 \text{ ml} = 0,25 \text{ L}$$

Ditanya: V₁...?

Penyelesaian:

$$1 \% = 96\% \times V_1 = 1 \% \times 0,25 \text{ L}$$

$$= 96 \% \times V_1 = 0,25 \text{ L}$$

$$V_1 = 0,00260 \text{ L}$$

$$V_1 = 2,60 \text{ ml}$$

- c. Larutan H₂SO₄ 2 %

Diketahui:

$$M_1 = 96 \%$$

$$M_2 = 2 \%$$

$$V_2 = 250 \text{ ml} = 0,25 \text{ L}$$

Ditanya: V₁...?

Penyelesaian:

$$2 \% = 96 \% \times V_1 = 2 \% \times 0,25 \text{ L}$$

$$= 96 \% \times V_1 = 0,5 \text{ L}$$

$$V_1 = 0,00250 \text{ L}$$

$$V_1 = 5,20 \text{ ml}$$

- d. Larutan H₂SO₄ 5 %

Diketahui:

$$M_1 = 96 \%$$

$$M_2 = 5 \%$$

$$V_2 = 250 \text{ ml} = 0,25 \text{ L}$$

Ditanya: V₁...?

Penyelesaian:

$$5 \% = 96 \% \times V_1 = 5 \% \times 0,25 \text{ L}$$

$$= 96 \% \times V_1 = 1,25 \text{ L}$$

$$V_1 = 0,0130 \text{ L}$$

$$V_1 = 13,02 \text{ ml}$$

Lampiran 2. Pembuatan Larutan Standar Glukosa

Diambil sebanyak 100 mg glukosa monohidrat dan dilarutkan dalam 100 mL akuades, Selanjutnya dari larutan tersebut diencerkan sehingga diperoleh larutan glukosa dengan konsentrasi 500, 1000, 1500, 2000, 2500, 3000, 3500 ppm yang digunakan pada pembuatan kurva baku (Rismawati *et al*, 2016).

Lampiran 3. Data Analisis Gula Pereduksi menggunakan UV-Vis

A. Variasi Konsentrasi Asam dengan Hidrolisis menggunakan *Microwave*

Sampel	Rata-rata	Absorbansi	Konsentrasi Sampel (ppm)	FP= 10 (ppm)	Konsentrasi Gula (g/L)
S 0.5 % M	4.648	0.301	3363.33	33633.33	33.63
S 1 % M	4.75	0.403	4496.67	44966.67	44.97
S 2 % M	4.743	0.396	4418.89	44188.89	44.19
S 5 % M	4.553	0.206	2307.78	23077.78	23.08

B. Variasi Konsentrasi Asam dengan Hidrolisis menggunakan *Autoclave*

Sampel	Rata-rata	Absorbansi	Konsentrasi Sampel (ppm)	FP= 10 (ppm)	Konsentrasi Gula (g/L)
S 0.5 % A	4.643	0.276	3085.56	30855.56	30.86
S 1 % A	4.559	0.212	2374.44	23744.44	23.74
S 2 % A	4.516	0.169	1896.67	18966.67	18.97
S 5 % A	4.489	0.142	1596.67	15966.67	15.97

Lampiran 4. Berat Jenis Etanol menggunakan Piknometer

$$\rho_1 = \frac{W_3 - W_1}{W_2 - W_1} \times \rho_2$$

Keterangan: W_1 : berat pikno kosong

W_2 : berat sampel

W_3 : berat aquades

Diketahui:

$$\rho_2 = 0,9962 \text{ g/ml}$$

$$W_1 = 11,1375 \text{ gr}$$

$$W_2 = 21,1725 \text{ gr}$$

$$W_3 = 21,1485 \text{ gr}$$

Ditanya: Kadar etanol...?

Penyelesaian:

$$\rho = \frac{W_3 - W_1}{W_2 - W_1}$$

$$\rho = \frac{21,1485 \text{ gr} - 11,1375 \text{ gr}}{21,1725 \text{ gr} - 11,1375 \text{ gr}} \times 0,9962 \text{ g/ml}$$

$$\rho = \frac{10,0128 \text{ gr}}{10,035 \text{ gr}} \times 0,9962 \text{ g/ml}$$

$$\rho = 0,9977 \text{ gr} \times 0,9962 \text{ g/ml}$$

$$\rho = 0,9939 \text{ gr/ml}$$

Lampiran 5. Konsentrasi Etanol berdasarkan Berat Jenis menggunakan Piknometer

Kadar %	Berat Jenis (Y)
0 %	0,99568
X	0,99390
1 %	0,99379

Interpolasi:

$$\begin{aligned} &= \frac{X-X_1}{X_2-X_1} = \frac{Y-Y_1}{Y_2-Y_1} \\ &= \frac{X-0}{1-0} = \frac{0,99390 \text{ g/ml}-0,99568 \text{ g/ml}}{0,99379 \text{ g/ml}-0,99568 \text{ g/ml}} \\ &= \frac{X}{1} = \frac{-0,00178 \text{ g/ml}}{-0,00189 \text{ g/ml}} \\ &= X = 0,89 \% \end{aligned}$$

Lampiran 6. Konsentrasi Etanol menggunakan Piknometer

$$\begin{aligned} \text{Konsentrasi etanol (g/L)} &= \text{Konsentrasi etanol} \times \rho \\ &= 0,89 \% \times 0,99390 \text{ g/ml} \\ &= 0,884 \text{ g/L} \end{aligned}$$

Lampiran 7. Yield Etanol Metode Berat Jenis Menggunakan Piknometer

$$\begin{aligned} \text{Yield (\%)} &= \frac{\text{Konsentrasi etanol } \left(\frac{\text{g}}{\text{L}}\right)}{\text{Kadar gula } \left(\frac{\text{g}}{\text{L}}\right)} \times 100 \% \\ &= \frac{0,884 \left(\frac{\text{g}}{\text{L}}\right)}{44,97 \left(\frac{\text{g}}{\text{L}}\right)} \times 100 \% \\ &= 1,96 \% \end{aligned}$$

Lampiran 8. Efisiensi Fermentasi Metode Berat Jenis menggunakan Piknometer

$$\begin{aligned} \text{EF} &= \frac{\text{Konsentrasi etanol } \left(\frac{\text{g}}{\text{L}}\right)}{0,51 \times \text{kadar gula } \left(\frac{\text{g}}{\text{L}}\right)} \times 100 \% \\ \text{EF} &= \frac{0,884 \left(\frac{\text{g}}{\text{L}}\right)}{0,51 \times 44,97 \left(\frac{\text{g}}{\text{L}}\right)} \times 100 \% \\ \text{EF} &= 0,0385 \times 100 \% \\ \text{EF} &= 3,85 \% \end{aligned}$$

Lampiran 9. Konsentrasi Etanol menggunakan Kromatografi Gas

$$\begin{aligned} \text{Konsentrasi Etanol (g/L)} &= \text{Konsentrasi etanol (\%)} \times \rho \\ &= 15,76 \% \times 0,97334 \\ &= 15,34 \text{ g/L} \end{aligned}$$

Lampiran 10. Yield Etanol menggunakan Kromatografi Gas

$$\begin{aligned} \text{Yield (\%)} &= \frac{\text{Konsentrasi etanol } \left(\frac{\text{g}}{\text{L}}\right)}{\text{Kadar gula } \left(\frac{\text{g}}{\text{L}}\right)} \times 100 \% \\ &= \frac{15,34 \left(\frac{\text{g}}{\text{L}}\right)}{44,97 \left(\frac{\text{g}}{\text{L}}\right)} \times 100 \% \\ &= 34,11 \% \end{aligned}$$

Lampiran 11. Efisiensi Fermentasi Analisis menggunakan Kromatografi Gas

$$\begin{aligned} \text{EF} &= \frac{\text{Konsentrasi etanol } \left(\frac{\text{g}}{\text{L}}\right)}{0,51 \times \text{kadar gula } \left(\frac{\text{g}}{\text{L}}\right)} \times 100 \% \\ \text{EF} &= \frac{15,34 \left(\frac{\text{g}}{\text{L}}\right)}{0,51 \times 44,97 \left(\frac{\text{g}}{\text{L}}\right)} \times 100 \% \\ \text{EF} &= 0,6728 \times 100 \% \\ \text{EF} &= 67,28 \% \end{aligned}$$

Lampiran 12. Hasil Pengujian Kromatografi Gas



LAPORAN HASIL PENGUJIAN

No. Seri : 087/200513001/LU/15/04/21
 Jenis Sampel : VS
 Nama Supplier : -
 WDNa.WD : Marketing and Sales Laboratory / 2021040738
 No. LPB : -
 Tanggal terima/tanggal analisa : 15 April 2021 / 16 April 2021
 Kondisi ruangan : RH = 49% , T = 23°C
 Jumlah Sampel : 1 botol (15 ml)
 Hasil analisa : -

No.	Parameter	Salah	Satuan	Hasil		Metode
				Rata-rata	Std Dev	
1	Purity Ethanol	-	%	15.76	0.09	GC

Mengetahui,

Surabaya, 16 April 2021

Dr. Mohamad Helli
 Factory Lab Manager

Kasumirah
 Lab. Material Technical Test Spv.

Lampiran 13. Kinerja Metode GC

8/16/2021

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=====
Agilent 7890A
=====
 Oven
 Equilibration Time           0.5 min
 Oven Temperature            240.0000000 C
 Flow Path                   Disabled
 Oven Program                On
      50.0000000 C for 2 min
      Then 30.0000000 C/min to 300.0000000 C for 2 min
 Run Time                     5 min

 Front Injector
 Syringe Size                10 µL
 Injection Volume            2 µL
 Injection Repetitions       1
 Injection Delay              0.0000000 sec
 Solvent A Washes (Preinj)   1
 Solvent A Washes (PostInj)  2
 Solvent A Volume (Preinj)   5 µL
 Solvent B Washes (Preinj)   1
 Solvent B Washes (PostInj)  2
 Solvent B Volume            5 µL
 Sample Washes               1
 Sample Wash Volume          5 µL
 Sample Pumps                1
 Swell Time (PreInj)         0 min
 Swell Time (PostInj)        0 min
 Solvent Wash Draw Speed    100 µL/min
 Solvent Wash Dispense Speed 6000 µL/min
 Sample Wash Draw Speed     100 µL/min
 Sample Wash Dispense Speed 6000 µL/min
 Injection Dispense Speed    6000 µL/min
 Viscosity Delay             0 sec
 Sample Delay                 Disabled

 Sample Overlap
 Sample overlap is not enabled

 Front RS Inlet AD
 Mode                        SolTic
 Heater                      On 250.0000000 C
 Pressure                     On 5 psi
 Total Flow                   On 50.0000000 mL/min
 Solvent Purge Flow          On 3.0000000 mL/min
 Gas Source                   On 20 mL/min After 2 min
 SolTic Ratio                 8.54107612036145 : 1
 Split Flow                   50 µL/min

 Thermal Aux 2 (user configurable)
 Heater                       Off
 Temperature Program         Off
      250.0000000 C for 0 min
 Run Time                     5 min

 Column #2
 Agilent 140400-124, Part 52727
 HP-1MOWAX Polyethylene Glycol
 200.0000000 C, 0.01 µm x 100 µm x 1 µm
 In: Front RS Inlet AD
 Out: Back Detector FID
 (Entered)                    50.0000000 C

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Pressure
Flow
Average Velocity
Holdup Time
Pressure Program
Flow 4 0.1 for 0 min
Run Time

Front Detector FCO
HEATER
Reference Flow
Makeup Flow
Const Col 4 Makeup
Negative Polarity
Filament

Back Detector #10
HEATER
H2 Flow
Air Flow
Makeup Flow
Const Col 1 Makeup
Flame
Electrode

Valve Box
Heater

Signal#
Signal #1: front signal
Signal #2: back signal
Signal #3: Test Pipe
Signal #4: Test Pipe

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ETHANOL 2021
4 0.1
0.8534 mL/min
12.004 CM/sec
1.1818 min
ON
4 min

off
ON 20 mL/min
ON 5 mL/min
OFF
ON
OFF

ON 250 °C
ON 20 mL/min
ON 250 mL/min
ON 30 mL/min
OFF
ON
ON

OFF
save off
NO Hz
save on
30 Hz
save off
50 Hz
save off
50 Hz

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14. Foto-foto Penelitian



Gambar 1. *Pretreatment* Kering Ampas Sorgum



Gambar 2. Setelah dihidrolisis



Gambar 3. Hidrolisis menggunakan *Autoclave* dan *Microwave*



Gambar 4. Hidrolisat 1 % Gambar 5. Penyaringan Gambar 6. Penetralan pH



Gambar 7. Proses Fermentasi



Gambar 8. Distilasi



Gambar 9. Etanol Sorgum.

Lampiran 15. Tabel AOAC

Concentration (in weight%) of Ethanol-Water Mixtures vs. Specific Gravity at various Temperature

wt. % Ethanol	Temperature (°C)				wt. % Ethanol	Temperature (°F)			
	20	25	30	35		20	25	30	35
0	1.0000	1.0000	1.0000	1.0000	50	1.0124	1.0065	1.0005	0.9945
1	1.0026	1.0022	1.0019	1.0017	51	1.0110	1.0051	0.9991	0.9931
2	1.0052	1.0048	1.0045	1.0043	52	1.0096	1.0037	0.9977	0.9917
3	1.0078	1.0074	1.0071	1.0069	53	1.0081	1.0022	0.9962	0.9902
4	1.0104	1.0099	1.0096	1.0094	54	1.0067	1.0007	0.9947	0.9887
5	1.0130	1.0125	1.0122	1.0120	55	1.0052	0.9993	0.9933	0.9873
6	1.0156	1.0151	1.0148	1.0146	56	1.0038	0.9978	0.9918	0.9858
7	1.0182	1.0177	1.0174	1.0172	57	1.0023	0.9959	0.9899	0.9839
8	1.0208	1.0203	1.0200	1.0198	58	1.0009	0.9940	0.9880	0.9820
9	1.0234	1.0229	1.0226	1.0224	59	0.9994	0.9921	0.9861	0.9801
10	1.0260	1.0255	1.0252	1.0250	60	0.9979	0.9906	0.9846	0.9786
11	1.0286	1.0281	1.0278	1.0276	61	0.9965	0.9892	0.9832	0.9772
12	1.0312	1.0307	1.0304	1.0302	62	0.9950	0.9877	0.9817	0.9757
13	1.0338	1.0333	1.0330	1.0328	63	0.9935	0.9862	0.9802	0.9742
14	1.0364	1.0359	1.0356	1.0354	64	0.9921	0.9848	0.9788	0.9728
15	1.0390	1.0385	1.0382	1.0380	65	0.9906	0.9833	0.9773	0.9713
16	1.0416	1.0411	1.0408	1.0406	66	0.9891	0.9818	0.9758	0.9698
17	1.0442	1.0437	1.0434	1.0432	67	0.9877	0.9804	0.9744	0.9684
18	1.0468	1.0463	1.0460	1.0458	68	0.9862	0.9789	0.9729	0.9669
19	1.0494	1.0489	1.0486	1.0484	69	0.9847	0.9774	0.9714	0.9654
20	1.0520	1.0515	1.0512	1.0510	70	0.9833	0.9760	0.9700	0.9640
21	1.0546	1.0541	1.0538	1.0536	71	0.9818	0.9745	0.9685	0.9625
22	1.0572	1.0567	1.0564	1.0562	72	0.9804	0.9731	0.9671	0.9611
23	1.0598	1.0593	1.0590	1.0588	73	0.9789	0.9716	0.9656	0.9596
24	1.0624	1.0619	1.0616	1.0614	74	0.9775	0.9702	0.9642	0.9582
25	1.0650	1.0645	1.0642	1.0640	75	0.9760	0.9687	0.9627	0.9567
26	1.0676	1.0671	1.0668	1.0666	76	0.9745	0.9672	0.9612	0.9552
27	1.0702	1.0697	1.0694	1.0692	77	0.9731	0.9658	0.9598	0.9538
28	1.0728	1.0723	1.0720	1.0718	78	0.9716	0.9643	0.9583	0.9523
29	1.0754	1.0749	1.0746	1.0744	79	0.9702	0.9629	0.9569	0.9509
30	1.0780	1.0775	1.0772	1.0770	80	0.9687	0.9614	0.9554	0.9494
31	1.0806	1.0801	1.0798	1.0796	81	0.9672	0.9600	0.9540	0.9480
32	1.0832	1.0827	1.0824	1.0822	82	0.9658	0.9585	0.9525	0.9465
33	1.0858	1.0853	1.0850	1.0848	83	0.9643	0.9571	0.9511	0.9451
34	1.0884	1.0879	1.0876	1.0874	84	0.9629	0.9556	0.9496	0.9436
35	1.0910	1.0905	1.0902	1.0900	85	0.9614	0.9542	0.9482	0.9422
36	1.0936	1.0931	1.0928	1.0926	86	0.9600	0.9527	0.9467	0.9407
37	1.0962	1.0957	1.0954	1.0952	87	0.9585	0.9513	0.9453	0.9393
38	1.0988	1.0983	1.0980	1.0978	88	0.9571	0.9498	0.9438	0.9378
39	1.1014	1.1009	1.1006	1.1004	89	0.9556	0.9484	0.9424	0.9364
40	1.1040	1.1035	1.1032	1.1030	90	0.9542	0.9470	0.9410	0.9350
41	1.1066	1.1061	1.1058	1.1056	91	0.9527	0.9455	0.9395	0.9335
42	1.1092	1.1087	1.1084	1.1082	92	0.9513	0.9441	0.9381	0.9321
43	1.1118	1.1113	1.1110	1.1108	93	0.9498	0.9426	0.9366	0.9306
44	1.1144	1.1139	1.1136	1.1134	94	0.9484	0.9412	0.9352	0.9292
45	1.1170	1.1165	1.1162	1.1160	95	0.9469	0.9397	0.9337	0.9277
46	1.1196	1.1191	1.1188	1.1186	96	0.9455	0.9383	0.9323	0.9263
47	1.1222	1.1217	1.1214	1.1212	97	0.9441	0.9369	0.9309	0.9249
48	1.1248	1.1243	1.1240	1.1238	98	0.9426	0.9354	0.9294	0.9234
49	1.1274	1.1269	1.1266	1.1264	99	0.9412	0.9340	0.9280	0.9220
50	1.1300	1.1295	1.1292	1.1290	100	0.9397	0.9325	0.9265	0.9205

NOTE: - Marston, M. and J. J. (1963-11), (p. 399) "Perry's Chemical Engineers' Handbook", 6th ed.

Daftar Riwayat Hidup



Penulis dilahirkan di Bogor Propinsi Jawa Barat pada 17 Juli 1999, sebagai anak pertama dari empat bersaudara dari pasangan Bapak Stefanus Nggubu dan Ibunda Roswita Auni. Pada tahun 2005 penulis mengikuti pendidikan pada SD Negeri Sainoni, tamat dan berijazah tahun 2011, penulis melanjutkan pendidikan di SMP Negeri Napan dan berijazah tahun 2014 penulis melanjutkan pendidikan pada SMA Negeri Bikomi Utara dan tamat berijazah tahun 2017. Pada tahun 2017 mendaftarkan diri pada Fakultas Pertanian (FAPERTA), Program Studi Kimia Universitas Timor–TTU lewat jalur SBMPTN selesainya penyusunan Skripsi ini dengan baik.

Moto

"Bersukacitalah dalam Harapan, Sabarlah dalam Kesusakan dan Bertekunlah dalam Doa"
(Roma 12:12)