

LAMPIRAN

Lampiran 1. Perhitungan

1. Persamaan reaksi pembentukan sitronelal dioksolana

	$C_{10}H_{18}O$	+	$C_2H_6O_2$	\rightleftharpoons	$C_{12}H_{22}O_2$	+	H_2O
Mula-mula	0,1 mol		0,2 mol				
Bereaksi	0,1 mol		0,1 mol		0,1 mol		0,1 mol
Sisa	-		0,1 mol		0,1 mol		0,1 mol

a) Volume air

Massa molar air 18,0153 g/mol

ρ air = 0,997 g/mL

Mol air = 0,1 mol

$$\begin{aligned}
 V \text{ air} &= \frac{\text{mol} \times Mr}{\rho} \\
 &= \frac{0,1 \text{ mol} \times 18,0153 \text{ g/mol}}{0,997 \text{ g/mL}} \\
 &= 1,807 \text{ mL}
 \end{aligned}$$

b) Volume sitronelal

Massa molar sitronelal = 154,55 g/mol

ρ sitronelal = 0,855 g/mL

Mol sitronelal = 0,1 mol

$$\begin{aligned}
 V \text{ sitronelal} &= \frac{\text{mol} \times Mr}{\rho} \\
 &= \frac{0,1 \text{ mol} \times 154,55 \text{ g/mol}}{0,855 \text{ g/mL}} \\
 &= 18,041 \text{ mL}
 \end{aligned}$$

c) Volume etilen glikol

Massa molar etilen glikol = 62,07 g/mol

ρ etilen glikol = 1,11 g/mL

Mol etilen glikol = 0,1 mol

$$\begin{aligned}
 V \text{ etilen glikol} &= \frac{\text{mol} \times Mr}{\rho} \\
 &= \frac{0,2 \text{ mol} \times 62,07 \text{ g/mol}}{1,11 \text{ g/mL}} \\
 &= 11,184 \text{ mL}
 \end{aligned}$$

d) Katalis H₂SO₄

a) Molaritas H₂SO₄

$$\begin{aligned} M \text{ H}_2\text{SO}_4 &= \frac{\% \times 10 \times \text{massa jenis}}{\text{massa molar}} \\ &= \frac{96 \times 10 \times 1,83 \text{ g/mL}}{98,079 \text{ g/mol}} \\ &= 17,9121 \text{ M} \end{aligned}$$

b) Volume dan % H₂SO₄

- Mol H₂SO₄ = 0,004 mol

$$\begin{aligned} V \text{ H}_2\text{SO}_4 &= \frac{\text{mol H}_2\text{SO}_4}{M \text{ H}_2\text{SO}_4} \\ &= \frac{0,004 \text{ mol}}{17,9121} \\ &= 0,0002233 \text{ L} \\ &= 0,2233 \text{ mL} \end{aligned}$$

$$\begin{aligned} \% \text{ katalis} &= \frac{\text{mol katalis}}{\text{mol reaktan pembatas}} \times 100\% \\ &= \frac{0,004 \text{ mol}}{0,1 \text{ mol}} \times 100\% \\ &= 4\text{mol}\% \end{aligned}$$

- Mol H₂SO₄ = 0,006 mol

$$\begin{aligned} V \text{ H}_2\text{SO}_4 &= \frac{\text{mol H}_2\text{SO}_4}{M \text{ H}_2\text{SO}_4} \\ &= \frac{0,006 \text{ mol}}{17,9121} \\ &= 0,0003349 \text{ L} \\ &= 0,3349 \text{ mL} \end{aligned}$$

$$\begin{aligned} \% \text{ katalis} &= \frac{\text{mol katalis}}{\text{mol reaktan pembatas}} \times 100\% \\ &= \frac{0,006 \text{ mL}}{0,1 \text{ mol}} \times 100\% \\ &= 6\text{mol}\% \end{aligned}$$

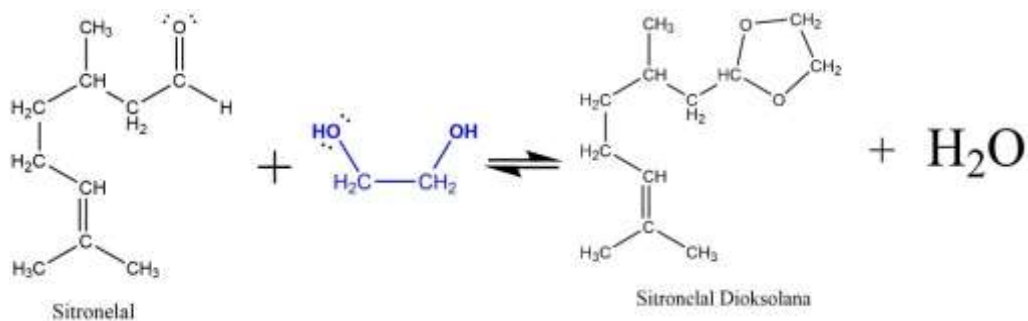
Lampiran 2. Perhitungan ΔH Reaksi Sintesis Sitronelal Dioksolan dari Data Energi Ikatan

Energi Ikatan Rata-Rata

Jenis ikatan	Atom-atom yang berikatan			
		H	C	O
Tunggal	C	413	348	358
	O	463	358	146
Rangkap dua	C		614	799

(Sunarya & Setiabudi, 2009)

Persamaan reaksi:



Ikatan yang putus pada pereaksi:

$$\text{C-H } 22 \text{ mol} \times 413 \text{ kJ/mol} = 9086 \text{ kJ}$$

$$\text{C-O } 2 \text{ mol} \times 358 \text{ kJ/mol} = 926 \text{ kJ}$$

$$\text{C=O } 1 \text{ mol} \times 799 \text{ kJ/mol} = 799 \text{ kJ}$$

$$\text{C=C } 1 \text{ mol} \times 614 \text{ kJ/mol} = 614 \text{ kJ}$$

$$\text{O-H } 2 \text{ mol} \times 463 \text{ kJ/mol} = 926 \text{ kJ}$$

$$\text{Total energi yang dibutuhkan} = 12351 \text{ kJ}$$

Ikatan yang terbentuk pada hasil reaksi:

$$\text{C-H } 22 \text{ mol} \times 413 \text{ kJ/mol} = 9086 \text{ kJ}$$

$$\text{C=C } 1 \text{ mol} \times 614 \text{ kJ/mol} = 614 \text{ kJ}$$

$$\text{C-O } 4 \text{ mol} \times 358 \text{ kJ/mol} = 1852 \text{ kJ}$$

$$\text{O-H } 2 \text{ mol} \times 463 \text{ kJ/mol} = 926 \text{ kJ}$$

$$\text{Total energi yang dilepaskan} = 12478 \text{ kJ}$$

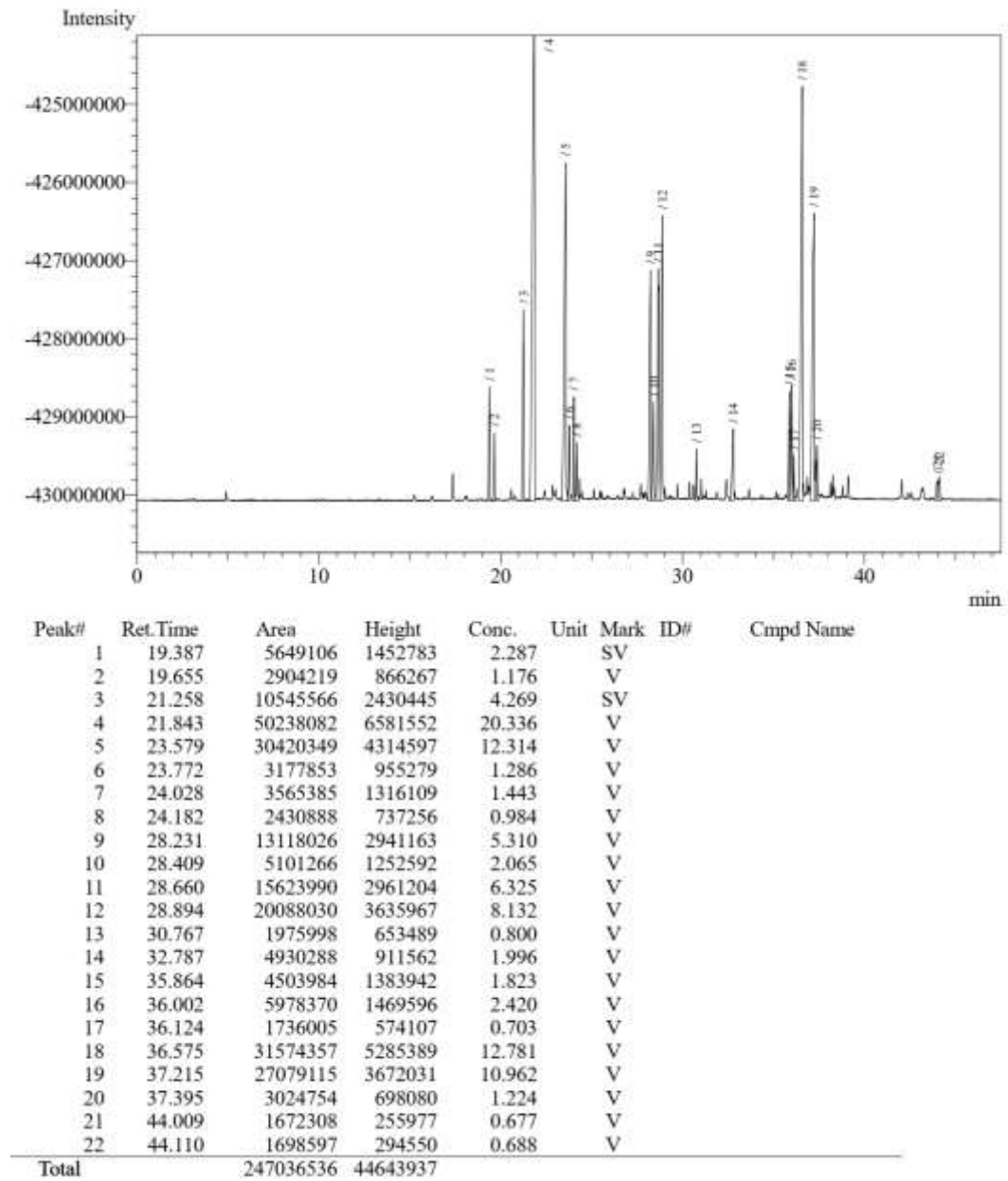
$$\Delta H_{\text{reaksi}} = \sum \text{pemutusan ikatan} - \sum \text{pembentukan ikatan}$$

$$= 12351 - 12478 = -127 \text{ kJ}$$

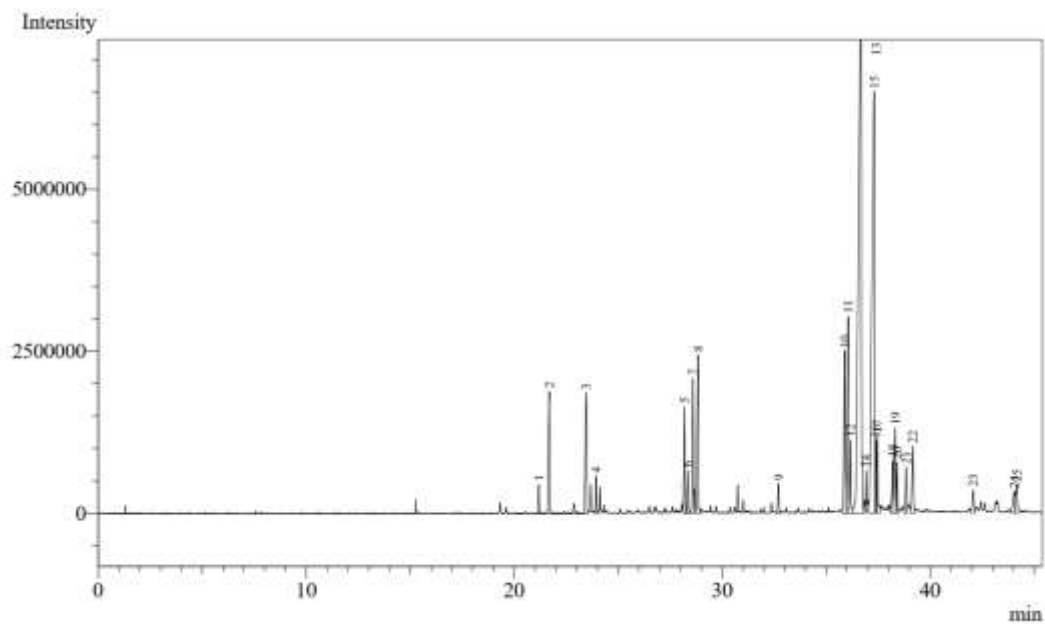
Jihan Nurafifah Hernawan, 2023

REAKSI SITRONELAL DENGAN ETILENA GLIKOL MENGGUNAKAN KATALIS ASAM SULFAT
Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

Lampiran 3. Kromatogram GC

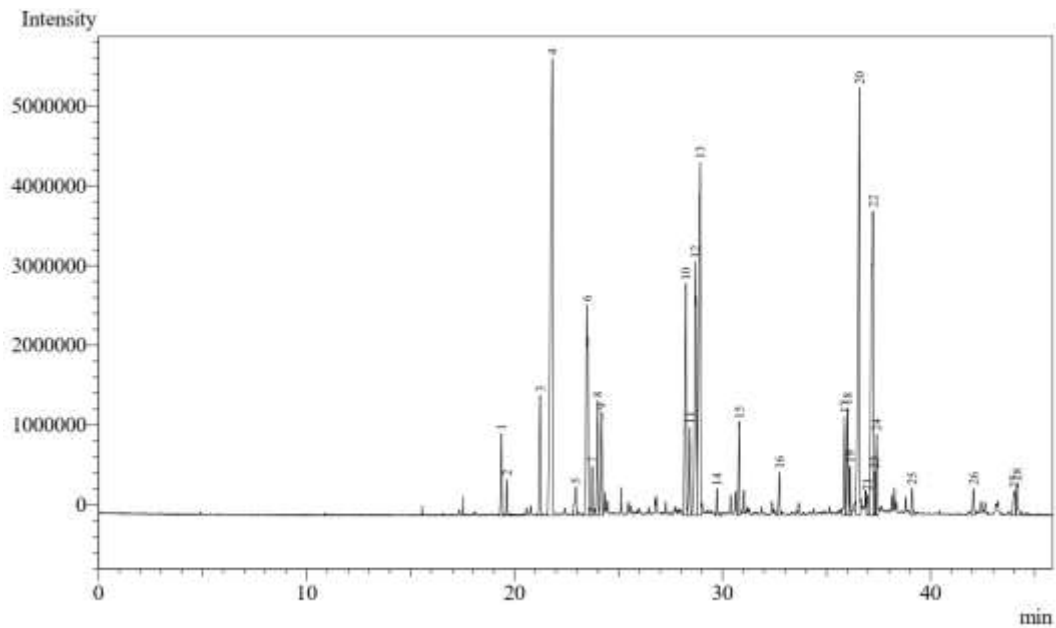


Kromatogram GC-FID Suhu Refluks 88°C 0,006 mol H₂SO₄



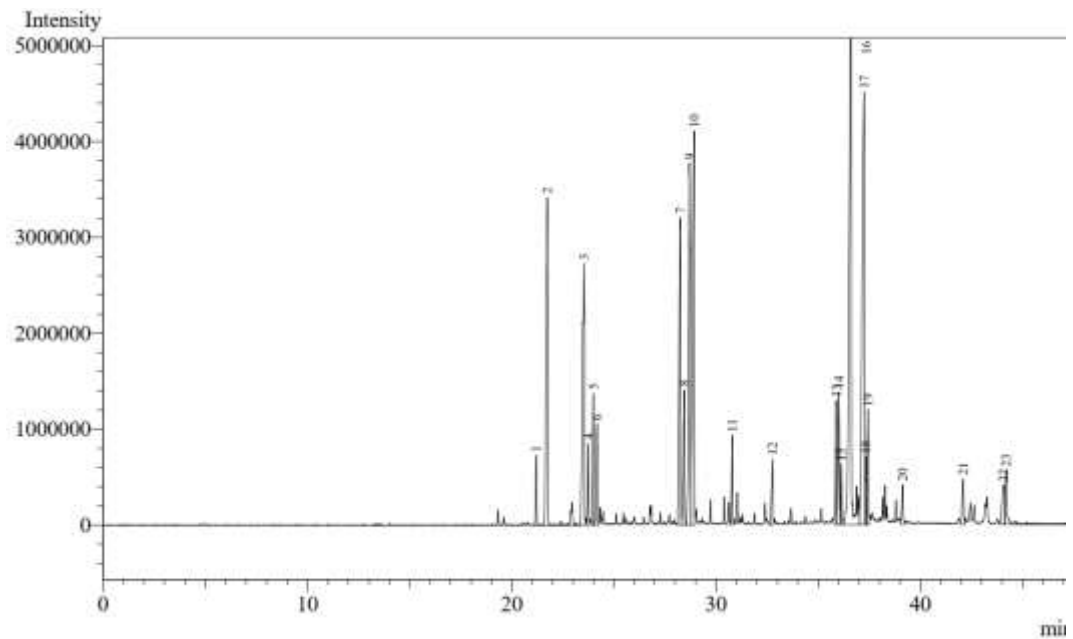
Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	ID#	Cmpd Name
1	21.185	1384453	445430	0.555		SV		
2	21.686	7116040	1875004	2.852		SV		
3	23.464	8748078	1862663	3.506		V		
4	23.949	1520137	570366	0.609		V		
5	28.194	5343103	1639713	2.141		V		
6	28.349	2362614	657077	0.947		V		
7	28.595	7543737	2068102	3.023		V		
8	28.842	10416650	2435697	4.175		V		
9	32.724	1772250	457862	0.710		V		
10	35.900	10876339	2495093	4.359		V		
11	36.055	14598758	3015045	5.851		V		
12	36.160	3489219	1122548	1.398		SV		
13	36.686	82152110	9068594	32.926		V		
14	36.925	1770110	651586	0.709		V		
15	37.306	58981939	6497055	23.639		V		
16	37.383	2309415	1106666	0.926		V		
17	37.464	4800589	1190354	1.924		SV		
18	38.195	3102339	812512	1.243		V		
19	38.327	4771353	1311324	1.912		V		
20	38.411	2272728	773526	0.911		V		
21	38.844	2564248	700168	1.028		V		
22	39.176	4624157	1024197	1.853		V		
23	42.077	1974280	351077	0.791		V		
24	44.047	2559232	331338	1.026		V		
25	44.167	2454899	425387	0.984		V		
Total		249508777	42888384					

Kromatogram GC-FID Suhu Refluks 90°C 0,006 mol H₂SO₄



Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	ID#	Cmpd Name
1	19.366	3582764	1021902	1.499		SV		
2	19.632	1748128	455457	0.731		SV		
3	21.226	5679664	1500334	2.376		V		
4	21.814	40540531	5726072	16.963		V		
5	22.948	1947285	354344	0.815		V		
6	23.479	15729090	2627485	6.581		V		
7	23.732	2047189	614495	0.857		V		
8	23.995	5334335	1430492	2.232		V		
9	24.188	5050203	1283803	2.113		V		
10	28.230	12497683	2905032	5.229		V		
11	28.422	4317355	1102546	1.806		V		
12	28.689	18066144	3180072	7.559		V		
13	28.924	28206406	4414279	11.802		V		
14	29.725	1314457	329438	0.550		SV		
15	30.797	4125018	1167531	1.726		V		
16	32.734	2299571	539010	0.962		V		
17	35.865	4309199	1234870	1.803		V		
18	36.002	5662695	1334770	2.369		V		
19	36.125	1819964	602589	0.761		V		
20	36.580	31543410	5340004	13.198		V		
21	36.952	1315816	260632	0.551		V		
22	37.225	28182158	3803237	11.792		V		
23	37.307	1620547	546442	0.678		V		
24	37.410	4102139	1008298	1.716		V		
25	39.112	1495628	339108	0.626		V		
26	42.069	1739941	333422	0.728		V		

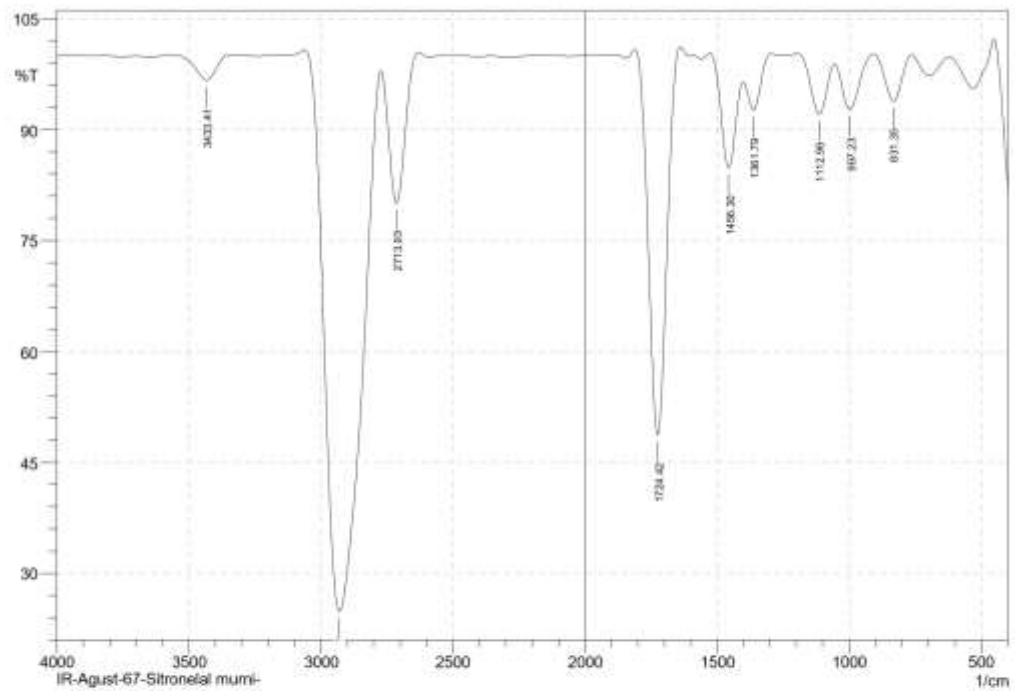
Kromatogram GC-FID Suhu Refluks 92°C 0,006 mol H₂SO₄



Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	ID#	Compd Name
1	21.197	2258182	723988	0.981		SV		
2	21.737	17037823	3387560	7.400		SV		
3	23.541	18016754	2722061	7.825		V		
4	23.738	2503538	852943	1.087		V		
5	23.993	4757979	1370560	2.066		V		
6	24.177	3684373	1052741	1.600		V		
7	28.240	13952211	3200098	6.060		V		
8	28.436	5800604	1402871	2.519		V		
9	28.695	20260172	3764766	8.799		V		
10	28.923	25297954	4094486	10.987		V		
11	30.791	3007476	924156	1.306		V		
12	32.766	3146781	683758	1.367		V		
13	35.871	4413477	1291300	1.917		V		
14	36.009	5897475	1372987	2.561		V		
15	36.132	1922808	629732	0.835		V		
16	36.610	44190861	6213666	19.193		SV		
17	37.244	36431200	4507973	15.823		V		
18	37.329	1792560	699520	0.779		V		
19	37.433	4858503	1196975	2.110		V		
20	39.126	1709326	412075	0.742		V		
21	42.098	2463763	473788	1.070		V		
22	44.072	3525559	409124	1.531		V		
23	44.195	3316223	558184	1.440		SV		
Total		230245602	41945312					

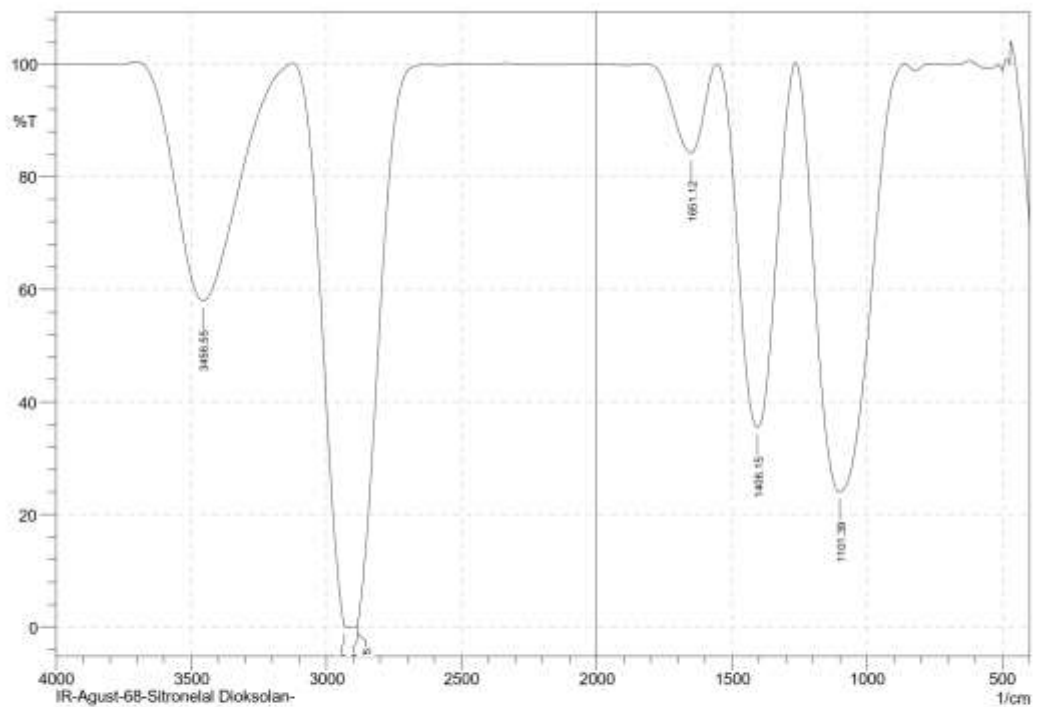
Kromatogram GC-FID Suhu Refluks 90°C 0,004 mol H₂SO₄

Lampiran 4. Spektrum FTIR



	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	831.35	93.848	6.308	908.5	763.84	1.79	1.89
2	997.23	92.72	6.678	1055.1	908.5	2.314	2.019
3	1112.96	92.106	7.342	1197.83	1055.1	2.372	2.111
4	1361.79	92.639	5.208	1400.37	1296.21	1.857	1.094
5	1456.3	84.84	13.294	1525.74	1402.3	4.44	3.538
6	1724.42	48.72	52.282	1809.29	1639.55	20.574	21.309
7	2713.93	80.027	18.942	2771.8	2630.99	6.3	5.813
8	2929.97	24.865	74.624	3061.13	2773.73	75.965	75.143
9	3433.41	96.665	3.494	3564.57	3335.03	1.203	1.363

Spektrum FTIR Bahan Sitronelal



	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	1101.39	24.003	76.232	1265.35	862.21	110.692	111.07
2	1406.15	35.467	64.706	1554.68	1267.27	57.727	57.938
3	1651.12	84.208	15.821	1809.29	1556.61	8.75	8.777
4	2881.75	0.645	0.776	2883.68	2636.78	70.71	0
5	2885.6	0	0.071	2887.53	2885.6	6.079	0
6	2933.83	0	0.262	2935.76	2931.9	771.552	190.688
7	3456.55	57.946	42.41	3703.45	3126.71	54.718	55.566

Spektrum FTIR Senyawa Hasil Reaksi