

### Lampiran A. Perhitungan

Pembuatan larutan HCl 1 M dengan kadar HCl 37%

Diketahui :  $\rho$  HCl = 1190 g/mL

$M_r$  = 36,46 g/mol

Molaritas HCl =  $\% (b/b) \times \frac{\rho}{M_r}$

$$= 37 \% \times \frac{1190 \text{ g/mL}}{36,46 \text{ g/mol}}$$

$$= 12,08 \text{ M}$$

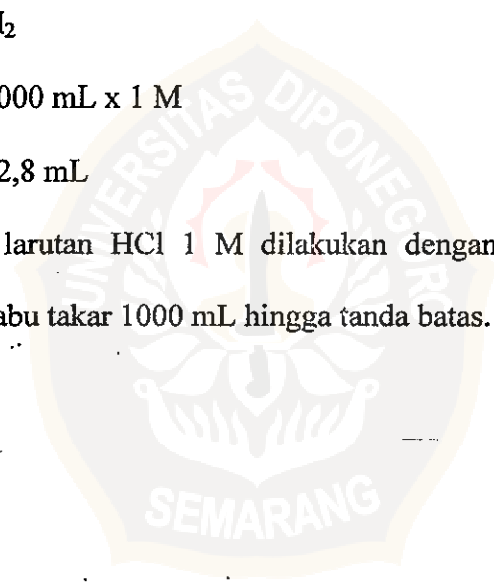
$$V_1 \times M_1 = V_2 \times M_2$$

$$V_1 \times 12,08 \text{ M} = 1000 \text{ mL} \times 1 \text{ M}$$

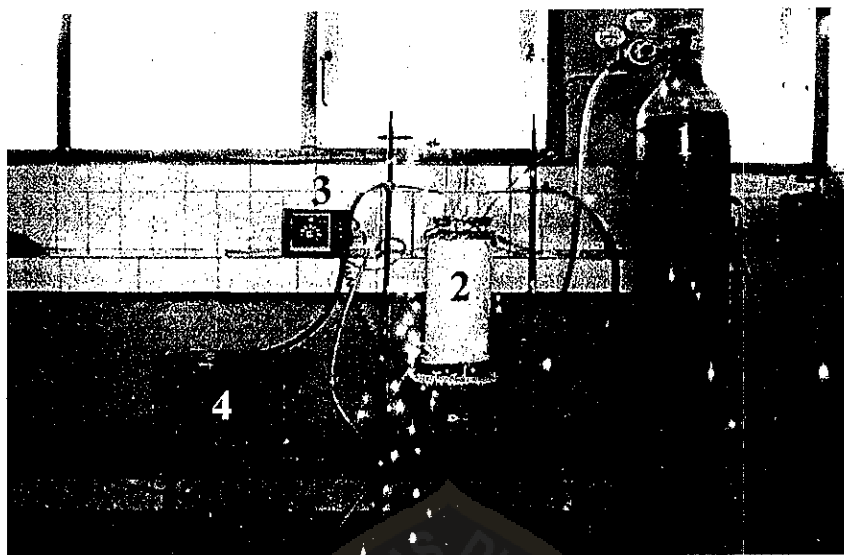
$$V_1 = 82,8 \text{ mL}$$

Untuk membuat larutan HCl 1 M dilakukan dengan pengenceran 82,8 mL

HCl 37% dalam labu takar 1000 mL hingga tanda batas.

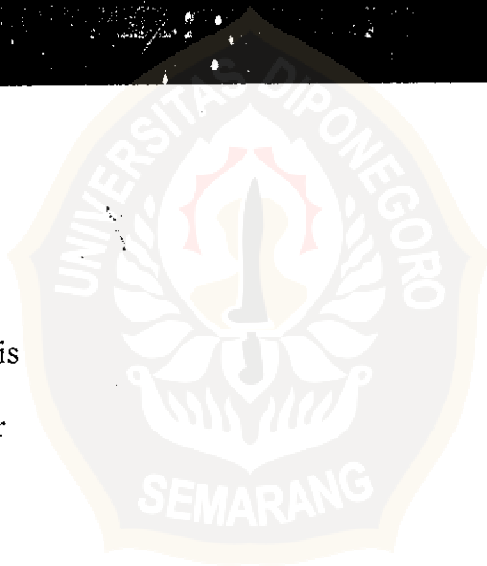


### Lampiran B. Gambar Reaktor Pirolisis



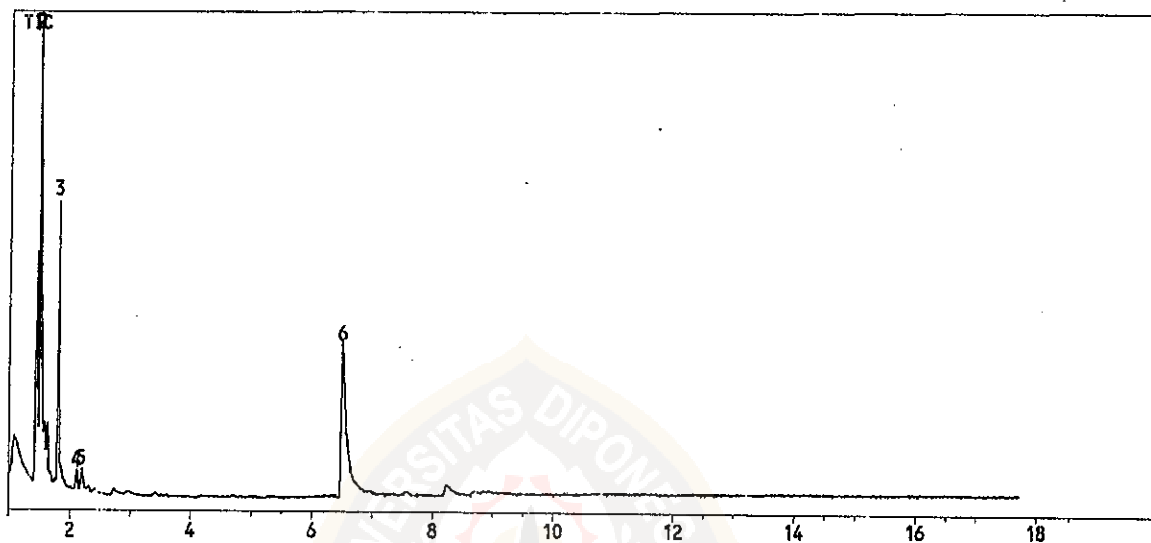
Keterangan gambar :

1. Gas Nitrogen
2. Reaktor Pirolisis
3. Termoregulator
4. Kondensor



### Lampiran C. Kromatogram hasil pirolisis lignin pada suhu 200°C

\*\*\*CLASS-500\*\*\* Report No. = 1 Data : HBB200.D01  
 Sample : Pirolisis Lignin 200 Habibi  
 ID : L7024  
 Operator ; dom  
 Method File Name : HABIBI.MET



#### \*\*\*\* Peak Report\*\*\*\*

PKNO	R.Time	I.Time	F.Time	Area	Height	A/H ( sec)	MK	%Total	Name
1	1.426	1.392	1.475	32085833	16827835	1.907		25.23	
2	1.494	1.475	1.725	43915067	17458302	2.515	v	34.53	
3	1.811	1.733	1.950	17280702	10401871	1.661		13.59	
4	2.112	2.075	2.152	1305042	692720	1.884		1.03	
5	2.194	2.158	2.283	1863535	726947	2.564	v	1.47	
6	6.504	6.433	6.783	30723401	5515236	5.571		24.16	
Total				127173579				100	

## Lampiran D. Spektra Massa Produk Pirolisis Lignin pada Suhu 200°C

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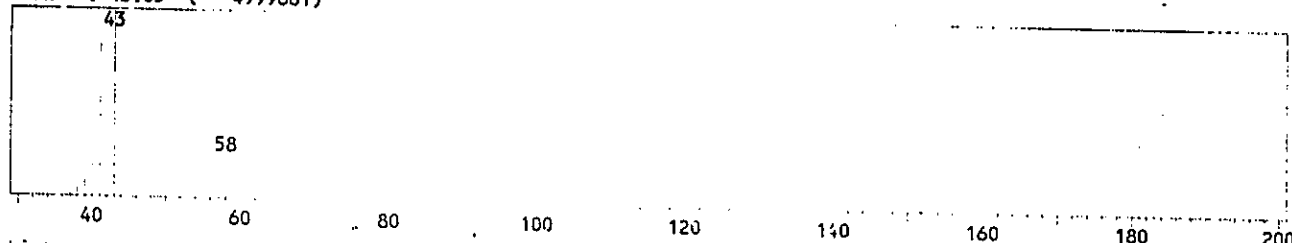
<Unknown Spectrum>

Data : HBB200.001

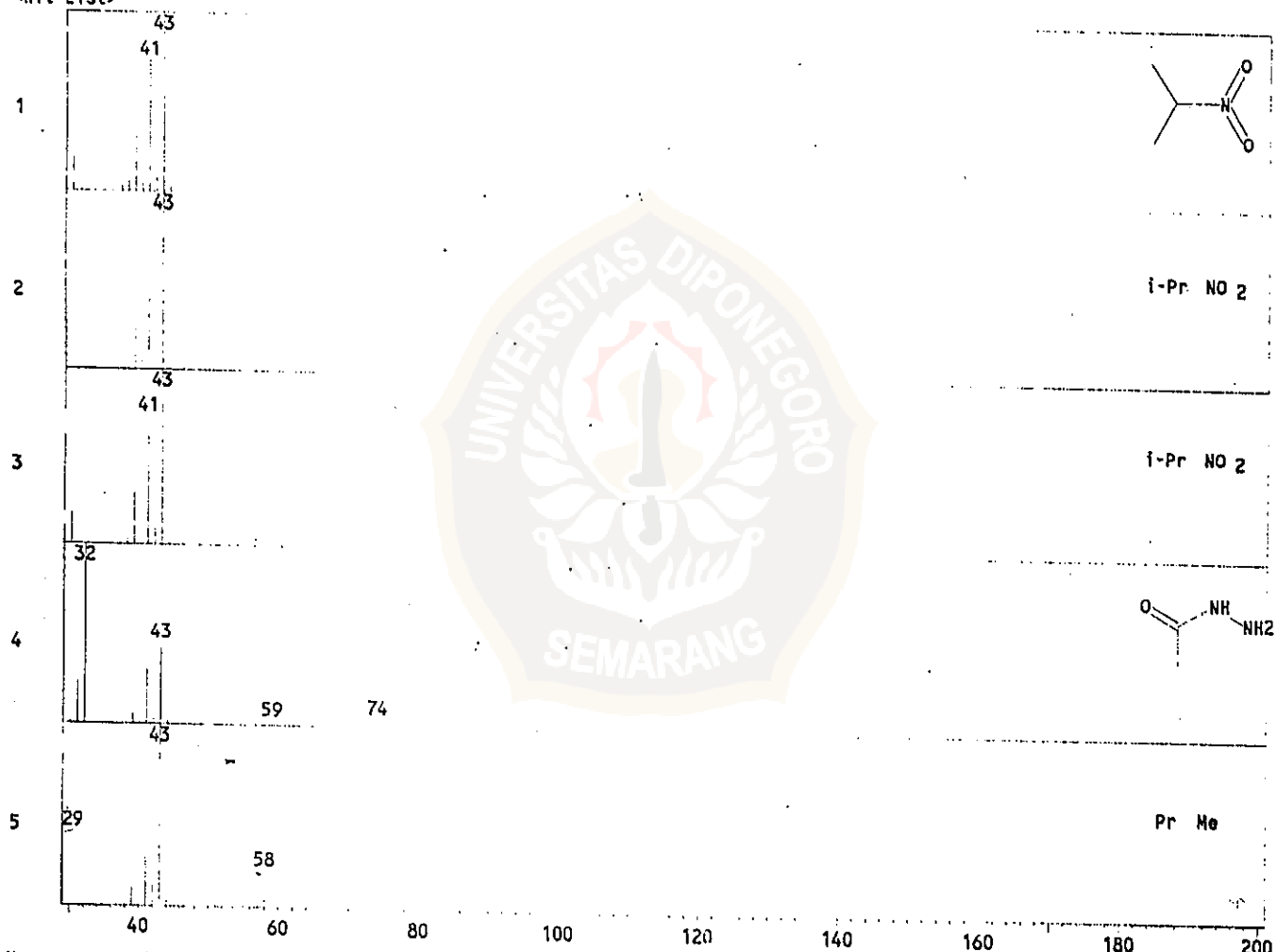
Mass Peak # : 11 Ret. Time : 1.500

Scan # : 61 B.G. Scan # : 57

Base Peak : 43.05 ( 4999681)



<Hit List>



No	SI	Mol. Wgt.	Mol. Form./Compound Name	CAS No.	Entry	LIB#
1	89	89	C <sub>3</sub> H <sub>7</sub> NO <sub>2</sub>	79-46-9	868	2
2	88	89	Propane, 2-nitro- \$\$ Dimethylnitromethane	79-46-9	3403	3
3	88	89	Propane, 2-nitro- (CAS) 2-Nitropropane	79-46-9	3402	3
4	87	74	C <sub>2</sub> H <sub>6</sub> N <sub>2</sub> O	1068-57-1	307	?
5	84	58	Acetic acid, hydrazide \$\$ Acetylhydrazide	106-97-8	480	3
			Butane (CAS) n-Butane \$\$ LPG \$\$ R 60J \$\$ Diethyl \$\$ Freon 600 \$\$ Liquefied petroleum			

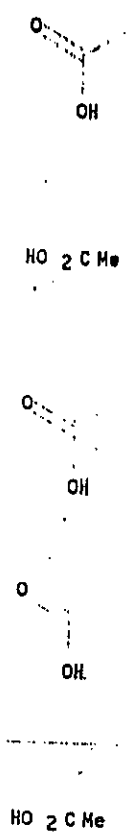
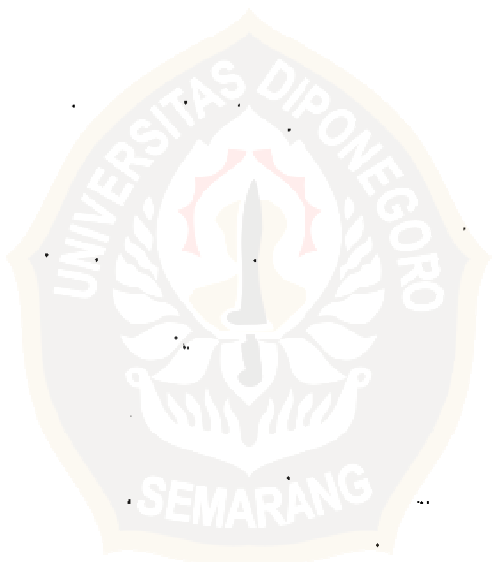
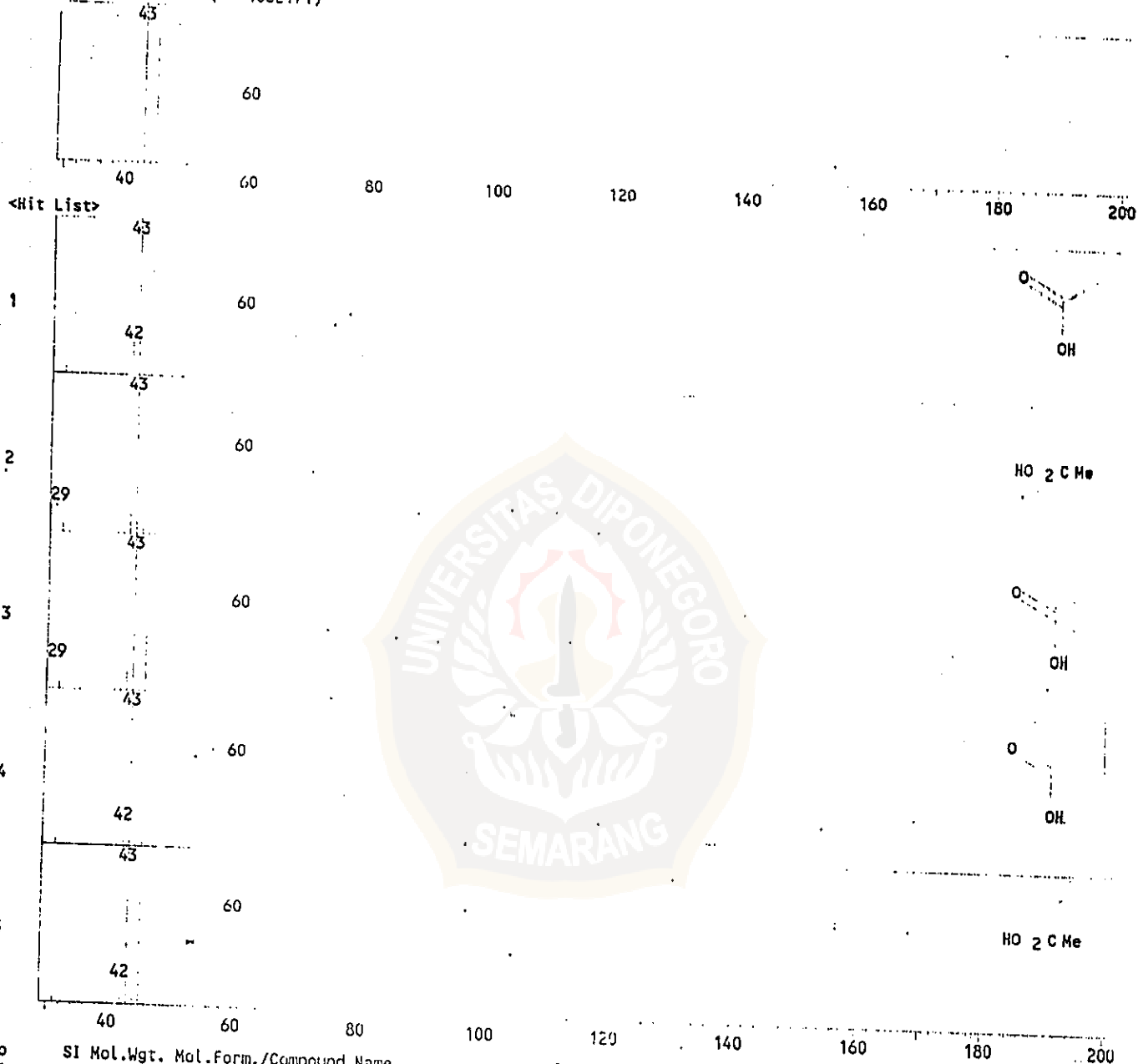
Library Name

(1) NIST12.LIB (2) NIST62.LIB (3) WILEY229.LIB

Lah Kimia Organik FMIPA UGM

<Unknown Spectrum>

Data : HBB200.D01  
 Mass Peak # : 8 Ret. Time : 1.817  
 Scan # : 99 B.G. Scan # : 90  
 Base Peak : 43.05 ( 4062171)



No	SI	Mol.Wgt.	Mol.Form./Compound Name	CAS No.	Entry	LIB#
1	99	60	C <sub>2</sub> H <sub>4</sub> O <sub>2</sub> Acetic acid	64-19-7	116	2
2	97	60	C <sub>2</sub> H <sub>4</sub> O <sub>2</sub> Acetic acid (CAS)	64-19-7	565	3
3	97	60	C <sub>2</sub> H <sub>4</sub> O <sub>2</sub> Acetic acid	64-19-7	118	1
4	97	60	C <sub>2</sub> H <sub>4</sub> O <sub>2</sub> Acetic acid	64-19-7	117	1
5	97	60	C <sub>2</sub> H <sub>4</sub> O <sub>2</sub> Acetic acid (CAS)	64-19-7	566	3

Library Name  
 (1) NIST12.LIB (2) NIST62.LIB (3) WILEY229.LIB

## Laboratorium Kimia Organik FMIPA USM

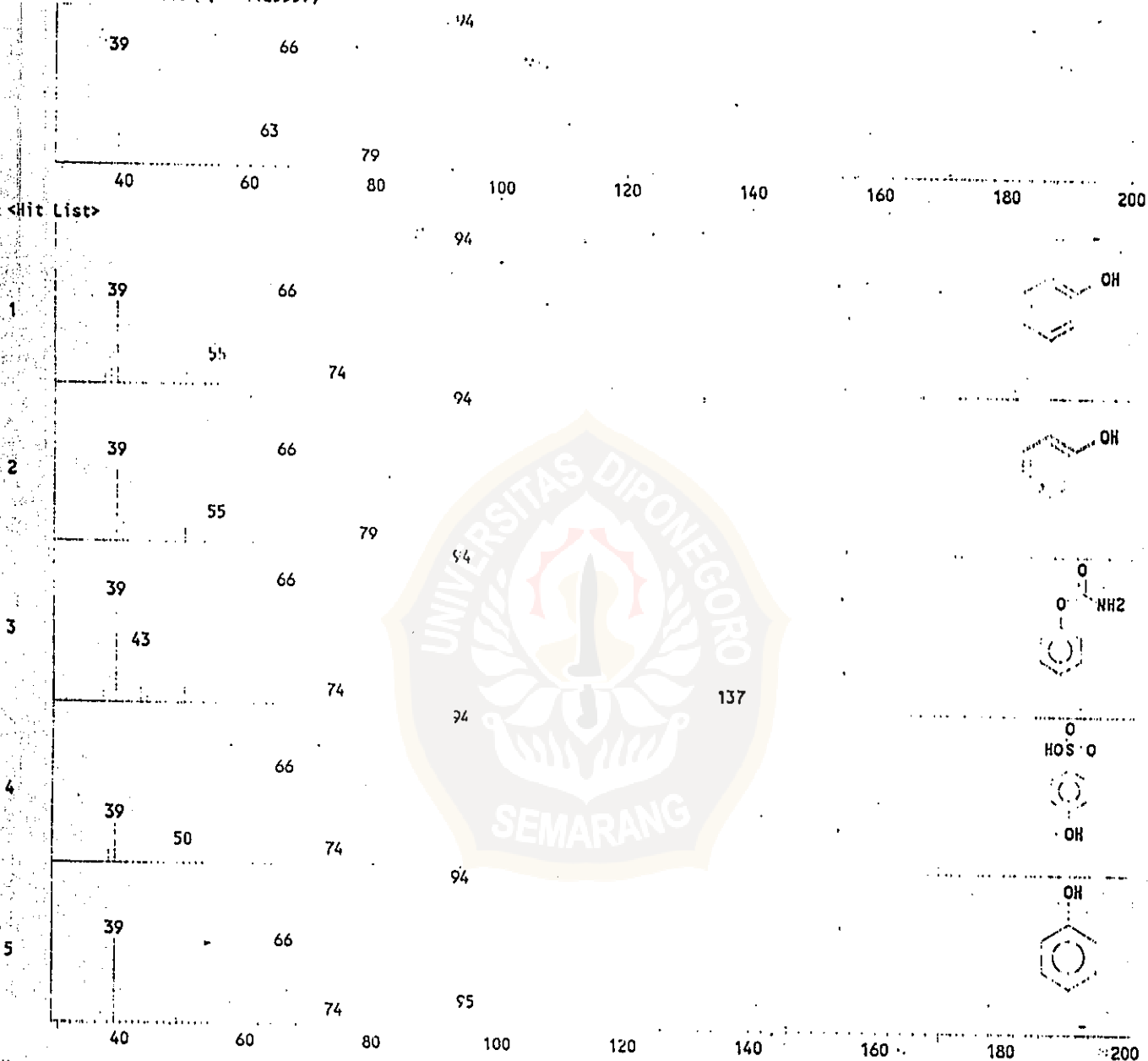
&lt;Unknown Spectrum&gt;

Data : HBB200.D01

Mass Peak # : 31 Ret. Time : 6.508

Scan # : 662 B.G. Scan # : 803

Base Peak : 94.10 ( 1125559)



&lt;Hit List&gt;

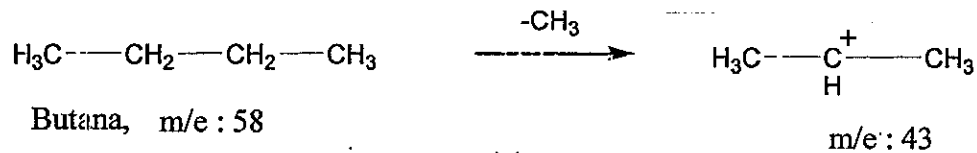
No	SI	Mol. Wgt.	Mol. Form./Compound Name	CAS No.	Entry	LIB#
1	93	94	C <sub>6</sub> H <sub>6</sub> O Phenol (CAS) IZAL \$\$\$ ENT 1814 \$\$\$ PhOH \$\$\$	108-95-2	3910	3
2	92	94	C <sub>6</sub> H <sub>6</sub> O Phenol (CAS) IZAL \$\$\$ ENT 1814 \$\$\$ PhOH \$\$\$	108-95-2	3915	3
3	91	137	C <sub>7</sub> H <sub>7</sub> NO <sub>2</sub> Carbamic acid, phenyl ester \$\$\$ Phenyl carbamate	622-46-8	6730	2
4	90	174	C <sub>6</sub> H <sub>6</sub> O <sub>4</sub> S Benzenesulfonic acid, 4-hydroxy-	98-67-9	16038	2
5	90	94	C <sub>6</sub> H <sub>6</sub> O Phenol	108-95-2	835	1

Library Name

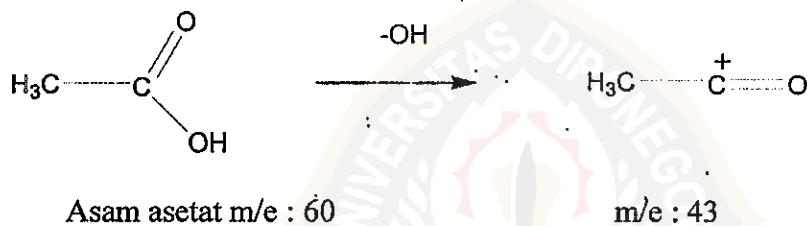
(1) NIST12.LIB (2) NIST62.LIB (3) WILEY229.LIB

### Lampiran E. Pola Fragmentasi Produk Pirolisis Lignin Pada Suhu 200°C

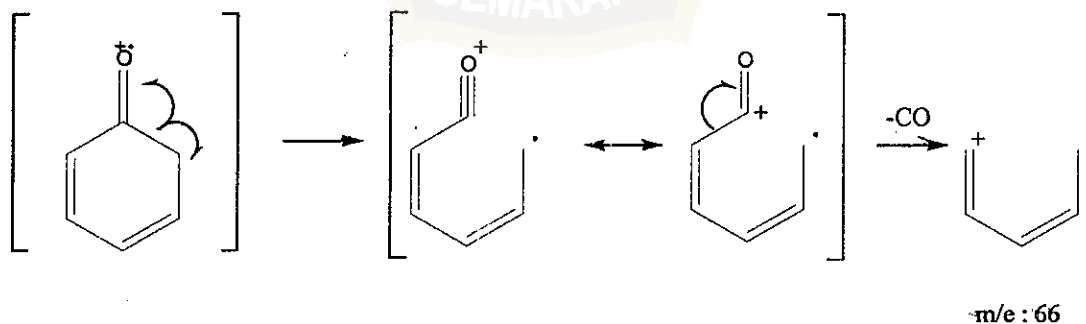
1. Spektrogram puncak kedua (waktu retensi 1.500 menit, 34,53 %) menunjukkan puncak ion molekuler pada  $m/e : 58$  yang merupakan berat molekul dari butana.



2. Spektrogram puncak ketiga (waktu retensi 1.817 menit, 13,59 %) menunjukkan puncak ion molekuler pada  $m/z : 60$  yang merupakan berat molekul dari asam asetat.



3. Spektrogram puncak keenam (waktu retensi 6.508 menit, 24,16 %) menunjukkan puncak ion molekuler pada  $m/z : 94$  yang merupakan berat molekul dari phenol.



20

### Lampiran F. Kromatogram hasil pirolisis Katalitik lignin pada suhu 200<sup>0</sup>C

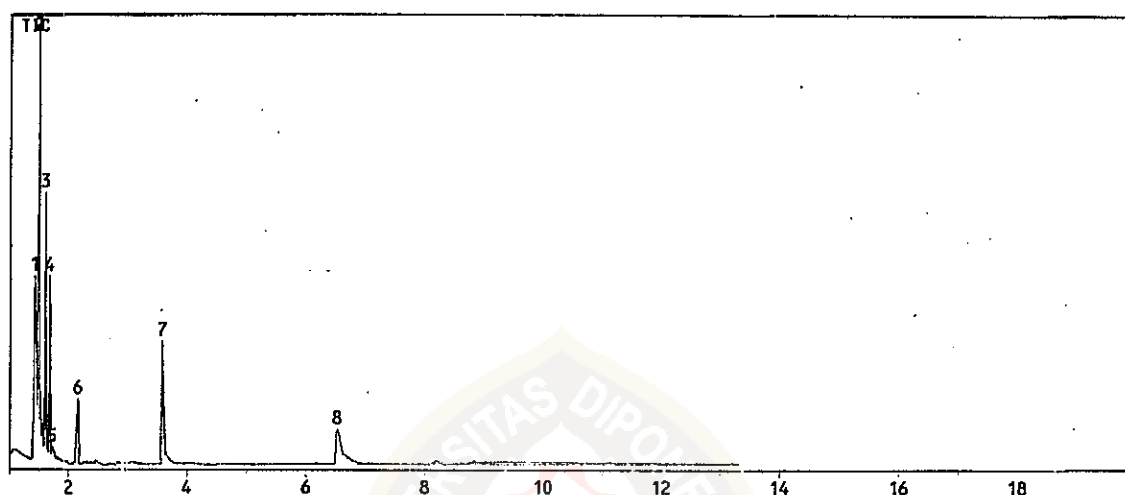
\*\*\*CLASS-500\*\*\* Report No. = 1 Data : HBB200K.D02

Sample : Pirolisis Lignin 200 Habibi

ID : L7024

Operator : dom

Method File Name : HABIBI.MET



#### \*\*\*\* Peak Report\*\*\*\*

PKNO	R.Time	I.Time	F.Time	Area	Height	A/H ( sec)	MK	%Total	Name
1	1.424	1.367	1.442	34574084	18167522	1.903		13.59	
2	1.486	1.442	1.583	91769785	43945884	2.088	v	36.08	
3	1.603	1.583	1.633	34617525	26216478	1.302	v	13.61	
4	1.679	1.633	1.717	24288137	18083018	1.343	v	9.55	
5	1.733	1.717	1.825	3089396	1291918	2.391	v	1.21	
6	2.160	2.083	2.233	11553337	6532272	1.769		4.54	
7	3.580	3.542	3.825	32400345	12299550	2.634		12.74	
8	6.521	6.475	6.775	22054362	3505185	6.292		8.67	

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 Total 254346969 100



### Lampiran G. Spektra massa produk pirolisis katalitik lignin pada suhu 200°C

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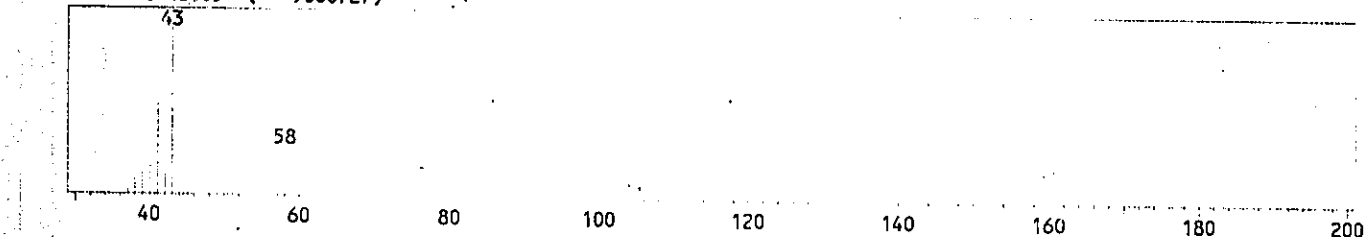
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Data : HBB200K.D02

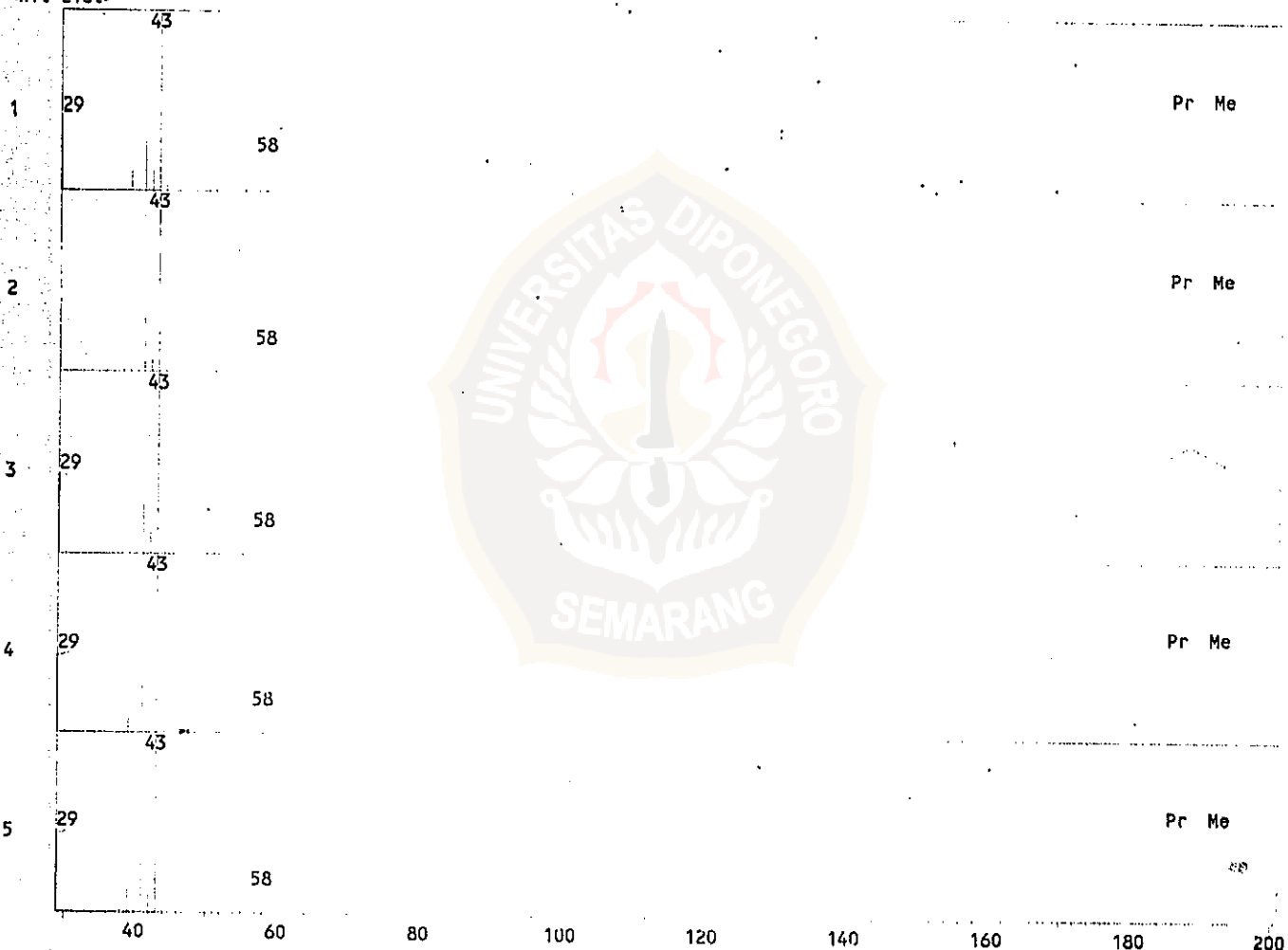
Mass Peak # : 11 Ret. Time : 1.500

Scan # : 61 B.G. Scan # : 57

Base Peak : 43.05 ( 9000727)



<Hit List>



No	SI	Mol. Wgt.	Mol. Form./Compound Name	CAS No.	Entry	LIB#
1	90	58	C <sub>4</sub> H <sub>10</sub> Butane (CAS) n-Butane	106-97-8	480	3
2	89	58	C <sub>4</sub> H <sub>10</sub> Butane (CAS) n-Butane	106-97-8	479	3
3	89	56	C <sub>4</sub> H <sub>10</sub> Butane	106-97-8	101	1
4	89	58	C <sub>4</sub> H <sub>10</sub> Butane (CAS) n-Butane	106-97-8	478	3
5	89	58	C <sub>4</sub> H <sub>10</sub> Butane (CAS) n-Butane	106-97-8	476	3

## Lab Kimia Organik FMIPA UGM

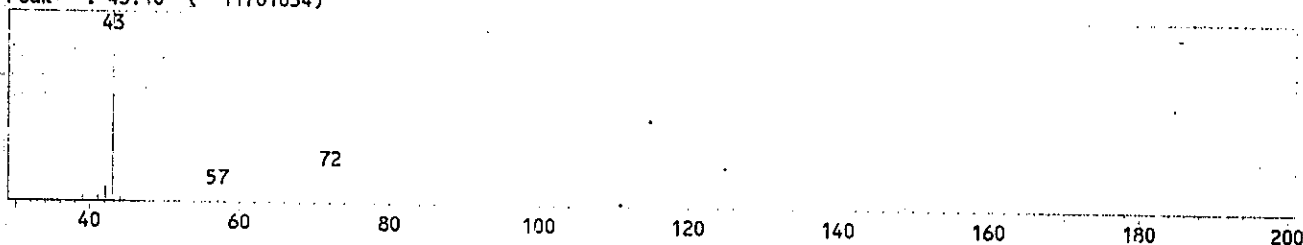
&lt;Unknown Spectrum&gt;

Data : HBB200K.DC2

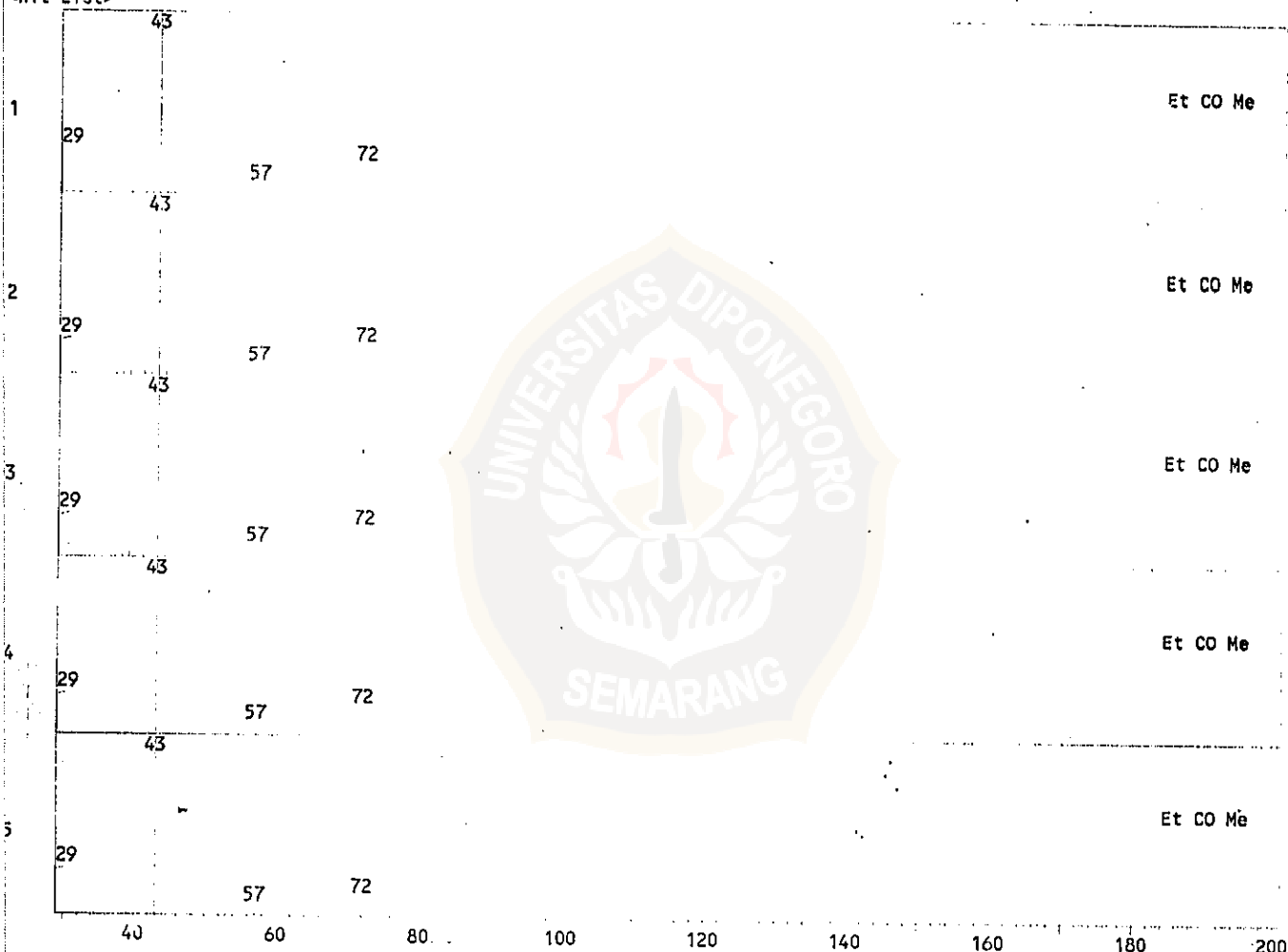
Mass Peak # : 7 Ret. Time : 1.600

Scan # : 73 B.G. Scan # : 70

Base Peak : 43.10 ( 11701034)



&lt;Hit List&gt;



SI	Mol.Wgt.	Mol.Form./Compound Name	CAS No.	Entry	LIB#
1	98	$C_4H_8O$ 2-Butanone (CAS) Methyl ethyl ketone	78-93-3	1154	3
2	97	$C_4H_8O$ 2-BUTANONE \$\$	78-93-3	1250	3
3	97	$C_4H_8O$ 2-Butanone (CAS) Methyl ethyl ketone	78-93-3	1158	3
4	97	$C_4H_8O$ 2-Butanone (CAS) Methyl ethyl ketone	78-93-3	1156	3
5	97	$C_4H_8O$ 2-Butanone (CAS) Methyl ethyl ketone	78-93-3	1150	3

Library Name

(1) NIST12.LIB (2) NIST62.LIB (3) WILEY229.LIB

## Lab Kimia Organik FMIPA UGM

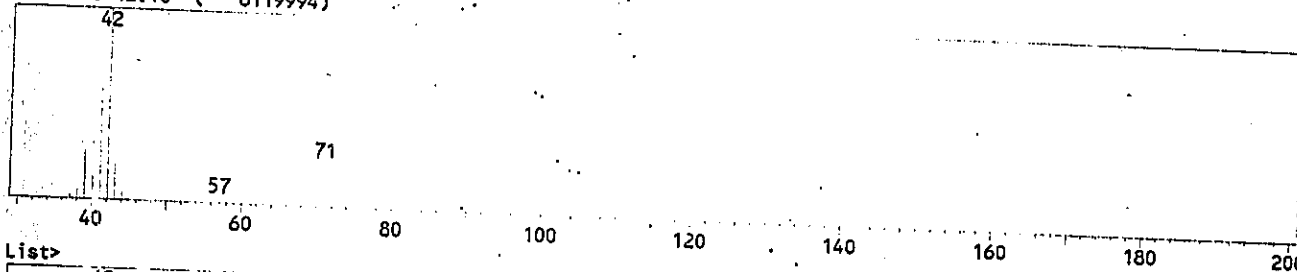
&lt;Unknown Spectrum&gt;

Data : HBB200K.D02

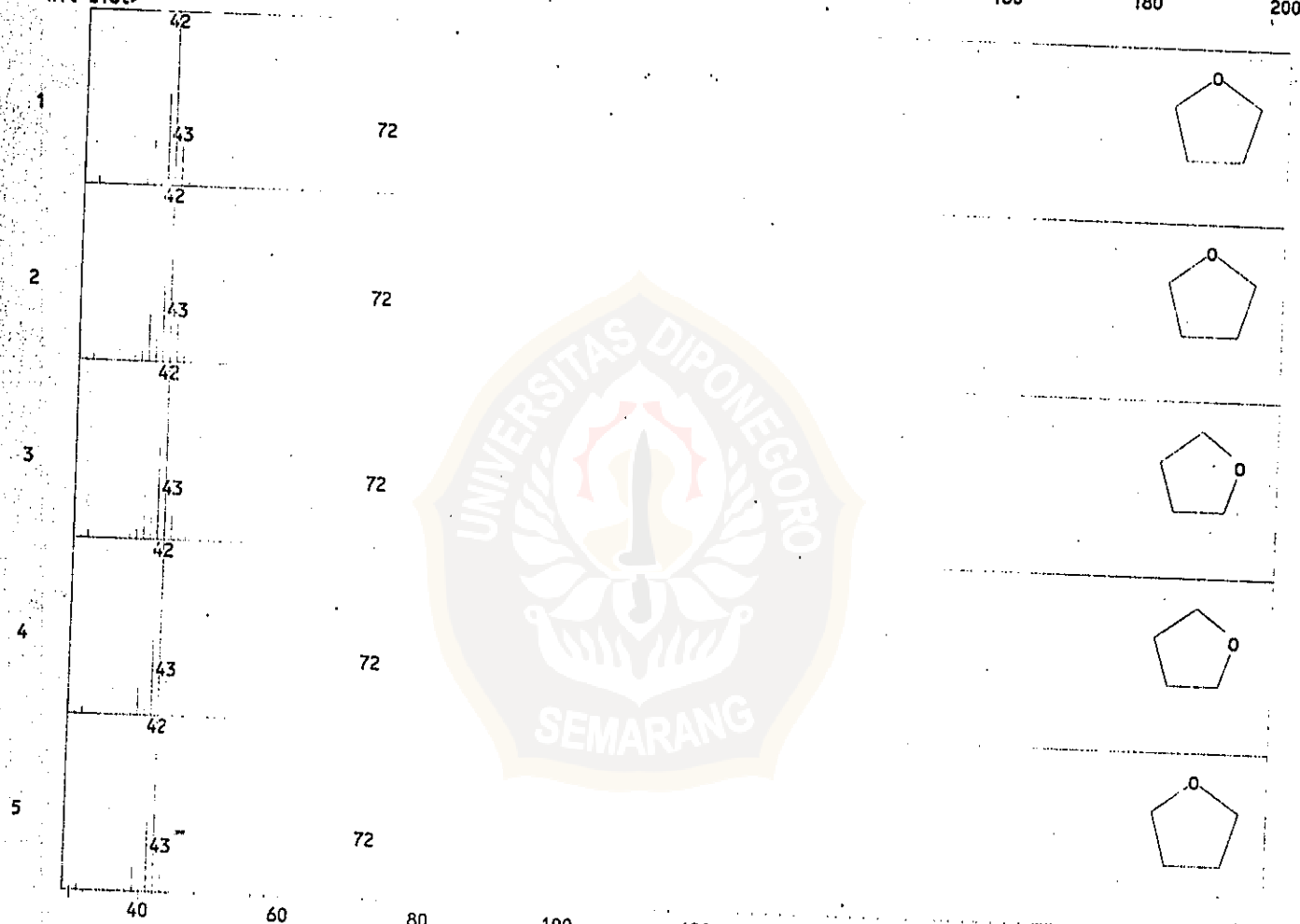
Mass Peak # : 11 Ret. Time : 1.663

Scan # : 83 B.G. Scan # : 79

Base Peak : 42.10 ( 6119994)



&lt;Hit List&gt;



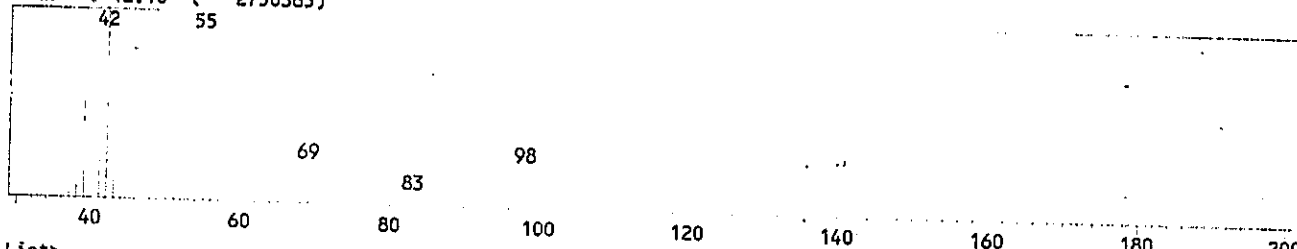
No	SI	Mol. Wt.	Mol. Form./Compound Name	CAS No.	Entry	LIB#
1	97	72	C <sub>4</sub> H <sub>8</sub> O Furan, tetrahydro-	109-99-9	272	1
2	97	72	C <sub>4</sub> H <sub>8</sub> O Furan, tetrahydro-	109-99-9	273	1
3	96	72	C <sub>4</sub> H <sub>8</sub> O Furan, tetrahydro- (CAS) Tetrahydrofuran	109-99-9	1237	3
4	95	72	C <sub>4</sub> H <sub>8</sub> O Furan, tetrahydro- (CAS) Tetrahydrofuran	109-99-9	1238	3
5	95	72	C <sub>4</sub> H <sub>8</sub> O Furan, tetrahydro-	109-99-9	270	1

Library Name

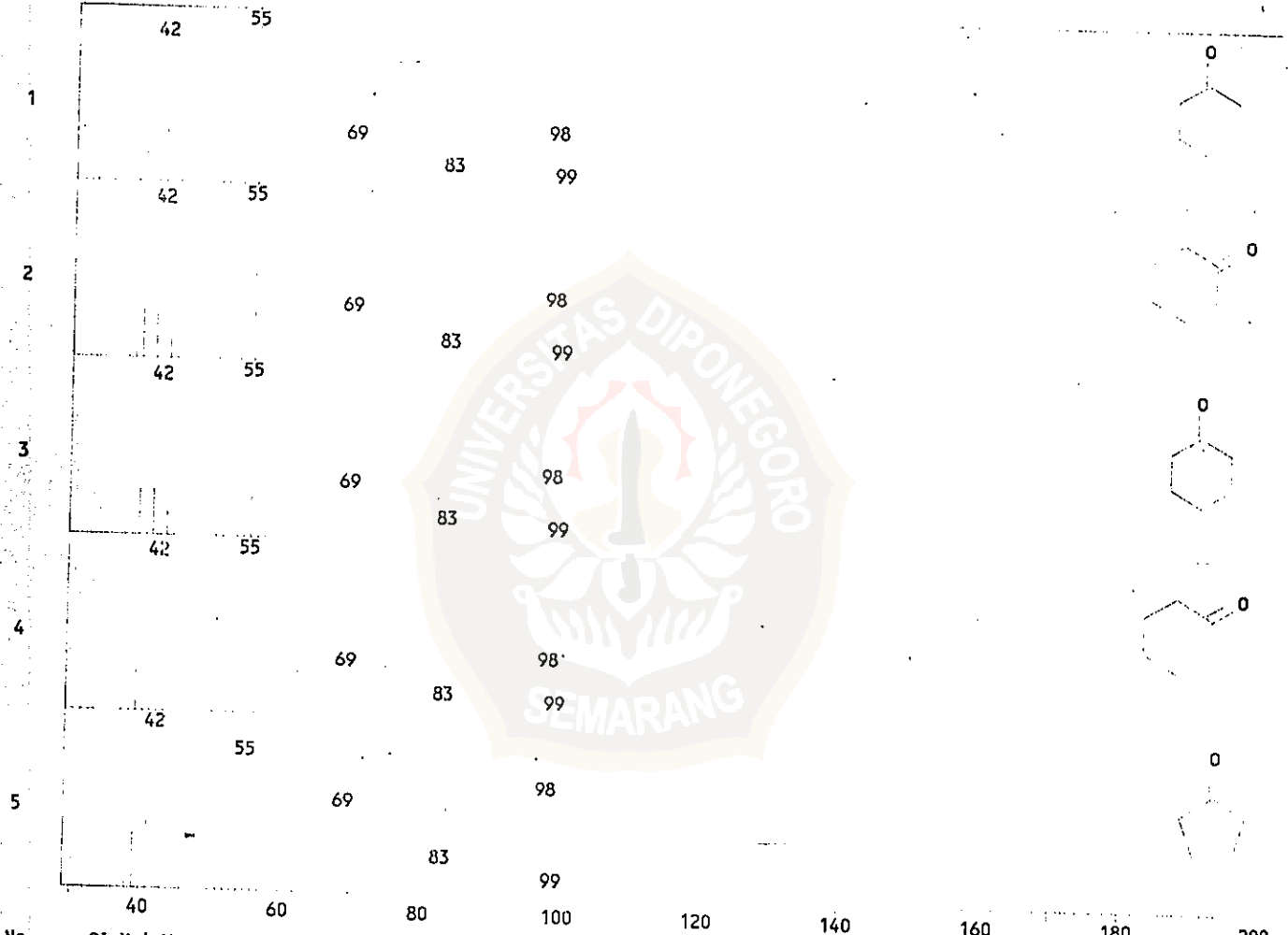
(1) NIST12.LIB (2) NIST62.LIB (3) WILEY229.LIB

Lab Kimia Organik FMIPA UGM

<Unknown Spectrum>  
 Data : HBB200K.D02  
 Mass Peak # : 27 Ret. Time : 3.583  
 Scan # : 311 B.G. Scan # : 256  
 Base Peak : 42.10 ( 2750365)



<Hit List>



Library Name

(1) NIST12.LIB (2) NIST62.LIB (3) WILEY229.LIB

## Lab Kimia Organik FMIPA UGM

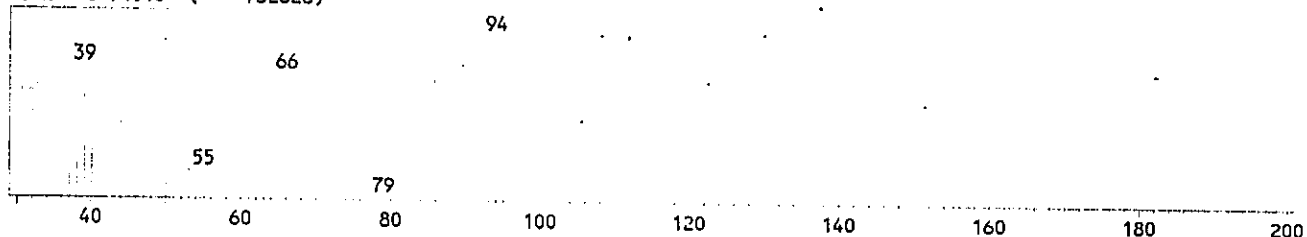
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Data : HBB200K.D02

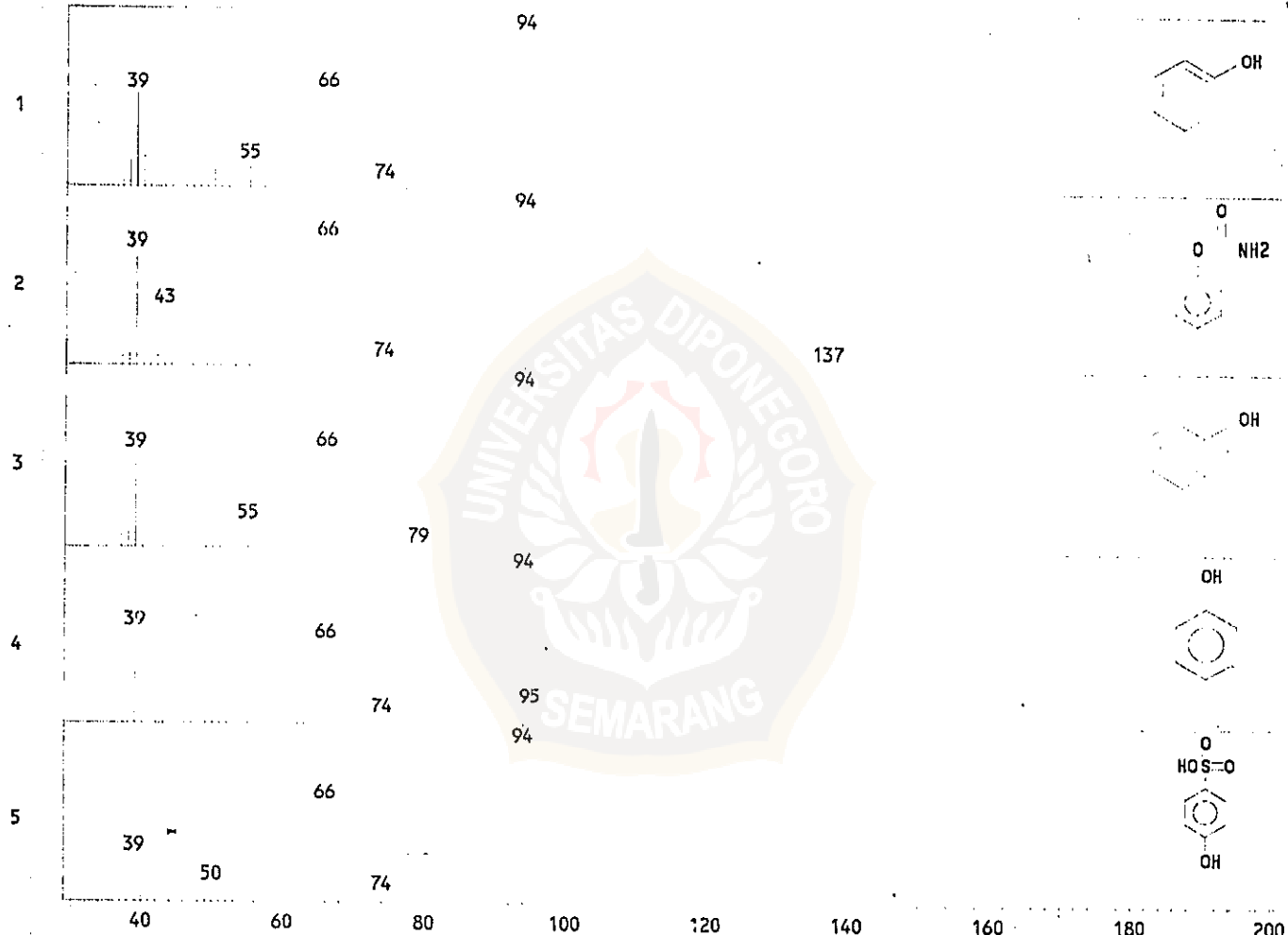
Mass Peak # : 37 Ret. Time : 6.525

Scan # : 664 B.G. Scan # : 602

Base Peak : 94.10 ( 732628)



&lt;Hit List&gt;



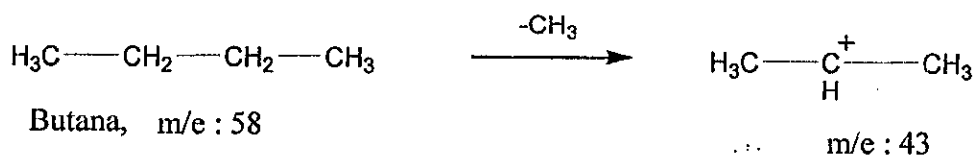
No	SI	Mol. Wgt.	Mol. Form./Compound Name	CAS No.	Entry	LIB#
1	94	94	C <sub>6</sub> H <sub>6</sub> O Phenol (CAS) IZAL ENT 1814 PhOH	108-95-2	3910	3
2	92	137	C <sub>7</sub> H <sub>7</sub> NO <sub>2</sub> Carbamic acid, phenyl ester Phenyl carbamate	622-46-8	6730	2
3	92	94	C <sub>6</sub> H <sub>6</sub> O Phenol (CAS) IZAL ENT 1814 PhOH	108-95-2	3915	3
4	90	94	C <sub>6</sub> H <sub>6</sub> O Phenol	108-95-2	835	1
5	90	174	C <sub>6</sub> H <sub>6</sub> O <sub>4</sub> S Benzenesulfonic acid, 4-hydroxy- Benzenesulfonic acid, p-hydroxy-	98-67-9	16038	2

Library Name

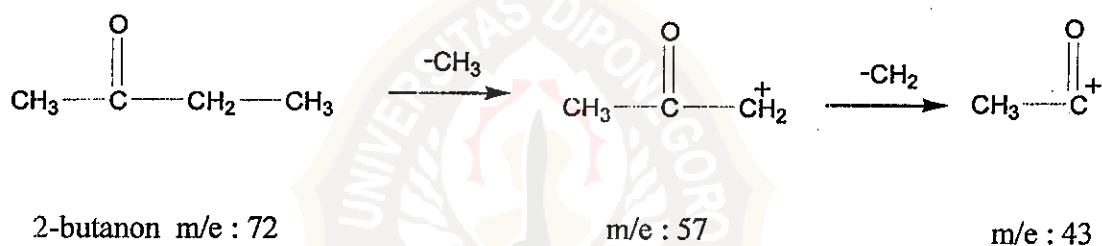
(1) NIST12.LIB (2) NIST62.LIB (3) WILEY229.LIB

**Lampiran H. Pola Fragmentasi Produk Pirolisis Katalitik Lignin  
Pada Suhu 200<sup>o</sup>C**

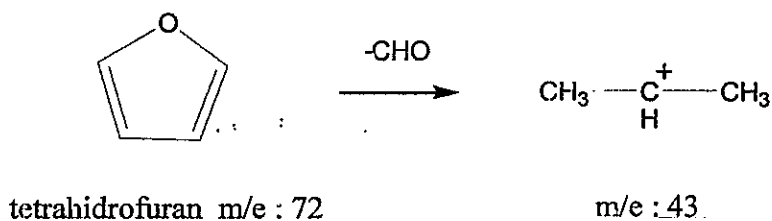
1. Spektrogram puncak kedua (waktu retensi 1.500 menit, 36,08 %) menunjukkan puncak ion molekuler pada m/e : 58 yang merupakan berat molekul dari butana.



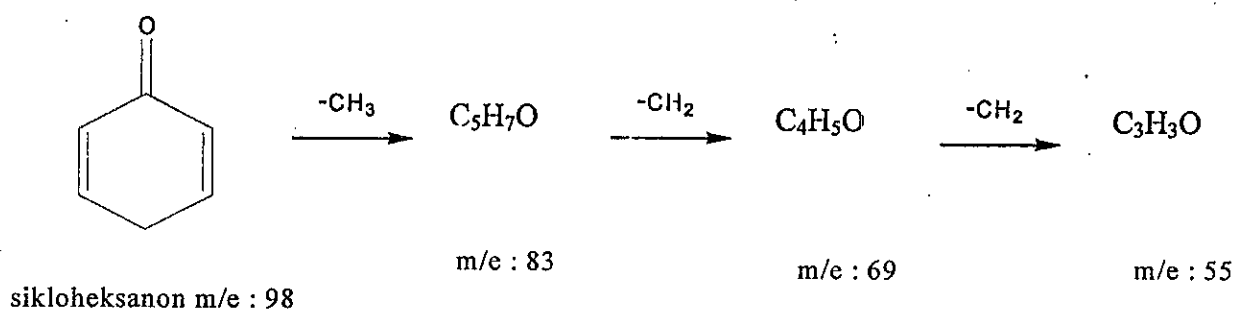
2. Spektrogram puncak ketiga (waktu retensi 1.600 menit, 13,61 %) menunjukkan puncak ion molekuler pada m/z : 72 yang merupakan berat molekul dari 2-butanon.



3. Spektrogram puncak keempat (waktu retensi 1.683 menit, 9,55 %) menunjukkan puncak ion molekuler pada m/z : 72 yang merupakan berat molekul dari tetrahidrofuran.



4. Spektrogram puncak keenam (waktu retensi 3.583 menit, 12,74 %) menunjukkan puncak ion molekuler pada  $m/z$  : 98 yang merupakan berat molekul dari sikloheksanon.



5. Spektrogram puncak ketujuh (waktu retensi 6.525 menit, 8,67 %) menunjukkan puncak ion molekuler pada  $m/z$  : 94 yang merupakan berat molekul dari phenol.

