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PYROLYSIS GAS CHROMATOGRAPHY

ANALYSIS OF 12 THERMO-LAG

FIRE BARRIER SAMPLES

Performed For:

ABB Impell Corporation
6500 West Freeway
Suite 400
Fort Worth, TX 76116

P.O. No. IM(S)93.NCS1
WRO #001
Project NUMARC

Distribution

ABB Impell: Cal Banning (1)

NUCON: 06A312 Master File (1)
Lab (1)

NUCON 06A312/01

NUCON 06A312/01



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Original Issue

Prepared By

Reviewed By

W. P. Freeman

T. S. Keller

20 OCT. 1993

20 OCT. 1993

Date

Date

I. ABSTRACT

Inspection of the pyrograms of 12 Thermo-Lag samples indicated that there was no appreciable difference among samples.

II. OBJECTIVE

Twelve Thermo-Lag fire barrier samples were qualitatively compared using pyrolysis gas chromatography.

III. DESCRIPTION OF MATERIALS AND METHODS

Twelve samples of Thermo-Lag materials were analyzed. The sample documentation slips accompanying each sample (copies attached) were compared to the listing in Cal Bannings 17 August 93 letter to W. Peter Freeman (copy attached) which, except for the lot # being left off the #9 sample, were in agreement.

The samples were compared by pyrolysis gas chromatography using ASTM D3452 (attached) as a general guide. A Varian Model 3700 gas chromatograph equipped with a flame ionization detector and helium as the carrier gas was used to generate the chromatograms of the pyrolysis products. The chromatographic and pyrolysis conditions used are shown in Table 1.

IV. PRESENTATION OF RESULTS

The twelve pyrograms for the twelve Thermo-Lag samples are shown in Figures 1-12. Accompanying each figure is an injection report that gives the retention times and relative area percents for selected peaks.

V. DISCUSSION OF RESULTS

Inspection of the chromatograms indicate that there is no appreciable difference among samples. Slight variations can be observed in the fingerprint region (retention times of 10-30 minutes) in terms of peak ratios, but the fact that all of these peaks are present from sample to sample is a clear indication that we are dealing with the same material. This can be seen dramatically in Figures 13 and 14 where sample chromatograms are plotted isometrically for samples 1-6 and 7-12. The ethyl acrylate to methylmethacrylate ratio (the monomers that make up the latex copolymer) is relatively constant among the samples (peaks 5 & 6 on the inspection reports) which is additional confirmation that the samples are the same.

TABLE 1
Chromatographic Conditions
30 meter 530u wide bore fused silica CP-WAX 52 CB capillary column.
Column Conditions
Carrier Gas: Helium, 10 mL/min.
Initial Temperature: 50°C for 4 minute hold
Temperature Ramp: 8°C/min to 225°C
Final Temperature: Hold at 225°C for 14 minutes
Injector Temperature: 200°C
Detector Temperature: 250°C
Electrometer: 1×10^{-11} amp/mv
Pyrolysis Conditions
Pyrolysis Temperature: 650°C
Interval: 20 seconds
Ramp: 2°C/millisecond
Probe Type: Platinum Coil
Interface Temperature: 205°C

FIGURE B.1
THERMO-LAG FIRE BARRIER MATERIAL
SAMPLE DOCUMENTATION

Sample No.: # 1

Material Part Number/Description: NUMARC Test Program
3" - 1 HR - Conduit Section
P.O. ITEM 6

Material Batch/Lot Number: F92-09030

Sample Selection/Witness Removal: J. D. Scott 7/16/93
Inspector Date

Sample Received By G. P. [Signature] 7-16-93
ABB Impell Date
Project Engineer

Ashland Chemical, Inc. -- Multichrom2 V2.0

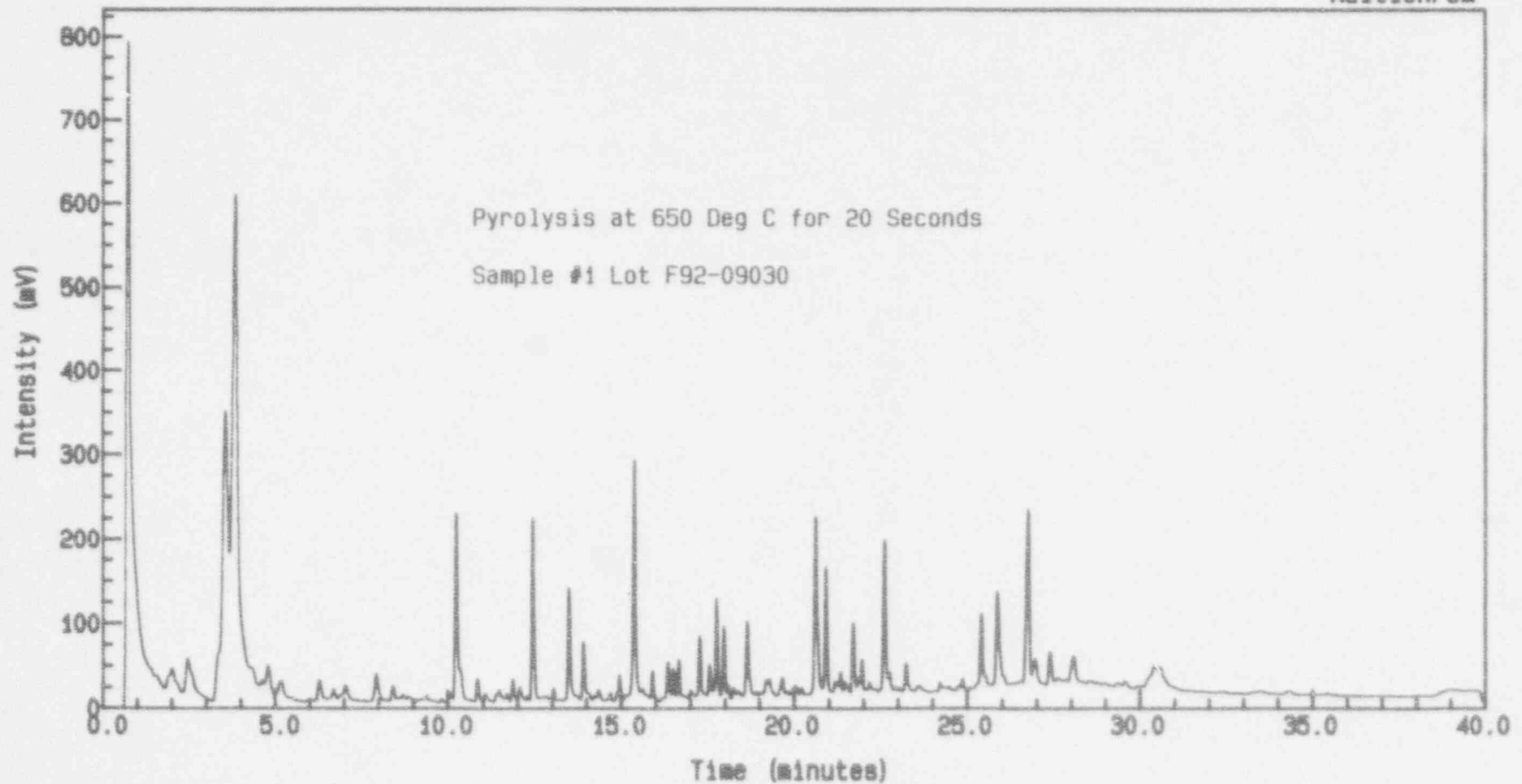


Analysis Name : [CONTRACT] 9 EM31681A, 14, 1.

Sample #1 Lot F92-09030 Amount : 1.430

PYROLYSIS OF THERMOLAG SAMPLES

Multichrom



Instrument : Vrn 3700

Method : EM31681

Channel Title : Channel #9

Calibration : EM31681

Lims ID : CF-31681

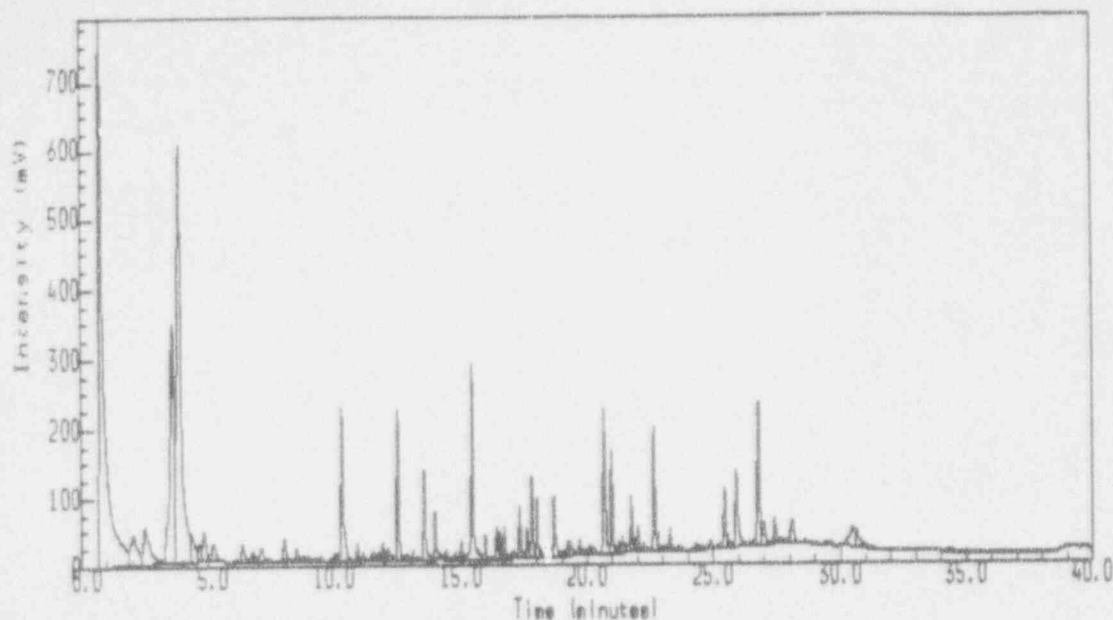
Run Sequence : EM31681A

Acquired on 25-AUG-1993 at 19:31

Reported on 26-AUG-1993 at 09:15

Injection Report

Acquired on 25-AUG-1993 at 19:31



Ashland Chemical, Inc. -- Multichrom2 V2.0

Analyst Name : MARTI
Lims Id : CF-31681
Comment : PYROLYSIS OF 12 THERMO LAG SAMPLES
Method Title : PYROLYSIS OF THERMOLAG SAMPLES
Sample Name : Sample #1 Lot F92-09030
Sample Id : CF-31681
Sample Type : Sample Amount=1.43000
Bottle No : 14

PEAK INFORMATION

Peak	RT mins	Area uVs	Area %
1	0.773	10125374	21.77
2	1.531	2631	0.06
3	2.158	851122	1.83
4	2.215	1015742	2.18
5	3.613	4239668	9.11
6	3.698	7662936	16.47
7	4.373	475376	1.02
8	4.676	183949	0.40
9	4.853	402578	0.87
10	5.227	277579	0.60
11	5.800	3786	8.14E-3
12	6.133	32062	0.07
13	6.342	218389	0.47

Peak	RT mins	Area uVs	Area %
14	6.756	128319	0.28
15	6.956	49892	0.11
16	7.102	186807	0.40
17	7.378	14172	0.03
18	7.640	8041	0.02
19	7.991	274432	0.59
20	8.289	14997	0.03
21	8.467	120519	0.26
22	8.622	21485	0.05
23	8.760	68272	0.15
24	8.933	58511	0.13
25	9.182	14455	0.03
26	9.449	80416	0.17
27	9.564	20523	0.04
28	9.871	21237	0.05
29	10.098	79235	0.17
30	10.302	1383786	2.97
31	10.684	21296	0.05
32	10.907	148427	0.32
33	11.138	71399	0.15
34	11.449	41804	0.09
35	11.529	91400	0.20
36	11.760	59194	0.13
37	11.929	131410	0.28
38	12.129	110690	0.24
39	12.342	28337	0.06
40	12.511	1049160	2.26
41	12.733	8944	0.02
42	12.889	30433	0.07
43	13.102	54010	0.12
44	13.271	4863	0.01
45	13.551	692190	1.49
46	13.969	385627	0.83
47	14.289	24432	0.05
48	14.404	75946	0.16
49	14.667	9629	0.02
50	14.747	37611	0.08
51	15.013	157308	0.34
52	15.187	44188	0.09
53	15.444	1622383	3.49
54	15.676	30144	0.06
55	15.960	153712	0.33
56	16.289	27801	0.06
57	16.409	254154	0.55
58	16.569	171379	0.37
59	16.724	199129	0.43
60	16.840	52940	0.11
61	17.071	81082	0.17
62	17.333	416090	0.89
63	17.613	194922	0.42
64	17.818	567983	1.22
65	18.022	374577	0.81
66	18.147	71706	0.15

Peak	RT mins	Area uVs	Area %
67	18.302	69312	0.15
68	18.427	73710	0.16
69	18.702	521177	1.12
70	18.973	34953	0.08
71	19.084	31792	0.07
72	19.240	122407	0.26
73	19.347	146596	0.32
74	19.716	148005	0.32
75	19.844	36528	0.08
76	20.102	128705	0.28
77	20.280	52184	0.11
78	20.453	8129	0.02
79	20.680	1260215	2.71
80	20.978	710620	1.53
81	21.244	81826	0.18
82	21.326	141950	0.31
83	21.529	68398	0.15
84	21.613	38261	0.08
85	21.760	372384	0.80
86	21.911	84794	0.18
87	22.018	174987	0.38
88	22.240	97529	0.21
89	22.422	26481	0.06
90	22.671	899708	1.93
91	22.804	121741	0.26
92	22.978	29568	0.06
93	23.107	18294	0.04
94	23.293	174102	0.37
95	23.613	24759	0.05
96	23.689	57014	0.12
97	24.107	13274	0.03
98	24.280	90918	0.20
99	24.529	34085	0.07
100	24.804	40350	0.09
101	24.916	65582	0.14
102	25.142	18070	0.04
103	25.467	522324	1.12
104	25.578	111079	0.24
105	25.778	25381	0.05
106	25.929	845865	1.82
107	26.244	19919	0.04
108	26.342	30810	0.07
109	26.467	33651	0.07
110	26.609	51816	0.11
111	26.818	1320635	2.84
112	27.013	289011	0.62
113	27.262	13516	0.03
114	27.449	236541	0.51
115	27.653	77466	0.17
116	27.884	37919	0.08
117	28.129	312488	0.67
118	28.658	25238	0.05
119	28.809	14959	0.03

Peak	RT mins	Area uVs	Area %
120	29.067	24254	0.05
121	29.262	2319	4.98E-3
122	29.382	42631	0.09
123	29.613	70042	0.15
124	30.480	377997	0.81
125	30.622	350590	0.75
126	31.538	6555	0.01
127	31.840	6401	0.01
128	32.502	17130	0.04
129	34.356	52969	0.11
130	35.484	20492	0.04
131	39.622	2096	4.50E-3

Totals		
Unknowns	0	0.00
Quantified	46516260	100.00
Grand Total	46516260	100.00

ANALYSIS SUMMARY

Method..... EM31681
Run sequence..... EM31681A
Data not quantified

FIGURE 2

Ashland Chemical, Inc. -- Multichrom2 V2.0

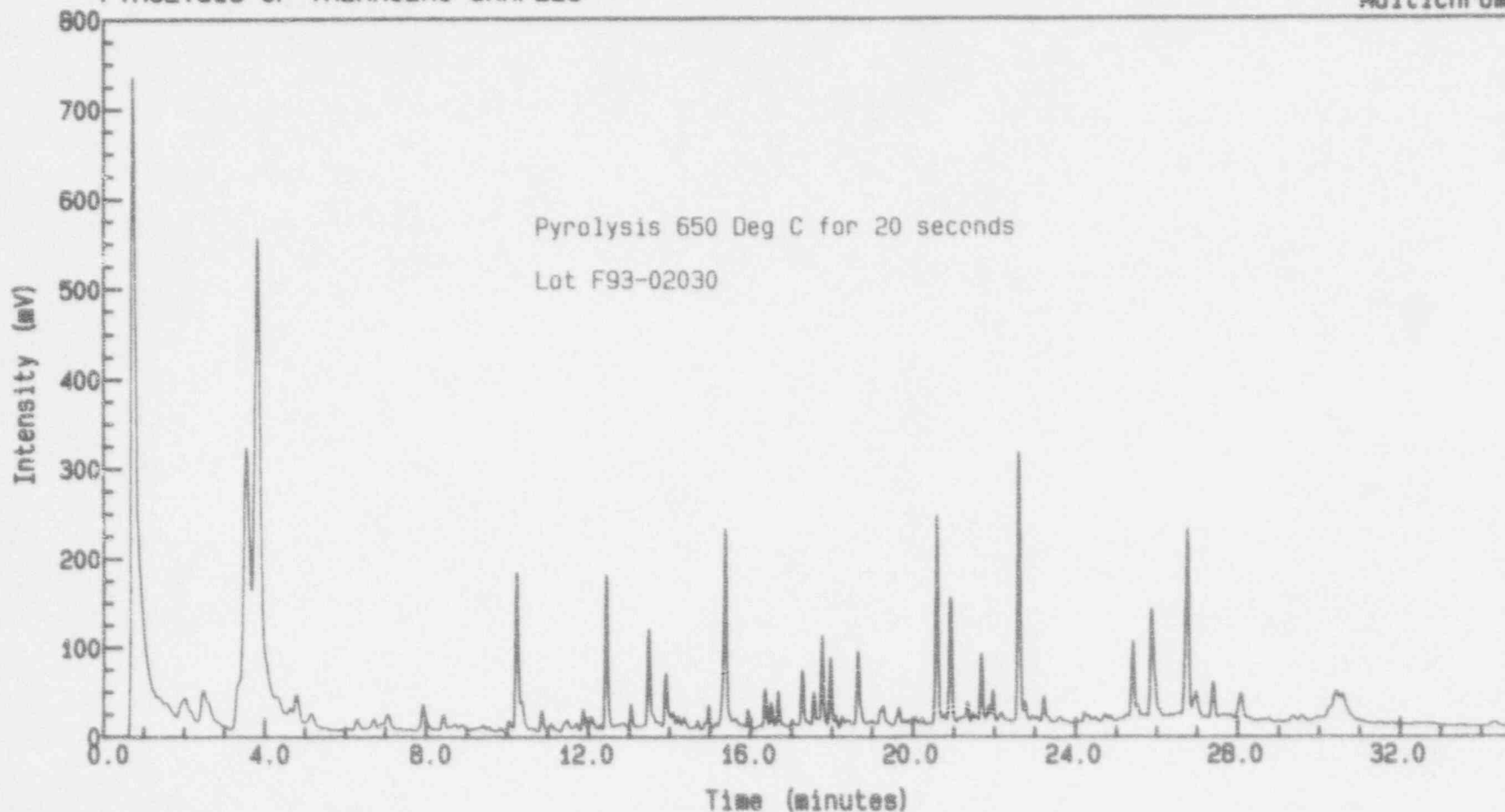


Analysis Name : [CONTRACT] 9 EM31681A, 2, 1.

Sample #2 Lot F93-02030 Amount : 1.260

PYROLYSIS OF THERMOLAG SAMPLES

Multichrom



Instrument : Vrn 3700

Channel Title : Channel #9

Lims ID : CF-31681

Acquired on 24-AUG-1993 at 09:59

Reported on 24-AUG-1993 at 11:55

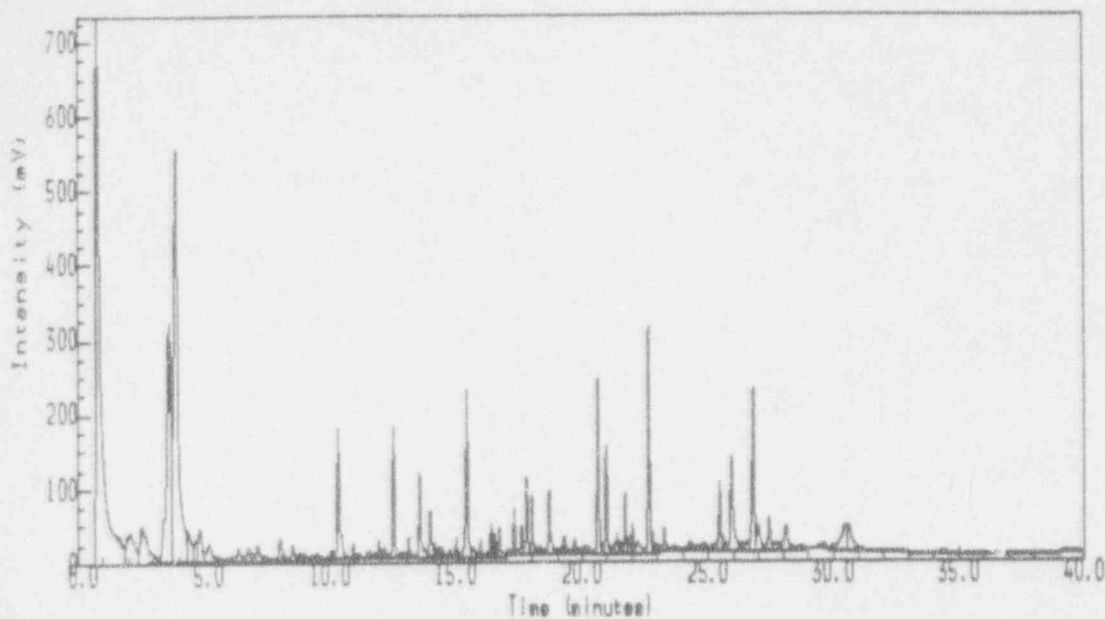
Method : EM31681

Calibration : EM31681

Run Sequence : EM31681A

Injection Report

Acquired on 24-AUG-1993 at 09:59



Ashland Chemical, Inc. -- Multichrom2 V2.0

Analyst Name : MARTI
Lims Id : CF-31681
Comment : PYROLYSIS OF 12 THERMO LAG SAMPLES
Method Title : PYROLYSIS OF THERMOLAG SAMPLES
Sample Name : Sample #2 Lot F93-02030
Sample Id : CF-31681
Sample Type : Sample Amount=1.26000
Bottle No : 2

PEAK INFORMATION

Peak	RT mins	Area uVs	Area %
1	0.778	9470773	19.84
2	1.640	21839	0.05
3	2.067	870140	1.82
4	2.524	1098242	2.30
5	3.600	4038044	8.46
6	3.889	7145357	14.97
7	4.351	572941	1.20
8	4.680	235723	0.49
9	4.849	481892	1.01
10	5.204	465321	0.97
11	5.796	35290	0.07
12	6.133	99396	0.21
13	6.347	158927	0.33

Peak	RT mins	Area uVs	Area %
14	6.760	186055	0.39
15	6.956	76264	0.16
16	7.102	231503	0.49
17	7.396	50380	0.11
18	7.636	42012	0.09
19	7.978	314497	0.66
20	8.293	32781	0.07
21	8.476	141828	0.30
22	8.631	30858	0.06
23	8.760	78584	0.16
24	8.933	80345	0.17
25	9.182	24922	0.05
26	9.444	95169	0.20
27	9.578	47454	0.10
28	9.880	27197	0.06
29	10.093	81711	0.17
30	10.293	1171910	2.46
31	10.689	5873	0.01
32	10.898	129270	0.27
33	11.133	67059	0.14
34	11.524	120672	0.25
35	11.751	59280	0.12
36	11.924	125660	0.26
37	12.116	114868	0.24
38	12.342	36592	0.08
39	12.498	848303	1.78
40	12.733	40636	0.09
41	12.871	98457	0.21
42	13.102	144514	0.30
43	13.262	34494	0.07
44	13.542	713001	1.49
45	13.960	388180	0.81
46	14.138	94143	0.20
47	14.262	87809	0.18
48	14.409	97041	0.20
49	14.742	57552	0.12
50	14.929	37344	0.08
51	15.018	104026	0.22
52	15.182	38914	0.08
53	15.431	1246910	2.61
54	15.680	106747	0.22
55	15.831	31315	0.07
56	15.982	96694	0.20
57	16.284	28443	0.06
58	16.404	208555	0.44
59	16.560	130280	0.27
60	16.738	209030	0.44
61	17.071	67366	0.14
62	17.329	367489	0.77
63	17.613	180171	0.38
64	17.818	485713	1.02
65	18.022	342860	0.72
66	18.142	62225	0.13

Peak	RT mins	Area uVs	Area %
67	18.298	66337	0.14
68	18.427	80609	0.17
69	18.702	491970	1.03
70	18.969	37735	0.08
71	19.040	39585	0.08
72	19.244	99102	0.21
73	19.316	164431	0.34
74	19.707	149376	0.31
75	19.840	39041	0.08
76	19.933	33907	0.07
77	20.111	105305	0.22
78	20.284	59462	0.12
79	20.431	31604	0.07
80	20.644	1094742	2.29
81	20.791	75605	0.16
82	20.969	732882	1.54
83	21.169	43088	0.09
84	21.240	44630	0.09
85	21.396	159864	0.33
86	21.533	77436	0.16
87	21.613	48708	0.10
88	21.733	369611	0.77
89	21.911	118854	0.25
90	22.009	185701	0.39
91	22.213	196112	0.41
92	22.658	1485106	3.11
93	22.809	143190	0.30
94	22.978	76834	0.16
95	23.102	51754	0.11
96	23.271	229253	0.48
97	23.667	126299	0.26
98	24.116	46654	0.10
99	24.262	76707	0.16
100	24.369	64055	0.13
101	24.524	78364	0.16
102	24.764	89639	0.19
103	24.880	72517	0.15
104	25.293	139015	0.29
105	25.462	505960	1.06
106	25.578	152943	0.32
107	25.773	61362	0.13
108	25.929	1031262	2.16
109	26.258	52438	0.11
110	26.373	64974	0.14
111	26.578	148948	0.31
112	26.818	1387607	2.91
113	27.018	357341	0.75
114	27.253	55465	0.12
115	27.440	312219	0.65
116	27.698	121445	0.25
117	27.853	70414	0.15
118	28.120	367567	0.77
119	28.644	31035	0.07

Peak	RT mins	Area uVs	Area %
120	28.796	34961	0.07
121	29.040	6020	0.01
122	29.422	56366	0.12
123	29.604	74793	0.16
124	30.031	74690	0.16
125	30.471	539483	1.13
126	30.618	466786	0.98
127	31.556	19840	0.04
128	31.818	18365	0.04
129	32.773	16446	0.03
130	34.333	58485	0.12

Totals

Unknowns	0	0.00
Quantified	47727144	100.00
Grand Total	47727144	100.00

ANALYSIS SUMMARY

Method..... EM31681
Run sequence..... EM31681A
Data not quantified

FIGURE B.1
THERMO-LAG FIRE BARRIER MATERIAL
SAMPLE DOCUMENTATION

Sample No.: #3

Material Part Number/Description: NUMARC Test Program
3/4" - 1 HR UPGRADE - Conduit
P.O. ITEM 11

Material Batch/Lot Number: F93-01013

Sample Selection/Witness Removal: J. D. Katt 7/16/93
Inspector Date

Sample Received By Gary D. Katt 7-16-93
ABB Impell Date
Project Engineer

FIGURE 3

Ashland Chemical, Inc. -- Multichrom2 V2.0

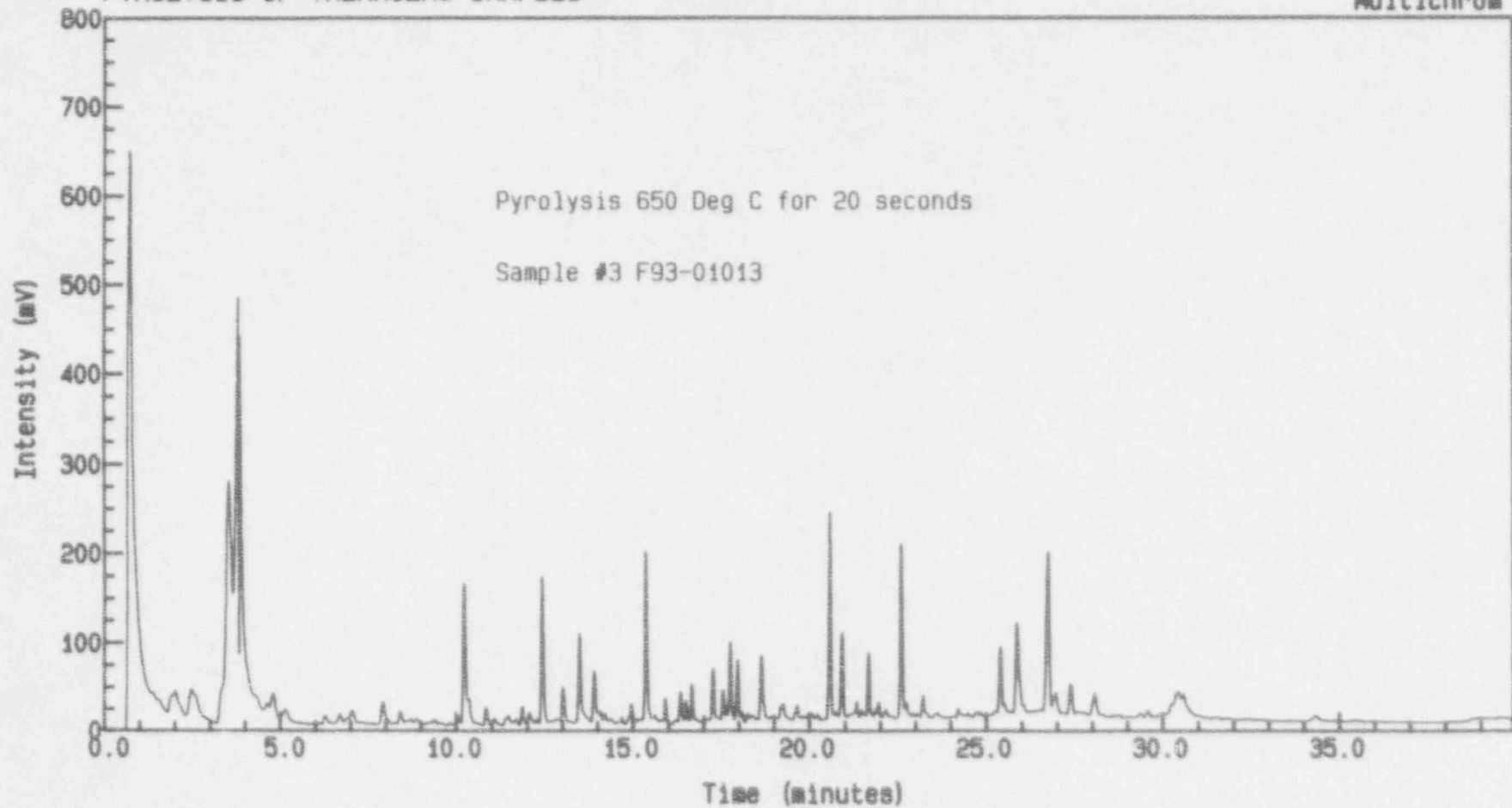


Analysis Name : [CONTRACT] 9 EM31681A, 3, 1.

Sample #3 F93-01013 Amount : 1.240

PYROLYSIS OF THERMOLAG SAMPLES

Multichrom

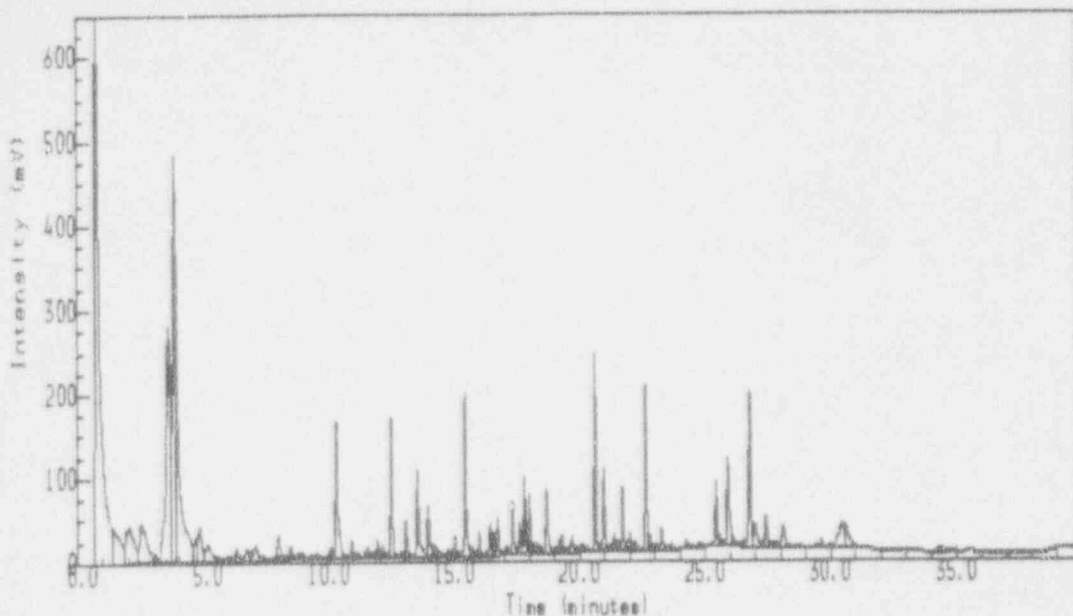


Instrument : Vrn 3700
Channel Title : Channel #9
Lims ID : CF-31681
Acquired on 24-AUG-1993 at 10: 49
Reported on 24-AUG-1993 at 11: 56

Method : EM31681
Calibration : EM31681
Run Sequence : EM31681A

Injection Report

Acquired on 24-AUG-1993 at 10:49



Ashland Chemical, Inc. -- Multichrom2 V2.0

Analyst Name : MARTI
Lims Id : CF-31681
Comment : PYROLYSIS OF 12 THERMO LAG SAMPLES
Method Title : PYROLYSIS OF THERMOLAG SAMPLES
Sample Name : Sample #3 F93-01013
Sample Id : CF-31681
Sample Type : Sample Amount=1.24000
Bottle No : 3

PEAK INFORMATION

Peak	RT mins	Area uVs	Area %
1	0.773	8270502	20.31
2	1.431	835687	2.05
3	2.058	924569	2.27
4	2.520	1081662	2.66
5	3.604	3514208	8.63
6	3.876	3009507	7.39
7	3.911	3451561	8.47
8	4.684	258015	0.63
9	4.844	439834	1.08
10	5.196	412187	1.01
11	5.791	29837	0.07
12	5.987	38355	0.09
13	6.129	46517	0.11

Peak	RT mins	Area uVs	Area %
14	6.342	132819	0.33
15	6.756	159622	0.39
16	6.960	71323	0.18
17	7.098	207782	0.51
18	7.400	48612	0.12
19	7.636	34027	0.08
20	7.987	270740	0.66
21	8.293	25579	0.06
22	8.471	118186	0.29
23	8.627	29084	0.07
24	8.760	67144	0.16
25	8.933	73111	0.18
26	9.178	17488	0.04
27	9.351	38165	0.09
28	9.444	43625	0.11
29	9.564	27293	0.07
30	9.871	18185	0.04
31	10.089	71446	0.18
32	10.289	1040886	2.56
33	10.689	4858	0.01
34	10.898	107817	0.26
35	11.138	57879	0.14
36	11.520	110945	0.27
37	11.751	48568	0.12
38	11.924	110041	0.27
39	12.120	107263	0.26
40	12.338	37087	0.09
41	12.498	797208	1.96
42	12.733	28842	0.07
43	12.911	78363	0.19
44	13.071	261392	0.64
45	13.551	634015	1.56
46	13.969	358254	0.88
47	14.138	73169	0.18
48	14.262	74339	0.18
49	14.418	48787	0.12
50	14.742	46819	0.11
51	14.933	34283	0.08
52	15.013	89551	0.22
53	15.182	32858	0.08
54	15.280	29708	0.07
55	15.431	884689	2.17
56	15.671	84406	0.21
57	15.831	21070	0.05
58	15.978	130962	0.32
59	16.284	28644	0.07
60	16.409	183367	0.45
61	16.560	115652	0.28
62	16.733	220905	0.54
63	17.067	60750	0.15
64	17.333	346313	0.85
65	17.613	167439	0.41
66	17.818	428776	1.05

Peak	RT mins	Area uVs	Area %
67	18.022	304823	0.75
68	18.147	53994	0.13
69	18.298	55615	0.14
70	18.431	67498	0.17
71	18.702	430290	1.06
72	18.973	28745	0.07
73	19.044	34831	0.09
74	19.244	92324	0.23
75	19.324	136792	0.34
76	19.711	124456	0.31
77	19.844	32788	0.08
78	19.951	26986	0.07
79	20.084	92935	0.23
80	20.280	47614	0.12
81	20.458	17590	0.04
82	20.644	929875	2.28
83	20.804	59330	0.15
84	20.987	487442	1.20
85	21.169	26287	0.06
86	21.258	39329	0.10
87	21.400	124326	0.31
88	21.533	57395	0.14
89	21.613	37463	0.09
90	21.733	311138	0.76
91	21.916	59993	0.15
92	22.022	90268	0.22
93	22.218	124944	0.31
94	22.658	883661	2.17
95	22.804	109041	0.27
96	22.978	42352	0.10
97	23.102	32631	0.08
98	23.271	171305	0.42
99	23.671	72994	0.18
100	24.102	15512	0.04
101	24.262	72817	0.18
102	24.529	35733	0.09
103	24.764	36098	0.09
104	24.889	22222	0.05
105	25.289	25120	0.06
106	25.458	382097	0.94
107	25.569	88925	0.22
108	25.769	24908	0.06
109	25.924	742835	1.82
110	26.120	67042	0.16
111	26.262	30449	0.07
112	26.364	33978	0.08
113	26.573	92466	0.23
114	26.809	1155381	2.84
115	27.022	260721	0.64
116	27.258	28938	0.07
117	27.440	241255	0.59
118	27.640	69890	0.17
119	27.849	36272	0.09

Peak	RT mins	Area uVs	Area %
120	28.120	260700	0.64
121	28.640	14770	0.04
122	28.804	21912	0.05
123	29.400	32398	0.08
124	29.631	60794	0.15
125	30.018	48253	0.12
126	30.489	480222	1.18
127	30.640	370425	0.91
128	31.556	11020	0.03
129	34.364	82174	0.20
130	39.822	22491	0.06

Totals		
Unknowns	6	0.00
Quantified	40727452	100.00
Grand Total	40727452	100.00

ANALYSIS SUMMARY

Method..... EM31681
Run sequence..... EM31681A
Data not quantified

FIGURE B.1
THERMO-LAG FIRE BARRIER MATERIAL
SAMPLE DOCUMENTATION

Sample No.: # 4

Material Part Number/Description: NUMARC Test Program
3" 3HR Conduit
P.O. ITEM 9

Material Batch/Lot Number: F92-11002

Sample Selection/Witness Removal: J. Blott 7/16/93
Inspector Date

Sample Received By: Steve D. Blott 7-16-93
ABB Impell Date
Project Engineer

FIGURE 4

Ashland Chemical, Inc. -- Multichrom2 V2.0

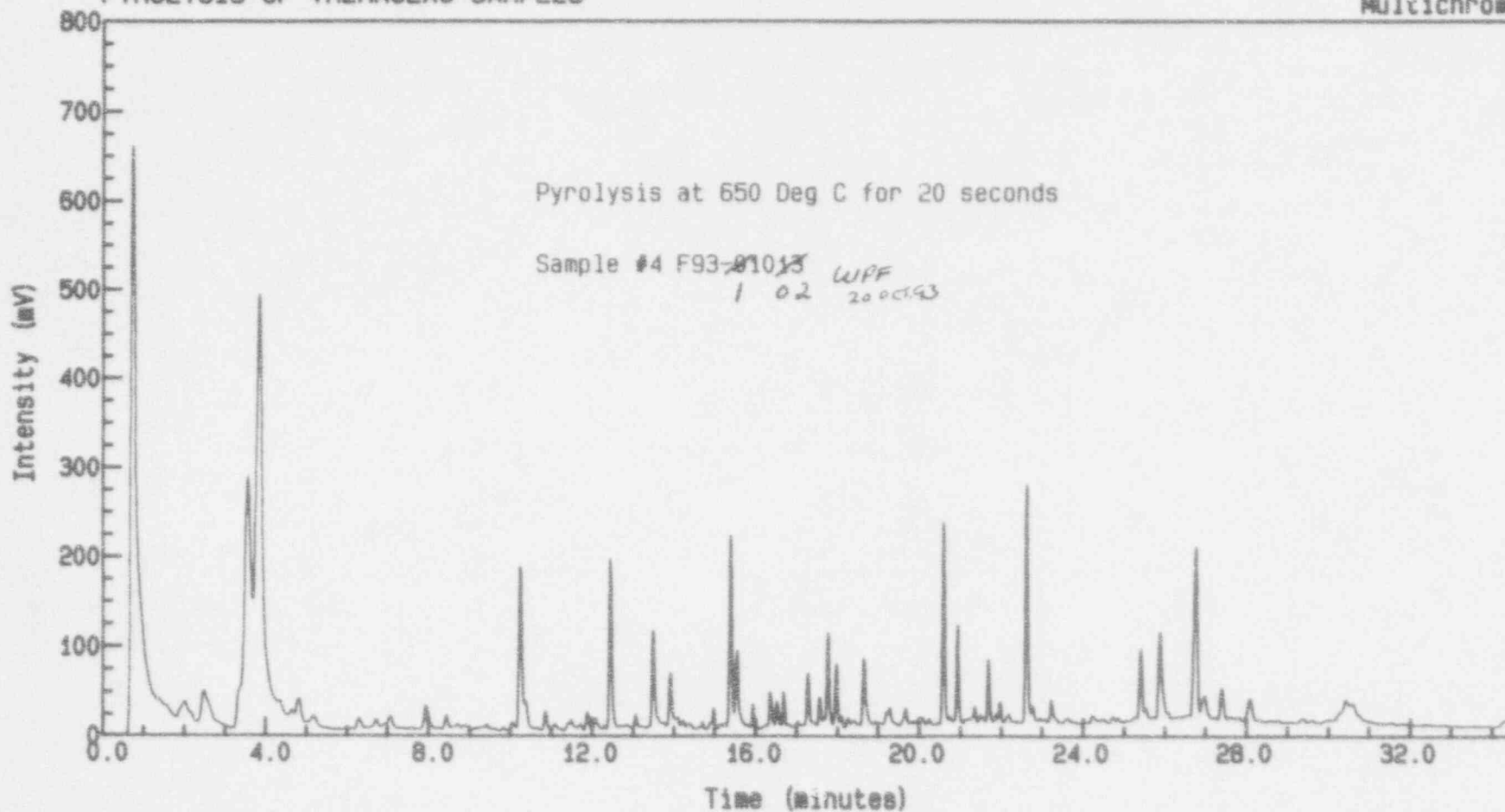


Analysis Name : [CONTRACT] 9 EM31681A, 4, 1.

Sample #4 F93-11002 Amount : 1.470

PYROLYSIS OF THERMOLAG SAMPLES

Multichrom



Instrument : Vrn 3700

Method : EM31681

Channel Title : Channel #9

Calibration : EM31681

Lims ID : CF-31681

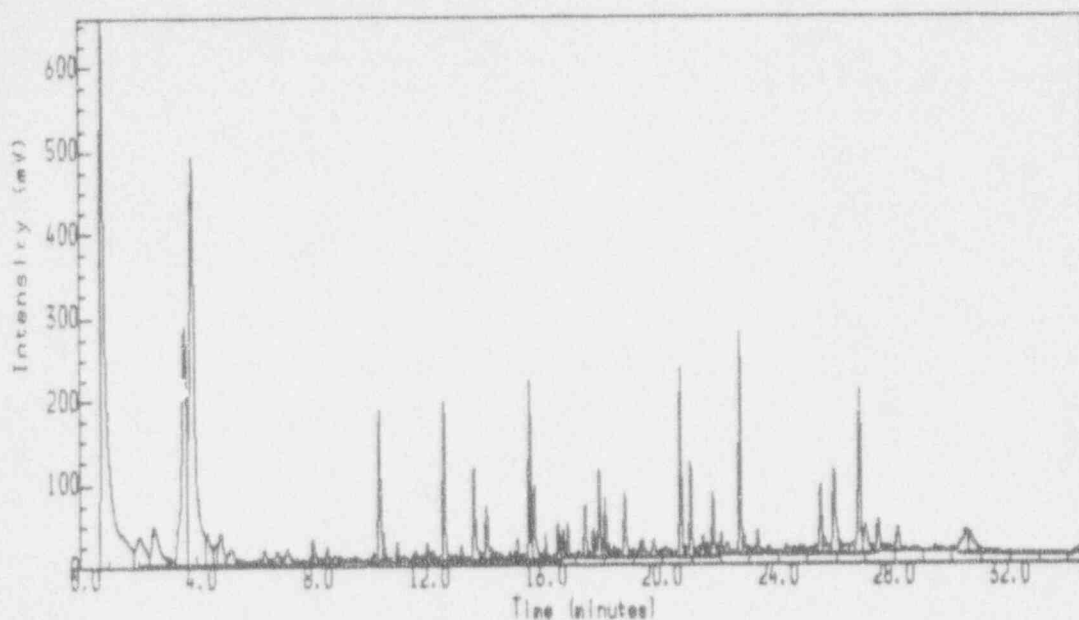
Run Sequence : EM31681A

Acquired on 24-AUG-1993 at 11:41

Reported on 24-AUG-1993 at 13:26

Injection Report

Acquired on 24-AUG-1993 at 11:41



Ashland Chemical, Inc. -- Multichrom2 V2.0

Analyst Name : MARTI
Lims Id : CF-31681
Comment : PYROLYSIS OF 12 THERMO LAG SAMPLES
Method Title : PYROLYSIS OF THERMOLAG SAMPLES
Sample Name : Sample #4 F93-11002
Sample Id : CF-31681
Sample Type : Sample Amount=1.47000
Bottle No : 4

PEAK INFORMATION

Peak	RT mins	Area uVs	Area %
1	0.773	8593318	20.01
2	2.062	790349	1.84
3	2.533	1032981	2.40
4	3.613	3600050	8.38
5	3.898	6538086	15.22
6	4.396	406149	0.95
7	4.684	245013	0.57
8	4.867	450691	1.05
9	5.222	379472	0.88
10	5.804	36120	0.08
11	6.156	82523	0.19
12	6.342	163864	0.38
13	6.769	169148	0.39

Peak	RT mins	Area uVs	Area %
14	6.969	65917	0.15
15	7.116	193289	0.45
16	7.404	46042	0.11
17	7.644	48946	0.11
18	7.991	284524	0.66
19	8.302	28714	0.07
20	8.484	125294	0.29
21	8.760	98304	0.23
22	8.942	69782	0.16
23	9.182	21209	0.05
24	9.360	41363	0.10
25	9.467	78328	0.18
26	9.884	23498	0.05
27	10.098	68638	0.16
28	10.302	970112	2.26
29	10.422	202620	0.47
30	10.693	17507	0.04
31	10.907	120284	0.28
32	11.138	56824	0.13
33	11.458	35224	0.08
34	11.533	77503	0.18
35	11.756	45354	0.11
36	11.429	108697	0.25
37	12.133	94264	0.22
38	12.351	26500	0.06
39	12.507	900337	2.10
40	12.733	30731	0.07
41	12.853	56889	0.13
42	13.111	112654	0.26
43	13.547	624475	1.45
44	13.796	44329	0.10
45	13.969	374096	0.87
46	14.147	65297	0.15
47	14.276	60110	0.14
48	14.422	55596	0.13
49	14.747	48469	0.11
50	14.933	32972	0.08
51	15.022	92040	0.21
52	15.187	33688	0.08
53	15.284	30096	0.07
54	15.444	933814	2.17
55	15.604	520122	1.23
56	15.836	31430	0.07
57	15.982	111513	0.26
58	16.289	27927	0.07
59	16.413	205408	0.48
60	16.578	143622	0.33
61	16.738	202821	0.47
62	17.080	61655	0.14
63	17.338	350112	0.82
64	17.618	161864	0.38
65	17.822	502598	1.17
66	18.027	323055	0.75

Peak	RT mins	Area uVs	Area %
67	18.151	62468	0.15
68	18.302	63944	0.15
69	18.453	82812	0.19
70	18.707	460638	1.07
71	18.978	39370	0.09
72	19.062	32502	0.08
73	19.253	103664	0.24
74	19.329	154736	0.36
75	19.716	145691	0.34
76	19.849	35714	0.08
77	19.951	33311	0.08
78	20.120	106229	0.25
79	20.289	63463	0.15
80	20.462	27412	0.06
81	20.649	955310	2.22
82	20.809	66173	0.15
83	20.991	496798	1.16
84	21.169	39208	0.09
85	21.249	49953	0.12
86	21.404	140219	0.33
87	21.538	69748	0.16
88	21.618	47282	0.11
89	21.738	320972	0.75
90	21.916	73375	0.17
91	22.018	131159	0.31
92	22.222	140934	0.33
93	22.422	33704	0.08
94	22.680	1227090	2.86
95	22.818	126380	0.29
96	22.982	58600	0.14
97	23.111	47268	0.11
98	23.276	211489	0.49
99	23.671	132414	0.31
100	24.084	47878	0.11
101	24.267	104771	0.24
102	24.533	80202	0.19
103	24.769	74309	0.17
104	24.902	62504	0.15
105	25.302	113197	0.26
105	25.467	448624	1.04
107	25.578	141664	0.33
108	25.769	44274	0.10
109	25.933	737470	1.72
110	26.124	76061	0.18
111	26.378	106267	0.25
112	26.582	136275	0.32
113	26.813	1239040	2.88
114	27.027	344209	0.80
115	27.267	47647	0.11
116	27.449	275197	0.64
117	27.644	96311	0.22
118	27.858	51384	0.12
119	28.133	302761	0.70

Peak	RT mins	Area uVs	Area %
120	28.658	27430	0.06
121	28.804	30232	0.07
122	29.422	43355	0.10
123	29.640	26652	0.06
124	30.467	439665	1.02
125	30.644	361733	0.84
126	31.582	26029	0.06
127	31.831	12816	0.03
128	34.391	95007	0.22

Totals		
Unknowns	0	0.00
Quantified	42955204	100.00
Grand Total	42955204	100.00

ANALYSIS SUMMARY

Method..... EM31681
Run sequence..... EM31681A
Data not quantified

FIGURE B.1
THERMO-LAG FIRE BARRIER MATERIAL
SAMPLE DOCUMENTATION

Sample No.: # 5
Material Part Number/Description: NUMARC Test Program
3 HR Base Line Panel
P.O. ITEM 4

Material Batch/Lot Number: F93 - 06008

Sample Selection/Witness Removal: J. Scott 7/16/93
Inspector Date

Sample Received By [Signature] 7-16-93
ABB Impell Date
Project Engineer

FIGURE 5

Ashland Chemical, Inc. -- Multichrom2 V2.0

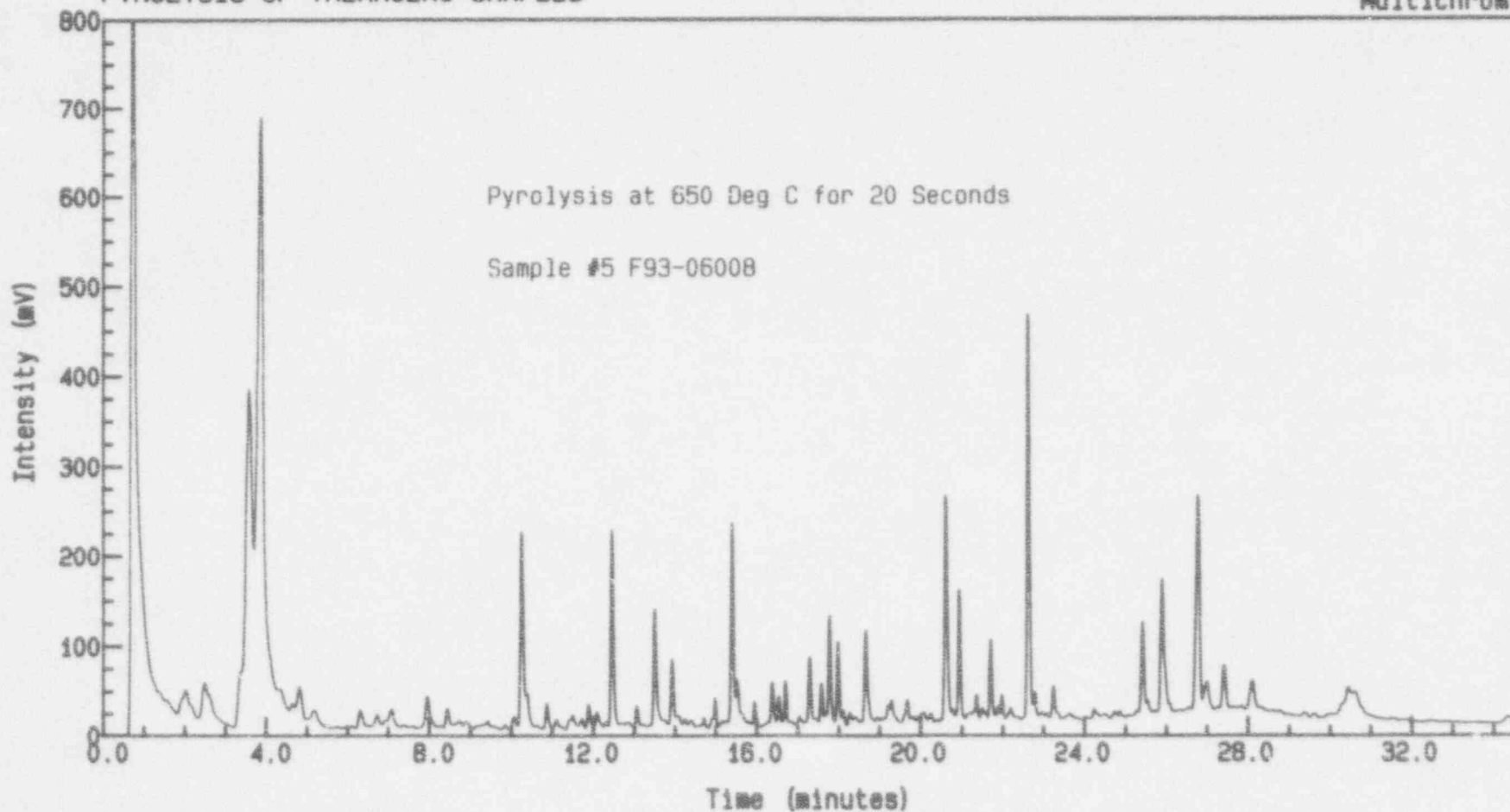


Analysis Name : [CONTRACT] 9 EM31681A, 5, 1.

Sample #5 F93-06008 Amount : 1.530

PYROLYSIS OF THERMOLAG SAMPLES

Multichrom

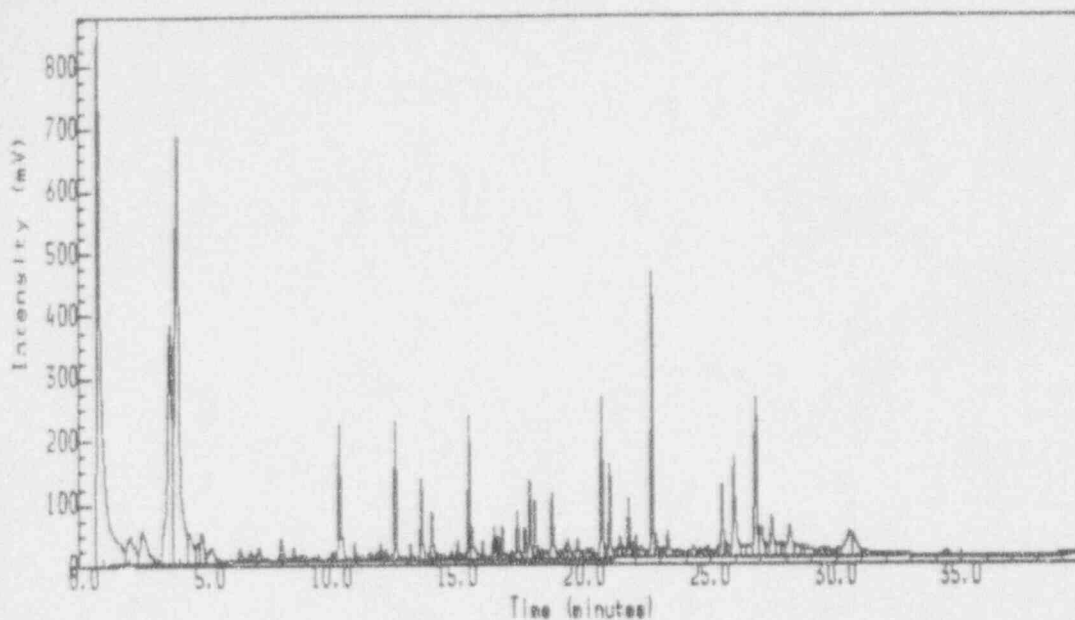


Instrument : Vrn 3700
Channel Title : Channel #9
Lims ID : CF-31681
Acquired on 24-AUG-1993 at 12:26
Reported on 24-AUG-1993 at 13:29

Method : EM31681
Calibration : EM31681
Run Sequence : EM31681A

Injection Report

Acquired on 24-AUG-1993 at 12:26



Ashland Chemical, Inc. -- Multichrom2 V2.0

Analyst Name : MARTI
Lims Id : CF-31681
Comment : PYROLYSIS OF 12 THERMO LAG SAMPLES
Method Title : PYROLYSIS OF THERMOLAG SAMPLES
Sample Name : Sample #5 F93-06008
Sample Id : CF-31681
Sample Type : Sample Amount=1.53000
Bottle No : 5

PEAK INFORMATION

Peak	RT mins	Area uVs	Area %
1	0.764	11144417	18.91
2	2.071	990696	1.68
3	2.529	1230154	2.09
4	3.640	4929414	8.37
5	3.929	8586200	14.57
6	4.378	608243	1.03
7	4.689	249957	0.42
8	4.867	536063	0.91
9	5.236	427172	0.72
10	5.800	27395	0.05
11	6.156	57152	0.10
12	6.360	191174	0.32
13	6.778	152306	0.26

Peak	RT mins	Area uVs	Area %
14	7.124	279377	0.47
15	7.427	35121	0.06
16	7.649	13532	0.02
17	8.000	293739	0.50
18	8.307	16806	0.03
19	8.493	137159	0.23
20	8.649	26788	0.05
21	8.769	69000	0.12
22	8.938	65691	0.11
23	9.204	14815	0.03
24	9.471	92832	0.16
25	9.591	24009	0.04
26	9.889	22891	0.04
27	10.116	91264	0.15
28	10.311	1388475	2.36
29	10.716	5923	0.01
30	10.920	148163	0.25
31	11.151	75385	0.13
32	11.547	144247	0.24
33	11.769	71992	0.12
34	11.938	144047	0.24
35	12.138	129957	0.22
36	12.364	38606	0.07
37	12.520	1117624	1.90
38	12.751	8605	0.01
39	12.871	27980	0.05
40	13.116	148196	0.25
41	13.560	767219	1.30
42	13.978	432738	0.73
43	14.151	57504	0.10
44	14.289	59998	0.10
45	14.440	65166	0.11
46	14.671	21275	0.04
47	14.760	45629	0.08
48	15.031	166943	0.28
49	15.196	43701	0.07
50	15.298	36576	0.06
51	15.453	1023401	1.74
52	15.564	400753	0.68
53	15.840	40212	0.07
54	15.991	125639	0.21
55	16.307	40095	0.07
56	16.422	261282	0.44
57	16.582	160256	0.27
58	16.747	267576	0.45
59	17.089	84499	0.14
60	17.342	458377	0.78
61	17.627	224995	0.38
62	17.831	596302	1.01
63	18.040	429689	0.73
64	18.156	82029	0.14
65	18.316	89906	0.15
66	18.431	112991	0.19

Peak	RT mins	Area uVs	Area %
67	18.720	629057	1.07
68	18.987	53317	0.09
69	19.062	49291	0.08
70	19.258	149681	0.25
71	19.342	230080	0.39
72	19.720	204493	0.35
73	19.858	62271	0.11
74	19.969	52111	0.09
75	20.129	150576	0.26
76	20.298	96477	0.16
77	20.476	46780	0.08
78	20.667	1353744	2.30
79	20.827	88480	0.15
80	20.996	722480	1.23
81	21.258	131668	0.22
82	21.409	217810	0.37
83	21.551	103930	0.18
84	21.636	77568	0.13
85	21.760	461403	0.78
86	21.929	117075	0.20
87	22.027	169277	0.29
88	22.236	270120	0.46
89	22.684	2173820	3.69
90	22.836	197635	0.34
91	22.991	104033	0.18
92	23.120	83366	0.14
93	23.289	361491	0.61
94	23.689	216969	0.37
95	24.098	115897	0.20
96	24.280	181145	0.31
97	24.542	145108	0.25
98	24.782	129480	0.22
99	24.907	122032	0.21
100	25.107	71468	0.12
101	25.316	153308	0.26
102	25.471	635599	1.08
103	25.587	161500	0.27
104	25.702	67079	0.11
105	25.791	78209	0.13
106	25.951	1294845	2.20
107	26.387	195393	0.33
108	26.609	247770	0.42
109	26.840	1752755	2.97
110	27.044	550267	0.93
111	27.302	137096	0.23
112	27.462	552514	0.94
113	27.662	225033	0.38
114	27.893	204418	0.35
115	28.160	600605	1.02
116	28.347	234749	0.40
117	28.671	165438	0.28
118	28.818	297134	0.50
119	29.240	50350	0.09

Peak	RT mins	Area uVs	Area %
120	29.440	141991	0.24
121	29.658	153798	0.26
122	30.084	163660	0.28
123	30.507	641692	1.09
124	30.653	633959	1.08
125	31.573	60075	0.10
126	31.836	49625	0.08
127	32.493	18572	0.03
128	34.400	112462	0.19
129	35.507	32097	0.05
130	39.013	60651	0.10
131	39.084	38961	0.07
132	39.360	9234	0.02
133	39.618	9557	0.02

Totals			
Unknowns		0	0.00
Quantified	58927848		100.00
Grand Total	58927848		100.00

ANALYSIS SUMMARY

Method..... EM31681
Run sequence..... EM31681A
Data not quantified

FIGURE B.1
THERMO-LAG FIRE BARRIER MATERIAL
SAMPLE DOCUMENTATION

Sample No.: #6
NUMARC Test Program

Material Part Number/Description: 1 HR - Baseline Panel
P.O. ITEM 1

Material Batch/Lot Number: F93-01013

Sample Selection/Witness Removal: J. Blott 7/16/93
Inspector Date

Sample Received By: [Signature] 7/16/93
ABB Impell Date
Project Engineer

FIGURE 6

Ashland Chemical, Inc. -- Multichrom2 V2.0

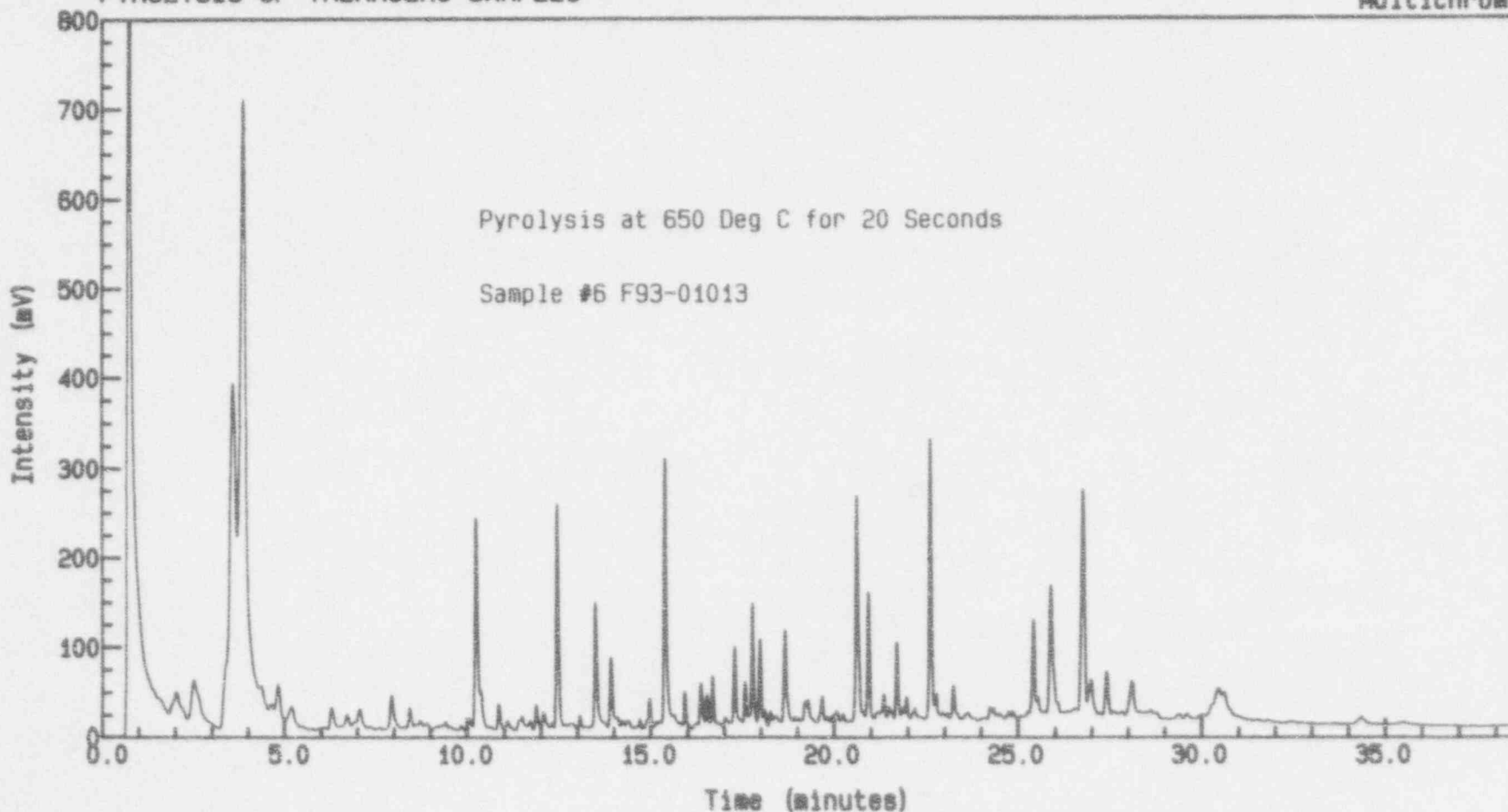


Analysis Name : [CONTRACT] 9 EM31681A, 6, 1.

Sample #6 F93-01013 Amount : 1.480

PYROLYSIS OF THERMOLAG SAMPLES

Multichrom

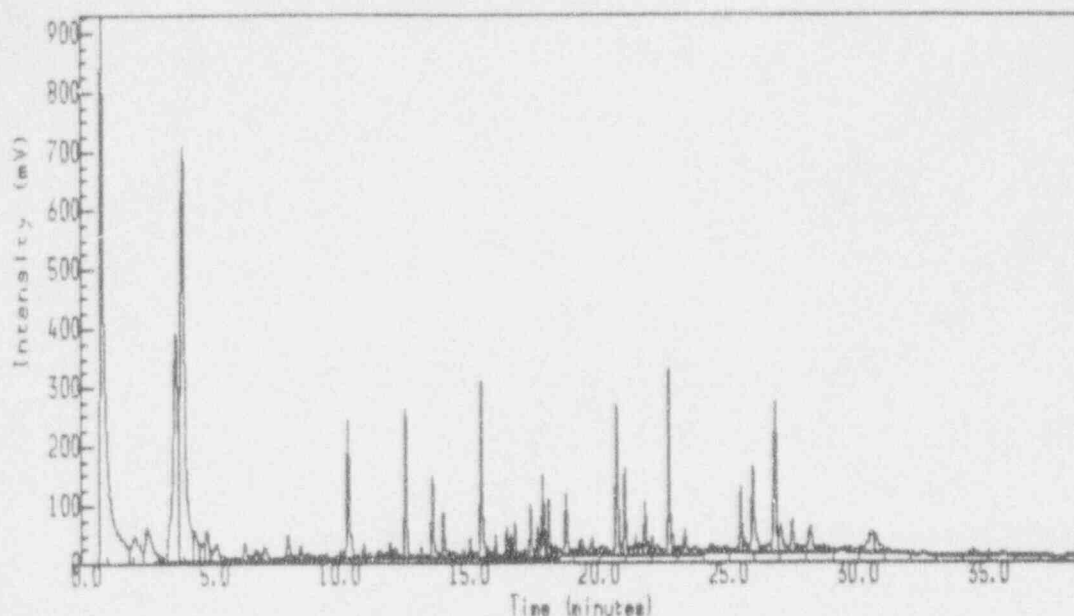


Instrument : Vrn 3700
Channel Title : Channel #9
Lims ID : CF-31681
Acquired on 24-AUG-1993 at 13:15
Reported on 24-AUG-1993 at 14:38

Method : EM31681
Calibration : EM31681
Run Sequence : EM31681A

Injection Report

Acquired on 24-AUG-1993 at 13:15



Ashland Chemical, Inc. -- Multichrom2 V2.0

Analyst Name : MARTI
Lims Id : CF-31681
Comment : PYROLYSIS OF 12 THERMO LAG SAMPLES
Method Title : PYROLYSIS OF THERMOLAG SAMPLES
Sample Name : Sample #6 F93-01013
Sample Id : CF-31681
Sample Type : Sample Amount=1.48000
Bottle No : 6

PEAK INFORMATION

Peak	RT mins	Area uVs	Area %
1	0.796	11929331	20.37
2	2.084	1008218	1.72
3	2.560	1349112	2.30
4	3.658	5187564	8.86
5	3.951	9124602	15.58
6	4.418	642922	1.10
7	4.689	297389	0.51
8	4.880	585083	1.00
9	5.253	561329	0.96
10	5.800	46203	0.08
11	6.138	99011	0.17
12	6.351	262854	0.45
13	6.769	229705	0.39

Peak	RT mins	Area uVs	Area %
14	7.124	348771	0.60
15	7.396	61908	0.11
16	7.658	40772	0.07
17	8.000	384540	0.66
18	8.302	38524	0.07
19	8.493	173630	0.30
20	8.636	41214	0.07
21	8.764	97611	0.17
22	8.956	88936	0.15
23	9.196	28975	0.05
24	9.307	31815	0.05
25	9.467	90109	0.15
26	9.582	39391	0.07
27	9.884	31534	0.05
28	10.111	89171	0.15
29	10.311	1525175	2.60
30	10.707	6155	0.01
31	10.916	157927	0.27
32	11.151	77651	0.13
33	11.462	45625	0.08
34	11.542	102273	0.17
35	11.769	64767	0.11
36	11.938	147948	0.25
37	12.138	137221	0.23
38	12.360	38750	0.07
39	12.520	1171900	2.00
40	12.747	37534	0.06
41	12.867	73193	0.12
42	13.120	96320	0.16
43	13.556	800738	1.37
44	13.978	439555	0.75
45	14.156	57405	0.10
46	14.284	54959	0.09
47	14.440	77413	0.13
48	14.667	17316	0.03
49	14.756	42085	0.07
50	15.027	169566	0.29
51	15.200	44232	0.08
52	15.293	41498	0.07
53	15.462	1579701	2.70
54	15.698	105347	0.18
55	15.840	41138	0.07
56	15.987	176253	0.30
57	16.298	38340	0.07
58	16.422	265885	0.45
59	16.587	178112	0.30
60	16.742	234707	0.40
61	16.862	54421	0.09
62	17.084	89133	0.15
63	17.351	503673	0.86
64	17.631	233338	0.40
65	17.831	644825	1.10
66	18.040	444650	0.76

Peak	RT mins	Area uVs	Area %
67	18.160	86083	0.15
68	18.316	94395	0.16
69	18.484	123138	0.21
70	18.720	640972	1.09
71	18.987	55739	0.10
72	19.080	54648	0.09
73	19.262	158620	0.27
74	19.347	208892	0.36
75	19.729	210170	0.36
76	19.853	61039	0.10
77	19.973	46046	0.08
78	20.124	151728	0.26
79	20.302	94180	0.16
80	20.471	40337	0.07
81	20.680	1341788	2.29
82	20.831	73852	0.13
83	20.996	713072	1.22
84	21.249	123178	0.21
85	21.409	207870	0.35
86	21.551	169601	0.29
87	21.760	428299	0.73
88	21.924	100678	0.17
89	22.022	154619	0.26
90	22.249	231366	0.39
91	22.680	1495129	2.55
92	22.831	178442	0.30
93	22.991	92404	0.16
94	23.120	62161	0.11
95	23.298	294064	0.50
96	23.689	190573	0.33
97	24.120	68744	0.12
98	24.280	87978	0.15
99	24.382	88932	0.15
100	24.547	103657	0.18
101	24.800	94690	0.16
102	24.920	84632	0.14
103	25.111	51408	0.09
104	25.320	97487	0.17
105	25.476	611949	1.04
106	25.591	202146	0.35
107	25.787	59426	0.10
108	25.951	1199934	2.05
109	26.284	46870	0.08
110	26.378	77211	0.13
111	26.573	178282	0.30
112	26.836	1641487	2.80
113	27.040	454065	0.78
114	27.289	61969	0.11
115	27.467	370638	0.63
116	27.653	109436	0.19
117	27.884	87011	0.15
118	28.156	444661	0.76
119	28.369	75872	0.13

Peak	RT mins	Area uVs	Area %
120	28.662	154152	0.26
121	28.818	67597	0.12
122	29.431	43910	0.07
123	29.649	49515	0.08
124	30.084	63319	0.11
125	30.502	526879	0.90
126	30.658	426376	0.73
127	31.560	14055	0.02
128	31.831	15501	0.03
129	34.404	103791	0.18

Totals		
Unknowns	0	0.00
Quantified	58573608	100.00
Grand Total	58573608	100.00

ANALYSIS SUMMARY

Method..... EM31681
Run sequence..... EM31681A
Data not quantified

FIGURE 7

Ashland Chemical, Inc. -- Multichrom2 V2.0

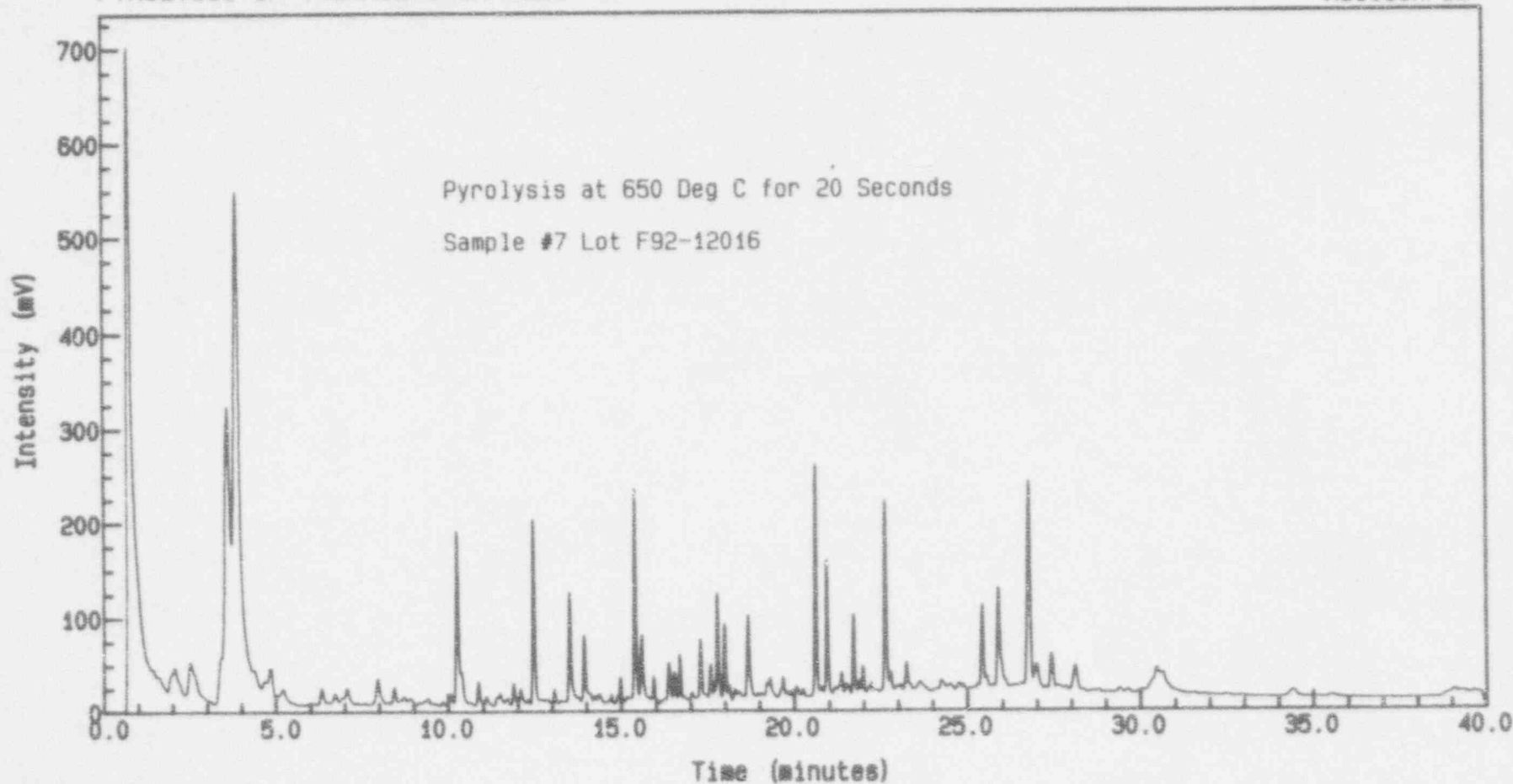


Analysis Name : [CONTRACT] 9 EM31681A, 7, 1.

Sample #7 f92-12016 Amount : 1.230

PYROLYSIS OF THERMOLAG SAMPLES

Multichrom

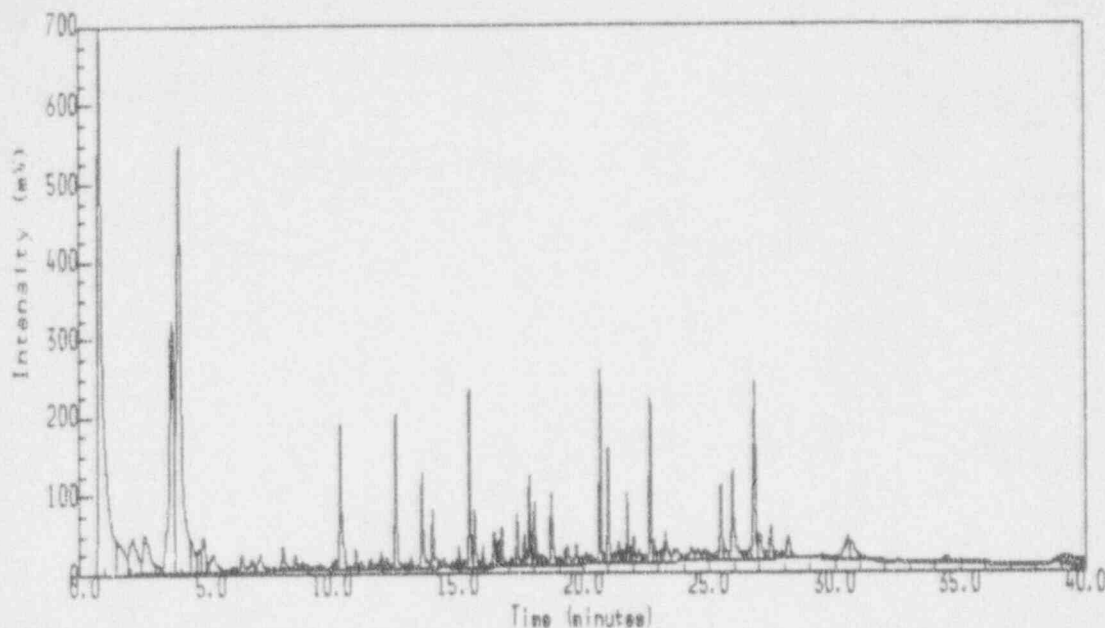


Instrument : Vrn 3700
Channel Title : Channel #9
Lims ID : CF-31681
Acquired on 24-AUG-1993 at 14:02
Reported on 24-AUG-1993 at 15:07

Method : EM31681
Calibration : EM31681
Run Sequence : EM31681A

Injection Report

Acquired on 24-AUG-1993 at 14:02



Ashland Chemical, Inc. -- Multichrom2 V2.0

Analyst Name : MARTI
Lims Id : CF-31681
Comment : PYROLYSIS OF 12 THERMO LAG SAMPLES
Method Title : PYROLYSIS OF THERMOLAG SAMPLES
Sample Name : Sample #7 f92-12016
Sample Id : CF-31681
Sample Type : Sample Amount=1.23000
Bottle No : 7

PEAK INFORMATION

Peak	RT mins	Area uVs	Area %
1	0.791	8834793	18.15
2	1.467	935742	1.92
3	2.107	984145	2.02
4	2.564	1160281	2.38
5	3.662	4142702	8.51
6	3.951	7246517	14.88
7	4.404	530508	1.09
8	4.720	269024	0.55
9	4.902	527990	1.08
10	5.262	452531	0.93
11	6.018	44826	0.09
12	6.156	44631	0.09

Peak	RT mins	Area uVs	Area %
13	6.387	198545	0.41
14	6.778	166750	0.34
15	7.129	289526	0.59
16	7.409	47783	0.10
17	7.640	48906	0.10
18	8.009	302545	0.62
19	8.307	28744	0.06
20	8.493	137286	0.28
21	8.644	39761	0.08
22	8.769	81927	0.17
23	8.947	83822	0.17
24	9.200	22245	0.05
25	9.471	110852	0.23
26	9.889	18399	0.04
27	10.111	78792	0.16
28	10.316	1204950	2.47
29	10.924	125726	0.26
30	11.156	64270	0.13
31	11.462	41154	0.08
32	11.547	83708	0.17
33	11.760	52776	0.11
34	11.938	119565	0.25
35	12.138	107465	0.22
36	12.351	28857	0.06
37	12.524	986979	2.03
38	12.756	5566	0.01
39	12.916	21982	0.05
40	13.116	64970	0.13
41	13.293	26880	0.06
42	13.564	675497	1.39
43	13.987	434211	0.89
44	14.298	46501	0.10
45	14.413	66854	0.14
46	14.676	11951	0.02
47	14.760	37100	0.08
48	15.027	147265	0.30
49	15.204	41850	0.09
50	15.302	31885	0.07
51	15.458	991016	2.04
52	15.649	404674	0.83
53	15.840	29289	0.06
54	15.987	135932	0.28
55	16.284	28726	0.06
56	16.431	235328	0.48
57	16.587	153561	0.32
58	16.747	250960	0.52
59	17.089	74117	0.15
60	17.342	390841	0.80
61	17.631	184099	0.38
62	17.836	550846	1.13
63	18.040	375244	0.77
64	18.164	78083	0.16
65	18.324	70108	0.14

[CONTRACT] 9 EM31681A,7,1
Reported on 24-AUG-1993 at 15:38

Peak	RT mins	Area uVs	Area %
66	18.440	91508	0.19
67	18.724	543860	1.12
68	18.987	43928	0.09
69	19.080	56546	0.12
70	19.262	95521	0.20
71	19.351	184197	0.38
72	19.724	170773	0.35
73	19.862	53094	0.11
74	19.982	41486	0.09
75	20.116	119736	0.25
76	20.298	76060	0.16
77	20.467	25059	0.05
78	20.684	1060696	2.18
79	20.836	76305	0.16
80	21.004	646812	1.33
81	21.227	94991	0.20
82	21.413	177005	0.36
83	21.551	86698	0.18
84	21.636	56901	0.12
85	21.764	370793	0.76
86	21.938	98667	0.20
87	22.031	147139	0.30
88	22.258	140862	0.29
89	22.364	41551	0.09
90	22.444	44344	0.09
91	22.689	1011498	2.08
92	22.836	148597	0.31
93	23.004	99004	0.20
94	23.120	77964	0.16
95	23.293	297517	0.61
96	23.693	310444	0.64
97	24.138	84847	0.17
98	24.289	187545	0.39
99	24.551	155673	0.32
100	24.796	121394	0.25
101	24.916	92850	0.19
102	25.111	63943	0.13
103	25.324	104637	0.21
104	25.484	510807	1.05
105	25.600	153228	0.31
106	25.787	51458	0.11
107	25.947	916225	1.88
108	26.396	72093	0.15
109	26.511	60657	0.12
110	26.591	92018	0.19
111	26.840	1427351	2.93
112	27.049	334610	0.69
113	27.284	46320	0.10
114	27.480	305845	0.63
115	27.653	95987	0.20
116	27.880	44037	0.09
117	28.169	293616	0.60
118	28.676	15841	0.03

Peak	RT mins	Area uVs	Area %
119	28.849	18722	0.04
120	29.422	40246	0.08
121	29.662	29407	0.06
122	30.080	41276	0.08
123	30.520	422368	0.87
124	30.698	387793	0.80
125	31.604	26617	0.05
126	31.876	17490	0.04
127	34.440	110703	0.23
128	35.533	35507	0.07
129	39.120	196904	0.40
130	39.267	50990	0.10
131	39.364	136846	0.28
132	39.658	146562	0.30
133	39.836	92962	0.19

Totals			
Unknowns		0	0.00
Quantified	48685288		100.00
Grand Total	48685288		100.00

ANALYSIS SUMMARY

Method..... EM31681
Run sequence..... EM31681A
Data not quantified

FIGURE B.1
THERMO-LAG FIRE BARRIER MATERIAL
SAMPLE DOCUMENTATION

Sample No.: X#8

Material Part Number/Description: 2" Pre-shaped conduit
 section

Material Batch/Lot Number: F92-09033

Sample Selection/Witness Removal: J. Christ 8-10-93
Inspector Date

Sample Received By [Signature] 8-10-93
ABB Impell Date
Project Engineer

FIGURE 8

Ashland Chemical, Inc. -- Multichrom2 V2.0

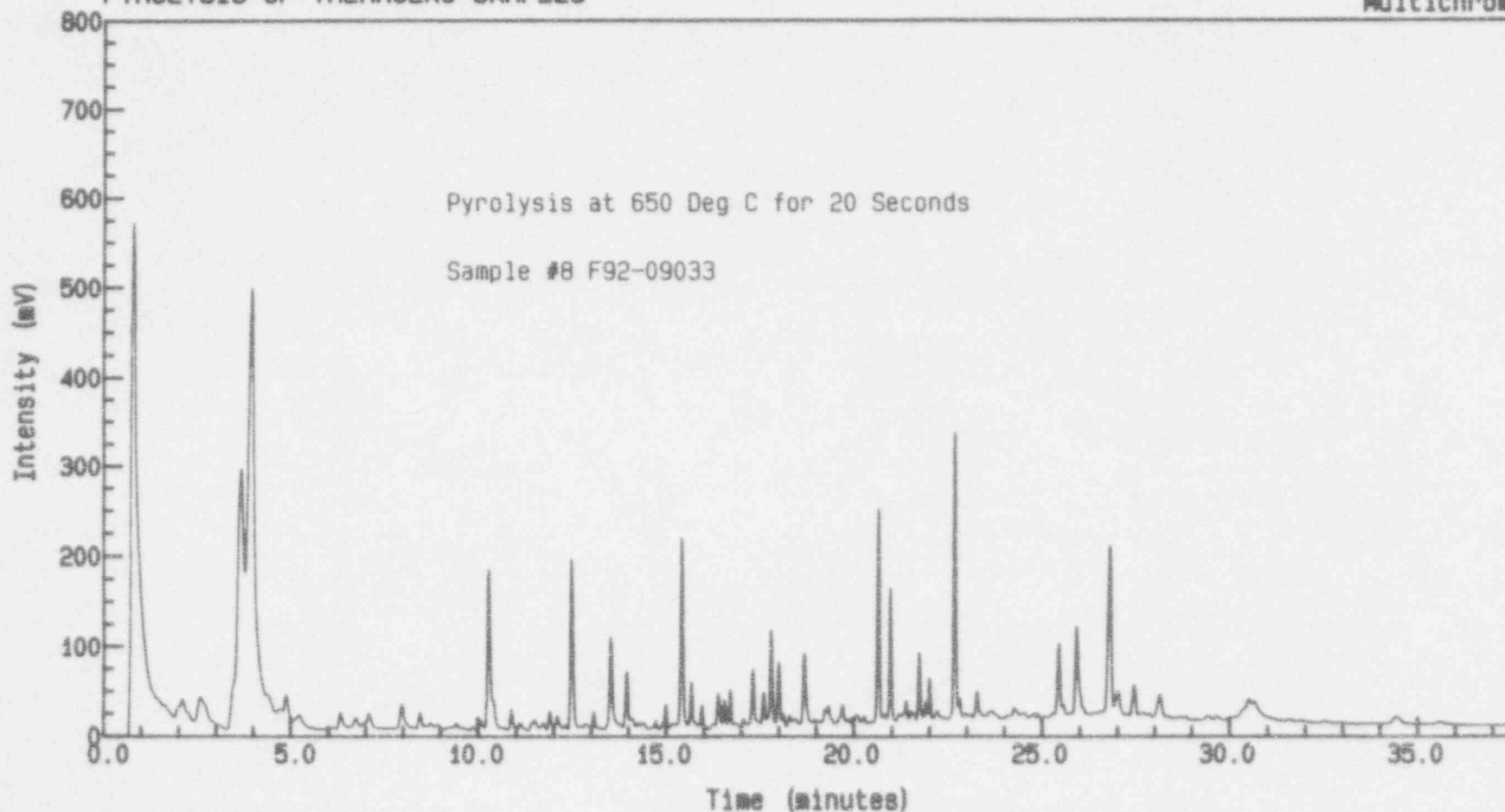


Analysis Name : [CONTRACT] 9 EM31681A, 8, 1.

Sample #8 F92-09033 Amount : 1.330

PYROLYSIS OF THERMOLAG SAMPLES

Multichrom

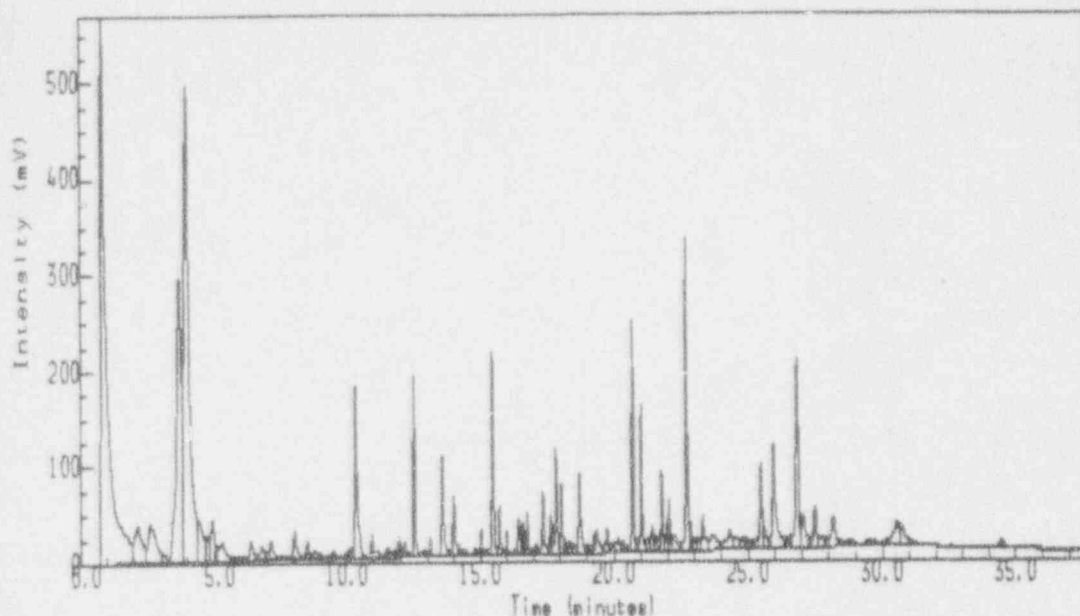


Instrument : Vrn 3700
Channel Title : Channel #9
Lims ID : CF-31681
Acquired on 24-AUG-1993 at 14:52
Reported on 24-AUG-1993 at 15:35

Method : EM31681
Calibration : EM31681
Run Sequence : EM31681A

Injection Report

Acquired on 24-AUG-1993 at 14:52



Ashland Chemical, Inc. -- Multichrom2 V2.0

Analyst Name : MARTI
Lims Id : CF-31681
Comment : PYROLYSIS OF 12 THERMO LAG SAMPLES
Method Title : PYROLYSIS OF THERMOLAG SAMPLES
Sample Name : Sample #8 F92-09033
Sample Id : CF-31681
Sample Type : Sample Amount=1.33000
Bottle No : 8

PEAK INFORMATION

Peak	RT mins	Area uVs	Area %
1	0.836	8701688	19.11
2	2.156	812153	1.78
3	2.631	969123	2.13
4	3.724	3772930	8.29
5	3.996	6846284	15.04
6	4.436	526660	1.16
7	4.764	273985	0.60
8	4.933	443440	0.97
9	5.302	391502	0.86
10	5.813	38958	0.09
11	6.044	32599	0.07
12	6.173	48147	0.11
13	6.396	204862	0.45

Peak	RT mins	Area uVs	Area %
14	6.800	170311	0.37
15	7.013	65866	0.14
16	7.147	199463	0.44
17	7.436	45597	0.10
18	7.684	44683	0.10
19	8.031	286768	0.63
20	8.320	26630	0.06
21	8.507	130252	0.29
22	8.658	35052	0.08
23	8.800	65773	0.14
24	8.978	61676	0.14
25	9.218	18507	0.04
26	9.484	83726	0.18
27	9.613	25576	0.06
28	9.907	17570	0.04
29	10.129	62223	0.14
30	10.333	1144184	2.51
31	10.729	4107	9.02E-3
32	10.938	108297	0.24
33	11.169	53221	0.12
34	11.480	36738	0.08
35	11.556	72895	0.16
36	11.796	46926	0.10
37	11.956	103475	0.23
38	12.156	92694	0.20
39	12.364	20072	0.04
40	12.542	876211	1.92
41	12.760	18838	0.04
42	12.911	43957	0.10
43	13.129	68279	0.15
44	13.582	616817	1.35
45	14.009	347945	0.76
46	14.164	49973	0.11
47	14.316	43851	0.10
48	14.449	54269	0.12
49	14.778	45979	0.10
50	15.044	128128	0.28
51	15.227	38008	0.08
52	15.320	27371	0.06
53	15.476	941674	2.07
54	15.729	224239	0.49
55	15.853	32824	0.07
56	16.004	111487	0.24
57	16.316	33166	0.07
58	16.440	214005	0.47
59	16.604	135949	0.30
60	16.760	174529	0.38
61	16.880	47664	0.10
62	17.107	69471	0.15
63	17.360	372041	0.82
64	17.644	181492	0.40
65	17.849	522145	1.15
66	18.058	334005	0.73

Peak	RT mins	Area uVs	Area %
67	18.178	71174	0.16
68	18.338	74725	0.16
69	18.489	96738	0.21
70	18.729	506159	1.11
71	19.000	44905	0.10
72	19.107	45001	0.10
73	19.280	103195	0.23
74	19.369	180757	0.40
75	19.747	172020	0.38
76	19.880	52731	0.12
77	20.000	44446	0.10
78	20.120	120983	0.27
79	20.320	79444	0.17
80	20.484	31903	0.07
81	20.707	1031922	2.27
82	20.853	80293	0.18
83	21.022	621929	1.37
84	21.240	98605	0.22
85	21.431	173774	0.38
86	21.569	91322	0.20
87	21.649	61113	0.13
88	21.782	356105	0.78
89	21.960	124795	0.27
90	22.058	215373	0.47
91	22.276	192924	0.42
92	22.480	49822	0.11
93	22.724	1407905	3.09
94	22.853	156338	0.34
95	23.013	102966	0.23
96	23.147	73486	0.16
97	23.320	297111	0.65
98	23.716	312094	0.69
99	24.307	325528	0.72
100	24.569	156144	0.34
101	24.827	108063	0.24
102	24.942	81870	0.18
103	25.129	66365	0.15
104	25.338	104585	0.23
105	25.493	485131	1.07
106	25.596	174032	0.38
107	25.813	58560	0.13
108	25.969	918224	2.02
109	26.404	91173	0.20
110	26.502	61746	0.14
111	26.604	68729	0.15
112	26.858	1352005	2.97
113	27.058	383804	0.84
114	27.298	67292	0.15
115	27.498	319141	0.70
116	27.707	132618	0.29
117	27.916	72844	0.16
118	28.182	394512	0.87
119	28.716	55965	0.12

Peak	RT mins	Area uVs	Area %
120	28.862	73634	0.16
121	29.462	78213	0.17
122	29.698	55662	0.12
123	30.147	51290	0.11
124	30.560	347555	0.76
125	30.698	326543	0.72
126	31.644	17205	0.04
127	31.929	13655	0.03
128	32.573	12245	0.03
129	32.947	8699	0.02
130	34.484	110669	0.24
131	35.636	37498	0.08

Totals		
Unknowns	0	0.00
Quantified	45524184	100.00
Grand Total	45524184	100.00

ANALYSIS SUMMARY

Method..... EM31681
Run sequence..... EM31681A
Data not quantified

Specification 0784-00001-S-01
Revision 0

FIGURE B.1
THERMO-LAG FIRE BARRIER MATERIAL
SAMPLE DOCUMENTATION

Sample No.: # 9

Material Part Number/Description: 501-3690

1 1/2" - 3 HR - 1" CONDUIT (PRESHAPED)

Material Batch/Lot Number: F9-089017

Sample Selection/Witness Removal: CKL Stricklin 8/16/93
Inspector Date

Sample Received By [Signature] 8-16-93
ABB Impell Date
Project Engineer

Ashland Chemical, Inc. -- Multichrom2 V2.0

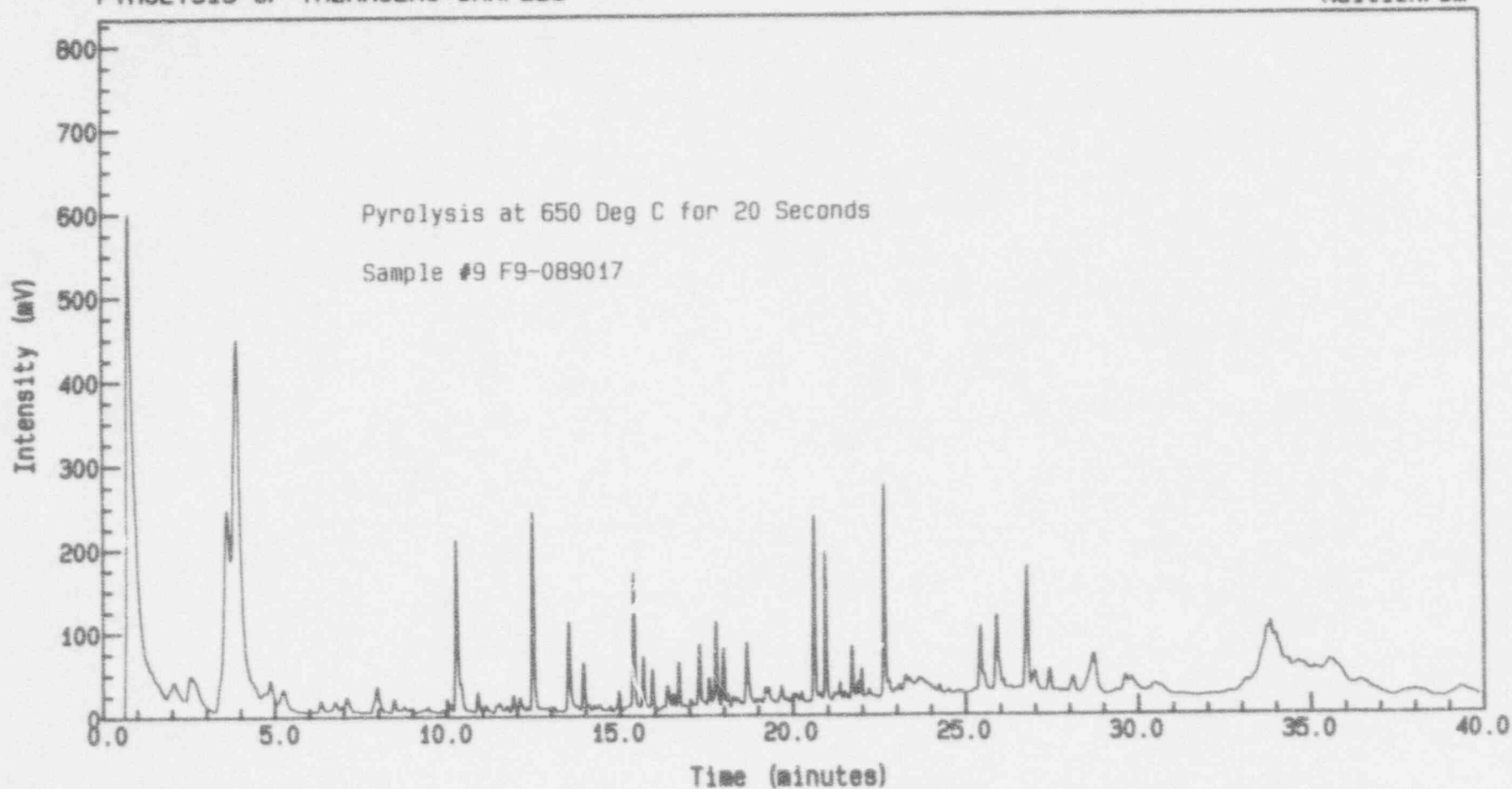


Analysis Name : [CONTRACT] 9 EM31681A, 9, 1.

Sample #9 F9-089017 Amount : 1.610

PYROLYSIS OF THERMOLAG SAMPLES

Multichrom



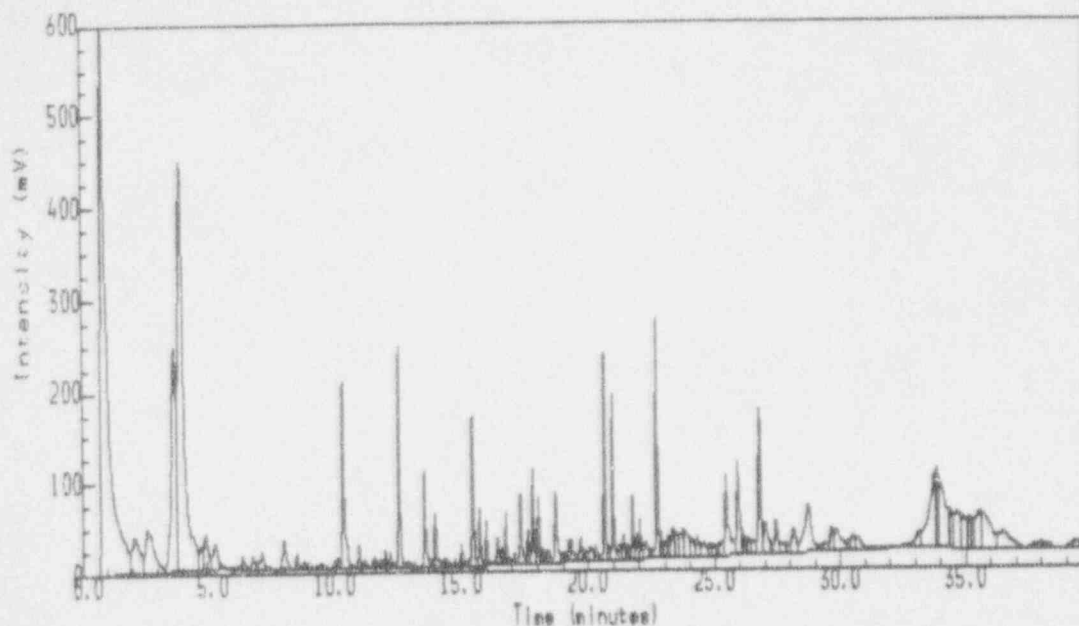
Instrument : Vrn 3700
Channel Title : Channel #9
Lims ID : CF-31681
Acquired on 25-AUG-1993 at 15:18
Reported on 26-AUG-1993 at 09:19

Method : EM31681
Calibration : EM31681
Run Sequence : EM31681A

[CONTRACT] 9 EM31681A,9,1
 Reported on 26-AUG-1993 at 09:19

Injection Report

Acquired on 25-AUG-1993 at 15:18



Ashland Chemical, Inc. -- Multichrom2 V2.0

Analyst Name : MARTI
 Lims Id : CF-31681
 Comment : PYROLYSIS OF 12 THERMO LAG SAMPLES
 Method Title : PYROLYSIS OF THERMOLAG SAMPLES
 Sample Name : Sample #9 F9-089017
 Sample Id : CF-31681
 Sample Type : Sample Amount=1.61000
 Bottle No : 9

PEAK INFORMATION

Peak	RT mins	Area uVs	Area %
1	0.844	10829989	18.32
2	2.124	912797	1.54
3	2.609	1159931	1.96
4	3.684	3291406	5.57
5	3.969	7497171	12.68
6	4.751	253339	0.43
7	4.929	444119	0.75
8	5.307	411759	0.70
9	6.049	5116	8.66E-3
10	6.173	9429	0.02
11	6.409	111941	0.19
12	6.809	133306	0.23

Peak	RT mins	Area uVs	Area %
13	7.147	212662	0.36
14	7.440	13280	0.02
15	7.680	7507	0.01
16	8.036	307236	0.52
17	8.524	101814	0.17
18	8.671	19720	0.03
19	8.800	55491	0.09
20	9.000	47936	0.08
21	9.498	83333	0.14
22	9.609	19478	0.03
23	9.916	18446	0.03
24	10.138	66016	0.11
25	10.338	1284179	2.17
26	10.733	4889	8.27E-3
27	10.938	130908	0.22
28	11.173	62115	0.11
29	11.484	35308	0.06
30	11.564	82008	0.14
31	11.787	49035	0.08
32	11.964	107842	0.18
33	12.160	110319	0.19
34	12.378	31761	0.05
35	12.547	1149735	1.94
36	12.764	7476	0.01
37	12.951	28339	0.05
38	13.147	20824	0.04
39	13.298	4638	7.85E-3
40	13.573	593600	1.00
41	13.822	39044	0.07
42	14.004	334038	0.57
43	14.311	42391	0.07
44	14.462	57329	0.10
45	14.662	17142	0.03
46	14.769	27371	0.05
47	15.031	121736	0.21
48	15.316	59813	0.10
49	15.467	752866	1.27
50	15.738	293116	0.50
51	15.996	210029	0.36
52	16.293	28510	0.05
53	16.431	189993	0.32
54	16.600	85541	0.14
55	16.760	224762	0.38
56	16.907	46867	0.08
57	17.102	72736	0.12
58	17.360	429663	0.73
59	17.640	173130	0.29
60	17.844	485628	0.82
61	18.053	325091	0.55
62	18.169	79069	0.13
63	18.329	79323	0.13
64	18.449	106004	0.18
65	18.733	500576	0.85

[CONTRACT] 9 EM31681A,9,1
Reported on 26-AUG-1993 at 09:19

Peak	RT mins	Area uVs	Area %
66	18.991	50335	0.09
67	19.089	69406	0.12
68	19.262	120509	0.20
69	19.360	191594	0.32
70	19.733	188621	0.32
71	19.871	65172	0.11
72	19.987	37929	0.06
73	20.093	166973	0.28
74	20.307	113789	0.19
75	20.489	36041	0.06
76	20.689	1006879	1.70
77	20.831	100082	0.17
78	21.009	752625	1.27
79	21.267	105775	0.18
80	21.418	169417	0.29
81	21.560	91845	0.16
82	21.640	55852	0.09
83	21.769	320248	0.54
84	21.947	142315	0.24
85	22.049	194130	0.33
86	22.267	211287	0.36
87	22.458	68640	0.12
88	22.716	1156593	1.96
89	22.836	181560	0.31
90	23.036	146074	0.25
91	23.138	139724	0.24
92	23.320	283010	0.48
93	23.427	276568	0.47
94	23.716	330066	0.56
95	23.800	358276	0.61
96	24.022	240446	0.41
97	24.293	192133	0.33
98	24.560	210692	0.36
99	24.822	144413	0.24
100	24.920	124308	0.21
101	25.147	98210	0.17
102	25.333	155165	0.26
103	25.484	864730	1.46
104	25.960	802537	1.36
105	26.133	157610	0.27
106	26.280	85902	0.15
107	26.342	139891	0.24
108	26.609	211712	0.36
109	26.836	1034403	1.75
110	27.049	432910	0.73
111	27.293	75701	0.13
112	27.471	317146	0.54
113	27.671	157688	0.27
114	27.907	104667	0.18
115	28.147	327540	0.55
116	28.764	1060807	1.79
117	29.449	182596	0.31
118	29.667	260410	0.44

Peak	RT mins	Area uVs	Area %
119	29.844	457812	0.77
120	30.342	87485	0.15
121	30.533	202172	0.34
122	30.662	219428	0.37
123	31.258	55892	0.09
124	32.058	8968	0.02
125	32.729	71462	0.12
126	33.182	272707	0.46
127	33.778	1439063	2.43
128	33.880	749044	1.27
129	34.009	1382157	2.34
130	34.404	282697	0.48
131	34.671	709161	1.20
132	34.844	597054	1.01
133	35.138	238047	0.40
134	35.231	264043	0.45
135	35.582	627361	1.06
136	35.649	1076042	1.82
137	36.449	726690	1.23
138	37.747	80568	0.14
139	38.031	210013	0.36
140	38.316	70199	0.12
141	39.382	273862	0.46

Totals			
Unknowns		0	0.00
Quantified	59112856		100.00
Grand Total	59112856		100.00

ANALYSIS SUMMARY

Method..... EM31681
Run sequence..... EM31681A
Data not quantified

Specification 0784-00001-S-01
Revision 0

FIGURE B.1
THERMO-LAG FIRE BARRIER MATERIAL
SAMPLE DOCUMENTATION

Sample No.: # 10

Material Part Number/Description: 501-3683
4'x6'¹/₂x1"
3 HR PREFABRICATED PANEL

Material Batch/Lot Number: F9-01001

Sample Selection/Witness Removal: *W. Stricklin* 8/16/93
Inspector Date

Sample received By: *[Signature]* 8-16-93
ABB Irpell Date
Project Engineer

FIGURE 10

Ashland Chemical, Inc. -- Multichrom2 V2.0

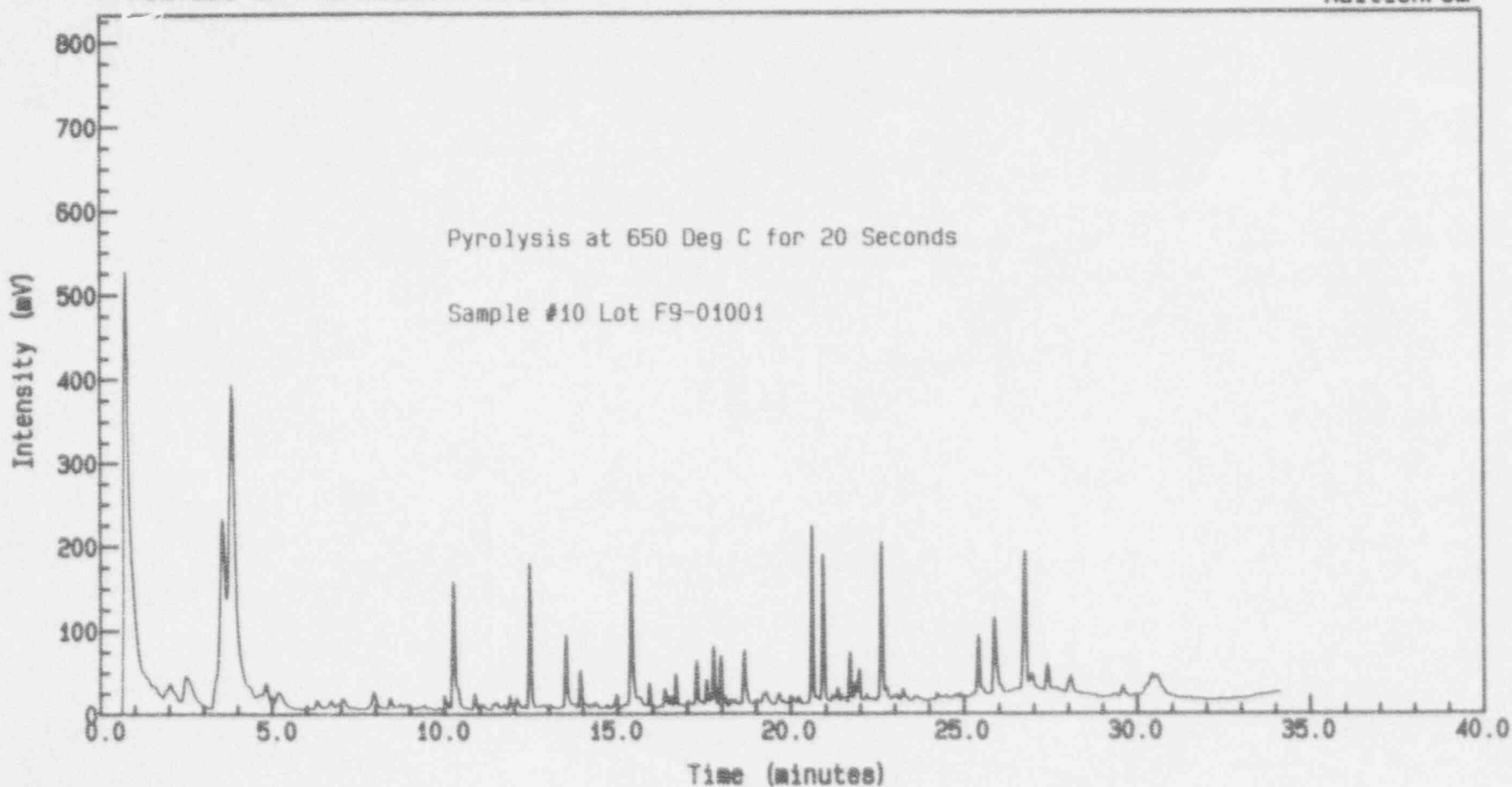


Analysis Name : [CONTRACT] 9 EM31681A, 13, 1.

Sample #10 Lot F9-01001 Amount : 1.450

PYROLYSIS OF THERMOLAG SAMPLES

Multichrom

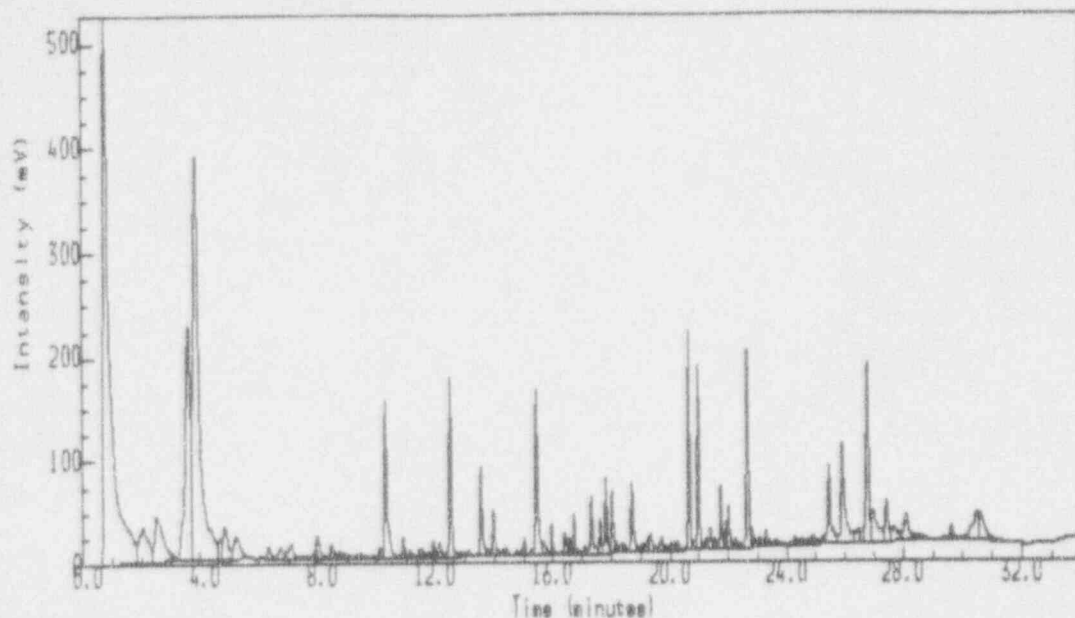


Instrument : Vrn 3700
Channel Title : Channel #9
Lims ID : CF-31681
Acquired on 25-AUG-1993 at 18:47
Reported on 26-AUG-1993 at 09:16

Method : EM31681
Calibration : EM31681
Run Sequence : EM31681A

Injection Report

Acquired on 25-AUG-1993 at 18:47



Ashland Chemical, Inc. -- Multichrom2 V2.0

Analyst Name : MARTI
Lims Id : CF-31681
Comment : PYROLYSIS OF 12 THERMO LAG SAMPLES
Method Title : PYROLYSIS OF THERMOLAG SAMPLES
Sample Name : Sample #10 Lot F9-01001
Sample Id : CF-31681
Sample Type : Sample Amount=1.45000
Bottle No : 13

PEAK INFORMATION

Peak	RT mins	Area uVs	Area %
1	0.800	8436426	22.33
2	2.076	733544	1.94
3	2.542	976610	2.59
4	3.618	2867705	7.59
5	3.893	5964959	15.79
6	4.702	179216	0.47
7	4.876	367415	0.97
8	5.244	343587	0.91
9	6.160	3574	9.46E-3
10	6.356	86782	0.23
11	6.778	100460	0.27
12	7.129	175268	0.46
13	7.404	12366	0.03

[CONTRACT] 9 EM31681A,13,1
Reported on 26-AUG-1993 at 09:20

Peak	RT mins	Area uVs	Area %
14	7.658	6649	0.02
15	8.009	220854	0.58
16	8.484	86582	0.23
17	8.640	16862	0.04
18	8.782	45263	0.12
19	8.938	46914	0.12
20	9.196	6847	0.02
21	9.462	69179	0.18
22	9.889	12697	0.03
23	10.098	61361	0.16
24	10.311	1005566	2.66
25	10.702	4181	0.01
26	10.924	106609	0.28
27	11.147	51421	0.14
28	11.458	33259	0.09
29	11.547	61566	0.16
30	11.769	40705	0.11
31	11.938	88670	0.23
32	12.138	91913	0.24
33	12.347	24279	0.06
34	12.520	869514	2.30
35	12.738	4059	0.01
36	12.924	24400	0.06
37	13.120	15042	0.04
38	13.267	4159	0.01
39	13.560	455755	1.21
40	13.800	32467	0.09
41	13.978	256670	0.68
42	14.298	22935	0.06
43	14.418	45328	0.12
44	14.667	6643	0.02
45	14.751	17514	0.05
46	15.027	31856	0.24
47	15.289	44055	0.12
48	15.453	938567	2.48
49	15.689	126531	0.33
50	15.969	128886	0.34
51	16.271	17520	0.05
52	16.418	137912	0.37
53	16.582	67303	0.18
54	16.733	161993	0.43
55	16.862	22949	0.06
56	16.973	8592	0.02
57	17.093	58641	0.16
58	17.338	313842	0.83
59	17.622	139665	0.37
60	17.827	344783	0.91
61	18.031	264949	0.70
62	18.156	50727	0.13
63	18.311	44530	0.12
64	18.436	52648	0.14
65	18.711	405160	1.07
66	18.982	24540	0.06

Peak	RT mins	Area uVs	Area %
67	19.080	42520	0.11
68	19.262	79973	0.21
69	19.351	117303	0.31
70	19.720	102313	0.27
71	19.853	27975	0.07
72	20.102	94560	0.25
73	20.276	59620	0.16
74	20.676	850817	2.25
75	20.804	56152	0.15
76	20.991	849109	2.25
77	21.253	58144	0.15
78	21.409	105056	0.28
79	21.542	51532	0.14
80	21.627	29628	0.08
81	21.760	243824	0.65
82	21.924	121317	0.32
83	22.027	199296	0.53
84	22.253	76541	0.20
85	22.436	33713	0.09
86	22.680	915174	2.42
87	22.822	111420	0.29
88	23.022	48315	0.13
89	23.116	45981	0.12
90	23.298	118400	0.31
91	23.684	78168	0.21
92	23.853	12300	0.03
93	24.107	21884	0.06
94	24.276	63072	0.17
95	24.542	77354	0.20
96	24.813	59880	0.16
97	24.929	57816	0.15
98	25.311	105165	0.28
99	25.467	542480	1.44
100	25.920	910049	2.41
101	26.458	143045	0.38
102	26.622	104861	0.28
103	26.813	1169454	3.10
104	26.991	467180	1.24
105	27.444	325854	0.86
106	27.680	235938	0.62
107	28.116	426158	1.13
108	28.809	20618	0.05
109	29.409	23317	0.06
110	29.636	106666	0.28
111	30.013	26643	0.07
112	30.480	407885	1.08
113	30.613	412407	1.09
114	31.560	8319	0.02

Totals		
Unknowns	0	0.00
Quantified	37774624	100.00
Grand Total	37774624	100.00

ANALYSIS SUMMARY

Method..... EM31681
Run sequence..... EM31681A
Data not quantified

FIGURE B.1
THERMO-LAG FIRE BARRIER MATERIAL
SAMPLE DOCUMENTATION

Sample No.: #11 ~~X~~

Material Part Number/Description: 3" 3hr Thermo-Lag
330

Material Batch/Lot Number: 9067003 6690137028

Sample Selection/Witness Removal: *[Signature]*
Inspector Date

Sample Received By: *[Signature]* 8-12-93
ABB Impell Date
Project Engineer

Ashland Chemical, Inc. -- Multichrom? V2.0

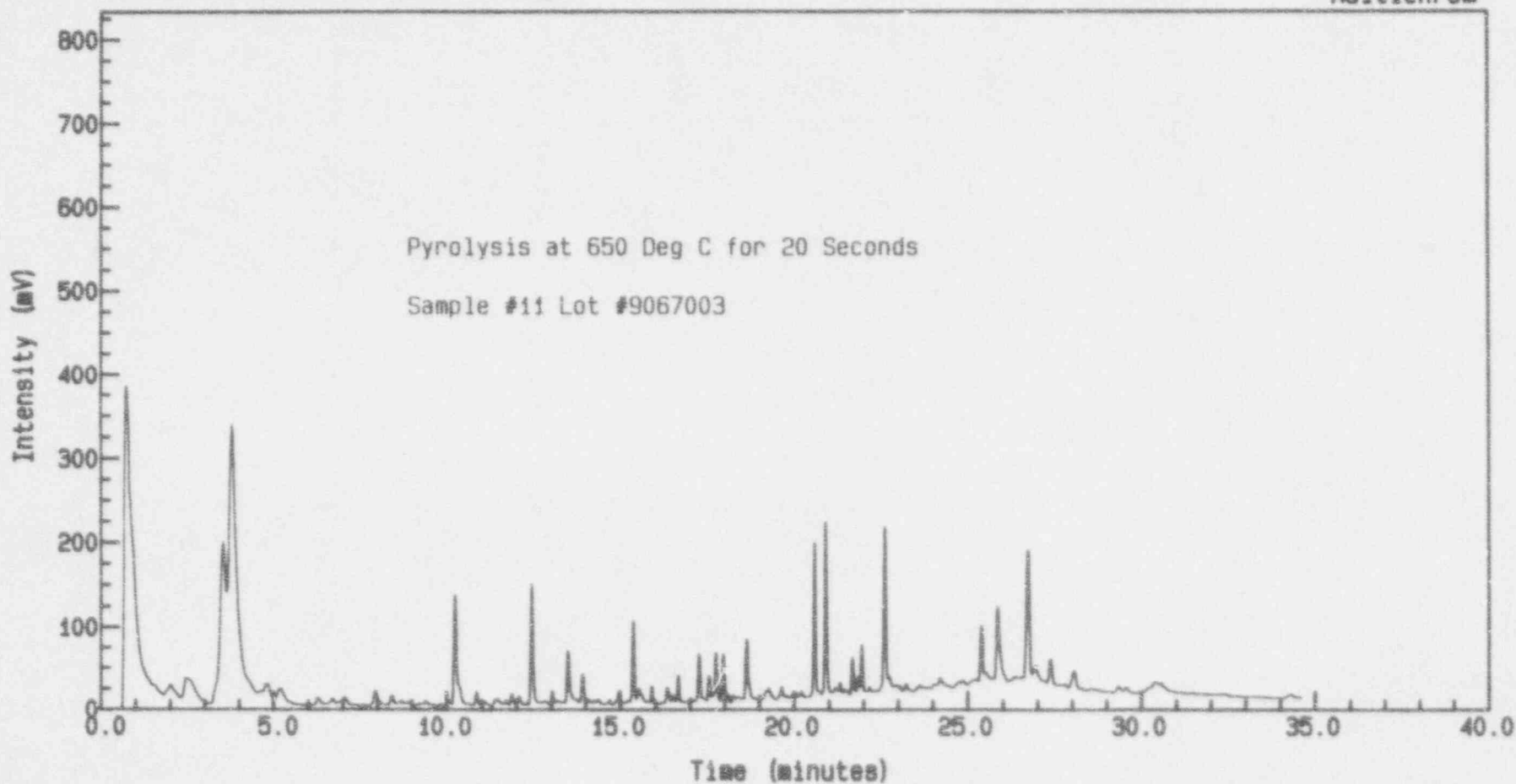


Analysis Name : [CONTRACT] 9 EM31681A, 11, 1.

Sample #11 Lot #9067003 Amount : 1.250

PYROLYSIS OF THERMOLAG SAMPLES

Multichrom



Instrument : Vrn 3700

Method : EM31681

Channel Title : Channel #9

Calibration : EM31681

Lims ID : CF-31681

Run Sequence : EM31681A

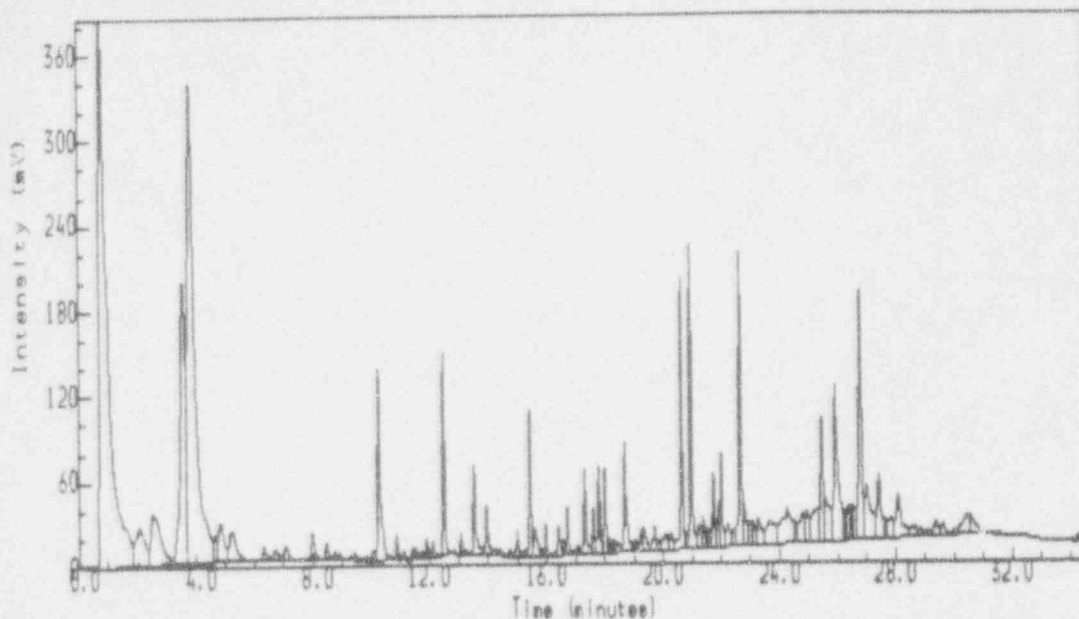
Acquired on 25-AUG-1993 at 17:19

Reported on 26-AUG-1993 at 09:18

ENH1081A,11,1
Reported on 26-AUG-1993 at 09:20

Injection Report

Acquired on 25-AUG-1993 at 17:19



Ashland Chemical, Inc. -- Multichrom2 V2.0

Analyst Name : MARTI
Lims Id : CF-31681
Comment : PYROLYSIS OF 12 THERMO LAG SAMPLES
Method Title : PYROLYSIS OF THERMOLAG SAMPLES
Sample Name : Sample #11 Lot #9067003
Sample Id : CF-31681
Sample Type : Sample Amount=1.25000
Bottle No : 11

PEAK INFORMATION

Peak	RT mins	Area uVs	Area %
1	0.796	7662482	19.65
2	2.062	587146	1.51
3	2.524	891176	2.28
4	3.587	2439333	6.25
5	3.858	5937048	15.22
6	4.684	162176	0.42
7	4.858	373393	0.96
8	5.240	328704	0.84
9	6.342	73980	0.19
10	6.760	82325	0.21
11	7.111	131221	0.34
12	7.378	4931	0.01
13	7.644	4477	0.01

Peak	RT mins	Area uVs	Area %
14	7.996	164721	0.42
15	8.476	80275	0.21
16	8.760	57165	0.15
17	8.929	36169	0.09
18	9.449	74585	0.19
19	9.880	10613	0.03
20	10.098	45438	0.12
21	10.302	857358	2.20
22	10.689	4469	0.01
23	10.907	80492	0.21
24	11.138	37286	0.10
25	11.449	34411	0.09
26	11.533	47071	0.12
27	11.760	33437	0.09
28	11.929	67369	0.17
29	12.133	59434	0.15
30	12.347	8218	0.02
31	12.507	673223	1.73
32	12.884	14250	0.04
33	13.089	59899	0.15
34	13.244	29975	0.08
35	13.418	9461	0.02
36	13.547	405218	1.04
37	13.969	223178	0.57
38	14.280	24104	0.06
39	14.418	36534	0.09
40	14.658	6999	0.02
41	14.747	21205	0.05
42	15.013	88220	0.23
43	15.284	40932	0.10
44	15.436	441965	1.13
45	15.587	169047	0.43
46	15.818	22545	0.06
47	15.964	94784	0.24
48	16.271	15344	0.04
49	16.404	116623	0.30
50	16.564	55213	0.14
51	16.724	155073	0.40
52	16.862	4452	0.01
53	17.067	46144	0.12
54	17.329	325380	0.83
55	17.609	145913	0.37
56	17.809	316339	0.81
57	18.018	268437	0.69
58	18.147	47273	0.12
59	18.302	52359	0.13
60	18.431	75871	0.19
61	18.693	454207	1.16
62	18.964	28148	0.07
63	19.053	45946	0.12
64	19.236	76115	0.20
65	19.333	158065	0.41
66	19.702	129724	0.33

Peak	RT mins	Area uVs	Area %
67	19.827	47576	0.12
68	20.107	137579	0.35
69	20.267	94904	0.24
70	20.653	828966	2.13
71	20.787	75093	0.19
72	20.973	1018308	2.61
73	21.244	130913	0.34
74	21.387	123968	0.32
75	21.520	82249	0.21
76	21.604	61539	0.16
77	21.742	252917	0.65
78	21.911	141104	0.36
79	22.013	331033	0.85
80	22.231	143369	0.37
81	22.431	94587	0.24
82	22.676	1074303	2.75
83	22.796	205408	0.53
84	22.991	145307	0.37
85	23.107	100275	0.26
86	23.280	213481	0.55
87	23.676	364628	0.93
88	24.253	559814	1.44
89	24.524	87565	0.22
90	24.804	267368	0.69
91	24.916	203924	0.52
92	25.298	391510	1.00
93	25.449	549720	1.41
94	25.569	414446	1.06
95	25.911	1100677	2.82
96	26.253	114715	0.29
97	26.382	188978	0.48
98	26.458	133967	0.34
99	26.596	171468	0.44
100	26.791	1260019	3.23
101	27.004	621750	1.59
102	27.431	409677	1.05
103	27.631	75891	0.19
104	27.836	182412	0.47
105	28.107	428216	1.10
106	28.618	114455	0.29
107	28.787	108458	0.28
108	29.382	109528	0.28
109	29.600	82834	0.21
110	30.462	269497	0.69
111	30.591	160706	0.41
112	31.524	10264	0.03
113	31.813	3444	8.83E-3
114	34.342	57267	0.15

Totals			
Unknowns		0	0.00
Quantified	39001148		100.00
Grand Total	39001148		100.00

ANALYSIS SUMMARY

Method..... EM31681
Run sequence..... EM31681A
Data not quantified

Specification 0784-00001-8-01
Revision 0

FIGURE B.1
THERMO-LAG FIRE BARRIER MATERIAL
SAMPLE DOCUMENTATION

Sample No.:

#12 ~~12~~

Material/ Part Number/Description:

4" - 1/2" ThermoLag
330

90137027

Material Batch/Lot Number:

9027008

Sample Selection/Witness Removal:

Joe Simpson 8/7/93
Inspector Date

Sample Received By

Cal B... 8-12-93
ABB Impel Date
Project Engineer

FIGURE 12

Ashland Chemical, Inc. -- Multichrom2 V2.0

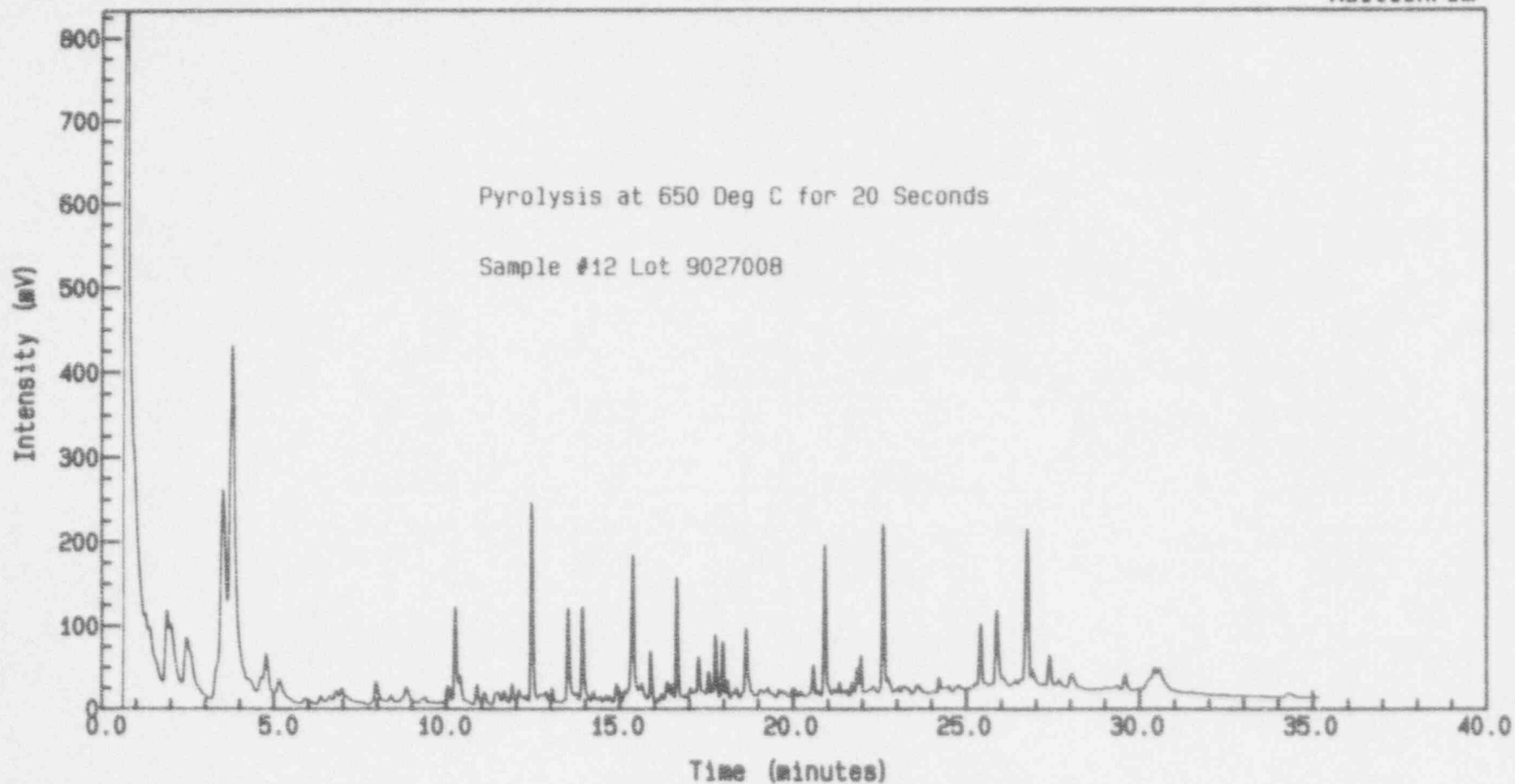


Analysis Name : [CONTRACT] 9 EM31681A, 12, 1.

Sample #12 Lot 9027008 Amount : 1.380

PYROLYSIS OF THERMOLAG SAMPLES

Multichrom



Instrument : Vrn 3700

Method : EM31681

Channel Title : Channel #9

Calibration : EM31681

Lims ID : CF-31681

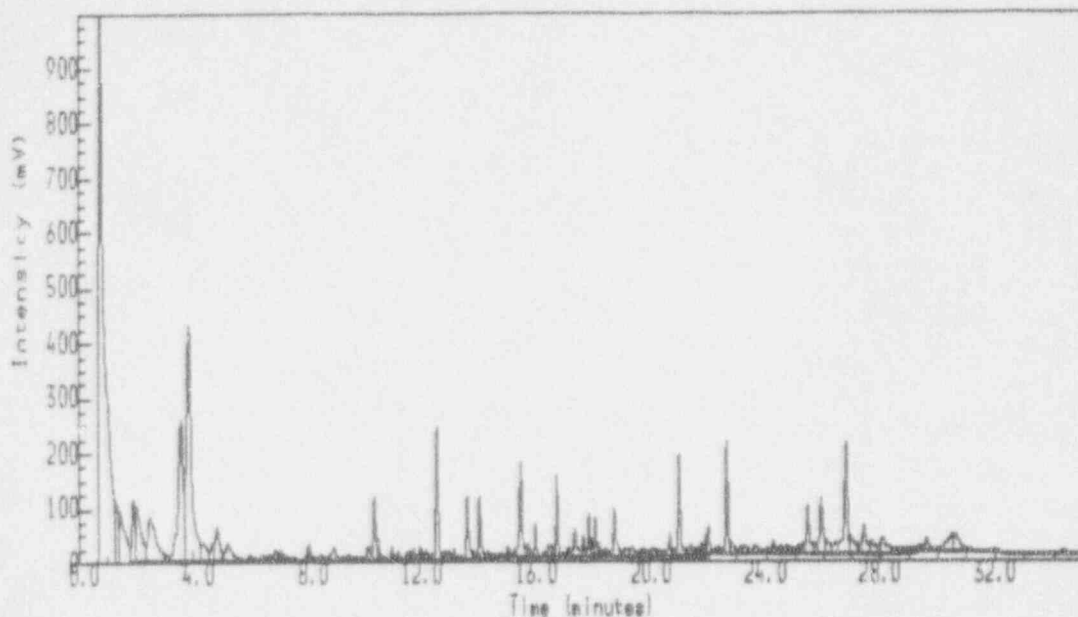
Run Sequence : EM31681A

Acquired on 25-AUG-1993 at 18:03

Reported on 26-AUG-1993 at 09:17

Injection Report

Acquired on 25-AUG-1993 at 18:03



Ashland Chemical, Inc. -- Multichrom2 V2.0

Analyst Name : MARTI
Lims Id : CF-31681
Comment : PYROLYSIS OF 12 THERMO LAG SAMPLES
Method Title : PYROLYSIS OF THERMOLAG SAMPLES
Sample Name : Sample #12 Lot 9027008
Sample Id : CF-31681
Sample Type : Sample Amount=1.38000
Bottle No : 12

PEAK INFORMATION

Peak	RT mins	Area uVs	Area %
1	0.760	14536991	
2	1.307	765425	1.80
3	1.431	1591581	3.75
4	1.938	932419	2.20
5	2.053	1339781	3.16
6	2.511	1777106	4.19
7	3.587	3197524	7.54
8	3.858	5569629	13.13
9	4.316	402437	0.95
10	4.684	279565	0.66
11	4.827	706956	1.67
12	5.209	457291	1.08
13	5.951	79268	0.19

Peak	RT mins	Area uVs	Area %
14	6.413	71757	0.17
15	6.676	88261	0.21
16	6.862	127029	0.30
17	7.031	155142	0.37
18	7.182	154311	0.36
19	8.027	286328	0.68
20	8.449	96130	0.23
21	8.622	23865	0.06
22	8.893	265459	0.63
23	9.178	22997	0.05
24	9.431	135938	0.32
25	9.871	25952	0.06
26	10.084	170383	0.40
27	10.311	637242	1.50
28	10.436	246992	0.58
29	10.920	136888	0.32
30	11.142	98271	0.23
31	11.467	72718	0.17
32	11.533	88486	0.21
33	11.707	111035	0.26
34	11.933	140920	0.33
35	12.124	148267	0.35
36	12.347	56200	0.13
37	12.520	1198424	2.83
38	12.747	89914	0.21
39	12.916	121436	0.29
40	13.089	93297	0.22
41	13.280	22865	0.05
42	13.564	677284	1.60
43	13.791	69631	0.16
44	13.982	642202	1.51
45	14.284	80170	0.19
46	14.404	23265	0.05
47	14.484	34767	0.08
48	14.649	49143	0.12
49	14.756	36572	0.09
50	14.947	165089	0.39
51	15.196	77941	0.18
52	15.440	1128956	2.66
53	15.680	200377	0.47
54	15.942	270856	0.64
55	16.076	18099	0.04
56	16.249	52958	0.12
57	16.418	178200	0.42
58	16.573	101624	0.24
59	16.702	600140	1.42
60	16.862	33852	0.08
61	16.960	39440	0.09
62	17.102	100328	0.24
63	17.218	70650	0.17
64	17.329	377913	0.89
65	17.613	176847	0.42
66	17.818	413718	0.98

Peak	RT mins	Area uVs	Area %
67	18.027	329868	0.78
68	18.151	112492	0.27
69	18.320	66615	0.16
70	18.418	87701	0.21
71	18.702	622956	1.47
72	18.973	28174	0.07
73	19.093	132933	0.31
74	19.329	203415	0.48
75	19.644	100864	0.24
76	19.778	93304	0.22
77	20.044	164490	0.39
78	20.271	89082	0.21
79	20.644	273158	0.64
80	20.782	75630	0.18
81	20.978	957085	2.26
82	21.240	85915	0.20
83	21.400	119056	0.28
84	21.529	72316	0.17
85	21.613	56179	0.13
86	21.756	111999	0.26
87	21.911	186219	0.44
88	22.018	272284	0.64
89	22.360	235642	0.56
90	22.653	1091011	2.57
91	22.800	190057	0.45
92	23.013	74456	0.18
93	23.111	77354	0.18
94	23.236	153705	0.36
95	23.396	70942	0.17
96	23.602	176081	0.42
97	23.764	51989	0.12
98	23.867	47845	0.11
99	24.093	104672	0.25
100	24.262	171099	0.40
101	24.542	196714	0.46
102	24.747	81056	0.19
103	24.818	160981	0.38
104	25.089	93834	0.22
105	25.213	88928	0.21
106	25.307	100563	0.24
107	25.462	647581	1.53
108	25.778	128109	0.30
109	25.924	817766	1.93
110	26.120	241903	0.57
111	26.462	246245	0.58
112	26.809	1515033	3.57
113	26.951	376303	0.89
114	27.258	124611	0.29
115	27.444	456112	1.08
116	27.716	279293	0.66
117	28.089	528686	1.25
118	28.622	79021	0.19
119	28.800	85658	0.20

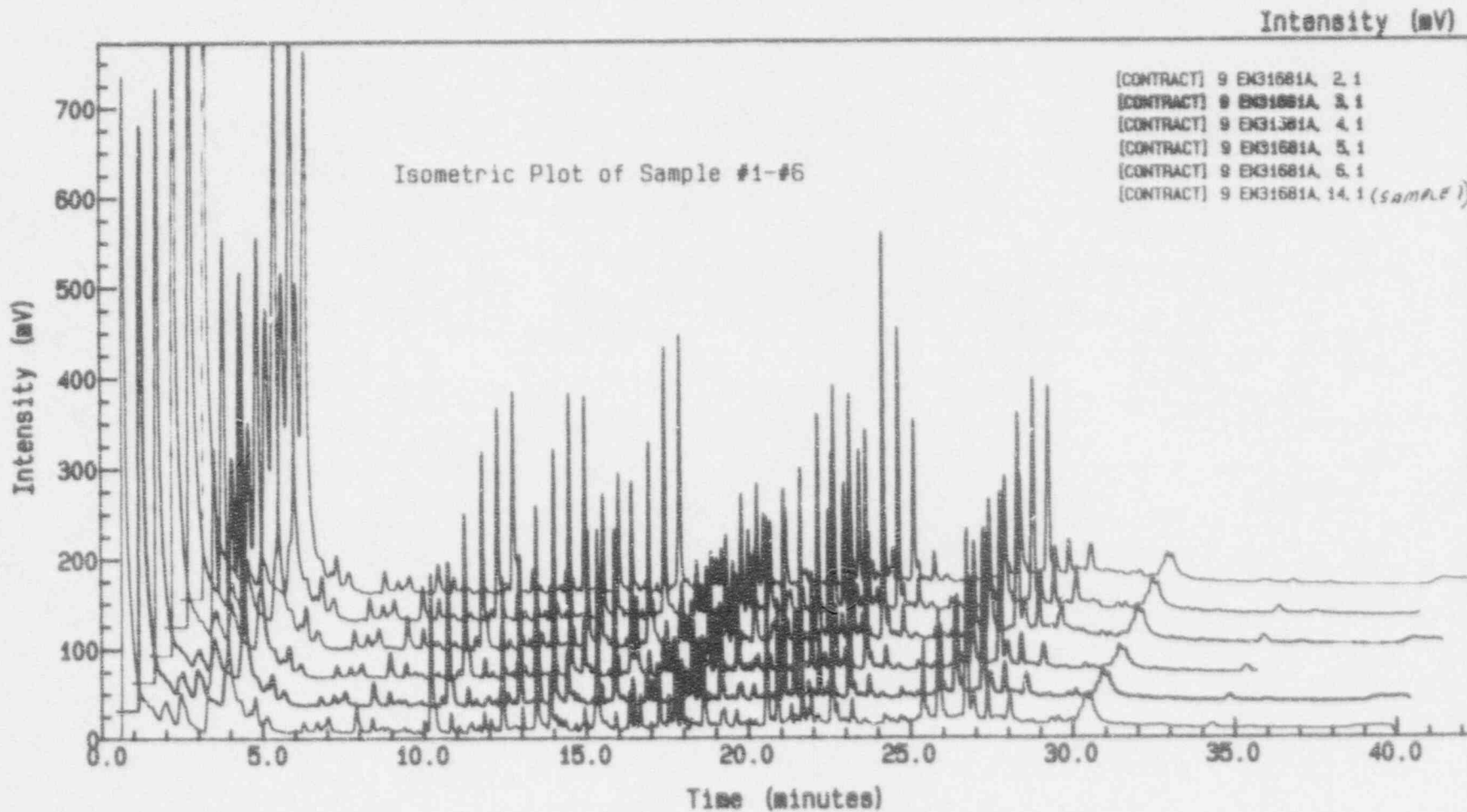
Peak	RT mins	Area uVs	Area %
120	29.067	142766	0.34
121	29.391	196356	0.46
122	29.631	266369	0.63
123	30.102	127862	0.30
124	30.480	500202	1.18
125	30.627	530236	1.25
126	31.556	28237	0.07
127	32.449	10485	0.02
128	34.338	66129	0.16

Totals			
Unknowns		0	0.00
Quantified	56946116		134.28
Grand Total	56946116		134.28

ANALYSIS SUMMARY

Method..... EM31681
Run sequence..... EM31681A
Data not quantified

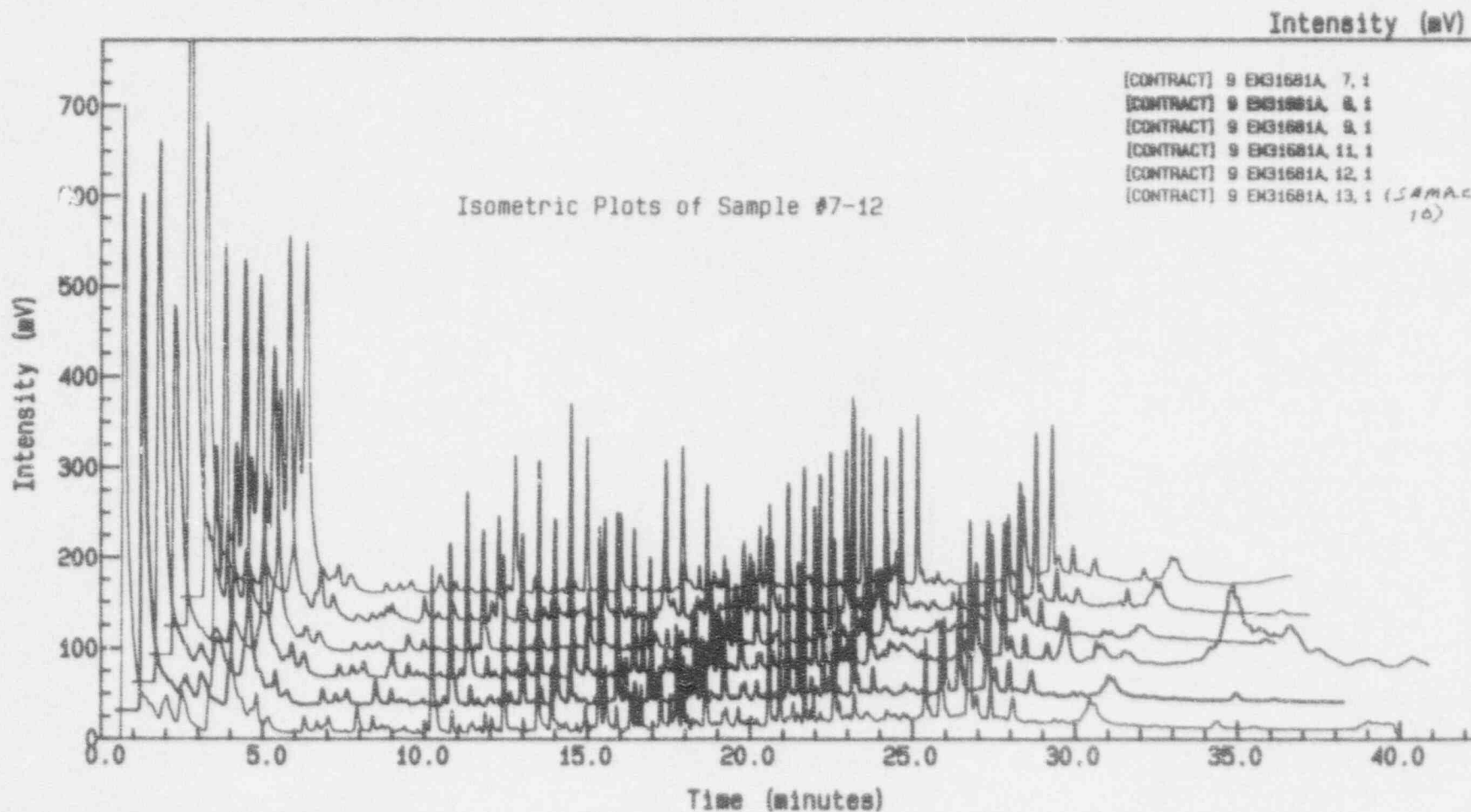
FIGURE 13



Instrument : Vrn 3700
Channel Title : Channel #9
Lims ID : CF-31681
Acquired on 25-AUG-1993 at 19:31
Reported on 26-AUG-1993 at 14:01

Method : EM31681
Calibration : EM31681
Run Sequence : EM31681A

FIGURE 14



Instrument : Vrn 3700
Channel Title : Channel #9
Lims ID : CF-31681
Acquired on 25-AUG-1993 at 18:47
Reported on 26-AUG-1993 at 14:03

Method : EM31681
Calibration : EM31681
Run Sequence : EM31681A



W

August 17, 1993

0784-0001-OC-103

W. Peter Freeman
Nuclear Consulting Services, Inc.
7000 Huntley Road
Columbus, OH 43229

Acc.
18 August 93

Dear Mr. Freeman:

Enclosed with this transmittal letter are twelve samples of Thermo-Lag 330-1 material for you to conduct Pyrolysis G. C. testing. Materials used for each test should be taken from the center of each sample since top coat material is located on the surface of two of the samples. For each sample, enclosed is a copy of a "Thermo-Lag Fire Barrier Material Sample Documentation" form.

The sample numbers, descriptions and lot numbers on these forms should be utilized in your program and test reports to identify samples. These are as follows:

<u>SAMPLE #</u>	<u>UTILITY OR PROVIDER</u>	<u>DESCRIPTION</u>	<u>LOT #</u>
<i>WPF</i> ✓ 1	NUMARC Testing Program	1 Hr. Conduit Pre-Fab	F92 09030
<i>WPF</i> ✓ 2	" " "	3 Hr. Upgrade Conduit Pre-Fab	F93-02030
<i>WPF</i> ✓ 3	" " "	1 Hr. Upgrade Conduit Pre-Fab	F93-01013
<i>WPF</i> ✓ 4	" " "	3 Hr. Conduit Pre-Fab	F92-11002
<i>WPF</i> ✓ 5	" " "	3 Hr. Panel	F93-06008
<i>WPF</i> ✓ 6	" " "	1 Hr. Panel	F93-01013
<i>WPF</i> ✓ 7	TU Electric	1 Hr. Panel	F92-12016
<i>WPF</i> ✓ 8	" "	1 Hr. Conduit Pre-Fab	F92-09033
<i>WPF</i> ✓ 9	Houston Lighting & Power <i>LOT # LEFT OFF OF SAMPLE</i>	3 Hr. Conduit Pre-Fab	F9-089017
<i>WPF</i> ✓ 10	" " "	3 Hr. Panel	F9-01001
<i>WPF</i> ✓ 11	Entergy Operations, Inc./ GGNS	3 Hr. Conduit Pre-Fab	9067003
<i>WPF</i> ✓ 12	" " " "	1 Hr. Conduit Pre-Fab	9027008

All the above listed samples which are composed of Thermo-Lag 330-1 material should be tested as identified in our contract to ensure consistency of chemical make-up. Test reports should identify any significant differences between the chemical composition of the samples. Test reports for each sample and conclusions should be completed within one week of

ABB Impell Corporation



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the test. Please contact Mr. David Walker prior to testing at 404-441-5316 to schedule ABB Impell Q.A. involvement in the test program.

Should you require any additional information concerning the samples or this program, please contact me at (800) 966-5253.

Very truly yours,

Calvin A. Banning
Project Engineer

Enclosures

cc: R.E. Bradley
E.A. Kleinsorg
R.L. Dible
PQAF



Standard Practice for Rubber—Identification by Pyrolysis-Gas Chromatography¹

This standard is issued under the fixed designation D 3452; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

¹ NOTE—Sections 9 and 18 were editorially changed and subsequent sections renumbered in April 1987.

PART 1. IDENTIFICATION OF SINGLE POLYMERS

1. Scope

1.1 This practice is a guide to the identification of polymers in raw rubbers, and cured and uncured compounds, based on a single polymer, by the gas chromatographic patterns of their pyrolysis products (pyrograms). Implementation of this guide presupposes a working knowledge of the principles and techniques of gas chromatography, sufficient to carry out this practice and to interpret the results correctly.²

1.2 This practice will identify the following polymers:

- 1.2.1 Polyisoprene of natural or synthetic origin,
- 1.2.2 Butadiene-styrene copolymers,
- 1.2.3 Polybutadiene,
- 1.2.4 Polychloroprene,
- 1.2.5 Butadiene-acrylonitrile copolymers,
- 1.2.6 Ethylene-propylene copolymers and related terpolymers, and
- 1.2.7 Isobutene-isoprene copolymers.

1.3 This practice will not differentiate the following polymers:

- 1.3.1 Natural polyisoprene from synthetic polyisoprene.
- 1.3.2 Butadiene-styrene copolymers produced by solution and emulsion polymerization. It is sometimes possible to distinguish butadiene-styrene copolymers containing different amounts of styrene as well as random polymers from block polymers.
- 1.3.3 Polybutadiene with different microstructures.
- 1.3.4 Different types of polychloroprenes.
- 1.3.5 Butadiene-acrylonitrile copolymers with different monomer ratios.
- 1.3.6 Ethylene-propylene copolymers with different monomer ratios, as well as the copolymers from the related terpolymers.
- 1.3.7 Isobutene-isoprene copolymers (butyl rubbers) from halogenated butyl rubbers.
- 1.3.8 Polyisoprene containing different amounts of *cis-trans* isomers.
- 1.3.9 The practice does not identify ebonite or hard rubbers.

1.4 The values stated in SI units are to be regarded as standard.

1.5 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Document

- 2.1 *ASTM Standard:*
D 297 Methods for Rubber Products—Chemical Analysis

3. Significance and Use

3.1 For research, development, and quality control purposes, it is advantageous to determine the composition of rubbers in cured, compounded products.

3.2 This practice provides such composition analysis utilizing a gas chromatograph and pyrolysis products from rubber decomposition.

4. Principle of the Practice

4.1 This practice is based upon comparison of the gas chromatographic pattern of the pyrolysis products of a known rubber with an unknown rubber. The results of this separation will hereafter be referred to as the pyrogram.

4.2 The pyrogram of the known rubber is filed for future reference. The pyrogram of the unknown rubber is compared to this for identification.

4.3 The success of the method depends upon examining the known and unknown rubbers under exactly the same experimental conditions.

4.4 The qualitative composition of the pyrolysis products depend upon the type of polymer being studied.

4.5 The quantitative composition of the pyrolysis products may be affected by the degree of cure, and recipe used, etc., but the most important factor is the type of pyrolysis device.

5. Apparatus

5.1 *Pyrolysis Devices*—The applicability of this practice has been checked on the following types:

¹ This practice is under the jurisdiction of ASTM Committee D-11 on Rubber and is the direct responsibility of Subcommittee D11.11 on Chemical Tests. Current edition approved April 28, 1978. Published July 1978. Originally published as D 3452 - 75. Last previous edition D 3452 - 75.

² Definitions of terms and general directions for the use of gas chromatography may be found in Recommended Practice E 335, Gas Chromatography Terms and Relationships and E 260, General Gas Chromatography Procedures, 1983 Annual Book of ASTM Standards, Vol 14.01.

³ Annual Book of ASTM Standards, Vol 09.01.

5.1.1 *Quartz Tubes*, electrically heated at a prefixed temperature. The volatile products enter the chromatograph through heated tubing.

5.1.2 *Platinum Filaments*, electrically heated. Pyrolysis is carried out within the chromatograph inlet and immediately swept into the column by the carrier gas.

5.1.3 *Small Coils of Ferromagnetic Wire*, heated to the Curie point temperature. The volatile products enter the chromatograph through heated tubing.

5.2 *Gas Chromatograph*—The applicability of this practice has been checked on a wide variety of gas chromatographs, employing both flame ionization and thermal conductivity detectors. Any commercially available instrument is satisfactory. Dual-column operation and temperature programming is strongly recommended, but not mandatory.

5.3 *Gas Chromatographic Columns*—The applicability of this practice has been checked on a wide variety of column lengths, diameters, supports, and liquid phases. The only requisite is that there be sharp separation between the following: isobutene, butadiene, isoprene, vinylcyclohexene, styrene, and dipentene.

NOTE 1—When selecting columns, the recommendations found in the following should be consulted:

"Preferred Stationary Liquids for Gas Chromatography," *Journal of Chromatographic Science*, Vol 13, March 1975, p. 115.

5.4 *Carrier Gas*—The applicability of this practice has been checked with both helium and nitrogen as the carrier gas. Both are satisfactory.

6. Sample Size

6.1 For thermal conductivity detection and electrically heated platinum filaments, a sample size of approximately 3 mg has been found satisfactory. This could be increased or decreased depending on the composition of the sample and the capacity of the probe.

6.2 For flame ionization and either Curie point apparatus or electrically heated platinum filaments, a sample size ranging from 0.2 to 2.0 mg has been found satisfactory.

7. Procedure

7.1 *Extraction*—Although not mandatory, some benefits may be obtained from extraction of the sample according to Methods D 297, Sections 18 and 25. If the sample has been extracted prior to obtaining the pyrogram, the known must also be extracted.

7.2 *Pyrolysis*—The following conditions apply to the three types of pyrolysis devices in 5.1:

7.2.1 *Quartz Tubes* (5.1.1)—Place 1 to 5 mg of sample in a small quartz or porcelain boat in the cold part of the pyrolysis tube. Stopper the tube and flush with carrier gas. Transfer the boat to the hot part of the tube, maintained at 500 to 800°C. Length of the time depends upon the pyrolysis device; however, time and temperature must be kept constant. To minimize condensation, convey the volatile pyrolysis products into the gas chromatograph through tubing heated to a known, fixed temperature, but slightly higher than the gas chromatograph inlet. Record the pyrogram.

7.2.2 *Electrically Heated Platinum Filaments* (5.1.2)—Place the required amount of sample in the pyrolysis probe.

Insert it into the injection port of the gas chromatograph and allow the base line to stabilize. Energize the probe, using the procedure recommended by the manufacturer of the unit to obtain temperatures of 800 to 1200°C.

7.2.3 *Curie Point Apparatus* (5.1.3)—Place the required amount of sample in the coils of ferromagnetic wire or wrap the wire securely around the required amount of sample and pyrolyze according to the manufacturer's directions for proper use of the unit. Energize the apparatus to obtain the required temperature of 550 to 650°C (depending on the composition of the alloy used for the wire) and introduce the pyrolysis products into the gas chromatograph. Record the pyrogram.

7.3 *Separation of the Volatile Pyrolysis Components*—As stated in 5.3, a wide variety of columns may be used. As an example, the following describes the separation of volatile pyrolysis components by means of suitable columns. Analysis of the products of polyisoprene pyrolysis are used in this example. In all cases, equivalent materials may be used.

7.3.1 *Polar Liquid Phase*—Stainless steel tubing, 4 to 6 m long, with an outside diameter of 3.2 mm (1/8 in.), packed with 10 to 20 % di(2-ethylhexyl)sebacate on a 150 to 180- μ m diatomaceous silica support.⁴ Carrier gas flow of 0.2 to 0.3 cm³/s. Inlet and detector temperature at 170°C. Oven temperature 50°C isothermal until isoprene is completely eluted, then program at 20 to 40°C/min to 150°C and maintain at this temperature until the dipentene is eluted.

7.3.2 *Non-Polar Liquid Phase*—Stainless steel tubing, 3 m long, with an outside diameter of 3.2 mm (1/8 in.), packed with 10 % high vacuum grease⁵ on a 150 to 180- μ m diatomaceous silica support.⁶ Carrier gas flow of 0.12 to 0.83 cm³/s. Inlet temperature of 170 to 200°C. Oven temperature at 50°C isothermal for 3 min or until isoprene is eluted, then raise the temperature to 130 to 150°C at 4 to 6°C/min. Maintain at the higher temperature until the dipentene is eluted.

8. Rubber Identification (Interpretation of the Pyrogram)

8.1 Each rubber type shows a distinctive pyrogram, under the same pyrolysis and gas chromatographic conditions.

8.2 Identification is achieved by comparing the pyrogram of the sample rubber (unknown) to the pyrogram of the known rubber, under exactly the same operating conditions.

8.3 Some rubbers produce very characteristic hydrocarbons and their identification is relatively easy. Examples of this type are:

8.3.1 Polyisoprene rubbers, which yield mainly isoprene and dipentene.

8.3.2 Butadiene-styrene copolymers, which yield mainly butadiene, vinyl cyclohexene, and styrene.

8.3.3 Polybutadiene rubbers, which yield mainly butadiene and vinyl cyclohexene.

8.3.4 Isobutene-isoprene copolymers, which yield mainly isobutylene.

8.4 Some rubbers do not yield very characteristic hydrocarbons. Careful inspection of the pyrogram is required.

⁴ Chromosorb P, available from Johns-Manville Products Corp., Celite Div., 22 E. 40th St., NY, NY 10016.

⁵ Apiezon L has been found satisfactory for this practice.

⁶ Celite has been found satisfactory for this practice.

Supplementary tests, such as those for halogen and nitrogen may be an aid to more definite identification.

8.5 It is recommended that, in addition to maintaining a library of pyrograms the analyst compare the unknown sample with a known, which appears most like his unknown, at the time of analysis. In this manner, slight variations in operating parameters, which might influence the pyrogram,

might be avoided.

9. Precision and Bias

9.1 No statement is made about either precision or bias for Practice D 3452 since this practice is intended primarily for the identification of polymers and their relative ratios and not the absolute levels of the polymers in the compounds being studied.

PART 2. IDENTIFICATION OF BLENDS OF POLYMERS

10. Scope

10.1 This practice is a guide to the identification of blends of rubbers in the raw, vulcanized, and unvulcanized state by the gas chromatographic patterns of pyrolysis products (pyrograms). Implementation of this guide presupposes a working knowledge of the principles and techniques of gas chromatography, sufficient to carry out the practice, as written, and to interpret the results correctly.

10.2 Two methods are described, depending upon the nature of the blend.

10.2.1 *Method A*—This method is used when styrene-butadiene copolymers are absent. The absence of the styrene peak, in a preliminary pyrogram, indicates this type of blend. Method A will identify blends of the following:

- 10.2.1.1 Polyisoprene of natural or synthetic origin,
- 10.2.1.2 Butadiene,
- 10.2.1.3 Isobutene-isoprene copolymers, and
- 10.2.1.4 Halogenated isobutene-isoprene rubbers.

10.2.2 *Method B*—This method is used when butadiene-styrene copolymers are present. The presence of the styrene peak, in a preliminary pyrogram, indicates this type of blend. The method fails if other styrene polymers or copolymers or unextractable styrene-containing resins are present. Method B is particularly suitable for the identification of polybutadiene in blends with styrene-butadiene copolymers. If the presence of polybutadiene in the unknown rubber can be excluded, use Method A. Method B will identify butadiene-styrene copolymers with blends of the following:

- 10.2.2.1 Polyisoprene of natural or synthetic origin,
- 10.2.2.2 Butadiene, and
- 10.2.2.3 Isobutene-isoprene copolymers and halogenated isobutene-isoprene rubbers.

10.3 Methods A and B will not differentiate the following in blends:

- 10.3.1 Natural polyisoprene from synthetic polyisoprene,
- 10.3.2 Polybutadiene containing different microstructures,
- 10.3.3 Isobutene-isoprene copolymers and their related halogenated rubbers, and
- 10.3.4 Styrene-butadiene copolymers with different monomer ratios or different microstructures.

11. Referenced Document

- 11.1 See Section 2.

12. Significance and Use

- 12.1 See Section 3.

13. Principle of the Practice

- 13.1 See Section 4 in addition to the following:

13.1.1 *Method A*—This method is based upon the identification of the characteristic hydrocarbon in the pyrogram of the unknown rubber. The identification of the characteristic hydrocarbon is achieved by comparison of retention times under the same chromatographic conditions for a known rubber as for an unknown rubber. These retention times can be obtained from pyrograms of known rubbers or by direct injection of the pure hydrocarbon into the chromatograph.

13.1.2 *Method B*—This method is based upon the identification of the peaks of vinylcyclohexene and styrene and their retention times, as in Method A. Identification of the butadiene peaks is useful but not strictly necessary.

13.2 The success of Method A or B depends upon examining the unknown rubber under exactly the same gas chromatographic conditions as were used for preparation of the calibration tables of Section 16.

14. Apparatus

14.1 See Section 5 in addition to the following:

14.1.1 All the devices in accordance with 5.1 may be used in Part 2, but the Curie point device is especially recommended when Method B is used.

14.2 See 5.2. Dual-column operation and temperature programming is strongly recommended, especially when Method B is used. Some means of integration is strongly recommended but not mandatory.

14.3 See 5.4. Nitrogen is the preferred carrier gas when the Curie point device is used. It should not be used with a thermal conductivity detector.

15. Procedure

15.1 Sections 6 and 7 apply whether Method A or B is used.

16. Calibration

16.1 *Method A*—Since the successful application of this guide to the analysis of rubber blends, using either Method A or B, depends upon a knowledge of the retention times of styrene, butadiene, vinylcyclohexene, isoprene, dipentene, and isobutene, the retention times of these hydrocarbons must be known. Retention times of the hydrocarbon can be found from injection of each individual hydrocarbon into the chromatograph or by pyrolysis of rubbers which will yield these hydrocarbons. This information must be obtained using the same equipment and operating conditions as will be used for analysis of unknown rubbers. Tabulate this data for ready reference.

16.2 *Method B*:

16.2.1 Record a pyrogram of a reference vulcanizate prepared with a suitable styrene-butadiene copolymer and

one or more reference vulcanizates based on known blends of the same butadiene-styrene copolymer and polybutadiene in the range of 80 butadiene-styrene to 20 butadiene and 20 butadiene-styrene to 80 butadiene.

NOTE 2—Since the amount of free styrene produced by pyrolysis depends upon the microstructure of the styrene-butadiene rubber and its content of bound styrene, the calibration table must be prepared using proper copolymer.

6.2.2 Measure the areas of the vinylcyclohexene and styrene peaks.

6.2.3 Calculate a ratio, A , as follows:

$$A = \frac{S}{S + 3V}$$

where:

- = ratio of styrene to vinylcyclohexene,
- = area of the styrene peak,
- = area of the vinylcyclohexene peak, and
- = empirical factor.

6.2.4 Plot the ratio, A , against the known blend composition.

Identification

7.1 Method A:

7.1.1 Pyrolyze the test portion in accordance with Section 7 and measure the retention times of the characteristic hydrocarbon peaks.

17.1.2 Compare the retention times as obtained in 17.1.1 with the retention times of the known hydrocarbons tabulated in accordance with Section 16, and identify the unknown rubber.

17.2 Method B:

17.2.1 Pyrolyze the test portion in accordance with Section 7 and measure the retention times of the vinylcyclohexene and styrene peaks.

17.2.2 Obtain the area of the peaks of 17.2.1.

17.2.3 Calculate the ratio of these peaks as in 16.2.3.

17.2.4 Determine the ratio of polybutadiene-styrene to butadiene copolymer from the calibration curve of 16.2.4.

NOTE 3—If the polybutadiene content is less than 20 % in the blend, as read from the calibration curve of 16.2.4, polybutadiene may be present but its presence is questionable. If polybutadiene content is more than 20 %, as read from the calibration curve of 16.2.4, polybutadiene is definitely present. Quantities of styrene-butadiene less than 20 % are easily identified as long as the styrene peak can be found in the pyrogram.

18. Precision and Bias

18.1 No statement is made about either precision or bias for Practice D 3452 since this practice is intended primarily for the identification of polymers and their relative ratios and not the absolute levels of the polymers in the compounds being studied.

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