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APPENDIX

Appendix A

Table A.1: The condition reactions of all parameter of catalytic coprocessing of LDPE with lignite using Ni-Mo on alumina and results.

BATCH NO.	CONDITION				PE(g)	COAL(g)	CAT.(g)	REACTOR (g)		BEAKER (g)		FILTER+PAPER FILTER(g)		%YIELD
	TEMP(^{0}C)	P (kg/cm^{2})	t (min)	RATIO PE:COAL				BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	
1	400	45	60	-	15.00	0.00	0.45							wax
2	420	45	60	-	15.01	0.00	0.45	743.15	744.65	50.14	58.48	116.65	117.02	55.56
3	435	45	60	-	15.00	0.00	0.45	745.84	747.25	50.15	57.92	116.70	117.02	51.80
4	450	45	60	-	14.97	0.00	0.45	742.92	744.08	50.15	59.06	121.34	122.01	59.52
5	400	60	60	-	15.00	0.00	0.45							wax
6	420	60	60	-	15.03	0.00	0.45	742.58	743.84	50.40	59.43	116.67	117.07	60.08
7	435	60	60	-	14.99	0.00	0.45	924.21	925.87	50.38	55.94	116.70	117.02	37.09
8	450	60	60	-	15.02	0.00	0.45	742.34	744.02	50.39	51.96	116.65	116.82	10.45
9	400	75	60	-	15.01	0.00	0.46	746.12	747.39	50.39	57.61	121.32	121.79	48.10
10	420	75	60	-	15.01	0.00	0.43	924.21	925.71	50.39	57.55	121.30	121.50	47.70
11	435	75	60	-	15.01	0.00	0.45	926.68	929.08	50.39	52.85	121.29	121.41	16.39
12	450	75	60	-	15.00	0.00	0.45	924.21	925.95	50.38	51.75	121.30	121.70	9.13
13	400	30	60	-	15.04	0.00	0.44							wax
14	420	30	60	-	15.00	0.00	0.45							wax
15	435	30	60	-	15.00	0.00	0.46	746.44	749.08	50.39	57.80	121.30	121.45	49.40
16	450	30	60	-	15.03	0.00	0.45	741.46	743.14	29.23	38.25	121.32	123.03	60.01

BATCH NO.	CONDITION				PE(g)	COAL(g)	CAT.(g)	REACTOR (g)		BEAKER (g)		FILTER+PAPER FILTER(g)		%YIELD
	TEMP(^{o}C)	P (kg/cm^{2})	t (min)	RATIO PE:COAL				BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	
17	420	45	60	3:1	15.01	4.99	0.44	746.20	753.72	67.14	71.24	116.67	117.85	27.32
18	420	45	60	5:1	15.00	3.00	0.46	746.44	749.57	67.14	72.02	121.30	121.59	32.53
19	420	45	60	6:1	15.00	2.51	0.44	744.98	750.01	50.39	58.20	121.32	121.62	52.07
20	420	45	60	15:1	15.00	0.98	0.46	745.03	749.85	50.39	58.95	116.67	117.36	57.07
21	420	45	60	15:0.5	15.01	0.50	0.46	744.97	747.41	67.14	77.41	116.67	117.23	68.42
22	420	60	60	3:1	15.00	5.01	0.44	745.3	754.05	50.15	54.30	121.32	121.70	27.67
23	420	60	60	5:1	14.99	3.01	0.46	744.93	752.10	50.15	55.90	121.32	121.70	38.36
24	420	60	60	6:1	14.99	2.50	0.45	745.57	749.85	50.13	58.64	121.30	121.68	56.77
25	420	60	60	15:1	15.00	1.00	0.45	743.93	746.68	56.81	67.03	116.71	116.98	68.13
26	420	60	60	15:0.5	15.01	0.50	0.45	744.91	747.15	67.14	76.73	121.31	121.79	63.89
27	420	75	60	3:1	15.01	5.00	0.46	926.11	933.02	49.94	55.63	116.69	118.00	37.91
28	420	75	60	5:1	15.01	2.99	0.46	744.28	750.24	50.14	59.56	116.67	117.01	62.76
29	420	75	60	6:1	15.01	2.49	0.46	926.49	928.57	50.16	50.40	116.66	117.23	1.60
30	420	75	60	15:1	15.00	1.00	0.45	745.50	748.49	50.14	59.05	121.32	121.61	59.40
31	420	75	60	15:0.5	15.01	0.50	0.45	744.93	746.54	50.14	58.20	121.31	121.80	53.70
32	435	60	60	3:1	15.00	5.00	0.45	744.18	751.68	65.46	68.60	116.66	117.25	20.93
33	435	60	60	5:1	15.00	3.00	0.46	926.33	935.43	50.32	56.80	121.37	122.23	43.20
34	435	60	60	6:1	15.00	2.48	0.46	745.43	749.50	65.94	73.08	121.32	122.82	47.60
35	435	60	60	15:1	15.02	1.00	0.45	744.02	747.19	50.39	59.03	116.67	116.96	57.52

BATCH NO.	CONDITION				PE(g)	COAL(g)	CAT.(g)	REACTOR (g)		BEAKER (g)		FILTER+PAPER FILTER(g)		%YIELD
	TEMP(^{O}C)	P (kg/cm^2)	t (min)	RATIO PE:COAL				BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	
36	435	75	60	3:1	15.00	5.00	0.44	745.73	755.73	50.15	53.85	121.32	121.75	24.67
37	435	75	60	5:1	15.00	3.00	0.45	926.30	932.54	50.15	55.73	121.32	121.68	37.20
38	435	75	60	6:1	15.02	2.51	0.45	924.32	928.78	50.14	52.40	121.30	121.85	15.05
39	435	75	60	15:1	15.00	1.00	0.45	745.45	748.5	50.14	57.89	121.32	121.63	51.67
40	450	45	60	3:1	15.02	4.99	0.46	742.92	749.58	29.23	29.93	121.30	122.03	4.66
41	450	45	60	5:1	15.01	3.02	0.45	743.92	750.62	67.20	71.14	121.30	121.91	26.25
42	450	45	60	6:1	15.01	2.51	0.45	743.92	750.31	50.39	56.95	116.66	117.35	43.70
43	450	45	60	15:1	15.01	1.00	0.45	743.92	746.65	49.54	58.36	121.31	121.67	58.76
44	420	60	30	15:1	15.01	1.00	0.45	925.15	928.75	50.32	59.71	121.30	122.63	62.56
45	420	60	90	15:1	15.01	1.00	0.45	926.33	931.23	50.32	57.79	121.31	122.14	49.77
46	420	60	120	15:1	14.99	1.00	0.45	925.15	928.17	65.50	72.67	116.67	116.93	47.83
47	420	60	180	15:1	15.01	1.00	0.46	925.15	928.11	67.65	77.34	121.31	122.24	44.50
48	435	45	60	3:1	15.00	5.00	0.45	744.18	751.69	49.12	55.90	116.66	117.58	45.20
49	435	45	60	5:1	15.00	3.00	0.45	745.43	750.08	65.93	72.81	121.32	122.89	45.87
50	435	45	60	6:1	15.01	2.43	0.45	744.18	748.12	49.13	58.52	116.66	117.75	62.56
51	435	45	60	15:1	14.99	1.00	0.45	745.40	748.48	50.39	59.03	116.67	117.60	57.64
52	450	60	60	15:1	15.01	1.00	0.45	925.15	927.97	66.46	73.22	116.66	117.32	45.04

Table A.2: The percentage of oil composition by GC Simulated Distillation.

Batch No.	Naphtha 65 - 200 °C	Kerosene 200 - 250 °C	Light Gas Oil 250 - 300 °C	Heavy Gas Oil 300 - 350 °C	Long Residue > 350 °C
6	41.0	17.5	12.5	10.5	18.5
17	60.8	15.2	10.0	6.5	7.5
18	40.6	18.9	13.5	9.5	17.5
19	59.5	14.5	9.5	6.5	10.0
20	61.2	13.8	9.0	6.5	9.5
22	67.0	14.0	9.0	5.0	5.0
23	63.5	14.5	9.5	5.5	7.0
24	66.0	14.0	9.0	5.0	6.0
25	65.0	14.0	9.3	4.7	7.0
26	60.0	13.0	10.0	6.0	11.0
28	64.0	14.5	9.5	6.0	6.0
30	64.5	14.5	9.0	6.0	6.0
35	63.5	15.0	9.5	5.5	6.5
38	61.5	15.5	10.5	6.0	6.5
39	66.0	14.0	8.5	5.5	6.0
40	46.5	22.5	13.5	8.5	9.0
44	41.7	13.3	12.0	10.0	23.0
45	36.4	16.1	13.1	11.0	23.5
46	31.8	11.6	13.5	11.5	31.6
47	25.8	10.3	16.2	13.5	33.7
48	46.4	15.4	12.0	9.3	16.9
52	55.0	15.3	11.2	7.6	10.9

Appendix B

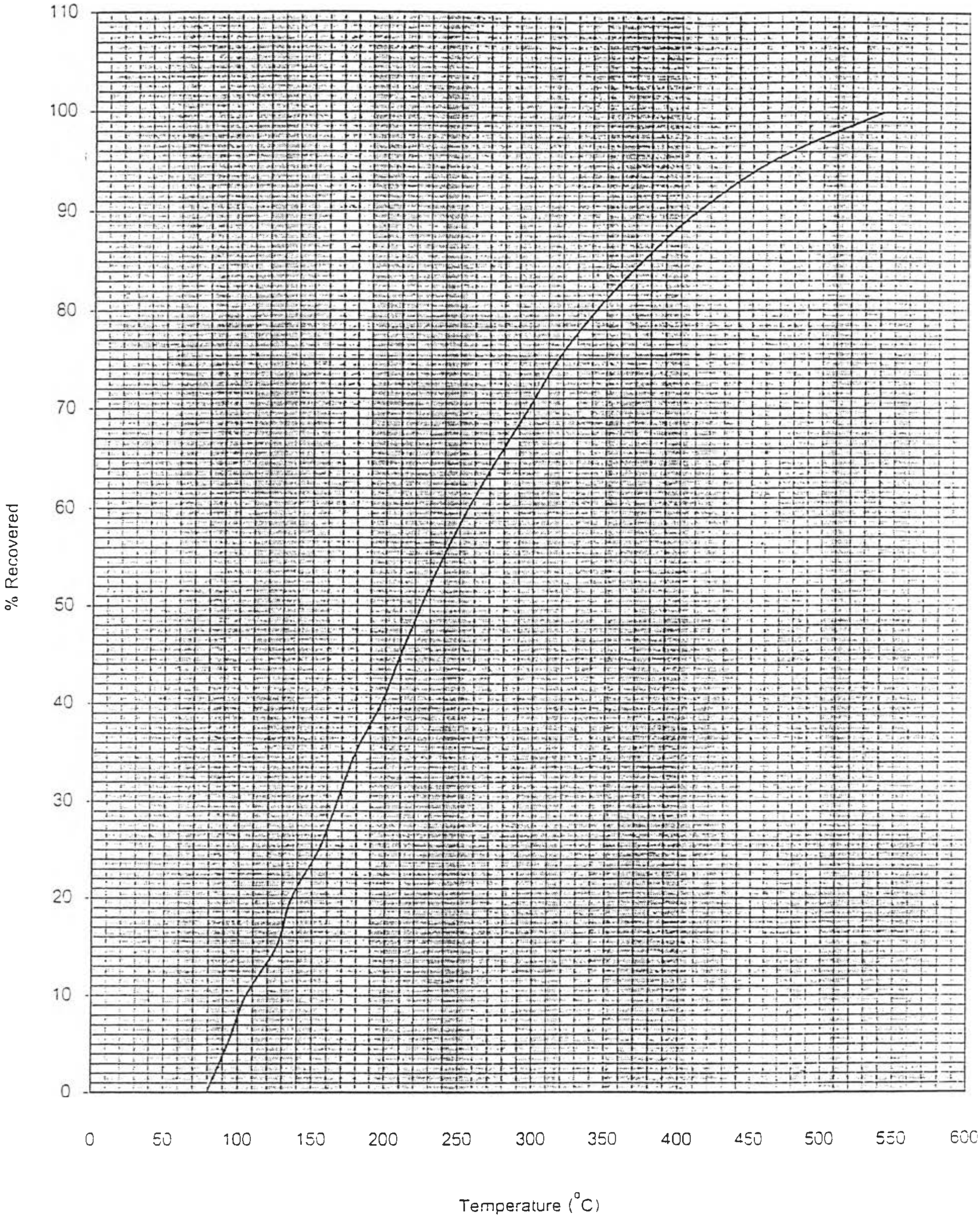

Figure B.1: Oil composition at condition 420°C of reaction temperature, 60 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15:0 by GC Simulated Distillation.

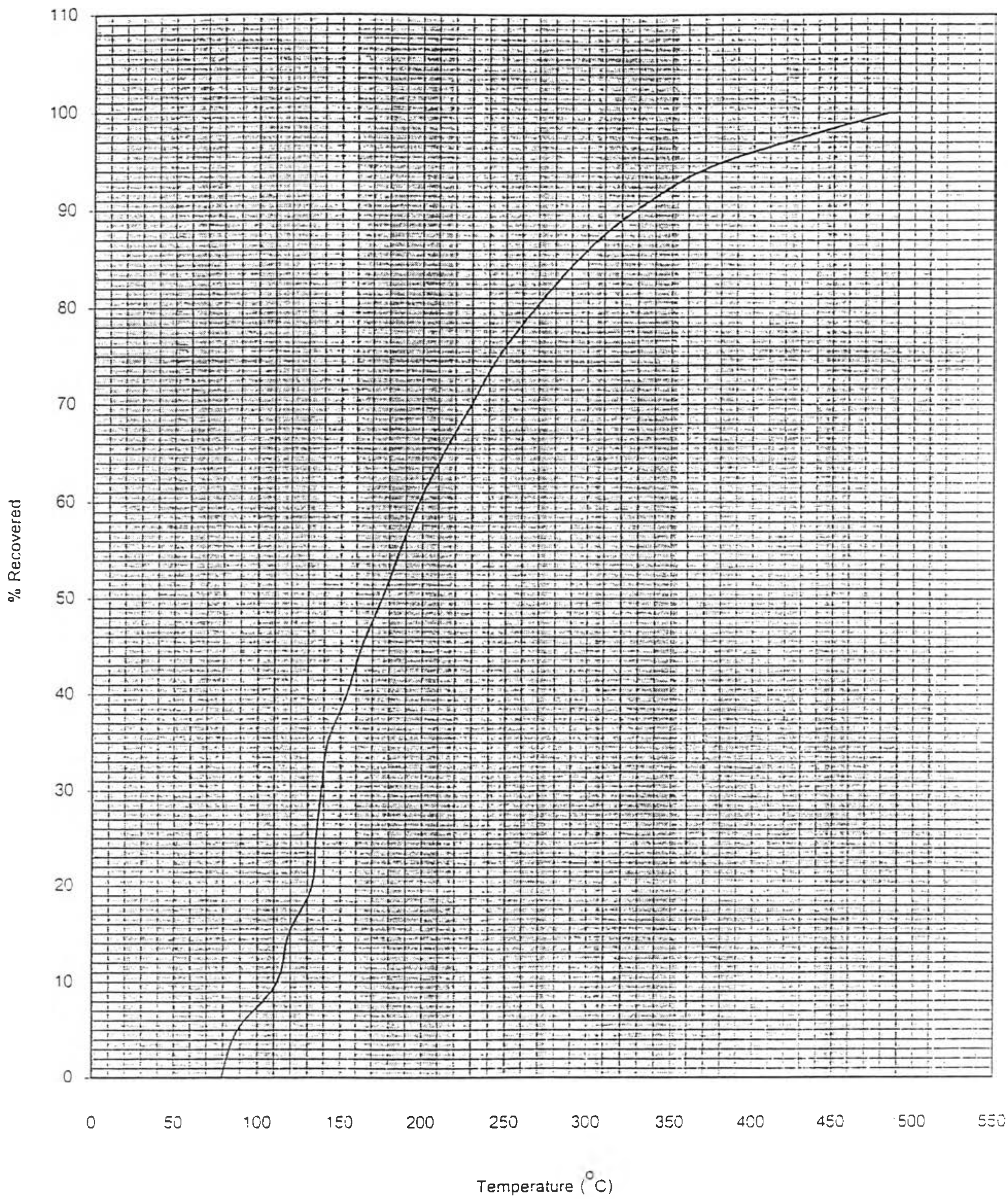

Figure B.2: Oil composition at condition 420°C of reaction temperature, 45 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 5 by GC Simulated Distillation.

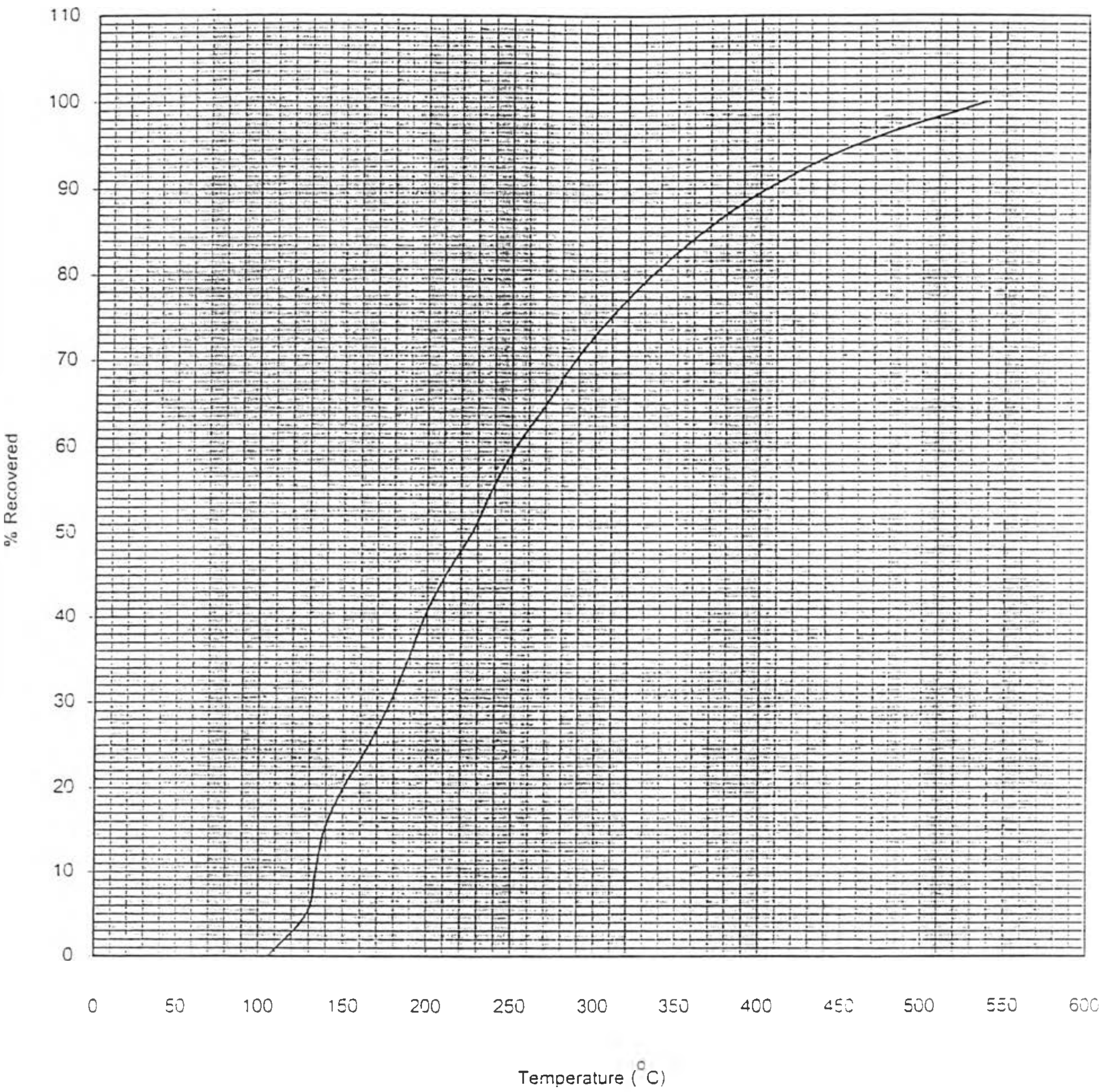

Figure B.3: Oil composition at condition 420°C of reaction temperature, 45 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 3 by GC Simulated Distillation.

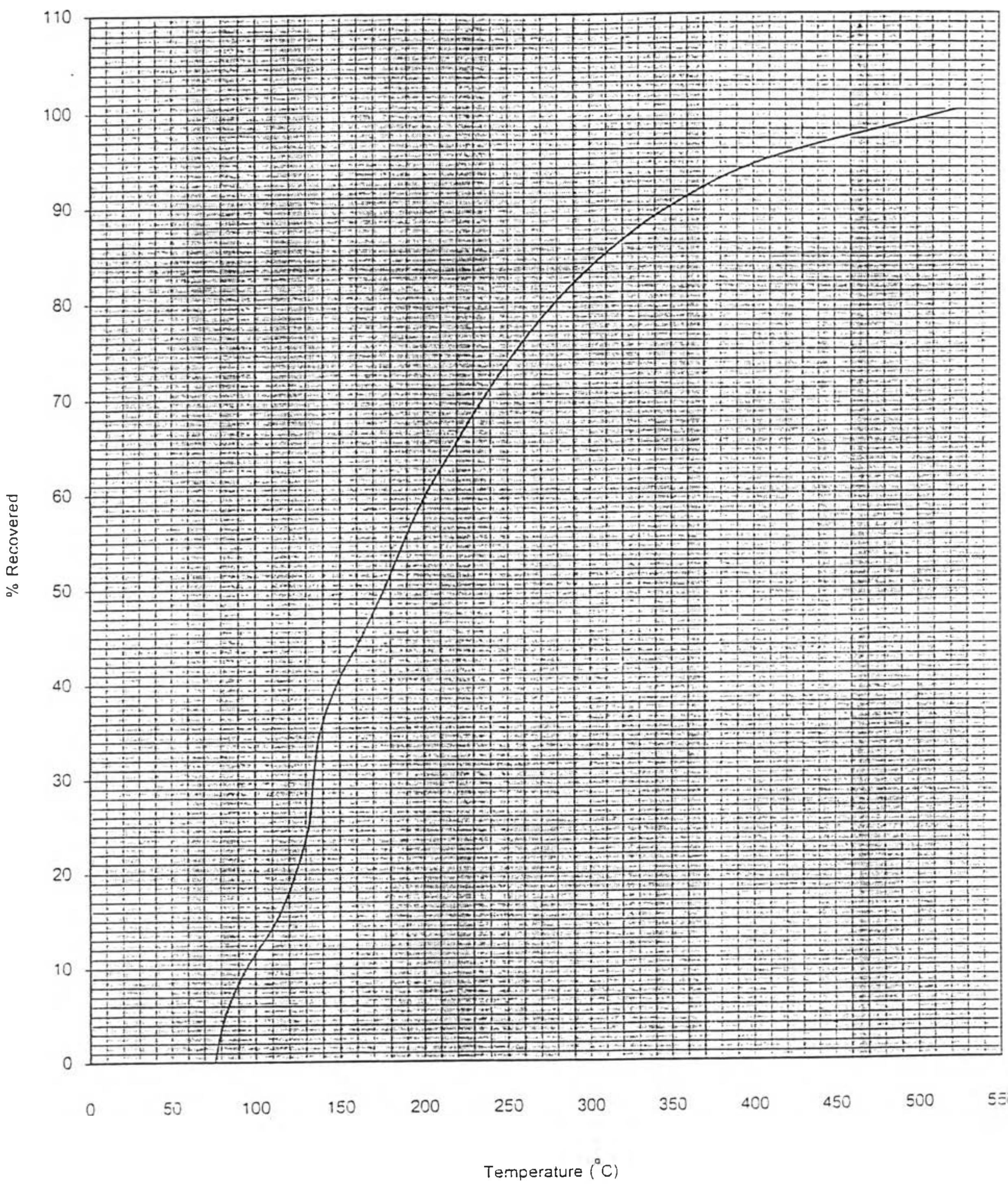

Figure B.4: Oil composition at condition 420°C of reaction temperature, 45 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 2.5 by GC Simulated Distillation.

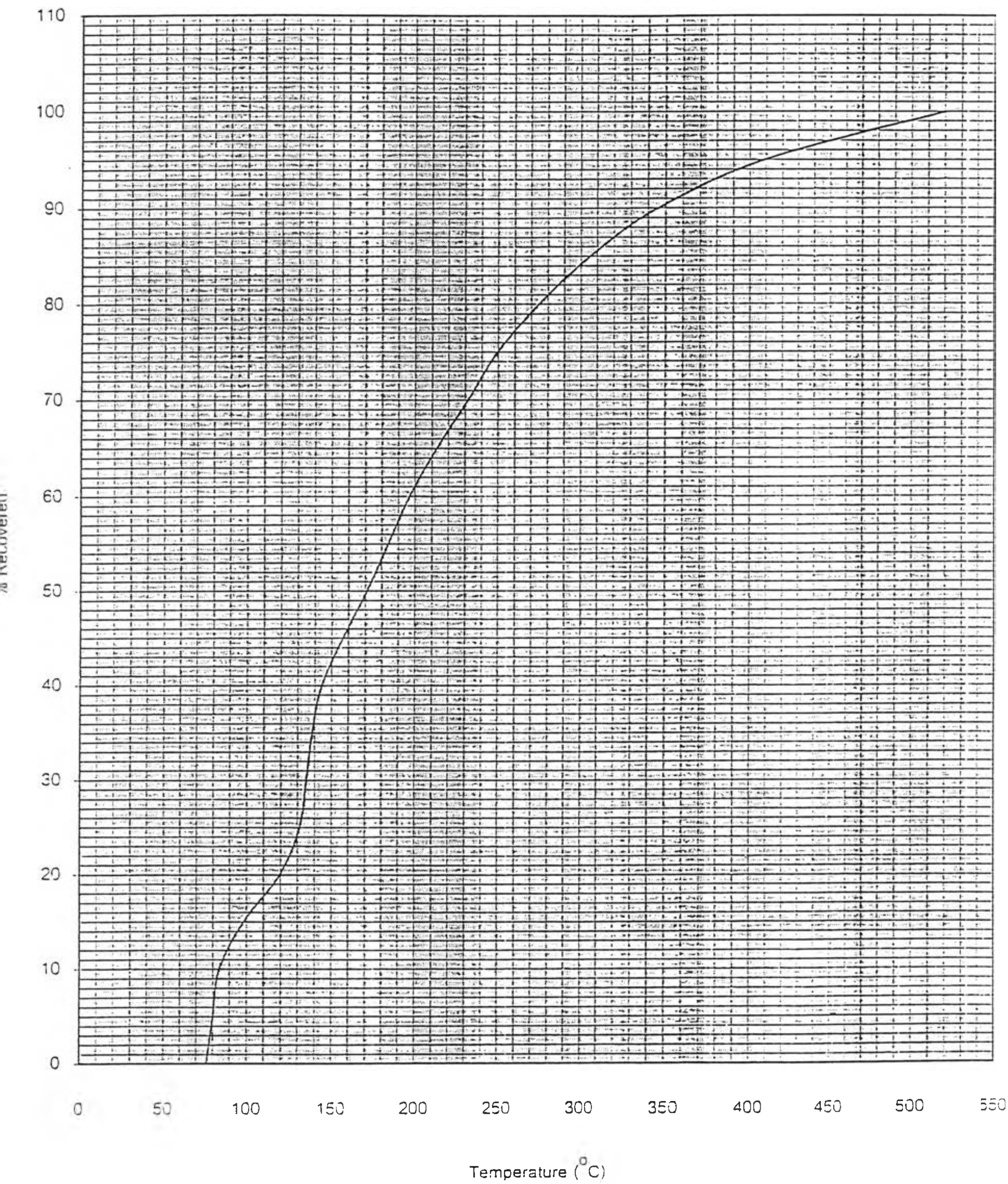

Figure B.5: Oil composition at condition 420°C of reaction temperature, 45 kg/cm² of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 1 by GC Simulated Distillation.

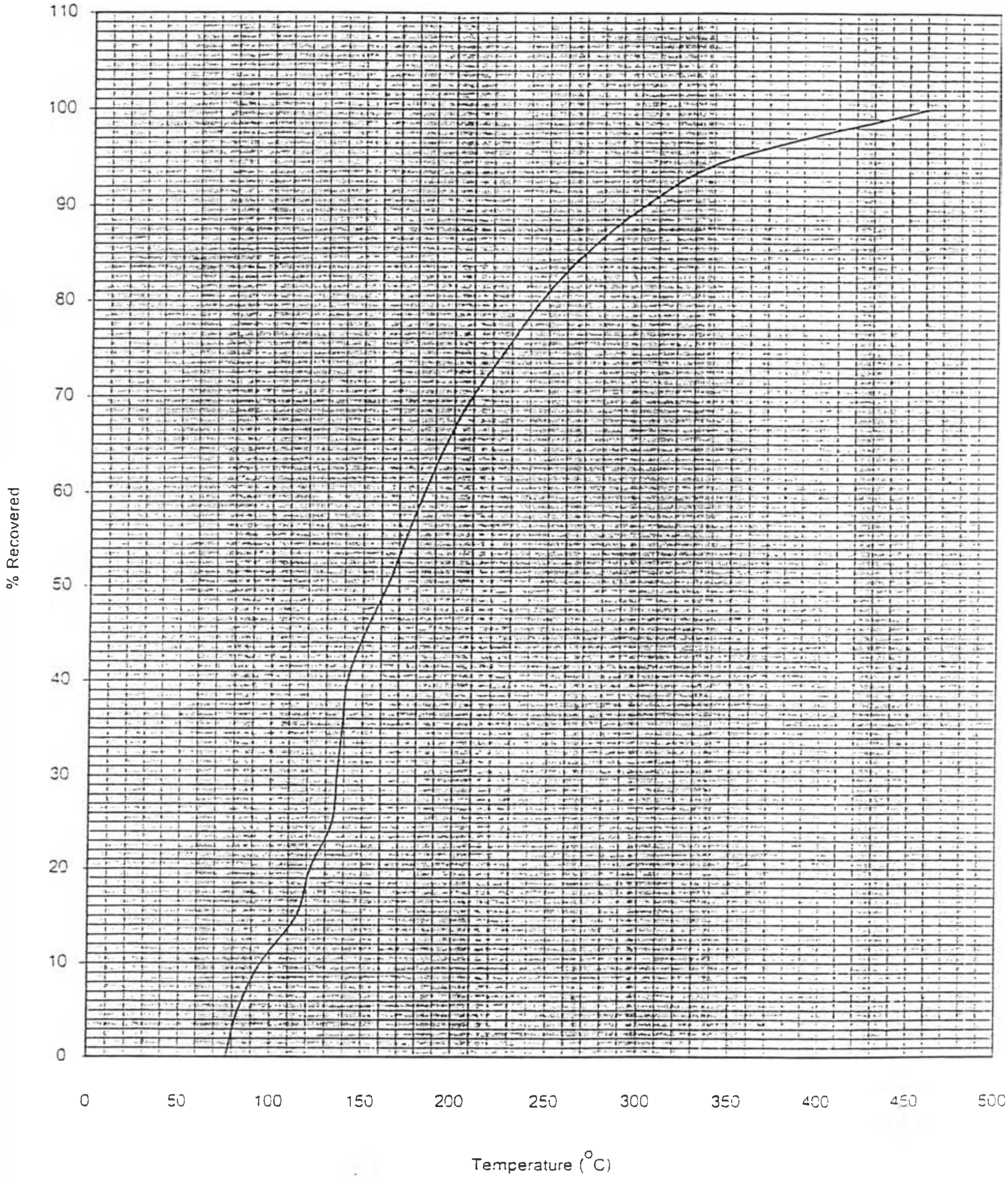

Figure B.6: Oil composition at condition 420°C of reaction temperature, 60 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 5 by GC Simulated Distillation.

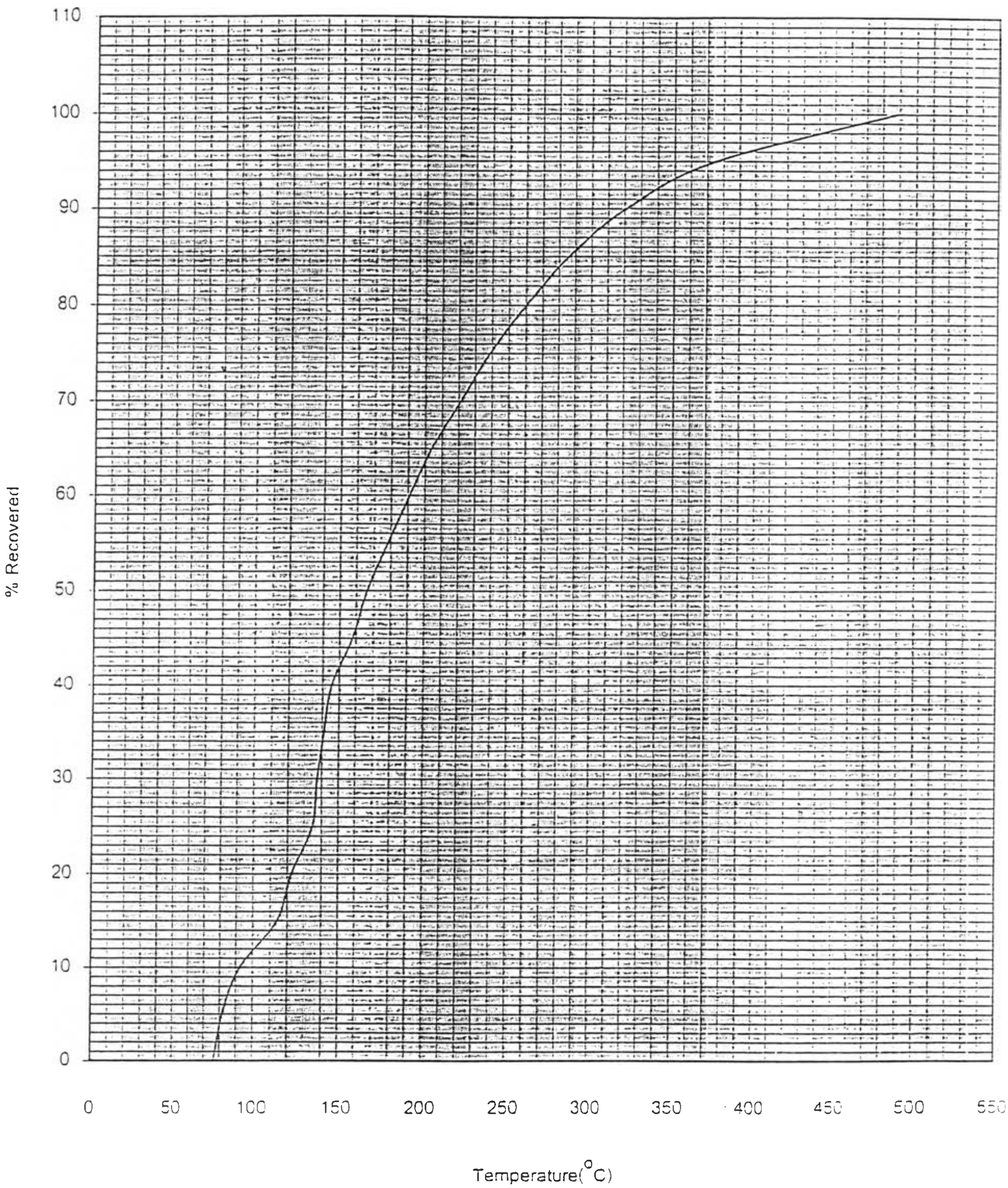

Figure B.7: Oil composition at condition 420°C of reaction temperature, 60 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 3 by GC Simulated Distillation.

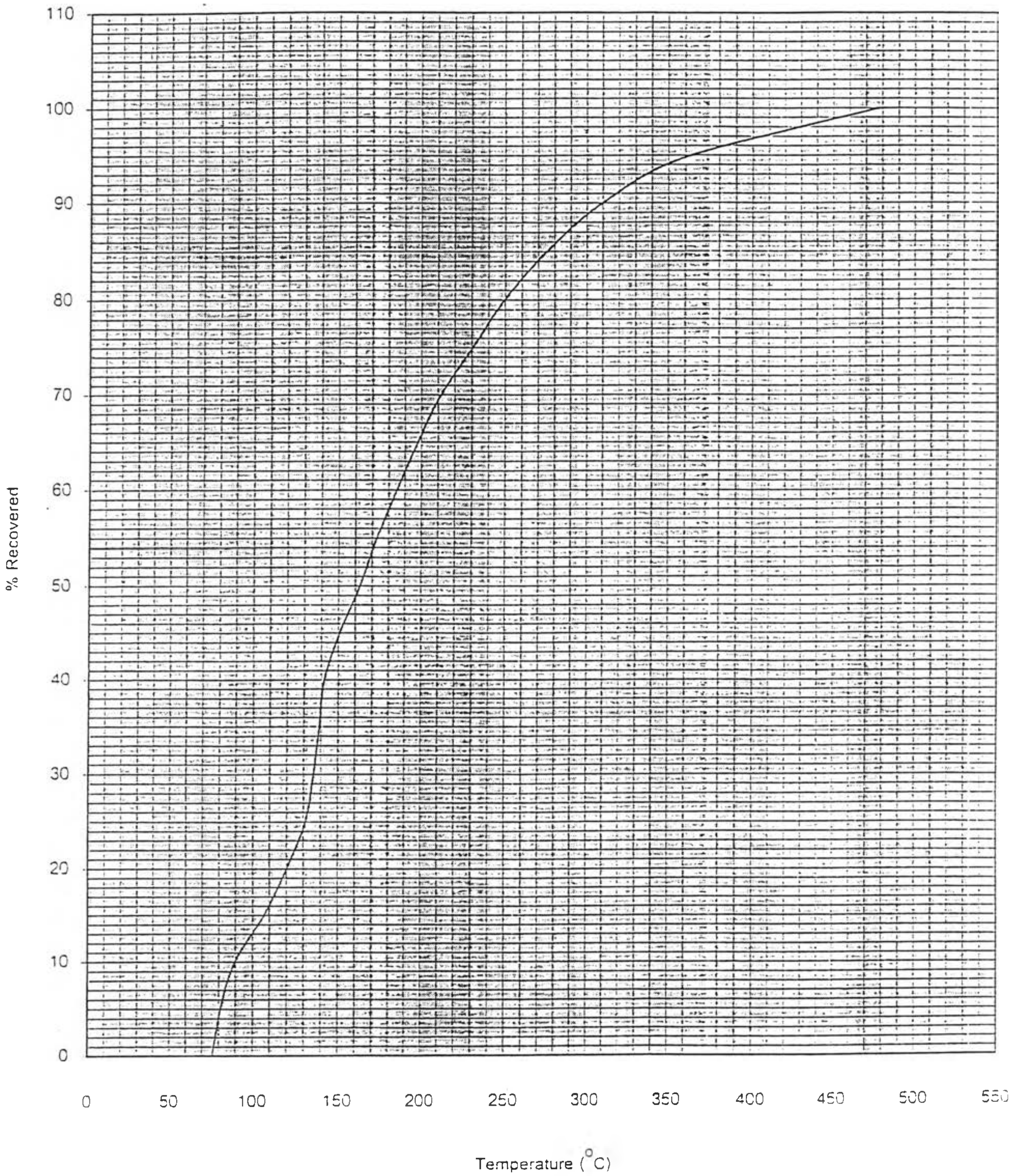

Figure B.8: Oil composition at condition 420°C of reaction temperature, 60 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 2.5 by GC Simulated Distillation.

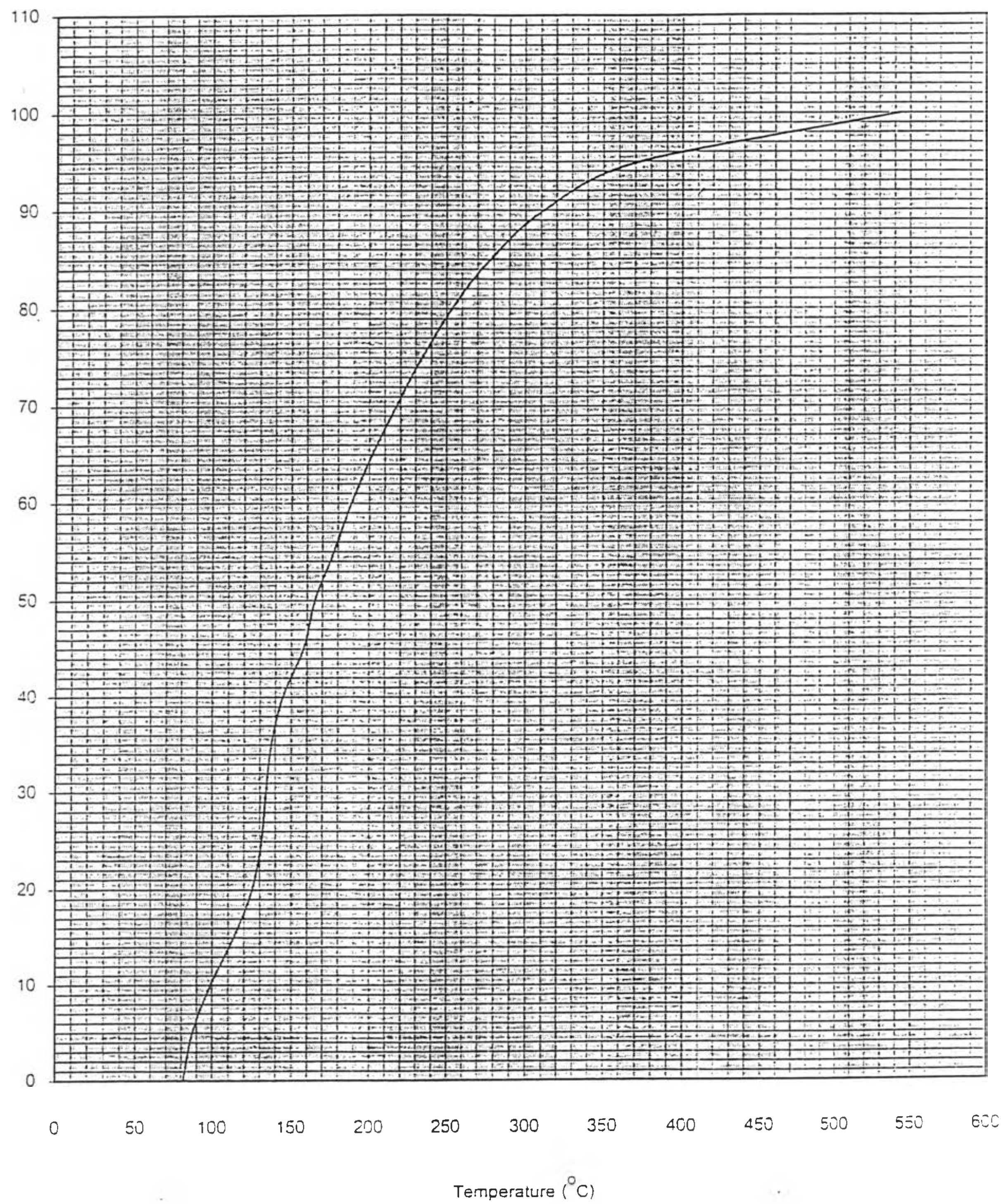

Figure B.9: Oil composition at condition 420°C of reaction temperature, 60 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 1 by GC Simulated Distillation.

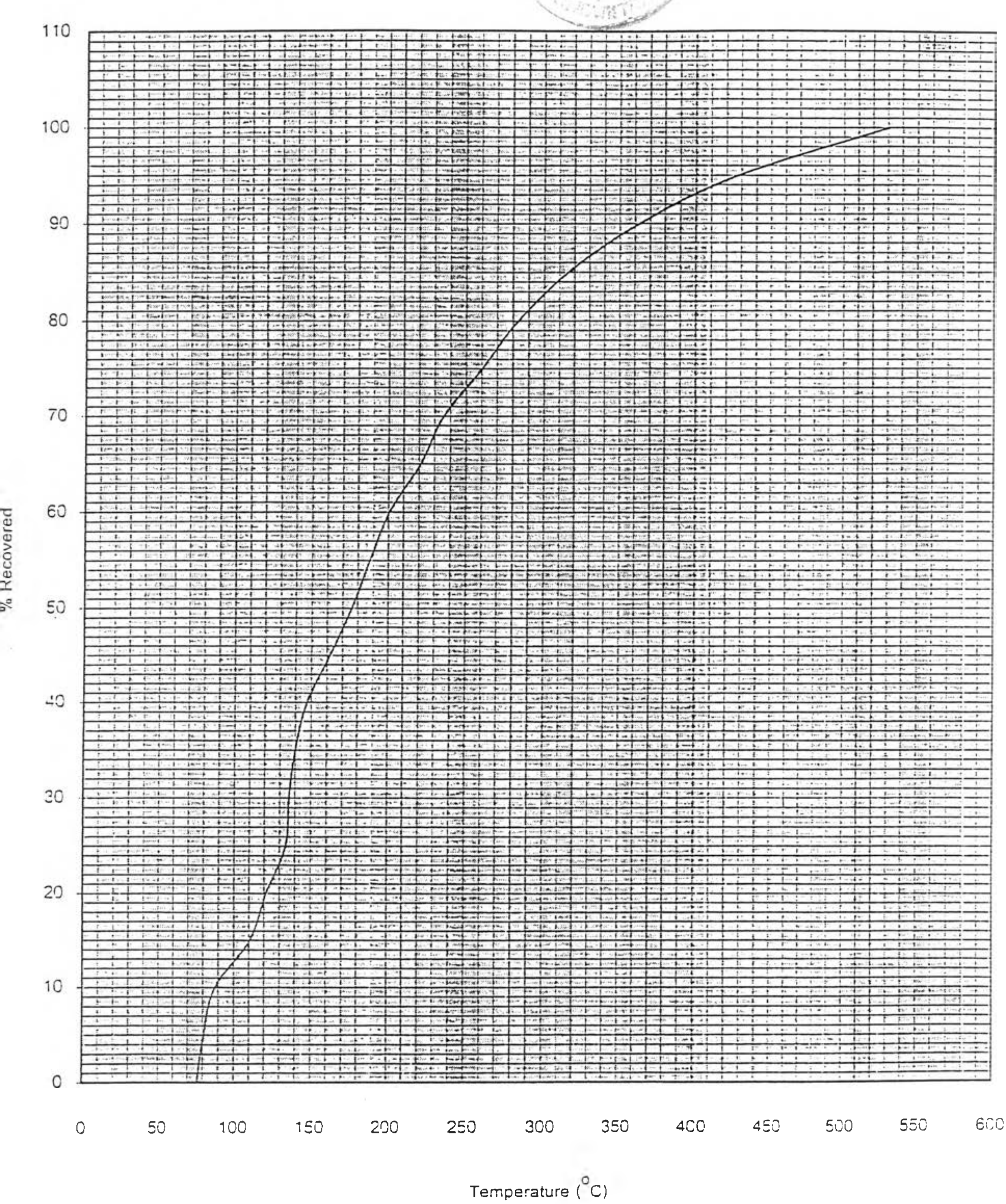

Figure B.10: Oil composition at condition 420°C of reaction temperature, 60 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 0.5 by GC Simulated Distillation.

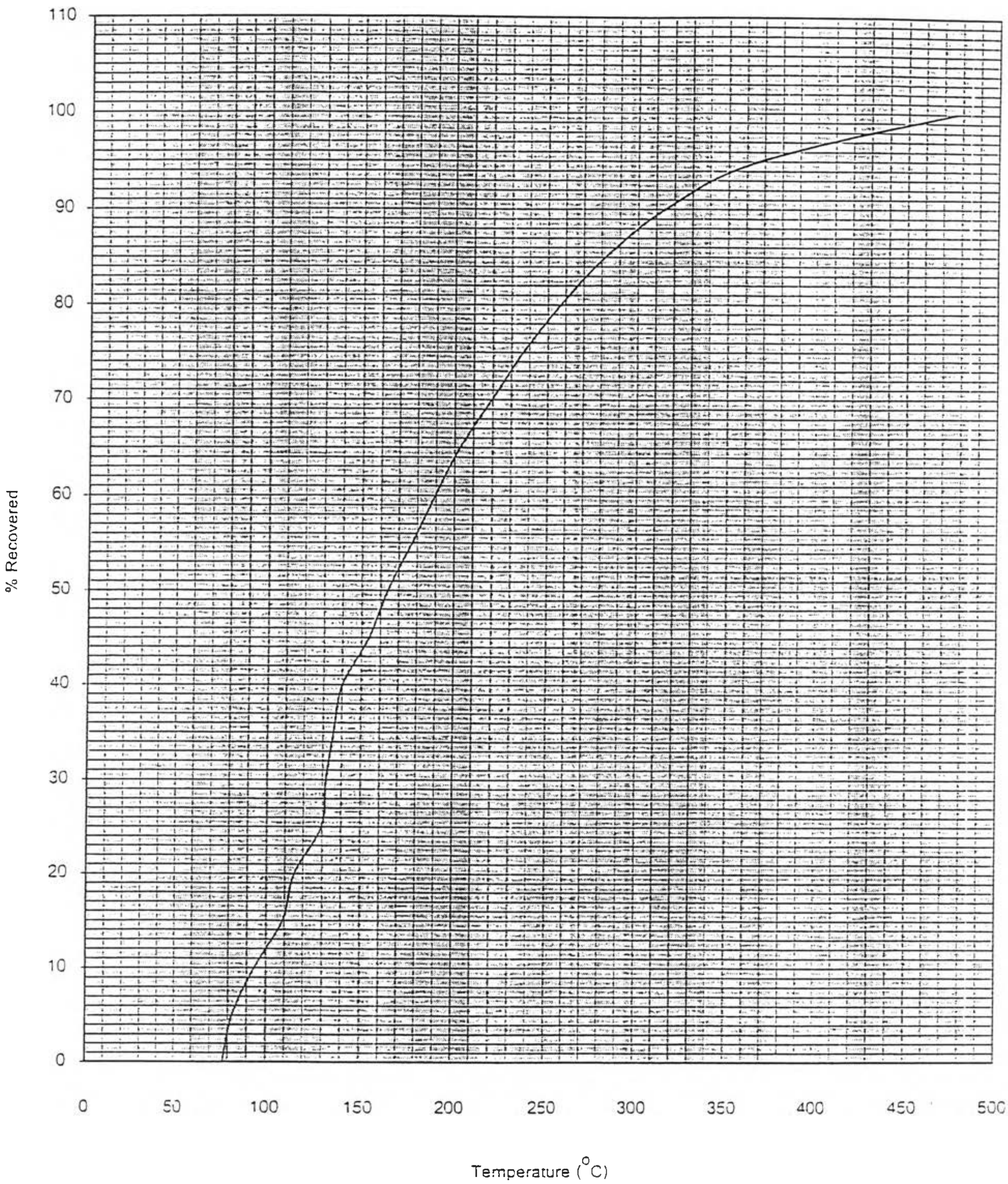

Figure B.11: Oil composition at condition 420°C of reaction temperature, 75 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 3 by GC Simulated Distillation.

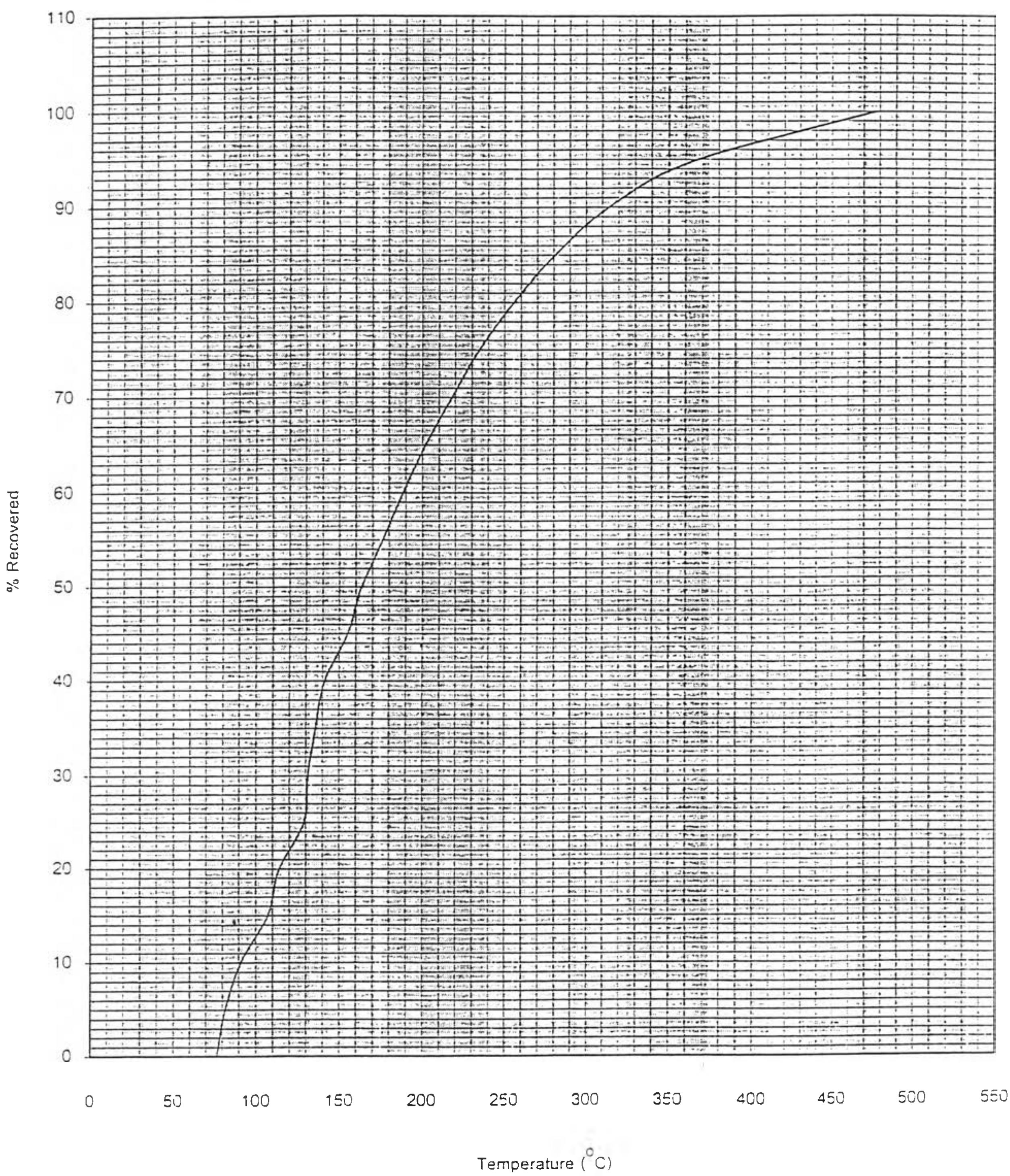

Figure B.12: Oil composition at condition 420°C of reaction temperature, 75 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 1 by GC Simulated Distillation.

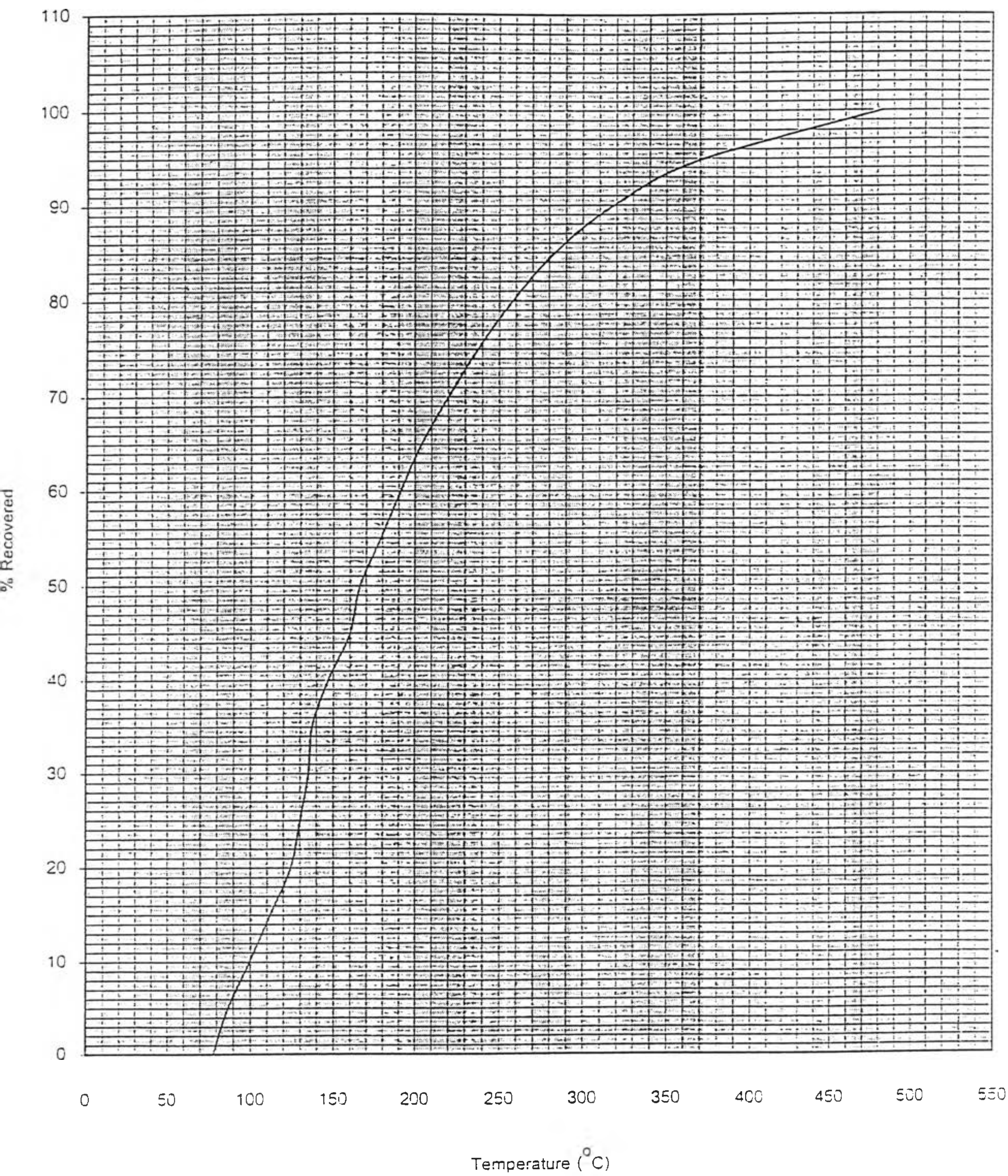

Figure B.13: Oil composition at condition 435°C of reaction temperature, 60 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 1 by GC Simulated Distillation.

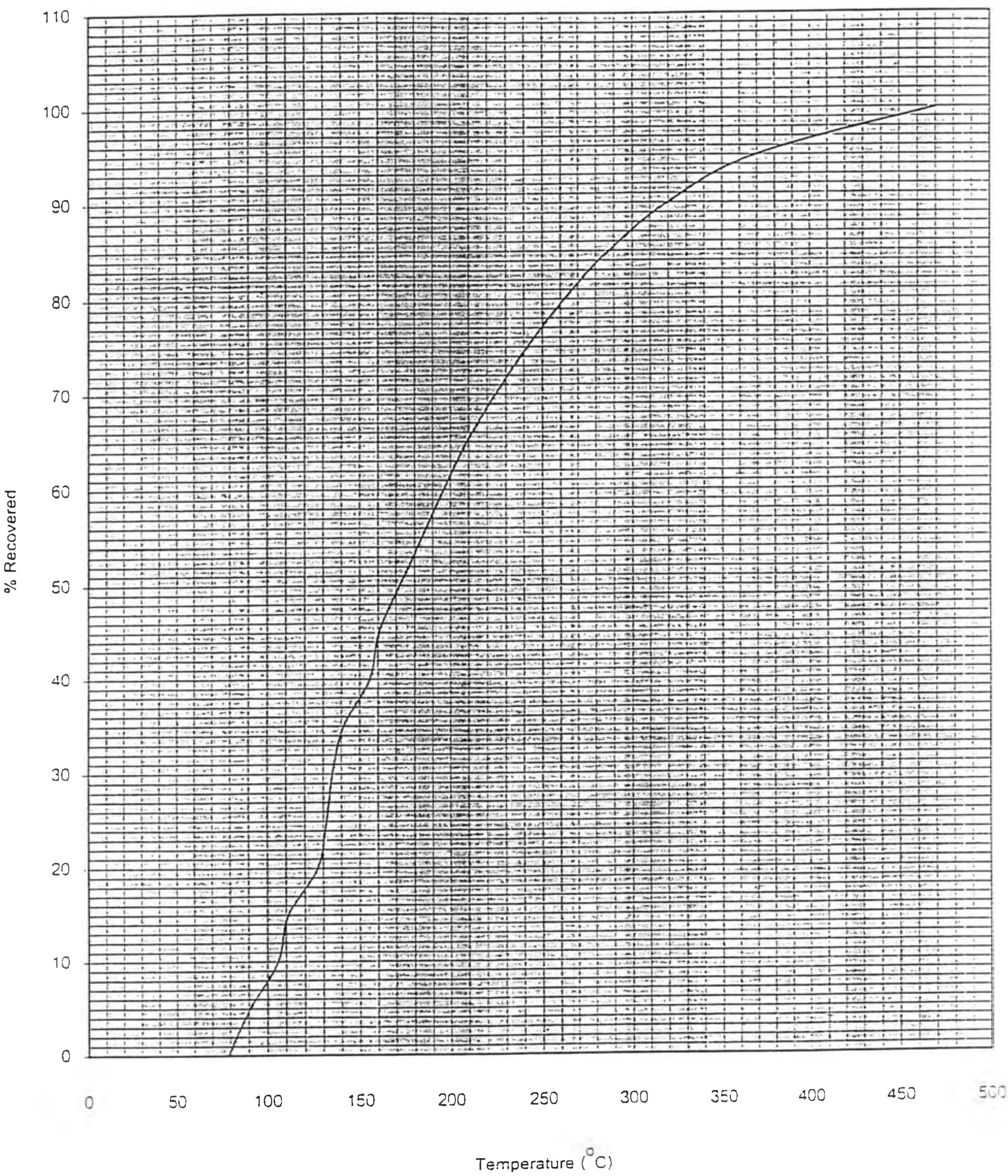

Figure B.14: Oil composition at condition 435°C of reaction temperature, 75 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 2.5 by GC Simulated Distillation.

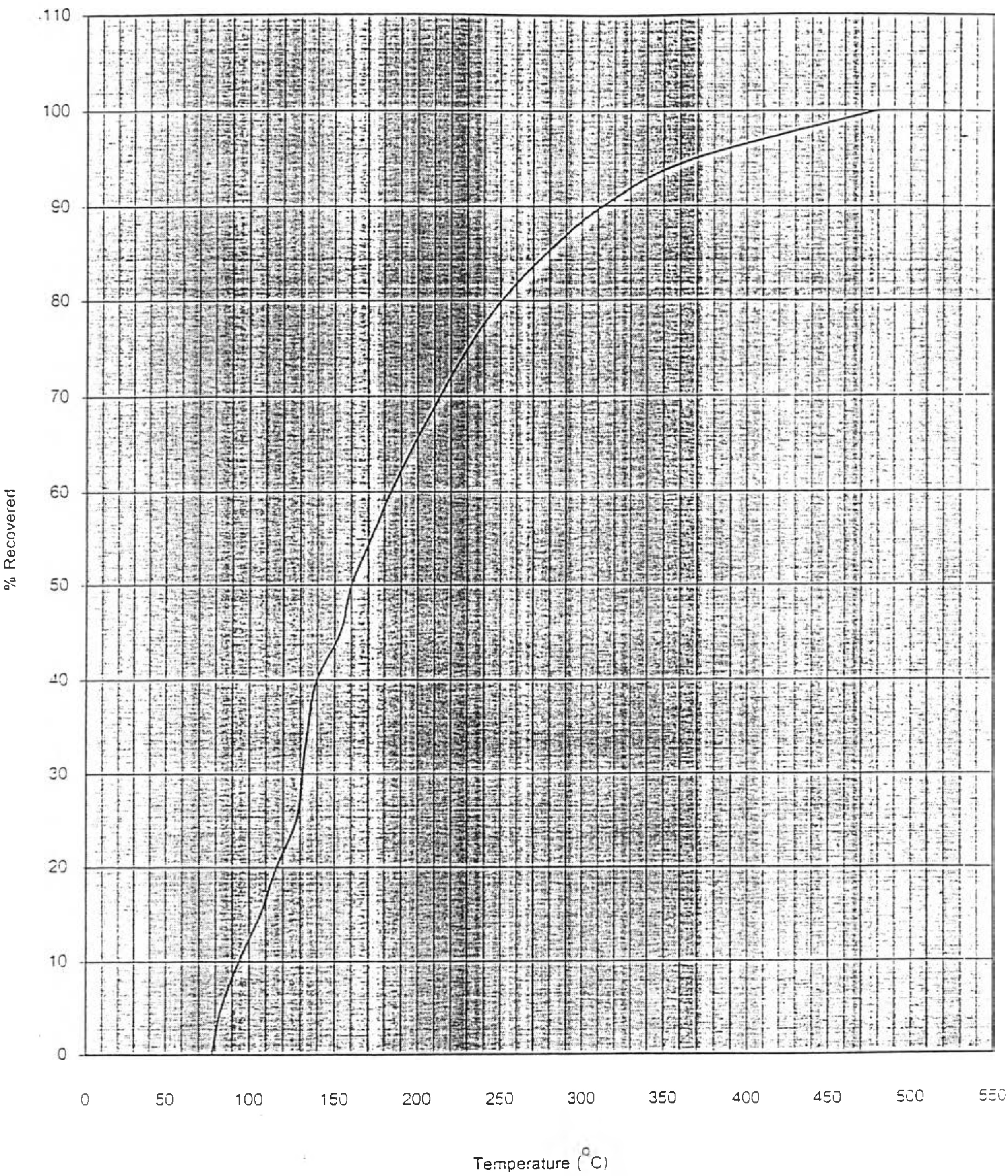

Figure B.15: Oil composition at condition 435°C of reaction temperature, 75 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 1 by GC Simulated Distillation.

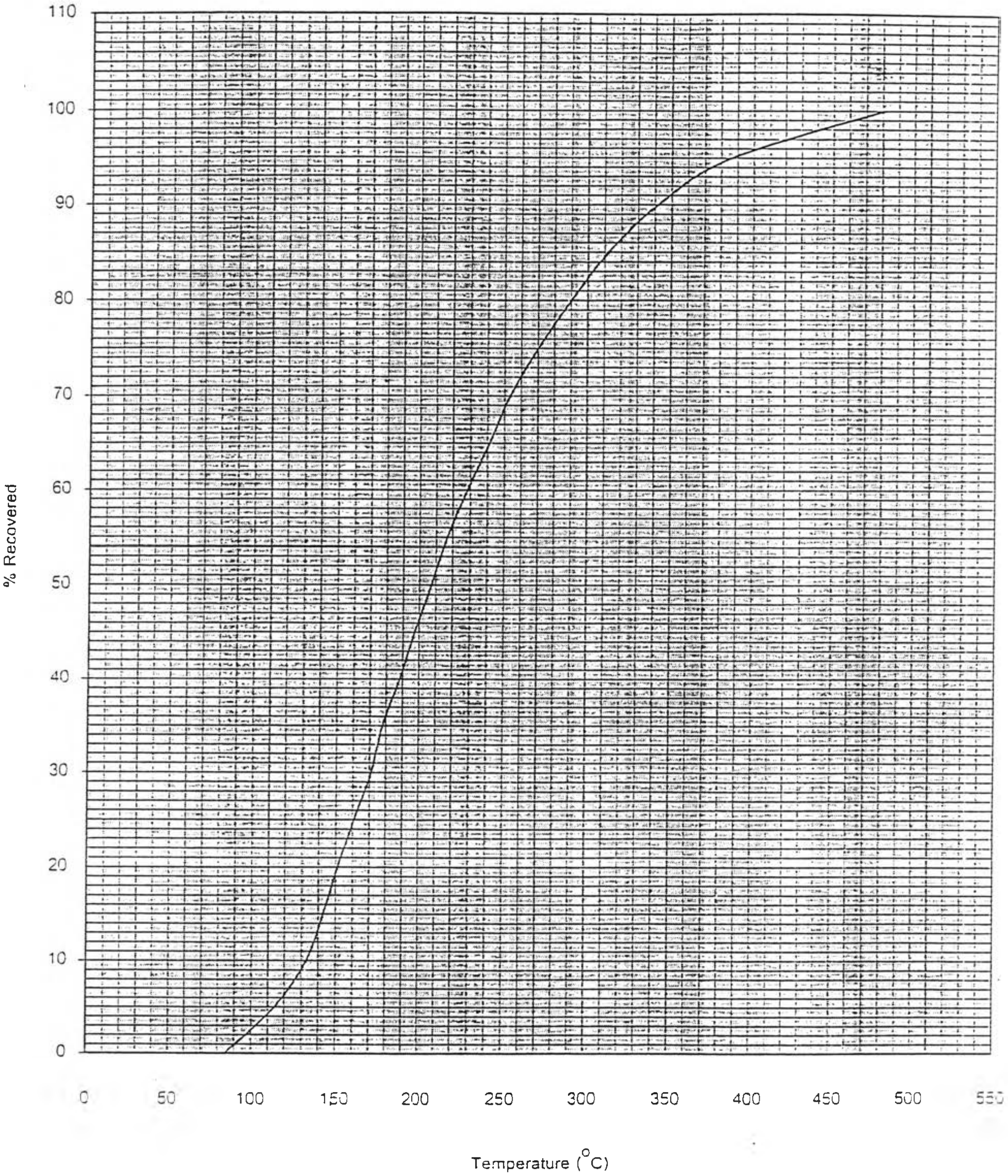

Figure B.16: Oil composition at condition 450°C of reaction temperature, 45 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 5 by GC Simulated Distillation.

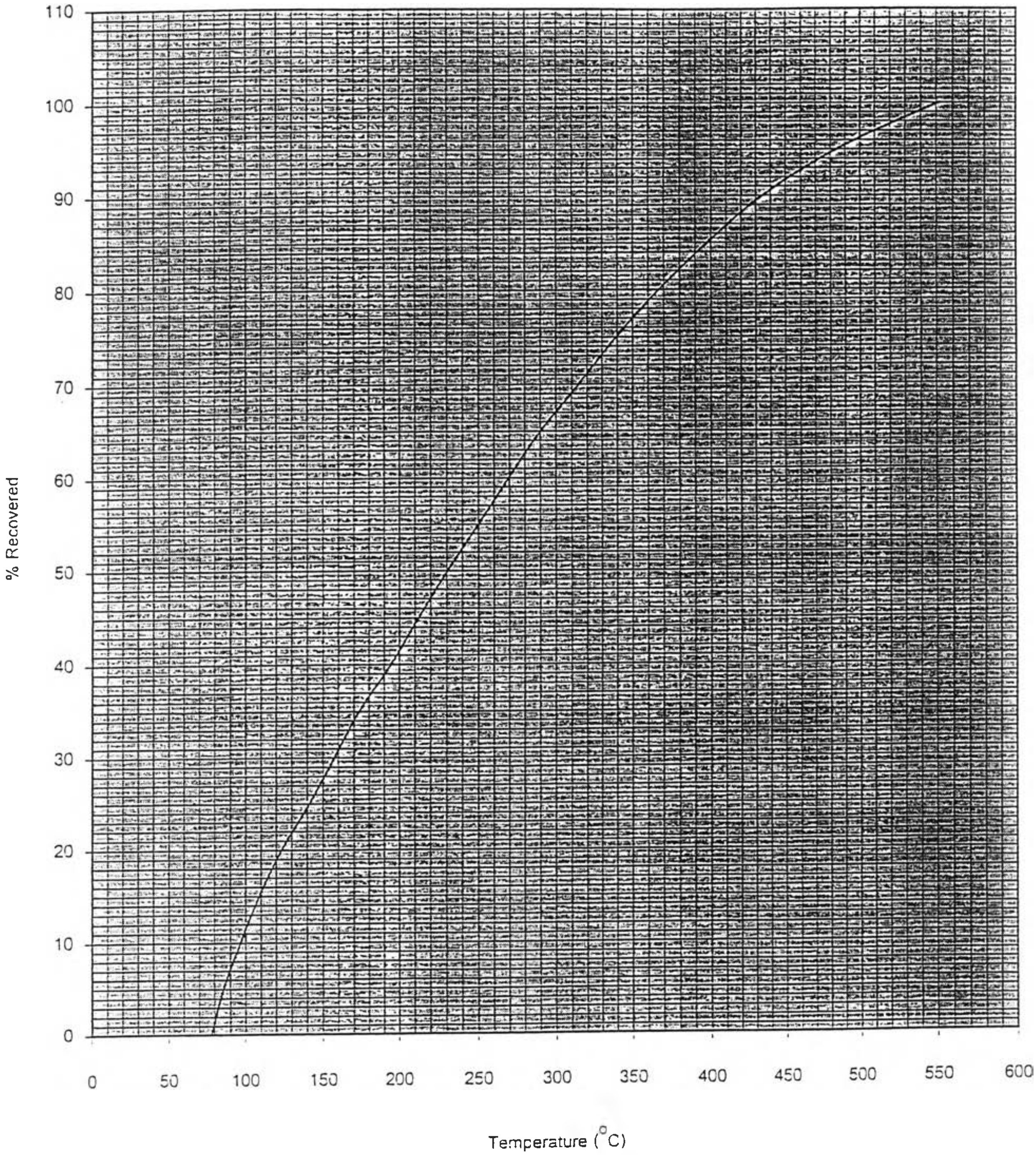

Figure B.17: Oil composition at condition 420°C of reaction temperature, 60 kg/cm^2 of hydrogen, 30 min of reaction time and ratio of LDPE: lignite as 15: 1 by GC Simulated Distillation.

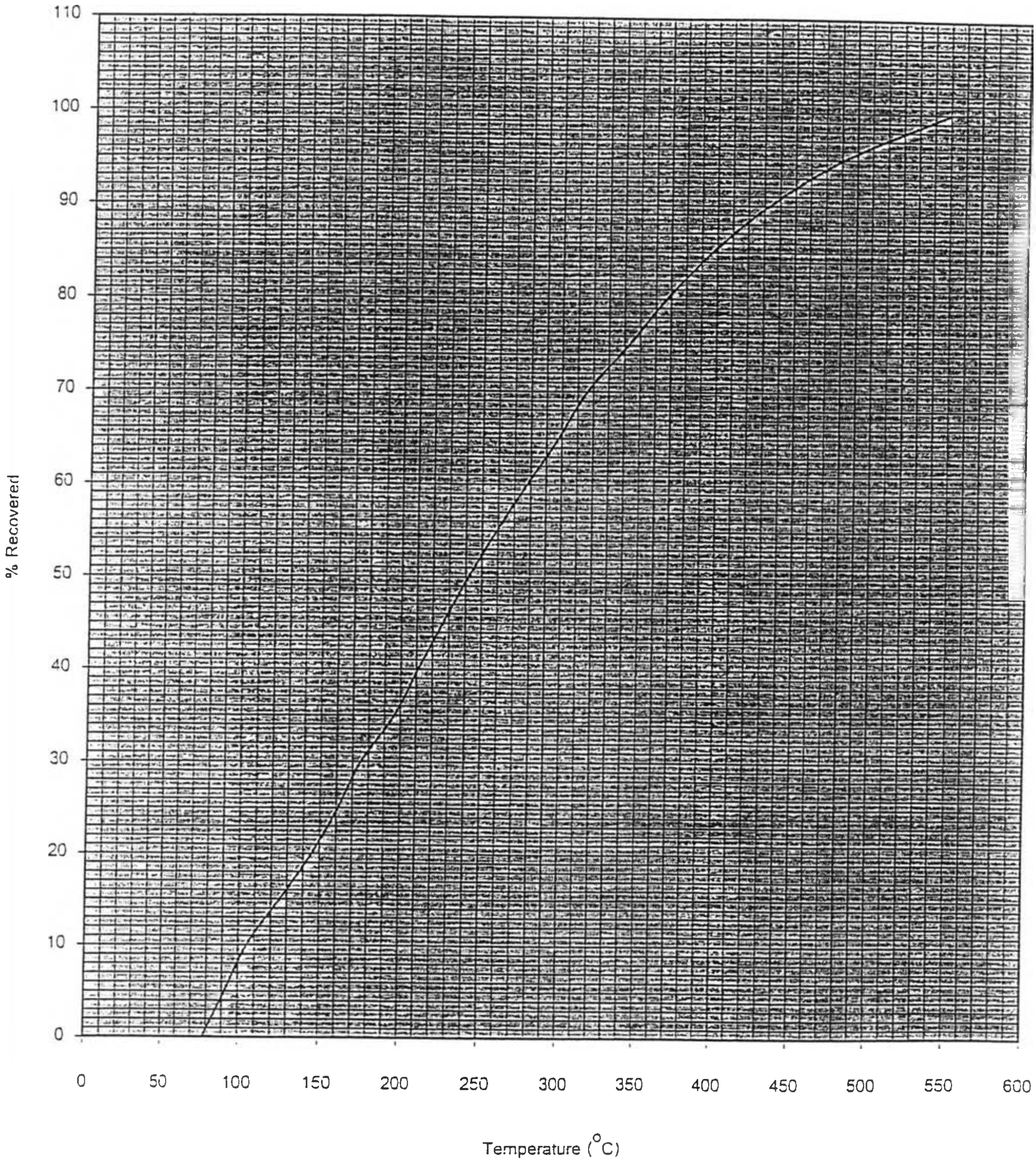

Figure B.18: Oil composition at condition 420°C of reaction temperature, 60 kg/cm^2 of hydrogen, 90 min of reaction time and ratio of LDPE: lignite as 15: 1 by GC Simulated Distillation.

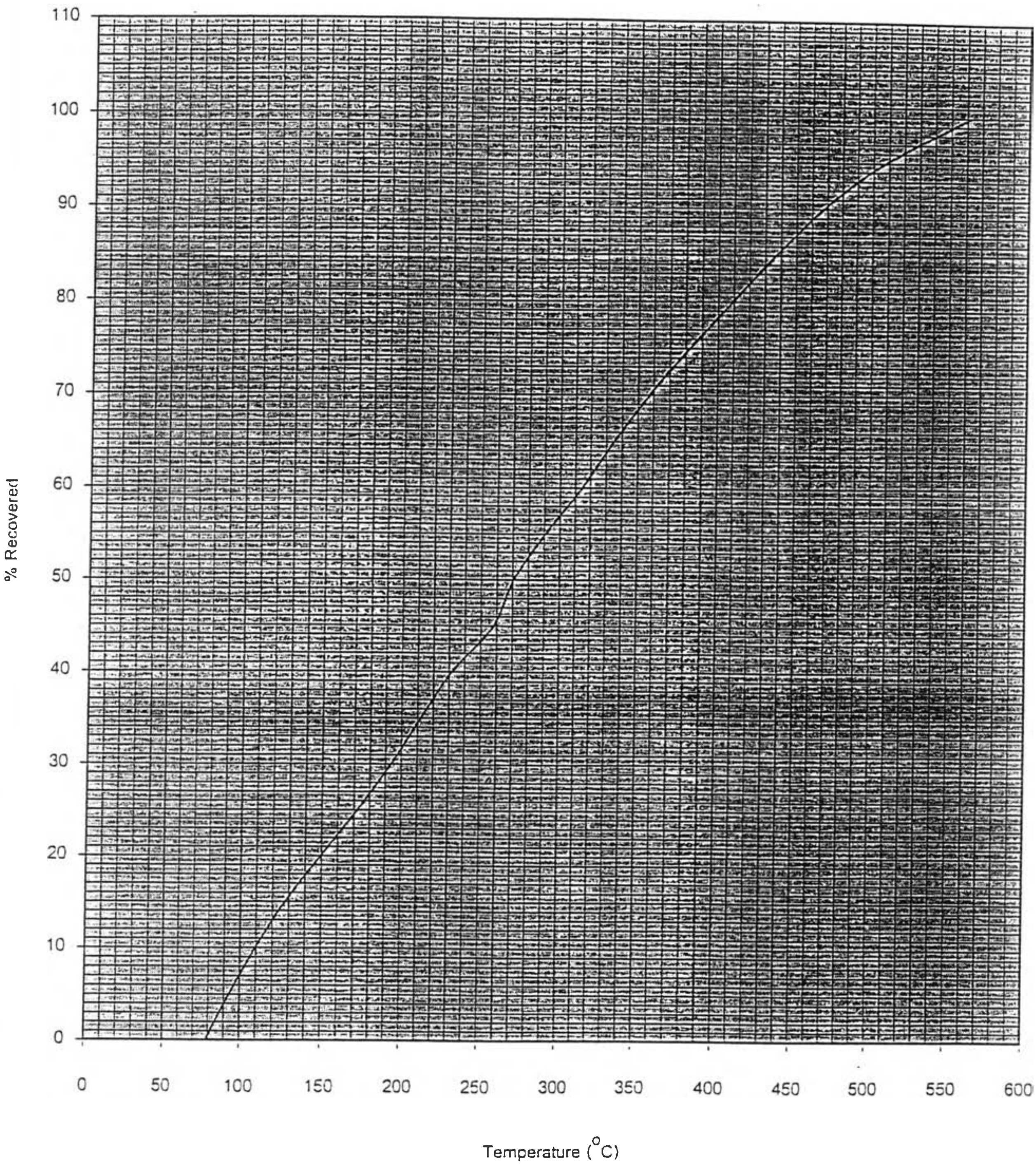

Figure B.19: Oil composition at condition 420°C of reaction temperature, 60 kg/cm^2 of hydrogen, 120 min of reaction time and ratio of LDPE: lignite as 15: 1 by GC Simulated Distillation.

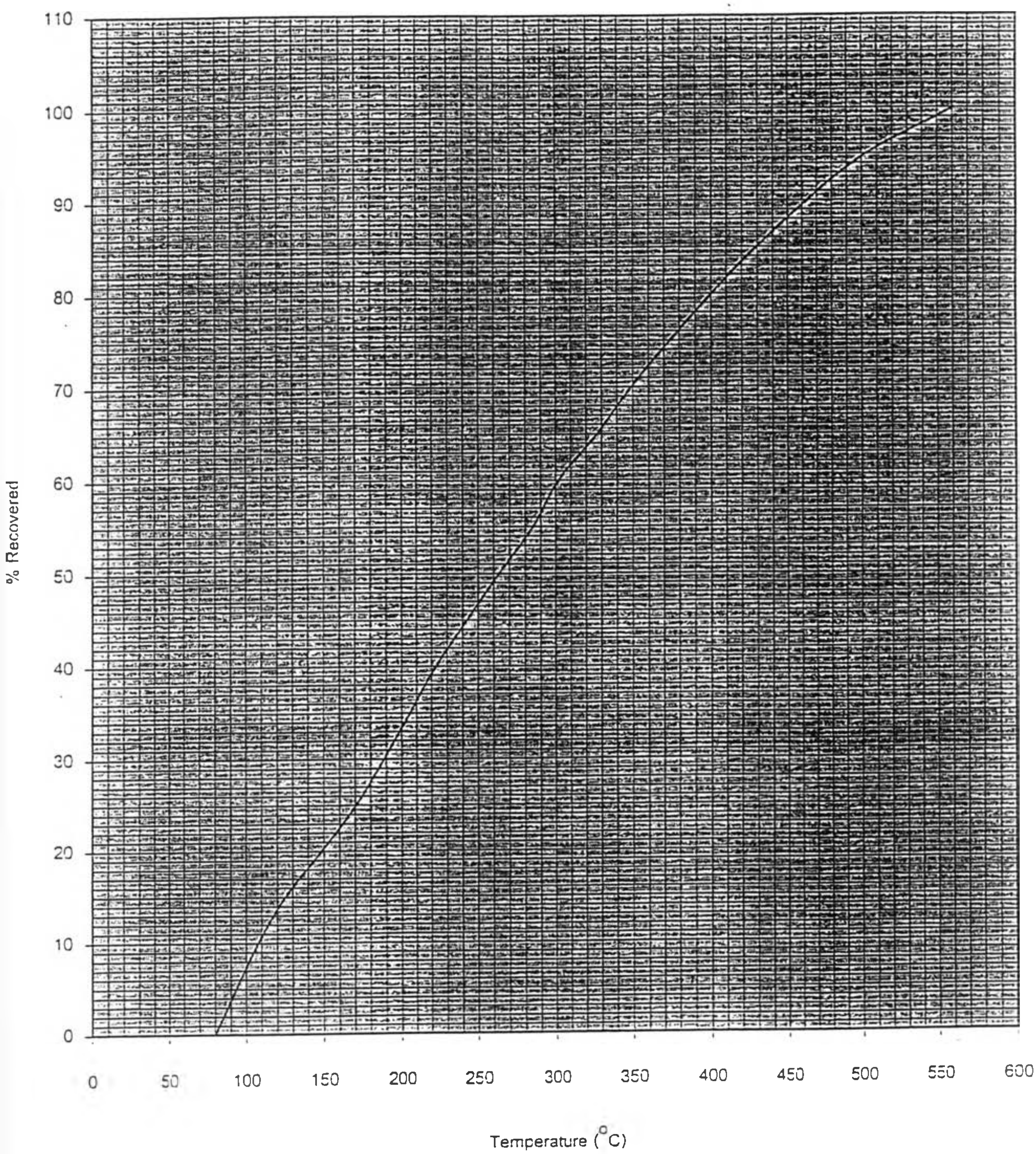

Figure B.20: Oil composition at condition 420°C of reaction temperature, 60 kg/cm^2 of hydrogen, 180 min of reaction time and ratio of LDPE: lignite as 15: 1 by GC Simulated Distillation.

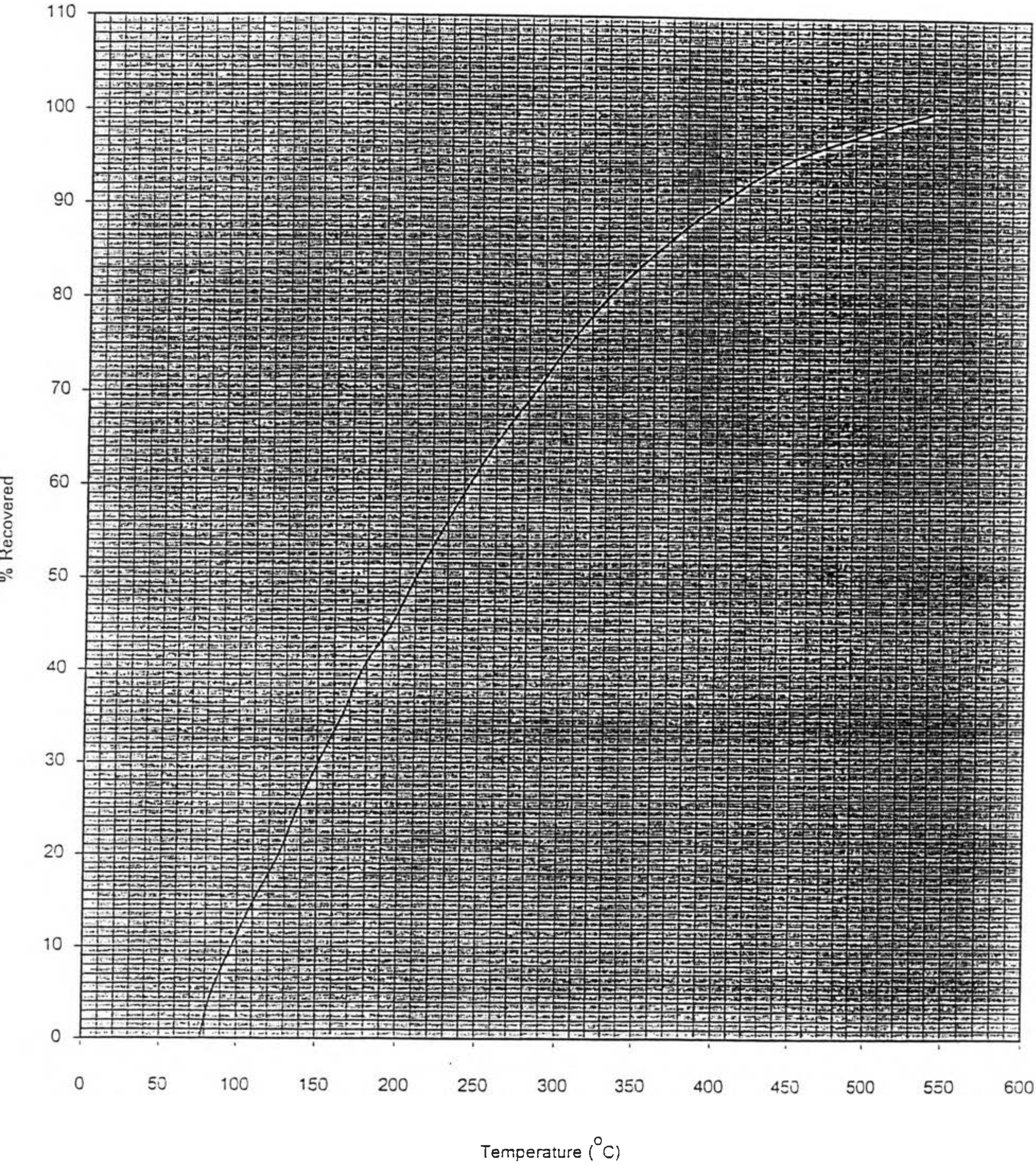

Figure B.21: Oil composition at condition 435°C of reaction temperature, 45 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 5 by GC Simulated Distillation.

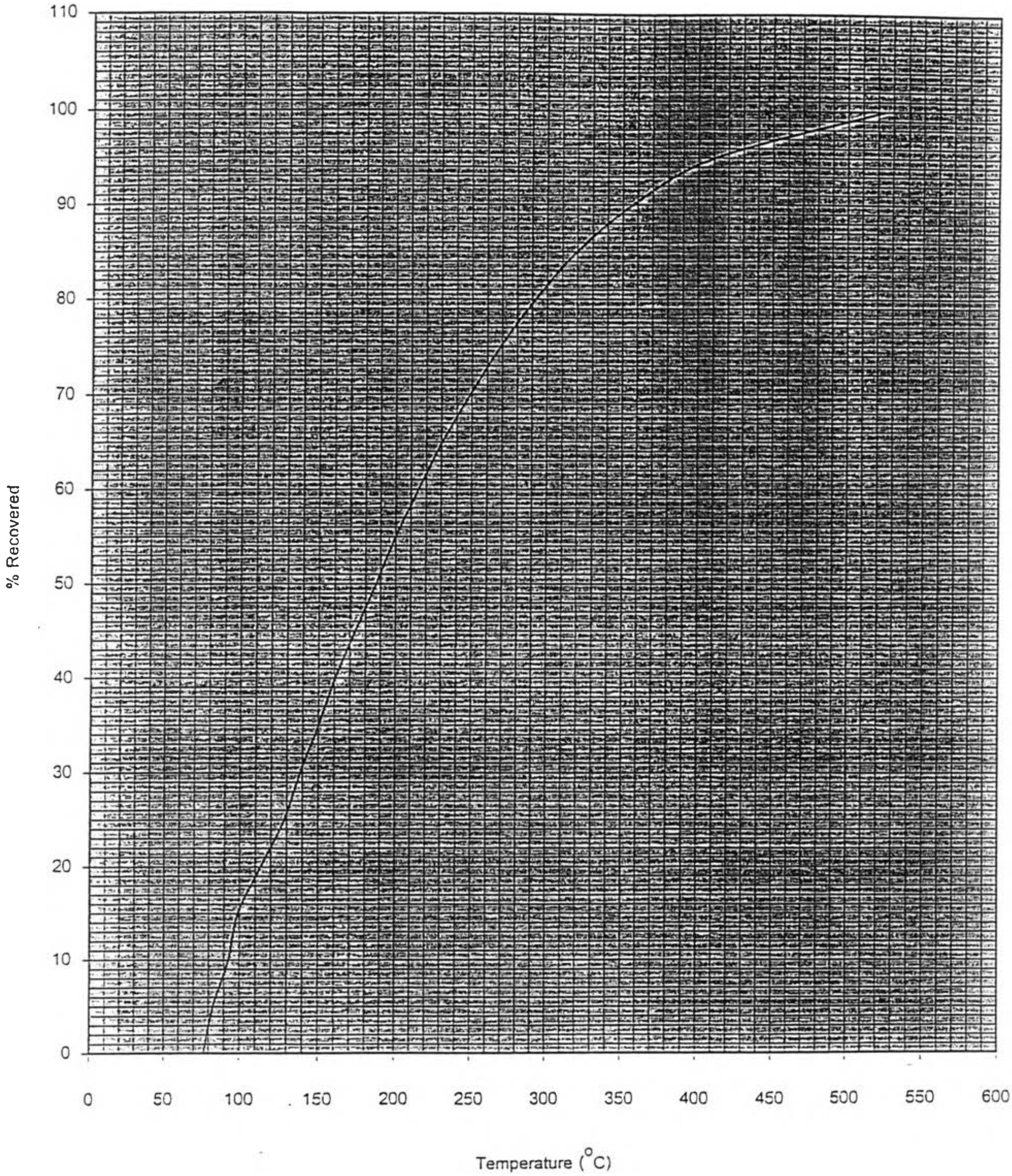

Figure B.22: Oil composition at condition 450°C of reaction temperature, 60 kg/cm^2 of hydrogen, 60 min of reaction time and ratio of LDPE: lignite as 15: 1 by GC Simulated Distillation.

Appendix C

Units of Heat

UNITS OF HEAT

*British therrnal unit (*B.t.u.)---the amount of heat required to raise the temperature of 1 lb of water by 1^{0}F from 60 F to 61^{0}F.

Gram calorie or calorie (g cal or cal)---the amount of heat required to raise the temperature of 1 g water by 1 C to 16^{0}C.

1 B.t.u. = 252 g cal.

These units are inconveniently small for industrial purposes. Larger units of heat are:

Therm = 100,000 B.t.u. (gas industry)

Kg cal = 1000 g cal

Tonne.cal = 1000 kg cal

UNITS OF CALORIFIC VALUE

(a) Solid Fuels

English units---B.t.u./lb---the number of B.t.u. evolved by the combustion of 1 lb of fuel.

C.G.S.*units*---cal/g---the number of calories evolved by the combustion of 1 g of fuel.

Kcal/kg---the number of kilogram calories evolved by the combustion of 1 kg of fuel.

1 ca/g = 1 kg cal/kg = 1.8 B.t.u./lb

ef. 1^{0}C = 1.8^{0}F.

Sometimes, also, the unit kcal/g is used = 1000 cal/g.

(b) *Liquid Fuels*----as for solid fuels, by weight, or as B.t.u./gal.

(c) *Gaseous Fuels*

English units---B.t.u./ft^{3}

C.G.S. units----Kg cal/m^{3}

Note that the temperature, pressure and humidity of a gas should be specified to prevent ambiguity, e.g.

1 B.t.u./ ft^{3} at 30 in., $6O^{0}$F, wet = 8.9 kg cal/m^{3} at 760 mm, 15^{0}C, wet.

Thermal Capacity or Specific Heat ---- The quantity of heat required to produce unit change of temperature in unit mass of a substance.

Units: B.t.u. /lb/ ^{0}F and cal/g/ ^{0}C.

(Units are equal in both systems.)

Alternatively, specific heat is the ratio of the thermal capacity of a substance to that of water at 60^{0}F (15.5^{0}C), since the thermal capacity of water at 15.5^{0}C = 1.000.

In the case of gases, it is necessary to distinguish between the specific heat at constant volume, C_p. These may be expressed on a weight or volume basis.

OTHER UNITS AND CONVERSION FACTORS

Temperature 1^{0}C = 1.8^{0}F

^{0}C to ^{0}F : ^{0}C x 9/5 + 32 = ^{0}F

^{0}F to ^{0}C : (^{0}F – 32)*5/9 = ^{0}C

Volume

1 cubic inch = 16.39 cm^3 = 0.01639 litres

1 Imperial gallon = 4546 cm^3 = 4.546 litres = 1.201 U.S.gallons

1 U.S. gallon = 3785 cm^3 = 3.785 litres

1 cubic foot = 28.32 litres = 0.02832 m^3

1 cubic metre = 35.315 ft^3

Mass

1 gram = 15.432 grains = 0.0022 lb

1 pound = 453.6 g = 7000 grains

1 ton = 1016 kg = 1.016 tonnes = 1.12 U.S. tons

1 U.S. ton = 907 kg = 0.907 tonnes = 0.893 tons

1 tonne = 1000 kg = 2204.6 lb

Pressure

1 atmosphere = 760 mm Hg at 0^{0}C = 29.93 in. Hg

= 33.9 ft H_2O =1.033 kg/cm^2 = 14.695 lb/in^2

= 2116 lb/ft^2

VITA

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