

**2. Results of Flue Gas Measurement
in Diagnostic Survey at 25 Establishments**

2. Results of flue Gas Measurement in Diagnostic Survey at 25 Establishments

A total of 25 establishments were selected for the diagnostic survey from those 97 establishments subjected to the detailed on-site questionnaire survey. Characteristics of the combustion facilities and the results of flue gas measurement conducted during the diagnostic survey are presented in the following tables by each of the 25 establishments shown below.

	(Visit No.)
1. Thermoelectric Power Plant (A)	(69)
2. Thermoelectric Power Plant (B)	(70)
3. Petroleum Refinery	(57)
4. Chemical Products Factory (A)	(1)
5. Chemical Products Factory (B)	(62)
6. Chemical Products Factory (C)	(72)
7. Chemical Products Factory (D)	(24)
8. Chemical Products Factory (E)	(67)
9. Petrochemical Products Factory (A)	(16)
10. Petrochemical Products Factory (B)	(8)
11. Petrochemical Products Factory (C)	(87)
12. Asphalt Plant	(11)
13. Cement Factory	(41)
14. Glass Factory (A)	(68)
15. Glass Factory (B)	(31)
16. Glass Factory (C)	(23)
17. Rubber Products Factory	(14)
18. Paper Factory	(30)
19. Paper Products Factory (A)	(34)
20. Paper Products Factory (B)	(76)
21. Metal Products Factory (A)	(55)
22. Metal Products Factory (B)	(19)
23. Food Products Factory	(65)
24. Alcoholic Drinks Factory	(47)
25. Public Bathhouse	(52)

1 Thermolectric Power Plant (A)
 1.1 Boiler No.1

No.69-1

Name of establishment		Type of facility : No.1 water tube boiler for power generation		Date		Weather	
Thermolectric Power Plant (A)		boiler for power generation		September 4, 1990		fair/cloudy	
Sampling time	(Rating)	15:00	16:00	16:30	17:00	17:30	18:00
Power capacity	kW	150,000	124,000	124,000	125,000	125,000	125,000
Evaporation	ton/hr	476.28	435	440	440	440	440
Steam pressure	kg/cm ² g	133.6	117	117	117	117	117
Steam temperature	°C	540.6	540	540	540	540	540
Fuel Consumption	liter/hr	32,404	1,641	1,641	1,641	1,641	1,641
Heavy oil Pressure	kg/cm ² g	18	18	18	18	18	18
Atomize press.	kg/cm ² g	20	20	20	20	20	20
Natural gas consumption	m ³ /hr	32,330	29,931	30,186	30,243	30,016	30,186
Comb. air A/H inlet	°C	110	110	110	110	110	110
A/H outlet	°C	240	240	240	240	240	240
Flue gas A/H inlet	°C	410, 380	407, 380	410, 382	405, 383	409, 381	409, 381
Flue gas A/H outlet	°C	165, 170	165, 172	165, 172	165, 175	165, 171	165, 170
Combustion air quantity	%	80	80	80	80	80	80
Air press. Fan outlet	mm Aq	430, 450	430, 450	430, 450	430, 450	430, 450	430, 450
Wind box	mm Aq	280	280	280	280	280	280
Furnace pressur	mm Aq	140	150	150	150	150	150
A/H : Air heater							

Analytical data of flue gas

Chimney	inside diameter of chimney: 3,800 mm	
	ppm	172
CO conc.	%	<0.05
CO ₂ conc.	%	7.7
O ₂ conc.	%	3.5
PM conc.	g/Nm ³	0.045
Temperature	°C	160
Gas velocity	m/s	23.8
Gas quantity	Nm ³ /hr	414,000
Theoretical gas quant.	Nm ³ /hr	314,000
A/H inlet Temperature	°C	410
O ₂ conc.	%	1.3
N ₂ conc. (O ₂ 5%)	ppm	154
N ₂ emission	kg/hr	140
SO ₂ emission	kg/hr	110
PM emission	kg/hr	19

Burner operating condition (1-oil burner, 18-gas burners)	
E	/G
D	/G
C	/G
B	/G
A	/G

Burner installation condition (20-oil burners, 20-gas burners)	
E	0/G
D	0/G
C	0/G
B	0/G
A	0/G

Size of combustion chamber	
W	7,900 mm
D	7,900 mm
H	18,500 mm
Volume of chamber	1,155 m ³
Load of c/c : rate in	270,000 kcal/m ³ hr
Load of c/c : normal	240,000 kcal/m ³ hr
c/c : Combustion chamber	

1.2 Boiler No.2 (1st survey)

No.69-2	Name of establishment		Type of facility : No.2 water tube boiler for power generation						Date		Weather	
	Thermoelectric Power Plant (A)								September 4, 1990			
Sampling time	(Rating)	9:30	boiler for power generation						10:00	11:00	11:30	cloudy
Power capacity	kW	158,000	137,000	134,000	134,000	134,000	134,000	136,000	136,000	136,000	135,000	135,000
Evaporation	ton/hr	max 503.5	470	465	460	460	465	465	465	465	465	465
Steam pressure	kg/cm2g	134.6	125	125	124	124	125	125	125	125	125	125
Steam temperature	°C	540.6	536	535	537	537	537	535	535	535	535	535
Fuel	liter/hr	34,602	369	369	369	369	369	369	369	369	369	369
heavy oil	kg/cm2g	50	50	50	50	50	50	50	50	50	50	50
N-gas	Consumption	35,076	32,083	31,913	31,631	31,639	32,055	31,989	32,197	31,989	32,027	32,027
Comb. air	A/H inlet	°C	27	100, 105	100, 105	100, 105	100, 105	100, 105	100, 105	100, 105	102, 105	100, 105
Temp.	A/H outlet	°C	315	355, 340	350, 340	350, 340	355, 335	350, 340	355, 340	350, 340	350, 340	350, 340
Flue gas	A/H inlet	°C	373	420, 435	420, 415	420, 415	420, 415	420, 435	420, 435	420, 415	420, 415	420, 415
Temp.	A/H outlet	°C	133	185, 170	185, 170	180, 170	180, 170	185, 170	185, 170	185, 170	185, 170	185, 170
Combustion air quantity	%	80	80	80	80	80	80	80	80	80	80	80
Air press.	Fan outlet	mm Aq	870	750	900, 720	870, 750	900, 760	850/ 770	850/ 770	850/ 770	850/ 770	850/ 770
Wind box	mm Aq	550	550	550	550	550	550	560	560	560	540	
Furnace presser	mm Aq	410	410	410	420	420	420	420	410	420	420	
M/A : Mechanical atomizing, A/H : Air heater												

Analytical data of flue gas Inside diameter of chimney: 3,900 mm

Chimney	NOx conc.	ppm	87	86	80	85	87	85	87	85	87
	CO conc.	%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
	CO2 conc.	%	7.1	7.5	7.9	8.1	8.3	8.4	8.3	8.3	8.3
	O2 conc.	%	4.9	4.7	4.7	4.5	4.8	4.5	4.5	4.5	4.5
	PM conc.	g/Nm3									0.0047
	Temperature	°C	175	177	177	177	178	178	180	170	170
	Gas velocity	m/s	23.5	23.1	23.5	23.0	24.0	24.0	24.0	24.0	25.5
	Gas quantity	Nm3/hr	421,000	412,000	419,000	410,000	427,000	427,000	425,000	425,000	461,000
Theoretical gas quant.	Nm3/hr		354,000	347,000	347,000	347,000	353,000	348,000	346,000	347,000	347,000
A/H inlet	Temperature	°C	420	420	420	420	420	420	420	420	420
	O2 conc.	%									3.8
	NOx conc. (02 5%)	ppm	86	84	88	82	86	82	84	82	82
	NOx emission	kg/hr	75	73	77	72	76	75	76	75	80
	SO2 emission	kg/hr	60	60	60	60	60	60	60	60	60
	PM emission	kg/hr									2.0

Size of combustion chamber

W	9,000 mm
D	9,000 mm
H	24,000 mm
Volume of chamber	1,944 m3
Load of c/c : rating	170,000 kcal/m3hr
Load of c/c : normal	140,000 kcal/m3hr

c/c : Combustion chamber

Burner operating condition (1-oil burner, 16-gas burners)

	1	2	3	4
F	x	x	x	x
E	x	x	x	x
D	0/G	/G	/G	/G
C	/G	/G	/G	/G
B	G	G	G	G
A	G	G	G	G

Burner installation condition (16-oil burners, 16-gas burners)

	1	2	3	4
F	0	0	0	0
E	0	0	0	0
D	0/G	0/G	0/G	0/G
C	0/G	0/G	0/G	0/G
B	G	G	G	G
A	G	G	G	G

1.3 Boiler No.2 (2nd survey)

No.69-2 (Gas : Oil = 50 : 50)

Name of establishment		Thermoelectric Power Plant (A)				Type of facility : No.2 water tube boiler for power generation				Date		Weather	
No.69		Thermoelectric Power Plant (A)				boiler for power generation				September 13, 1990		fair/cloudy	
Sampling time	(Rating)	11:00	12:00	13:00	14:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00
Power capacity	kW	158,000	133,000	133,000	133,000	133,000	133,000	134,000	134,000	134,000	134,000	134,000	134,000
Evaporation	ton/hr	max 503.5	455	455	455	465	465	465	465	465	465	465	465
Steam pressure	kg/cm ² g	139.6	126	127	127	127	127	127	127	127	127	128	126
Steam temperature	°C	540.6	538	537	537	537	537	537	537	537	537	537	537
Fuel Consumption	liter/hr	34,602	20,488	20,488	20,488	20,488	20,488	20,488	20,488	20,488	20,488	20,488	20,488
Heavy oil	kg/cm ² g	50	50	50	50	50	50	50	50	50	50	50	50
N-gas	m ³ /hr	35,076	18,400	18,400	18,400	18,400	18,400	18,400	18,400	18,400	18,400	18,400	18,400
Comb. air	°C	27	96	105	96	105	98	105	95	105	98	105	95
A/H inlet temp.	°C	315	330	315	330	315	330	315	330	315	330	315	330
A/H outlet temp.	°C	373	395	390	395	390	395	390	395	390	395	390	395
A/H inlet temp.	°C	133	175	160	175	160	175	160	175	160	175	160	175
A/H outlet temp.	°C	80	80	80	80	80	80	80	80	80	80	80	80
Combustion air quantity	mm Aq	880	780	880	780	880	780	880	780	880	780	880	780
Air press.	mm Aq	560	560	560	560	560	560	560	560	560	560	560	560
Wind box	mm Aq	390	390	390	390	390	390	390	390	390	390	390	390
Furnace pressur	mm Aq	400	400	400	400	400	400	400	400	400	400	400	400

M/A : Mechanical atomizing, A/H : Air heater

Analytical data of flue gas Inside diameter of chimney: 3,900 mm

Chimney	NOx conc.	ppm	98	99	100	98	100	98	100	100	100	100	100
	CO conc.	%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
	CO2 conc.	%	8.9	9.2	9.9	9.8	9.8	9.8	10.1	10.2	10.2	10.2	9.7
	O2 conc.	%	5.5	5.6	5.3	4.9	5.3	5.2	5.2	5.2	5.2	5.2	5.1
	PH conc.	g/Nm ³	115	134	127	138	150	145	154	150	154	150	150
	Temperature	°C	24.5	21.0	21.0	21.0	26.0	25.5	26.0	25.0	26.0	25.0	25.0
	Gas velocity	m/s	523,500	427,700	435,200	423,600	509,500	505,700	504,800	489,900	504,800	489,900	489,900
	Gas quantity	Nm ³ /hr	483,900	487,100	477,800	465,900	477,800	474,700	474,700	471,800	474,700	471,800	471,800
	Theoretical gas quant.	Nm ³ /hr	350	355	376	378	379	369	369	369	369	369	369
	A/H inlet Temperature	°C	101	103	101	99	100	101	101	101	101	101	101
	O2 conc. (O2 5%)	ppm	110	87	88	87	88	87	87	87	87	87	87
	NOx emission	kg/hr	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
	SO2 emission	kg/hr											
	PH emission	kg/hr											

Burner operating condition (7-oil burners, 8-gas burners)

	1	2	3	4
F	x	x	x	x
E	x	0	x	x
D	x/x	0/x	0/x	0/x
C	0/x	0/x	0/x	x/x
B	G	G	G	G
A	G	G	G	G

Burner installation condition (16-oil burners, 16-gas burners)

	1	2	3	4
F	0	0	0	0
E	0	0	0	0
D	0/G	0/G	0/G	0/G
C	0/G	0/G	0/G	0/G
B	G	G	G	G
A	G	G	G	G

Size of combustion chamber	
W	8,580 mm
D	10,270 mm
H	18,000 mm
Volume of chamber	1,588 m ³
Load of c/c rating	210,000 kcal/m ³ hr
Load of c/c normal	220,000 kcal/m ³ hr

c/c : Combustion chamber

1.4 Boiler No.3

Name of establishment		Thermoelectric Power Plant (A)		Type of facility : No.3 water tube boiler for power generation		Date	weather
No.69		(Rating)		boiler for power generation		November 14, 1990	fair
Sampling time	12:30	12:30	13:30	14:00	14:30	15:00	15:30
Power capacity	158,000 kW	127,000	122,000	125,000	124,000	125,000	125,000
Evaporation	503.5 ton/hr	485	475	470	470	470	470
Steam pressure	134.6 kg/cm ² g	125	127	121	130	121	131
Steam temperature	540.6 °C	539	524	542	540	531	531
Fuel	Consumption liter/hr	48	48	48	48	48	48
Pressure	kg/cm ² g	34.602	15,000	15,000	15,000	15,000	15,000
Atomize press.	kg/cm ² g	N/A	64	64	64	64	64
Temperature	°C	80	80	80	80	80	80
Natural gas consumption	m ³ /hr	35,076	24,917	24,928	24,946	24,959	24,969
Comb. air A/H inlet	°C	27	78	68	80	70	82
A/H outlet	°C	315	316	320	320	320	318
Flue gas A/H inlet	°C	373	500	385	500	385	500
A/H outlet	°C	133	162	145	162	143	165
Air press.	mm Hg	400	400	400	400	400	400
Wind box	mm Hg	660	620	670	650	670	640
Furnace pressurizer	mm Hg	290	290	300	290	290	290
Flue press. A/H outlet	mm Hg	80	80	80	80	80	80
Damper opening of FGR	%	64	64	64	64	64	64
O ₂ concentration	%	4.1-4.2	4.93	4.5	5.3	4.96	4.96

N/A : Mechanical atomizing, A/H : Air heater

Analytical data of flue gas		Inside diameter of chimney: 3,900 mm	
Chimney	NOx conc. ppm	95	115
	CO conc. %	< 0.05	< 0.05
	CO ₂ conc. %	7.5	7.3
	O ₂ conc. %	8.1	8.4
	PM conc. g/Nm ³		
	Temp. A/H in °C	378	379
	Temp. A/H out °C	122	130
	Gas velocity m/s	30.3	32.5
	Gas quantity Nm ³ /hr	623,000	637,000
	Theoretical gas quant. Nm ³ /hr	645,000	660,000
	NOx conc. (0.2 5%) ppm	112	146
	SO ₂ emission kg/hr	115	150
	PM emission kg/hr	1,100	1,100

Size of combustion chamber	
W	9,000 mm
D	9,000 mm
H	24,000 mm
Volume of chamber	1944.0 m ³
Load of c/c : rating	190,000 kcal/m ³ hr
Load of c/c : normal	170,000 kcal/m ³ hr

c/c : Combustion chamber

1	2	3	4
F	0	0	0
E	0	0	0
D	0/G	0/G	0/G
C	0/G	0/G	0/G
B	G	G	G
A	G	G	G

Burner used gas burner-10 oil burner-6
 Burner installed gas burner-16 oil burner-16

1.5 Boiler No.4

Name of establishment		Type of facility : No.4 water tube boiler for power generation		Date	Weather
No.69	Thermoelectric Power Plant (4)			September 13, 1990	cloudy
Sampling time	(Rating)	13:00	14:00	15:00	
Power capacity	kW	300,000	235,000	235,000	235,000
Evaporation	ton/hr	900	830	830	830
Steam pressure	kg/cm ² g	174	185	185	185
Steam temperature	°C	540	540	540	540
Fuel	litter/hr	46,875	6,000	6,000	6,000
heavy oil	kg/cm ² g	10	10	10	10
	Atomize press. steam	18	18	18	18
Natural gas consumption	m ³ /hr	63,720	55,500	55,500	55,500
Comb. air	A/H inlet	75/55	75/55	75/55	75/55
temp.	A/H outlet	275/275	275/275	275/275	275/275
Flue gas	A/H inlet	345/330	345/330	345/330	345/330
temp.	A/H outlet	140/140	140/140	140/140	140/140
Air	Fan outlet	580/570	580/570	600/580	600/580
pressure	Wind box front	440	420	420	420
	Wind box back	440	420	410	410
Furnace pressure	mm Aq	290	240	240	240
A/H : Air heater					

Analytical data of flue gas		Inside size of chimney : 10,850 x 3,500mm		37.975 m ²
Chimney	NOx conc.	ppm	104	148
	CO conc.	%	0.15	0.10
	CO ₂ conc.	%	6.5	6.9
	O ₂ conc.	%	6.2	6.9
	PM conc.	g/Nm ³		0.12
	Temperature	°C	160	154
	Gas velocity	m/s	14.8	14.8
Theoretical gas quantity	Nm ³ /hr		881,000	875,000
A/H inlet	Temperature	°C	345	345
	O ₂ conc.	%	0.4	0.8
NOx conc. (02.5%)	ppm		112	168
NOx emission	kg/hr		190	270
SO ₂ emission	kg/hr		280	420
PM emission	kg/hr			100

Burner operating condition (1-oil burner, 14-gas burners)	
Sied Level	1 2 3
Back	E /G /G /G
	D /G /G /G
Front	C /G /G /G
	B /G /G /G
	A /G /G /G

Burner installation condition (15-oil burners, 15-gas burners)	
Sied Level	1 2 3
Back	E O/G O/G O/G
	D O/G O/G O/G
Front	C O/G O/G O/G
	B O/G O/G O/G
	A O/G O/G O/G

Size of combustion chamber	
W	9,745 mm
D	9,745 mm
H	32,918 mm
Volume of chamber	3,126 m ³
Load of c/c : rating	230,000 kcal/m ² hr
c/c : Combustion chamber	170,000 kcal/m ² hr

2. Thermoelectric Power Plant (B)

2.1 Boiler No.1

No.70-1 NG80% : 01L20% → NG50% : 01L50%

Name of establishment		Thermoelectric Power Plant (B)					Type of facility : No.1 water tube boiler for power generation					Date		Weather		
No.70		(Rating)					12:30					September 6, 1990		fair		
Sampling time		12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00
Power capacity	MW	32,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Evaporation	ton/hr	150	139	139	139	138	138	137	137	137	137	137	137	137	137	137
Steam pressure	kg/cm2g	70.3	64.0	64.0	64.0	64.0	64.0	64.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0
Steam temperature	°C	487	485	485	485	485	485	485	485	485	485	485	485	485	485	485
Fuel Consumption	liter/hr	10,246	2,640	2,640	2,640	2,640	2,640	2,640	change	change	change	change	change	change	change	change
Heavy oil Pressure	kg/cm2g	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Atomize press.	kg/cm2g	steam	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Temperature	°C	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
Natural gas Consumption	m3/hr	12,278	8,310	8,310	8,310	8,310	8,310	8,310	change	change	change	change	change	change	change	change
Pressure	kg/cm2g	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Comb. air A/H inlet	°C	70	70	70	70	72	72	72	72	72	72	72	72	72	72	72
A/H outlet	°C	269	269	269	269	270	270	270	270	270	270	270	270	270	270	270
Flue gas A/H inlet	°C	410	410	410	410	411	411	411	411	411	411	411	411	411	411	411
A/H outlet	°C	170	170	170	170	172	172	172	173	173	173	173	173	173	173	173
Air pressure	mm Hg	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
A/H inlet	mm Hg	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
A/H outlet	mm Hg	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
Furnace pressure	mm Hg	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5
Flue gas A/H inlet	mm Hg	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100
A/H outlet	mm Hg	-160	-160	-160	-160	-160	-160	-160	-160	-160	-160	-160	-160	-160	-160	-160
A/H : Air heater																

Analytical data of flue gas inside diameter of chimney: 2,320 mm

Chimney	NOx conc.	ppm	231	238	239	232	230	182	180	204	220
CO conc.	%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.5	0.5	-	-
CO2 conc.	%	7.2	7.0	7.0	7.0	7.0	6.9	6.9	6.9	7.5	7.4
O2 conc.	%	7.4	7.2	7.1	7.0	7.0	7.0	6.6	6.6	7.4	7.7
PM conc.	g/m3			0.045							0.27
Temperature	°C	168	169	170	170	170	170	170	170	168	169
Gas velocity	m/s	20.5	20.5	19.9	19.8	19.8	19.8	19.6	20.6	20.6	20.7
Gas quantity	Nm3/hr	133,000	133,000	129,000	128,000	128,000	128,000	127,000	133,000	134,000	134,000
Theoretical gas quant.	Nm3/hr	146,000	148,000	143,000	142,000	142,000	142,000	142,000	156,000	156,000	160,000
A/H inlet Temperature	°C	410	410	410	410	410	410	411	411	411	411
O2 conc.	%	2.4	2.3	2.3	2.3	2.3	2.3	1.8	1.8	3.1	3.5
NOx conc. (02.5%)	ppm	272	276	275	265	265	263	202	200	240	265
NOx emission	kg/hr	63	65	63	61	61	60	47	49	56	61
SO2 emission	kg/hr	180	180	180	180	180	180	-	-	440	440
PM emission	kg/hr			5.8							36

Size of combustion chamber	
W	10,360 mm
D	5,800 mm
H	7,600 mm
Volume of chamber	458 m3
Load of c/c : rating	230,000 kcal/m3hr
Load of c/c : normal	210,000 kcal/m3hr

c/c : Combustion chamber

Burner operating condition (1-oil burner, 5-gas burners)

B	1	2	3
A	/G	/G	/G
A	O/	/G	/G

Burner operation condition (6-oil burners, 6-gas burners)

B	1	2	3
A	O/G	O/G	O/G
A	O/G	O/G	O/G

2.2 Boiler No.2

No.70-2 NG80% : 0:1:20% → NG50% : 0:1:50%

Name of establishment No.70 Thermoelectric Power Plant (B)	Type of facility : No.2 water tube boiler for power generation					Date		Weather
	(Rating)	13:30	14:00	14:30	15:00	15:30	16:30	
Sampling time	KW	32,000	30,000	30,000	30,000	30,000	30,000	30,000
Power capacity	ton/hr	150	140	140	140	140	140	140
Evaporation	kg/cm ² g	64	64	63	63	63	63	63
Steam pressure	°C	487	485	485	485	485	485	485
Feed water temperature	°C	40	40	40	40	40	40	40
Fuel consumption	liter/hr	10,246	2,432	2,432	2,432	←change→	6,022	6,022
Heavy oil	kg/cm ² g	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Atomize press.	kg/cm ² g	5	5	5	5	5	5	5
Temperature	°C	110	110	110	110	110	110	110
Natural gas	m ³ /hr	12,278	10,636	10,636	←change→	6,994	6,994	6,994
Pressure	kg/cm ² g	0.77	0.77	0.77	0.77	0.76	0.76	0.76
Comb. air temp.	°C	80	80	80	80	80	80	80
A/H inlet	°C	272	272	276	276	276	276	276
A/H outlet	°C	410	410	410	410	410	410	410
Flue gas temp.	°C	180	180	180	180	180	180	180
Air pressure	mm Aq	75	75	73	73	73	73	73
A/H inlet	mm Aq	78	78	80	80	80	80	80
A/H outlet	mm Aq	272	272	276	276	276	276	276
Furnace pressure	mm Aq	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5
Flue gas pressure	mm Aq	-65	-65	-67	-67	-67	-67	-67
A/H outlet	mm Aq	-160	-160	-162	-162	-162	-162	-162

A/H : Air heater

Analytical data of flue gas	Inside diameter of chimney: 2,260 mm	
	NOx conc.	ppm
CO conc.	%	< 0.05
CO2 conc.	%	8.5
O2 conc.	%	5.3
PH conc.	g/m ³	0.025
Temperature	°C	185
Gas velocity	m/s	28.5
Gas quantity	Nm ³ /hr	168,000
Theoretical gas quant.	Nm ³ /hr	148,000
A/H inlet temperature	°C	367
O2 conc.	%	1.5
NOx conc. (02.5%)	ppm	175
NOx emission	kg/hr	59
SO2 emission	kg/hr	164
PH emission	kg/hr	4.2

Burner operating condition (1-oil burner, 5-gas burners)

B	/G	2	3
A	O/	/G	/G

Burner operation condition (6-oil burners, 6-gas burners)

B	O/G	2	3
A	O/G	O/G	O/G

Size of combustion chamber	
W	10,380 mm
D	5,800 mm
H	7,600 mm
Volume of chamber	457.6 m ³
Load of c/c : rating	- kcal/m ³ hr
Load of c/c : normal	250,000 kcal/m ³ hr

c/c : Combustion chamber

3. Petroleum Refinery

3.1 Oil Heating Furnace AA-F1, AA-F2

No. 57-5		Name of establishment Petroleum Refinery		Type of facility : AA-F1, F2 atoms- pheric distillation heating furnace		Date September 25, 1990		Weather fair	
Sampling time 11:30		AA-F1		AA-F2		12:30		AA-F1	
Name of furnace Heat transfer in furnace		AA-F1		AA-F2		12:30		AA-F1	
Quantity		538.6		538.6		538.6		538.6	
Inlet temp.		174		174		174		174	
Outlet temp.		346.2		346.2		346.2		346.2	
Pressure		-		-		-		-	
Natural gas consumption		3.074		3.050		2.832		3.122	
Comb. air temperature		-		-		-		-	
Furnace temperature		612		612		612		612	
Air press. Wind box		0		0		0		0	
Dumper opening at flue		40		40		40		40	
Furnace pressure		-3		-3		-3		-3	

Note #: Estimated by the Refinery, ☆ : Inlet of convection zone.

Analytical data of flue gas		Inside diameter of chimney: 3,430 mm	
Chimney	NOx conc.	84	87
	CO conc.	< 0.05	< 0.05
	CO2 conc.	7.7	8.0
	O2 conc.	5.5	5.6
	PM conc.		< 0.0008
	Temperature	567	560
	Gas velocity	7.8	7.7
	Gas quantity	54,500	58,000
	Theoretical gas quantity	68,700	68,500
	NOx conc. (02.5%)	87	90
	NOx emission	9.4	10
	PM emission		< 0.018

Burner operating condition (28-gas burners x 2 sides x 2 heaters)

Name & side	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
AA-F1	E Side	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
AA-F2	E Side	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
	W Side	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G

3.2 Oil Heating Furnace AA-F3

No.57-6

Name of establishment No.57 Petroleum Refinery		Type of facility : AA-F3 crude oil feating furnace					Date September 10,1990		Weather fair	
Sampling time	(Rating)	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	
Heat transfer in furnace	10,000kcal/hr	851.6	851.6	851.6	851.6	851.6	851.6	851.6	851.6	
Process fluid	Quantity m ³ /day	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	
	Inlet temp. °C	175	175	175	175	175	175	175	175	
	Outlet temp. °C	345	345	345	345	345	345	345	345	
Natural gas consumption	* m ³ /hr	543	543	543	543	543	543	543	543	
Comb. air temperature	☆ °C	ambience	ambience	ambience	ambience	ambience	ambience	ambience	ambience	
Furnace temperature	☆ °C	550	550	550	550	550	550	550	550	
Flue gas temperature	☆ °C	430	430	430	430	430	430	430	430	
Air press. Wind box	mm Hg	0	0	0	0	0	0	0	0	
Furnace pressure	mm Hg	-2	-2	-2	-2	-2	-2	-2	-2	

Note ☆: Estimated by the Refinery, ☆: Inlet of convection zone.

Analytical data of flue gas		Inside diameter of chimney: 2,134 mm									
Chimney		54	53	53	50	54	54	54	54	54	54
NOx conc.	ppm	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
CO conc.	%	7.4	5.7	6.9	7.1	7.5	7.8	7.6	7.8	7.6	7.8
CO2 conc.	%	6.8	9.3	6.8	7.0	6.8	6.7	6.8	6.8	6.8	6.6
PM conc.	g/Nm ³							0.0007			
Temperature	°C	415	408	403	396	395	399	400	400	400	400
Gas velocity	m/s	3.1	3.0	2.9	2.5	1.3	1.6	1.6	1.6	1.6	3.5
Gas quantity	Nm ³ /hr	11,100	10,800	10,500	9,200	7,000	5,800	5,800	5,800	5,800	12,800
Theoretical gas quantity	Nm ³ /hr	6,800	8,200	6,800	6,900	6,800	6,700	6,800	6,800	6,800	6,700
NOx conc. (O2 5%)	ppm	81	72	60	57	61	60	61	61	61	60
NOx emission	kg/hr	1.2	1.2	1.1	0.94	0.78	0.64	0.64	0.64	0.64	1.4
PM emission	kg/hr										0.0041

Burner operating condition (16-gas burners)

Side	1	2	3	4	5	6	7	8
Left	G	G	G	G	G	G	G	G
Right	G	G	G	G	G	G	G	G

Test with air ratio change

Emission	Unit	Standard	Damper Open	Damper Close
NOx	ppm	54	47	56
CO	%	0	0	0
CO2	%	7.4	6.7	8.2
O2	%	6.8	8.8	6
NOx ppm/O2=0%		80	81	78

3.3 Oil Heating Furnace RV-H1, RV-H2

Sampling time	12:30		13:00		13:30		14:00		Weather
	RV-H1	RV-H2	RV-H1	RV-H2	RV-H1	RV-H2	RV-H1	RV-H2	
Name of establishment	No. 57 Petroleum Refinery								
Name of furnace	Type of facility : RV-H1, H2 gasoline desulfurization heating furnace								
Heat transfer in furnace	10,000kcal/hr	300	300	300	300	300	300	300	300
Quantity	m ³ /day	1,000	1,035	1,000	1,035	1,000	1,035	1,000	1,035
Inlet temp.	°C	204/204	227/228	204/204	227/228	204/204	227/228	204/204	227/228
Outlet temp.	°C	390/390	394/394	390/390	394/394	390/390	394/394	390/390	394/394
Pressure	kg/cm ² g	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Natural gas consumption	m ³ /hr	1,543	1,543	1,543	1,543	1,543	1,543	1,543	1,543
Comb. air temperature	°C	28	28	28	28	29	30	29	29
Furnace temperature	°C	463/467	488/522	463/467	488/522	463/467	488/522	463/467	488/522
Air press. Wind box	mm Aq	0	0	0	0	0	0	0	0
Bumper opening at flue	mm Aq	3	1	3	1	3	1	3	1
Furnace pressure	mm Aq	-4	-2	-4	-2	-4	-2	-4	-2

Note *: Estimated by the Refinery, ☆ : Inlet of convection zone.

Analytical data of flue gas	Inside diameter of chimney:	1,980 mm
Chimney		
NOx conc.	ppm	49
CO conc.	%	< 0.05
CO2 conc.	%	6.4
O2 conc.	%	6.9
PM conc.	g/Nm ³	0.0013
Temperature	°C	386
Gas velocity	m/s	6.3
Gas quantity	Nm ³ /hr	19,800
Theoretical gas quantity	Nm ³ /hr	19,000
NOx conc. (32.5%)	ppm	57
NOx emission	kg/hr	2.0
PM emission	kg/hr	0.024

Burner operating condition (12-gas burners x 2 sides)

Name & side	1	2	3	4	5	6
RV-H1	G	G	G	G	G	G
	E Side					
	W Side					
RV-H2	G	G	G	G	G	G
	E Side					
	W Side					

3.4 Oil Heating Furnace AW-H1

No. 57-10

Name of establishment	Type of facility : AW-H1 naphtha heating furnace				Date	Weather
No. 57 Petroleum Refinery	12:00	13:00	14:00	15:00	September 11, 1990	cloudy
Sampling time (kating)	11:30	12:30	13:30	14:30	15:30	
Heat transfer in furnace 10,000 kcal/hr 504	535	535	535	535	535	
Process	79.5	79.5	79.5	79.5	79.5	
Quantity m ³ /day	223	223	223	223	223	
Inlet temp. °C	401	401	401	401	401	
Outlet temp. °C	540	540	540	540	540	
Natural gas consumption * m ³ /hr	596	599	599	599	599	
Comb. air temperature °C	ambience	ambience	ambience	ambience	ambience	
Furnace temperature ☆ °C	599	599	599	599	599	
Air press. Wind box mm Aq	-	-	-	-	-	
Furnace pressure mm Aq	-	-	-	-	-	

Note ☆: Estimated by the Refinery, ☆☆: Inlet of convection zone.

Analytical data of flue gas

Inside diameter of chimney: 2,134 mm

Chimney	69	74	78	70	71	68	69
NOx conc. ppm	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
CO conc. %	10.2	9.9	10.2	10.1	10.4	10.2	10.5
CO2 conc. %	2.0	2.1	2.0	1.8	3.1	1.9	1.8
O2 conc. %							
PH conc. g/Nm ³			0.0009				
Temperature °C	592	588	595	606	600	680	690
Gas velocity m/s	5.2	4.5	4.5	4.5	4.0	5.5	6.0
Gas quantity Nm ³ /hr	14,300	12,400	12,300	12,100	10,900	13,700	14,800
Theoretical gas quantity Nm ³ /hr	4,900	4,900	4,900	4,800	5,200	4,800	4,800
NOx conc. (02 5%) ppm	58	63	66	58	63	57	58
NOx emission kg/hr	2.0	1.9	2.0	1.7	1.6	1.9	2.1
PM emission kg/hr			0.011				

Burner operating condition (12-gas)

1	2	3	4	5	6
G	G	G	G	G	G
Left	G	G	G	G	G
Right	G	G	G	G	G

3.5 Oil Heating Furnace RE-H10

No. 57-12		Name of establishment		Type of facility : RE-H10 oil heating furnace		Date		Weather	
No. 57 Petroleum Refinery		No. 57 Petroleum Refinery		September 21, 1990		September 21, 1990		fair	
Sampling time		(Rating)		12:00		13:00		14:00	
Heat transfer in furnace		10,000 kcal/hr		Uncalculatable because a latent heat is unknown by accompanying specific heat, gravity and phase change of liquid fuel.		Uncalculatable because a latent heat is unknown by accompanying specific heat, gravity and phase change of liquid fuel.		Uncalculatable because a latent heat is unknown by accompanying specific heat, gravity and phase change of liquid fuel.	
Process fluid		Quantity		151		151		151	
Inlet temp.		°C		410		410		410	
Outlet temp.		°C		445		445		445	
Natural gas consumption		m ³ /hr		1,306		1,306		1,306	
Comb. air temperature		°C		ambience		ambience		ambience	
Air press. Wind box		mm Aq		0		0		0	
Furnace pressure		mm Aq		-3		-3		-3	
Note #: Estimated by the Refinery.									

Analytical data of flue gas		Inside diameter of chimney: 3,048 mm	
Chimney			
NOx conc.		ppm	
CO conc.		%	
CO2 conc.		%	
O2 conc.		%	
PM conc.		g/Nm ³	
Temperature		°C	
Gas velocity		m/s	
Gas quantity		Nm ³ /hr	
Theoretical gas quantity		Nm ³ /hr	
NOx conc. (O2 5%)		ppm	
NOx emission		kg/hr	
PM emission		kg/hr	

Burner operating condition and installation (40-gas burners)

Roof 1	Roof 2	Roof 3	Roof 4	Roof 5	Roof 6	Roof 7	Roof 8
G	G	G	G	G	G	G	G
G	G	G	G	G	G	G	G
G	G	G	G	G	G	G	G
G	G	G	G	G	G	G	G
G	G	G	G	G	G	G	G

3.6 Oil Heating Furnace AR-HI, AU-HI

No. 57-13
Name of establishment
NO. 57. Petroleum Refinery

Type of facility : AR-HI, AU-HI oil heating furnace

Date
September 10, 1990

Weather
fair

Sampling time	12:00		13:00		14:00		15:00	
	AR-HI	AU-HI	AR-HI	AU-HI	AR-HI	AU-HI	AR-HI	AU-HI
Name of furnace	AR-HI	AU-HI	AR-HI	AU-HI	AR-HI	AU-HI	AR-HI	AU-HI
Heat transfer 10,000kcal/hr	372.6	138.9	372.6	138.9	372.6	138.9	372.6	138.9
Process fluid	Quantity m ³ /day	308	308	308	253	308	253	308
Inlet temp. °C	168	308	168	308	168	308	168	308
Outlet temp. °C	211	320	211	320	211	320	211	320
Natural gas	Consumption * m ³ /hr	2,111	250	2,145	144	2,145	144	2,145
Pressure kg/cm ² g	12	0.5	12	0.5	12	0.5	12	0.5
Comb. air temperature °C	ambience	ambience	ambience	ambience	ambience	ambience	ambience	ambience
Flue gas temp. °C	329	312	330	317	335	315	329	329
Air press. Wind box mm Aq	0	0	0	0	0	0	0	0
Furnace pressure mm Aq	-3	-3	-3	-3	-3	-3	-3	-3

Note. Load : AR-HI 84%, AU-HI 0%, #: Estimated by the Refinery.

Analytical data of flue gas Inside diameter of chimney: 2.841 mm

Chimney	Time	12:30					13:30					13:50																					
		NDx conc. ppm	CO conc. %	CO2 conc. %	O2 conc. %	PM conc. g/m ³	Temperature °C	Gas velocity m/s	Gas quantity Nm ³ /hr	NDx conc. (O2 5%) ppm	kg/hr	kg/hr	NDx conc. ppm	CO conc. %	CO2 conc. %	O2 conc. %	PM conc. g/m ³	Temperature °C	Gas velocity m/s	Gas quantity Nm ³ /hr	NDx conc. (O2 5%) ppm	kg/hr	kg/hr	NDx conc. ppm	CO conc. %	CO2 conc. %	O2 conc. %	PM conc. g/m ³	Temperature °C	Gas velocity m/s	Gas quantity Nm ³ /hr	NDx conc. (O2 5%) ppm	kg/hr
		30	< 0.05	6.8	9.5	0.0014	390	3.0	25,800	43	1.6	0.044	31	< 0.05	6.8	10.0	365	4.4	31,500	42	1.9	0.044	29	< 0.05	6.8	9.5	0.0014	370	4.2	29,600	45	1.8	0.044

Note : Due to malfunction of downstream equipment, AU-HI was being operated at a low load so as to keep warmth of the furnace.

Burner operating condition (24-gas burners) and installation(28-gas burners)

AR-HI	Wall	Roof 1	Roof 2	Roof 3	Roof 4	Roof 5
Front side	G	G	G	G	G	G
Rear side	G	G	G	G	G	G
	G	G	G	G	G	G
	G	G	G	G	G	G

Burner operating condition (3-gas burners) and installation(12-gas burners)

AU-HI	6	5	4	3	2	1
Left	○					
Right						○

Due to malfunction of downstream equipment, burners being used on AU-HI were limited.

3.7 Oil Heating Furnace AQ-H1

No. 57-16

Name of establishment: Petroleum Refinery

Name of facility: AQ-H1 diesel heating furnace

Sampling time	(Rating)	11:00	12:30	13:00	13:30	14:00	Date	Weather
Heat transfer in furnace	10,000kcal/hr						September 14, 1990	fair
Process fluid	m ³ /day	19,845	19,845	19,845	19,845	19,845	14:30	
Inlet temp.	°C	270	270	270	270	270		
Outlet temp.	°C	326	326	326	326	326		
Natural gas consumption	m ³ /hr	700	700	700	700	700		
Comb. air temperature	°C	ambience	ambience	ambience	ambience	ambience		
Furnace temperature	°C	421	421	421	421	421		
Flue gas temperature	°C	323	323	323	323	323		
Air press. Wind box	mm Aq	0	0	0	0	0		
Furnace pressure	mm Aq	-3	-3	-3	-3	-3		

Note #: Estimated by the Refinery, ☆: Inlet of convection zone.

Analytical data of flue gas

Inside diameter of chimney: 1,450 mm

Chimney NOx conc.	ppm	50	47	52	49	50
CO conc.	%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
CO2 conc.	%	5.4	5.0	5.4	4.8	5.1
O2 conc.	%	10.5	11.3	10.0	10.3	10.5
PM conc.	g/Nm ³	< 0.0005				
Temperature	°C	415	413	422	415	415
Gas velocity	m/s	7.0	8.0	8.0	7.7	7.3
Gas quantity	Nm ³ /hr	11,800	13,500	13,300	13,000	12,300
Theoretical gas quantity	Nm ³ /hr	12,100	13,100	11,500	11,800	12,100
NOx conc. (O2 5%)	ppm	76	78	76	73	76
NOx emission	kg/hr	1.2	1.3	1.4	1.3	1.3
PM emission	kg/hr	< 0.0058				

Burner operating condition (12-gas burners) and installation (24-gas burners)

	1	2	3	4	5	6	7	8	9	10	11	12
Left	G/O	G/O	G/O	G/O	G/O	G/O	G/O	G/O	G/O	G/O	G/O	G/O
Right	G/x	G/x	G/x	G/x	G/x	G/x	G/x	G/x	G/x	G/x	G/x	G/x

O: in use x: not in use

Test with air ratio change

Emission	Unit	Standard	Damper Open	Damper Close
NOx	ppm	54	47.3	56
CO	%	0	0	0
CO2	%	7.4	6.7	8.2
O2	%	6.8	8.8	6
NOx ppm/O2=0%		80	81	78

3.8 Boiler G1

No. 57-1-1		Name of establishment		Type of facility :		Date		Weather	
No. 57 Petroleum Refinery		G-1 water tube boiler for power generation		September 27, 1990		fair/cloudy			
Sampling time	(Rating)	12:00	13:00	13:30	14:00	14:30	15:00	15:30	16:00
Power capacity	kW	56	51.0	50.0	53.0	52.0	54.0	54.0	
Evaporation	ton/hr	42	41.0	41.0	351	361	359	360	
Steam pressure	kg/cm ² g								
Steam temperature	°C								
Fuel									
Heavy oil	liter/hr	4,640	565	565	565				
Natural gas	m ³ /hr	5,485	4,890	4,890	4,890	4,890	4,890	4,890	
Heavy oil	liter/hr		405	405	405				
Natural gas	m ³ /hr		2,891	2,892	2,811	3,114	3,203	3,588	
Comb. air	°C		32	32	33	34	34	36	
A/H inlet temp.	°C		227	227	228	235	244	251	
Flue gas	°C		365	362	364	375	375	403	
A/H inlet temp.	°C		197	198	198	204	204	213	
Air press.	mm Hg		Draft meters were out of order.						
Wind box	mm Hg								
Furnace pressure	mm Hg								
Flue gas	mm Hg								
A/H inlet presser	mm Hg								
A/H outlet	mm Hg								

Note. A/H : Air heater, #: Estimated by the Refinery, *: Estimated by the Study Team.

Analytical data of flue gas		Inside diameter of chimney: 2,134 mm	
Chimney		140	143
NOx conc.	ppm	140	145
CO conc.	%	< 0.05	< 0.05
CO2 conc.	%	10.4	8.4
O2 conc.	%	5.1	5.1
PM conc.	g/Nm ³	0.090	0.090
Temperature	°C	230	230
Gas velocity	m/s	13.0	13.5
Gas quantity	Nm ³ /hr	62,000	64,400
Theoretical gas quant. *	Nm ³ /hr	60,300	60,300
	Nm ³ /hr	38,500	36,500
A/H inlet Temperature	°C	285	299
(O2 conc.	%	4.4	4.2
NOx conc. (02.5%)	ppm	141	146
SO2 emission	kg/hr	18	19
PM emission	kg/hr	35	35

*: Estimated by Study Team, #: Estimated by REFINERIA 18 DE MARZO

Burner operating condition (2-oil burners, 4-gas burners)		
	Left	Right
Upper side	0/G	0/G
Lower side	0/G	0/G

Burner installation condition (4-oil burners, 4-gas burners)		
	Left	Right
Upper side	0/G	0/G
Lower side	0/G	0/G

Size of combustion chamber	
	mm
W	5,500
D	5,000
H	5,000
Volume of chamber	165.0 m ³
Load of c/c : rating	283,000 kcal/m ³ hr
Load of c/c : normal	290,000 kcal/m ³ hr

c/c : Combustion chamber

No. 57-1-2		Name of establishment		Type of facility : G-2 water tube boiler for power generation		Date	Weather
No. 57 Petroleum Refinery						September 11, 1980	cloudy
Sampling time	(Rating)	12:40	13:10	13:40	14:10	14:40	15:10
Power capacity	kW	39	40	42	42	42	
Evaporation	ton/hr	41	41	41	41	41	
Steam pressure	kg/cm ²	370	370	365	362	362	
Steam temperature	°C	4,640	1,455	1,455	1,455	1,455	
Fuel	# liter/hr	5,485	2,247	2,580	2,669	2,669	
Natural gas	# m ³ /hr	30	35	31	30	30	
Comb. air	A/H inlet	246	244	247	247	245	
temp.	°C	370	366	370	370	369	
Flue gas	A/H inlet	228	222	223	223	221	
temp.	°C	85	85	85	85	85	
Air press.	Fan outlet	50	50	50	50	45	
	mm Hg	-6	-6	-5	-5	-6	
Furnace pressure	mm Hg	-40	-40	-40	-40	-40	
Flue gas	A/H inlet	-100	-100	-100	-100	-100	
presser	A/H outlet						

Note. A/H : Air heater, †: Estimated by the Refinery, ‡: Estimated by the Study Team.

Analytical data of flue gas		Inside diameter of chimney: 2,134 mm	
Chimney		121	118
NOx conc.	ppm	0.10	0.05
CO conc.	%	8.0	8.2
CO ₂ conc.	%	5.3	4.8
PM conc.	kg/hr	0.0060	0.0060
Temperature	°C	212	214
Gas velocity	m/s	4.5	4.3
Gas quantity	Nm ³ /hr	22,000	21,000
Theoretical gas quant.	† Nm ³ /hr	42,700	44,000
A/H inlet	Temperature	370	366
	°C	4.6	4.2
NOx conc. (02.5%)	ppm	123	115
NOx emission	kg/hr	5.5	5.0
SO ₂ emission	kg/hr	91	91
PM emission	kg/hr	0.13	0.13

‡: Estimated by REFINERIA 18 DE MARZO.

Burner operating condition (2-oil burners, 4-gas burners)	
A	1 /G 0/G
B	2 /G 0/G

Burner installation condition (4-oil burners, 4-gas burners)	
A	1 0/G 0/G
B	2 0/G 0/G

Size of combustion chamber	
W	5,000 mm
D	5,500 mm
H	6,000 mm
Volume of chamber	165.0 m ³
Load of c/c : rating	283,000 kcal/m ³ hr
Load of c/c : normal	200,000 kcal/m ³ hr

c/c : Combustion chamber

3.10 Boiler G3

No. 57-1-3		Name of establishment		Type of facility : G-3 water tube boiler for power generation		Date		Weather	
No. 57 Petroleum Refinery		Sampling time		(Rating)		September 17, 1990		cloudy/rain	
Power capacity	kw	10:30	11:00	11:30	12:00	12:30	13:00		
Evaporation	ton/hr	56	10	13	10	10	10		
Steam pressure	kg/cm ² g	42	40	40	40	40	40		
Steam temperature	°C	360	358	361	361	361	361		
Fuel	Revy oil	4,640	382	382	382	382	382		
	Natural gas #	5,485	1,752	1,752	1,752	1,752	1,752		
Comb. air	A/H inlet	34	34	34	34	34	34		
temp.	A/H outlet	237	237	237	232	232	232		
Flue gas	A/H inlet	306	311	311	306	306	306		
temp.	A/H outlet	225	228	228	225	225	225		
Air press.	Fan outlet	0	0	0	0	0	0		
	Wind box	0	0	0	0	0	0		
Furnace pressure	mm Aq	-15	-15	-15	-15	-15	-15		
Flue gas	A/H inlet	-15	-15	-15	-15	-15	-15		
pressure	A/H outlet	-35	-35	-35	-35	-35	-35		

Note: A/H : Air heater, #: Estimated by the Refinery, *: Estimated by the Study Team.

Analytical data of flue gas		Inside diameter of chimney: 2,134 mm	
Chimney	NOx conc.	ppm	50
	CO conc.	%	< 0.05
	CO2 conc.	%	5.7
	O2 conc.	%	10.0
	PM conc.	g/Na3	0.0071
	Temperature	°C	223
	Gas velocity	m/s	9.0
	Gas quantity	Nm ³ /hr	45,500
Theoretical gas quant. #		Nm ³ /hr	36,000
A/H inlet	Temperature	°C	330
	O2 conc.	%	8.8
	NOx conc. (02.5%)	ppm	73
	SO2 emission	kg/hr	4.7
	PM emission	kg/hr	24

* : Estimated by REFINERIA 18 DE MARZO.

Burner operating condition (2-oil burners, 4-gas burners)	
A	0/G
B	0/G
Burner installation condition (4-oil burners, 4-gas burners)	
A	0/G
B	0/G
Size of combustion chamber	
W	5,500 mm
D	5,000 mm
H	6,000 mm
Volume of chamber	
Load of c/c : rating	283,000 kcal/m ³ hr
Load of c/c : normal	110,000 kcal/m ³ hr

c/c : Combustion chamber

3.11 Boiler G5

No. 57-2		Name of establishment		Type of facility : G-5 water tube boiler for power generation		Date	Weather
No. 57. Petroleum Refinery						September 26, 1990	fair/cloudy
Sampling time	(Rating)	11:30	12:00	12:30	13:00	13:30	14:00
Power capacity	kW		90	90	90	90	
Evaporation	ton/hr	120	42	42	42	42	
Steam pressure	kg/cm ²		361	361	361	361	
Steam temperature	°C		1,130	1,130	1,130	1,130	
Fuel	Heavy oil	* liter/hr	8,793.6	8,793.6	8,793.6	8,793.6	
	Natural gas	* m ³ /hr	23	23	29	29	
Comb. air	A/H inlet	°C	234	235	238	238	
temp.	A/H outlet	°C	415	410	412	417	
Flue gas	A/H inlet	°C	264	261	260	268	
temp.	A/H outlet	°C					
Air press.	Fan outlet	mm Aq	out of order				
	Wind box	mm Aq					
Furnace pressure		mm Aq	-10	-10	-10	-10	
Flue gas	A/H inlet	mm Aq	-80	-80	-80	-80	
pressure	A/H outlet	mm Aq	-100	-100	-100	-100	

Note A/H : Air heater, #: Estimated by the Refinery.

Analytical data of flue gas		Inside diameter of chimney: 3,275 mm	
Chimney	NOx conc.	ppm	130
	CO conc.	%	< 0.05
	CO2 conc.	%	8.3
	O2 conc.	%	5.9
	PM conc.	g/Nm ³	0.051
	Temperature	°C	213
	Gas velocity	m/s	7.5
	Gas quantity	Nm ³ /hr	88,200
Theoretical gas quant.		Nm ³ /hr	117,000
A/H inlet	Temperature	°C	208
	O2 conc.	%	3.5
	NOx conc. (02.5%)	ppm	138
	NOx emission	kg/hr	24
	SO2 emission	kg/hr	71
	PM emission	kg/hr	

Burner operating condition		Size of combustion chamber	
(3-oil burners, 6-gas burners)		W	5,186 mm
Left	0/G	D	11,000 mm
Right	0/G	H	11,929 mm
Burner installation condition		Volume of chamber	680.5 m ³
(6-oil burners, 6-gas burners)		Load of c/c : rating	150,000 kcal/m ³ hr
Left	0/G	Load of c/c : normal	130,000 kcal/m ³ hr
Right	0/G		

c/c : Combustion chamber

3.12 CP Boiler

No.57-3
Name of establishment
No.57 Petroleum Refinery

	(Rating)	Type of facility : CP water tube boiler for power generation					Date	Weather
		11:00	11:30	12:00	12:30	13:00		
Sampling time	55	28.8	31.5	31.5	31.5	13:30	14:00	fair/cloudy
Steam quantity	ton/hr	55	31.5	31.5	31.5	31.5	31.5	15:00
Steam pressure	kg/cm2g	max 62.7	40.5	40.5	40.5	40.5	40.5	31.5
Steam temperature	°C	430	430	430	430	430	430	40.5
Feed water temperature	°C	103	103	103	103	103	103	430
Fuel	Heavy oil	469	469	469	469	469	469	103
	liter/hr	4.008	2.150	2.150	2.150	2.150	2.150	469
	kg/hr	0.44/2.5	0.44/2.5	0.44/2.5	0.44/2.5	0.44/2.5	0.44/2.5	2.150
Comb. air temperature	°C	32	32	32	32	32	32	0.44/2.5
Flue gas temperature	°C	311	311	311	311	311	311	0.44/2.5
Furnace pressure	mm Hg	80	80	80	80	80	80	0.44/2.5

Note, #: Estimated by the Refinery, *: Estimated by the Study Team.

Analytical data of flue gas

	ppm	103	106	105	106	106	103	102	83
Chimney									
NOx conc.	ppm	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
CO conc.	%	11.1	10.7	10.2	11.4	11.6	11.9	11.4	11.4
SO2 conc.	%	1.3	1.5	1.4	1.4	1.3	1.1	1.1	1.8
O2 conc.	%								
PM conc.	g/Nm3				< 0.0002				
Temperature	°C	270	280	285	290	270	285	285	285
Gas velocity	m/s	8.2	7.5	8.5	8.0	8.0	8.5	8.5	9.0
Gas quantity	Nm3/hr	35,800	32,200	36,100	33,700	35,000	36,100	37,600	37,600
Theoretical gas quantity	Nm3/hr	23,400	23,600	23,500	23,500	23,400	23,100	24,000	24,000
NOx conc. (02 5%)	ppm	84	87	86	87	84	82	82	69
NOx emission	kg/hr	7.6	7.0	7.4	7.3	7.4	7.6	7.6	6.4
SO2 emission	kg/hr	29	29	29	29	29	29	29	29
PM emission	kg/hr				0.0088				

Inside diameter of chimney: 2,134 mm

Burner operating condition
(2-gas burners)

	Upper	Lower
Size of combustion chamber		
W	2,134 mm	
D	7,417 mm	
H	2,413 mm	
Volume of chamber	38.2 m3	
Load of c/c : rating	900,000 kcal/m3hr	
Load of c/c : normal	410,000 kcal/m3hr	

c/c : Combustion chamber

4. Chemical Products Factory (A)

4.1 Boiler D

No. I-5		Name of establishment		Type of facility : No. D water tube boiler for processing		Date	Weather
No. 1		Chemical Products Factory (A)		boiler for processing		October 8, 1990	fair
Sampling time	(Rating)	16:30	17:00				
Feed water flow rate	ton/hr	5.0	3.0				
Steam pressure at drum	kg/cm ² g	30	28.0	29.0	29.0		
Steam temperature	°C	saturated	saturated	saturated	saturated		
Feed water temperature	°C	85	85	85	85		
Fuel	Consumption	Nm ³ /hr	750	450	450		
Natural gas	Temperature	°C	25	25	25		
Comb. air temperature	Pressure	kg/cm ² g	0.46	0.46	0.46		
Flue gas temperature	°C	30	30	30	30		
Air press. Window box	mm Aq	90	90	90	90		
Furnace pressure	mm Aq	22	22	22	22		

Analytical data of flue gas		Inside diameter of chimney: 763 mm	
Chimney	N ₂ conc.	ppm	30
	CO conc.	%	0.7
	CO ₂ conc.	%	10.5
	O ₂ conc.	%	0.9
	PM conc.	g/Nm ³	0.0015
	Temperature	°C	275
	Gas velocity	m/s	258
	Gas quantity	Nm ³ /hr	8.5
	Theoretical gas quantity	Nm ³ /hr	4.700
	N ₂ conc. (O ₂ %)	ppm	4.100
	N ₂ emission	kg/hr	24
	PM emission	kg/hr	0.29
			0.0069

Burner : Lance type (B & W)
Register : CW type

4.2 Boiler E

No.1-1

Name of establishment		Type of facility : No.E water tube boiler for processing		Date	Weather	
Chemical Products Factory (A)				October 8, 1990	fair	
No.1	(Rating)	12:30	13:00	13:30	14:00	14:30
Sampling time		12:30	13:00	13:30	14:00	14:30
Feed water flow rate	ton/hr	15.0	10.0	10.0	10.0	10.0
Steam pressure at drum	kg/cm ² g	13.45	12.7	12.5	12.5	11.5
Steam temperature	°C	saturated	saturated	saturated	saturated	saturated
Feed water temperature	°C	85	85	85	85	85
Fuel Consumption	Nm ³ /hr	1,000	1,000	1,000	1,000	1,000
Natural gas	Temperature °C	25	25	25	25	25
	Pressure kg/cm ² g	0.34	0.35	0.35	0.35	0.35
Comb. air temperature	°C	30	30	30	30	30
Flue gas temperature	°C	190	190	190	190	190
Air press. window box	mm Aq	—	—	—	—	—
Furnace pressure	mm Aq	9	9	9	9	9

Analytical data of flue gas

		Inside diameter of chimney: 1,266 mm	
Chimney		64	67
NOx conc.	ppm	64	65
CO conc.	%	< 0.05	< 0.05
CO ₂ conc.	%	8.8	9.0
O ₂ conc.	%	4.2	4.0
PM conc.	g/Nm ³	0.0009	0.0009
Temperature	°C	252	249
Gas velocity	m/s	7.5	7.5
Gas quantity	Nm ³ /hr	12,200	12,300
Theoretical gas quantity	Nm ³ /hr	13,000	13,000
NOx conc. (O ₂ 5%)	ppm	61	63
NOx emission	kg/hr	1.7	1.8
PM emission	kg/hr	0.011	0.011

Burner : Lance type (B & W)

4.3 Heat Transfer Medium Boiler No.100

No.1-6

Name of establishment		Type of facility : No.100 heat medium boiler for processing				Date	Weather
No.1 Chemical Products Factory (A)		boiler for processing				October 9, 1990	fair
Sampling time	(Rating)	13:30	14:00	14:30	15:00	15:30	
Heat medium	Medium quant. m ³ /hr						
	Inlet temp. °C	230	230	230	230	230	
	Outlet temp. °C	280	280	280	280	280	
	Inlet press. kg/cm ² g	5.8	5.8	5.8	5.8	5.8	
	Outlet press. kg/cm ² g	2.9	2.9	2.9	2.9	2.9	
Fuel	Heat transfer kcal/hr	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	
Natural gas	Consumption Nm ³ /hr	105	100	100	100	100	
	Temperature °C	25	25	25	25	25	
	Pressure mm Aq	180	180	180	180	180	
Comb. air temperature	°C						
Flue gas temperature	°C	240	240	240	240	240	
Air press. (fan outlet)	mm Aq						
Furnace pressure	mm Aq						

Analytical data of flue gas		Inside diameter of chimney: 350 mm					
Chimney	NOx conc. ppm	68	68	70	73		
	CO conc. %	< 0.05	< 0.05	< 0.05	< 0.05		
	CO ₂ conc. %	7.3	7.2	7.2	7.5		
	O ₂ conc. %	5.5	5.0	5.1	5.0		
	PM conc. g/Nm ³	< 0.0004					
Temperature °C	130	200	200	189			
Gas velocity m/s	10.3	10.3	10.1	10.0			
Gas quantity Nm ³ /hr	1,600	1,400	1,400	1,400			
Theoretical gas quantity Nm ³ /hr	1,200	1,200	1,200	1,200			
NOx conc. (O ₂ 5%) ppm	70	68	70	73			
NOx emission kg/hr	0.22	0.20	0.20	0.21			
PM emission kg/hr	< 0.0005						

Manufacturer :
THERMOPAC (Italy)

1 nozzle mix type gas burner
Downward reverse firing type.
Blower location is side bottom of the boiler and
the air flows from bottom to top of the wall so
as to cool the wall.

4.4 Heat Transfer Medium Boiler No.300

No. I-8		Name of establishment		Type of facility : No.300 heat medium boiler for processing		Date	Weather
No.1		Chemical Products Factory (A)		boiler for processing		October 9, 1990	fair
Sampling time	(Rating)	11:30	12:00	12:30	13:00		
Medium quant.	m ³ /hr	155.3					
Inlet temp.	°C	245	245	245	245		
Outlet temp.	°C	280	261	261	261		
Inlet press.	kg/cm ² g	5.2	5.2	5.2	5.2		
Outlet press.	kg/cm ² g	1.1	1.1	1.1	1.1		
Heat transfer	kcal/hr	3,000,000					
Consumption	Nm ³ /hr	312.5	300	300	300		
Temperature	°C	25	25	25	25		
Pressure	mm Aq	90	90	90	90		
Comb. air temperature	°C	ambience	ambience	ambience	ambience		
Flue gas temperature	°C	195	195	195	195		
Air press. (fan outlet)	mm Aq	34	34	34	34		
Furnace pressure	mm Aq	20	20	20	20		

Analytical data of flue gas		Inside diameter of chimney:		580 mm
Chimney	NOx conc.	ppm	85	92
	CO conc.	%	0.1	< 0.05
	CO ₂ conc.	%	7.0	7.0
	O ₂ conc.	%	8.3	7.6
	PM conc.	g/Nm ³	< 0.0004	
	Temperature	°C	165	170
	Gas velocity	m/s	9.0	9.0
	Gas quantity	Nm ³ /hr	3,800	3,700
	Theoretical gas quantity	Nm ³ /hr	4,600	4,300
	NOx conc. (O ₂ 5%)	ppm	107	109
	NOx emission	kg/hr	0.66	0.70
	PM emission	kg/hr	< 0.0015	

Size of combustion chamber	
W	2,695 mm
DxH	1,570 mm
Volume of chamber	5.2 m ³
Load of c/c : rating	510,000 kcal/m ³ hr
Load of c/c : normal	490,000 kcal/m ³ hr

Manufacturer :
THERMOPAC (Italy)

I nozzle mix type gas burner
Downward reverse firing type.
Blower location is side bottom of the boiler and
the air flows from bottom to top of the wall so
as to cool the wall.

4.5 Dryer No.1

No.1-11		Name of establishment		Type of facility : No.1 drier for		Date		Weather	
No.1 Chemical Products Factory (A)		(Rating)		powdered sops		October 8, 1980		fair	
Sampling time	(Rating)	12:00	13:00	13:30	14:00	14:30	15:00		
Quantity of product	ton/hr	10	8.5	8.5	8.5	8.5	8.5		
Fuel Consumption	Nm ³ /hr	350	297	297	297	297	297		
Natural Pressure	Kg/cm ² g	0.4	0.4	0.4	0.4	0.4	0.4		
Temperature	°C	21	21	21	21	21	21		
Temp. of heater outlet	°C	345	345	345	345	345	345		
Input quant. of slully #	ton/hr	12.3	12.3	12.3	12.3	12.3	12.3		
Input press. of slully	Kg/cm ² g	40	40	40	40	40	40		
Gas quant. of drier	Nm ³ /hr	84,900	50,100	49,600	50,800	50,700	51,000	49,700	
Tempe. of drier outlet	°C	110	111	111	115	117	115	123	
* : water content : approx. 35%									
Analytical data of flue gas									
Chimney Inside diameter of chimney: 1,240 mm									
Outlet of N/C	NOx conc.	ppm	16	14	15	15	15		
	CO conc.	%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05		
	CO ₂ conc.	%	1.1	1.3	1.3	1.3	1.3		
	O ₂ conc.	%	18.9	18.8	18.9	18.8	18.7	18.6	
	PH conc.	g/Nm ³					0.027		
	Temperature	°C	110	111	115	117	115	116	
	Gas velocity	m/s	23.7	23.5	24.3	24.4	24.4	24.5	
	Gas quantity	Nm ³ /hr	50,100	49,600	50,800	50,700	51,000	49,700	
	Theoretical gas quantity	Nm ³ /hr	24,500	23,400	24,500	23,400	22,400	21,400	
	NOx conc. (02 5%)	ppm	122	102	114	109	104	100	
	NOx emission	kg/hr	1.6	1.4	1.6	1.6	1.6	1.6	
	PH emission	kg/hr					1.4		
N/C : Multi-cyclone									
Natural gas burner : 1									

4.6 Dryer No.2

No.1-12	Name of establishment	Type of facility : No.2 drier for powdered soap												Date	Weather	
		No.1 Chemical Products Factory (A)														
Sampling time	(Rating)	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:25	15:50	16:15	16:40	17:05	17:30	17:55	18:20
Quantity of product	ton/hr	15	15.25	15.25	15.25	15.25	15.25	15.25	15.25	15.25	15.25	15.25	15.25	15.25	15.25	15.25
Fuel Consumption	Nm ³ /hr	365	364	364	364	364	364	364	364	364	364	364	364	364	364	364
Natural gas	kg/cm ² g		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Temp. of heater outlet	°C		25	25	25	25	25	25	25	25	25	25	25	25	25	25
Input quant. of steam	ton/hr		175	175	175	175	175	175	175	175	175	175	175	175	175	175
Input press. of steam	kg/cm ² g		22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4
Gas quant. of drier	Nm ³ /hr		90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000
Temp. of drier outlet	°C		100	100	100	100	100	100	100	100	100	100	100	100	100	100
* : water content : approx. 35%																
Analytical data of flue gas																
Inside diameter of chimney: 1.680 mms																
Chimney			12	12	12	12	12	12	12	12	12	12	12	12	12	12
Outlet of M/C			< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
NOx conc.	ppm															
CO conc.	%															
CO2 conc.	%		0.9	0.8	0.75	0.8	0.75	0.8	0.75	0.8	0.75	0.8	0.75	0.8	0.75	0.7
O2 conc.	%		18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.5
PM conc.	g/Nm ³				0.043											
Temperature	°C		87	82	80	85	85	85	85	85	85	85	85	85	85	69
Gas velocity	m/s		14.8	16.1	16.1	15.2	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	16.1
Gas quantity	Nm ³ /hr		59,000	65,100	65,400	61,000	62,800	62,800	62,800	62,800	62,800	62,800	62,800	62,800	62,800	67,500
Theoretical gas quantity	Nm ³ /hr		24,600	24,600	30,200	30,200	30,200	30,200	30,200	30,200	30,200	30,200	30,200	30,200	30,200	26,600
NOx conc. (O2 5%)	ppm		71	71	87	87	87	87	87	87	87	87	87	87	87	80
PM emission	kg/hr		1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.7
M/C : Multi-cyclone					2.8											
Natural gas burner : 1																

5. Chemical Products Factory (B)
5.1 Boiler No.1

No. 62-1

Name of establishment		Type of facility : No.1 smoke tube boiler for processing		Date		Weather	
No. 62 Chemical Products Factory (B)		12:00 12:30 13:00 13:30		October 29, 1990		cloudy	
Sampling time		approx. 20% (normal load)		15:00 15:30		15:40	
Load condition		approx. 80% load					
Feed water quant.	ton/hr	7.6	7.6	7.6	7.8	normal	7.3
Steam pressure	kg/cm ² g	10.5	7.6	7.6	7.6	normal	7.3
Steam temperature	°C	55	56	56	56	02 conc.	56
Feed water temp.	°C	30	20	25	25	control	35
Fuel Consumption	liter/hr	149	1.8/0.82	1.8/0.82	1.8/0.82	2.4/0.85	1
Pressure	kg/cm ² g	2.0/0.7	1.8/0.82	1.8/0.82	1.8/0.82	1	1
Atomize press.	kg/cm ² g	air	1	1	1	1	1
Temperature	°C	82.5	80	80	80	83	83
Comb. air temperature	°C	ambience	ambience	ambience	ambience	ambience	ambience
Flue gas temperature	°C	185	170	170	170	208	205
Air press. Wind box	mm Aq	-	-	-	-	-	-
Furnace pressure	mm Aq	50	50	50	50	50	50
	mm Aq	estimated	50	50	50	50	50

Analytical data of flue gas

Chimney		Inside diameter of chimney: 400 mm	
NOx conc.	ppm	283	196
CO conc.	%	< 0.05	< 0.05
CO2 conc.	%	9.5	8.0
O2 conc.	%	8.0	8.8
PM conc.	g/Nm ³	168	170
Temperature	°C	3.0	2.9
Gas velocity	m/s	610	590
Gas quantity	Nm ³ /hr	490	350
Theoretical gas quantity	Nm ³ /hr	250	257
NOx conc. (02 5%)	ppm	0.25	0.24
NOx emission	kg/hr	1.7	1.1
SO2 emission	kg/hr	1.4	1.4
PM emission	kg/hr	1.4	1.4

Size of combustion chamber

D	572 mm
L	4,242 mm
Volume of chamber	4.358 m ³
Sectional area	1.027 m ²
Load of c/c	#1) 340,000 #2) 70,000
Load of s/a	#1) 1,430,000 #2) 290,000
	*1) kcal/m ³ h *2) kcal/m ² h
	c/c : Combustion chamber
	s/a : Sectional area

1 air and pressure atomizing oil burner
1 LPG pilot burner
Manufacture: Cleaver Brooks de Mexico SA / Caldera Compact
Others : Diesel oil is used when start-up the boiler.

5.2 Heat Transfer Medium Boiler

No. 62-2		Name of establishment		Type of facility :		Date		weather	
No. 62		Chemical Products Factory (B)		Heat medium boiler for processing		October 29, 1980		cloudy	
Sampling time		(Rating)		11:00		12:30		13:30	
Outlet temp. °C		215		220		225		235	
Inlet press. kg/cm ² g		3.4		3.4		3.4		3.4	
Outlet press. kg/cm ² g		1.1		1.1		1.1		1.1	
Heat transfer kcal/hr									
Consumption Nm ³ /hr		8.30		8.30		8.30		8.30	
Temperature °C		ambience		ambience		ambience		ambience	
Pressure mm Aq									
Comb. air temperature °C		ambience		ambience		ambience		ambience	
Flue gas temperature °C		340		355		362		365	
Air pressure mm Aq		none							
Furnace pressure #		-1		-1		-1		-1	
								natural draft	

: Chimney height: 9 m

Analytical data of flue gas		Inside diameter of chimney: 150 mm	
Chimney			
NOx conc. ppm		24	
CO conc. %		< 0.05	
CO ₂ conc. %		7.8	
O ₂ conc. %		9.3	
PM conc. g/Nm ³		0.033	
Temperature °C		340	
Gas velocity m/s		5.3	
Gas quantity Nm ³ /hr		110	
Theoretical gas quantity Nm ³ /hr		150	
NOx conc. (O ₂ 5%) ppm		33	
NOx emission kg/hr		0.005	
SOx emission kg/hr		0.14	
PM emission kg/hr		0.0036	

Mechanical atomizing heavy oil burner.
Atomized fuel oil is burnt by imping
the oil to the furnace floor.

Brick wall type furnace

Size of combustion chamber	
W	400 mm
H	230 mm
L	1710 mm
Volume of chamber	0.157 m ³
Sectional area	0.092 m ²
Rate	Normal
Load of c/c #1)	460,000
Load of s/a #2)	780,000
#1) kcal/m ³ h	#2) kcal/m ² h

c/c : Combustion chamber
s/a : Sectional area

6. Chemical Products Factory (C)
Boiler No.1 and No.2

No. 72-1.2		Name of establishment		Type of facility : Nos.1,2 smoke tube boiler for processing		Date	Weather
No. 72		Chemical Products Factory (C)				November 12, 1990	fair
Sampling time	12:30	13:30	14:00	14:30	15:00	15:30	16:00
Name of boiler	No.1 boiler (2.4t/hr)	No.1 boiler (2.4t/hr)	No.1 boiler (2.4t/hr)	No.2 boiler (1.6t/hr)	No.2 boiler (1.6t/hr)	No.2 boiler (1.6t/hr)	No.2 boiler (1.6t/hr)
Steam pressure at drum	kg/cm ² g max 10.5	5.6	5.6	5.6	5.6	10.5	8.8
Steam temperature	°C	saturated	saturated	saturated	saturated	saturated	saturated
Feed water temperature	°C	60	60	60	60	60	60
Fuel	Consumption m ³ /h	168	* 109	* 109	* 109	* 113	* 101
N-gas	Pressure kg/cm ² g	3.2/0.027	3.2/0.027	3.2/0.027	3.2/0.027	3.2/	3.2/
Flue gas temperature	°C	170	170	170	170	170	170
Air press. window box	mm Aq	-	-	-	-	-	-
Furnace pressure	mm Aq	20	20	20	20	20	20
N-gas : Natural gas							
* : gas consumption was estimated from the opening angle of valve.							

Analytical data of flue gas		Inside diameter of chimney:		360 mm		350 mm	
Chimney	NOx conc. ppm	65	35	55	65	44	44
	CO conc. %	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
	CO2 conc. %	7.5	4.5	7.8	8.5	7.2	7.5
	O2 conc. %	7.5	11.8	10.5	9.3	7.1	7.1
	PM conc. g/m ³			0.0075			< 0.0009
	Temperature °C	160	161	160	170	153	154
	Gas velocity m/s	6.5	2.5	2.0	4.5	1.4	1.4
	Gas quantity Nm ³ /hr	1,100	410	330	730	280	234
	Theoretical gas quantity Nm ³ /hr	1,700	2,500	2,200	2,000	1,500	1,500
	NOx conc. (O2 5%) ppm	77	61	84	89	51	66
	NOx emission kg/hr	0.15	0.03	0.04	0.10	0.02	0.02
	PM emission kg/hr			0.0037			< 0.0013

Size of combustion chamber (2.4t/hr)	
L	3,454 mm
D	610 mm
Volume of chamber	1.01 m ³
Sectional area	0.29 m ²
Load of c/c : rating	430,000 kcal/m ³ hr
Load of s/a : rating	950,000 kcal/m ² hr

Size of combustion chamber (1.6t/hr)	
L	1,895 mm
D	508 mm
Volume of chamber	0.38 m ³
Sectional area	0.20 m ²
Load of c/c : rating	520,000 kcal/m ³ hr
Load of s/a : rating	780,000 kcal/m ² hr

c/c : Combustion chamber
s/a : Sectional area

No.1 buener installation No.2 buener installation
Wind box type Fan separated type
1 gas burner 1 gas burner

Burner manufacture : SELMEX
Boiler manufacture : CLEVER BLOOKS de MEXICO, S.A.

7. Chemical Products Factory (D)
Boiler No.4

No.24-1

Name of establishment		Type of facility :				Date		Weather	
No.24 Chemical Products Factory (D)		No.4 water tube boiler for processing				October 1, 1990		fair	
Sampling time	(Rating)	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:30
Feed water flow rate	ton/hr	7.2	5.4	5.4	5.4	5.4	5.4	5.4	7.1
Steam pressure at drum	kg/cm ² g	12	12	12	12	12	12	12	11
Steam temperature	°C	saturated	saturated	saturated	saturated	saturated	saturated	saturated	saturated
Feed water temperature	°C	25	25	25	25	25	25	25	25
Fuel	Nm ³ /hr	770	534	534	534	534	534	534	705
N-gas	kg/cm ² g	420	420	420	420	420	420	420	500
Comb. air temperature	°C	30	30	30	30	30	30	30	30
Flue gas temperature	°C	260	260	260	260	260	260	260	285
Air press. Window box	mm Aq	55	55	55	55	55	55	55	65
Furnace pressure	mm Aq	10	10	10	10	10	10	10	12

N-gas : Natural gas

Analytical data of flue gas

	ppm	45	48	48	50	50	48	52	59
NOx conc.	%	1.5	1.5	1.5	1.5	1.0	< 0.05	< 0.05	< 0.05
CO conc.	%	8.3	8.3	8.3	10.0	9.8	9.8	9.8	9.9
CO2 conc.	%	1.8	1.8	1.8	1.8	1.8	3.0	2.3	2.5
PM conc.	g/Nm ³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Temperature	°C	275	275	285	280	280	270	270	305
Gas velocity	m/s	15.5	14.5	13.5	13.0	13.0	13.0	14.0	18.0
Gas quantity	Nm ³ /hr	5,900	5,900	5,000	4,900	4,900	5,000	5,400	6,600
Theoretical gas quantity	Nm ³ /hr	4,700	4,700	4,700	4,700	4,700	5,000	4,800	6,600
NOx conc. (O2 5%)	ppm	38	40	40	42	42	43	44	51
PM emission	kg/hr	0.55	0.54	0.49	0.50	0.50	0.49	0.58	0.80
PM emission	kg/hr	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011

Inside diameter of chimney: 635 mm

Size of combustion chamber	
W	1664 mm
D	4200 mm
H	2200 mm
Volume of chamber	15.4 m ³
Load of c/c : rating	430,000 kcal/hr
Load of c/c : normal	300,000 kcal/hr
c/c : Combustion chamber	

1 Natural gas burner
Register : DAZ type
Burner : Ring type
Burner maker : COEN CO.
Boiler maker
PROTHERM DE MEXICO FABRICACION

8. Chemical Products Factory (E)
Boiler No.1

Name of establishment		Type of facility : No.1 water tube boiler for processing		Date		Weather	
No.67 Chemical Products Factory (E)				November 6, 1990		fair	
Sampling time	(Rating)	11:30	12:00	12:30	13:00	13:30	14:30
Estimated load	%	20	30	40	90	90	30
Steam pressure	kg/cm ² g	12	12	12	12	12	11.5
Steam temperature	°C	144	144	144	147	147	144
Feed water temp.	°C	44	44	44	42	42	42
Fuel							
Consumption	liter/hr	567	170.1	170.1	538.65	170.1	170.1
Pressure	kg/cm ² g	11.5	11.5	11.5	12.0	12.0	11.0
Atomize press.	kg/cm ² g steam	11.5	11.5	11.5	12.0	12.0	11.0
Temperature	°C	122	122	122	125	125	124
Comb. air temperature	°C	ambience	ambience	ambience	ambience	ambience	ambience
Flue gas temperature	°C	-	275	280	300	285	285
Furnace pressure	mm Hg.	-2	-2	-2	-2	-2	-2

↑ load up

Analytical data of flue gas		Inside diameter of chimney: 930 mm	
Chimney		93	90
NOx conc.	ppm	93	148
CO conc.	%	< 0.05	< 0.05
CO ₂ conc.	%	6.0	5.8
O ₂ conc.	%	12.5	12.5
PM conc.	g/Nm ³		0.051
Temperature	°C	275	280
Gas velocity	m/s	6.5	6.9
Gas quantity	Nm ³ /hr	5,500	5,800
Theoretical gas quantity	Nm ³ /hr	4,100	8,000
NOx conc. (O ₂ 5%)	ppm	175	169
SO ₂ emission	kg/hr	1.1	1.7
PM emission	kg/hr	10	10
			0.29

Size of combustion chamber	
W	2,600 mm
D	3,000 mm
H	2,850 mm
Volume of chamber	22.2 m ³
Load of c/c : rating	250,000 kcal/m ³ hr
Load of c/c : normal	170,000 kcal/m ³ hr

2 steam atomizing heavy oil burners.
Drafi fan type
Diesel is used when start-up and shut-off the boiler.
Burner manufacture B & W
Boiler manufacture B & W

9. Petrochemical Products Factory (A)

9.1 Boiler No.3

No.16-3		Name of establishment		Type of facility : No.3 water tube boiler for power generation		Date		Weather	
NO.16 Petrochemical Products Factory (A)		(Rating)		11:30		12:00		13:30	
Sampling time		11:30		12:30		13:00		14:30	
Power capacity	kW	28	18	18	← change →	24	24	24	24
Evaporation	ton/hr	38	38	38	38	38	38	38	38
Steam pressure	kg/cm ² g	452	410	410	410	410	410	410	410
Steam temperature	°C	2,650	1,808	1,808	2,100	2,100	2,100	2,100	2,100
Fuel Consumption	liter/hr	3.8	3.8	3.8	4.0	4.0	4.0	4.0	4.0
Heavy oil Pressure	kg/cm ² g	8.1	8.1	8.1	8.5	8.5	8.5	8.5	8.5
Atomize press.	kg/cm ² g	oil only	oil only	oil only	oil only	oil only	oil only	oil only	oil only
Natural gas Consumption	m ³ /hr	3,200	oil only	oil only	oil only	oil only	oil only	oil only	oil only
Pressure	kg/cm ² g	oil only	oil only	oil only	oil only	oil only	oil only	oil only	oil only
Comb. air A/H inlet	°C	30	30	30	30	30	30	30	30
A/H outlet	°C	210	210	210	220	220	220	220	220
Flue gas A/H inlet	°C	360	360	360	370	370	370	370	370
temp.	°C	280	280	280	300	300	300	300	300
A/H outlet	°C	110	110	110	130	130	130	130	130
Air press. Wind box	mm Aq	18	18	18	19	19	19	19	19
Furnace pressure	mm Aq	12	12	12	12	12	12	12	12
Flue gas A/H inlet	mm Aq	7	7	7	7	7	7	7	7
pressure	mm Aq	7	7	7	7	7	7	7	7
A/H : Air heater	mm Aq	7	7	7	7	7	7	7	7

Analytical data of flue gas		Inside diameter of chimney: 1.514 mm	
Chimney		267	280
NOx conc.	ppm	< 0.05	< 0.05
CO conc.	%	8.7	9.1
CO2 conc.	%	9.1	7.5
O2 conc.	%	0.058	0.078
PM conc.	g/m ³	189	181
Temperature	°C	8.3	8.8
Gas velocity	m/s	22,700	24,500
Gas quantity	Nm ³ /hr	31,500	27,800
Theoretical gas quantity	Nm ³ /hr	360	360
A/H inlet Temperature	°C	6.6	5.2
O2 conc.	%	359	332
NOx conc. (02.5%)	ppm	12	14
NOx emission	kg/hr	100	100
SO2 emission	kg/hr	1.4	1.4
PM emission	kg/hr	1.4	1.4

Burner operating condition (3-oil burners, 0-gas burner)	
A	1
B	0/

Burner installation condition (3-oil burners, 3-gas burners)	
A	1
B	0/G

Size of combustion chamber	
W	3,197 mm
D	5,543 mm
H	5,500 mm
Volume of chamber	97.5 m ³
Load of c/c : rating	270,000 kcal/m ³ hr
Load of c/c : normal	180,000 kcal/m ³ hr

c/c : Combustion chamber

9.2 Boiler No.4

No. 16-4		Name of establishment		Type of facility : No.4 water tube boiler for power generation		Date		Weather	
No.16 Petrochemical Products Factory (A)		(rating)		13:00 14:00 14:30 15:00 15:15		September 21, 1980		fair	
Power capacity	kW	41	32	32	32	32	32	32	33
Evaporation	ton/hr	38	38	38	38	38	38	38	38
Steam pressure	kg/cm ² g	452	425	425	425	425	425	425	425
Steam temperature	°C	90	90	90	90	90	90	90	90
Feed water temperature	°C	gas only	gas only	gas only	gas only	gas only	gas only	gas only	gas only
Fuel	l/iter/hr	3,850	3,850	3,850	3,850	3,850	3,850	3,850	3,850
Heavy oil	kg/cm ² g	4,550	4,550	4,550	4,550	4,550	4,550	4,550	4,550
Natural gas	kg/cm ² g	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Atomize press.	kg/cm ² g	28	28	28	28	28	28	28	28
Pressure	kg/cm ² g	200	200	200	200	200	200	200	200
Comb. air temp.	°C	estimated	estimated	estimated	estimated	estimated	estimated	estimated	estimated
A/H outlet temp.	°C	270	270	270	270	270	270	270	270
A/H inlet temp.	°C	245	245	245	245	245	245	245	245
Air press.	mm Aq	80	80	80	80	80	80	80	80
Fan outlet	mm Aq	50	50	50	50	50	50	50	50
Wind box	mm Aq	50	50	50	50	50	50	50	50
Furnace pressure	mm Aq	50	50	50	50	50	50	50	50
Flue gas p	mm Aq	50	50	50	50	50	50	50	50
A/H : Air heater									

Analytical data of flue gas		Inside diameter of chimney: 1,680 mm	
Chimney		160	157
NOx conc.	ppm	153	184
CO conc.	%	< 0.05	< 0.05
CO2 conc.	%	6.8	7.0
O2 conc.	%	5.8	5.7
PM conc.	g/Nm ³		< 0.0001
Temperature	°C	270	268
Gas velocity	m/s	12.8	12.4
Gas quantity	Nm ³ /hr	35,900	34,900
Theoretical gas quantity	Nm ³ /hr	37,800	42,300
A/H inlet O2 conc.	%	3.5	3.4
NOx conc.(O2 5%)	ppm	168	164
NOx emission	kg/hr	12	11
PM emission	kg/hr		

Size of combustion chamber	
W	4,619 mm
D	5,081 mm
H	5,600 mm
Volume of chamber	131.4 m ³
Load of c/c : rating	300,000 kcal/m ³ hr
Load of c/c : normal	210,000 kcal/m ³ hr
c/c : Combustion chamber	

Burner installation condition (4-oil burners, 4-gas burners)	
A	0/G
B	0/G

Burner operating condition (0-oil burner, 3-gas burners)	
A	1 /G
B	2 /G

①: Burner is out of order.
Air register is fully closed.

10. Petrochemical Products Factory (B)

10.1 Boiler No.2

No.8-2	Name of establishment	Petrochemical Products Factory (B)		Type of facility : No.2 water tube boiler for power generation				Date	Weather						
		(Rating)	(Rating)	11:30	12:00	12:30	13:00			13:30	14:00	14:30			
	Sampling time			3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	cloudy
	Power Capacity		kW	26	26	26	26	26	26	26	26	26	26	26	
	Evaporation		ton/hr	42	42	42	42	42	42	42	42	42	42	42	
	Steam pressure		kg/cm ² g	385	385	385	385	385	385	385	385	385	385	385	
	Steam temperature		°C	105	105	105	105	105	105	105	105	105	105	105	
	Feed water temperature		°C	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	
	Fuel		liter/hr	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	
	Heavy oil		kg/cm ² g	6	6	6	6	6	6	6	6	6	6	6	
	Atomize press.		kg/cm ² g steam	112	112	112	112	112	112	112	112	112	112	112	
	Temperature		°C	30	30	30	30	30	30	30	30	30	30	30	
	Comb. air		°C	170	170	170	170	170	170	170	170	170	170	170	
	A/H inlet		°C	330	330	330	330	330	330	330	330	330	330	330	
	A/H outlet		°C	-	-	-	-	-	-	-	-	-	-	-	
	Flue gas		°C	300	300	300	300	300	300	300	300	300	300	300	
	A/H inlet		mm Hg	290	290	290	290	290	290	290	290	290	290	290	
	A/H outlet		mm Hg	200	200	200	200	200	200	200	200	200	200	200	
	Furnace pressure		mm Hg	40	40	40	40	40	40	40	40	40	40	40	
	Flue gas		mm Hg	8	8	8	8	8	8	8	8	8	8	8	
	A/H inlet		mm Hg	8	8	8	8	8	8	8	8	8	8	8	
	A/H outlet		mm Hg	8	8	8	8	8	8	8	8	8	8	8	
	A/H heater		mm Hg	8	8	8	8	8	8	8	8	8	8	8	

Analytical data of flue gas		Inside diameter of chimney: 1,970 mm	
Chimney	NOx conc. ppm	267	265
	CO conc. %	< 0.05	< 0.05
	CO ₂ conc. %	10.5	10.1
	O ₂ conc. %	5.2	5.3
	PM conc. g/m ³	0.037	0.037
	Temperature °C	225	216
	Gas velocity m/s	8.7	8.0
	Gas quantity Nm ³ /hr	36,500	34,200
	Theoretical gas quantity Nm ³ /hr	28,300	29,600
A/H inlet	Temperature °C	341	345
	O ₂ conc. %	3.2	3.1
	NOx conc. (0.5%) ppm	270	256
	SO ₂ emission kg/hr	18	18
	PM emission kg/hr	130	130
		1.4	1.4

1 steam atomizing oil burner	
Size of combustion chamber	W 2,195 mm
	D 7,381 mm
	H 4,674 mm
Volume of chamber	75.8 m ³
Load of c/c : rating	440,000 kcal/m ³ hr
Load of c/c : normal	280,000 kcal/m ³ hr
c/c : Combustion chamber	

10.2 Boiler No.3

No.8-3		Name of establishment		Type of facility : No.3 water tube boiler for processing		Date	weather
No.8		Petrochemical Products Factory (B)				October 10, 1990	cloudy
Sampling time	(Rating)	11:30	12:30	13:00	13:30	14:00	
Feed water quant.	ton/hr	13.0	6.5	6.5	6.5	6.5	
Steam pressure	kg/cm2g	13.0	12.6	12.6	12.6	12.6	
Steam temperature	°C	saturated	saturated	saturated	saturated	saturated	
Feed water temp.	°C	25	25	25	25	25	
Fuel Consumption	kg/hr	1,200	600	600	600	600	
Heavy oil Pressure	kg/cm2g	1.1	1.1	1.1	1.1	1.1	
Atomize press.	kg/cm2g	steam	2.7	2.7	2.7	2.7	
Temperature	°C	100	100	100	100	100	
Comb. air temperature	°C	30	30	30	30	30	
Flue gas temperature	°C	240	240	240	240	240	
Air press. wind box	mm Aq	60	60	60	60	60	
Furnace pressure	mm Aq	10	10	10	10	10	

Analytical data of flue gas		Inside diameter of chimney: 1,500 mm	
Chimney	ppm	309	318
NOx conc.	%	<0.05	<0.05
CO conc.	%	12.6	12.5
CO2 conc.	%	5.5	5.6
PM conc.	g/Nm3	0.23	0.23
Temperature	°C	255	255
Gas velocity	m/s	2.4	2.6
Gas quantity	Nm3/hr	5,800	6,200
Theoretical gas quantity	Nm3/hr	8,100	8,300
NOx conc.(O2 5%)	ppm	319	330
NOx emission	kg/hr	3.7	4.0
SO2 emission	kg/hr	34	34
PM emission	kg/hr	1.4	1.4

Size of combustion chamber	
W	1,767 mm
D	4,627 mm
H	2,400 mm
Volume of chamber	19.6 m3
Load of c/c :rating	600,000 kcal/hr
Load of c/c :normal	300,000 kcal/hr
c/c : Combustion chamber	

1 steam atomizing oil burner

11. Petrochemical Products Factory (C)

Boiler No.1

No.87-1

Name of establishment	Petrochemical Products Factory (C)				Date	November 16, 1990	Weather	fair
No.87	Petrochemical Products Factory (C)				Type of facility :	No.1 smoke tube boiler for processing		
Sampling time	12:00	12:30	13:00	13:30	14:00	14:30		
Estimated load	%	20	20	20	20	85		
Steam quantity	t/hr	2.352	7.0	7.0	7.0	7.4		
Steam presser	kg/cm ² g	max 10.5	7.0	7.0	7.0	7.4		
Steam temperature	°C	181 saturated	saturated	saturated	saturated	saturated		
Feed water temp.	°C	70	70	70	70	70		
Fuel	Consumption	liter/hr	158	45	45	45		
Pressure	kg/cm ² g	1.6 / 0.6	1.6 / 0.6	1.6 / 0.6	1.6 / 0.6	1.6 / 0.6		
Atomize press.	kg/cm ² g	air	1	1	1	1		
Temperature	°C		ambience	ambience	ambience	ambience		
Comb. air temperature	°C	225	225	225	240	290		
Flue gas temperature	°C							
Air press. Wind box	mm Aq							
Furnace pressure	mm Aq	estimated	20	20	20	20		

Analytical data of flue gas				Inside diameter of chimney: 400 mm			
Chimney	NOx conc.	ppm	175	170	180	175	195
	CO conc.	%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
	CO ₂ conc.	%	5.7	5.6	5.4	5.3	5.9
	O ₂ conc.	%	13.0	13.0	12.6	12.8	12.0
	PM conc.	g/Nm ³			0.19		
	Temperature	°C	195	195	195	190	203
	Gas velocity	m/s	6.8	6.2	6.2	6.2	6
	Gas quantity	Nm ³ /hr	1,200	1,200	1,200	1,200	1,200
	Theoretical gas quantity	Nm ³ /hr	1,200	1,200	1,200	1,200	1,200
	NOx conc. (02.5%)	ppm	350	340	343	341	346
	NOx emission	kg/hr	0.47	0.42	0.44	0.43	0.48
	SO ₂ emission	kg/hr	2.6	2.6	2.6	2.6	2.6
	PH emission	kg/hr			0.23		

1 heavy oil burner
 LPG is used for pilot burner
 Burner manufacture : SELMEC
 Boiler manufacture : CLEVER BROOKS

Size of combustion chamber	
D	564 mm
L	3,500 mm
Volume of chamber	0.90 m ³
Sectional area	0.20 m ²
Load of c/c : rate	7,720,000 kcal/m ³ hr
c/c : Combustion chamber	
s/a : Sectional area	

12. Asphalt Plant
12.1 Rotary Kiln No.1

Name of establishment No.11 Asphalt Plant		Type of facility : No.1 rotary kiln with asphalt mixing chamber				Date	Weather
Sampling time	(Rating)	12:00	13:00	13:30	14:00	14:30	15:00
Aggregate quantity	ton/hr	250	122	122	122	122	122
Fuel	liter/hr	854	854	854	854	854	854
Diesel	kg/cm2g						
Temperature	°C						
Atmize press.	mm Aq	1,000	1,000	1,000	1,000	1,000	1,000
Feed asphalt quantity	liter/hr	8,550	8,550	8,550	8,550	8,550	8,550
Feed asphalt temperature	°C	115	115	115	115	115	115
Temp. of rear of kiln	°C	110-200	110-200	110-200	110-200	110-200	110-200
Temp. of asphalt mix	°C	140	140	140	140	140	140
Temp. of bag filter	°C	160	160	160	160	160	160

Analytical data of flue gas		inside size of chimney: 2,020 x 750 mm		1.515 m ²	
Chimney	NOx conc.	40	38	50	52
(B/F out- let)	CO conc.	< 0.05	< 0.05	< 0.05	< 0.05
	CO2 conc.	2.4	2.6	2.7	2.8
	O2 conc.	17.0	17.0	16.8	16.8
	PM conc.	1.9	105	106	108
	Temperature	101	105	106	104
	Gas velocity	15.0	15.0	15.0	15.0
	Gas quantity	40,300	39,900	39,800	39,600
Theoretical	gas quantity	39,000	39,000	37,200	37,200
Bag filter	O2 conc.	13.8	13.0	14.2	13.8
inlet	Temperature	150	146	155	145
	PM conc.				
	NOx conc.(02.5%)	160	152	190	198
	NOx emission	3.3	3.1	4.1	4.2
	SO2 emission	15	15	15	15
	PM emission	77			

1 low pressure air atomizing buener (Diesel oil) Kiln dimension 2,590 D X 12,000 L

B/F : Bag filter

12.2 Rotary Kiln No.2

No.11-2		Type of facility : No.2 rotary kiln with asphalt mixing chamber		Date	
Name of establishment		(Rating)		October 5, 1990	
No.11 Asphalt Plant		250		Weather	
Sampling time		11:30		fair	
Aggregate quantity	ton/hr	138	122	127	127
Fuel Consumption	liter/hr	966	854	888	889
Diesel Pressure	kg/cm ² g	-	-	-	-
Temperature	°C	ambience	ambience	ambience	ambience
Atmize press.	mm Hg	1,000	1,000	1,000	1,000
Feed asphalt quantity	liter/hr	9,890	8,550	8,955	8,955
Feed asphalt temperature	°C	115	115	115	115
Temp. of rear of kiln	°C	110	200	110	200
Temp. of asphalt mix	°C	140	140	140	140
Gas temp. of V/S inlet	°C	160	160	160	160

Analytical data of flue gas		Inside diameter of chimney: 1,209 mm	
Chimney	ppm	69	68
(V/S out-let)	%	0.05	0.05
CO conc.	%	4.1	3.7
CO2 conc.	%	15.9	16.0
PH conc.	g/Nm ³	3.0	3.0
Temperature	°C	100	95
Gas velocity	m/s	17.4	15.7
Gas quantity	Nm ³ /hr	33,900	31,000
Theoretical gas quantity	Nm ³ /hr	33,700	30,400
V/S inlet	%	13.4	12.5
Temperature	°C	160	160
NOx conc.(02 5%)	ppm	216	224
NOx emission	kg/hr	4.8	4.5
SO2 emission	kg/hr	17	15
PH emission	kg/hr	93	93

1 low pressure air atomizing buener (Diesel oil) Kiln dimension 2,580 D X 12,000 L

V/S : Venturi scrubber

12.3 Rotary Kiln No.3

No.11-3		Name of establishment		Type of facility : No.3 rotary kiln		Date	Weather
No.11 Asphalt Plant		without asphalt mixing chamber		October 16, 1990		fair	
Sampling time	(Rating)	12:00	13:00	13:30	14:00		
Aggregate quantity	ton/hr	106	155	174	250	106	
Fuel Consumption	liter/hr	469	699	781	1143	747	
Pressure	kg/cm2g	-	-	-	-	-	
Temperature	°C	22	22	22	22	22	
Atomize press.	mm. Ag	-	-	-	-	-	
Temp. of kiln	°C	600	600	600	600	600	
Temp. of aggregate	°C	130	130	130	130	130	
Analytical data of flue gas							
Chimney	inside size of chimney: 990 x 910 mm	0.901 m ²					
(B/F outlet)		41	44	45	45	39	
NOx conc.	ppm						
CO conc.	%	0.10	0.05	< 0.05	< 0.05	< 0.05	
CO2 conc.	%	2.8	2.8	3.0	2.9	3.0	
O2 conc.	%	16.8	16.5	16.5	16.1	16.5	
PH conc.	g/Nm ³				6.2		
Temperature	°C	80	83	85	93	90	
Gas velocity	m/s	33.4	33.4	33.4	33.4	33.4	
Gas quantity	Nm ³ /hr	55,900	55,500	55,200	54,000	54,400	
Theoretical gas quantity	Nm ³ /hr	20,600	28,600	32,000	43,000	30,600	
NOx conc.(02 5%)	ppm	156	156	160	147	139	
NOx emission	kg/hr	4.7	5.0	5.1	5.0	4.4	
SO2 emission	kg/hr	8.4	13	14	20	13	
PM emission	kg/hr				330		
B/F : Bag filter							
1 low pressure air atomizing buener (Diesel oil)							

13. Cement Factory
13.1 Cement Kiln No.4

Name of establishment No.41 Cement Factory		Type of facility : No.4 cement SP Kiln										Date September 18, 1990		Weather				
No.41-4												14:50		15:20	cloudy			
Sampling time		(Rating)										12:20		13:20		14:20		
Clinker quantity		ton/hr										85		87		89		76
Consumption		kg/hr										8,020		8,020		8,020		8,010
Pressure		kg/cm2g										39		39		39		39
Temperature		°C										138		138		138		138
Primary air p.		mm Aq										850		850		850		850
Consumption		kg/hr										800		1,000		1,000		0
Pressure		kg/cm2g										30		33		33		0
Temperature		°C										60		65		70		
Primary air p.		mm Aq																
Material in		°C										120		120		120		120
temp. out		°C										830		830		830		830
Gas temp. in		°C										1,100		1,100		1,100		1,100
out		°C										390		390		390		390
Gas press. in		mm Aq										-42		-42		-42		-42
out		mm Aq										-650		-650		-650		-650
Clinker in		°C										830		830		830		830
temp. out		°C										1,300		1,200		1,200		1,300
Gas press. in		mm Aq										-2		-2		-2		-2
out		mm Aq										-42		-42		-42		-42
Clinker in		°C										1,300		1,200		1,200		1,300
temp. out		°C										145		145		145		145
Gas press. in		mm Aq										328		328		328		328
out		mm Aq										-2		-2		-2		-2
Gas temp. in		°C										390		390		390		390
out		°C										130		130		130		130
Gas press. in		mm Aq										-650		-650		-650		-650
out		mm Aq										-650		-650		-650		-650
Gas temp. in		°C										130		130		130		130
Gas press. in		mm Aq										-55		-55		-55		-55
Kiln outlet O2		%										3		4		4		4
No.2 burner O2		%										4		4		4		6
CO		%										1		0		0		0
E/P inlet CO		%										0		0		0		0
Note, # : Three E/Ps are installed parallel.																		
Analytical data of flue gas																		
inside diameter of chimney: 2,200 mm																		
E/P out-		ppm																
NOx conc.		550																
CO conc.		< 0.05																
CO2 conc.		21.3																
O2 conc.		7.6																
PM conc.		g/Nm3																
Temperature		°C																
Gas velocity		m/s																
Gas quantity		Nm3/hr																
Theoretical gas quantity		Nm3/hr																
E/P inlet O2 conc.		%																
NOx conc.(O2 5%)		ppm																
PM emission		kg/hr																
		41																

13.2 Dryer

No. 41-8 Name of establishment Cement Factory		Type of facility : cement raw material				No. 8 drier for		Date	Weather
No. 41		Type of facility : cement raw material				No. 8 drier for		September 17, 1980	cloudy
Sampling time	(Rating)	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00
Cement raw material quantity/hr	180	157	157	157	157	157	157	157	157
Hot stove Temperature °C		670	685	670	670	670	670	670	670
Pressure mm Hg		-25	-25	-25	-25	-25	-25	-25	-25
Fuel Consumption Nm ³ /hr		644	644	644	644	644	644	644	644
N-gas Pressure kg/cm ² g		0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Combustion Temperature °C		30	30	30	30	30	30	30	30
Air Quantity Nm ³ /hr		-	-	-	-	-	-	-	-
Pressure mm Hg		5	5	5	5	5	5	5	5
Furnace pressure mm Hg		-25	-25	-25	-25	-25	-25	-25	-25
Drier Temperature °C		108	103	103	103	103	103	103	103
Drier outlet Pressure mm Hg		-140	-140	-140	-140	-140	-140	-140	-140
N-gas : Natural gas									

Analytical data of flue gas		Inside diameter of chimney: 1,774 mm									
E/P out-let		27	28	27	28	25	26	25	26	28	
NOx conc.	ppm	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	
CO conc.	%	1.8	1.6	1.5	1.5	1.5	1.5	1.5	1.7	1.8	
CO ₂ conc.	%	17.0	17.1	17.3	17.3	17.4	17.4	17.5	17.5	17.3	
PM conc.	g/Nm ³	-	-	-	-	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	
Temperature	°C	-	-	-	-	92	97	97	93	93	
Gas velocity	m/s	-	-	-	-	7.7	7.7	7.7	7.8	7.8	
Gas quantity	Nm ³ /hr	-	-	-	-	29,400	29,400	29,400	30,100	30,100	
Theoretical gas quantity	Nm ³ /hr	23,800	24,400	25,700	25,700	26,400	26,400	27,200	25,700	25,700	
H/A outlet O ₂ conc.	%	16.5	16.4	16.5	16.5	16.6	16.6	16.6	16.6	16.5	
NOx conc. (O ₂ 5%)	ppm	118	118	118	118	118	118	118	126	129	
NOx emission	kg/hr	-	-	-	-	1.5	1.5	1.5	1.6	1.7	
PM emission	kg/hr	-	-	-	-	< 0.0029	< 0.0029	< 0.0029	< 0.0029	< 0.0029	

E/P : Electric precipitator, H/A : Hot air heater

14. Glass Factory (A)
Glass Melting Furnace B

No. 68-2	Name of establishment No. 68 Glass Factory (A)	Type of facility : No. B glass melting furnace for glass bottle						Date September 28, 1990	Weather fair
		(Rating)	12:30	13:00	13:30	14:00	14:30		
Sampling time		230	173	173	173	173	15:30		
Glass melting quantity	ton/day								
Fuel Consumption	liter/hr	1,400	1,400	1,400	1,354	1,354	1,354	1,354	
Pressure	kg/cm ² g	2	2	2	2	2	2	2	
Atomize press.	kg/cm ² g air	2	2	2	2	2	2	2	
Temperature	°C	147	147	141	141	141	141	141	
R/G inlet (E)	°C	35	35	35	35	35	35	35	
R/G inlet (W)	°C	35	35	35	35	35	35	35	
R/G outlet (E)	°C	644	644	646	646	646	642	642	
R/G outlet (W)	°C	624	624	637	637	642	642	642	
R/G inlet (E)	°C	1,447	1,447	1,446	1,446	1,438	1,400	1,400	
R/G inlet (W)	°C	1,447	1,447	1,446	1,446	1,438	1,400	1,400	
R/G outlet (E)	°C	-	-	-	-	-	-	-	
R/G outlet (W)	°C	-	-	-	-	-	-	-	
Furnace Melting tank	1 °C	1,447	1,447	1,446	1,446	1,438	1,400	1,400	
Furnace temperature	2 °C	1,526	1,526	1,536	1,536	1,536	1,536	1,536	
Working tank (East side)	°C	1,280	1,280	1,278	1,278	1,278	1,278	1,278	
Working tank (West side)	Nm ³ /h	10,000	10,000	9,600	9,600	9,600	9,600	9,600	
Total quantity	Nm ³ /h	10,800	10,800	10,400	10,400	10,400	10,400	10,400	
Air press. Wind box	Nm ³ /h	20,800	20,800	20,000	20,000	20,000	20,000	20,000	
Furnace pressure	mm Hg	21	21	20.5	20.8	20.5	20.3	20.3	
	mm Hg	0.03	0.03	0.03	0.03	0.03	0.03	0.03	

R/G : Regenerator, (E) : east side, (W) : west side

Analytical data of flue gas	Inside diameter of chimney: 1,720 mm	R/G Out-let	
		ppm	660
NOx conc.		705	660
CO conc.		< 0.05	< 0.05
CO ₂ conc.		17.6	17.4
O ₂ conc.		3.2	2.7
PM conc.	g/Nm ³		0.76
Temperature	°C	800	810
Gas velocity	m/s	3.9	3.9
Gas quantity	Nm ³ /hr	11,900	11,800
Theoretical gas quant.	Nm ³ /hr	15,600	15,300
R/G inlet O ₂ conc.	%	1.8	1.8
NOx conc. (O ₂ 5%)	ppm	634	585
SOx emission	kg/hr	17	16
PM emission	kg/hr	74	72
		74	72
		9.0	9.0

Note : Energy usage rate 1,897 Mkal/ton

Size of combustion chamber	
W	6,600 mm
D	15,000 mm
H	1,500 mm
Volume of chamber	148.5 m ³
Load of c/c : rating	- kcal/m ³ hr
Load of c/c : normal	90,000 kcal/m ³ hr

18 heavy oil burners		2 burners	
East side	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0	0
West side	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0	0
		Melting tank	Working tank

15. Glass Factory (B)
Glass Melting Furnace No.2

No. 31-2	Name of establishment No. 31 Glass factory (B)	Type of facility : No. 2 glass melting furnace for glass fiber				Date September 24, 1990	Weather fair
		(Rating)	13:40	14:10	14:40		
Sampling time		0.86	1.078	1.078	1.078	1.078	
Glass melting quantity	ton/hr						
Fuel	N-gas burner	284	284	284	284	284	air-gas burner
consump- tion	m ³ /hr	27	27	27	27	27	02-gas burner
(Melting t)	N-gas total	311	311	311	311	311	
Working t)	02-gas	62	62	62	62	62	
Total natural gas	m ³ /hr	109	109	109	109	109	air-gas burner
Fuel	N-gas burner	420	420	420	420	420	
pressure	02 burner N-gas	1.5	1.5	1.5	1.5	1.5	
	kg/cm ² g						
	02 gas	7	7	7	7	7	
Electric heater	Melting tank	0	0	0	0	0	
	E1	34	34	34	34	34	
	E2	102	102	102	102	102	
	E3	19	19	19	19	19	
	E4	155	155	155	155	155	
Comb. air	Total	30	30	30	30	30	
temp.	A/H inlet	670	670	670	670	670	
	A/H outlet	1,515	1,515	1,515	1,515	1,515	
Flue gas	A/H inlet	1,515	1,515	1,515	1,515	1,515	
temp.	A/H outlet	1,515	1,515	1,515	1,515	1,515	
Furnace	Melting tank	1,515	1,515	1,515	1,515	1,515	
tempera- ture	Working tank	1,230	1,230	1,230	1,230	1,230	
	T1	1,280	1,280	1,280	1,280	1,280	
	T2	1,260	1,260	1,260	1,260	1,260	
	T3	1,260	1,260	1,260	1,260	1,260	
	T4	1,120	1,120	1,120	1,120	1,120	
Air press.	Fan outlet	0.05	0.05	0.05	0.05	0.05	
	mm Aq						
Furnace pressure	Wind box	0.05	0.05	0.05	0.05	0.05	
	mm Aq						
	A/H : Air heater, t : tank						

Analytical data of flue gas		Inside diameter of chimney: 1,220 mm	
Chimney	NOx conc.	ppm	1,195
	%		1,190
	CO conc.	%	< 0.05
	CO2 conc.	%	< 0.05
	02 conc.	%	11.4
	PM conc.	g/Nm ³	5.7
	Temperature	°C	860
	Gas velocity	m/s	4.3
	Gas quantity	Nm ³ /hr	2,900
Theoretical	gas quant.	Nm ³ /hr	3,400
Inside of	Temperature	°C	1,400
furnace	02 conc.	%	0.9
NOx conc. (02 5%)	ppm		1,244
NOx emission	kg/hr		7.1
PM emission	kg/hr		8.9

Size of combustion chamber	
W	1,981 mm
D	6,552 mm
H	1,400 mm
Volume of chamber	18.2 m ³
Load of c/c : rating	150,000 kcal/m ³ hr
Load of c/c : normal	150,000 kcal/m ³ hr
c/c : Combustion chamber	

Melting tank	
1	G G
2	G G
3	G G
4	G G
5	G G
6	G G
7	G G
8	G G
9	G G
10	G G
11	G G
12	G G
13	G G
14	G G
15	G G
16	G G
17	G G
18	G G
19	G G
20	G G

Note : G0 means oxygen burner
Energy usage rate (Total) 3.44 Mka/ton
Energy usage rate (N gas) 3.31 Mka/ton
Energy usage rate (Elec.) 144 kwh/ton

16. Glass Factory (C)

16.1 Glass Melting Furnace No.84

No. 23-1	Name of establishment No. 23 Glass Factory (C)	Type of facility : No.84 glass melting furnace for glass bottle (400 t/hr)				Date				Weather				
		(Rating)		12:00		13:30		14:00		November 13, 1990		15:30		16:30
Sampling time			1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440
Furnace temperature			2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280
Fuel Consumption	Nm ³ /hr		1	1	1	1	1	1	1	1	1	1	1	1
N-gas Pressure	kg/cm ² g		ambience	ambience	ambience	ambience	ambience	ambience	ambience	ambience	ambience	ambience	ambience	ambience
Comb. air R/G inlet temp.	°C		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
R/G outlet	°C	estimated	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440
Flue gas R/G inlet temp.	°C		465	465	465	465	465	465	465	465	465	465	465	465
R/G outlet	°C		27,300	27,300	27,300	27,300	27,300	27,300	27,300	27,300	27,300	27,300	27,300	27,300
Feed air quantity	Nm ³ /hr		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Air press. burner inlet	mm Aq		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Furnace pressure	mm Aq		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

Analytical data of flue gas Inside diameter of chimney: 3,784 mm

R/G Out-let	NOx conc.	ppm	610	540	530	630	610	540
	CO conc.	%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
	CO ₂ conc.	%	9.5	9.6	9.8	9.2	10.6	10.6
	O ₂ conc.	%	7.0	6.7	6.5	6.5	7	6.7
	PM conc.	g/Nm ³			0.12			
	Temperature	°C	410	400	393	420	403	403
	Gas velocity	m/s	3.6	3.0	2.8	3.4	3.2	2.0
	Gas quantity	Nm ³ /hr	38,900	32,900	31,000	36,200	34,900	21,800
	Theoretical gas quant.	Nm ³ /hr	32,400	31,700	31,200	31,200	32,400	31,700
	NOx conc. (O ₂ 5%)	ppm	697	604	585	695	697	604
	PM emission	kg/hr	50	36	34	50	44	24

Note : Production plan on the date measurement conducted 368ton/day.

Nozzle mix gas burners are installed at the hot air ports which supply combustion air from regenerative heat exchanger to the furnace. There are 6 ports, 2 burners installed on each port, 12 burners installed on one side, so total number of burner is 24 sets.

Gas consump.	H81	H82	H84	PEMEX
Jun	599,990	1,035,775	1,507,770	4,743,118
Jul	651,240	1,062,100	1,806,520	5,220,101
Aug	684,840	1,174,975	1,651,760	5,349,184

(m³/month)

Size of combustion chamber	
W	6,706 mm
D	10,973 mm
H	2,095 mm
Volume of chamber	154.1 m ³
Load of c/c : Rating	-
Load of c/c : normal	130,000 kcal/m ³ hr

c/c : Combustion chamber

16.2 Glass Melting Furnace No.82

No. 23-2

Name of establishment No. 23 Glass Factory (C)		Type of facility : No. 82 glass melting furnace for glass bottle (200 t/hr)				Date November 13, 1990		Weather fair	
Sampling time	(Rating)	12:30	13:30	14:00	14:30	15:00	15:30	16:00	16:30
Furnace temperature	°C	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450
Fuel	Nm ³ /hr	1,840	1,840	1,840	1,840	1,840	1,840	1,840	1,840
N-gas	kg/cm ² g	1	1	1	1	1	1	1	1
Comb. air	°C	ambience	ambience	ambience	ambience	ambience	ambience	ambience	ambience
R/G inlet	°C	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
R/G outlet	°C	est. imated							
Fine gas	°C	1,492	1,492	1,492	1,492	1,492	1,492	1,492	1,492
temp.	°C	564-574	564-574	564-574	564-574	564-574	564-574	564-574	564-574
Comb. air quantity	Nm ³ /hr	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500
Air press.	mm Hg	-	-	-	-	-	-	-	-
Fan outlet	mm Hg	-	-	-	-	-	-	-	-
Burner inlet	mm Hg	-	-	-	-	-	-	-	-
Furnace pressure	mm Hg	1.0-1.2	1.0-1.2	1.0-1.2	1.0-1.2	1.0-1.2	1.0-1.2	1.0-1.2	1.0-1.2
R/G : Regenerator									

Analytical data of flue gas Inside diameter of chimney: 3.217 mm

R/G Out-let	N ₂ O _x conc.	ppm	835	600	550	-	-	-	800	660	640
	CO conc.	%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
	CO ₂ conc.	%	10.8	10.5	10.6	10.3	11.0	11.6	10.5	11.3	11.0
	O ₂ conc.	%	5.5	6.0	5.8	5.7	5.0	5.0	5.5	6.0	5.5
	PM conc.	g/Nm ³	-	-	-	-	0.39	-	-	-	-
	Temperature	°C	460	470	455	445	470	460	465	455	470
	Gas velocity	m/s	-	-	-	-	4.5	4.0	4.0	4.0	4.0
	Gas quantity	Nm ³ /hr	-	-	-	-	32,300	31,300	28,900	29,300	28,700
	Theoretical gas quant.	Nm ³ /hr	23,600	24,400	24,000	23,900	22,800	22,800	23,600	24,400	23,600
	N ₂ O _x conc. (O ₂ 5%)	ppm	862	640	642	575	-	-	-	853	681
	PM emission	kg/hr	-	-	-	-	-	-	-	50	40

Note : Production plan on the date measurement conducted 212ton/day
 Nozzle mix gas burners are installed at the hot air ports which supply
 combustion air from regenerative heat exchanger to the furnace.
 There are 5 ports, 2 burners installed on each port, 10 burners installed
 on one side, so total number of burner is 20 sets.

Size of combustion chamber	
W	6,706 mm
D	10,973 mm
H	2,095 mm
Volume of chamber	154.1 m ³
Load of c/c : rating	- kcal/m ³ hr
Load of c/c : normal	100,000 kcal/m ³ hr
c/c : Combustion chamber	

Gas consump.	H81	H82	H84	PEMEX
Jun	599,990	1,035,775	1,507,770	4,743,118
Jul	651,240	1,062,100	1,606,520	5,220,101
Aug	684,840	1,174,975	1,651,760	5,349,184
	(m ³ /month)			

17. Rubber Products Factory
Boiler

No. 14-1

Name of establishment		Type of facility : 800Hp water tube boiler for processing		Date		Weather	
No. 14 Rubber Products Factory				September 25, 1990		fair	
Sampling time	(Rating)	11:30	12:30	13:00	13:30	14:00	14:40
Feed water quant.	ton/hr	10.0	4.5	3.9	5.0	4.8	6.0
Steam pressure	kg/cm ² g	24	16	16	16	16	16
Steam temperature	°C	saturated	saturated	saturated	saturated	saturated	saturated
Feed water temp.	°C	101	101	101	101	101	102
Fuel	Consumption liter/hr	814	372	390	438	420	390
Heavy oil	Pressure kg/cm ² g	2.4	3.8	2.1	2.7	2.6	2.1
	Atomize press. kg/cm ² g	steam	3.4	5.0	3.7	4.1	4.0
	Temperature °C	110	115	115	113	112	113
Comb. air temperature	°C	35	35	35	35	35	35
Flue gas temperature	°C	280	320	280	280	280	300
Air press. Wind box	mm Aq		110	80	85	80	110
furnace pressure	mm Aq	--	60	--	--	--	--

Analytical data of flue gas

Chimney	Inside diameter of chimney: 690 mm	
	ppm	155
NOx conc.	142	145
CO conc.	< 0.05	< 0.05
CO ₂ conc.	7.2	6.6
O ₂ conc.	8.0	10.0
PM conc.		0.26
Temperature	285	285
Gas velocity	14.4	14.5
Gas quantity	6,500	5,900
Theoretical gas quantity	7,700	7,100
NOx conc. (O ₂ 5%)	191	207
NOx emission	2.1	1.7
SO ₂ emission	29	26
PM emission		1.7

Size of combustion chamber	
W	1,700 mm
D	5,588 mm
H	2,000 mm
Volume of chamber	19.0 m ³
Load of c/c : rating	420,000 kcal/m ² hr
Load of c/c : normal	190,000 kcal/m ² hr
c/c : Combustion chamber	

1 Heavy oil burner
Register : DAZ type
Burner nozzle : inside mixing type
Burner maker : COBN CO.
Boiler maker :
PROTHERM DE MEXICO FABRICACION
S.A. DE C.V.

18. Paper Factory
Boiler No.1 and No.2

No.30-1.2		Name of establishment		Type of facility : No.1,2 water tube boiler for power generation		Date		Weather	
No.30 Paper Factory		No.1,2 Paper Factory		October 4, 1990		fair			
Sampling time		(Rating)		12:30		13:30		14:30	
Name of boiler		NO.1		NO.2		NO.1		NO.2	
Power capacity	kW	1,000	900	900	900	900	900	900	900
Evaporation	ton/hr	12.9	15.9	8.4	11.5	8.4	11.5	8.4	11.5
Steam pressure	kg/cm2g	19	18	18	18	18	18	18	18
Steam temperature	°C	301	301	270	270	270	270	270	270
Feed water temperature	°C			90	90	90	90	90	90
Fuel Consumption	liter/hr	1,100	1,350	714	973	714	973	714	973
Heavy oil Pressure	kg/cm2g								
Atomize press.	kg/cm2g								
Temperature	°C			90	100	90	100	90	100
Comb. air A/H inlet	°C			ambience	ambience	ambience	ambience	ambience	ambience
A/H outlet	°C			200	200	200	200	200	200
Flue gas A/H inlet	°C			286	450	288	460	288	462
A/H outlet	°C			163	265	163	265	166	265
Air press. fan outlet	mm Aq			37	65	37	65	37	65
Wind box	mm Aq								
Furnace pressur	mm Aq			-5	-1.5	-5	-1.5	-5	-1.5
Flue gas A/H inlet	mm Aq								
pressur. A/H outlet	mm Aq			-10	-10	-10	-10	-10	-10
A/H : Air heater									

Analytical data of flue gas		Inside diameter of chimney: 1,960 mm	
Chimney	NOx conc. ppm	(boiler outlet)	175
NOx conc.	ppm		155
CO conc.	%	(boiler outlet)	< 0.05
CO2 conc.	%	(boiler outlet)	8.0
O2 conc.	%	(boiler outlet)	10.8
PM conc.	g/Nm3		11.8
Temperature	°C		215
Gas velocity	m/s		7.5
Gas quantity	Nm3/hr		31,100
Theoretical gas quantity	Nm3/hr		36,400
A/H inlet Temperature	°C		286
O2 conc.	%		10.8
A/H out- Temperature	°C		163
let O2 conc.	%		13.2
NOx conc. (O2 5%)	ppm		270
NOx emission	kg/hr		10
SO2 emission	kg/hr		100
PM emission	kg/hr		14

Size of combustion chamber (No.2 Boiler)	
W	3,524 mm
D	3,500 mm
H	3,000 mm
Volume of chamber	37.0 m3
Load of c/c : rating	360,000 kcal/m3hr
Load of c/c : normal	280,000 kcal/m3hr
c/c : Combustion chamber	

No.1 boiler		No.2 boiler	
2 heavy oil burners		3 heavy oil burners	
A	0	A	0
B	0	B	0
Y-jet burner	0	Y-jet burner	0

No.1 boiler		No.2 boiler	
2 heavy oil burners		3 heavy oil burners	
A	1	A	1
B	0	B	0
Y-jet burner	0	Y-jet burner	0

19. Paper Products Factory (A)
Boiler No.1

Name of establishment		Type of facility : No.1 water tube boiler for processing				Date	weather
No.34 Paper Products Factory (A)						September 27, 1990	fair
Sampling time	(Rating)	13:00	14:00	14:30	15:00		
Feed water quant.	ton/hr	9.4	12.0	13.0	11.0	12.5	
Steam pressure	kg/cm2g	10.0	12.0	13.0	11.0	12.5	
Steam temperature	°C	saturated	saturated	saturated	saturated	saturated	
Fuel	Consumption liter/hr	808	820	800	800	800	
Heavy oil	kg/cm2g	2.8	2.8	2.8	2.8	2.8	
	Atomize press. kg/cm2g	4.3	4.3	4.3	4.3	4.3	
	Temperature °C	85	85	85	85	85	
Comb. air temperature	°C	30	30	30	30	30	
Flue gas temperature	°C	235	235	235	235	235	
Air press. Fan outlet	mm Aq	130	130	130	130	130	
Wind box	mm Aq	-15	-15	-15	-15	-15	
Furnace pressure	mm Aq	-30	-30	-30	-30	-30	
Analytical data of flue gas Inside diameter of chimney: 1,650 mm							
Chimney	NOx conc. ppm	120	128	115	130	118	130
	CO conc. %	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
	CO2 conc. %	7.8	7.4	8.0	6.9	7.6	5.7
	O2 conc. %	9.6	10.3	9.3	10.3	9.8	11.8
	PM conc. g/m3		0.28				
	Temperature °C	253	258	258	249	253	250
	Gas velocity m/s	4.7	5.3	6.3	5.1	4.6	4.6
	Gas quantity Nm3/hr	13,500	15,100	18,000	14,800	13,300	13,300
Theoretical gas quantity	Nm3/hr	15,100	16,100	14,300	15,700	15,000	18,200
Exhauster	Temperature °C	385	381	387	382	388	376
	CO2 conc. %	5.1	5.3	3.8	5.3	4.8	7.5
NOx conc. (02.5%)	ppm	168	191	157	194	169	226
NOx emission	kg/hr	3.3	4.0	4.3	4.0	3.2	3.6
SO2 emission	kg/hr	48	48	46	46	46	46
PM emission	kg/hr			5			

Size of combustion chamber	
W	1,700 mm
D	5,588 mm
H	2,000 mm
Volume of chamber	19.0 m3
Load of c/c : rating	420,000 kcal/m3hr
Load of c/c : normal	420,000 kcal/m3hr
c/c : Combustion chamber	

B & W

2 Heavy oil burners
Register : Single lower type
Burner nozzle : Y-jet type
Burner maker : パーナルスル : Y-jet
Boiler maker : B & W

20. Paper Products Factory (B)
Boiler No.1

No. 76-1

Name of establishment		Type of facility : No.1 water tube boiler for processing		Date		Weather			
No. 76 Paper Products Factory (B)				November 7, 1990		cloudy			
Sampling time	(Rating)	11:00	11:30	12:00	12:25	13:25	14:00	14:30	15:00
Estimated steam quantity ton/hr	9.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Steam pressure kg/cm ² g	max 17.2	8.2	8.0	8.0	8.2	8.0	8.0	8.0	8.0
Steam temperature °C		saturated	saturated	saturated	saturated	saturated	saturated	saturated	saturated
Feed water temp. °C		95	95	95	95	95	95	95	95
Fuel Consumption liter/hr	870	783	783	783	783	783	783	783	783
Heavy oil Pressure kg/cm ² g		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Atomize press. kg/cm ² g	steam	7.3	7.3	7.3	7.3	7.2	7.2	7.2	7.2
Temperature °C		101	102	102	102	102	102	102	102
Comb. air temperature °C		ambience	ambience	ambience	ambience	ambience	ambience	ambience	ambience
Flue gas temperature °C		350	355	340	345	360	355	355	335
Air press. Wind box mm Hg		-	-	-	-	-	-	-	-
Furnace pressure mm Hg		-	-	-	-	-	-	-	-

↑ normal operation ↑ low air ratio 1 ↑ low air ratio (min.) 2

Analytical data of flue gas

Chimney	NOx conc. ppm	CO conc. %	CO ₂ conc. %	O ₂ conc. %	PM conc. g/Nm ³	Temperature °C	Gas velocity m/s	Gas quantity Nm ³ /hr	Theoretical gas quantity Nm ³ /hr	NOx conc. (0.5%) ppm	SO ₂ emission kg/hr	PM emission kg/hr	inside diameter of chimney: 730 mm	
													190	180
		< 0.05	< 0.05	9.5	6.8	350	14.4	6,600	11,200	214	45	45	195	187
		10.0	9.0	6.5	0.034	355	14.3	6,400	10,200	200	45	45	< 0.05	< 0.05
		6.8	6.8	6.5		340	13.7	6,200	9,900	187	45	45	11.0	11.0
						360	13.7	6,400	10,100	190	45	45	5.4	5.2
						355	12.7	6,100	10,100	185	45	45	5.2	5.2
						360	12.7	6,200	10,100	185	45	45	5.2	5.2
						355	12.7	6,400	10,100	185	45	45	5.2	5.2
						340	12.7	6,200	10,100	185	45	45	5.2	5.2
						360	12.7	6,400	10,100	185	45	45	5.2	5.2
						355	12.7	6,200	10,100	185	45	45	5.2	5.2
						340	12.7	6,400	10,100	185	45	45	5.2	5.2
						360	12.7	6,200	10,100	185	45	45	5.2	5.2
						355	12.7	6,400	10,100	185	45	45	5.2	5.2
						340	12.7	6,200	10,100	185	45	45	5.2	5.2
						360	12.7	6,400	10,100	185	45	45	5.2	5.2
						355	12.7	6,200	10,100	185	45	45	5.2	5.2
						340	12.7	6,400	10,100	185	45	45	5.2	5.2
						360	12.7	6,200	10,100	185	45	45	5.2	5.2
						355	12.7	6,400	10,100	185	45	45	5.2	5.2
						340	12.7	6,200	10,100	185	45	45	5.2	5.2
						360	12.7	6,400	10,100	185	45	45	5.2	5.2
						355	12.7	6,200	10,100	185	45	45	5.2	5.2
						340	12.7	6,400	10,100	185	45	45	5.2	5.2
						360	12.7	6,200	10,100	185	45	45	5.2	5.2
						355	12.7	6,400	10,100	185	45	45	5.2	5.2
						340	12.7	6,200	10,100	185	45	45	5.2	5.2
						360	12.7	6,400	10,100	185	45	45	5.2	5.2
						355	12.7	6,200	10,100	185	45	45	5.2	5.2
						340	12.7	6,400	10,100	185	45	45	5.2	5.2
						360	12.7	6,200	10,100	185	45	45	5.2	5.2
						355	12.7	6,400	10,100	185	45	45	5.2	5.2
						340	12.7	6,200	10,100	185	45	45	5.2	5.2
						360	12.7	6,400	10,100	185	45	45	5.2	5.2
						355	12.7	6,200	10,100	185	45	45	5.2	5.2
						340	12.7	6,400	10,100	185	45	45	5.2	5.2
						360	12.7	6,200	10,100	185	45	45	5.2	5.2
						355	12.7	6,400	10,100	185	45	45	5.2	5.2
						340	12.7	6,200	10,100	185	45	45	5.2	5.2
						360	12.7	6,400	10,100	185	45	45	5.2	5.2
						355	12.7	6,200	10,100	185	45	45	5.2	5.2
						340	12.7	6,400	10,100	185	45	45	5.2	5.2
						360	12.7	6,200	10,100	185	45	45	5.2	5.2
						355	12.7	6,400	10,100	185	45	45	5.2	5.2
						340	12.7	6,200	10,100	185	45	45	5.2	5.2
						360	12.7	6,400	10,100	185	45	45	5.2	5.2
						355	12.7	6,200	10,100	185	45	45	5.2	5.2
						340	12.7	6,400	10,100	185	45	45	5.2	5.2
						360	12.7	6,200	10,100	185	45	45	5.2	5.2
						355	12.7	6,400	10,100	185	45	45	5.2	5.2
						340	12.7	6,200	10,100	185	45	45	5.2	5.2
						360	12.7	6,400	10,100	185	45	45	5.2	5.2
						355	12.7	6,200	10,100	185	45	45	5.2	5.2
						340	12.7	6,400	10,100	185	45	45	5.2	5.2
						360	12.7	6,200	10,100	185	45	45	5.2	5.2
						355	12.7	6,400	10,100	185	45	45	5.2	5.2
						340	12.7	6,200	10,100	185	45	45	5.2	5.2
						360	12.7	6,400	10,100	185	45	45	5.2	5.2
						355	12.7	6,200	10,100	185	45	45	5.2	5.2
						340	12.7	6,400	10,100	185	45	45	5.2	5.2
						360	12.7	6,200	10,100	185	45	45	5.2	5.2
						355	12.7	6,400	10,100	185	45	45	5.2	5.2
						340	12.7	6,200	10,100	185	45	45	5.2	5.2
						360	12.7	6,400	10,100	185	45	45	5.2	5.2
						355	12.7	6,200	10,100	185	45	45	5.2	5.2
						340	12.7	6,400	10,100	185	45	45	5.2	5.2
						360	12.7	6,200	10,100	185	45	45	5.2	5.2
						355	12.7	6,400	10,100	185	45	45	5.2	5.2
						340	12.7	6,200	10,100	185	45	45	5.2	5.2
						360	12.7	6,400	10,100	185	45	45	5.2	5.2
						355	12.7	6,200	10,100	185	45	45	5.2	5.2
						340	12.7	6,400	10,100	185	45	45	5.2	5.2
						360	12.7	6,200	10,100	185	45	45	5.2	5.2
						355	12.7	6,400	10,100	185	45	45	5.2	5.2
						340	12.7	6,200	10,100	185	45	45	5.2	5.2
						360	12.7	6,400	10,100	185	45	45	5.2	5.2
						355	12.7	6,200	10,100	185	45	45	5.2	5.2
						340	12.7	6,400	10,100	185	45	45	5.2	5.2
						360	12.7	6,200	10,100	185	45	45	5.2	5.2
						355	12.7	6,400	10,100	185	45	45	5.2	5.2
						340	12.7	6,200	10,100	185	45	45	5.2	5.2
						360	12.7	6,400	10,100	185	45	45	5.2	5.2
						355	12.7	6,200	10,100	185	45	45	5.2	5.2
						340	12.7	6,400	10,100	185	45	45	5.2	5.2
						360	12.7	6,200	10,100	185	45	45	5.2	5.2
						355	12.7	6,400	10,100	185	45	45	5.2	5.2
						340	12.7	6,200	10,100	185	45	45	5.2	5.2
</														

21. Metal Products Factory (A)
Heating Furnace

No. 55-1

Name of establishment		Type of facility : Heating furnace				Date	Weather
No. 55 Metal Products Factory (A)		for casting billet				November 5, 1980	fair
Sampling time	(Rating)	11:00	12:00	12:30	13:00	13:30	
Fuel	Consumption Nm ³ /hr	1,000	782	782	782	782	
Natural gas	Temperature °C	4.0	4.0	4.0	4.0	4.0	
	Pressure kg/cm ² g	0.8	0.8	0.8	0.8	0.8	
	Comb. air temperature °C	ambience	ambience	ambience	ambience	ambience	
	Flue gas temperature °C	1,040	1,040	1,040	1,040	1,040	
	Max. temp. in furnace °C	1,200	1,200	1,200	1,200	1,200	
	Air press. Window box mm Aq	-	-	-	-	-	
	Furnace pressure mm Aq	-1	-1	-1	-1	-1	

Note: Gas consumption is of assumed value based on 3 months (7,8,9) monthly consumption and operating hours.
Applied efficiency is of assumed value approx. 10.5%

Analytical data of flue gas

Inside diameter of chimney: 610 mm

Chimney	NOx conc.	ppm	19	135	100	115	125	120
	CO conc.	%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
	CO ₂ conc.	%	3.3	10.0	8.6	9.2	8.3	8.5
	O ₂ conc.	%	14.7	2.9	4.5	3.8	4.9	4.8
	PM conc.	g/Nm ³	*	*	*	*	*	*
	Temperature °C		765	945	930	870	800	705
	Gas velocity m/s		17.6	17.6	17.6	17.6	17.6	17.6
	Gas quantity Nm ³ /hr		-	-	-	6,000	-	-
	Theoretical gas quantity Nm ³ /hr		-	-	-	9,200	-	-
	NOx conc. (02.5%) ppm		48	119	97	107	124	119
	PM emission kg/hr		-	-	-	1.42	-	-
	PM emission kg/hr		-	-	-	-	-	-

* : It was impossible to measure PM because working environment was high temperature.

Furnace general specification		Burner general specification	
Type	Sloped hearth pusher furnace	Type	Nozzle mix gas burner
Use	Billet heater for rod mill	Type	NORTH AMERICAN MFC. Co.
Out side	4,160 W#1,860 H#10,550 L	Number	2
In side	2,560 W#1,200 H#10,550 L		

Furnace operating condition						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
Light on	Closed	5:30	5:30	5:30	5:30	5:30
Shut down	Closed	22:00	22:00	22:00	22:00	22:00
Start ope.	Closed	7:00	7:00	7:00	7:00	7:00
Finish ope.	Closed	22:30	22:30	22:30	22:30	22:30

30 minutes, noon recess from 1 o'clock pm. 16.5 hour operation in a day.

Size of combustion chamber	
W	2,560 mm
D	1,200 mm
H	10,550 mm
Volume of chamber	32.4 m ³
Load of c/c : rate	270,000 kcal/m ³ hr
Load of c/c : normal	210,000 kcal/m ³ hr
Load of s/a : rate	2,800,000 kcal/m ² hr
c/c : Combustion chamber	
s/a : Sectional area	

22. Metal Products Factory (B)

22.1 Aluminum Melting Furnace (1st survey)

No.19-1(1)

Name of establishment	Metal Products Factory (B)		Type of facility : Aluminum melting furnace for extrusion molding	Date	November 8, 1990	Weather	fair/cloudy
No.19	(Rating)		12:00	12:30	13:00	13:30	14:00
Sampling time			melting	remove slag	tapping	molding of ingot	
Operation condition of furnace			820	820	790	790	760
Furnace temperature	°C		117	117	117	117	72
Fuel	Consumption Nm ³ /hr		264	264	264	264	264
N-gas	mm Ag		185	185	185	185	185
Comb. air temperature	°C		ambience	ambience	ambience	ambience	ambience
Air press. Window box	mm Ag		279.4	279.4	279.4	279.4	279.4
Furnace pressure	mm Ag		-1	-1	-1	-1	-1
N-gas : natural gas							

Analytical data of flue gas

Chimney #	Inside diameter of chimney: 747 mm		7	5	8	16
NOx conc.	ppm		< 0.05	< 0.05	< 0.05	< 0.05
CO conc.	%		2.8	2.7	2.7	2.6
CO2 conc.	%		15.7	15.5	15.5	15.7
PM conc.	g/Nm ³		280	80	250	290
Temperature	°C		4.5	4.3	3.2	3.7
Gas velocity	m/s		2.600	3.900	2.000	2.100
Theoretical gas quantity	Nm ³ /hr		4,900	4,700	-	3,000
NOx conc.(O2 5%)	ppm		24	20	100	48
PM emission	kg/hr		0.04	0.04	0.03	0.07
PM emission	kg/hr			2.2		

Note # : flue gas was diluted with air at hood between chimney and duct.

Size of combustion chamber

W	3,960 mm
D	1,715 mm
H	3,860 mm
Volume of chamber	26.2 m ³
Load of c/c : rate	100,000 kca/m ³ hr
Load of c/c : normal	40,000 kca/m ³ hr

c/c : Combustion chamber

Furnace general specification		Burner general specification	
Type	Reverberatory furnace	Type	HMG1080 natural gas
Use	Production of aluminum ingot	Manufac.	HAUCK MANUFACTURING Co.
Outside	4,686W x 4,165H x 4,678L	P.A.	U.S.A
Inside	3,960W x 1,715H x 3,860L	Number	1
Manufac.	HORNOS INDUSTRIALES	Blower	4,699 m ³ /h

Operation 2 times a day.
 Operated during a year, except closed days of 2 weeks. When this large melting furnace is out of order, 4 of small melting furnace are to be operated at their max capacity.

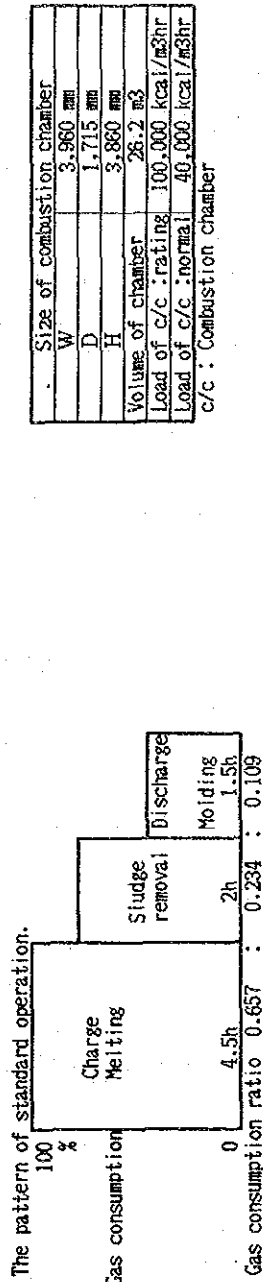
Gas consumption

1 Large melting furnace	30% x 1	30
2 Small melting furnace	7.5% x 4	30
3 Car type annealing furnace	6.0% x 1	6
4 Hot air normalizing furnace	6.0% x 4	24
Total		90

22.2 Aluminum Melting Furnace (2nd survey)

No.19-1 (2)		Name of establishment		Type of facility : Aluminum melting furnace for extrusion molding ingot		Date		Weather	
No.19		Metal Products Factory (B)		12:55 13:00 13:30 14:00		November 9, 1990		Fair/cloudy	
Sampling time		(Rating)		start to charge, finish 13:19 → ← melting		14:30 15:00		15:30 16:00	
Operation condition of furnace		°C		760 740 720 730		730 780		790 790	
Furnace temperature		Nm ³ /hr		264		117		117 117	
Fuel Consumption		mm Aq		165 estimated		35 35		35 35	
N-gas Pressure		°C		ambience		ambience		ambience ambience	
Comb. air temperature		mm Aq		279.4		60 60		60 60	
Air press. Window box		mm Aq		-1		-1		-1 -1	
Furnace pressure		mm Aq		-1		-1		-1 -1	
N-gas : Natural gas									

Analytical data of flue gas		Inside diameter of chimney: 477 mm	
Flue duct	NOx conc. ppm	28	28
	CO conc. %	< 0.05	< 0.05
	CO2 conc. %	7.0	7.0
	O2 conc. %	6.8	6.7
	PM conc. g/Nm ³	0.13	0.13
	Temperature °C	770	840
	Gas velocity m/s	12.0	14.5
	Gas quantity Nm ³ /hr	1,400	1,700
	Theoretical gas quantity Nm ³ /hr	1,700	1,700
	NOx conc. (02.5%) ppm	32	31
	PM emission kg/hr	0.08	0.09
			0.22



Size of combustion chamber	
W	3,960 mm
D	1,715 mm
H	3,860 mm
Volume of chamber	26.2 m ³
Load of c/c : rating	100,000 kcal/m ³ hr
Load of c/c : normal	40,000 kcal/m ³ hr
c/c : Combustion chamber	

23. Food Products Factory
Boiler No.2

Name of establishment No.65 Food Products Factory		Type of facility : No.2 water tube boiler for processing				Date October 31, 1990		Weather fair	
Sampling time	(Rating)	11:00	12:00	12:30	13:00	13:30	13:50	14:50	15:15
Steam quantity	ton/hr	20.4	19.5	22.8	22.8	21.6	38.0	36.0	20.4
Steam pressure	kg/cm ² g	14.0	12.0	10.9	10.9	10.8	12.0	11.6	11.8
Steam temperature	°C	saturated	saturated	saturated	saturated	saturated	saturated	saturated	saturated
Feed water temp.	°C	97	98	98	98	98	96	97	98
Fuel Consumption #	liter/hr	2,800	2,800	2,800	2,800	2,800	4,500	4,500	2,800
Heavy oil Pressure	kg/cm ² g	11.0	11.0	11.0	11.0	11.0	13.0	13.0	13.0
Atomize press.	kg/cm ² g	11.5	11.5	11.5	11.5	11.5	11.8	11.0	11.0
Temperature	°C	98	98	99	99	99	98	97	97
Comb. air temperature	°C	21/85	22/90	23/90	23/90	25/91	24/120	25/120	27/100
Flue gas temp. A/H in/out	°C	280/205	275/205	280/205	280/205	280/205	352/262	370/250	265/200
Air press. Wind box	mm Aq	105	105	106	106	110	370	270	90
Furnace pressure	mm Aq								

A/H : air heater
* : Consumption was measured by float level of tank.
↑ normal operation.
↑ max. Load
↑ low air ratio

Analytical data of flue gas		Inside diameter of chimney: 1,677 mm	
Chimney			
NOx conc.	ppm	165	182
CO conc.	%	< 0.05	< 0.05
CO2 conc.	%	9.8	10.5
O2 conc.	%	7.4	5.4
PM conc.	g/Nm ³		
Temperature	°C	180	185
Gas velocity	m/s	4.1	4.1
Gas quantity	Nm ³ /hr	13,700	13,600
Theoretical gas quantity	Nm ³ /hr	41,800	38,900
NOx conc. (O2 5%)	ppm	194	187
NOx emission	kg/hr	4.6	4.7
SO2 emission	kg/hr	180	160
PM emission	kg/hr		

Size of combustion chamber	
W	1,920 mm
D	3,900 mm
H	5,310 mm
Volume of chamber	36.7 m ³
Load of c/c : rating	820,000 kcal/m ³ hr
Load of c/c : normal	750,000 kcal/m ³ hr

c/c : Combustion chamber
1 heavy oil burner installed.
Diesel oil is used when start-up the boiler.
Butane gas is used for pilot burner.
Burner : B & W Mark 'V' atomizer
Boiler : Babcock & wilcox (de Mexico, S.A. DE C.V.)

24. Alcoholic Drinks Factory
Boiler No.2

No.47-1

Name of establishment		Type of facility : No.2 water tube boiler for power generation		Date	Weather
No.47 Alcoholic Drinks Factory				September 26, 1990	fair
Sampling time	(Rating)	15:00	16:30	17:00	17:30
Power capacity	kW	41,800	61	47	47
Evaporation	ton/hr	63.5	61	47	47
Steam pressure	kg/cm ² g	30	28.8	28.8	28.8
Steam temperature	°C	343	345	345	345
Fuel	liter/hr	5,400	4,700	4,700	4,700
Heavy oil	kg/cm ² g	5.0	5.0	4.8	4.8
Atomize press.	kg/cm ² g steam	6.0	6.0	5.8	5.8
Temperature	°C	105	105	105	105
Comb. air	A/H inlet	30	30	30	30
temp.	A/H outlet	190	195	195	195
Flue gas	A/H inlet	315	315	317	317
temp.	A/H outlet	190	190	190	190
Air press.	Wind box	310	310	280	280
Furnace pressure	mm Ag	145	145	130	130
Flue gas	A/H inlet	80	80	73	73
pressure	A/H outlet	3	3	2	2
A/H : Air heater					

Analytical data of flue gas		Size of duct: 2.4 m ² (1,000 x 2,400 mm)	
Flue duct	ppm	242	240
NOx conc.	%	< 0.05	< 0.05
CO conc.	%	12.0	11.1
CO ₂ conc.	%	4.3	5.5
O ₂ conc.	%	0.41	0.41
PH conc.	g/Nm ³	178	176
Temperature	°C	16.9	16.3
Gas velocity	m/s	61,800	61,800
gas quantity	Nm ³ /hr	65,600	66,200
Theoretical gas quantity	Nm ³ /hr	320	320
A/H inlet	°C	2.5	3.1
Temperature	%	232	256
O ₂ conc.	ppm	31	30
NOx conc.(02.5%)	kg/hr	310	270
NOx emission	kg/hr	25	25
SO ₂ emission	kg/hr		
PH emission	kg/hr		

Burner operating condition (4-oil burners, 0-gas burner)	
A	0/ 0/ 3 4
B	0/ 0/ 0/ 0/

Burner installation condition (3-oil burners, 3-gas burners)

A	1 2 3 4
B	0/G 0/G 0/G 0/G

Corner firing arrangement

Size of combustion chamber	
W	4,700 mm
D	4,156 mm
H	8,534 mm
Volume of chamber	166.7 m ³
Load of c/c rating	320,000 kcal/m ³ hr
Load of c/c : normal	320,000 kcal/m ³ hr

c/c : Combustion chamber

25. Public Bathhouse
Boiler No.1

No. 52-1

Name of establishment No. 52 Public Bathhouse		Type of facility : No.1 smoke tube boiler				Date November 19, 1990	Weather fair
Sampling time	(Rating)	11:00	12:00	12:30	13:00	13:30	
Steam quantity	ton/hr	1.56	1.00	0.80	0.64	0.51	0.41
Steam pressure	kg/cm2g	10.5	5.0	5.2	5.0	5.3	5.2
Steam temperature	°C		saturated	saturated	saturated	saturated	saturated
Feed water temp.	°C						
Fuel Consumption	liter/hr	140	100	100	100	100	100
Heavy oil Pressure	kg/cm2g						
Atomize press.	kg/cm2g	steam					
Temperature	°C	80	80	80	80	80	80
Comb. air temperature	°C	ambience	ambience	ambience	ambience	ambience	ambience
Flue gas temperature	°C		170	160	172	170	
Air press. Wind box	mm Aq	natural draft					
Furnace pressure	mm Aq	-1	-1	-1	-1	-1	-1

Analytical data of flue gas

Inside diameter of chimney: 550 mm

Chimney	NOx conc.	ppm	145	148	125	120	125
	CO conc.	%	< 0.05	0.05	0.15	0.35	0.20
	CO2 conc.	%	6.6	6.2	7.1	5.9	5.6
	O2 conc.	%	10.3	10.3	8.8	10.3	11.3
	PM conc.	g/Nm3			0.15		
	Temperature	°C		170	160	172	170
	Gas velocity	m/s		4.0	3.6	4.2	4.1
	Gas quantity	Nm3/hr		1,600	1,400	1,600	1,600
	Theoretical gas quantity	Nm3/hr		2,000	1,700	2,000	2,200
	NOx conc. (02.5%)	ppm		217	164	179	206
	SO2 emission	kg/hr			0.49	0.39	0.41
	PM emission	kg/hr		5.8	5.8	5.8	5.8
		kg/hr			0.21		

Size of combustion chamber	
Diameter	610 mm
L	3,000 mm
Volume of chamber	0.88 m3
Sectional area	0.29 m2
Load of s/a : rating	560,000 kcal/m3hr
c/c : Combustion chamber	680,000 kcal/m3hr
s/a : Sectional area	

1 natural draft steam atomizing oil burner
Boiler manufacture : STRUTHERS WELLS DE MEXICO, S.A.
Fuel consumption : 4,500 l/month

