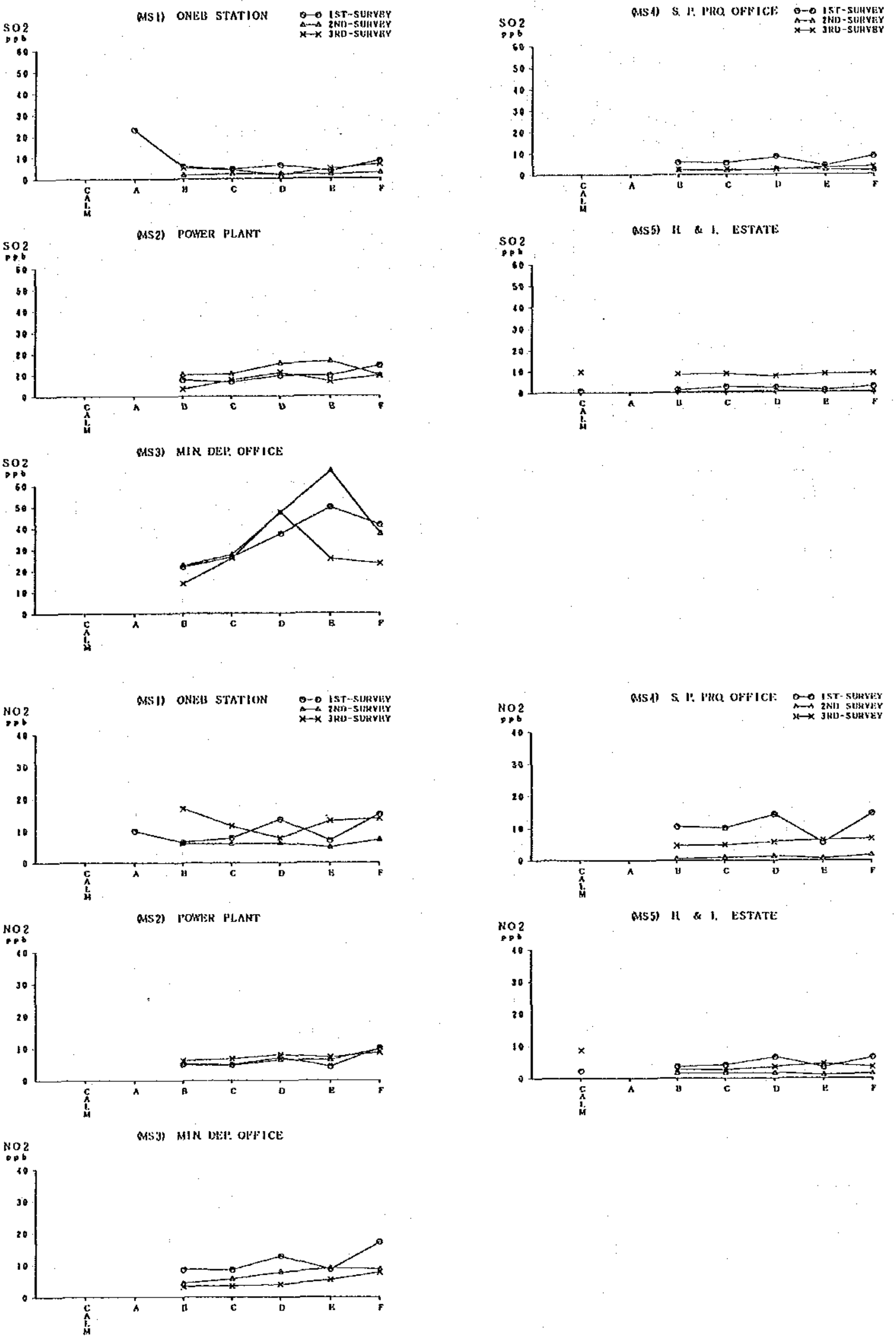


Fig. 2-8(1) Dependence of Air Pollutant Concentration during the Short Term Field Survey on Atmospheric Stability

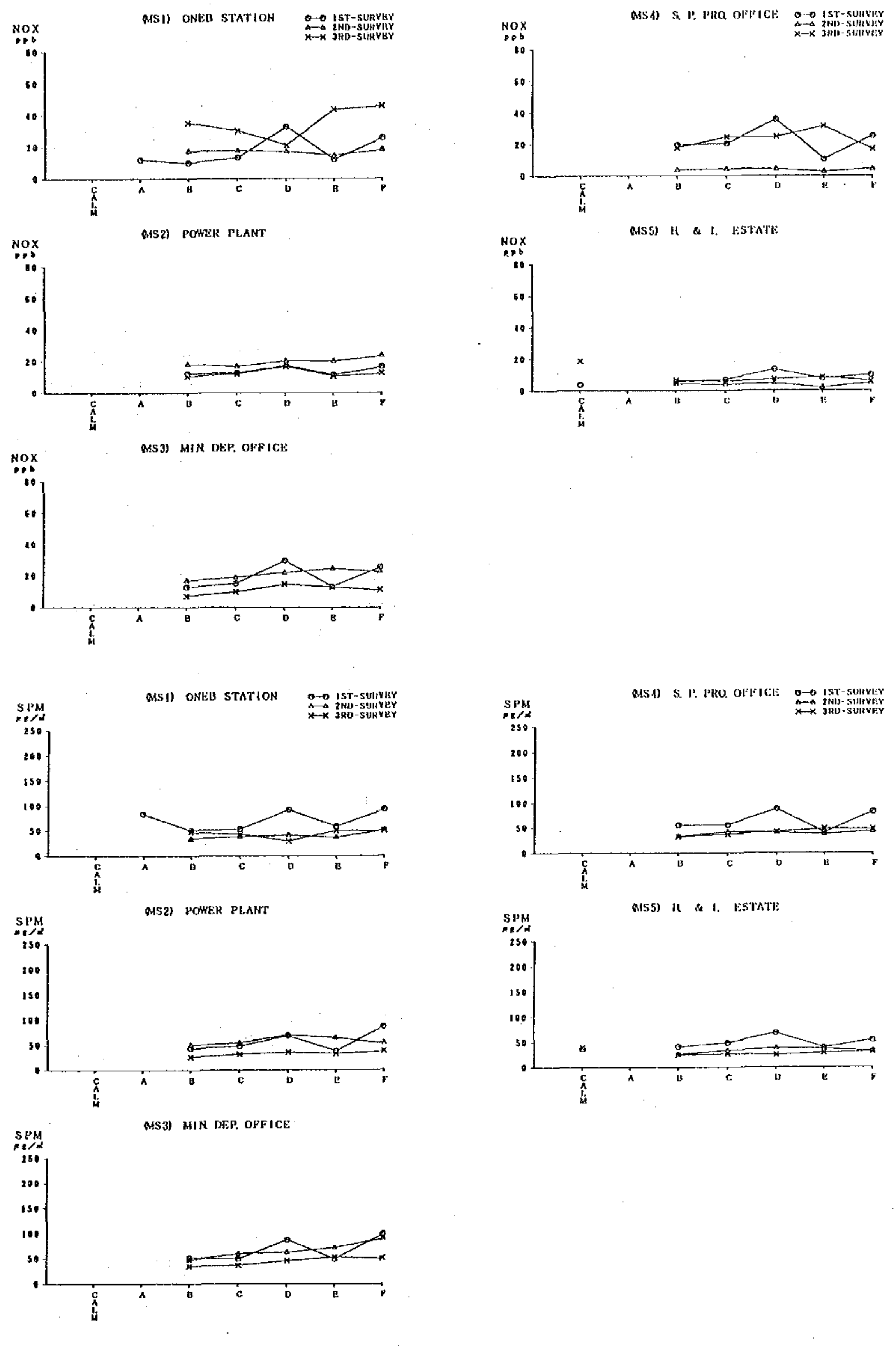


Fig. 2-8(2) Dependence of Air Pollutant Concentration during the Short Term Field Survey on Atmospheric Stability

3. Data Analysis of Chemical Components Contained in Particulate Matter

Another analytical study was done on the chemical components in particulate matter collected on filter papers by Low-volume and Andersen samplers. In case of the data analysis above where concentrations of chemical components are found less than the detection confidence level, 1/2 of such detection limit values are used in calculation.

3.1 Average Concentration of Chemical Components

Table 3-1 shows the average concentration of chemical components in each short term field survey. In this table, the figures marked "*" are those in which the number of nondetectable data is 50% or more. The data on Ag, Ba, Cs, La, Lu, Ni, and W are mostly less than the detection confidence level. Table 3-2 shows the names of top 10 chemical components which rank in high average concentration. The concentration of soil particle (Si, Ca, Al), sea-salt particle (Na, Cl), secondary particle (SO_4^{2-} and NH_4^+) and carbon are found relatively high.

Table 3-1(1) Average Concentrations of Chemical Components in Particulate Matter

Low-volume Sampler

(unit;ng/m^3)

Method of analysis	Components	First survey Average	First survey Geometric mean	Second survey Average	Second survey Geometric mean	Third survey Average	Third survey Geometric mean	Average of 3 seasons Average	Average of 3 seasons Geometric mean
Instrument activation analysis	Ag	0.530*	0.394*	0.200*	0.178*	0.410*	0.339*	0.380*	0.288*
	Al	1362.000	1289.657	556.000	532.392	630.000	601.202	849.333	744.576
	As	7.840	6.972	4.142	2.803	9.360	8.726	7.114	5.545
	Ba	19.000*	17.972*	10.000*	8.706*	11.800*	11.370*	13.600*	12.117*
	Br	29.000	27.146	13.000	12.588	12.440	10.372	18.147	15.247
	Ca	1920.000	1855.848	996.000	747.643	1320.000	1280.865	1412.000	1211.286
	Ce	2.480	2.407	0.910	0.845	1.540	1.470	1.643	1.440
	Cl	1750.000	1635.348	2266.000	1937.528	1140.000	1086.201	1718.667	1509.812
	Co	0.770	0.716	0.430*	0.191*	0.750	0.719	0.650	0.462
	Cr	10.640	7.564	5.474	3.832	6.520	6.341	7.545	5.686
	Cs	0.212	0.167	0.135	0.128	0.136	0.118	0.161	0.136
	Cu	23.600*	21.237*	27.000*	25.970*	10.000*	10.000*	20.200*	17.668*
	Fe	2100.000	1809.948	756.000	571.850	1026.000	937.669	1294.000	990.070
	Hf	0.082*	0.077*	0.070*	0.049*	0.047*	0.047*	0.066*	0.056*
	K	1460.000	1422.981	716.000	652.122	750.000*	644.125*	975.333	842.364
	La	1.030	0.880	0.230*	0.202*	0.616	0.522	0.625	0.453
	Lu	0.018*	0.017*	0.013*	0.010*	0.001*	0.001*	0.011*	0.006*
	Mg	628.000	529.070	722.000	708.941	418.000	385.268	589.333	524.761
	Mn	118.800	82.631	60.000	33.078	44.200	38.442	74.333	47.188
	Na	1360.000	1339.956	2000.000	1949.423	902.000	893.467	1420.667	1326.452
	Ni	17.000*	11.230*	17.300	9.198	13.000	10.823	15.767	10.379
	Sb	26.480	19.605	3.034	2.060	10.960	7.439	13.491	6.697
	Sc	0.190	0.187	0.078	0.076	0.130	0.128	0.133	0.122
	Se	0.662*	0.613*	11.010	2.091	0.650*	0.513*	4.107*	0.870*
	Sm	0.173	0.164	0.057	0.054	0.099	0.094	0.110	0.094
	Th	0.308	0.282	0.102	0.093	0.144	0.128	0.185	0.150
	Ti	114.600	109.483	76.800	74.017	51.600	47.674	81.000	72.831
	V	15.080	11.998	20.400	9.981	10.680	8.817	15.387	10.183
	W	0.560*	0.417*	0.558	0.463	1.140*	0.843*	0.753*	0.546*
	Zn	1256.000	770.813	670.000	160.651	592.000	470.801	839.333	387.755
X-ray fluorescence	Cd	2.000	1.783	1.100*	0.871*	1.100*	0.822*	1.400	1.084
	Pb	628.000	344.544	101.000	39.404	346.000	198.951	358.333	139.266
	S	1882.000	1794.742	1080.000	963.152	842.000	778.579	1268.000	1104.078
	Si	6120.000	5907.875	2760.000	2652.205	2880.000	2672.505	3920.000	3472.580
F P	Na^+	1518.000	1477.559	1416.000	1355.362	1142.000	1109.829	1358.667	1305.024
	K^+	1210.000	1180.115	716.000	662.021	476.000	441.523	800.667	708.313
AAS	Ca^{2+}	702.000	647.146	176.000	134.183	308.000	224.463	395.333	269.121
	Mg^{2+}	100.000	89.600	84.000*	74.206*	64.000*	59.568*	82.667*	73.438*
S P	NH_4^+	136.000	107.565	200.000	135.871	86.000*	67.846*	140.667*	99.718*
I C	Cl^-	970.000	823.724	622.000	365.148	946.000	811.537	846.000	624.961
	NO_3^-	1014.000	945.199	980.000	931.180	388.000	298.473	794.000	640.453
	SO_4^{2-}	6520.000	6254.551	4620.000	4206.121	3960.000	3605.674	5033.333	4560.594
Carbon analysis	TotalC	22230.000	21798.293	13540.000	13245.695	10320.000	9801.129	15380.000	14144.613
	Elem-C	14180.000	13913.012	8840.000	8566.070	7580.000	7121.914	10200.000	9468.180
	Orga-C	8080.000	7817.617	4700.000	4647.324	2780.000	2679.948	5186.667	4600.461

Note ; * is marked when trace date are over 50% .
FP ; Flame photometry
AAS ; Atomic absorption spectrometry
SP ; Spectrophotometry
IC ; Ion chromatography

Andersen Sampler (Fine+Coarse)

(unit;ng/m^3)

Method of analysis	Components	First survey Average	First survey Geometric mean	Second survey Average	Second survey Geometric mean	Third survey Average	Third survey Geometric mean	Average of 3 seasons Average	Average of 3 seasons Geometric mean
Instrument activation analysis	Ag	0.548*	0.483*	0.414	0.374	0.382*	0.352*	0.443*	0.399*
	Al	1513.400	1417.026	750.400	706.173	857.600	801.965	1040.467	929.283
	As	7.160	6.674	4.478	3.025	8.140	7.732	6.593	5.385
	Ba	28.000	27.162	11.100*	10.038*	13.800*	12.382*	17.633*	15.002*
	Br	26.500	25.160	14.280	13.945	14.200	11.737	18.327	16.029
	Ca	2084.600	2001.979	1386.600	1288.153	1652.200	1561.158	1707.800	1590.833
	Ce	2.738	2.654	1.408	1.372	1.176	1.049	1.774	1.563
	Cl	1994.000	1921.252	3122.000	3072.950	1926.000	1918.895	2347.333	2245.934
	Co	0.782	0.714	0.663	0.504	0.500	0.487	0.648	0.559
	Cr	9.750	7.863	6.500	5.094	6.700	6.491	7.650	6.382
	Cs	0.205	0.197	0.116	0.113	0.144	0.135	0.155	0.144
	Cu	22.800	21.567	14.200*	13.128*	18.100*	17.227*	18.367*	16.959*
	Fe	1692.000	1518.450	926.200	739.458	984.000	946.326	1200.733	1020.434
	Hf	0.102*	0.095*	0.074	0.072	0.080	0.078	0.085	0.081
	K	1312.000	1284.995	848.000	835.650	1202.000	1163.635	1120.667	1077.165
	La	0.910	0.843	0.456	0.452	0.740	0.704	0.702	0.645
	Lu	0.016*	0.015*	0.011	0.009	0.002*	0.002*	0.010*	0.006*
	Mg	828.000	792.378	602.000	583.708	696.000	646.072	708.667	668.554
	Mn	104.520	78.734	56.124	33.631	47.980	41.905	69.541	48.053
	Na	1242.000	1229.989	1950.000	1885.929	1180.000	1162.750	1457.333	1391.995
	Ni	8.100*	8.027*	8.660*	6.396*	5.800*	5.643*	7.520*	6.617*
	Sb	22.336	17.146	2.970	1.983	9.624	6.550	11.643	6.061
	Sc	0.212	0.199	0.110	0.104	0.136	0.133	0.153	0.140
	Se	1.096	1.019	14.166	2.226	0.802	0.712	5.355	1.171
	Sm	0.147	0.136	0.076	0.072	0.111	0.105	0.111	0.101
	Th	0.330	0.285	0.173	0.152	0.167	0.154	0.223	0.188
	Ti	102.600	101.345	60.200	53.915	62.760	59.107	75.187	68.609
	V	13.820	11.467	20.700	10.872	11.940	9.884	15.487	10.721
	W	0.664	0.577	0.646*	0.468*	1.084	0.885	0.798	0.621
	Zn	1217.800	1052.460	669.400	228.136	525.400	402.271	804.200	458.817
X-ray fluorescence	Cd	4.100*	4.095*	3.500*	3.500*	4.300*	4.293*	3.967*	3.948*
	Pb	624.000	364.694	107.000*	68.636*	306.000	169.534	345.657	161.899
	S	2250.000	2218.145	2206.000	2083.648	2208.000	2200.090	2221.333	2166.465
	Si	4240.000	3945.622	2370.000	2204.952	2740.000	2472.735	3116.667	2781.190
F P	Na^+	1168.000	1145.553	1758.000	1700.241	1016.000	1003.551	1314.000	1250.322
	K^+	908.000	895.825	562.000	535.544	360.000	314.961	610.000	532.629
AAS	Ca^{2+}	670.000	630.540	574.000	537.975	442.000	419.823	562.000	522.212
	Mg^{2+}	100.000*	100.000*	190.000	171.601	100.000*	100.000*	130.000*	119.722*
S P	NH_4^+	624.000	614.384	744.000	533.877	310.000	240.206	559.333	428.701
I C	Cl^-	1016.000	962.053	1740.000	1666.895	882.000	878.735	1212.667	1121.127
	NO_3^-	1194.000	1188.521	1308.000	1307.234	430.000	429.667	977.333	873.972
	SO_4^{2-}	5082.000	4922.922	5842.000	5110.184	2954.000	2751.701	4626.000	4106.012

Note ; * is marked when trace date are over 50% .
FP ; Flame photometry
AAS ; Atomic absorption spectrometry
SP ; Spectrophotometry
IC ; Ion chromatography

Table 3-1(2) Average Concentrations of Chemical Components in Particulate Matter

Andersen Sampler (Fine)

(unit;ng/m³)

Method of analysis	Components	First survey Average	First survey Geometric mean	Second survey Average	Second survey Geometric mean	Third survey Average	Third survey Geometric mean	Average of 3 seasons Average	Average of 3 seasons Geometric mean
Instrument activation analysis	Ag	0.266*	0.216*	0.284	0.237	0.242*	0.201*	0.264*	0.218*
	Al	91.400	88.563	70.400	69.704	105.600	105.283	89.133	86.621
	As	4.880	4.348	3.088	1.979	6.500	5.817	4.823	3.685
	Ba	8.000*	7.579*	4.800*	4.300*	4.400*	4.317*	5.733*	5.201*
	Br	19.200	18.482	10.080	9.763	8.220	6.680	12.500	10.643
	Ca	104.600	84.993	64.600	63.384	92.200	81.603	87.133	76.037
	Ce	0.638	0.498	0.234*	0.212*	0.274	0.214	0.382	0.283
	Cl	374.000	304.528	402.000	309.836	386.000	361.966	387.333	324.446
	Co	0.234*	0.153*	0.249*	0.101*	0.186*	0.114*	0.223*	0.121*
	Cr	3.570	2.316	3.120	1.505	3.160	2.834	3.283	2.146
	Cs	0.079	0.075	0.057*	0.043*	0.061*	0.050*	0.066*	0.055*
	Cu	12.800	10.496	8.200*	6.662*	8.100*	6.523*	9.700*	7.698*
	Fe	366.000	208.113	196.200	95.213	302.000	268.008	288.067	174.467
	Hf	0.038*	0.037*	0.026*	0.024*	0.027*	0.026*	0.030*	0.028*
	K	792.000	783.479	492.000	475.085	626.000	564.000	636.667	594.328
	La	0.212	0.179	0.114*	0.096*	0.176	0.163	0.167	0.141
	Lu	0.007*	0.007*	0.007*	0.005*	0.001*	0.001*	0.005*	0.003*
	Mg	120.000*	108.878*	160.000*	131.951*	126.000*	106.961*	135.333*	115.396*
	Mn	45.520	25.276	22.024	7.796	20.180	15.074	29.241	14.375
	Na	344.000	328.436	430.000	396.028	472.000	453.397	415.333	389.241
	Ni	3.900*	3.707*	5.960*	3.590*	3.100*	2.983*	4.320*	3.412*
	Sb	16.100	13.260	1.770	1.332	7.360	5.338	8.410	4.552
	Sc	0.010*	0.009*	0.010	0.010	0.022	0.022	0.014	0.012
	Se	0.816	0.711	13.628	1.374	0.612	0.497	5.019	0.786
	Sm	0.020	0.019	0.009	0.007	0.021	0.018	0.017	0.014
	Th	0.020*	0.019*	0.011*	0.010*	0.021*	0.018*	0.017*	0.015*
	Ti	12.000*	11.487*	10.600*	10.571*	13.560*	11.608*	12.053*	11.212*
	V	8.760	6.412	15.320	6.903	7.940	6.225	10.673	6.507
	W	0.234*	0.178*	0.230*	0.163*	0.210*	0.206*	0.225*	0.184*
	Zn	869.800	447.191	344.400	123.697	365.400	280.149	459.866	249.314
X-ray fluore-scence	Cd	2.000*	2.000*	1.500*	1.500*	2.000*	2.000*	1.833*	1.817*
	Pb	388.000	223.485	59.000*	35.577*	206.000	113.959	217.667	96.766
	S	1234.000	1212.252	1002.000	952.417	1070.000	1060.578	1102.000	1069.845
	Si	180.000*	178.260*	150.000*	150.000*	200.000*	200.000*	176.667*	174.874*
F P	Na^+	380.000	367.236	398.000	363.670	350.000	324.879	376.000	351.392
	K^+	728.000	718.661	414.000	398.167	258.000	212.984	466.667	393.531
A A S	Ca^{2+}	50.000*	50.000*	50.000*	50.000*	76.000*	64.600*	58.667*	54.457*
	Mg^{2+}	50.000*	50.000*	50.000*	50.000*	50.000*	50.000*	50.000*	50.000*
S P	NH_4^+	574.000	563.516	694.000	438.936	260.000	168.267	509.333	346.552
I C	Cl^-	164.000	113.847	180.000	142.154	128.000	115.053	157.333	123.025
	NO_3^-	220.000	203.215	188.000	186.068	142.000	141.487	183.333	174.896
	SO_4^{2-}	3700.000	3625.398	4160.000	3608.637	2012.000	1844.911	3290.667	2889.957

Note ; * is marked when trace date are over 50% .
FP ; Flame photometry
AAS ; Atomic absorption spectrometry
SP ; Spectrophotometry
IC ; Ion chromatography

Andersen Sampler (Coarse)

(unit;ng/m³)

Method of analysis	Components	First survey Average	First survey Geometric mean	Second survey Average	Second survey Geometric mean	Third survey Average	Third survey Geometric mean	Average of 3 seasons Average	Average of 3 seasons Geometric mean
Instrument activation analysis	Ag	0.282*	0.257*	0.130*	0.120*	0.140*	0.138*	0.184*	0.162*
	Al	1422.000	1319.172	680.000	630.447	752.000	689.356	951.333	830.739
	As	2.280	2.195	1.390	0.997	1.640	1.599	1.770	1.519
	Ba	20.000	18.001	6.300*	5.601*	9.400*	7.708*	11.900*	9.194*
	Br	7.300	5.895	4.200	4.080	5.980	4.536	5.827	4.778
	Ca	1980.000	1880.748	1322.000	1215.859	1560.000	1472.860	1620.657	1498.966
	Ce	2.100	1.952	1.174	1.146	0.902	0.807	1.392	1.218
	Cl	1620.000	1542.903	2720.000	2682.123	1540.000	1528.966	1960.000	1849.574
	Co	0.548	0.524	0.414	0.369	0.314	0.308	0.425	0.390
	Cr	6.180	5.408	3.380	2.754	3.540	3.377	4.367	3.691
	Cs	0.126	0.113	0.060	0.055	0.083	0.068	0.090	0.075
	Cu	10.000*	10.000*	6.000*	5.743*	10.000*	10.000*	8.667*	8.312*
	Fe	1326.000	1261.263	730.000	622.761	682.000	668.117	912.667	806.603
	Hf	0.064*	0.055*	0.048	0.043	0.053	0.050	0.055	0.049
	K	520.000	473.361	356.000	353.406	576.000	489.696	484.000	434.308
	La	0.698	0.647	0.342	0.341	0.564	0.526	0.535	0.487
	Lu	0.009*	0.007*	0.004*	0.004*	0.001*	0.001*	0.005*	0.003*
	Mg	708.000	570.595	442.000	428.204	570.000	529.703	573.333	533.803
	Mn	59.000	50.782	34.100	23.562	27.800	25.827	40.300	31.381
	Na	898.000	887.854	1520.000	1484.407	708.000	700.970	1042.000	973.938
	Ni	4.200*	4.146*	2.700*	2.480*	2.700*	2.652*	3.200*	3.010*
	Sb	6.236	3.464	1.200	0.429	2.264	1.102	3.233	1.179
	Sc	0.202	0.190	0.100	0.093	0.114	0.110	0.139	0.124
	Se	0.280*	0.277*	0.538	0.495	0.190*	0.186*	0.336*	0.295*
	Sm	0.126	0.113	0.067	0.063	0.090	0.084	0.094	0.085
	Th	0.310	0.260	0.162	0.138	0.146	0.126	0.206	0.166
	Ti	90.600	88.777	49.600	40.756	49.200	44.264	63.133	54.306
	V	5.060	4.731	5.380	3.486	4.000	3.524	4.813	3.874
	W	0.430	0.357	0.416*	0.299*	0.874	0.614	0.573	0.403
	Zn	548.000	443.905	325.000	92.215	160.000	122.054	344.333	170.955
X-ray fluore-scence	Cd	2.100*	2.091*	2.000*	2.000*	2.300*	2.287*	2.133*	2.123*
	Pb	236.000	137.118	48.000*	32.453*	100.000*	47.330*	128.000	59.497
	S	1016.000	974.625	1204.000	1086.467	1138.000	1118.754	1119.333	1058.107
	Si	4060.000	3754.766	2220.000	2042.196	2540.000	2248.331	2940.000	2583.332
F P	Na^+	788.000	772.232	1360.000	1329.233	666.000	662.357	938.000	879.320
	K^+	180.000	173.470	148.000	130.615	102.000	91.173	143.333	127.359
A A S	Ca^{2+}	620.000	577.183	524.000	484.726	366.000	343.624	503.333	458.104
	Mg^{2+}	50.000*	50.000*	140.000	113.123	50.000*	50.000*	80.000*	65.639*
S P	NH_4^+	50.000*	50.000*	50.000*	50.000*	50.000*	50.000*	50.000*	50.000*
I C	Cl^-	852.000	806.287	1560.000	1493.644	754.000	749.164	1055.333	966.284
	NO_2^-	974.000	971.560	1120.000	1119.309	288.000	287.771	794.000	678.926
	SO_4^{2-}	1382.000	1235.928	1682.000	1412.273	942.000	886.165	1335.333	1156.491

Note ; * is marked when trace date are over 50% .
FP ; Flame photometry
AAS ; Atomic absorption spectrometry
SP ; Spectrophotometry
IC ; Ion chromatography

Table 3-2 Top Ten Average Concentrations of Chemical Components

(unit : ng/m³)

SEQ)	Low volume sampler	Andersen sampler Fine (< 2.1μm)	Andersen sampler Coarse (> 2.1μm)	Andersen sampler Total
1)	C 15380	SO_4^{--} 3291	Si 2940	SO_4^{--} 4626
2)	SO_4^{--} 5033	S 1102	Cl 1960	Si 3117
3)	Si 3920	K 637	Ca 1621	Cl 2347
4)	Cl 1719	NH_4^+ 509	SO_4^{--} 1335	S 2221
5)	Na 1421	K^+ 467	S 1119	Ca 1708
6)	Ca 1412	Zn 460	Cl^- 1055	Na 1457
7)	Na^+ 1359	Na 415	Na 1042	Na^+ 1314
8)	Fe 1294	Cl 387	Al 951	Cl^- 1213
9)	S 1268	Na^+ 376	Na^+ 938	Fe 1201
10)	K 975	Fe 288	Fe 913	K 1120

Note) Carbon is measured by low volume sampler, but not measured by andersen sampler.

3.2 Spatial Distribution of Chemical Components

Fig. 3-1 shows the spatial distribution of the concentration of representative chemical components. These components are considered to be marker elements of the main emission sources. The marker elements are as follows: All results are shown in the APPENDIX.

Sc, Al, Ti	Soil
Na, Cl, Na^+	Sea-salt particle
Pb, Br	Gasoline automobile
V	Petroleum combustion
Mn, Cr, Fe	Steel mill
Zn, K	Wastes incineration and Glass industry
Ca, Si	Road dust
SO_4^{2-}, NO_3^-	Secondary particle
Organic C	Diesel automobile

The spatial distribution of these components classified by main emission sources are as follows:

(1) Soil

The highest concentration of Sc, Al and Ti are measured at MS5 compared with other monitoring stations as the location of MS5 is surrounded by fields. The concentration of those at MS1 and MS4 also are relatively high, which may be due to the dust blown up from roads.

(2) Sea-salt particle

The concentration of Cl, Na and Na^+ are relatively high at MS2, MS3 and MS4 located near Chao Phraya river, but their concentrations are low at MS1 and MS5 located in inland sites.

(3) Gasoline automobile

The concentration of Br is relatively high at MS1 and MS4 located near roads. It seems due to the influence of the exhaust gas from gasoline automobiles. But, the concentration of Pb at those monitoring stations are low contrary to our expectation in spite of Pb as well as Br being contained in the exhaust gas of gasoline automobiles. We cannot figure out the cause of the phenomenon. At MS5, the concentration of Pb is found to be extremely low.

(4) Petroleum combustion

V (Vanadium) is the marker element of petroleum combustion. The concentration of V is relatively high at MS2 and highest at MS3. The amount of V in fine particles is found always higher than that of coarse particles.

(5) Steel mill

The concentrations of Mn, Cr and Fe at MS3 are extremely higher than the concentration of those at other monitoring stations. This seems due to the influence of the electric arc furnace plant located near MS3.

(6) Wastes incineration and Glass industry

Zn and K are marker elements of incineration of the wastes and Glass industry. The concentration of Zn at MS3 is extremely high, but the concentrations of K maintains almost the same level in all monitoring stations.

(7) Road dust

Ca and Si are originated from road dust picked up by car transportation or from soil blown up by wind. The little differences of the concentration of those elements between the monitoring stations are found.

(8) Secondary particle

Generally, SO_4^{2-} and NO_3^- have their origin in secondary particles, and the regional difference of the concentration of SO_4^{2-} and NO_3^- are found not so clear because the reaction speed of "$SO_2 \rightarrow SO_4^{2-}$" and "$NO \rightarrow NO_3^-$" is slow. Therefore, the regional difference of NO_3^- is found not clearly in this study. But significant differences of SO_4^{2-} concentration between the stations were found. This is probably due to the reason that SO_4^{2-} also originates from sea-salt.

(9) Diesel automobile

The concentration of organic carbon is relatively high at MS1, MS3 and MS4. Diesel car and vessels are thought contributing to concentration at these monitoring stations.

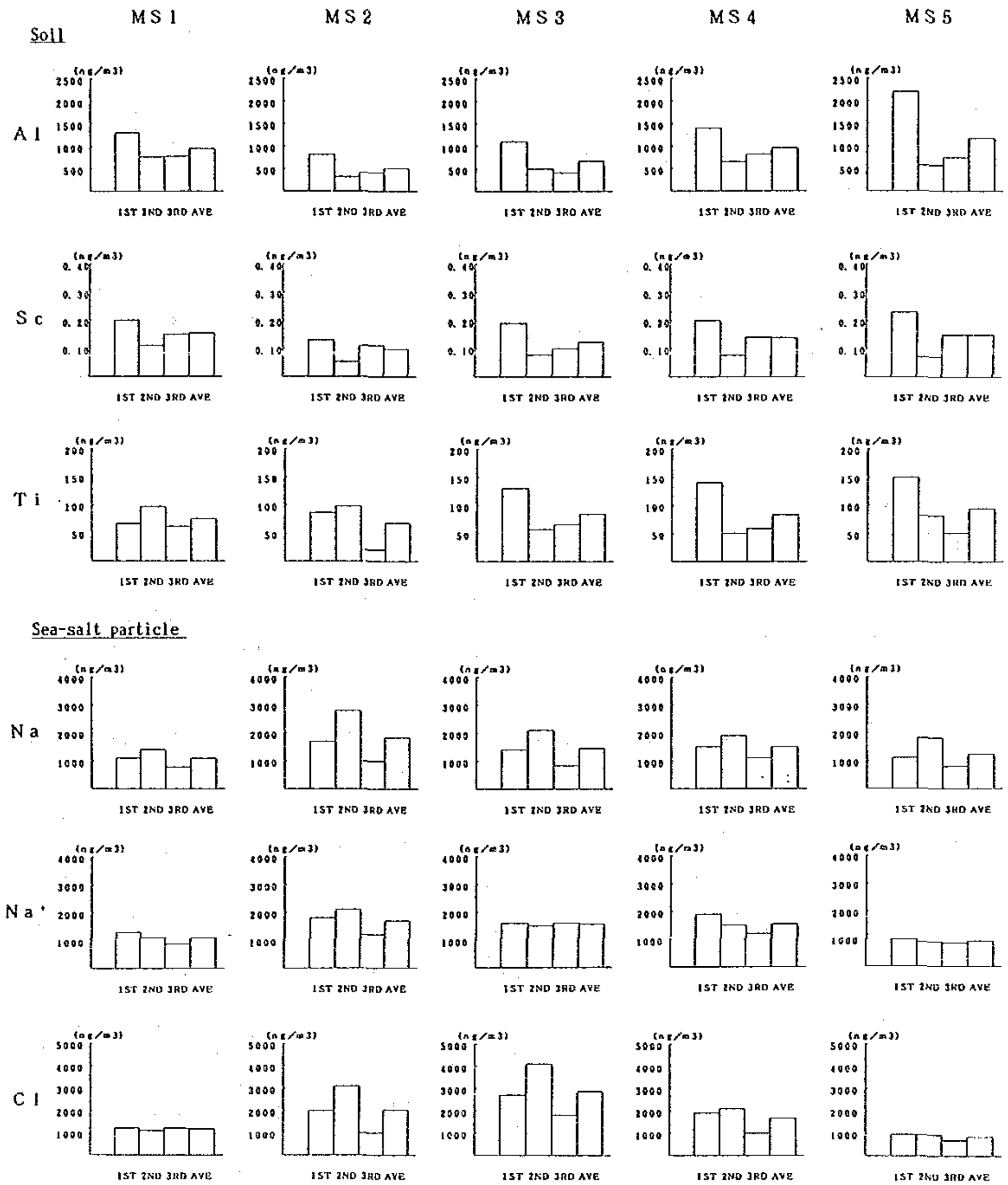


Fig. 3-1(1) Spatial Distribution of Chemical Components (Low-Volume Sampler)

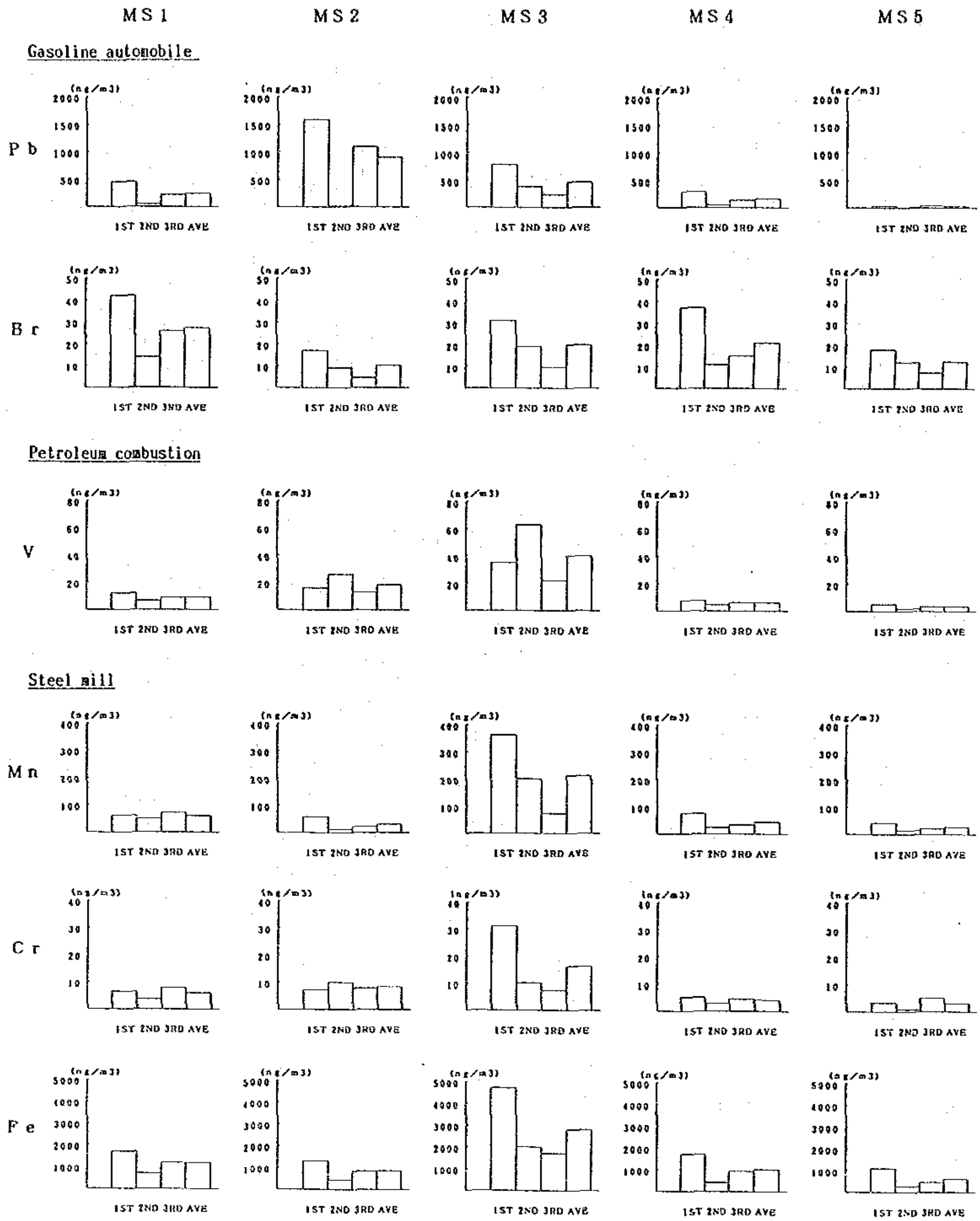


Fig. 3-1(2) Spatial Distribution of Chemical Components (Low-Volume Sampler)

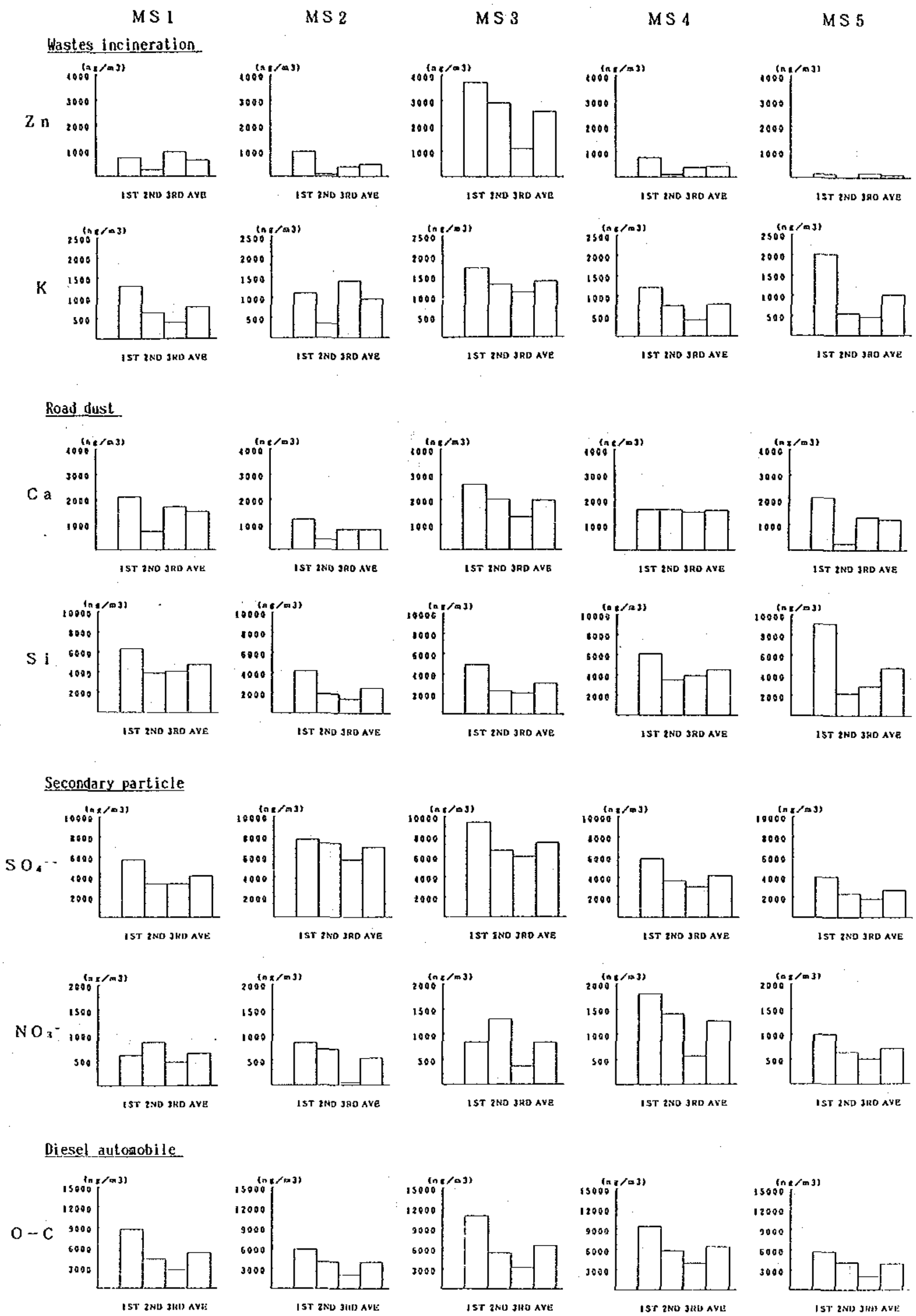


Fig. 3-1(3) Spatial Distribution of Chemical Components (Low-Volume Sampler)

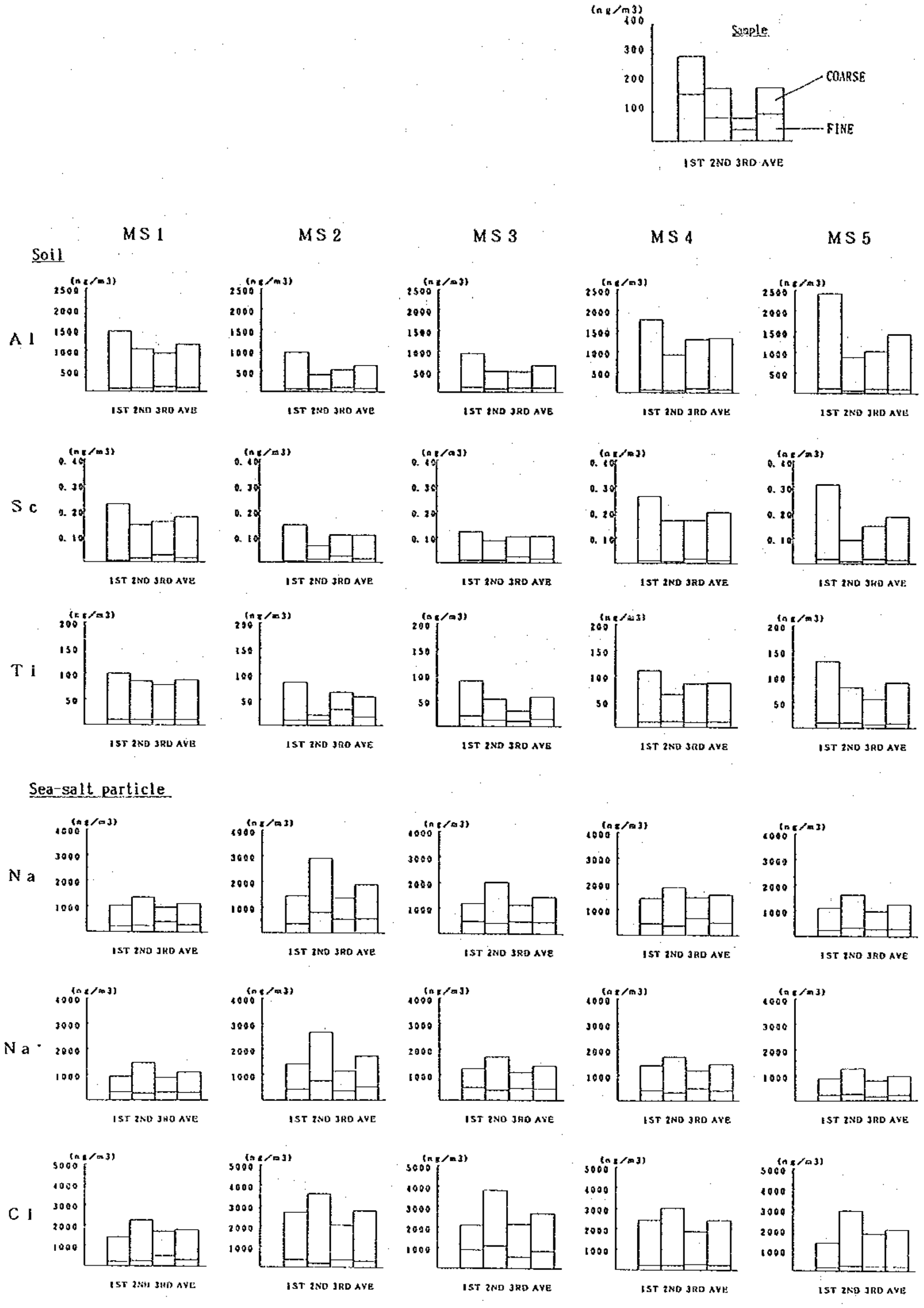


Fig. 3-1(4) Spatial Distribution of Chemical Components (Andersen Sampler)

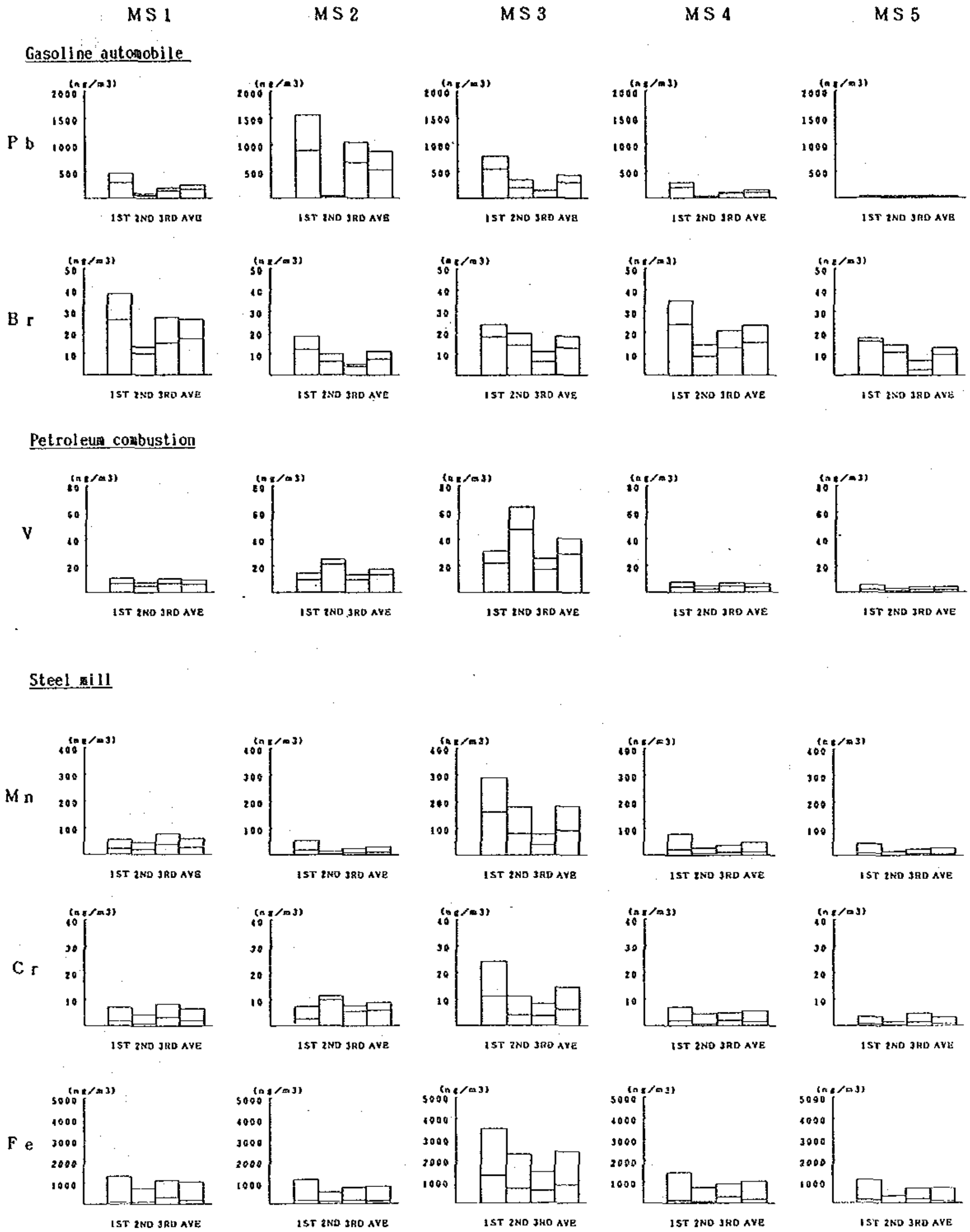


Fig. 3-1(5) Spatial Distribution of Chemical Components (Andersen Sampler)

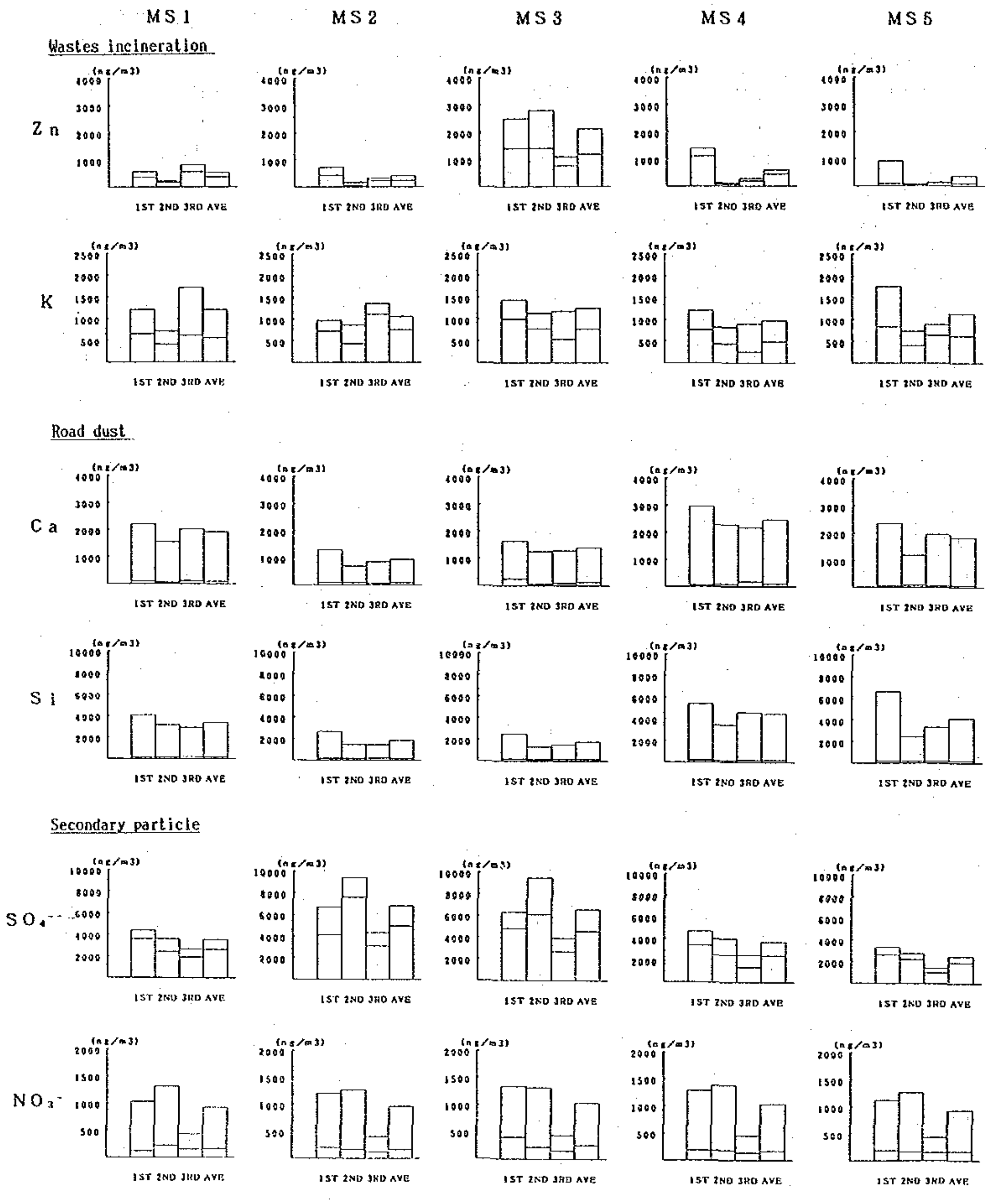


Fig. 3-1(6) Spatial Distribution of Chemical Components (Andersen Sampler)

3.3 Comparison of the Concentrations of Chemical Components between Monitoring Stations

This section discusses the comparison of the concentration of chemical components between MS5 having the lowest concentration of TSP and other monitoring stations.

Fig. 3-2 shows the results of the comparisons, and the X and Y axes are shown logarithmically because the chemical component concentrations vary in the broad range of 10^{-2}~10^{4} ng/m^3. These concentrations positioned above the 45° diagonal line, correspond to concentrations higher than those of MS5. The data smaller than the detection confidence level are excluded because of unreliable figures. The element concentration analyzed by fluorescence X-ray method has the symbol (*) attached to elemental ones.

Observed points through this comparative study are:

(1) MS1

The difference of concentration of each chemical component between MS1 and MS5 is relatively large, above all with respect to Pb, Zn, Sb, V, Mn. This trend is probably due to the effects of petroleum combustion, automobiles, steel mills, wastes incineration and the glass industry.

(2) MS2 and MS3

Since MS2 and MS3 locate in an industrial area, the concentrations of chemical components, are high except for the marker components of soil and secondary particles. It is thought that the high concentration of V is due to burning of petroleum, those of high Mn, Cr and Fe to steel mills, Na, Cl and Cl^- to sea-salt particles, and Zn and Sb to wastes incineration and glass industry, respectively.

(3) MS4

The concentrations of Pb, Zn, V, Sb and Cl^- are relatively high. But the concentrations of other components showed the same levels as those at MS5.

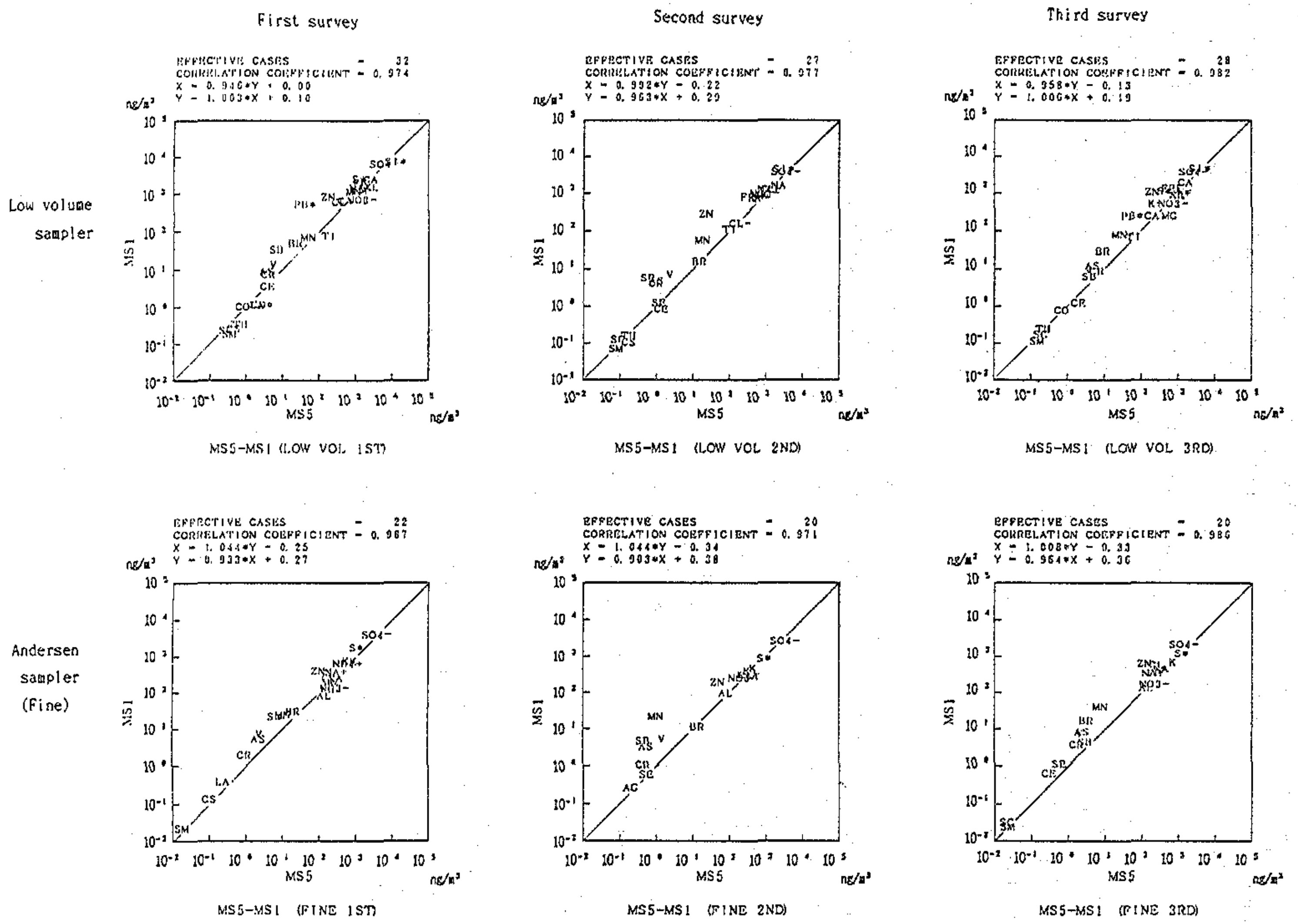


Fig. 3-2(1) Concentration of Chemical Components in MS5 and MS1

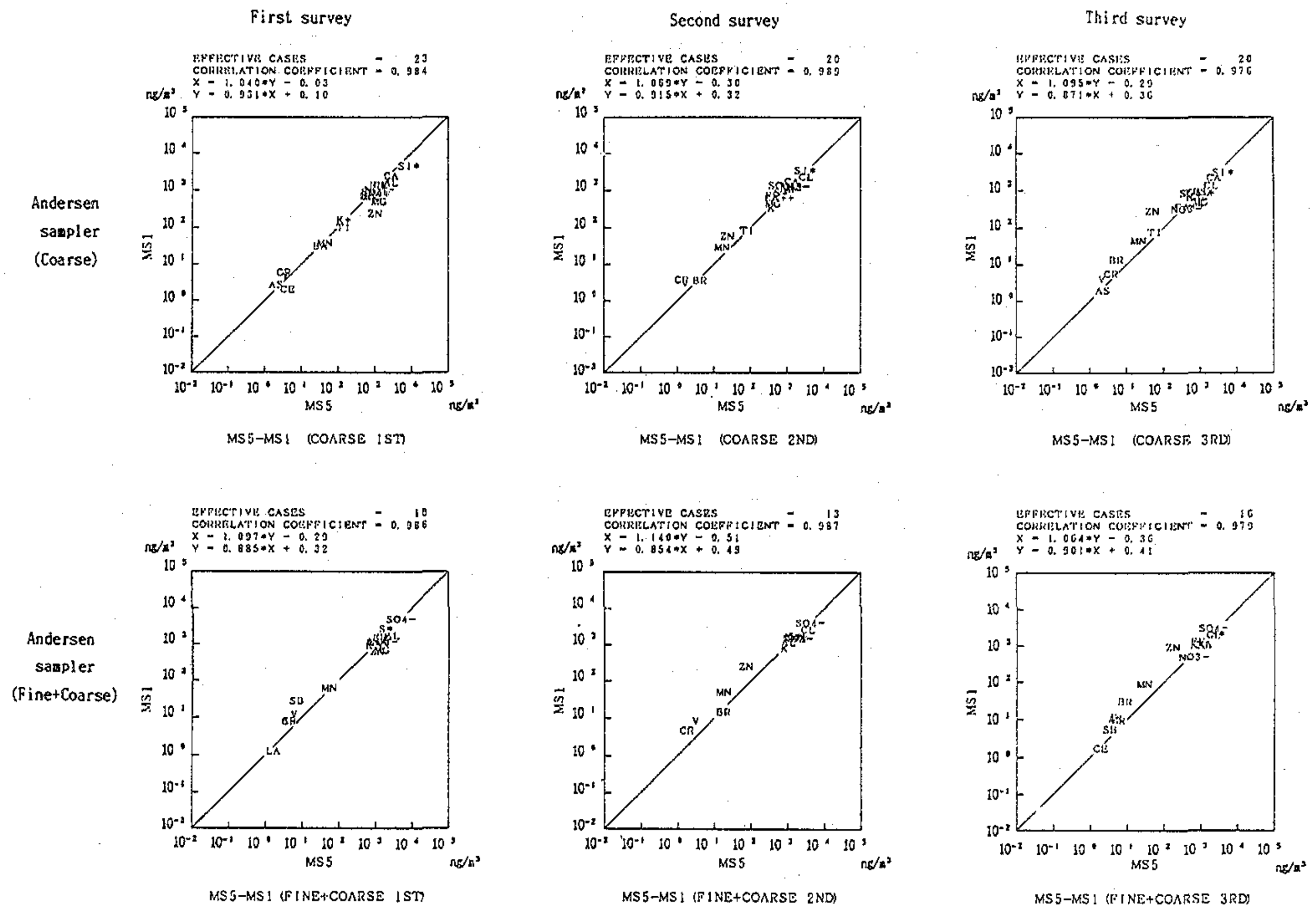


Fig. 3-2(2) Concentration of Chemical Components in MS5 and MS1

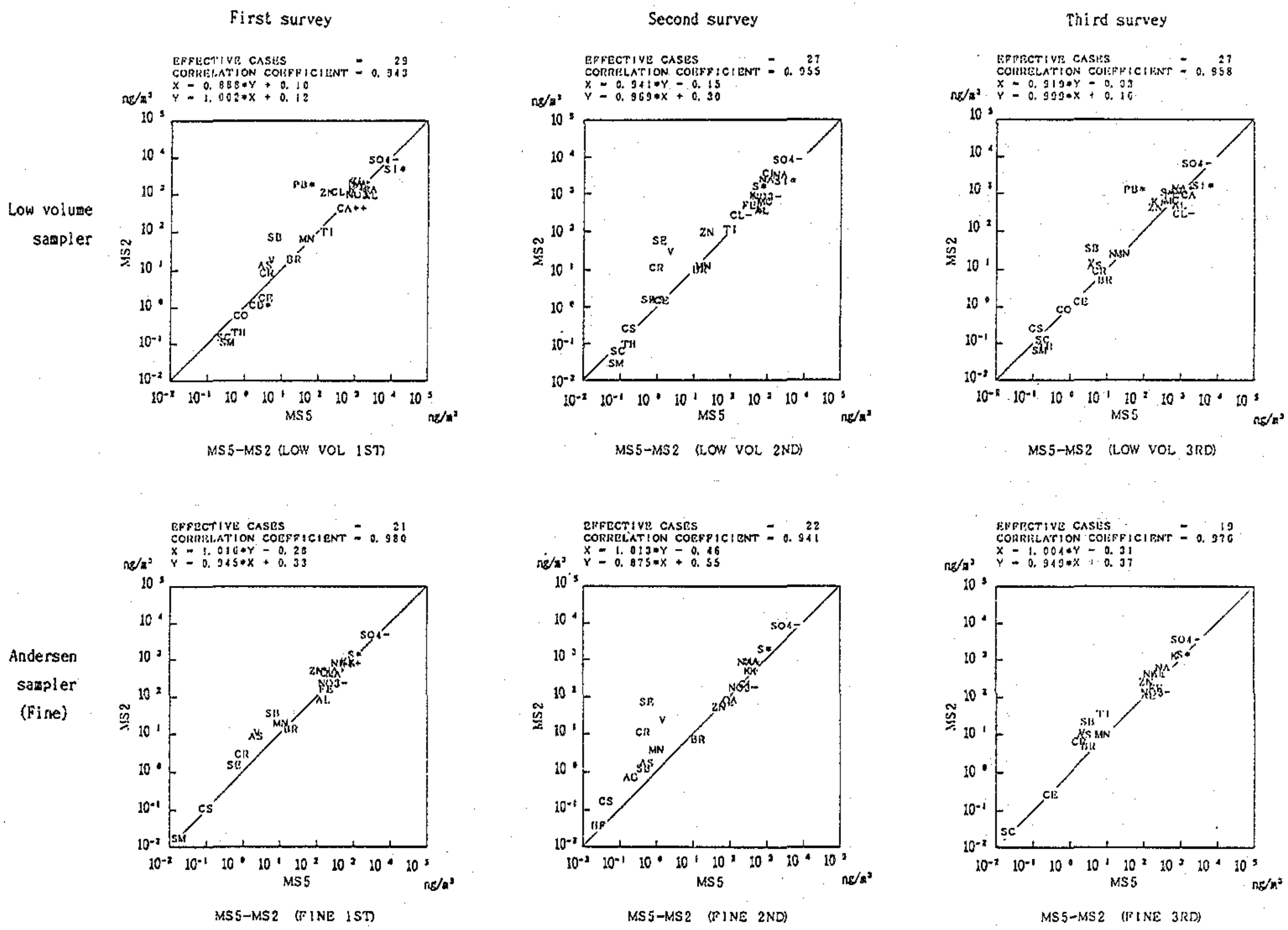


Fig. 3-2(3) Concentration of Chemical Components in MS5 and MS2

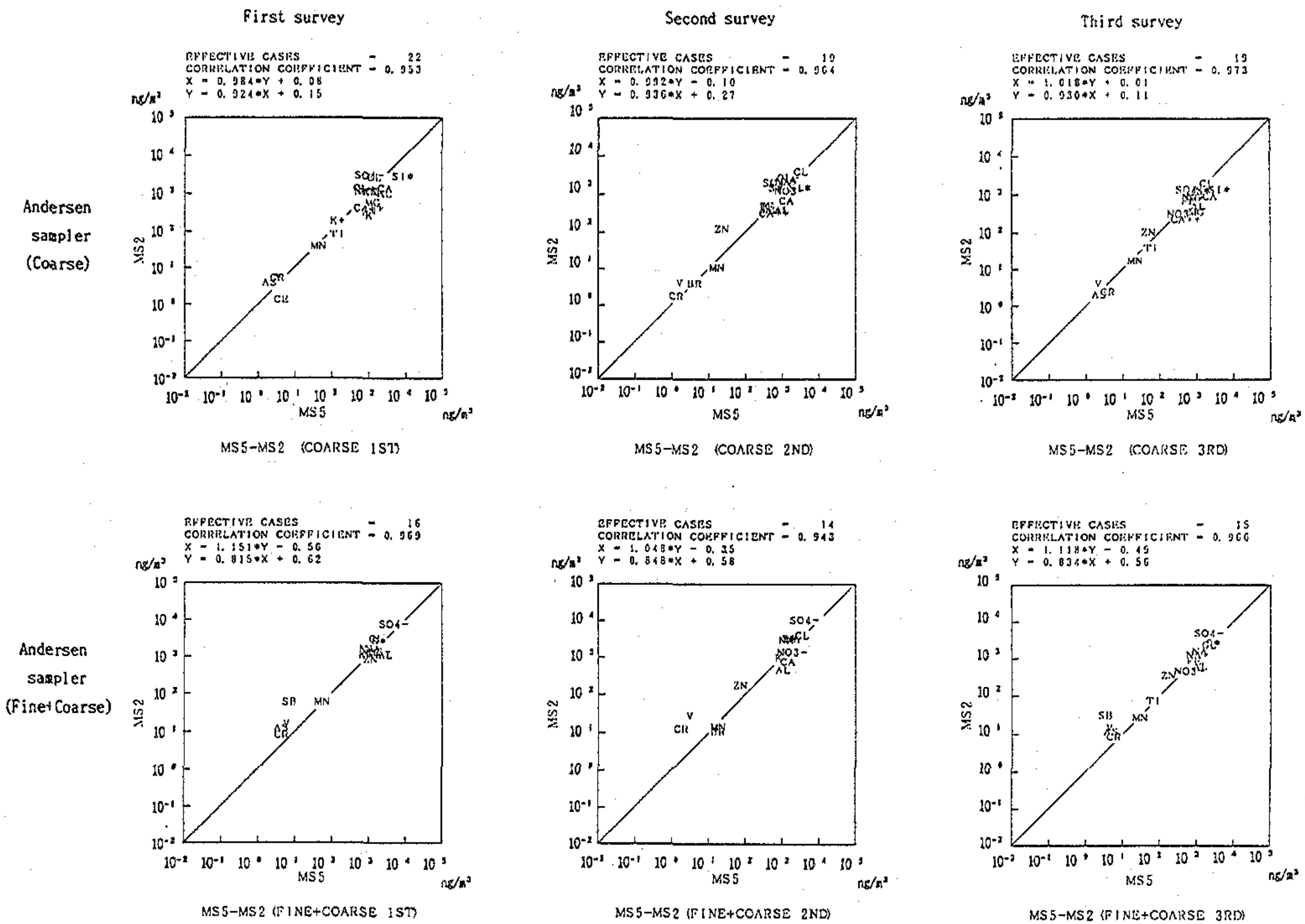


Fig. 3-2(4) Concentration of Chemical Components in MS5 and MS2

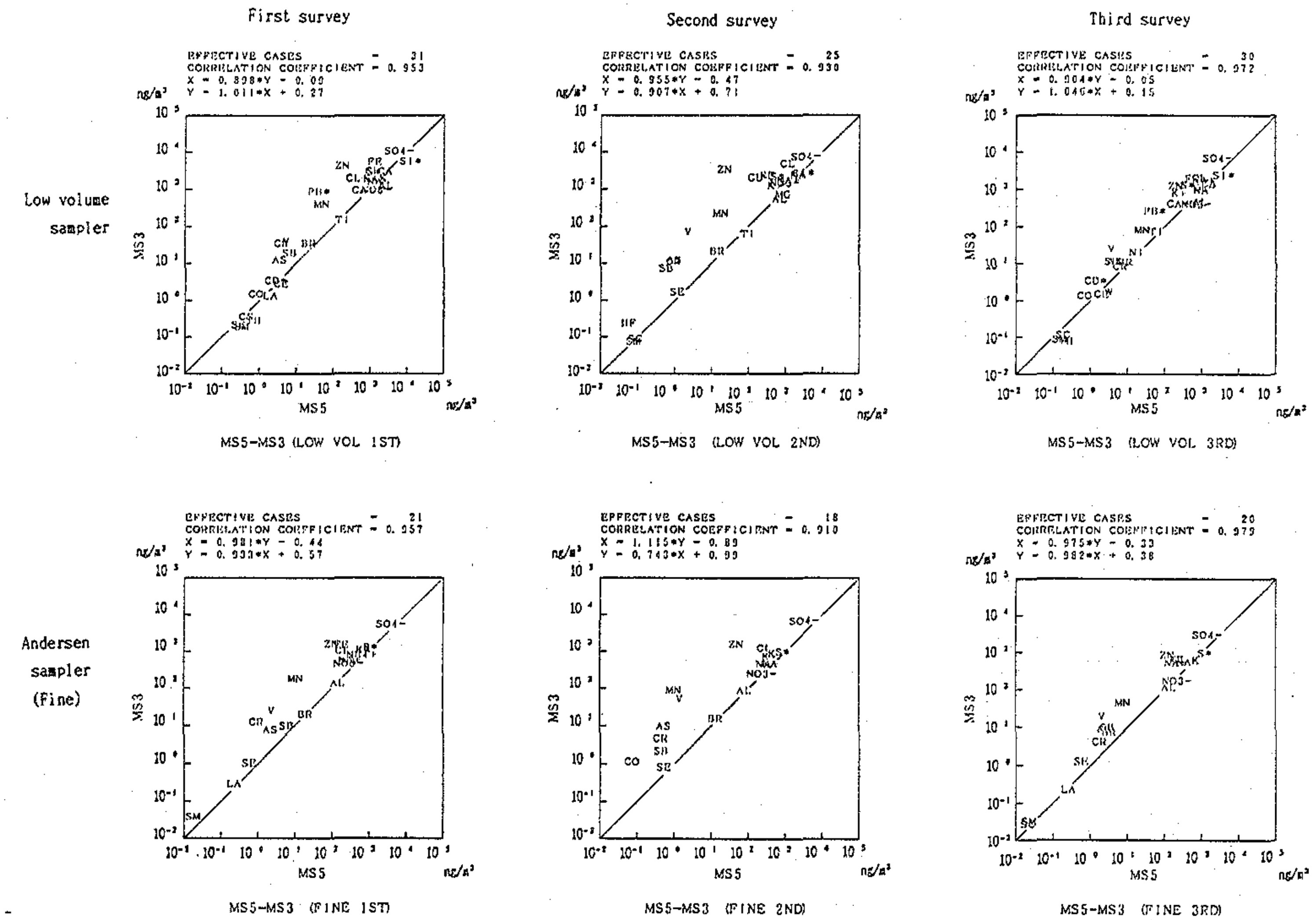


Fig. 3-2(5) Concentration of Chemical Components in MS5 and MS3

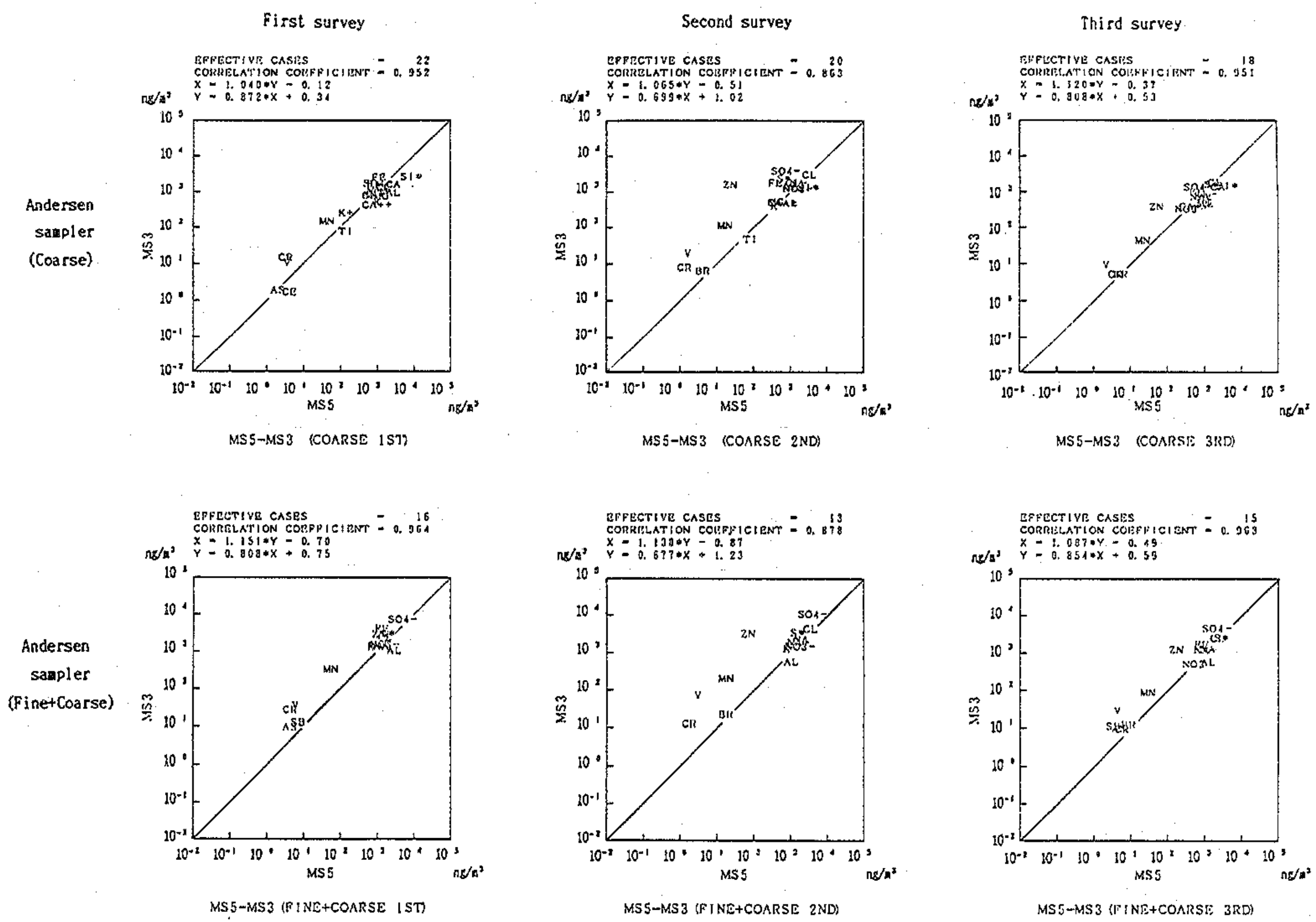


Fig. 3-2(6) Concentration of Chemical Components in MS5 and MS3

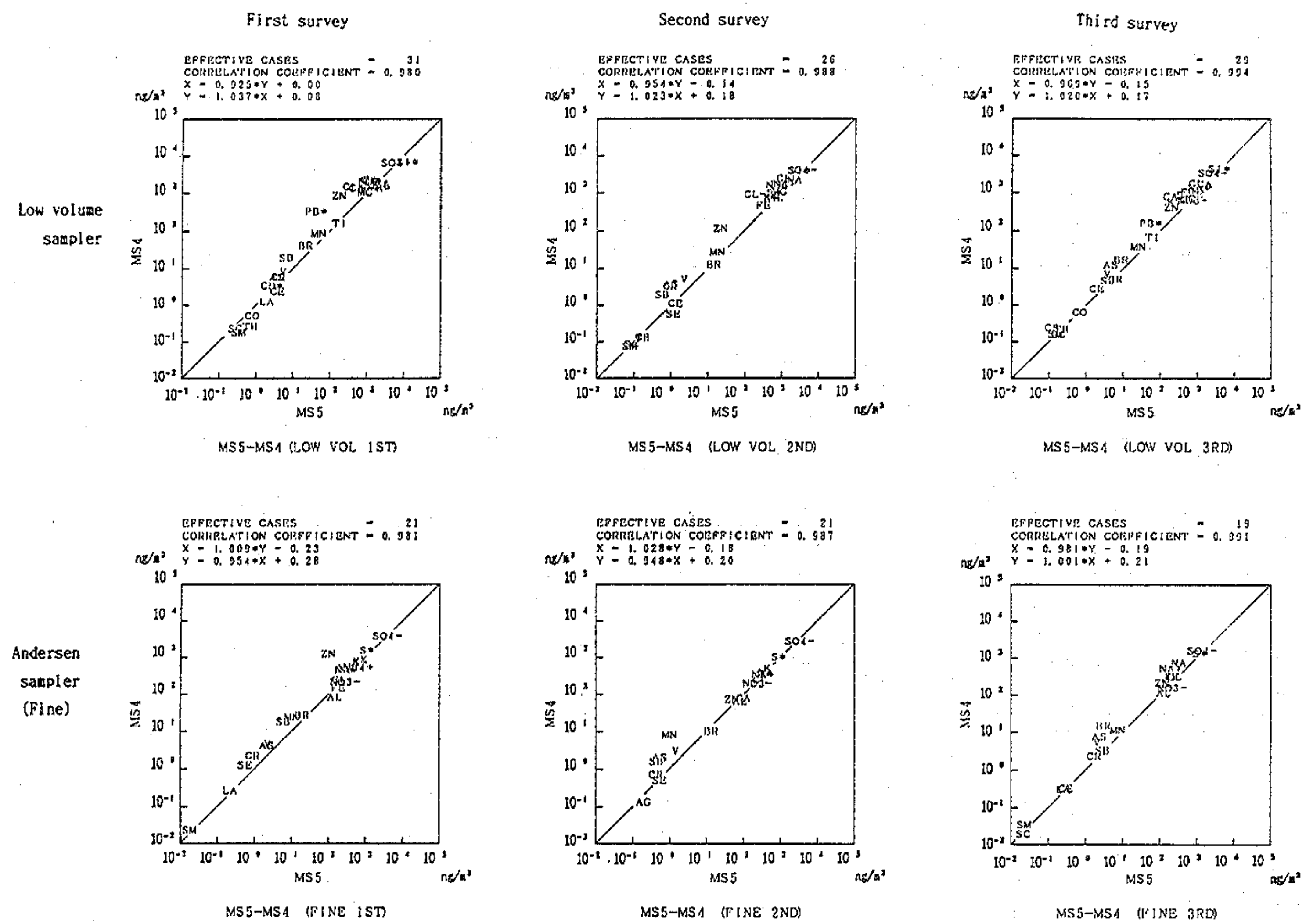


Fig. 3-2(7) Concentration of Chemical Components in MS5 and MS4

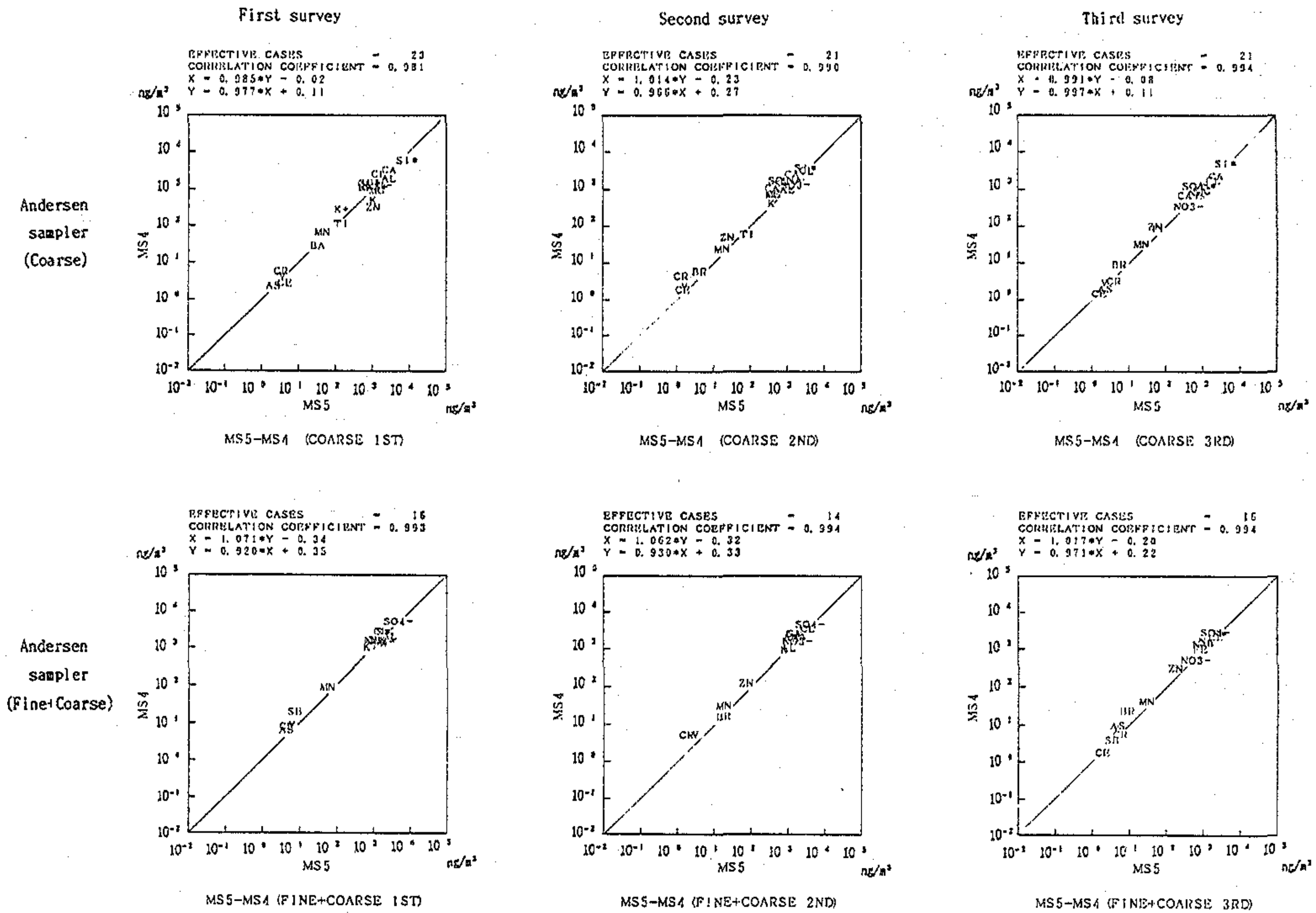


Fig. 3-2(8) Concentration of Chemical Components in MS5 and MS4

3.4 Resemblance among the Monitoring Stations by Cluster Analysis Based on Correlation Coefficients of Chemical Components Concentration

The cluster analysis is sometimes instrumental for us to elucidate the regional resemblance among monitoring stations. Taken as a measure to represent the degree of regional resemblance in this study is the correlation coefficient calculated with respect to concentration of chemical components contained in total suspended particulate collected by Low-volume sampler and Andersen samplers among monitoring stations. As for TSP collected by Andersen sampler, the sample was divided into two parts, coarse and fine particle fractions and cluster analysis was done. The group averaging method were used as the solution methods for cluster analysis in this study. In order to avoid the effect by absolute value of each chemical component influencing the correlation coefficients, the data were normalized according to the equation (3-1). For the data which have values less than the detection minimum, a half value of such detection limit was assigned to them. Also, the chemical components having the value less than the detection minimum by more than 50% were excluded from the calculation.

$$Z_{\alpha i} = \frac{X_{\alpha i} - \overline{X}_{\alpha}}{S_{\alpha}} \quad \cdots\cdots \quad (3\text{-}1)$$

where

$Z_{\alpha i}$; normalized concentration value of component α at point i

$X_{\alpha i}$; absolute value of component α at point i

$\overline{X}_{\alpha}$; means of 5 points with respect to component α

S_{α}; standard deviation of 5 points with respect to component α

The correlation coefficient of chemical components concentration among regions and the results of cluster analysis are shown in Table 3-3 and Fig. 3-3 respectively. While admitting some difference coming from seasonal changes and types of dust meters, one can notice the following three clusterings to represent the regional difference.

① the region adjoining industrial areas represented by MS2 and MS3 stations

② the region apart from industrial areas represented by MS4 and MS5 stations

③ the region neighboring the urban area represented by MS1 position

Table 3-3 Correlation Coefficient of Chemical Components Concentration among Monitoring Stations

1st survey

	MS1	MS2	MS3	MS4	MS5
MS1) ONEB STATION					
MS2) POWER PLANT	-0.33				
MS3) MIN.DEP.OFFICE	-0.23	0.08			
MS4) S.P.PRO.OFFICE	-0.24	-0.16	-0.26		
MS5) H.& I. ESTATE	0.07	-0.62	-0.51	-0.21	

2nd survey

	MS1	MS2	MS3	MS4	MS5
MS1) ONEB STATION					
MS2) POWER PLANT	-0.56				
MS3) MIN.DEP.OFFICE	-0.38	-0.24			
MS4) S.P.PRO.OFFICE	0.03	-0.45	-0.23		
MS5) H.& I. ESTATE	0.45	-0.11	-0.69	-0.03	

3rd survey

	MS1	MS2	MS3	MS4	MS5
MS1) ONEB STATION					
MS2) POWER PLANT	-0.59				
MS3) MIN.DEP.OFFICE	-0.11	0.17			
MS4) S.P.PRO.OFFICE	-0.06	-0.51	-0.58		
MS5) H.& I. ESTATE	-0.06	-0.37	-0.67	0.35	

All seasons

	MS1	MS2	MS3	MS4	MS5
MS1) ONEB STATION					
MS2) POWER PLANT	-0.49				
MS3) MIN.DEP.OFFICE	-0.28	0.00			
MS4) S.P.PRO.OFFICE	-0.03	-0.37	-0.39		
MS5) H.& I. ESTATE	0.08	-0.41	-0.52	-0.01	

1st survey

	MS1	MS2	MS3	MS4	MS5
MS1) ONEB STATION					
MS2) POWER PLANT	-0.20				
MS3) MIN.DEP.OFFICE	-0.65	-0.31			
MS4) S.P.PRO.OFFICE	0.06	-0.26	-0.24		
MS5) H.& I. ESTATE	-0.13	-0.43	0.03	-0.30	

2nd survey

	MS1	MS2	MS3	MS4	MS5
MS1) ONEB STATION					
MS2) POWER PLANT	-0.48				
MS3) MIN.DEP.OFFICE	-0.02	-0.54			
MS4) S.P.PRO.OFFICE	-0.21	-0.21	-0.38		
MS5) H.& I. ESTATE	-0.23	-0.16	-0.41	0.51	

3rd survey

	MS1	MS2	MS3	MS4	MS5
MS1) ONEB STATION					
MS2) POWER PLANT	-0.38				
MS3) MIN.DEP.OFFICE	-0.14	-0.25			
MS4) S.P.PRO.OFFICE	-0.29	-0.37	-0.29		
MS5) H.& I. ESTATE	0.10	-0.36	-0.38	-0.33	

All seasons

	MS1	MS2	MS3	MS4	MS5
MS1) ONEB STATION					
MS2) POWER PLANT	-0.35				
MS3) MIN.DEP.OFFICE	-0.32	-0.37			
MS4) S.P.PRO.OFFICE	-0.11	-0.31	-0.28		
MS5) H.& I. ESTATE	-0.09	-0.29	-0.23	-0.03	

1st survey

	MS1	MS2	MS3	MS4	MS5
MS1) ONEB STATION					
MS2) POWER PLANT	-0.41				
MS3) MIN.DEP.OFFICE	-0.27	0.03			
MS4) S.P.PRO.OFFICE	-0.05	-0.12	-0.54		
MS5) H.& I. ESTATE	0.14	-0.65	-0.53	0.05	

2nd survey

	MS1	MS2	MS3	MS4	MS5
MS1) ONEB STATION					
MS2) POWER PLANT	-0.74				
MS3) MIN.DEP.OFFICE	-0.40	0.08			
MS4) S.P.PRO.OFFICE	0.22	-0.43	-0.64		
MS5) H.& I. ESTATE	0.52	-0.47	-0.62	0.30	

3rd survey

	MS1	MS2	MS3	MS4	MS5
MS1) ONEB STATION					
MS2) POWER PLANT	-0.64				
MS3) MIN.DEP.OFFICE	-0.13	0.13			
MS4) S.P.PRO.OFFICE	-0.13	-0.20	-0.67		
MS5) H.& I. ESTATE	-0.18	-0.36	-0.55	0.26	

All seasons

	MS1	MS2	MS3	MS4	MS5
MS1) ONEB STATION					
MS2) POWER PLANT	-0.60				
MS3) MIN.DEP.OFFICE	-0.25	0.03			
MS4) S.P.PRO.OFFICE	0.02	-0.27	-0.58		
MS5) H.& I. ESTATE	0.08	-0.47	-0.56	0.14	

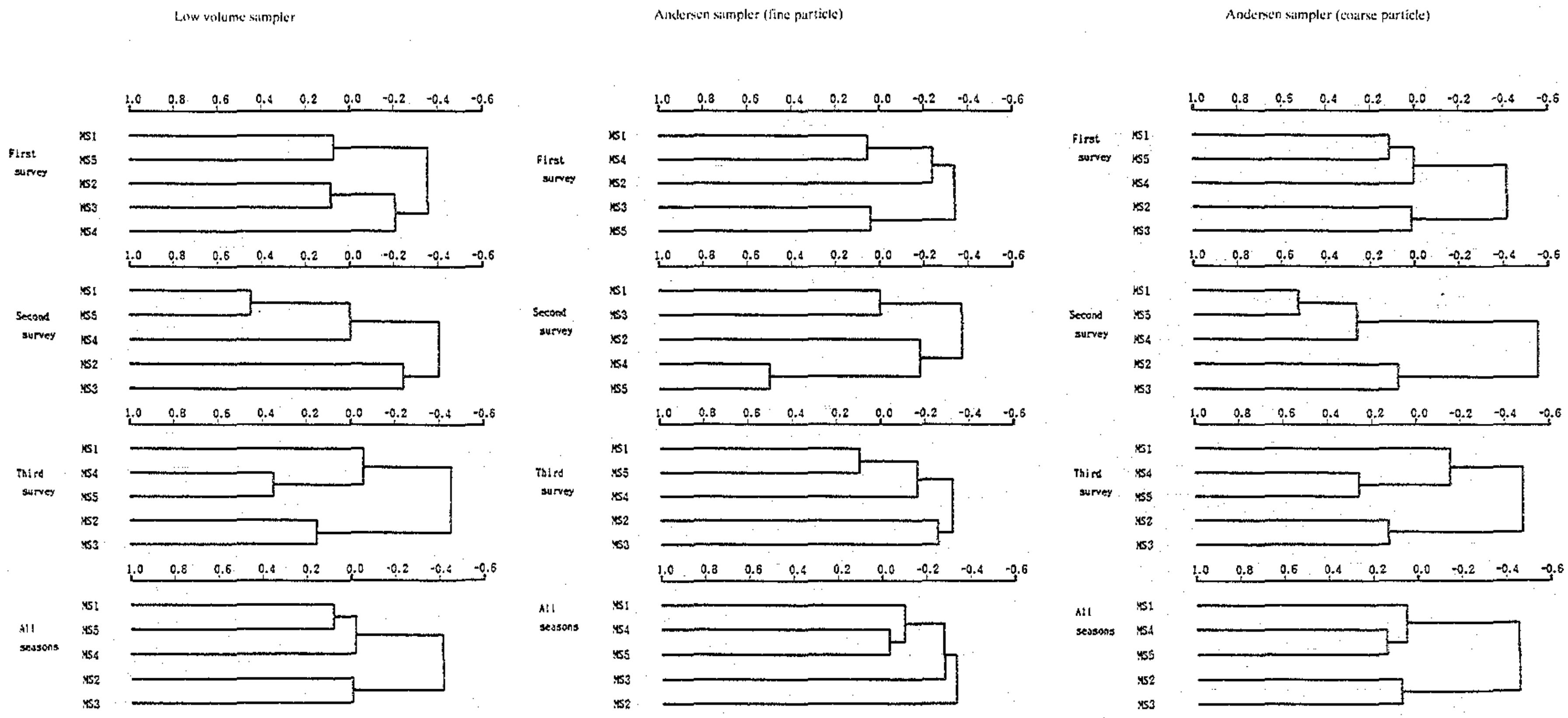


Fig. 3-3 Hierarchical Structure of Monitoring Station by the Cluster Analysis

3.5 The Relationships betwen Chemical Components

The relationships between chemical components were analyzed in this section. As it is difficult to analyze the relationship of all combinations of chemical components because of the number of combinations involved, the analytical study was limited to seven emission sources and the pairs of chemical components of each emission source are selected as shown in Table 3-4.

Table 3-4 Pair of Components for the Relationship Among Chemical Components

Soil	Sea-salt	Secondary particle	Petroleum combustion	Steel mill	Automobile	Others
Al–Sc	Cl–Na	NH_4^+–SO_4^{2-}	S–SO_4^{2-}	Cr–Mn	Pb–Br	E–C–Zn
Al–Ti	Cl^-–Na	NH_4^+–NO_3^-	V–SO_4^{2-}	Fe–Mn	Pb–E–C	O–C–Zn
Al–Si	SO_4^{2-}–Cl	Na–NO_3^-	V–S	Fe–Cr	Pb–O–C	E–C–K
Al–Fe	SO_4^{2-}–Na	SO_4^{2-}–NO_3^-	V-elemental carbon (V–E–C)	Ca–Mn	Br–E–C	O–C–K
Sc–Ti	Br–Cl		V-organic carbon (V–O–C)	Ca–Cr	Br–O–C	Pb–As
Sc–Si	Br–Na				Br–SO_4^{2-}	Zn–K
Sc–Fe	Br–SO_4^{2-}				Br–NO_3^-	Zn–As
Si–Ti	Br–Cl^-				Br–K	Pb–Sb
Si–Fe					E–C–SO_4^{2-}	Zn–Sb
Fe–Ti					O–C–SO_4^{2-}	
Al–Ca						
Si–Ca						
Sc–Ca						
Ti–Ca						

The result of regression analysis among various chemical components concentration is summarized in Table 3-5, in which data are treated in two ways, one excluding those less than the detection limit and the other applying a half value of the detection limit value for such data smaller than the detection limit. The correlation coefficients diagram among chemical components concentration is exemplified in Fig. 3-4 and the rest is filed in Data Sheets.

Reviewing those analytical data, one can notice a significant correlation coefficient ($r \geqq 0.8$) between two components listed below.

- Low-volume sampler case
  Al–Sc, Al–Si, Sc–Si, S–SO_4^{2-}, Br–E–C, Br–O–C, Cr–Mn, Fe–Mn, Fe–Cr, Pb–Sb
- Andersen sampler case (with respect to TSP)
  Al–Sc, Al–Ti, Al–Si, Sc–Ti, Sc–Si, Si–Ca, Sc–Ca, Cl–Na, Cl^-–Na, NH_4^+–SO_4^{2-}, Cr–Mn, Fe–Mn, Fe–Cr, Pb–Sb
- Andersen sampler case (fine particles only)
  Al–Sc, NH_4^+–SO_4^{2-}, Fe–Mn, Ca–Mn, Pb–Sb
- Andersen sampler case (coarse particles only)
  Al–Sc, Al–Ti, Al–Si, Sc–Ti, Sc–Si, Si–Ti, Si–Ca, Sc–Ca, Cl–Na, Cl^-–Na, V–S, Cr–Mn, Fe–Mn, Fe–Cr, Pb–Sb

Above all, noteworthy is a significant correlation ($r \geqq 0.9$) among those chemical component combinations of coarse particles in the Andersen sampler. The chemistry of such components is thought identical to those of soil and thus components like Al, Sc, Ti, Si or coarse particles have their origin in soil of the ground.

The combination of Cl–Na or Cl^-–Na of coarse particles are found the same in a significant correlationship and it is thought most likely that they exist in NaCl form as sea salt and in the coarse particle range.

Another high correlation found in combinations of Cr–Mn, Fe–Mn, Fe–Cr of coarse particles may be traced back to steel plant dust or it is thought contributory to the coarser size range of trapped dust.

The combination of Pb and Sb also shows a significant correlation and is thought attributable to the glass industry as an element source.

As for fine particle size, a significant correlation seen in NH_4^+–SO_4^{--} suggests the existence of $(NH_4)_2SO_4$ salt as a secondary particle. But the NH_4NO_3 salt is less likely to exist since the regression coefficient is found to be 0.152. The reason to support this conclusion is that the NO_3^- ion generally exists as a nitric acid fume and reacts with NaCl of sea salt to form the $NaNO_3$ coarse particle. But in a cold climate, the nitric acid particle formed by heterogenous nucleus reaction neutralizes the NH_4^+ ion to form NH_4NO_3 fine particles[11]. Accordingly, it is thought that in the warm climate of Thailand, the correlation coefficient of NH_4^+ and NO_3^- remains small (r=0.152) and that of Na and NO_3^- remain comparatively larger (r=0.680) in the coarse particle size range.

Table 3-5(1) Results of Regression Analysis between Chemical Components

(Low volume sampler)

Chemical components	X = Y	Except for trace data				Adopted half value for trace data			
		a	b	r	n	a	b	r	n
Soil	Al = Sc	9.77*10^{-5}	0.050	0.885	15	9.77*10^{-5}	0.050	0.885	15
	Al = Ti	0.044	48.22	0.675	13	0.052	36.78	0.698	15
	Al = Si	4.108	430.62	0.979	15	4.108	430.62	0.979	15
	Al = Fe	0.558	820.07	0.250	15	0.558	820.07	0.250	15
	Sc = Ti	301.195	46.30	0.499	13	360.779	33.16	0.534	15
	Sc = Si	33016.926	-458.03	0.869	15	33016.926	-458.03	0.869	15
	Sc = Fe	9007.086	99.66	0.445	15	9007.086	99.66	0.445	15
	Si = Ti	0.010	44.85	0.650	13	0.012	32.63	0.693	15
	Si = Fe	0.140	745.94	0.263	15	0.140	745.94	0.263	15
	Fe = Ti	0.010	74.69	0.327	13	0.013	64.41	0.383	15
	Al = Ca	0.557	1071.18	0.516	13	0.788	742.76	0.581	15
	Si = Ca	0.138	1000.25	0.531	13	0.198	636.08	0.612	15
	Sc = Ca	5640.391	770.49	0.523	13	8332.891	307.06	0.679	15
	Ti = Ca	4.649	1240.36	0.322	11	4.927	1012.91	0.271	15
Sea-salt	Cl = Na	0.412	711.91	0.705	15	0.412	711.91	0.705	15
	Cl^- = Na	-0.075	1484.41	-0.077	15	-0.075	1484.41	-0.077	15
	SO_4^{2-} Cl	0.303	193.15	0.690	15	0.303	193.15	0.690	15
	SO_4^{2-} Na	0.093	950.33	0.363	15	0.093	950.33	0.363	15
	Br = Cl	9.216	1551.43	0.106	15	9.216	1551.43	0.106	15
	Br = Na	-6.204	1533.26	-0.122	15	-6.204	1533.26	-0.122	15
	Br = SO_4^{2-}	62.946	3891.07	0.319	15	62.946	3891.07	0.319	15
	Br = Cl^-	17.862	521.86	0.347	15	17.862	521.86	0.347	15
Petroleum combustion	S = SO_4^{2-}	2.799	1483.70	0.841	15	2.799	1483.70	0.841	15
	V = SO_4^{2-}	90.395	3642.46	0.665	15	90.395	3642.46	0.665	15
	V = S	24.224	895.27	0.593	15	24.224	895.27	0.593	15
	V = E-C	64.686	9204.69	0.269	15	64.686	9204.69	0.269	15
	V = O-C	35.180	4645.36	0.215	15	35.180	4645.36	0.215	15
Secondary particle	NH_4^+ SO_4^{2-}	3.149	5802.23	0.212	7	10.053	3619.16	0.598	15
	NH_4^+ NO_3^-	1.476	426.64	0.654	7	0.565	714.46	0.167	15
	Na = NO_3^-	0.292	424.07	0.411	14	0.355	290.36	0.452	15
	SO_4^{2-} NO_3^-	0.036	665.71	0.203	14	0.028	651.83	0.140	15
Gasoline automobile	Pb = Br	0.002	17.85	0.079	14	0.003	17.21	0.108	15
	Pb = E-C	2.477	9535.75	0.300	14	2.874	9170.30	0.341	15
	Pb = O-C	1.039	4865.72	0.178	14	1.130	4781.57	0.197	15
	Br = E-C	298.739	4778.87	0.856	15	298.739	4778.87	0.856	15
	Br = O-C	191.073	1719.31	0.804	15	191.073	1719.31	0.804	15
	Br = SO_4^{2-}	62.946	3891.07	0.319	15	62.946	3891.07	0.319	15
	Br = NO_3^-	11.008	636.65	0.294	14	16.016	503.37	0.403	15
	Br = K	16.197	812.66	0.397	12	16.636	673.44	0.359	15
	E-C = SO_4^{2-}	0.329	1677.36	0.582	15	0.329	1677.36	0.582	15
	O-C = SO_4^{2-}	0.463	2633.08	0.558	15	0.463	2633.08	0.558	15
Steel mill	Cr = Mn	11.640	-13.49	0.892	15	11.640	-13.49	0.892	15
	Fe = Mn	0.079	-28.19	0.947	15	0.079	-28.19	0.947	15
	Fe = Cr	0.006	0.15	0.891	15	0.006	0.15	0.891	15
	Ca = Mn	0.118	-103.17	0.665	13	0.091	-53.65	0.658	15
	Ca = Cr	0.008	-4.26	0.565	13	0.005	0.12	0.496	15
Others	E-C = Zn	0.153	-722.56	0.555	15	0.153	-722.56	0.555	15
	O-C = Zn	0.210	-247.88	0.517	15	0.210	-247.88	0.517	15
	E-C = K	0.050	574.41	0.410	12	0.060	361.23	0.453	15
	O-C = K	0.074	691.04	0.402	12	0.106	426.49	0.542	15
	Pb = As	0.005	5.50	0.654	14	0.006	4.98	0.669	15
	Zn = K	0.188	941.51	0.459	12	0.222	789.00	0.461	15
	Zn = As	0.002	5.21	0.593	15	0.002	5.21	0.593	15
	Pb = Sb	0.034	1.22	0.932	14	0.035	1.12	0.935	15
	Zn = Sb	0.002	11.42	0.155	15	0.002	11.42	0.155	15

(Andersen sampler , Fine+Coarse)

Chemical components	X = Y	Except for trace data				Adopted half value for trace data			
		a	b	r	n	a	b	r	n
Soil	Al = Sc	1.21*10^{-4}	0.026	0.956	15	1.21*10^{-4}	0.026	0.956	15
	Al = Ti	0.038	40.11	0.901	13	0.047	25.23	0.883	15
	Al = Si	2.805	197.87	0.973	15	2.805	197.87	0.973	15
	Al = Fe	-0.029	1230.65	-0.019	15	-0.029	1230.65	-0.019	15
	Sc = Ti	275.705	37.88	0.835	13	354.033	21.18	0.833	15
	Sc = Si	21587.461	-176.42	0.947	15	21587.461	-176.42	0.947	15
	Sc = Fe	-307.073	1247.58	-0.026	15	-307.073	1247.58	-0.026	15
	Si = Ti	0.010	44.85	0.650	13	0.015	27.46	0.822	15
	Si = Fe	-0.054	1368.16	-0.104	15	-0.054	1368.16	-0.104	15
	Fe = Ti	0.002	80.42	0.077	13	0.005	69.08	0.141	15
	Al = Ca	0.925	745.01	0.786	15	0.925	745.01	0.786	15
	Si = Ca	0.351	614.27	0.860	15	0.351	614.27	0.860	15
	Sc = Ca	7944.680	495.87	0.853	15	7944.680	495.87	0.853	15
	Ti = Ca	14.986	576.55	0.554	13	14.887	588.46	0.680	15
Sea-salt	Cl = Na	0.593	65.04	0.860	15	0.593	65.04	0.860	15
	Cl^- = Na	0.892	375.90	0.938	15	0.892	375.90	0.938	15
	SO_4^{2-} Cl	0.219	1332.02	0.716	15	0.219	1332.02	0.716	15
	SO_4^{2-} Na	0.150	764.19	0.709	15	0.150	764.19	0.709	15
	Br = Cl	-20.982	2731.87	-0.273	15	-20.982	2731.87	-0.273	15
	Br = Na	-14.450	1722.16	-0.272	15	-14.450	1722.16	-0.272	15
	Br = SO_4^{2-}	8.652	4467.44	0.034	15	8.652	4467.44	0.034	15
	Br = Cl^-	-12.010	1432.76	-0.215	15	-12.010	1432.76	-0.215	15
Petroleum combustion	S = SO_4^{2-}	3.623	-3422.22	0.745	15	3.623	-3422.22	0.745	15
	V = SO_4^{2-}	117.306	2809.31	0.782	15	117.306	2809.31	0.782	15
	V = S	20.957	1896.78	0.679	15	20.957	1896.78	0.679	15
Secondary particle	NH_4^+ SO_4^{2-}	6.726	695.62	0.955	12	6.128	1198.37	0.955	15
	NH_4^+ NO_3^-	0.522	691.12	0.437	12	0.544	673.18	0.494	15
	Na = NO_3^-	0.381	422.79	0.468	15	0.381	422.79	0.468	15
	SO_4^{2-} NO_3^-	0.092	553.57	0.533	15	0.092	553.57	0.533	15
Gasoline automobile	Pb = Br	-0.004	23.35	-0.205	10	0.001	17.85	0.065	15
	Br = SO_4^{2-}	8.652	4467.44	0.034	15	8.652	4457.44	0.034	15
	Br = NO_3^-	10.544	784.10	0.244	15	10.544	784.10	0.244	15
	Br = K	11.840	903.69	0.338	15	11.840	903.69	0.338	15
Steel mill	Cr = Mn	12.048	-22.63	0.861	15	12.048	-22.63	0.861	15
	Fe = Mn	0.091	-39.72	0.982	15	0.091	-39.72	0.982	15
	Fe = Cr	0.006	0.84	0.856	15	0.006	0.84	0.856	15
	Ca = Mn	0.003	64.82	0.024	15	0.003	64.82	0.024	15
	Ca = Cr	-0.002	10.66	-0.210	15	-0.002	10.66	-0.210	15
Others	Pb = As	0.002	7.35	0.523	10	0.005	4.67	0.651	15
	Zn = K	0.175	980.02	0.447	15	0.175	980.02	0.447	15
	Zn = As	0.002	4.83	0.544	15	0.002	4.83	0.544	15
	Pb = Sb	0.028	2.29	0.891	10	0.029	1.77	0.914	15
	Zn = Sb	0.001	10.57	0.082	15	0.001	10.57	0.082	15

Note) in regression line $Y = a X + b$,
a : regression coefficient
b : intercept
r : correlation coefficient
n : number of data

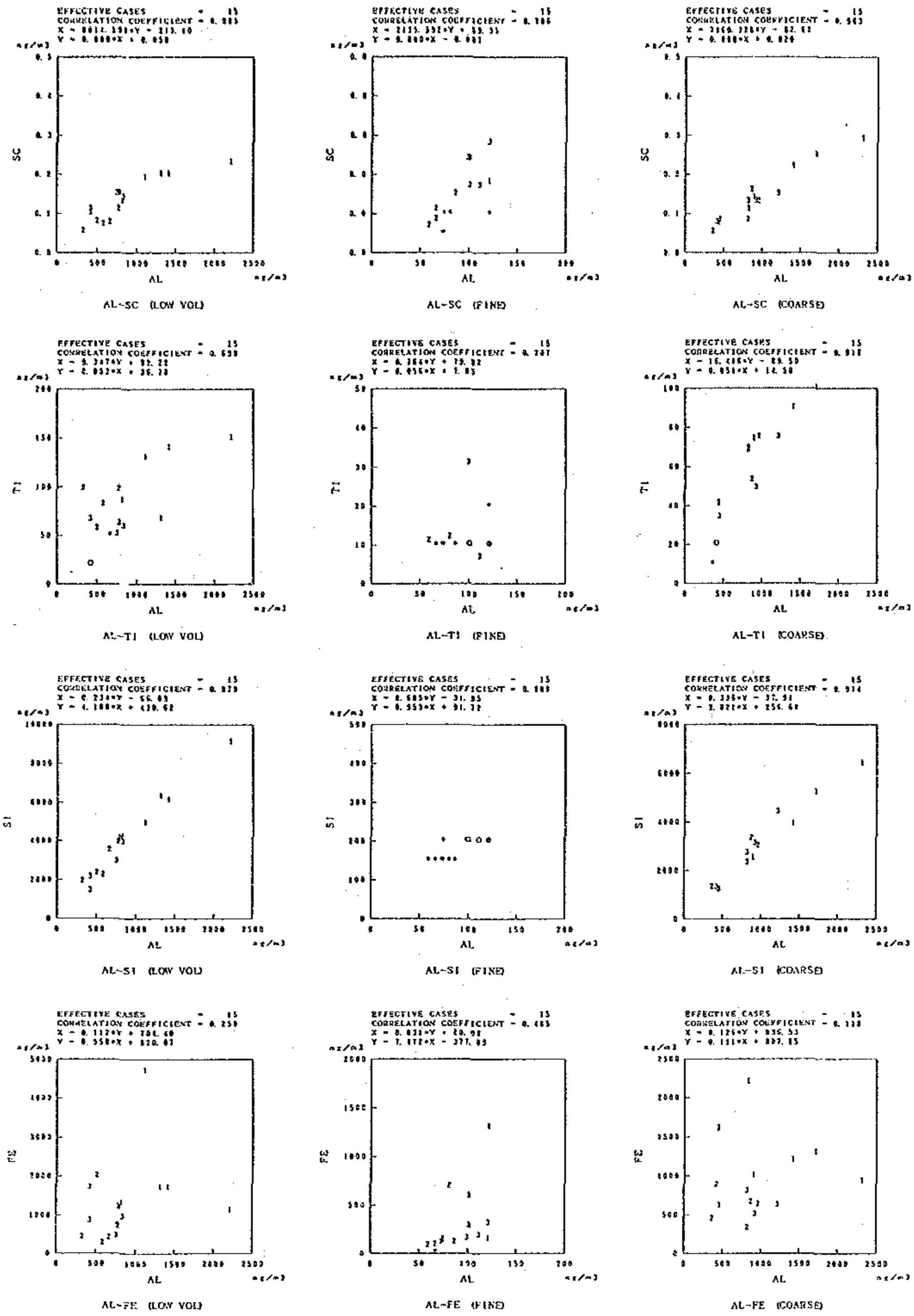
Table 3-5(2) Results of Regression Analysis between Chemical Components

(Andersen sampler , Fine)

Chemical components	X Y	Except for trace data a	b	r	n	Adopted half value for trace data a	b	r	n
Soil	Al = Sc	$2.52*10^{-4}$	-0.006	0.827	10	$2.33*10^{-4}$	-0.007	0.706	15
	Al = Ti	0.082	8.09	0.174	4	0.056	7.05	0.207	15
	Al = Si	—	—	—	0	0.953	91.72	0.808	15
	Al = Fe	7.078	-335.47	0.448	14	7.472	-377.89	0.485	15
	Sc = Ti	1048.301	-0.44	0.701	3	200.287	9.26	0.244	15
	Sc = Si	—	—	—	0	2484.198	142.02	0.696	15
	Sc = Fe	15434.074	-60.64	0.637	9	3296.188	242.10	0.071	15
	Si = Ti	—	—	—	0	0.061	1.29	0.265	15
	Si = Fe	—	—	—	0	4.208	-455.32	0.322	15
	Fe = Ti	-0.007	17.16	-0.186	4	0.005	10.58	0.291	15
	Al = Ca	1.758	-37.77	0.719	9	0.961	1.52	0.377	15
	Si = Ca	—	—	—	0	0.584	-15.96	0.270	15
	Sc = Ca	1706.476	71.09	0.390	6	-389.668	92.57	-0.051	15
	Ti = Ca	—	—	—	1	1.810	65.32	0.192	15
Sea-salt	Cl = Na	0.060	392.13	0.103	15	0.060	392.13	0.103	15
	Cl^- = Na	-0.250	518.08	-0.203	11	0.218	380.98	0.170	15
	SO_4^{2-} Cl	0.063	181.50	0.402	15	0.063	181.50	0.402	15
	SO_4^{2-} Na	0.042	278.06	0.460	15	0.042	278.06	0.460	15
	Br = Cl	3.617	342.12	0.088	15	3.617	342.12	0.088	15
	Br = Na	-6.782	500.11	-0.283	15	-6.782	500.11	-0.283	15
	Br = SO_4^{2-}	30.689	2907.06	0.116	15	30.689	2907.06	0.116	15
	Br = Cl^-	5.461	130.89	0.252	11	1.578	137.60	0.085	15
Petroleum combustion	S = SO_4^{2-}	3.019	-36.23	0.485	15	3.019	-36.23	0.485	15
	V = SO_4^{2-}	108.303	2134.71	0.741	15	108.303	2134.71	0.741	15
	V = S	0.841	1093.02	0.036	15	0.841	1093.02	0.036	15
Secondary particle	NH_4^+ SO_4^{2-}	5.110	543.59	0.978	12	4.598	948.53	0.967	15
	NH_4^+ NO_3^-	0.035	169.98	0.152	12	0.050	157.78	0.275	15
	Na = NO_3^-	-0.018	190.90	-0.043	15	-0.018	190.90	-0.043	15
	SO_4^{2-} NO_3^-	0.013	141.92	0.329	15	0.013	141.92	0.329	15
Gasoline automobile	Pb = Br	-0.004	15.39	-0.146	10	0.003	11.94	0.103	15
	Br = SO_4^{2-}	30.689	2907.06	0.116	15	30.689	2907.06	0.116	15
	Br = NO_3^-	2.447	152.75	0.242	15	2.447	152.75	0.242	15
	Br = K	6.399	584.52	0.205	14	6.068	560.82	0.173	15
Steel mill	Cr = Mn	8.033	2.87	0.623	15	8.033	2.87	0.623	15
	Fe = Mn	0.119	-5.22	0.962	14	0.118	-4.73	0.963	15
	Fe = Cr	0.006	1.73	0.608	14	0.006	1.56	0.630	15
	Ca = Mn	0.701	-46.41	0.843	9	0.508	-15.03	0.686	15
	Ca = Cr	0.035	-0.07	0.540	9	0.031	0.61	0.533	15
Others	Pb = As	0.003	5.64	0.358	10	0.007	3.35	0.617	15
	Zn = K	0.205	566.11	0.468	14	0.234	529.03	0.482	15
	Zn = As	0.004	3.19	0.582	15	0.004	3.19	0.582	15
	Pb = Sb	0.028	2.76	0.811	10	0.029	2.07	0.859	15
	Zn = Sb	0.003	7.10	0.151	15	0.003	7.10	0.151	15

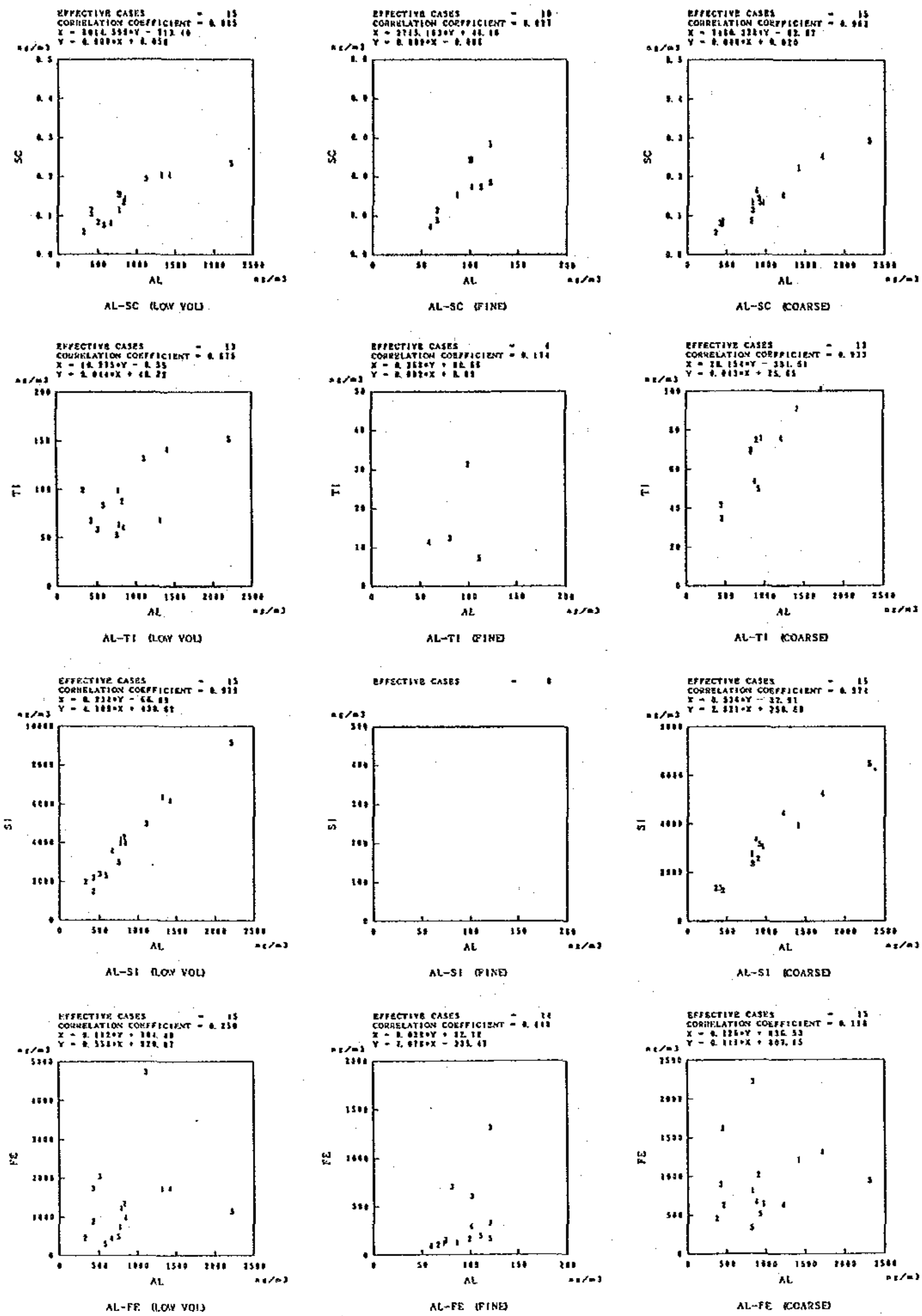
(Andersen sampler , Coarse)

Chemical components	X Y	Except for trace data a	b	r	n	Adopted half value for trace data a	b	r	n
Soil	Al = Sc	$1.24*10^{-4}$	0.020	0.963	15	$1.24*10^{-4}$	0.020	0.963	15
	Al = Ti	0.043	25.65	0.933	13	0.051	14.50	0.918	15
	Al = Si	2.821	256.68	0.974	15	2.821	256.68	0.974	15
	Al = Fe	0.111	807.15	0.118	15	0.111	807.15	0.118	15
	Sc = Ti	311.531	23.83	0.869	13	377.689	10.79	0.875	15
	Sc = Si	21235.816	-3.27	0.947	15	21235.816	-3.27	0.947	15
	Sc = Fe	1224.892	742.90	0.168	15	1224.892	742.90	0.168	15
	Si = Ti	0.014	26.18	0.873	13	0.017	13.68	0.875	15
	Si = Fe	0.010	884.57	0.029	15	0.010	884.57	0.029	15
	Fe = Ti	0.006	64.93	0.129	13	0.014	50.13	0.240	15
	Al = Ca	0.942	724.24	0.793	15	0.942	724.24	0.793	15
	Si = Ca	0.354	580.64	0.862	15	0.354	580.64	0.862	15
	Sc = Ca	7956.297	517.93	0.864	15	7956.297	517.93	0.864	15
	Ti = Ca	15.884	610.31	0.639	13	15.614	634.88	0.732	15
Sea-salt	Cl = Na	0.566	-66.60	0.932	15	0.566	-66.60	0.932	15
	Cl^- = Na	0.808	188.81	0.956	15	0.808	188.81	0.956	15
	SO_4^{2-} Cl	0.439	1373.40	0.497	15	0.439	1373.40	0.497	15
	SO_4^{2-} Na	0.284	662.12	0.530	15	0.284	662.12	0.530	15
	Br = Cl	-116.765	2801.03	-0.525	13	-53.088	2269.32	-0.266	15
	Br = Na	-64.979	1497.44	-0.464	13	-34.118	1240.79	-0.282	15
	Br = SO_4^{2-}	-45.911	1692.91	-0.177	13	-10.521	1396.63	-0.047	15
	Br = Cl^-	-70.072	1574.55	-0.439	13	-25.834	1205.86	-0.181	15
Petroleum combustion	S = SO_4^{2-}	1.524	-370.10	0.760	15	1.524	-370.10	0.760	15
	V = SO_4^{2-}	146.252	631.37	0.740	15	146.252	631.37	0.740	15
	V = S	79.566	736.36	0.807	15	79.566	736.36	0.807	15
Secondary particle	NH_4^+ SO_4^{2-}	—	—	—	0	0	1335.33	0	15
	NH_4^+ NO_3^-	—	—	—	0	0	794.00	0	15
	Na = NO_3^-	0.608	160.69	0.680	15	0.608	160.69	0.680	15
	SO_4^{2-} NO_3^-	0.193	536.09	0.402	15	0.193	536.09	0.402	15
Gasoline automobile	Pb = Br	-0.004	8.70	-0.221	7	$-1.82*10^{-4}$	5.85	-0.009	15
	Br = SO_4^{2-}	-45.911	1692.91	-0.177	13	-10.521	1396.63	-0.047	15
	Br = NO_3^-	-26.567	997.35	-0.225	13	-6.179	830.00	-0.057	15
	Br = K	42.704	199.72	0.607	12	26.780	327.96	0.371	15
Steel mill	Cr = Mn	10.857	-7.11	0.930	15	10.857	-7.11	0.930	15
	Fe = Mn	0.064	-18.18	0.954	15	0.064	-18.18	0.954	15
	Fe = Cr	0.005	-0.57	0.941	15	0.005	-0.57	0.941	15
	Ca = Mn	0.004	33.82	0.075	15	0.004	33.82	0.075	15
	Ca = Cr	$4.62*10^{-4}$	3.62	0.102	15	$4.62*10^{-4}$	3.62	0.102	15
Others	Pb = As	0.002	1.78	0.653	8	0.003	1.39	0.661	15
	Zn = K	0.032	507.69	0.055	13	0.089	453.22	0.150	15
	Zn = As	0.001	1.55	0.342	15	0.001	1.55	0.342	15
	Pb = Sb	0.029	-0.81	0.955	8	0.028	-0.34	0.964	15
	Zn = Sb	0.001	3.21	0.055	14	0.001	2.85	0.089	15



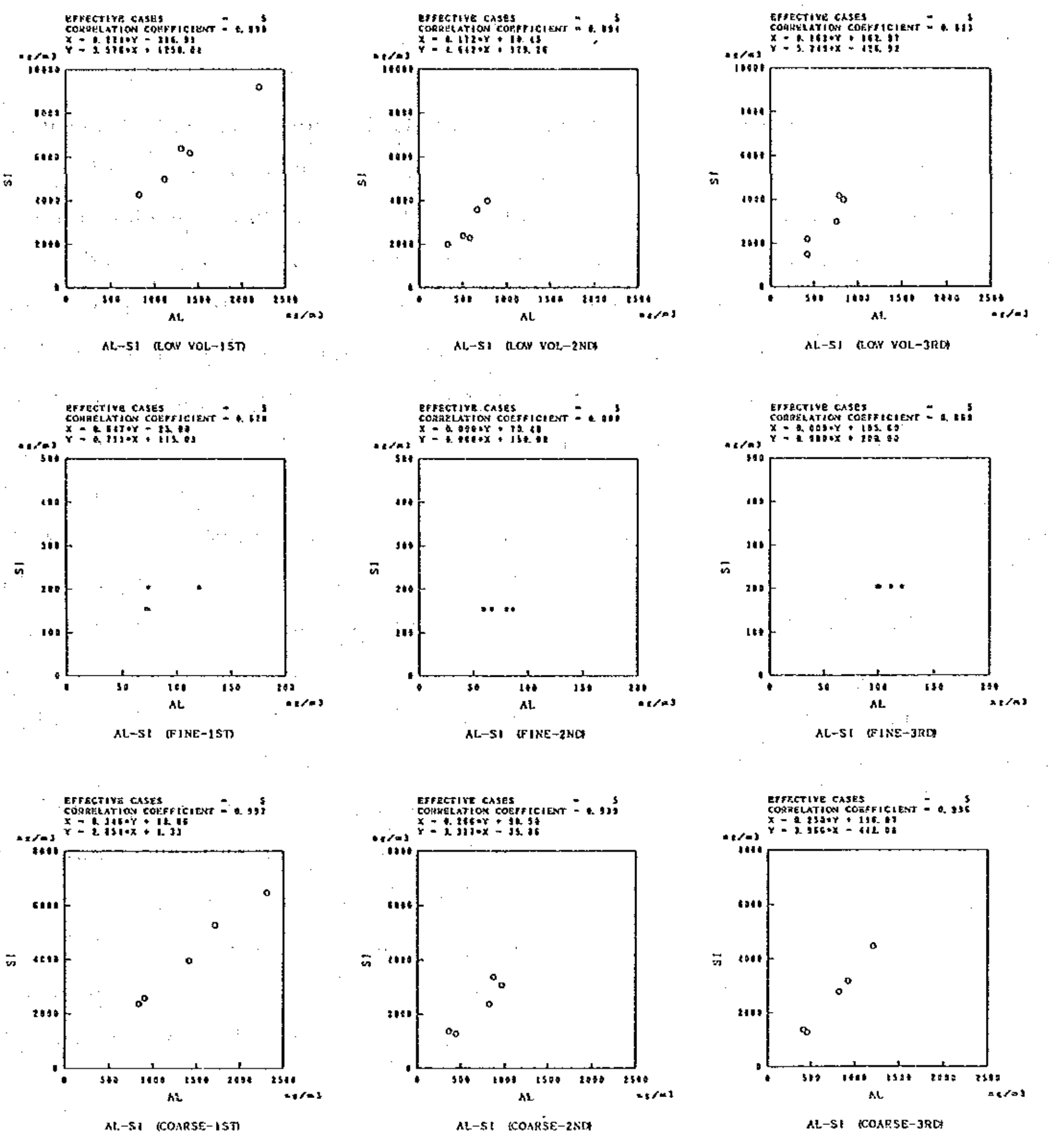
Survey	Normal data	Trace data
1st survey	1	+
2nd survey	2	*
3rd survey	3	0

Fig. 3-4(1) An Example of Scatter Grams of Chemical Components for Variation of Seasons



Station	Normal data
MS1	1
MS2	2
MS3	3
MS4	4
MS5	5

Fig. 3-4(2) An Example of Scatter Grams of Chemical Components for Variation of Stations



Normal data	Trace data
0	*

Fig. 3-4(3) An Example of Scatter Grams of Chemical Components for Comparison with Seasons

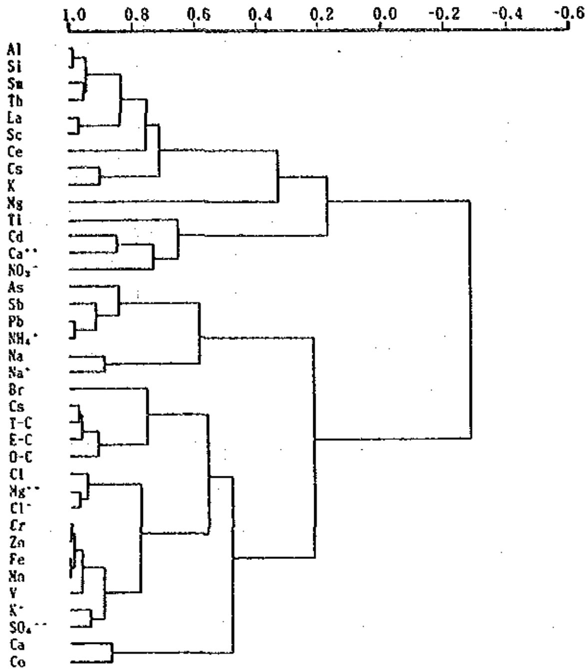
3.6 Resemblance among the Chemical Components by Cluster Analysis Based on Correlation Coefficients of Chemical Components Concentration

In order to check the similarity among chemical components, cluster analysis was done on their data obtained with respect to dust samples trapped by Low-volume sampler as well as Andersen sampler. As a measure to quantify the degree of similarity among variables, correlation coefficients among such chemical components concentration were calculated while setting the linkage distance approximated by the group average method. Data smaller than the detection limit value were thought to be equal to 1/2 of that detection limit. As for those chemical components in which more than 50 pct of the data drop below the detection minimum, they were excluded from analytical study. The result of cluster analysis is shown in Fig. 3-5.

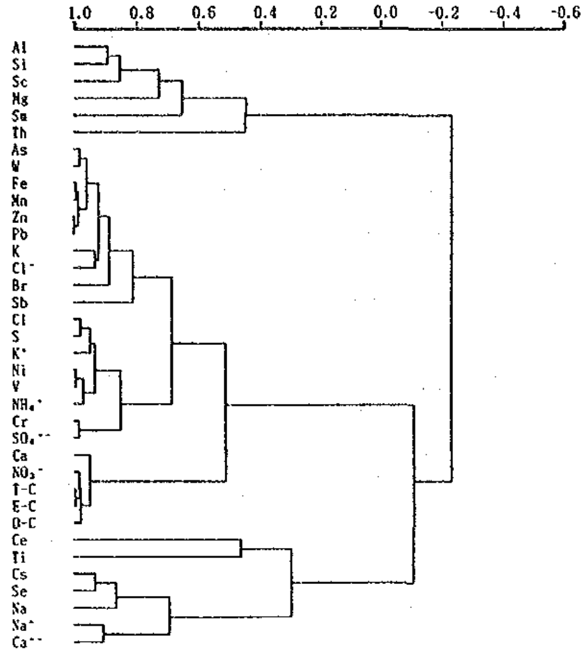
As for clustering analysis of all seasonal data by Low volume sampler, the chemical components are found classifiable into five groups. The first group of Al, Si, Th, Sm and Sc has a high value of similarity of 0.9 and with their origin in soil. The second of Sb and Pb is supposedly related to glass and nonferrous industries. The third of T–C, E–C, O–C neighboring with the Br, S group with a similarity of 0.8 to cover chemical components coming from Diesel and gasoline cars. The fourth of Ni and V having their origin in fuel oil combustion. And the fifth of Mn, Zn, Fe and Cr cluster having similarity of 0.8–0.9 originated in the industrial park with steel mills in it.

Thus the clustering analysis of chemical components found in dust sample trapped by Low-volume sampler gave the information on dust origins, namely ground soil, glass and nonferrous industries, automobiles, combustion fuel oil and steel plants. This information coupled with cluster analysis done on dust in two particle size ranges, fine and coarse, made it clear that the cluster of Na, Na^+, Cl and Cl^- having similarity of over 0.9 indicates the existence of sea salt in a coarser range whereas that of NH_4^+ and SO_4^{--} found in fine particles shows the existence of secondary particles.

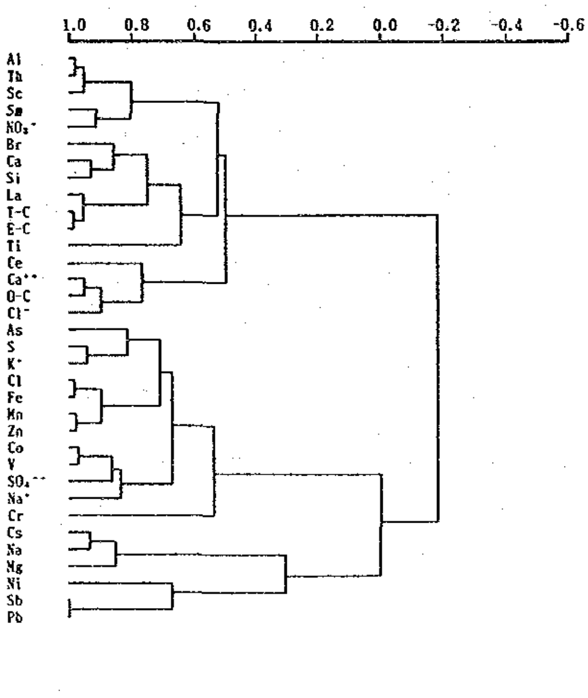
First survey



Second survey



Third survey



All seasons

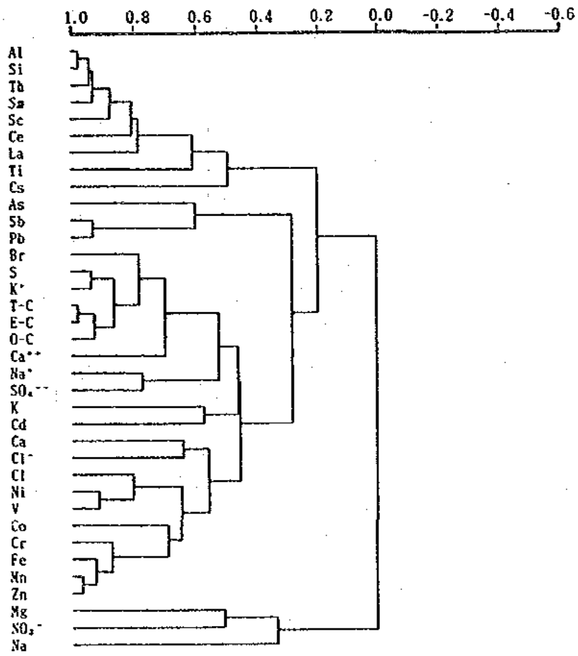


Fig. 3-5(1) Hierarchical Structure of Chemical Components by Cluster Analysis (Low Volume Sampler)

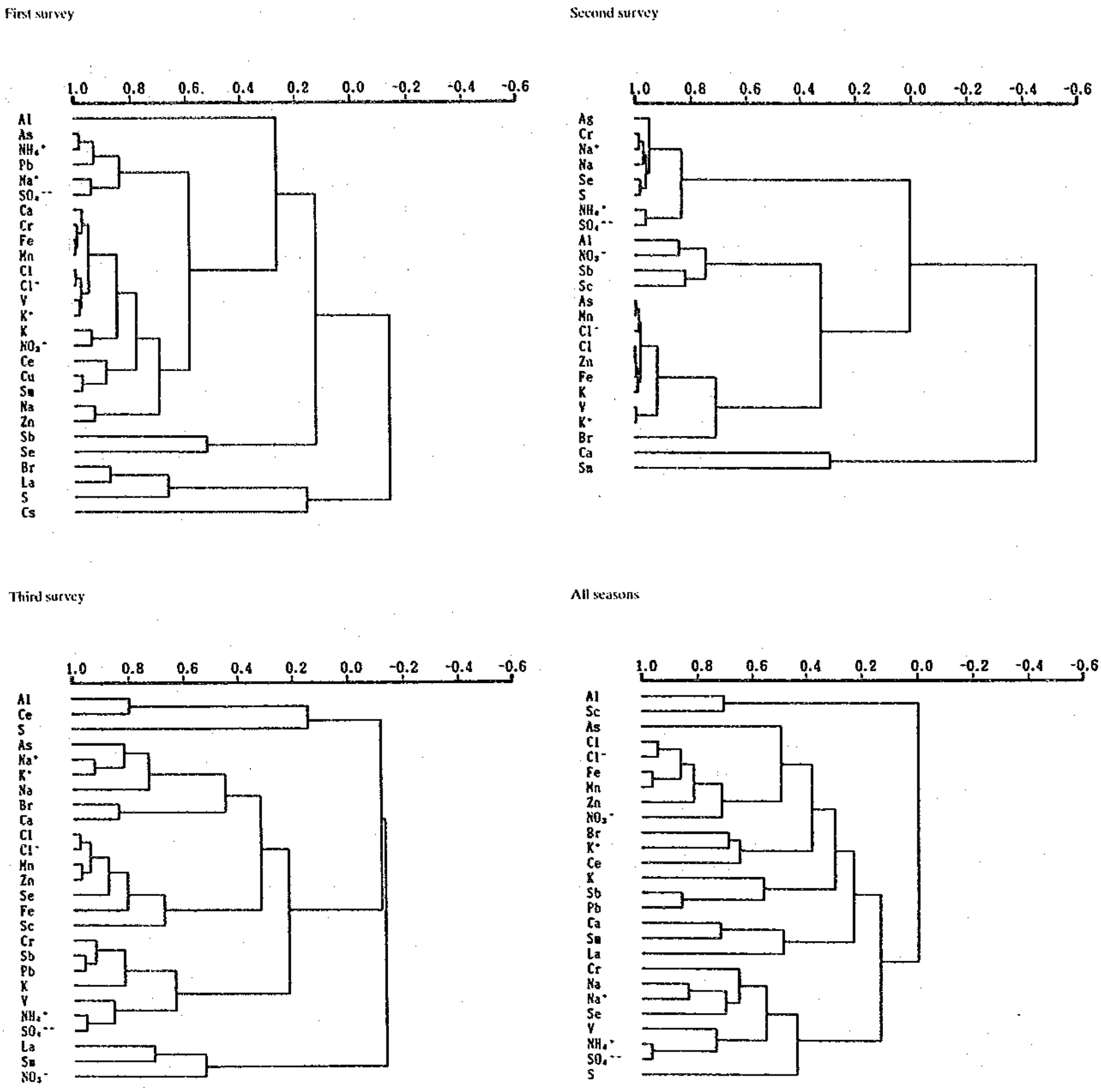
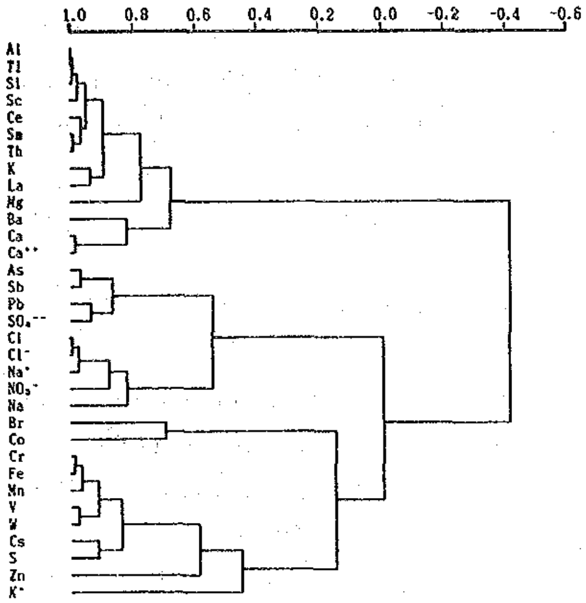
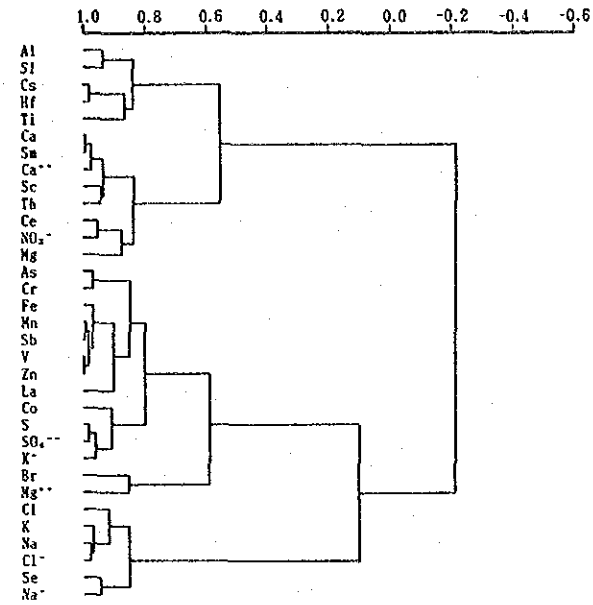


Fig. 3-5(2) Hierarchical Structure of Chemical Components by Cluster Analysis (Andersen Sampler, Fine Particle)

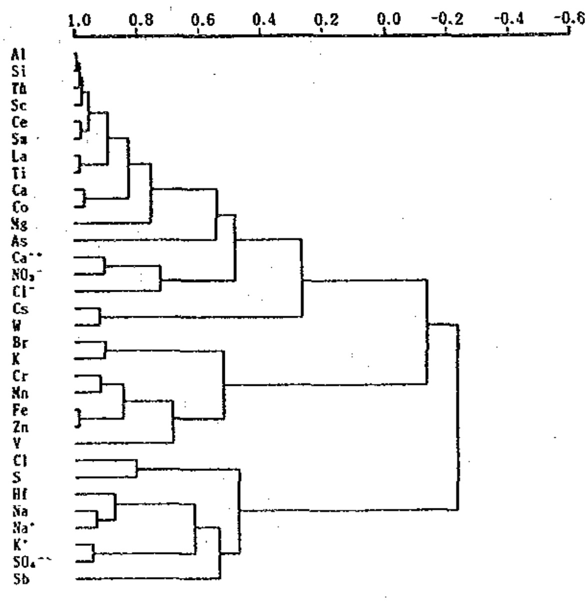
First survey



Second survey



Third survey



All seasons

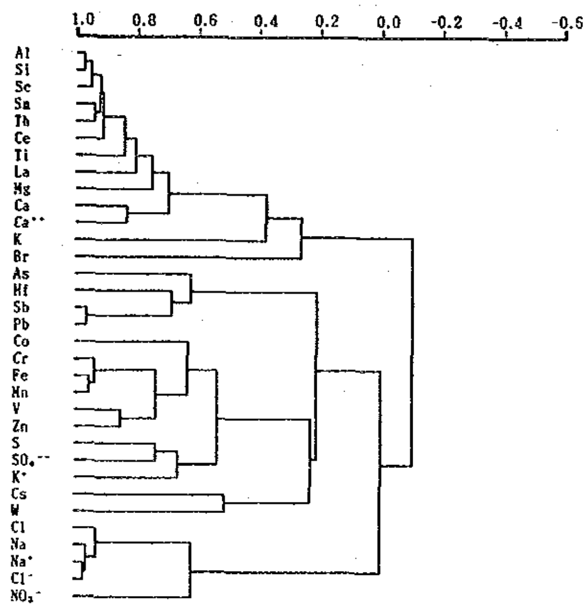


Fig. 3-5(3) Hierarchical Structure of Chemical Components by Cluster Analysis
(Andersen Sampler, Coarse Particle)

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PART IV ANALYTICAL STUDY ON CURRENT EMISSION VOLUME OF ATMOSPHERIC POLLUTANTS (SO_2 and NO_x)

1. Sources investigated

Among a number of jobs leading to a successful development of the environmental control management plan, of utmost importance is not only the estimation of pollutant emission volumes but the accuracy with which such emission volumes from sources in the specified district are monitored. The management plan requires a total simulation map to cover the whole specified area or pollutant sources within the area. Such environmental pollution maps developed were initially checked at several points such that the calculated values come in a good agreement with observed ones. Once insignificant differences confirmed, the proposed diffusion model, diffusion factors as well as emission volumes from sources were assumed practically applicable and were used to project the probable points where the pollutant concentrations are likely to reach the maximum or to such levels to exceed the national control standards. When highly polluted points are made known, say, in topoghraphic maps developed, the next step is to evaluate the degree of contribution by each source to the situation and thereby to prepare the reduction plan against each pollution source. Same stepwise approaches were thought effective against sources expected in future as well.

This investigation covered the present and future SO_2 and NO_x emissions from all stationary sources, vehicles, ships and ferryboats in Samut Prakarn District. This part, however, discussed the analytical study result only about the present status (as of 1988) and left same analytical study for the future sources in the part VI.

2. SO_2 and NO_x emission volume from factories

2.1 Summary of survey

The estimation of SO_2 and NO_x emission volume from factories is mainly dependent on the survey by questionnaire. Small plants, however, not quite suitable for such data survey method were treated such that fuel consumption and emission volume are proportional to the number of employees and they can be calculated by multiplying the unit fuel consumption per person by the number of workforce. The items listed in the questionnaire are supposed to cover all informations required for calculation of atmospheric pollutant concentrations but there were quite a few questionnaire retreieved partially filled, which required additional make-up efforts through hearing and those described in the succeeding chapter. As for NO_x emission, measurement data were not available from the factories and so they were calculated by knowing such factors as fuel consumption and type, equipment, production amount, etc, based on a method applied in Japan.

2.2 Questionnaire survey

As stated above, variables to influence the pollutants from each stationary source is the amount and type of fuels used and thus upon consultation with ONEB the JICA contractor sent questionnaire to 577 factories of 2,456 in total which have smoke stacks in Samut Prakarn area. The list of factories who reported back the information is shown in Table 2-1 and counts 208 in total. The plants listed in Table 2-2, with facility number zero (0) are those without any smoke stack and counts 11 in total.

Table 2-1 The number of factories from which questionnaire were retrieved

Name of county	Registered in master list	Questionnaire mail	Questionnaire return
1 Muang	974	185	63
2 Bang Plee	286	94	28
3 Phra Pradaeng	1196	298	117
TOTAL	2456	577	208

About a few of selected plants, the joint survey team of ONEB and Japanese staff visited them and confirmed the specifications and status data and for those in which some discrepancy be found followup actions were taken to make data consistency. The number of factories and facilities by county listed in Table 2-3 shows 59% of facilities in Phra Pradaeng. Table 2-4 summarizes the facilities by equipment type and shows 58% of facilities having the boiler in them.

The fuel type and consumption by facility type are shown in Table 2-5. It shows the type of fuel in use in Samut Prakarn area is mainly of fossil one, above all, fuel oil but others are also used such as firewood and rice chaff in boiler and drier furnace. Table 2-6 shows the type and consumption of fuel by business type, from which one can notice South Bangkok Power Plant being the largest consumer.

Table 2-2 (1) List of factory

County	Factory No.	Name of Factory	Registered Number	Area (m²)	Num. Employee	Num. Facility	Fuel Consu. (kℓ/Y)
1	1	ADAMS (THAILAND) CO., LTD.	12(7)-1/13	6564	183	1	425
	2	SIAM CHEMICAL INDUSTRY CO., LTD.	42-4/18	83200	110	4	722
	6	CPC (THAILAND) CO., LTD.	4(3)-1/16	24000	91	2	912
	7	BAYER THAI CO., LTD.	43-1/29	12400	125	1	45
	8	SIAM STEEL SYNDICATE CO., LTD.	59-1/23	102400	311	2	86
	9	PD-SIAMROD CO., LTD.	60-3/27	1500	21	1	0
	10	YOO HUAT RICE MILL (closed)	9(1)-1/13	400	3	0	0
	11	PAIROJ (TANG SANG HAB) CO., LTD.	13(2)-1/13	20800	179	0	0
	12	THAI TEXTILE PRINTING (1980)	22(3)-2/25	95400	400	3	12000
	13	WING GONG	51-1/18	200	8	1	24
	14	THAI UNION FACTORY	15(2)-1/15	16000	17	1	100
	15	THAI METAL WORK CO., LTD.	64(1)-1/22	4860	141	6	2394
	16	CONSOLIDATED ELECTRIC CO., LTD.	70-2/20	16000	80	1	24
	17	NESTLE (THAILAND) CO., LTD.	5(3)-1/12	33600	377	3	2200
	18	SRITHAI PASUSUK FEEDMILL CO., LTD.	15(2)-1/14	9600	113	2	403
	19	SOONTHRON PRINTING CO., LTD.	22(4)-1/22	7380	115	2	663
	20	LUCKYTEX (THAI) CO., LTD.	22(1)-1/20	119500	421	8	8434
	21	NIPPON DENSO (THAILAND) CO., LTD.	77(2)-1/17	32000	415	4	108
	22	MONGKOL WEAVING CO., LTD.	22(2)-5/14	4000	70	1	1728
	23	RAMA FOAM INDUSTRIAL (closed)	52(2)-1/16	2112	36	1	0
	24	SIAM RUNG RUENG WEAVING	22(2)-9/16	13200	165	1	35
	25	PHATHANATHAI WEAVING CO., LTD.	22(2)-14/15	3200	150	1	26
	27	VAROPAKORN	60-3/26	1600	18	1	2
	29	SIAM G.S. BATTERY CO., LTD.	74(5)-3/13	3780	295	5	1202
	30	SAMUTPRAKARN INDUSTRY CO., LTD.	7(2)-2/22	2400	60	1	52
	32	TANGPRASIT WEAVING	22(2)-2/21	9600	100	1	330
	33	RAMA LAUNDRY CO., LTD.	98-1/29	3200	150	1	438
	34	LIAN KI WEAVING LTD.,PART	22(2)-5/19	6400	35	1	144
	35	THAI TEPAROS FOOD PRODUCTS CO., LTD.	13(2)-4/13	112000	210	2	700
	36	MAHAKIJ THAI RUBBER FACTORY	52(2)-1/19	24000	250	2	360
	39	YIP YIN TUM CO., LTD.	38(2)-2/15	160000	120	1	3311
	40	PRACHAKIT RUBBER FACTORY	52(1)-1/25	1404	12	1	59
	41	ASIA FIBER CO., LTD.	44-1/15	184000	967	4	4488
	42	THAI NYLON CO., LTD.	26-1/36	28800	400	2	232
	44	THAI CHEMICAL PRODUCT CO., LTD.	48(9)-1/19	920	4	1	10
	45	YUASA BATTERY THAILAND CO., LTD.	74(5)-1/13	7695	188	8	402
	46	Y.K.K. ZIPPER (THAILAND) CO., LTD.	64(2)-2/21	48000	201	4	144
	48	SUNG HENG LEE LTD.,PART	22(2)-9/21	8000	39	2	316
	49	PEONY BLANKET INDUSTRIAL CO., LTD.	22(2)-12/13	76800	900	3	407
	51	FRIENDSHIP CORN STARTH CO., LTD.	9(2)-1/22	128000	95	4	945
	52	SIAM TEXTILE CHEMICAL CO., LTD.	42-2/18	450	39	2	137
	53	SIAM INSULATION	53(8)-2/18	6400	80	2	366
	54	PHELPS DODGE THAILAND CO., LTD.	74(2)-1/14	31080	268	1	991
	55	THAI DEVELOPMENT PAPER CO., LTD.	38(2)-1/22	27200	364	2	9600
	56	THAI DAIRY INDUSTRY CO., LTD.	5(3)-1/13	40000	435	8	1201
	58	WARNER-LAMBERT (THAILAND) CO., LTD.	46-1/15	3004	60	1	98
	59	K.SINTHAI WEAVING & DYEING LTD.,PART	22(2)-10/17	14400	111	2	90
	60	SAENG CHAROEN CHEMICAL (closed)	48(10)-1/22			0	0
	61	JUMPOLPOKPHAND PANICH	15(2)-4/20	15396	20	1	702
	62	UNION TEXTILE INDUSTRIES CORP.	22(2)-13/15			0	0
	63	NGUAN CHUN HUAD CO., LTD.	52(1)-1/13	11200	27	1	9
	64	SIAM UNION SAHAMITR CO., LTD.	47(2)-1/24	12000	82	3	1499
	65	KOKI PRODUCT CO., LTD.	60-1/26	285	7	2	2
	66	THAI TEXTILE INDUSTRY CO., LTD.	22(2)-6/23	40000	1700	2	1980
	67	THE PHIPBATANAKIT TEXTILE CO., LTD.	22(2)-24/15	28000	1205	2	360
	68	THAI TRICOT CO., LTD.	22(3)-4/13	76000	700	8	10498
	69	M & H MANUFACTURING CO., LTD.	46-3/15	17325	93	2	65
	70	UNION GLASS CO., LTD.	55-2/17	40000	250	4	8470
	71	ALUCON MANUFACTURING CO., LTD.	64(1)-1/19	4500	550	2	0
	72	HITACHI CONSUMMER PRODUCT (THAILAND)	71-1/15	40252	682	2	677
	73	NATIONAL THAI CO., LTD.	72-1/13	48936	1650	6	545
	74	THON BURI AUTOMOTIVE ASSEMBLY	77(1)-7/15	52800	661	3	160
	75	THE THAI KNITTING FACTORY CO., LTD.	24-1/15	3200	1007	0	0
2	1	TEPHSAYAM CO., LTD.	91-3/26	9600	16	0	0
	2	PORN PAIROJ	9(1)-4/24	3200	3	0	0
	3	SIAM ALGAE CO., LTD.	2(1)-1/21	51200	49	1	245
	4	ASIAN CHEMICAL CO., LTD.	42-1/22	6800	75	1	414
	5	SIAM AUTOMOTIVE INDUSTRY CO., LTD.	77(1)-1/20	88000	364	6	842
	6	KLONG SUAN RICE CO., LTD.	9(1)-5/24	4800	6	1	179
	7	PHATHANA FABRIC CO., LTD.	22(4)-1/24	5400	37	2	41
	8	BANGKOK FISHING NET CO., LTD.	26-3/18	24000	399	1	120
	9	ETHANOL RESIN CO., LTD.	42-2/25	64000	262	4	1470
	10	BATA SHOE COMPANY OF THAILAND LTD.	33-3/23	20800	1302	2	408
	11	THAI ACRYLIC CO., LTD.	22(1)-4/19	41600	750	2	1200
	12	MICRO FIBER INDUSTRY CO., LTD.	55-2/20	80992	143	1	1980
	13	SAHA PAIBOON RICE MILL	9(1)-24/15	3200	10	1	826
	14	SIAM DAIKIN CO., LTD.	70-1/21	8807	50	1	22
	15	STANDARD CANNED FOOD LTD.,PART	4(4)-1/13	3200	30	1	180
	16	THAI-YANHEE MANUFACTURING CO., LTD.	47(3)-1/22	3200	24	1	1
	17	MUANG THONG INDUSTRY FACTORY	60-2/25	22400	196	3	443
	18	THAI SONG SERM RICE MILL	9(1)-17/15	3200	2	1	11
	19	SRITHAI POULTRY PROCESSING CO., LTD.	4(1)-1/24	44800	1000	2	538
	20	CHULA MANEE METAL WORKS	64(9)-2/28	400	41	1	20
	21	SRISIAM RICE MILL CO., LTD.	9(1)-1/27	8000	7	1	93
	22	KLONG BANGKRATEIM RICE MILL	9(1)-1/25	200	2	1	2
	23	BANGKOK FEED MILL CO., LTD.	15(1)-1/18	68800	257	5	1000
	24	SIAM YAMAHA CO., LTD.	78(1)-1/21	91243	618	4	5000
	25	THAI SAMMIT AUTOPART INDUSTRY	77(2)-1/23	75424	1166	1	208
	26	BANGKOK DICASTING & INJECTION	77(2)-5/24	19200	420	3	185
	27	KLID FIBER CEMENT CO., LTD.	58(1)-7/22	80000	639	0	0
	28	THAI ARROW PRODUCT CO., LTD.	77(2)-5/27	34664	2009	0	0
3	1	THAI STEEL BAR (closed in Sep.1988)	59-2/32	147200	491	4	2880
	2	THANAKORN VEGETABLE OIL PRODUCT	8(1)-1/20	105600	236	2	5760
	3	DUSIT TEXTILE CO., LTD.	22(2)-1/20	58823	772	1	951
	4	THAI-SCOTT PAPER CO., LTD.	38(2)-1/14	28800	295	1	2130
	5	AJINOMOTO (THAILAND) CO., LTD.	13(2)-1/14	84800	372	4	21164
	6	SIAM STEEL INDUSTRY CO., LTD.	59-6/19	19700	217	3	1623
	7	GENERAL STANDARD STEEL WORK CO., LTD.	59-4/23	9600	148	2	792
	8	ERAWAN TEXTILE CO., LTD.	22(2)-2/14	82663	802	1	616
	9	KAO INDUSTRIAL (THAILAND) CO., LTD.	47(1)-1/14	22400	300	4	583
	10	SAHAVIRIYA LIGHT GAUGE STEEL	59-6/27	37128	62	1	545
	11	SAIPAN THAI INDUSTRY	52(2)-2/16	2400	159	2	396
	12	THAI CHIPBOARD CO., LTD.	34(3)-3/15	36972	169	2	501
	13	CHAO PHRAYA CO., LTD.	9(6)-3/26	10000	91	2	2280
	14	THAI UNION PAPER CO., LTD.	38(2)-1/15	80000	829	4	12261
	15	TAITAN	6(1)-1/18	2400	8	1	87

Table 2-2 (2) List of factory

Country	Factory No.	Name of Factory	Registered Number	Area (㎡)	Num. Employee	Num. Facility	Fuel Consu. (kℓ/Y)
	16	SIAM TYRE CO., LTD.	51-3/13	107200	661	4	3316
	17	THAI CASTOR OIL INDUSTRY CO., LTD.	8(1)-2/22	10400	80	2	1749
	18	FOREMOST FRIESLAND (THAILAND)	5(3)-1/14	52800	250	4	817
	19	THAI BATTERY INDUSTRIAL CO., LTD.	74(5)-3/19	1453	49	2	37
	20	UNION COMMERCIAL DEVELOPMENT	52(1)-1/17	20000	100	1	209
	21	GIFFITT LABORATORIES (THAILAND)	13(2)-2/26	3200	76	1	1
	22	THAI ROONGKIT WOOD PRODUCT CO., LTD.	34(1)-2/23	1600	9	1	0
	23	SCH INDUSTRIES CO., LTD.	60-1/13	9900	257	7	1814
	24	ISUZU MOTORS (THAILAND) CO., LTD.	77(1)-6/15	11000	800	5	501
	25	NAMBOON BLEACHING & DYEING FACTORY	22(3)-3/13	8000	111	3	300
	26	ALPHATEXE INDUSTRY CO., LTD.	22(2)-5/18	11200	300	2	300
	27	PHRAPRADAENG WEAVING CO., LTD.	22(2)-4/21	7200	250	2	253
	28	NONYANG TIRE CO., LTD.	51-4/15	5640	192	1	144
	29	METAL BOX (THAILAND) CO., LTD.	64(1)-1/12	35588	555	14	1997
	30	SARONTHAI (1979) CO., LTD.	22(4)-3/14	11200	60	2	144
	31	TEINVIWAT INDUSTRY LTD., PART	47(1)-3/16	2192	10	2	36
	32	CHAIYAPORN WEAVING LTD., PART	22(2)-9/23	8000	100	2	216
	33	PACIFIC PLASTICS (THAILAND)	44-1/21	56660	42	3	321
	34	LAEMTHONG CORPORATION CO., LTD.	2(1)-1/18	20000	339	4	1100
	35	SIN SIAM FISHMEAL CO., LTD.	15(2)-3/15	8000	35	2	2479
	36	PEACE CANNING (1958) CO., LTD.	6(1)-1/15	1400	536	1	569
	37	THAI CHAREON	22(3)-8/15	4800	25	1	287
	38	SOOKTHAI RUBBER INDUSTRY CO., LTD.	52(1)-2/15	6400	45	3	182
	39	CHER SEIM HEANG TEXTILE	22(2)-4/13	10540	100	2	104
	40	SANG THAI RUBBER CO., LTD.	52(1)-1/20	3750	76	1	144
	41	SIN LEE HUAD	6(2)-1/20	800	5	1	9
3	42	TOKAI DYEING (THAILAND) CO., LTD.	22(2)-9/14	36800	1100	2	520
	43	MUI KOUNG PRINTING & DYEING LTD., PART	22(4)-1/25	5600	10	1	186
	44	NIMITRI INTERNATIONAL CO., LTD.	7(1)-1/19	8000	511	2	534
	45	T.S. FOOD	10(2)-1/21	4800	37	2	162
	46	SINSAENEE CO., LTD.	22(2)-11/21	11300	43	6	336
	47	THAI PLASTIC AND CHEMICAL CO., LTD.	44-1/14	80000	385	4	7084
	48	MUANG THAI STEEL CO., LTD.	59-1/14	28800	80	3	240
	49	THAI TIN PLATE MANUFACTURING	64(10)-2/16	65600	491	2	1664
	50	YAN S SIAM INDUSTRY CO., LTD.	52(1)-1/24	3300	80	3	144
	51	THE BANGKOK IRON AND STEEL WORKS	59-2/23	54400	471	4	5870
	52	RUBIA INDUSTRY CO., LTD.	47(1)-1/16	10426	505	2	1850
	53	SCI AMERICAN PHARMACEUTICLES	46-1/12	9120	73	1	8
	54	THAI CHUROS CO., LTD.	13(2)-1/12	44000	415	4	3456
	55	PRAKORN LTD., PART 《closed》	48(2)-1/16	1200	4	1	0
	56	SAHAROJ WEAVING FACTORY	22(2)-11/26	2400	180	1	324
	57	THAI EDIBLE OIL CO., LTD.	8(1)-4/15	19344	131	3	2974
	58	SUKSAWAD VEGETABLE OIL 《closed》	8(1)-1/18		16	1	0
	59	CENTURIES TEXTILE CO., LTD.	22(2)-1/29	14400	600	4	2956
	60	PATTANAKIT INDUSTRY LTD., PART	22(2)-16/17	2400	70	1	72
	61	TIENG NGUAN HUAD WEAVING CO., LTD.	22(2)-2/19		40	1	147
	62	SUKSAWAD AGRICULTURAL PRODUCT	2(2)-2/24	1600	30	3	292
	63	THAI HERN PATTANA CO., LTD.	53(7)-1/14	4800	93	2	33
	64	TOYOTA MOTOR THAILAND CO., LTD.	77(1)-1/18	87360	544	3	150
	65	KRIENG SIN RUBBER PRODUCT CO., LTD.	52(1)-1/15	3200	43	1	84
	66	POJAI INDUSTRIES CO., LTD.	22(4)-3/12	14200	90	1	165
	67	THAI PETROLEUM TRADING CO., LTD.	50(4)-1/26	11200	100	4	210
	68	FANCY TEXTILE MANUFACTURING CO., LTD.	22(2)-2/20	16000	110	2	540
	69	THAI INDUSTRIES PROMOTION CO., LTD.	22(1)-1/22	60800	2100	2	1440
	70	SIAM BROTHER CO., LTD.	26-1/12	48000	1100	2	600
	71	LUCKYTEX (THAILAND) LTD.MILL#1	22(2)-3/13	160000	2600	2	1748
	72	ORION PRINTING AND DYEING CO., LTD.	22(3)-2/23	17600	154	1	68
	73	THAI WANAPHAN CO., LTD.	34(3)-2/15	128000	300	2	5501
	74	DRAGON THAI STEEL CO., LTD.	59-2/21	3200	50	2	278
	75	UNITED GRAIN CO., LTD.	2(1)-1/25	30000	36	4	4800
	76	CHERRY FOOD INDUSTRY	13(2)-5/20	700	17	2	37
	77	CHAROEN APORN WATTANA WEAVING	22(2)-1/17	4800	60	1	109
	78	LIAN CHAI WEAVING	22(2)-1/24	12800	65	2	300
	79	THAI SOON SENG CO., LTD.	22(2)-15/17	24000	300	2	720
	80	YONG LEE WEAVING LTD., PART	22(2)-7/16	6400	57	1	44
	81	THAI DETERGENT CO., LTD.	47(1)-5/15	9600	20	1	23
	82	THAIPHRAN CO., LTD.	22(4)-1/15		124	2	1260
	83	NGUAN CHIEN FOOD INDUSTRY CO., LTD.	13(2)-5/28	7500	70	1	144
	84	SIRI TEXTILE CO., LTD.	22(2)-39/15	3200	80	1	120
	85	WONGSE SANG TEXTILE LTD., PART	22(2)-21/13	3200	60	2	72
	86	WONGSE SIN INDUSTRY CO., LTD.	46-2/13	3200	30	1	72
	87	BHASICHAROEN CORD INDUSTRY CO., LTD.	26-4/18	4000	600	2	641
	88	RUAM PHATHANA TEXTILE CO., LTD.	22(2)-40/15		61	0	0
	89	ADILEK TEXTILE	22(2)-1/21	6400	50	1	41
	90	THAI NUM BLEACHING & DYEING FACTORY	22(3)-1/28	16000	60	1	441
	91	CHUNG HA HANG LTD., PART	13(2)-2/12	8000	20	1	80
	93	WATTANA INDUSTRIES FACTORY LTD., PART	10(3)-1/13	3200	8	1	2
3	94	THAI SILO & INDUSTRY CO., LTD.	2(1)-1/19	29448	59	2	120
	95	THAI NAIL WORKS CO., LTD.	64(5)-2/13	8000	89	2	360
	96	BANGKOK DRYING & SILO CO., LTD.	2(5)-2/12	38400	81	3	285
	97	NANAPAN ENTERPRISE CO., LTD.	2(5)-1/27	27600	63	4	88
	98	SOUTH BANGKOK THERMAL PLANT	88	454000	1113	5	1994760
	99	THAI FISHSAUCE & CANNED FOOD	7(1)-1/18	9600	900	3	720
	100	BUAN SUN HAENG WEAVING (1981)	24-2/27	72000	50	2	110
	101	YENJITT INDUSTRY LTD., PART	22(3)-2/14		15	1	396
	102	S.THAISERI INDUSTRY CO., LTD.	8(1)-1/13	16800	30	3	268
	103	T.C.RUBBER INDUSTRY CO., LTD.	52(2)-1/25	3200	35	1	20
	104	JADED ESTER CO., LTD.	53(8)-2/16	1800	13	3	12
	105	THAI-ASAHI GLASS CO., LTD.	55-2/15	272000	1000	2	43800
	106	AH-EYL	64(8)-1/26	1680	50	1	3
	107	SIAM FINE CHEMICAL CO., LTD.	48(3)-2/19	8000	80	1	64
	108	SONGCHAI SPINNING CO., LTD.	22(1)-3/19	40000	661	1	24
	109	THAI DURABLE TEXTILE CO., LTD.	22(1)-4/15	124160	3795	2	1050
	110	METRO SPINNING CO., LTD.	22(2)-34/15	17200	1100	3	1091
	111	BANGKOK STEEL INDUSTRY CO., LTD.	59-8/15	90000	600	5	6249
	112	BANGKOK ELECTRIC WIRE AND CABLE	74(2)-3/15	62400	407	2	426
	113	N.H.K. SPRING (THAILAND) CO., LTD.	77(2)-4/15	38400	400	9	1336
	114	THAI BICYCLE INDUSTRY CO., LTD.	78(1)-2/15	22400	805	5	146
	115	THAI HONDA MANUFACTURING CO., LTD.	78(1)-4/15	17600	1045	4	269
	116	SRISUKSAWAD SPINNING CO., LTD.	22(1)-3/15	32000	990	0	0
	117	THAI PATHANA STEEL INDUSTRY CO., LTD.	59-3/20	14350	129	3	2532
	118	THAI INDIA STEEL CO., LTD.	59-1/17	33612	222	3	1080

Table 2-3 Number of factories and facilities by county

Name of county	Number of factories	Number of facilities
1 Muang	63	145
2 Bang Plee	28	47
3 Phra Pradaeng	117	278
TOTAL	208	470

Table 2-4 Number of facilities by equipment

Code	Name of facility type	Number of facilities
101	Boiler (for electric power)	5
103	〃 (other)	267
502	Metal fusion furnace (for aluminum smelting)	6
503	〃 〃 (for other smelting)	2
601	Metal rolling furnace (steel/continuous)	16
602	〃 〃 (steel/batch)	4
603	〃 〃 (aluminum/continuous)	2
607	Metal heat treatment furnace (steel/continuous)	5
608	〃 〃 (steel/batch)	3
611	〃 〃 (other/continuous)	3
612	〃 〃 (other/batch)	5
613	Metal forging furnace (steel/continuous)	1
702	Oil heating furnace (updraft)	2
703	〃 〃 (other)	6
915	Glass melting furnace (tank furnace)	5
918	Other melting furnace	2
1001	Reaction furnace (for inorganic chemicals)	1
1004	Direct heating furnace (for foodstuffs)	8
1105	Detergent drying furnace	1
1106	Other drying furnace	67
1201	Electric furnace (arc furnace for iron manufacture)	8
1202	〃 〃 (three-phase resistance for iron)	1
1205	〃 〃 (three-phase resistance for iron)	1
1209	〃 〃 (low frequency induction furnace)	1
1302	Waste incinerator (for domestic urban wastes/batch)	2
1303	〃 〃 (for industrial wastes/continuous)	1
1304	〃 〃 (for industrial wastes/batch)	3
1416	Fusion furnace (crucible furnace for lead)	2
1419	〃 〃 (crucible furnace for zinc)	1
1421	〃 〃 (other for zinc)	3
1423	Drying furnace (for lead)	3
1802	Activated carbon manufacturing reactor (other)	1
2501	Fusion furnace (for manufac.of lead storage battery)	10
2603	Reactor (for manufacture of lead pigment)	1
1	Diesel generator	3
8	Other	18
TOTAL		470

Table 2-5 Fuel type and consumption by facility type

fuel consumption (number of facilities)

Code	Name of facility type	Heavy Oil (kℓ)	Light Oil (kℓ)	Kero-sene (kℓ)	Other liquid (kℓ)	Coal (ton)	Lumber (ton)	Paddy & Husk (ton)	Other solid (ton)	LNG (ton)	LPG (ton)	Iron (ton)	Sulfi-de Ore (ton)	Nonfer ro.Ore (ton)	Raw Coke (ton)	Other Raw (ton)	Domes. Wastes (ton)	Indus. Wastes (ton)	Elect-ricity (MWH)
0101	Boiler (for electric power)	324000 (1)								1285200 (5)									
0103	〃 (other)	151716 (224)	1504 (14)	30 (2)	35 (1)	7035 (3)	21979 (14)	8817 (6)	8580 (2)		887 (6)								
0502	Metal fusion f. (alumi/smelt.)	2261(5)	20(1)																
0503	〃 〃 (other/smelt.)	23(2)																	
0601	Metal rolling f. (steel/cont.)	16363 (18)	51 (1)									11000 (3)							
0602	〃 〃 (steel/batch)	2810(4)																	
0603	〃 〃 (alumi/cont.)										769(2)								
0607	Metal heat tre.f.(steel/cont.)	955(5)																	0(1)
0608	〃 〃 (steel/batch)	156(3)																	
0611	〃 〃 (other/cont.)	1728(3)																	
0612	〃 〃 (other/batch)																		13053 (5)
0613	Metal forging f. (steel/cont.)	120(1)																	
0702	Oil heating furnace (updraft)	844(2)																	
0703	〃 〃 (other)	529(3)	3(1)								330(2)								
0915	Glass melting furnace (tank)	50100 (4)									1650 (1)								
0918	Other melting furnace						22(2)												
1001	Reaction furnace (chemicals)												217(1)						
1004	Direct heating furnace (food)	88(4)	2(1)	324(3)															
1105	Detergent drying furnace		450(1)																
1106	Other drying furnace	6692 (17)	1503 (6)					1048 (1)			7041 (37)					0 (2)			18 (9)
1201	Electric furnace (arc furnace)	956 (2)										334610 (5)			1800 (2)	115200 (3)			356384 (8)
1202	〃 〃 (three-phase)															28080 (1)			29372 (1)
1205	〃 〃 (three-phase)															34500 (1)			43560 (1)
1209	〃 〃 (low frequ.)													900(1)					5160(1)
1302	Waste inciner. (domest./batch)																18(1)	0(1)	
1303	〃 〃 (indust./cont.)																	0(1)	
1304	〃 〃 (indust./batch)		48(2)															158(2)	
1416	Fusion furnace (crucible/lead)										2(2)			30(2)					
1419	〃 〃 (crucible/zinc)	240(1)																	
1421	〃 〃 (other/zinc)	86(2)									0(1)								
1423	Drying furnace (for lead)										278(3)								
1802	Activated carbon manu. reactor			289(1)															
2501	Fusion f. (lead stor. battery)		11(1)	122(2)	71(4)						265(4)								
2603	Reactor (lead pigment)																		26(1)
0001	Diesel generator		16(3)																
0008	Other	1305(8)	1470(2)								84(7)					7800(1)			3951(3)
	TOTAL	560972 (309)	5078 (33)	765 (8)	106 (5)	7035 (3)	22001 (16)	9865 (7)	8580 (2)	1285200 (5)	11306 (65)	345610 (8)	217 (1)	930 (3)	1800 (2)	185580 (8)	18 (1)	158 (4)	451534 (30)

Table 2-6 Consumption of fuel by business catogory

fuel consumption (number of facilities)

Code	Name of business category	Heavy Oil (kl)	Light Oil (kl)	Kerosene (kl)	Other liquid (kl)	Coal (ton)	Lumber (ton)	Paddy & Husk (ton)	Other solid (ton)	LNG (ton)	LPG (ton)	Iron (ton)	Sulfide Ore (ton)	Nonferro Ore (ton)	Raw Coke (ton)	Other Raw (ton)	Domes. Wastes (ton)	Indus. Wastes (ton)	Electricity (MWh)
1~21	Food industry	52233(76)	18(5)	613(4)		900(1)	4851(5)	8817(6)	8100(1)		56(6)							66(1)	
22~33	Textile industry	34777(95)	25(1)			1405(1)	2719(5)		480(1)		608(7)								0(1)
34~37	Wood industry	134(1)					14400(2)	1048(1)											1(1)
38~41	Pulp and Paper	23991(7)				4730(1)													
42~53	Chemical Industry	23613(53)	761(12)		35(1)		31(4)				267(4)		217(1)				18(1)	92(3)	
54~58	Ceramic industry	30100(4)	1400(1)								2350(2)								
59	Iron and Steel	22127(30)	51(1)									345610(8)			1800(2)	177780(5)			423316(10)
60	Non-ferrous metal	2178(7)									70(4)			930(3)					9278(3)
61~83	Metal and Machine	7381(34)	2823(13)	152(4)	71(4)						7955(42)					7800(3)			12939(15)
84~99	Other manufactory	324438(2)								1285200(5)									
TOTAL		560972 (309)	5078 (33)	765 (8)	106 (5)	7035 (3)	22001 (16)	9865 (7)	8580 (2)	1285200 (5)	11306 (65)	345610 (8)	217 (1)	930 (3)	1800 (2)	185580 (8)	18 (1)	158 (4)	451534 (30)

2.3 Calculation of SO_2 and NO_x emission volume and exhaust gas volume based on the questionnaire survey data

2.3.1 Exhaust gas volume

The volume of exhaust gas from each plant was reported in the questionnaire. But for those not reported by questionnaire they were calculated by using the equation (2-1). If the calculated value is found exceeding 30 m/s in term of the stack exit velocity, it was thought erroneous. Taken as corrective actions are reexamination of reported data such as fuel consumption, stack geometry through additional hearing of the factory involved. The emission volume was calculated based on confirmed data. The residual oxygen content and wet exhaust gas factor are shown in Table 2-7 and Table 2-8 respectively. They are average figures in use in Japan.

$$\underset{(Nm^3/hr)}{\text{Exht. gas vol.}} = \underset{\substack{(liter/yr)\\ kg/yr\\ Nm^3/yr}}{\text{Annual fuel consump.}} \times \underset{\substack{wet\ (Nm^3/liter)\\ Nm^3/kg\\ Nm^3/Nm^3}}{\text{Exhaust gas factor}} \times \underset{(hr/yr)}{\text{Working time}} \times \frac{21}{21 - O_2} \quad \cdots\cdots (2\text{-}1)$$

The exhaust gas volume by each factory and each facility type is shown in Table 2-9 where the pattern (1) deals with consolidated data about each facility and the pattern (2), about the stack. Also included are SO_2, NO_x emission volume data calculated by the formula which will be mentioned later.

Table 2-7 Residual O_2 in flue gas by facility type (mean value in Japan)

Code	Name of facility type	O_2 (%)
0101	Boiler (for electric power)	5
0102	Boiler (for heating)	11
0103	Boiler (other)	7
0201	Gas generator	6
0202	Gas heater	10
0301~0305	Roasting furnace	10
0306~0308	Sintering furnace	16
0312~0314	Pellet calcination furnace	18
0401~0402	Blast furnace	2
0403~0404	Converter	6
0501~0506	Metal fusion furnace	14
0601~0606	Metal rolling furnace	9
0607~0612	Metal heat treatment furnace	10
0613~0618	Metal forging furnace	13
0701~0703	Oil heating furnace	7
0821	Combustion furnace	6
0901~0905	Cement calcination furnace	10
0906~0907	Brick calcination furnace	16
0909	Lime calcination furnace	10
0912~0913	Pottery calcination furnace	18
0914	Other calcination furnace	13
0915~0917	Glass melting furnace	13
1001~1002	Reaction furnace	6
1003~1004	Direct heating furnace	1
1101	Aggregate drying furnace	17
1102	Cement raw material drying furnace	17
1103	Brick raw material drying furnace	18
1104	Cast drying furnace	14
1106	Other drying furnace	15
1201~1212	Electric furnace	19
1301~1304	Waste incinerator	13
1401~1403	Roasting furnace(for copper, lead, zinc)	17
1407~1409	Blast furnace (for copper, lead, zinc)	3
1413~1421	Fusion furnace (for copper, lead, zinc)	18
1422~1424	Drying furnace (for copper, lead, zinc)	3
2801	Coke furnace	5
	average	10

[Source] Ministry of International Trade and Industry (MITI), "Manual of Ambient SOx and NOx Prediction Method in Comprehensive Environmental Assessment", 367p, IPCAJ (in Japanese), (1985).

Table 2-8 Fuel properties by fuel type (mean value in Japan)

	Fuel Classification	Sulfur Contents (%)	Specific Gravity	Gross Carolific Value	Gross Carolific unit	Base exhaust gas factor wet	Base exhaust gas factor dry	Base exhaust gas factor unit
11	A Heavy Oil	0.5059	0.8435	9225		9.91	8.9	
12	B Heavy Oil	1.8883	0.9088	9625		10.45	9.3	
13	C Heavy Oil	1.7983	0.9306	9767		10.60	9.5	
14	Light Oil	0.3530	0.8286	9073	kcal/ℓ	10.03	8.8	Nm^3/ℓ
15	Kerosene	0.0333	0.7951	8826		9.65	8.4	
16	Crude Oil	0.1000	0.8569	9289		9.98	8.749	
18	Naphtha	0.0250	0.6800	9813		8.73	7.55	
19	Other Liquid fuels	0.6000	0.8940	9288		8.09	6.92	
21	General coal	0.5000	—	6399		7.79	7.21	
22	Coke	0.6450	—	7020		7.36	7.22	
23	Lumber	0.1000	—	3500	kcal/kg	4.16	3.45	Nm^3/kg
24	Charcoal	0.0630	—	3500		7.93	7.60	
25	Paddy and husk		—					
26	Other solid fuels	0.1000	—	3300		7.00	7.00	
31	Coal gas	0.0200	—	4500		5.64	4.50	
32	Coke furnace gas	0.0200	—	5200	kcal/Nm^3	5.72	4.50	Nm^3/Nm^3
33	Blast furnace gas	0.0030	—	800		2.04	1.46	
34	LNG	0.0030	—	13253	kcal/kg	17.11	14.228	Nm^3/kg
35	LPG	0.0020	—	12145		12.96	11.029	
36	Converter gas	0	—	1981		2.78	2.20	
37	Refinary Off gas	0	—	10775	kcal/Nm^3	13.87	11.20	Nm^3/Nm^3
38	Other gaseous fuels	0	—	4662		5.83	4.587	
41	Iron and iron ore	0.0410	—	0		0	0	
42	Sulfide ore	47.0000	—	1500		0	0	
43	Nonferrous metal ore	1.3910	—	0		0	0	
44	Raw coal	0.5300	—	7500		8.06	7.458	
45	Raw coke	0.5700	—	7000	kcal/kg	7.36	7.22	Nm^3/kg
46	Other raw materials	0	—	0		0	0	
51	Pulp waste fluid	0.4630	—	3292		6.70	6.70	
53	Domestic wastes	0.0300	—	1560		3.35	1.86	
54	Industrial waste	0.1270	—	4000		3.35	1.86	
55	Those other than 51-54	0	—	0		10.00	10.00	
61	Electricity	—	—	—	—	—	—	—

[Source] Ministry of International Trade and Industry (MITI), "Manual of Ambient SOx and NOx Prediction Method in Comprehensive Environmental Assessment", 367p, IPCAJ (in Japanese), (1985).

Table 2-9 List of factory and facility

LIST OF FACILITY (PATTERN 1)

SEQ)	COUNTRY	FACTORY	FACILITY	BUSINESS CATEGORY	FACILITY TYPE	STARTING Y&M	OPE. HOUR (H)	OPERATING TIME ZONE START-END	OPERATING PERIOD	FUEL AND RAW MATERIAL TO BE USED: NAME	SULFUR (%)	GRAVITY	CALORY (KCAL/)	RATING (/H)	NORMAL (/H)	ANNUAL (/Y)
1)	1	1	1	12(7)	103	65	4428	21:00-15:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	111	96	425
2)	1	2	1	42	103	75	1675	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	240	402
3)	1	2	2	42	103	75	8040	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	14	110
4)	1	2	3	42	103	75	8040	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	19	150
5)	1	2	4	42	103	81	1675	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	4	7
6)	1	6	1	4(3)	103	73	3000	9:00-17:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	52	156
7)	1	6	2	4(3)	103	79	7200	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	105	756
8)	1	7	1	43	1304	86	1680	8:00-17:00	1-12	14 LIGHT OIL	1.200	0.8660	10950*	38	25	47
										54 INDUSTRI.WASTE	0.000	-1.0000	4000*	90	50	92
9)	1	8	1	59	601	86	7200	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9329	10340	-1	5	38
										14 LIGHT OIL	1.800	0.8660	10950*	-1	7	51
10)	1	8	2	59	1201	87	7200	0:00-24:00	1-12	41 IRON	0.000	-1.0000	0*	-1	12445	89604
										61 ELECTRICITY	0.000*	-1.0000	860*	-1	8320	59904
11)	1	9	1	60	1209	8404	7200	0:00-24:00	1-12	43 NONFERROUS ORE	0.000	-1.0000	0*	-1	125	900
										61 ELECTRICITY	0.000*	-1.0000	860*	-1	717	5160
12)	1	12	1	22(3)	103	74	4800	8:20- 0:20	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	1250	6000
13)	1	12	2	22(3)	103	74	4800	8:20- 0:20	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	1250	6000
14)	1	12	3	22(3)	103	74	0	0:20- 8:20	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	0	0
15)	1	13	1	51	103	84	2000	8:00-17:00	1-12	14 LIGHT OIL	0.600	0.8450	10950*	-1	13	25
16)	1	14	1	15(2)	103	84	1450	8:00-17:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	69	100
17)	1	15	1	64(1)	502	75	8760	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	84	737
18)	1	15	2	64(1)	502	88	8760	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	84	737
19)	1	15	3	64(1)	603	75	8760	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	88	767
20)	1	15	4	64(1)	612	88	8760	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	450	3942
21)	1	15	5	64(1)	612	88	8760	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	450	3942
22)	1	15	6	64(1)	612	88	8760	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	120	1051
23)	1	16	1	70	1106	77	2400	8:00-17:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	8	20
24)	1	17	1	5(3)	103	79	7200	0:00-24:00	1-12	13 C HEAVY OIL	1.950	0.9400	10295	590	300	2200
25)	1	17	2	5(3)	103	84	0	0:00-24:00	1-12	13 C HEAVY OIL	1.950	0.9400	10295	-1	0	0
26)	1	17	3	5(3)	1304	84	1500	9:00-15:00	1-12	54 INDUSTRI.WASTE	0.000	-1.0000	4000*	-1	44	66
27)	1	18	1	15(2)	103	82	4800	7:30-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	75	70	336
28)	1	18	2	15(2)	1106	84	800	8:00-17:00	10-12	35 LPG	0.002*	-1.0000	12145*	-1	70	56
29)	1	19	1	22(4)	103	80	6240	8:00-24:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	100	63	390
30)	1	19	2	22(4)	103	88	4368	8:00-20:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	100	63	273
31)	1	20	1	22(1)	103	74	6912	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	1128	7800
32)	1	20	2	22(1)	103	74	0	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	0	0
33)	1	20	3	22(1)	103	74	0	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	0	0
34)	1	20	4	22(1)	103	74	0	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	0	0
35)	1	20	5	22(1)	703	74	6912	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	38	264
36)	1	20	6	22(1)	703	74	6912	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	10	66
37)	1	20	7	22(1)	1106	74	6912	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	29	198
38)	1	21	1	77(2)	103	74	1048	8:00-12:00	1-12	15 KEROSENE	0.033*	0.7951*	11100*	-1	6	6
39)	1	21	2	77(2)	103	81	3930	6:00-21:00	1-12	15 KEROSENE	0.033*	0.7951*	11100*	-1	6	24
40)	1	21	3	77(2)	502	88	3000	8:00-21:00	1-12	14 LIGHT OIL	0.600	0.8450	10950*	-1	7	20
41)	1	21	4	77(2)	1106	-1	3000	8:00-21:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	18	52
42)	1	22	1	22(2)	103	-1	3600	6:00-18:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	500	480	1728
43)	1	23	1	52(2)	103	-1	0	8:00-17:00	1-12	23 LUMBER	0.100	-1.0000	3500	-1	0	0
44)	1	24	1	22(2)	103	88	2080	8:00-17:00	1-12	13 C HEAVY OIL	2.920	0.9510	10513	-1	17	35
45)	1	25	1	22(2)	103	83	2400	8:00-16:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	-1	11	26
46)	1	27	1	60	603	83	3840	8:00-24:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	1	2
47)	1	29	1	74(5)	103	70	5760	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	44	38	315
48)	1	29	2	74(5)	103	78	5760	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	44	38	315
49)	1	29	3	74(5)	103	84	5760	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	44	38	315
50)	1	29	4	74(5)	1423	70	8400	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	13	107
51)	1	29	5	74(5)	1423	70	8400	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	13	107
52)	1	30	1	7(2)	103	-1	4160	8:00-24:00	1-12	11 A HEAVY OIL	1.980*	0.9300*	10495*	-1	13	52
53)	1	32	1	22(2)	103	87	7200	0:00-24:00	1-12	23 LUMBER	0.100*	-1.0000	3820	-1	120	865
54)	1	33	1	98	103	88	5110	10:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	114	86	438
55)	1	34	1	22(2)	103	82	2700	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	53	144
56)	1	35	1	13(2)	103	83	1480	7:00-17:00	1-12	11 A HEAVY OIL	2.920	0.9500	10518	280	220	350
57)	1	35	2	13(2)	103	85	1470	7:00-17:00	1-12	11 A HEAVY OIL	2.920	0.9500	10518	280	220	350
58)	1	36	1	52(2)	103	81	2400	7:30-16:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	75	180
59)	1	36	2	52(2)	103	82	2400	7:30-16:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	75	180
60)	1	39	1	38(2)	103	83	8760	0:00-24:00	1-12	21 GENERAL COAL	3.000	-1.0000	6399*	-1	540	4730
61)	1	40	1	52(1)	103	80	2360	8:00-17:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	30	25	59
62)	1	41	1	44	103	-1	5460	0:00-24:00	1- 8	13 C HEAVY OIL	2.660	0.9764	10400	-1	125	684
63)	1	41	2	44	103	-1	5460	0:00-24:00	1- 8	13 C HEAVY OIL	2.660	0.9764	10400	-1	125	684
64)	1	41	3	44	103	-1	5460	0:00-24:00	1- 8	13 C HEAVY OIL	2.660	0.9764	10400	-1	125	684
65)	1	41	4	44	103	8808	3300	0:00-24:00	8-12	13 C HEAVY OIL	2.660	0.9764	10400	-1	738	2436

LIST OF FACILITY (PATTERN 1)

SEQ)	CO UN TY	FAC TOR Y	FAC ILI TY	BUSINE SS CAT EGORY	FACI LITY TYPE	STAR TING Y&M	OPE. HOUR (H)	OPERATING TIME ZONE START-END	OPERA TING PERIOD	FUEL AND RAW MATERIAL TO BE USED: N A M E	SULFUR (%)	GRAVITY	CALORY (KCAL/)	RATING (/H)	NORMAL (/H)	ANNUAL (/Y)
66)	1	42	1	26	103	76	4640	7:00-23:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	60	50	232
67)	1	42	2	26	103	68	0	7:00-23:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	0	0
68)	1	44	1	48(9)	103	71	800	8:00-16:00	8-12	11 A HEAVY OIL	2.160	0.9612	10461	15	12	10
69)	1	45	1	74(5)	103	-1	7200	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	36	258
70)	1	45	2	74(5)	103	-1	0	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	0	0
71)	1	45	3	74(5)	2501	-1	7200	0:00-24:00	1-12	19 OTHER LIQUID	1.236	0.8866	10600	-1	2	16
72)	1	45	4	74(5)	2501	-1	7200	0:00-24:00	1-12	19 OTHER LIQUID	1.236	0.8866	10600	-1	2	16
73)	1	45	5	74(5)	2501	-1	7200	0:00-24:00	1-12	19 OTHER LIQUID	1.236	0.8866	10600	-1	2	16
74)	1	45	6	74(5)	2501	-1	7200	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	8	56
75)	1	45	7	74(5)	2501	-1	7200	0:00-24:00	1-12	19 OTHER LIQUID	1.236	0.8866	10600	-1	3	23
76)	1	45	8	74(5)	2501	-1	3300	0:00-24:00	1-12	14 LIGHT OIL	1.200	0.8660	10950*	-1	3	11
77)	1	46	1	64(2)	103	78	3600	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	-1	15	54
78)	1	46	2	64(2)	103	87	3600	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	-1	19	68
79)	1	46	3	64(2)	8	81	4500	6:30-21:30	1-12	35 LPG	0.002*	-1.0000	11158	-1	4	18
80)	1	46	4	64(2)	1421	80	56	8:30-17:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	4	0
81)	1	48	1	22(2)	103	86	1320	7:00-16:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	120	158
82)	1	48	2	22(2)	103	86	1320	7:00-16:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	120	158
83)	1	49	1	22(2)	103	77	2482	5:30-22:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	88	218
84)	1	49	2	22(2)	103	65	2482	5:30-22:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	29	71
85)	1	49	3	22(2)	103	72	2482	5:30-22:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	48	118
86)	1	51	1	9(2)	103	85	8472	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	34	25	214
87)	1	51	2	9(2)	1106	80	8472	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	-1	35	292
88)	1	51	3	9(2)	1106	80	8472	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	-1	17	147
89)	1	51	4	9(2)	1106	87	8472	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	-1	35	292
90)	1	52	1	42	103	74	4480	8:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	50	30	134
91)	1	52	2	42	703	85	750	8:30-14:00	1-12	14 LIGHT OIL	1.200	0.8660	10950*	-1	4	3
92)	1	53	1	53(8)	103	83	4752	7:00-23:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	69	328
93)	1	53	2	53(8)	103	86	832	7:00-23:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	46	38
94)	1	54	1	74(2)	103	-1	7200	0:00-24:00	1-12	14 LIGHT OIL	0.560*	0.8300*	10950*	-1	145	1043
95)	1	55	1	38(2)	103	8303	8400	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9900	10336	-1	571	4800
96)	1	55	2	38(2)	103	8402	8400	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9900	10336	-1	571	4800
97)	1	56	1	5(3)	103	72	0	7:00- 3:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	0	0
98)	1	56	2	5(3)	103	79	6000	7:00- 3:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	200	1200
99)	1	56	3	5(3)	8	-1	1240	8:00-17:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	0	0
100)	1	56	4	5(3)	1304	-1	1240	8:00-17:00	1-12	14 LIGHT OIL	0.360*	0.8300*	10950*	-1	1	1
101)	1	56	5	5(3)	8	65	7200	7:00- 3:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	0	0
102)	1	56	6	5(3)	8	65	7200	7:00- 3:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	0	0
103)	1	56	7	5(3)	8	65	7200	7:00- 3:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	0	0
104)	1	56	8	5(3)	8	65	7200	7:00- 3:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	0	0
105)	1	58	1	46	103	79	1960	8:00-16:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	63	50	98
106)	1	59	1	22(2)	103	75	1800	8:00-20:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	-1	25	45
107)	1	59	2	22(2)	103	83	1800	8:00-20:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	-1	25	45
108)	1	61	1	15(2)	103	86	3600	0:00-24:00	1-10	25 PADDY & HUSK	0.000*	-1.0000	2600	-1	750	2700
109)	1	63	1	52(1)	103	72	96	8:00-17:00	1-12	14 LIGHT OIL	0.460	0.8300*	10950*	-1	94	9
110)	1	64	1	47(2)	103	83	7200	0:00-24:00	1-12	13 C HEAVY OIL	2.660	0.9764	10400	217	180	1296
111)	1	64	2	47(2)	103	74	6480	0:00-24:00	1-12	11 A HEAVY OIL	2.160	0.9609	10461	42	31	203
112)	1	64	3	47(2)	103	72	0	0:00-24:00	1-12	13 C HEAVY OIL	2.660	0.9764	10400	-1	0	0
113)	1	65	1	60	1416	82	270	0:00-24:00	1-12	43 NONFERROUS ORE	0.000	-1.0000	0*	-1	56	15
										35 LPG	0.002*	-1.0000	12145*	-1	3	1
114)	1	65	2	60	1416	82	270	0:00-24:00	1-12	43 NONFERROUS ORE	0.000	-1.0000	0*	-1	56	15
										35 LPG	0.002*	-1.0000	12145*	-1	3	1
115)	1	66	1	22(2)	103	87	3600	0:00-24:00	1-12	11 A HEAVY OIL	2.800	0.9383	10394	337	250	900
116)	1	66	2	22(2)	103	88	3600	0:00-24:00	1-12	11 A HEAVY OIL	2.800	0.9383	10394	524	300	1080
117)	1	67	1	22(2)	103	70	3600	0:00-24:00	1-12	11 A HEAVY OIL	3.000	0.9850	10000	54	50	180
118)	1	67	2	22(2)	103	70	3600	0:00-24:00	1-12	11 A HEAVY OIL	3.000	0.9850	10000	54	50	180
119)	1	68	1	22(3)	103	68	7200	0:00-24:00	1-12	13 C HEAVY OIL	3.000	0.9561	10296	-1	251	1810
120)	1	68	2	22(3)	103	83	7200	0:00-24:00	1-12	13 C HEAVY OIL	3.000	0.9561	10296	-1	302	2172
121)	1	68	3	22(3)	103	69	7200	0:00-24:00	1-12	13 C HEAVY OIL	3.000	0.9561	10296	-1	302	2172
122)	1	68	4	22(3)	103	69	7200	0:00-24:00	1-12	13 C HEAVY OIL	3.000	0.9561	10296	-1	302	2172
123)	1	68	5	22(3)	103	69	7200	0:00-24:00	1-12	13 C HEAVY OIL	3.000	0.9561	10296	-1	302	2172
124)	1	68	6	22(3)	103	69	0	0:00-24:00	1-12	13 C HEAVY OIL	3.000	0.9561	10296	-1	0	0
125)	1	68	7	22(3)	103	69	0	0:00-24:00	1-12	13 C HEAVY OIL	3.000	0.9561	10296	-1	0	0
126)	1	68	8	22(3)	103	69	0	0:00-24:00	1-12	13 C HEAVY OIL	3.000	0.9561	10296	-1	0	0
127)	1	69	1	46	103	60	1000	9:00-13:00	1-12	11 A HEAVY OIL	3.000	0.9850	10000	78	65	65
128)	1	69	2	46	1302	60	192	14:00-16:00	1-12	54 INDUSTRI.WASTE	0.127*	-1.0000	4000*	-1	0	0
129)	1	70	1	55	915	79	8400	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9900	9900	-1	333	2800
130)	1	70	2	55	915	84	8400	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9900	9900	-1	417	3500
131)	1	70	3	55	8	79	8400	0:00-24:00	1-12	14 LIGHT OIL	1.500	0.9200	10950*	-1	167	1400
132)	1	70	4	55	1106	79	8400	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	83	700
133)	1	71	1	64(1)	1106	60	4800	6:00-22:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	2	9
										46 OTHER RAW	0.000*	-1.0000	0*	-1	0	0
134)	1	71	2	64(1)	1106	60	4800	6:00-22:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	2	9
										46 OTHER RAW	0.000*	-1.0000	0*	-1	0	0
135)	1	72	1	71	103	8810	2000	8:00-16:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	141	282
136)	1	72	2	71	103	8810	2000	8:00-16:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	141	282

LIST OF FACILITY (PATTERN 1)

SEQ)	CO UN TY	FAC TOR Y	FAC ILI TY	BUSINE SS CAT EGORY	FACI LITY TYPE	STAR TING Y&M	OPE. HOUR (H)	OPERATING TIME ZONE START-END	OPERA TING PERIOD	FUEL AND RAW MATERIAL TO BE USED						
										N A M E	SULFUR (%)	GRAVITY	CALORY (KCAL/)	RATING (/H)	NORMAL (/H)	ANNUAL (/Y)
137)	1	73	1	72	2501	88	6048	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11900	-1	3	15
138)	1	73	2	72	2501	80	6048	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11900	-1	27	163
										15 KEROSENE	0.033*	0.9900	11056	-1	10	61
139)	1	73	3	72	2501	80	4032	7:00-24:00	1-12	15 KEROSENE	0.033*	0.9900	11056	-1	10	61
140)	1	73	4	72	1423	84	6336	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11900	-1	10	64
141)	1	73	5	72	103	81	2304	8:00-17:00	1-12	14 LIGHT OIL	1.300	0.9200	10670	11	11	26
142)	1	73	6	72	103	85	2112	8:00-17:00	1-12	14 LIGHT OIL	1.300	0.9200	10670	60	60	127
143)	1	74	1	77(1)	1106	79	4046	6:00-20:00	1-12	14 LIGHT OIL	1.200	0.8660	10950*	-1	14	56
144)	1	74	2	77(1)	1106	79	4046	6:00-20:00	1-12	14 LIGHT OIL	1.200	0.8660	10950*	-1	14	56
145)	1	74	3	77(1)	1106	79	4046	6:00-20:00	1-12	14 LIGHT OIL	1.200	0.8660	10950*	-1	14	56
146)	2	3	1	2(1)	103	78	8760	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	38	28	245
147)	2	4	1	42	103	80	3000	8:00-18:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	140	138	414
148)	2	5	1	77(1)	1106	77	4224	8:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	27	112
149)	2	5	2	77(1)	1106	77	4224	8:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	27	112
150)	2	5	3	77(1)	1106	77	4224	8:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	27	112
151)	2	5	4	77(1)	1106	77	2112	8:00-16:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	18	37
152)	2	5	5	77(1)	1106	77	2112	8:00-16:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	70	149
153)	2	5	6	77(1)	103	77	2640	8:00-20:00	1-12	12 B HEAVY OIL	2.500	0.9750	10000	-1	82	216
154)	2	6	1	9(1)	103	85	960	8:00-16:00	1-12	25 PADDY & HUSK	0.000*	-1.0000	3440	-1	542	520
155)	2	7	1	22(4)	103	81	0	8:00-17:00	11- 4	11 A HEAVY OIL	2.000	0.9408	10430	-1	0	0
156)	2	7	2	22(4)	103	87	1600	8:00-17:00	11- 4	11 A HEAVY OIL	2.000	0.9408	10430	31	26	41
157)	2	8	1	26	103	-1	2400	8:00-17:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	65	50	120
158)	2	9	1	42	103	81	0	7:00- 8:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	0	0
159)	2	9	2	42	103	83	2640	7:00-15:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	93	245
160)	2	9	3	42	103	84	2640	7:00-15:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	186	490
161)	2	9	4	42	103	87	2640	7:00-15:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	278	735
162)	2	10	1	33	103	77	3600	7:30-22:45	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	57	204
163)	2	10	2	33	103	86	3600	7:30-22:45	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	57	204
164)	2	11	1	22(1)	103	75	4200	7:00-21:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	143	600
165)	2	11	2	22(1)	103	75	4200	7:00-21:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	143	600
166)	2	12	1	55	915	77	7854	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	221	208	1650
167)	2	13	1	9(1)	103	57	2400	8:00-16:00	1-12	25 PADDY & HUSK	0.000*	-1.0000	3440	-1	1000	2400
168)	2	14	1	70	103	82	2080	8:00-16:00	1-12	14 LIGHT OIL	1.500	0.9200	10950*	15	11	23
169)	2	15	1	4(4)	103	85	1500	8:00-17:00	1-12	11 A HEAVY OIL	2.700	0.9358	10016	-1	120	180
170)	2	16	1	47(3)	103	-1	1500	9:00-14:05	1-12	14 LIGHT OIL	0.460	0.8596	10950*	1	1	1
171)	2	17	1	60	103	82	7200	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9950	9900	27	25	183
172)	2	17	2	60	502	82	4320	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9950	9900	54	42	181
173)	2	17	3	60	8	82	4500	8:00-23:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	15	66
174)	2	18	1	9(1)	1	-1	960	8:00-17:00	1-12	14 LIGHT OIL	0.660	0.8413	10950*	-1	13	12
175)	2	19	1	4(1)	103	80	0	0:00-24:00	1-12	11 A HEAVY OIL	2.760	0.9358	10495*	-1	0	0
176)	2	19	2	4(1)	103	80	7680	0:00-24:00	1-12	11 A HEAVY OIL	2.760	0.9358	10495*	-1	70	538
177)	2	20	1	64(9)	503	87	870	10:30-13:30	1-12	12 B HEAVY OIL	1.500	0.9750	10000	-1	22	20
178)	2	21	1	9(1)	103	85	1080	7:30-16:30	1-12	25 PADDY & HUSK	0.000*	-1.0000	3440	-1	250	270
179)	2	22	1	9(1)	1	81	720	8:00-11:00	1-12	14 LIGHT OIL	1.500	0.9200	10950*	-1	3	2
180)	2	23	1	15(1)	103	86	7200	0:00-24:00	1-12	21 GENERAL COAL	4.000	-1.0000	3800	167	125	900
181)	2	23	2	15(1)	103	82	1600	8:00-16:00	1-12	13 C HEAVY OIL	2.500	0.9529	9900	100	75	120
182)	2	23	3	15(1)	103	74	0	8:00-16:00	1-12	13 C HEAVY OIL	2.500	0.9529	9900	-1	0	0
183)	2	23	4	15(1)	1106	82	1600	8:00-16:00	1-12	11 A HEAVY OIL	2.000	0.9408	10000	-1	78	125
184)	2	23	5	15(1)	1106	82	1600	8:00-16:00	1-12	11 A HEAVY OIL	2.000	0.9408	10000	-1	78	125
185)	2	24	1	78(1)	1106	77	4368	6:00-22:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	233	1018
										14 LIGHT OIL	0.560*	0.8300*	10950*	-1	102	445
186)	2	24	2	78(1)	1106	77	4368	6:00-22:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	233	1018
										14 LIGHT OIL	0.560*	0.8300*	10950*	-1	102	445
187)	2	24	3	78(1)	1106	77	4368	6:00-22:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	233	1018
										14 LIGHT OIL	0.560*	0.8300*	10950*	-1	102	445
188)	2	24	4	78(1)	8	77	4368	6:00-22:00	1-12	14 LIGHT OIL	1.200	0.8660	10950*	-1	16	70
189)	2	25	1	77(2)	1106	81	2400	8:00-16:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	72	173
190)	2	26	1	77(2)	502	81	7200	0:00-24:00	1-12	11 A HEAVY OIL	3.000	0.9850	10000	-1	25	180
191)	2	26	2	77(2)	1106	81	810	8:00-13:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	5	4
192)	2	26	3	77(2)	8	81	7200	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	0	0
193)	3	1	1	59	1201	6803	4864	0:00-24:00	1- 8	46 OTHER RAW	0.000	-1.0000	0*	13461	11538	57600
										61 ELECTRICITY	0.000	-1.0000	860*	8297	7111	35500
194)	3	1	2	59	1201	6803	4864	0:00-24:00	1- 8	46 OTHER RAW	0.000	-1.0000	0*	13461	11538	57600
										61 ELECTRICITY	0.000	-1.0000	860*	8297	7111	35500
195)	3	1	3	59	1201	7202	0	0:00-24:00	1- 8	46 OTHER RAW	0.000	-1.0000	0*	-1	0	0
										61 ELECTRICITY	0.000	-1.0000	860*	-1	0	0
196)	3	1	4	59	601	6803	4864	0:00-24:00	1- 8	13 C HEAVY OIL	3.200	0.9900	10006	673	576	2880
197)	3	2	1	8(1)	103	7706	7200	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	600	400	2880
198)	3	2	2	8(1)	103	7706	7200	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	600	400	2880
199)	3	3	1	22(2)	103	6506	8448	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	315	113	951
200)	3	4	1	38(2)	103	8801	8520	0:00-24:00	1-12	13 C HEAVY OIL	2.660	0.9765	10400	271	250	2130

LIST OF FACILITY (PATTERN 1)

SEQ)	CO UN TY	FAC TOR Y	FAC ILI TY	BUSINE SS CAT EGORY	FACI LITY TYPE	STAR TING Y&M	OPE. HOUR (H)	OPERATING TIME ZONE START-END	OPERA TING PERIOD	FUEL AND RAW MATERIAL TO BE USED						
										N A M E	SULFUR (%)	GRAVITY	CALORY (KCAL/)	RATING (/H)	NORMAL (/H)	ANNUAL (/Y)
201)	3	5	1	13(2)	103	7406	8040	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	3270	2600	20904
202)	3	5	2	13(2)	103	64	0	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	-1	0	0
203)	3	5	3	13(2)	103	64	0	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	-1	0	0
204)	3	5	4	13(2)	1802	7502	8040	0:00-24:00	1-12	15 KEROSENE	0.033*	0.7951*	11000	72	36	289
205)	3	6	1	59	601	6812	2352	8:00-17:00	1-12	13 C HEAVY OIL	2.660	0.9764	10400	200	175	412
										41 IRON	0.000	-1.0000	0*	-1	1190	2800
206)	3	6	2	59	601	6812	2352	8:00-17:00	1-12	13 C HEAVY OIL	2.660	0.9764	10400	220	190	447
										41 IRON	0.000	-1.0000	0*	-1	1275	3000
207)	3	6	3	59	601	6812	2352	8:00-17:00	1-12	13 C HEAVY OIL	2.660	0.9764	10400	360	325	764
										41 IRON	0.000	-1.0000	0*	-1	2210	5200
208)	3	7	1	59	601	8707	2400	7:30-16:00	1-12	13 C HEAVY OIL	2.660	0.9764	10400	-1	220	528
209)	3	7	2	59	601	8707	2400	7:30-16:00	1-12	13 C HEAVY OIL	2.660	0.9764	10400	-1	110	264
210)	3	8	1	22(2)	103	8801	8448	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9900	10495*	372	73	616
211)	3	9	1	47(1)	1001	68	7896	0:00-24:00	1-12	42 SULFIDE ORE	99.999	-1.0000	1500*	-1	28	217
212)	3	9	2	47(1)	103	68	7896	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	21	17	132
213)	3	9	3	47(1)	103	68	1440	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	21	17	24
214)	3	9	4	47(1)	1105	68	6000	0:00-24:00	1-12	14 LIGHT OIL	0.600	0.8450	10950*	83	75	450
215)	3	10	1	59	601	7801	2368	8:00-17:00	1-12	13 C HEAVY OIL	2.160	0.9612	10461	338	230	545
216)	3	11	1	52(2)	103	82	4800	8:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	38	180
217)	3	11	2	52(2)	103	87	4800	8:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	45	216
218)	3	12	1	34(3)	1106	68	8400	0:00-24:00	1-12	25 PADDY & HUSK	0.000*	-1.0000	3500*	208	125	1048
219)	3	12	2	34(3)	1106	71	2160	7:15-19:15	1-12	11 A HEAVY OIL	1.280	0.9462	10000	110	62	134
220)	3	13	1	9(6)	103	82	6000	0:00-24:00	1-12	13 C HEAVY OIL	1.798	0.9306	10495	250	190	1140
221)	3	13	2	9(6)	103	83	6000	0:00-24:00	1-12	13 C HEAVY OIL	1.798	0.9306	10495	250	190	1140
222)	3	14	1	38(2)	103	6412	7920	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	558	516	4087
223)	3	14	2	38(2)	103	72	7920	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	558	516	4087
224)	3	14	3	38(2)	103	72	7920	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	558	516	4087
225)	3	14	4	38(2)	103	72	0	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	0	0
226)	3	15	1	6(1)	103	-1	1800	8:00-14:00	1-12	23 LUMBER	0.100*	-1.0000	3500*	-1	133	240
										11 A HEAVY OIL	2.160	0.9612	10461	10	10	3
227)	3	16	1	51	103	63	4200	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9950	9900	233	225	945
228)	3	16	2	51	103	63	4200	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9950	9900	233	225	945
229)	3	16	3	51	103	68	2112	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9950	9900	311	300	634
230)	3	16	4	51	103	80	2112	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9950	9900	389	375	792
231)	3	17	1	8(1)	103	79	900	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9900	9900	300	216	194
232)	3	17	2	8(1)	103	85	7200	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9900	9900	300	216	1555
233)	3	18	1	5(3)	103	68	3200	6:00-22:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	103	62	197
234)	3	18	2	5(3)	103	70	7200	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	105	63	456
235)	3	18	3	5(3)	103	87	3200	6:00-22:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	85	51	164
236)	3	18	4	5(3)	103	89	0	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	0	0
237)	3	19	1	74(5)	2501	8510	6240	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11805	8	5	31
238)	3	19	2	74(5)	2603	7801	3744	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	15	7	26
239)	3	20	1	52(1)	103	73	7200	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	29	209
240)	3	21	1	13(2)	103	84	60	8:00-17:00	1-12	14 LIGHT OIL	0.600	0.8450	10950*	-1	7	1
241)	3	22	1	34(1)	8	-1	2496	8:00-17:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	0	1
242)	3	23	1	60	611	71	7200	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	100	80	576
243)	3	23	2	60	611	71	7200	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	100	80	576
244)	3	23	3	60	611	71	7200	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	100	80	576
245)	3	23	4	60	612	83	4800	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	429	2059
246)	3	23	5	60	612	83	4800	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	429	2059
247)	3	23	6	60	1421	86	540	8:00-15:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	100	80	43
248)	3	23	7	60	1421	86	540	8:00-15:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	100	80	43
249)	3	24	1	77(1)	103	62	2096	7:00-16:00	1-12	13 C HEAVY OIL	3.500	0.9900	9900	75	63	131
250)	3	24	2	77(1)	1106	62	2096	7:00-16:00	1-12	35 LPG	0.002*	-1.0000	11158	41	37	77
251)	3	24	3	77(1)	1106	62	2096	7:00-16:00	1-12	35 LPG	0.002*	-1.0000	11158	41	37	77
252)	3	24	4	77(1)	1106	72	2096	7:00-16:00	1-12	35 LPG	0.002*	-1.0000	11158	41	37	77
253)	3	24	5	77(1)	1106	72	2096	7:00-16:00	1-12	35 LPG	0.002*	-1.0000	11158	41	37	77
254)	3	25	1	22(3)	103	64	960	8:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	10	10
255)	3	25	2	22(3)	103	64	960	8:00-24:00	1-12	11 A HEAVY OIL	2.160	0.9612	10401	-1	15	15
256)	3	25	3	22(3)	103	-1	2880	8:00-24:00	1-12	23 LUMBER	0.100*	-1.0000	3820	-1	250	720
257)	3	26	1	22(2)	103	82	0	0:00-24:00	1-12	11 A HEAVY OIL	1.980*	0.9300*	10495*	-1	0	0
258)	3	26	2	22(2)	103	86	6000	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	63	50	300
259)	3	27	1	22(2)	103	88	1500	8:00-16:00	1-12	23 LUMBER	0.100*	-1.0000	3820	480	400	600
260)	3	27	2	22(2)	103	87	300	8:00-16:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	80	24
261)	3	28	1	51	103	64	2400	7:00-17:00	1-12	11 A HEAVY OIL	3.000	0.9850	10000	-1	60	144
262)	3	29	1	64(1)	1106	72	6336	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	33	208
263)	3	29	2	64(1)	1106	72	6336	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	33	208
264)	3	29	3	64(1)	1106	72	6336	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	33	208
265)	3	29	4	64(1)	1106	72	6336	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	33	208
266)	3	29	5	64(1)	1106	72	6336	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	33	208
267)	3	29	6	64(1)	1106	72	6336	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	33	208
268)	3	29	7	64(1)	1106	72	6336	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	33	208
269)	3	29	8	64(1)	1106	72	6336	0:00-24:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	33	208
270)	3	29	9	64(1)	1106	72	6336	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	0	0
271)	3	29	10	64(1)	1106	72	6336	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	0	0
272)	3	29	11	64(1)	1106	72	6336	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	0	0

LIST OF FACILITY (PATTERN 1)

SEQ	COUNTY	FACTORY	FACILITY	BUSINESS CATEGORY	FACILITY TYPE	STARTING Y&M	OPE. HOUR (H)	OPERATING TIME ZONE START-END	OPERATING PERIOD	FUEL AND RAW MATERIAL TO BE USED: NAME	SULFUR (%)	GRAVITY	CALORY (KCAL/)	RATING (/H)	NORMAL (/H)	ANNUAL (/Y)
273)	3	29	12	64(1)	1106	72	6336	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	0	0
274)	3	29	13	64(1)	1106	72	6336	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	0	0
275)	3	29	14	64(1)	1106	72	6336	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	0	0
276)	3	30	1	22(4)	103	-1	2400	8:00-17:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	90	60	144
277)	3	30	2	22(4)	103	-1	0	8:00-17:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	0	0
278)	3	31	1	47(1)	103	-1	560	8:00-10:00	1-12	11 A HEAVY OIL	2.760	0.9358	10495*	-1	32	18
279)	3	31	2	47(1)	103	-1	560	8:00-10:00	1-12	11 A HEAVY OIL	2.760	0.9358	10495*	-1	32	18
280)	3	32	1	22(2)	103	80	2700	8:00-21:00	1-12	11 A HEAVY OIL	2.760	0.9358	10495*	-1	40	108
281)	3	32	2	22(2)	103	87	2700	8:00-21:00	1-12	11 A HEAVY OIL	2.760	0.9358	10495*	-1	40	108
282)	3	33	1	44	703	78	8400	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	50	38	319
283)	3	33	2	44	1	78	12	1:00- 1:30	1-12	14 LIGHT OIL	1.200	0.8700	10950*	1	1	2
284)	3	33	3	44	1302	78	490	14:00-16:00	1-12	53 DOMESTIC WASTE	0.030*	-1.0000	1560*	-1	37	18
285)	3	34	1	2(1)	103	75	5200	8:30- 7:30	1-12	11 A HEAVY OIL	3.000	0.9850	10000	60	56	291
286)	3	34	2	2(1)	103	77	5200	8:30- 7:30	1-12	11 A HEAVY OIL	3.000	0.9850	10000	90	84	437
287)	3	34	3	2(1)	1106	73	1440	8:30-24:00	8-12	11 A HEAVY OIL	3.000	0.9850	10000	110	103	149
288)	3	34	4	2(1)	1106	75	1440	8:30-24:00	8-12	11 A HEAVY OIL	3.000	0.9850	10000	160	155	223
289)	3	35	1	15(2)	103	88	0	8:00- 2:00	1-12	23 LUMBER	0.100*	-1.0000	3820	-1	0	0
										25 PADDY & HUSK	0.000*	-1.0000	2600	-1	0	0
290)	3	35	2	15(2)	103	87	5400	8:00- 2:00	1-12	23 LUMBER	0.100*	-1.0000	3820	-1	833	4498
										25 PADDY & HUSK	0.000*	-1.0000	2600	-1	542	2927
291)	3	36	1	6(1)	103	84	3900	4:00-16:00	1-12	13 C HEAVY OIL	2.920	0.9509	10495*	-1	140	569
292)	3	37	1	22(3)	103	78	2610	8:00-15:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	120	110	287
293)	3	38	1	52(1)	103	65	2400	8:00-16:00	1-12	14 LIGHT OIL	0.460	0.8596	10950*	400	80	192
294)	3	38	2	52(1)	103	65	0	8:00-16:00	1-12	14 LIGHT OIL	0.460	0.8596	10950*	400	0	0
295)	3	38	3	52(1)	103	65	0	8:00-16:00	1-12	14 LIGHT OIL	0.460	0.8596	10950*	400	0	0
296)	3	39	1	22(2)	103	78	2080	8:00-16:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	30	19	39
297)	3	39	2	22(2)	103	82	2080	16:00-24:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	38	32	65
298)	3	40	1	52(1)	103	78	2560	8:00-16:30	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	56	144
299)	3	41	1	6(2)	103	78	1140	9:00-13:00	1-12	23 LUMBER	0.100*	-1.0000	3820	-1	20	23
300)	3	42	1	22(2)	103	71	6500	0:00-24:00	1-12	11 A HEAVY OIL	2.660	0.9764	10400	45	40	260
301)	3	42	2	22(2)	103	71	6500	0:00-24:00	1-12	11 A HEAVY OIL	2.660	0.9764	10400	45	40	260
302)	3	43	1	22(4)	103	82	2655	8:00-17:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	80	70	186
303)	3	44	1	7(1)	103	76	936	7:00-10:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	120	100	94
304)	3	44	2	7(1)	103	83	3520	9:00-19:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	125	125	440
305)	3	45	1	10(2)	103	83	3168	8:00-17:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	56	51	162
306)	3	45	2	10(2)	103	-1	0	8:00-17:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	-1	0	0
307)	3	46	1	22(2)	103	7907	1860	8:00-21:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	65	120
308)	3	46	2	22(2)	103	7907	1860	8:00-21:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	65	120
309)	3	46	3	22(2)	1106	7907	930	8:00-17:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	21	20
310)	3	46	4	22(2)	1106	7907	930	8:00-17:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	21	20
311)	3	46	5	22(2)	1106	7907	930	8:00-17:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	21	20
312)	3	46	6	22(2)	1106	7907	930	8:00-17:00	1-12	35 LPG	0.002*	-1.0000	12145*	-1	21	20
313)	3	47	1	44	103	85	8640	0:00-24:00	1-12	13 C HEAVY OIL	2.660	0.9764	10400	450	410	3542
314)	3	47	2	44	103	85	8640	0:00-24:00	1-12	13 C HEAVY OIL	2.660	0.9764	10400	450	410	3542
315)	3	47	3	44	103	-1	0	0:00-24:00	1-12	13 C HEAVY OIL	2.660	0.9764	10400	450	0	0
316)	3	47	4	44	103	-1	0	0:00-24:00	1-12	13 C HEAVY OIL	2.660	0.9764	10400	450	0	0
317)	3	48	1	59	601	70	2400	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	160	100	240
318)	3	48	2	59	601	71	0	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	0	0
319)	3	48	3	59	601	87	0	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	0	0
320)	3	49	1	64	103	73	3960	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	250	210	832
321)	3	49	2	64	103	73	3960	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	250	210	832
322)	3	50	1	52(1)	103	84	2400	8:00-16:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	40	30	72
323)	3	50	2	52(1)	103	84	2400	8:00-16:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	40	30	72
324)	3	50	3	52(1)	103	84	0	8:00-16:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	0	0
325)	3	51	1	59	1201	77	5760	0:00-24:00	1- 8	41 IRON	0.000	-1.0000	0*	-1	7800	65006
										61 ELECTRICITY	0.000*	-1.0000	860*	-1	12760	73500
										12 B HEAVY OIL	1.950	0.9370	9900	167	83	478
										45 RAW COKE	0.570*	-1.0000	7000*	-1	156	900
326)	3	51	2	59	1201	78	5760	0:00-24:00	3-12	41 IRON	0.000	-1.0000	0*	-1	7800	45000
										61 ELECTRICITY	0.000*	-1.0000	860*	-1	12760	73500
										12 B HEAVY OIL	1.950	0.9370	9900	167	83	478
										45 RAW COKE	0.570*	-1.0000	7000*	-1	156	900
327)	3	51	3	59	601	69	4800	8:00-24:00	1-12	12 B HEAVY OIL	1.950	0.9370	9900	700	585	2808
328)	3	51	4	59	601	80	3600	8:00-20:00	1-12	12 B HEAVY OIL	1.950	0.9370	9900	700	585	2106
329)	3	52	1	47(1)	103	73	0	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	0	0
330)	3	52	2	47(1)	103	80	7200	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	400	257	1850
331)	3	53	1	46	103	72	1600	8:00-16:00	1-12	14 LIGHT OIL	0.600	0.8450	10950*	-1	5	8
332)	3	54	1	13(2)	103	69	2880	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9900	9900	400	300	864
333)	3	54	2	13(2)	103	71	2880	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9900	9900	400	300	864
334)	3	54	3	13(2)	103	71	2880	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9900	9900	400	300	864
335)	3	54	4	13(2)	103	80	4320	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9900	9900	400	300	864
336)	3	55	1	48(2)	103	-1	0	8:00-17:00	1-12	13 C HEAVY OIL	2.460*	0.9300*	10495*	-1	0	0
337)	3	56	1	22(2)	103	81	4200	7:00-21:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	77	324
338)	3	57	1	8(1)	103	77	6480	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	29	29	188

LIST OF FACILITY (PATTERN 1)

SEQ)	COUNTY	FACTORY	FACILITY	BUSINESS CATEGORY	FACILITY TYPE	STARTING Y&M	OPE. HOUR (H)	OPERATING TIME ZONE START-END	OPERATING PERIOD	FUEL AND RAW MATERIAL TO BE USED: N A M E	SULFUR (%)	GRAVITY	CALORY (KCAL/)	RATING (/H)	NORMAL (/H)	ANNUAL (/Y)
339)	3	57	2	8(1)	103	77	0	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	0	0
340)	3	57	3	8(1)	103	83	6480	0:00-24:00	1-12	26 OTHER SOLID	0.100*	-1.0000	3440	1458	1250	8100
341)	3	58	1	8(1)	103	-1	0	0:00-24:00	1-12	13 C HEAVY OIL	2.460*	0.9300*	10495*	-1	13	0
342)	3	59	1	22(2)	103	76	0	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	0	0
343)	3	59	2	22(2)	103	84	8448	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	250	2112
344)	3	59	3	22(2)	702	82	8448	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	50	422
345)	3	59	4	22(2)	702	86	8448	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	50	422
346)	3	60	1	22(2)	103	78	2700	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9600	10461	-1	27	72
347)	3	61	1	22(2)	103	88	2400	7:30-15:00	1-12	23 LUMBER	0.100*	-1.0000	3500*	-1	175	420
348)	3	62	1	2(2)	1004	80	4500	8:00-23:00	1-12	15 KEROSENE	0.033*	0.7951*	11100*	27	24	108
349)	3	62	2	2(2)	1004	80	4500	8:00-23:00	1-12	15 KEROSENE	0.033*	0.7951*	11100*	27	24	108
350)	3	62	3	2(2)	1004	80	4500	8:00-23:00	1-12	15 KEROSENE	0.033*	0.7951*	11100*	27	24	108
351)	3	63	1	53(7)	103	71	2320	8:00-16:00	1-12	19 OTHER LIQUID	0.100	0.8569	10840	-1	15	35
352)	3	63	2	53(7)	1106	-1	0	8:00-16:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	0	0
353)	3	64	1	77(1)	103	74	2750	7:30-20:00	1-12	11 A HEAVY OIL	1.290	0.9176	10542	-1	18	50
354)	3	64	2	77(1)	103	74	2750	7:30-20:00	1-12	11 A HEAVY OIL	1.290	0.9176	10542	-1	18	50
355)	3	64	3	77(1)	103	74	2750	7:30-20:00	1-12	11 A HEAVY OIL	1.290	0.9176	10542	-1	18	50
356)	3	65	1	52(1)	103	85	2400	7:00-17:00	1-12	11 A HEAVY OIL	2.460	0.9358	10560	-1	35	84
357)	3	66	1	22(4)	103	8401	4080	5:00-17:00	1-12	26 OTHER SOLID	0.000	-1.0000	3440	-1	200	480
358)	3	67	1	50(4)	703	83	2440	7:30-16:30	1-12	13 C HEAVY OIL	2.500	0.9529	10340	98	86	210
359)	3	67	2	50(4)	703	86	0	7:30-16:30	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	0	0
360)	3	67	3	50(4)	8	86	0	7:30-16:30	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	0	0
361)	3	67	4	50(4)	1303	86	90	7:30-16:30	1-12	54 INDUSTRI.WASTE	0.127*	-1.0000	4000*	-1	0	0
362)	3	68	1	22(2)	103	88	7200	0:00-24:00	1-12	11 A HEAVY OIL	2.760	0.9358	10495*	50	38	270
363)	3	68	2	22(2)	103	77	7200	0:00-24:00	1-12	11 A HEAVY OIL	2.760	0.9358	10495*	50	38	270
364)	3	69	1	22(1)	103	80	7200	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	100	720
365)	3	69	2	22(1)	103	82	7200	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	100	720
366)	3	70	1	26	103	83	4800	8:00-24:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	83	400
367)	3	70	2	26	103	84	2400	0:00- 8:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	83	200
368)	3	71	1	22(2)	103	76	4200	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	208	874
369)	3	71	2	22(2)	103	76	4200	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	208	874
370)	3	72	1	22(3)	103	71	4800	7:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	17	14	68
371)	3	73	1	34(3)	103	77	7200	0:00-24:00	1-12	23 LUMBER	0.100*	-1.0000	3820	-1	750	5400
372)	3	73	2	34(3)	103	87	7200	0:00-24:00	1-12	23 LUMBER	0.100*	-1.0000	3820	-1	1250	9000
373)	3	74	1	59	602	84	2208	8:00-16:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	94	63	139
374)	3	74	2	59	602	84	2208	8:00-16:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	94	63	139
375)	3	75	1	2(1)	1106	80	2400	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	600	500	1200
376)	3	75	2	2(1)	1106	80	2400	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	600	500	1200
377)	3	75	3	2(1)	1106	84	2400	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	600	500	1200
378)	3	75	4	2(1)	1106	84	2400	0:00-24:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	600	500	1200
379)	3	76	1	13(2)	103	82	1095	8:00-11:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	45	34	37
380)	3	76	2	13(2)	103	86	0	8:00-11:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	0	0
381)	3	77	1	22(2)	103	74	8448	0:00-24:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	17	13	109
382)	3	78	1	22(2)	103	81	6000	8:00- 4:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	35	35	210
383)	3	78	2	22(2)	103	86	3000	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	30	30	90
384)	3	79	1	22(2)	103	85	5400	8:00- 2:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	-1	133	720
385)	3	79	2	22(2)	103	84	0	8:00- 2:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	-1	0	0
386)	3	80	1	22(2)	103	83	7200	0:00-24:00	1-12	23 LUMBER	0.000	-1.0000	3820	-1	16	114
387)	3	81	1	47(1)	103	78	4800	8:00-24:00	1-12	14 LIGHT OIL	0.460	0.8596	10950*	-1	5	24
388)	3	82	1	22(4)	103	84	3600	7:00-19:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	300	200	720
389)	3	82	2	22(4)	103	78	3600	7:00-19:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	300	150	540
390)	3	83	1	13(2)	103	85	3000	7:00-17:00	1-12	11 A HEAVY OIL	2.760	0.9358	10495*	-1	48	144
391)	3	84	1	22(2)	103	84	2700	9:00-18:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	44	120
392)	3	85	1	22(2)	103	82	2700	8:00-17:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	27	72
393)	3	85	2	22(2)	103	85	0	8:00-17:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	-1	0	0
394)	3	86	1	46	103	84	1800	8:00-14:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	-1	40	72
395)	3	87	1	26	103	75	7680	0:00-24:00	1-12	13 C HEAVY OIL	2.920	0.9509	10495*	-1	39	296
396)	3	87	2	26	103	76	7680	0:00-24:00	1-12	13 C HEAVY OIL	2.920	0.9509	10495*	-1	45	345
397)	3	89	1	22(2)	103	85	3000	8:00-18:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	14	41
398)	3	90	1	22(3)	103	8805	2320	8:00-16:00	1-12	13 C HEAVY OIL	2.660	0.9764	10400	200	190	441
399)	3	91	1	13(2)	103	73	1600	7:00-15:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	65	50	80
400)	3	93	1	10(3)	1004	6607	300	9:00-15:00	10- 6	14 LIGHT OIL	0.660	0.8413	10950*	-1	7	2
401)	3	94	1	2(1)	1106	86	480	8:00-17:00	9-12	11 A HEAVY OIL	2.000	0.9408	10480	250	125	60
402)	3	94	2	2(1)	1106	66	480	8:00-17:00	9-12	11 A HEAVY OIL	2.000	0.9408	10480	250	125	60
403)	3	95	1	64(5)	613	72	7200	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	17	120

LIST OF FACILITY (PATTERN 1)

SEQ)	CO UN TY	FAC TOR Y	FAC ILI TY	BUSINE SS CAT EGORY	FACI LITY TYPE	STAR TING Y&M	OPE. HOUR (H)	OPERATING TIME ZONE START-END	OPERA TING PERIOD	FUEL AND RAW MATERIAL TO BE USED						
										NAME	SULFUR (%)	GRAVITY	CALORY (KCAL/)	RATING (/H)	NORMAL (/H)	ANNUAL (/Y)
404)	3	95	2	64(5)	1419	72	7200	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	33	240
405)	3	96	1	2(5)	1106	78	270	8:00-17:00	8-11	11 A HEAVY OIL	1.280	0.9462	10000	139	139	37
406)	3	96	2	2(5)	1106	78	270	8:00-17:00	8-11	11 A HEAVY OIL	1.280	0.9462	10000	139	139	37
407)	3	96	3	2(5)	1106	87	810	8:00-17:00	8-11	11 A HEAVY OIL	1.280	0.9462	10000	260	260	211
408)	3	97	1	2(5)	1004	81	3590	0:00-24:00	7-11	13 C HEAVY OIL	2.500	0.9529	10340	-1	6	22
409)	3	97	2	2(5)	1004	83	3590	0:00-24:00	7-11	13 C HEAVY OIL	2.500	0.9529	10340	-1	6	22
410)	3	97	3	2(5)	1004	84	3590	0:00-24:00	7-11	13 C HEAVY OIL	2.500	0.9529	10340	-1	6	22
411)	3	97	4	2(5)	1004	85	3590	0:00-24:00	7-11	13 C HEAVY OIL	2.500	0.9529	10340	-1	6	22
412)	3	98	1	88	101	7012	8400	0:00-24:00	1-12	34 LNG	0.000	-1.0000	13286	-1	24500	205800
413)	3	98	2	88	101	7111	8400	0:00-24:00	1-12	34 LNG	0.000	-1.0000	13286	-1	24500	205800
414)	3	98	3	88	101	7401	8400	0:00-24:00	1-12	34 LNG	0.000	-1.0000	13286	-1	45500	382200
415)	3	98	4	88	101	7508	8400	0:00-24:00	1-12	34 LNG	0.000	-1.0000	13286	-1	45500	382200
416)	3	98	5	88	101	7710	8400	0:00-24:00	1-12	34 LNG	0.000	-1.0000	13286	-1	45500	109200
										11 A HEAVY OIL	0.450	0.9000	10700	-1	54000	324000
417)	3	99	1	7(1)	103	83	4800	6:00-24:00	1-12	13 C HEAVY OIL	2.920	0.9900	10513	-1	50	240
418)	3	99	2	7(1)	103	85	4800	6:00-24:00	1-12	13 C HEAVY OIL	2.920	0.9900	10513	-1	50	240
419)	3	99	3	7(1)	103	87	4800	6:00-24:00	1-12	13 C HEAVY OIL	2.920	0.9900	10513	-1	50	240
420)	3	100	1	24	103	80	1098	9:00-15:00	1-12	11 A HEAVY OIL	2.000	0.9408	10430	134	100	110
421)	3	100	2	24	1106	80	1098	9:00-15:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	0	0
422)	3	101	1	22(3)	103	-1	7920	0:00-24:00	1-12	11 A HEAVY OIL	1.980*	0.9300*	10495*	-1	50	396
423)	3	102	1	8(1)	103	83	720	8:00-16:00	1-12	11 A HEAVY OIL	2.760	0.9358	10495*	-1	313	225
424)	3	102	2	8(1)	103	80	720	8:00-16:00	1-12	23 LUMBER	0.100*	-1.0000	3820	-1	125	90
425)	3	102	3	8(1)	8	83	720	8:00-16:00	1-12	11 A HEAVY OIL	2.760	0.9358	10495*	-1	13	9
426)	3	103	1	52(2)	103	82	1400	9:00-16:30	1-12	11 A HEAVY OIL	1.280	0.9850	10000	21	14	20
427)	3	104	1	53(8)	103	86	1200	8:00-12:00	1-12	23 LUMBER	0.100*	-1.0000	3820	-1	8	9
428)	3	104	2	53(8)	918	87	7200	0:00-24:00	1-12	23 LUMBER	0.100*	-1.0000	3820	-1	2	11
429)	3	104	3	53(8)	918	87	7200	0:00-24:00	1-12	23 LUMBER	0.100*	-1.0000	3820	-1	2	11
430)	3	105	1	55	915	71	8760	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	2083	1667	14600
431)	3	105	2	55	915	71	8760	0:00-24:00	1-12	11 A HEAVY OIL	1.280	0.9462	10000	4167	3333	29200
432)	3	106	1	64(8)	503	8712	2400	8:00-17:00	1-12	11 A HEAVY OIL	2.760	0.9558	10495*	-1	1	3
433)	3	107	1	48(3)	103	-1	1055	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	76	61	64
434)	3	108	1	22(1)	103	86	2920	8:00-16:00	1-12	14 LIGHT OIL	1.200	0.8660	10950*	-1	9	25
435)	3	109	1	22(1)	103	80	3600	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9950	9900	-1	167	600
436)	3	109	2	22(1)	103	86	3600	0:00-24:00	1-12	13 C HEAVY OIL	3.500	0.9950	9900	-1	125	450
437)	3	110	1	22(2)	103	73	0	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	0	0
438)	3	110	2	22(2)	103	80	1440	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	75	108
439)	3	110	3	22(2)	103	87	6744	0:00-24:00	1-12	21 GENERAL COAL	3.000	-1.0000	4400	-1	208	1405
440)	3	111	1	59	1201	71	7200	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	10000	72000
										41 IRON	0.000	-1.0000	0*	-1	17200	123850
441)	3	111	2	59	1201	74	1296	0:00-24:00	1-12	61 ELECTRICITY	0.000*	-1.0000	860*	-1	5000	6480
										41 IRON	0.000	-1.0000	0*	-1	8600	11150
442)	3	111	3	59	601	77	6000	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	236	1417
										13 C HEAVY OIL	3.500	0.9900	9900	-1	236	1417
										13 C HEAVY OIL	3.500	0.9900	10495*	-1	236	1417
443)	3	111	4	59	103	85	7200	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	38	333
										13 C HEAVY OIL	3.500	0.9900	9900	-1	38	333
										13 C HEAVY OIL	3.500	0.9900	10495*	-1	38	333
444)	3	111	5	59	8	85	7200	0:00-24:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	38	333
										13 C HEAVY OIL	3.500	0.9900	9900	-1	38	333
										13 C HEAVY OIL	3.500	0.9900	10495*	-1	38	333
445)	3	112	1	74(2)	502	73	2568	0:00-24:00	1-12	11 A HEAVY OIL	1.980*	0.9300*	10495*	-1	166	426
446)	3	112	2	74(2)	8	83	7200	0:00-24:00	1-12	46 OTHER RAW	0.000	-1.0000	0*	-1	1083	7800
										61 ELECTRICITY	0.000*	-1.0000	860*	-1	550	3960
447)	3	113	1	77(2)	607	63	2120	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	160	339
448)	3	113	2	77(2)	607	78	2120	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	150	319
449)	3	113	3	77(2)	607	63	2120	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	40	85
450)	3	113	4	77(2)	607	78	2120	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	40	85
451)	3	113	5	77(2)	607	78	2120	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	60	127
										61 ELECTRICITY	0.000*	-1.0000	860*	-1	0	0
452)	3	113	6	77(2)	608	78	2120	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	40	84
453)	3	113	7	77(2)	8	78	2120	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	60	127
454)	3	113	8	77(2)	8	78	2120	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	40	85
455)	3	113	9	77(2)	8	78	2120	8:00-17:00	1-12	11 A HEAVY OIL	2.160	0.9612	10461	-1	40	85
456)	3	114	1	78(1)	608	87	1896	6:00-14:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	19	36
457)	3	114	2	78(1)	608	87	1896	6:00-14:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	19	36
458)	3	114	3	78(1)	103	87	1896	6:00-14:00	1-12	13 C HEAVY OIL	2.500	0.9529	10340	-1	13	24
459)	3	114	4	78(1)	1106	87	1896	8:00-16:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	11	21
460)	3	114	5	78(1)	1106	87	1896	8:00-16:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	11	21
461)	3	115	1	78(1)	103	88	4160	6:55-23:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	14	56
462)	3	115	2	78(1)	1106	78	4160	6:55-23:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	14	56
463)	3	115	3	78(1)	1106	88	4160	6:55-23:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	14	56
464)	3	115	4	78(1)	1106	88	4160	6:55-23:00	1-12	35 LPG	0.002*	-1.0000	11158	-1	14	56
465)	3	117	1	59	1205	85	7920	0:00-24:00	1-12	46 OTHER RAW	0.000*	-1.0000	0*	-1	4400	34500
										61 ELECTRICITY	0.000*	-1.0000	860*	7000	5500	43560
466)	3	117	2	59	602	70	3960	8:00-20:00	1-12	13 C HEAVY OIL	2.660	0.9764	10400	500	450	1782
467)	3	117	3	59	602	87	1500	8:00-18:00	1-12	13 C HEAVY OIL	2.660	0.9764	10400	600	500	750
468)	3	118	1	59	1202	76	6480	0:00-24:00	1-12	46 OTHER RAW	0.000*	-1.0000	0*	-1	4333	28080
										61 ELECTRICITY	0.000*	-1.0000	860*	-1	4533	29372
469)	3	118	2	59	601	72	1080	8:00-17:00	1-12	13 C HEAVY OIL	2.460*	0.9300*	10495*	-1	500	540
470)	3	118	3	59	601	72	1080	8:00-17:00	1-12	13 C HEAVY OIL	2.460*	0.9300*	10495*	-1	500	540

LIST OF FACILITY (PATTERN 2)

SEQ)	COUNTY	FACTORY	FACILITY	OPE. HOUR (H)	ANNUAL PRODUC. (TON/Y)	EMITTED GAS RATING (NM3/H)	EMITTED GAS NORMAL (NM3/H)	ANNUAL SOX (NM3/Y)	ANNUAL NOX (NM3/Y)	STACK DATA NO	SHAPE	HEI (M)	DIA (M)	TEM (°C)	MX	MY	DX (M)	DY (M)
1)	1	1	1	4428	-1	-1	1526*	6177	927	1	B	15	0.5	215	22	23	120	960
2)	1	2	1	1675	-1	-1	3816*	6704	860	1	B	12	0.6	200	26	10	460	300
3)	1	2	2	8040	-1	-1	272*	2	194	2	B	12	0.4	200	26	10	460	300
4)	1	2	3	8040	-1	-1	369*	2	264	3	B	12	0.4	200	26	10	460	300
5)	1	2	4	1675	-1	-1	78*	0	12	4	B	12	0.6	200	26	10	460	300
6)	1	6	1	3000	-1	-1	827*	1323	320	1	B	12	0.3	200	26	11	600	40
7)	1	6	2	7200	-1	-1	1670*	6409	1553	2	B	12	0.3	200	26	11	600	40
8)	1	7	1	1680	-1	-1	1098*	342	55	1	B	26	0.7	150	28	11	20	180
9)	1	8	1	7200	-1	-1	216*	1177	188	1	B	25	1.5	100	21	14	40	820
10)	1	8	2	7200	72000	-1	42000*	0	12503	1	B	25	1.5	100	21	14	40	820
11)	1	9	1	7200	8600	-1	5017*	0	1493	1	B	5	9.9	-1	22	23	620	120
12)	1	12	1	4800	-1	-1	19875*	100054	12831	1	B	26	0.8	190	27	9	220	120
13)	1	12	2	4800	-1	-1	19875*	100054	12831	2	B	26	0.8	190	27	9	220	120
14)	1	12	3	0	-1	-1	0	0	0	3	B	26	0.8	-1	27	9	220	120
15)	1	13	1	2000	-1	-1	196*	89	33	1	A	20	0.3	-1	22	21	540	880
16)	1	14	1	1450	-1	-1	1097*	848	205	1	B	25	0.4	-1	22	12	240	560
17)	1	15	1	8760	-1	-1	2671*	12290	2452	1	B	12	1.6	80	34	8	500	200
18)	1	15	2	8760	-1	-1	2671*	12290	2452	2	B	12	1.3	80	34	8	500	200
19)	1	15	3	8760	-1	-1	1996*	11	915	3	B	12	0.6	80	34	8	500	200
20)	1	15	4	8760	-1	-1	0*	0	0	4	B	6	0.8	-1	34	8	500	200
21)	1	15	5	8760	-1	-1	0*	0	0	5	B	6	0.6	-1	34	8	500	200
22)	1	15	6	8760	-1	-1	0*	0	0	6	B	6	0.6	-1	34	8	500	200
23)	1	16	1	2400	-1	-1	363*	0	42	1	B	5	9.9	-1	28	19	120	180
24)	1	17	1	7200	-1	-1	4770*	28228	4621	1	A	20	0.9	250	23	21	240	860
25)	1	17	2	0	-1	-1	0	0	0	1	A	20	0.9	250	23	21	240	860
26)	1	17	3	1500	-1	-1	387*	0	0	2	A	3	0.6	-1	23	21	160	780
27)	1	18	1	4800	-1	-1	1113*	4426	716	1	B	16	0.5	-1	24	21	500	340
28)	1	18	2	800	-1	-1	3175*	1	116	2	B	5	9.9	-1	24	21	500	340
29)	1	19	1	6240	-1	-1	1002*	5668	851	1	B	18	0.5	-1	22	12	280	800
30)	1	19	2	4368	-1	-1	1002*	3968	596	2	A	16	0.6	-1	22	12	280	800
31)	1	20	1	6912	-1	-1	17935*	130071	16680	1	B	15	1.0	250	30	8	380	300
32)	1	20	2	0	-1	-1	0	0	0	1	B	15	1.0	250	30	8	380	300
33)	1	20	3	0	-1	-1	0	0	0	2	B	15	1.0	250	30	8	380	300
34)	1	20	4	0	-1	-1	0	0	0	2	B	15	1.0	250	30	8	380	300
35)	1	20	5	6912	-1	-1	739*	4	483	3	B	15	0.7	-1	30	8	380	300
36)	1	20	6	6912	-1	-1	194*	1	121	4	B	15	0.5	-1	30	8	380	300
37)	1	20	7	6912	-1	-1	1315*	3	411	5	B	12	0.4	-1	30	8	380	300
38)	1	21	1	1048	-1	-1	87*	1	5	1	A	7	0.3	-1	24	21	480	220
39)	1	21	2	3930	-1	-1	87*	4	21	2	A	7	0.3	-1	24	21	480	220
40)	1	21	3	3000	-1	-1	211*	71	34	3	A	7	0.3	-1	24	21	480	220
41)	1	21	4	3000	-1	-1	816*	1	108	4	A	7	0.4	-1	24	21	480	220
42)	1	22	1	3600	-1	-1	7632*	25114	3771	1	B	20	0.5	-1	22	13	860	640
43)	1	23	1	0	-1	-1	0	0	0	1	A	18	0.4	-1	25	20	260	460
44)	1	24	1	2080	-1	-1	270*	680	76	1	A	17	0.3	115	22	13	80	960
45)	1	25	1	2400	-1	-1	175*	342	55	1	B	6	0.5	-1	23	13	500	500
46)	1	27	1	3840	-1	-1	23*	0	3	1	B	5	0.3	-1	34	8	500	200
47)	1	29	1	5760	-1	-1	604*	2671	647	1	B	12	0.4	270	28	8	500	800
48)	1	29	2	5760	-1	-1	604*	2671	647	2	B	12	0.4	270	28	8	500	800
49)	1	29	3	5760	-1	-1	604*	2671	647	3	B	12	0.4	270	28	8	500	800
50)	1	29	4	8400	-1	-1	197*	1	372	4	B	15	0.8	-1	28	8	500	800
51)	1	29	5	8400	-1	-1	197*	1	372	4	B	15	0.8	-1	28	8	500	800
52)	1	30	1	4160	-1	-1	207*	670	110	1	B	9	0.3	-1	22	14	140	700
53)	1	32	1	7200	-1	-1	749*	605	214	1	A	12	0.5	-1	23	12	20	780
54)	1	33	1	5110	-1	-1	1367*	5769	933	1	A	12	0.3	-1	23	23	540	720
55)	1	34	1	2700	-1	-1	843*	2093	314	1	B	20	0.5	-1	22	14	880	460
56)	1	35	1	1480	-1	-1	3498*	6796	759	1	A	15	0.7	210	21	14	600	260
57)	1	35	2	1470	-1	-1	3498*	6796	759	2	A	15	0.7	210	21	14	600	260
58)	1	36	1	2400	-1	-1	1193*	1526	370	1	B	12	0.8	-1	22	13	120	720
59)	1	36	2	2400	-1	-1	1193*	1526	370	2	B	12	0.8	-1	22	13	120	720
60)	1	39	1	8760	-1	-1	6310*	99330	13417	1	B	15	0.5	-1	23	21	580	800
61)	1	40	1	2360	-1	-1	398*	984	126	1	A	14	0.4	-1	22	21	180	900
62)	1	41	1	5460	-1	-1	1988*	12435	1507	1	B	21	0.5	-1	26	11	640	160
63)	1	41	2	5460	-1	-1	1988*	12435	1507	2	B	21	0.7	-1	26	11	640	160
64)	1	41	3	5460	-1	-1	1988*	12435	1507	3	B	21	0.7	-1	26	11	640	160
65)	1	41	4	3300	-1	-1	11734*	44288	5369	4	B	21	0.8	-1	26	11	640	160
66)	1	42	1	4640	-1	-1	795*	1967	476	1	B	25	0.3	80	22	18	200	660
67)	1	42	2	0	-1	-1	0	0	0	2	B	25	0.3	80	22	18	200	660
68)	1	44	1	800	-1	-1	191*	145	22	1	B	12	0.4	-1	23	22	900	840

LIST OF FACILITY (PATTERN 2)

SEQ)	COUNTY	FACTORY	FACILITY	OPE. HOUR (H)	ANNUAL PRODUC. (TON/Y)	---EMITTED GAS-- RATING (NM3/H)	NORMAL (NM3/H)	ANNUAL SOX (NM3/Y)	ANNUAL NOX (NM3/Y)	---STACK DATA--- NO	SHAPE	HEI (M)	DIA (M)	TEM (°C)	MX	MY	DX (M)	DY (M)
69)	1	45	1	7200	-1	-1	572*	4302	552	1	B	11	0.4	-1	24	12	420	880
70)	1	45	2	0	-1	-1	0	0	0	2	B	8	0.4	-1	24	12	420	880
71)	1	45	3	7200	-1	-1	26*	123	48	3	B	8	0.2	-1	24	12	420	880
72)	1	45	4	7200	-1	-1	26*	123	48	4	B	12	0.3	-1	24	12	420	880
73)	1	45	5	7200	-1	-1	26*	123	48	5	B	8	0.3	-1	24	12	420	880
74)	1	45	6	7200	-1	-1	167*	1	155	6	B	12	0.3	-1	24	12	420	880
75)	1	45	7	7200	-1	-1	39*	176	69	7	B	5	0.2	-1	24	12	420	880
76)	1	45	8	3300	-1	-1	49*	80	22	8	B	6	0.2	-1	24	12	420	880
77)	1	46	1	3600	-1	-1	239*	711	115	1	B	15	0.9	170	26	9	480	280
78)	1	46	2	3600	-1	-1	302*	896	145	2	B	15	0.4	170	26	9	480	280
79)	1	46	3	4500	-1	-1	109*	0	32	3	B	5	9.9	-1	26	9	480	280
80)	1	46	4	56	-1	-1	363*	0	0	4	B	10	0.4	-1	26	9	480	280
81)	1	48	1	1320	-1	-1	1908*	1340	324	1	B	15	0.5	-1	23	13	320	320
82)	1	48	2	1320	-1	-1	1908*	1340	324	2	B	15	0.5	-1	23	13	320	320
83)	1	49	1	2482	-1	-1	1399*	1848	448	1	B	20	0.3	-1	23	14	20	620
84)	1	49	2	2482	-1	-1	461*	602	146	2	B	20	0.3	-1	23	14	20	620
85)	1	49	3	2482	-1	-1	763*	1000	242	3	B	20	0.3	-1	23	14	20	620
86)	1	51	1	8472	-1	-1	398*	2819	456	1	B	15	0.6	165	38	6	480	720
87)	1	51	2	8472	-1	-1	1299*	3846	692	2	B	10	0.5	-1	38	6	480	720
88)	1	51	3	8472	-1	-1	631*	1936	348	2	B	10	0.5	-1	38	6	480	720
89)	1	51	4	8472	-1	-1	1299*	3846	692	2	B	10	0.5	-1	38	6	480	720
90)	1	52	1	4480	-1	-1	477*	2235	287	1	B	25	0.3	-1	22	14	60	320
91)	1	52	2	750	-1	-1	60*	22	3	2	B	15	0.2	-1	22	14	60	320
92)	1	53	1	4752	-1	-1	1097*	4767	716	1	B	21	0.7	-1	21	23	920	720
93)	1	53	2	832	-1	-1	731*	552	83	2	B	21	0.7	-1	21	23	920	720
94)	1	54	1	7200	-1	-1	2182*	3394	1370	1	B	9	0.3	-1	22	23	560	60
95)	1	55	1	8400	-1	-1	9079*	116424	10660	1	B	30	0.6	120	22	12	180	540
96)	1	55	2	8400	-1	-1	9079*	116424	10660	2	B	30	0.6	120	22	12	180	540
97)	1	56	1	0	-1	-1	0	0	0	1	B	6	0.6	-1	21	19	480	920
98)	1	56	2	6000	-1	-1	3180*	10174	2464	2	B	6	0.6	175	21	19	480	920
99)	1	56	3	1240	-1	-1	0*	0	0	3	B	6	0.6	-1	21	19	480	920
100)	1	56	4	1240	-1	-1	26*	3	0	4	B	6	0.3	-1	21	19	640	960
101)	1	56	5	7200	-1	-1	0*	0	0	5	B	4	0.3	-1	21	19	640	960
102)	1	56	6	7200	-1	-1	0*	0	0	6	B	4	0.3	-1	21	19	640	960
103)	1	56	7	7200	-1	-1	0*	0	0	7	B	5	0.3	-1	21	19	640	960
104)	1	56	8	7200	-1	-1	0*	0	0	7	B	5	0.3	-1	21	19	640	960
105)	1	58	1	1960	-1	-1	795*	1424	214	1	B	15	0.5	-1	22	23	160	940
106)	1	59	1	1800	-1	-1	398*	593	96	1	B	21	0.6	135	23	12	600	880
107)	1	59	2	1800	-1	-1	398*	593	96	2	B	21	0.6	135	23	12	600	880
108)	1	61	1	3600	-1	-1	4680*	0	454	1	A	18	0.5	-1	22	12	400	880
109)	1	63	1	96	-1	-1	1414*	35	12	1	B	15	0.5	-1	22	13	840	720
110)	1	64	1	7200	-1	-1	2862*	23562	2856	1	B	10	0.5	-1	23	21	600	940
111)	1	64	2	6480	-1	-1	493*	2949	443	2	B	6	0.3	-1	23	21	600	940
112)	1	64	3	0	-1	-1	0	0	0	3	B	15	0.8	-1	23	21	600	940
113)	1	65	1	270	-1	-1	272*	0	2	1	B	11	0.2	-1	22	22	620	20
114)	1	65	2	270	-1	-1	272*	0	2	1	B	11	0.2	-1	22	22	620	20
115)	1	66	1	3600	-1	-1	3975*	16552	1905	1	B	10	0.4	180	23	13	400	80
116)	1	66	2	3600	-1	-1	4770*	19862	2286	2	B	14	0.6	180	23	13	400	80
117)	1	67	1	3600	-1	-1	795*	3723	385	1	B	21	0.4	-1	25	15	460	620
118)	1	67	2	3600	-1	-1	795*	3723	385	2	B	21	0.4	-1	25	15	460	620
119)	1	68	1	7200	-1	-1	3991*	36341	3867	1	A	15	1.2	-1	25	9	720	760
120)	1	68	2	7200	-1	-1	4802*	43610	4640	2	A	20	1.5	-1	25	9	720	760
121)	1	68	3	7200	-1	-1	4802*	43610	4640	2	A	20	1.5	-1	25	9	720	760
122)	1	68	4	7200	-1	-1	4802*	43610	4640	2	A	20	1.5	-1	25	9	720	760
123)	1	68	5	7200	-1	-1	4802*	43610	4640	3	A	20	1.5	-1	25	9	720	760
124)	1	68	6	0	-1	-1	0	0	0	3	A	20	1.5	-1	25	9	720	760
125)	1	68	7	0	-1	-1	0	0	0	3	A	20	1.5	-1	25	9	720	760
126)	1	68	8	0	-1	-1	0	0	0	4	A	15	1.3	-1	25	9	720	760
127)	1	69	1	1000	-1	-1	1034*	1345	139	1	B	10	0.4	-1	21	19	520	820
128)	1	69	2	192	-1	-1	0*	0	0	2	B	15	0.4	-1	21	19	520	820
129)	1	70	1	8400	-1	-1	9266*	67914	34280	1	A	18	0.6	-1	25	15	500	760
130)	1	70	2	8400	-1	-1	11603*	84892	42850	2	A	18	0.6	-1	25	15	500	760
131)	1	70	3	8400	-1	-1	3518*	13524	2039	3	B	6	1.7	-1	25	15	520	900
132)	1	70	4	8400	-1	-1	3765*	10	1453	4	B	9	1.0	-1	25	15	520	900
133)	1	71	1	4800	-1	-1	0*	0	0	1	B	12	0.3	-1	22	24	440	440
134)	1	71	2	4800	-1	-1	0*	0	0	2	B	16	0.5	-1	22	24	440	440
135)	1	72	1	2000	-1	-1	2741*	4	496	1	B	13	0.6	-1	21	21	440	720
136)	1	72	2	2000	-1	-1	2741*	4	496	2	B	15	0.6	-1	21	21	440	720
137)	1	73	1	6048	-1	-1	63*	0	41	1	C	10	0.5	90	21	21	560	680
138)	1	73	2	6048	-1	-1	721*	16	545	2	B	10	0.2	90	21	21	560	680
139)	1	73	3	4032	-1	-1	156*	14	102	3	B	10	0.2	90	21	21	580	660
140)	1	73	4	6336	-1	-1	151*	1	218	4	C	10	0.2	60	21	21	580	660
141)	1	73	5	2304	-1	-1	165*	218	37	5	C	10	0.2	-1	21	21	480	480
142)	1	73	6	2112	-1	-1	903*	1063	180	6	A	15	0.3	-1	21	21	560	560
143)	1	74	1	4046	-1	-1	491*	407	84	1	B	8	0.4	-1	21	20	480	740

LIST OF FACILITY (PATTERN 2)

SEQ)	COUNTY	FACTORY	FACILITY	OPE. HOUR (H)	ANNUAL PRODUC. (TON/Y)	EMITTED GAS RATING (NM3/H)	EMITTED GAS NORMAL (NM3/H)	ANNUAL SOX (NM3/Y)	ANNUAL NOX (NM3/Y)	STACK DATA NO	SHAPE	HEI (M)	DIA (M)	TEM (°C)	MX	MY	DX (M)	DY (M)
144)	1	74	2	4046	-1	-1	491*	407	84	2	B	8	0.4	-1	21	20	500	840
145)	1	74	3	4046	-1	-1	491*	407	84	3	B	8	0.5	-1	21	20	500	840
146)	2	3	1	8760	-1	-1	445*	2077	503	1	A	8	0.3	270	45	16	280	800
147)	2	4	1	3000	-1	-1	2194*	5453	882	1	B	20	0.5	-1	30	19	500	40
148)	2	5	1	4224	-1	-1	1225*	2	214	1	B	10	0.5	-1	42	18	820	720
149)	2	5	2	4224	-1	-1	1225*	2	214	2	B	10	0.5	-1	42	18	820	720
150)	2	5	3	4224	-1	-1	1225*	2	214	3	B	10	0.5	-1	42	18	880	860
151)	2	5	4	2112	-1	-1	816*	1	71	4	B	10	0.5	-1	42	18	880	860
152)	2	5	5	2112	-1	-1	3175*	2	284	5	B	10	0.5	-1	42	18	800	800
153)	2	5	6	2640	-1	-1	1304*	3685	457	6	B	10	0.5	-1	42	18	800	800
154)	2	6	1	960	-1	-1	3382*	0	116	1	A	30	1.1	-1	43	24	640	620
155)	2	7	1	0	-1	-1	0	0	0	1	B	13	0.4	-1	34	18	600	420
156)	2	7	2	1600	-1	-1	413*	540	87	2	B	13	0.5	-1	34	18	600	420
157)	2	8	1	2400	-1	-1	795*	1017	246	1	B	12	0.5	-1	42	18	900	160
158)	2	9	1	0	-1	-1	0	0	0	1	B	18	0.5	-1	44	18	520	120
159)	2	9	2	2640	-1	-1	1479*	2077	503	2	B	15	0.5	-1	44	18	520	120
160)	2	9	3	2640	-1	-1	2957*	4154	1006	3	B	15	0.5	-1	44	18	440	60
161)	2	9	4	2640	-1	-1	4420*	6231	1509	4	B	15	0.5	-1	44	18	440	60
162)	2	10	1	3600	-1	-1	906*	1730	419	1	B	12	0.2	-1	36	28	920	420
163)	2	10	2	3600	-1	-1	906*	1730	419	2	B	12	0.4	-1	36	28	920	420
164)	2	11	1	4200	-1	-1	2274*	10005	1283	1	A	25	0.8	-1	38	19	660	800
165)	2	11	2	4200	-1	-1	2274*	10005	1283	2	A	25	0.8	-1	38	19	660	820
166)	2	12	1	7854	-1	-1	7076*	23	13089	1	B	12	0.5	-1	35	25	80	20
167)	2	13	1	2400	-1	-1	6240*	0	534	1	A	23	0.6	-1	45	15	20	920
168)	2	14	1	2080	-1	-1	165*	222	33	1	B	5	0.5	-1	42	18	660	200
169)	2	15	1	1500	-1	-1	1908*	3184	366	1	B	13	0.4	-1	29	25	320	260
170)	2	16	1	1500	-1	-1	15*	3	1	1	B	10	0.3	175	30	24	80	40
171)	2	17	1	7200	-1	-1	398*	4461	391	1	B	12	0.4	-1	41	18	540	140
172)	2	17	2	4320	-1	-1	1336*	4412	602	2	A	27	0.6	-1	41	18	540	140
173)	2	17	3	4500	-1	-1	408*	1	116	3	B	5	9.9	-1	41	18	540	140
174)	2	18	1	960	-1	-1	304*	47	221	1	B	5	9.9	-1	49	18	460	320
175)	2	19	1	0	-1	-1	0	0	0	1	B	6	0.8	250	35	24	460	400
176)	2	19	2	7680	-1	-1	1113*	9727	1147	2	B	6	1.2	250	35	24	460	400
177)	2	20	1	870	-1	-1	700*	205	59	1	A	10	0.5	-1	55	13	260	20
178)	2	21	1	1080	-1	-1	1560*	0	60	1	A	31	0.9	-1	55	13	500	760
179)	2	22	1	720	-1	-1	70*	19	40	1	C	5	0.1	-1	45	17	220	360
180)	2	23	1	7200	-1	-1	1461*	25200	1516	1	A	19	1.1	200	42	18	500	760
181)	2	23	2	1600	-1	-1	1193*	2001	246	2	B	20	0.8	200	42	18	500	760
182)	2	23	3	0	-1	-1	0	0	0	3	B	20	0.8	-1	42	18	500	760
183)	2	23	4	1600	-1	-1	2894*	1646	284	4	B	5	9.9	-1	42	18	500	760
184)	2	23	5	1600	-1	-1	2894*	1646	284	4	B	5	9.9	-1	42	18	500	760
185)	2	24	1	4368	-1	-1	14150*	1462	2579	1	B	5	9.9	-1	43	18	280	500
186)	2	24	2	4368	-1	-1	14150*	1462	2579	1	B	5	9.9	-1	43	18	280	500
187)	2	24	3	4368	-1	-1	14150*	1462	2579	1	B	5	9.9	-1	43	18	280	500
188)	2	24	4	4368	-1	-1	337*	509	96	2	C	2	0.2	-1	43	18	280	500
189)	2	25	1	2400	-1	-1	3266*	2	330	1	B	5	9.9	-1	37	20	860	60
190)	2	26	1	7200	-1	-1	795*	3723	599	1	A	8	0.5	-1	34	20	40	40
191)	2	26	2	810	-1	-1	227*	0	8	2	A	8	0.2	-1	34	20	40	40
192)	2	26	3	7200	-1	-1	0*	0	0	3	B	5	9.9	-1	34	20	40	40
193)	3	1	1	4864	23567	-1	21000	0	4092	1	A	21	9.9	40	17	22	880	920
194)	3	1	2	4864	23567	-1	21000	0	4092	1	A	21	9.9	40	17	22	880	920
195)	3	1	3	0	0	-1	0	0	0	1	A	21	9.9	40	17	22	880	920
196)	3	1	4	4864	-1	-1	10685*	63867	6736	2	A	35	1.6	-1	17	22	880	920
197)	3	2	1	7200	-1	-1	6360*	48026	6159	1	A	31	1.4	250	20	18	140	440
198)	3	2	2	7200	-1	-1	6360*	48026	6159	1	A	31	1.4	250	20	18	140	440
199)	3	3	1	8448	-1	-1	1797*	15859	2034	1	B	20	0.5	180	18	22	500	480
200)	3	4	1	8520	-1	-1	3975*	38729	4695	1	B	20	0.6	-1	17	23	140	600
201)	3	5	1	8040	-1	-1	41340*	275331	44519	1	A	34	1.4	250	14	22	380	620
202)	3	5	2	0	-1	-1	0	0	0	2	A	24	0.8	250	14	22	380	620
203)	3	5	3	0	-1	-1	0	0	0	3	A	24	1.4	250	14	22	380	620
204)	3	5	4	8040	-1	-1	663*	53	15	4	A	25	1.4	240	14	22	420	540
205)	3	6	1	2352	-1	-1	3246*	7490	988	1	B	24	0.4	250	18	17	20	360
206)	3	6	2	2352	-1	-1	3525*	8127	1072	2	B	21	0.4	250	18	17	20	360
207)	3	6	3	2352	-1	-1	6029*	13890	1832	3	B	23	0.8	250	18	17	20	360
208)	3	7	1	2400	-1	-1	4081*	9599	1266	1	B	20	0.6	-1	16	18	720	120
209)	3	7	2	2400	-1	-1	2041*	4800	633	2	B	20	0.6	-1	16	18	720	120
210)	3	8	1	8448	-1	-1	1161*	14941	1389	1	B	15	0.6	180	18	22	640	820
211)	3	9	1	7896	-1	-1	0*	0	0	1	B	5	9.9	-1	19	22	520	840

LIST OF FACILITY (PATTERN 2)

SEQ)	COUNTY	FACTORY	FACILITY	OPE. HOUR (H)	ANNUAL PRODUC. (TON/Y)	EMITTED GAS RATING (NM3/H)	EMITTED GAS NORMAL (NM3/H)	ANNUAL SOX (NM3/Y)	ANNUAL NOX (NM3/Y)	STACK DATA NO	SHAPE	HEI (M)	DIA (M)	TEM (°C)	MX	MY	DX (M)	DY (M)
212)	3	9	2	7896	-1	-1	270*	1119	271	2	B	13	0.2	30	19	22	520	840
213)	3	9	3	1440	-1	-1	270*	203	49	3	A	21	0.9	50	19	22	520	840
214)	3	9	4	6000	-1	-1	2633*	1597	518	4	A	16	0.4	350	19	22	520	840
215)	3	10	1	2368	-1	-1	4267*	7921	1294	1	B	16	0.4	250	18	18	160	100
216)	3	11	1	4800	-1	-1	604*	1526	370	1	B	15	0.5	-1	21	23	20	700
217)	3	11	2	4800	-1	-1	716*	1831	444	2	B	12	0.4	-1	21	23	20	700
218)	3	12	1	8400	-1	-1	1820*	0	258	1	B	12	0.6	145	13	21	620	960
219)	3	12	2	2160	-1	-1	2300*	1136	306	2	A	18	0.9	225	13	21	620	960
220)	3	13	1	6000	-1	-1	3021*	13352	2416	1	A	15	0.5	246	17	23	220	560
221)	3	13	2	6000	-1	-1	3021*	13352	2416	2	A	15	0.5	246	17	23	220	560
222)	3	14	1	7920	-1	-1	8204*	68154	8740	1	A	20	0.8	210	18	23	260	380
223)	3	14	2	7920	-1	-1	8204*	68154	8740	2	A	20	0.8	210	18	23	260	380
224)	3	14	3	7920	-1	-1	8204*	68154	8740	3	A	20	0.8	210	18	23	280	320
225)	3	14	4	0	-1	-1	0	0	0	1	A	20	0.8	210	18	23	260	380
226)	3	15	1	1800	-1	-1	989*	212	61	1	B	15	0.3	-1	14	22	780	600
227)	3	16	1	4200	-1	-1	3578*	23037	2020	1	B	15	0.6	200	19	23	60	80
228)	3	16	2	4200	-1	-1	3578*	23037	2020	2	B	15	0.6	200	19	23	60	80
229)	3	16	3	2112	-1	-1	4770*	15455	1355	3	B	15	0.6	200	19	23	60	80
230)	3	16	4	2112	-1	-1	5963*	19307	1693	4	B	15	0.6	200	19	23	60	80
231)	3	17	1	900	-1	-1	3434*	4705	413	1	A	21	0.5	276	18	27	20	200
232)	3	17	2	7200	-1	-1	3434*	37716	3308	2	A	20	0.5	270	18	27	20	200
233)	3	18	1	3200	-1	-1	986*	1670	405	1	B	15	0.5	210	19	22	940	180
234)	3	18	2	7200	-1	-1	1002*	3866	936	2	B	18	0.8	210	19	22	940	180
235)	3	18	3	3200	-1	-1	811*	1390	337	3	B	15	0.5	210	19	22	940	180
236)	3	18	4	0	-1	-1	0	0	0	4	B	19	0.5	-1	19	22	940	180
237)	3	19	1	6240	-1	-1	105*	0	84	1	A	11	0.6	-1	18	23	780	520
238)	3	19	2	3744	-1	-1	0*	0	0	1	A	11	0.6	-1	18	23	780	520
239)	3	20	1	7200	-1	-1	461*	3485	447	1	B	21	0.5	150	21	22	320	560
240)	3	21	1	60	-1	-1	105*	4	1	1	B	10	0.2	-1	20	21	820	780
241)	3	22	1	2496	-1	-1	0*	0	0	1	B	5	9.9	-1	20	21	540	920
242)	3	23	1	7200	-1	-1	1619*	7587	1542	1	A	12	0.6	-1	20	23	420	280
243)	3	23	2	7200	-1	-1	1619*	7587	1542	2	A	12	0.6	-1	20	23	420	280
244)	3	23	3	7200	-1	-1	1619*	7587	1542	3	A	22	0.6	-1	20	23	420	280
245)	3	23	4	4800	-1	-1	0*	0	0	4	B	14	0.6	-1	20	23	420	280
246)	3	23	5	4800	-1	-1	0*	0	0	4	B	14	0.6	-1	20	23	420	280
247)	3	23	6	540	-1	-1	5936*	566	98	5	B	5	9.9	-1	20	23	420	280
248)	3	23	7	540	-1	-1	5936*	566	98	5	B	5	9.9	-1	20	23	420	280
249)	3	24	1	2096	-1	-1	1002*	3177	279	1	A	7	0.4	-1	19	22	240	840
250)	3	24	2	2096	-1	-1	1678*	1	147	2	A	11	0.7	-1	19	22	240	840
251)	3	24	3	2096	-1	-1	1678*	1	147	3	A	11	0.6	-1	19	22	240	840
252)	3	24	4	2096	-1	-1	1678*	1	147	4	A	11	1.5	-1	19	22	240	840
253)	3	24	5	2096	-1	-1	1678*	1	147	5	A	11	0.7	-1	19	22	240	840
254)	3	25	1	960	-1	-1	159*	85	21	1	B	18	0.5	-1	20	23	560	560
255)	3	25	2	960	-1	-1	239*	218	33	2	B	18	1.0	-1	20	23	560	560
256)	3	25	3	2880	-1	-1	1560*	504	178	3	B	15	0.8	-1	20	23	560	560
257)	3	26	1	0	-1	-1	0	0	0	1	B	25	0.8	-1	16	19	660	400
258)	3	26	2	6000	-1	-1	795*	5003	642	2	B	25	0.8	100	16	19	660	400
259)	3	27	1	1500	-1	-1	2496*	420	148	1	A	25	0.5	-1	14	21	820	920
260)	3	27	2	300	-1	-1	1272*	349	52	2	A	25	0.4	-1	14	21	820	920
261)	3	28	1	2400	-1	-1	954*	2979	308	1	B	10	0.4	-1	14	22	400	160
262)	3	29	1	6336	-1	-1	1497*	3	397	1	B	18	0.5	40	19	22	860	240
263)	3	29	2	6336	-1	-1	1497*	3	397	2	B	18	0.5	40	19	22	860	240
264)	3	29	3	6336	-1	-1	1497*	3	397	3	B	18	0.7	45	19	22	860	240
265)	3	29	4	6336	-1	-1	1497*	3	397	4	B	18	0.7	45	19	22	860	240
266)	3	29	5	6336	-1	-1	1497*	3	397	5	B	18	0.7	45	19	22	860	240
267)	3	29	6	6336	-1	-1	1497*	3	397	6	B	18	0.7	45	19	22	860	240
268)	3	29	7	6336	-1	-1	1497*	3	397	7	B	18	0.7	45	19	22	860	240
269)	3	29	8	6336	-1	-1	1497*	3	397	8	B	18	0.7	45	19	22	860	240
270)	3	29	9	6336	-1	-1	0*	0	0	9	B	18	0.7	-1	19	22	880	260
271)	3	29	10	6336	-1	-1	0*	0	0	10	B	18	0.7	-1	19	22	880	260
272)	3	29	11	6336	-1	-1	0*	0	0	11	B	18	0.7	-1	19	22	880	260
273)	3	29	12	6336	-1	-1	0*	0	0	12	B	18	0.7	-1	19	22	880	260
274)	3	29	13	6336	-1	-1	0*	0	0	13	B	18	0.7	-1	19	22	880	260
275)	3	29	14	6336	-1	-1	0*	0	0	14	B	18	0.7	-1	19	22	880	260
276)	3	30	1	2400	-1	-1	954*	1221	296	1	A	24	1.0	-1	15	20	460	340
277)	3	30	2	0	-1	-1	0	0	0	2	A	15	1.0	-1	15	20	460	340
278)	3	31	1	560	-1	-1	509*	325	38	1	B	8	0.3	-1	14	20	740	500
279)	3	31	2	560	-1	-1	509*	325	38	2	B	8	0.3	-1	14	20	740	500
280)	3	32	1	2700	-1	-1	636*	1953	230	1	A	18	0.8	-1	18	14	500	760
281)	3	32	2	2700	-1	-1	636*	1953	230	2	B	12	1.1	-1	18	14	500	760
282)	3	33	1	8400	-1	-1	604*	4202	708	1	B	15	0.5	370	18	18	880	660
283)	3	33	2	12	-1	-1	23*	15	38	2	B	6	0.6	-1	18	18	880	660
284)	3	33	3	490	-1	-1	325*	4	16	3	B	13	0.5	-1	18	18	880	660
285)	3	34	1	5200	-1	-1	890*	6019	622	1	B	14	0.3	230	19	18	420	460
286)	3	34	2	5200	-1	-1	1336*	9039	934	2	B	14	0.5	230	19	18	420	460

LIST OF FACILITY (PATTERN 2)

SEQ)	COUNTY	FACTORY	FACILITY	OPE. HOUR (H)	ANNUAL PRODUC. (TON/Y)	---EMITTED GAS-- RATING (NM3/H)	NORMAL (NM3/H)	ANNUAL SOX (NM3/Y)	ANNUAL NOX (NM3/Y)	-----STACK DATA----- NO	SHAPE	HEI (M)	DIA (M)	TEM (°C)	MX	MY	DX (M)	DY (M)
287)	3	34	3	1440	-1	-1	3821*	3082	354	3	B	5	9.9	-1	19	18	420	460
288)	3	34	4	1440	-1	-1	5751*	4613	531	3	B	5	9.9	-1	19	18	420	460
289)	3	35	1	0	-1	-1	0	0	0	1	A	24	0.8	-1	20	16	320	620
290)	3	35	2	5400	-1	-1	8580*	3149	1603	2	A	24	0.8	-1	20	16	320	620
291)	3	36	1	3900	-1	-1	2226*	11059	1232	1	B	15	0.7	175	14	22	780	880
292)	3	37	1	2610	-1	-1	1749*	4786	614	1	B	25	0.8	-1	20	22	500	680
293)	3	38	1	2400	-1	-1	1204*	531	261	1	B	12	0.3	-1	19	22	860	40
294)	3	38	2	0	-1	-1	0	0	0	2	B	12	0.3	-1	19	22	860	40
295)	3	38	3	0	-1	-1	0	0	0	3	B	12	0.3	-1	19	22	860	40
296)	3	39	1	2080	-1	-1	302*	567	85	1	B	15	0.5	-1	14	21	620	980
297)	3	39	2	2080	-1	-1	509*	945	142	2	B	15	0.5	-1	14	21	620	980
298)	3	40	1	2560	-1	-1	890*	2401	308	1	A	15	0.6	-1	21	22	140	600
299)	3	41	1	1140	-1	-1	125*	16	6	1	A	10	0.3	-1	14	22	80	660
300)	3	42	1	6500	-1	-1	636*	4727	573	1	B	15	0.3	-1	20	22	300	800
301)	3	42	2	6500	-1	-1	636*	4727	573	2	B	15	0.3	-1	20	22	300	800
302)	3	43	1	2655	-1	-1	1113*	2450	396	1	A	8	0.3	-1	20	22	220	820
303)	3	44	1	936	-1	-1	1590*	1238	200	1	B	10	0.5	-1	19	21	540	840
304)	3	44	2	3520	-1	-1	1988*	5795	937	2	B	12	0.5	-1	19	21	540	840
305)	3	45	1	3168	-1	-1	811*	2134	345	1	B	14	0.5	-1	19	21	840	920
306)	3	45	2	0	-1	-1	0	0	0	2	B	14	0.5	-1	19	21	840	920
307)	3	46	1	1860	-1	-1	1034*	2001	257	1	B	15	0.5	150	17	18	180	680
308)	3	46	2	1860	-1	-1	1034*	2001	257	2	B	15	0.5	150	17	18	180	680
309)	3	46	3	930	-1	-1	953*	0	42	3	B	15	0.5	100	17	18	180	680
310)	3	46	4	930	-1	-1	953*	0	42	4	B	15	0.6	100	17	18	180	680
311)	3	46	5	930	-1	-1	953*	0	42	5	B	15	0.3	100	17	18	180	680
312)	3	46	6	930	-1	-1	953*	0	42	6	B	15	0.3	100	17	18	180	680
313)	3	47	1	8640	-1	-1	6519*	64396	7806	1	A	25	0.7	225	15	22	800	480
314)	3	47	2	8640	-1	-1	6519*	64396	7806	2	A	25	0.7	225	15	22	800	480
315)	3	47	3	0	-1	-1	0	0	0	3	B	12	0.7	225	15	22	800	480
316)	3	47	4	0	-1	-1	0	0	0	4	B	12	0.7	225	15	22	800	480
317)	3	48	1	2400	-1	-1	1855*	3488	570	1	B	10	0.4	-1	18	17	20	940
318)	3	48	2	0	-1	-1	0	0	0	2	B	10	0.4	-1	18	17	20	940
319)	3	48	3	0	-1	-1	0	0	0	3	B	10	0.4	-1	18	17	20	940
320)	3	49	1	3960	-1	-1	3339*	7054	1709	1	B	12	0.6	180	19	24	480	40
321)	3	49	2	3960	-1	-1	3339*	7054	1709	2	B	12	0.6	180	19	24	480	40
322)	3	50	1	2400	-1	-1	477*	1201	154	1	B	10	1.3	-1	16	19	200	860
323)	3	50	2	2400	-1	-1	477*	1201	154	2	B	10	1.3	-1	16	19	200	860
324)	3	50	3	0	-1	-1	0	0	0	3	B	10	1.3	-1	16	19	200	860
325)	3	51	1	5760	30000	-1	21294*	9705	5209	1	A	20	1.8	120	15	21	300	540
326)	3	51	2	5760	30000	-1	21294*	9705	5209	1	A	20	1.8	120	15	21	300	540
327)	3	51	3	4800	-1	-1	10852*	35914	6151	2	B	28	1.0	300	15	21	260	480
328)	3	51	4	3600	-1	-1	10852*	26936	4613	3	B	22	0.7	300	15	21	260	480
329)	3	52	1	0	-1	-1	0	0	0	1	B	14	0.5	155	16	23	360	360
330)	3	52	2	7200	-1	-1	4086*	15684	3799	2	B	14	0.7	215	16	23	360	360
331)	3	53	1	1600	-1	-1	75*	28	11	1	B	10	0.2	150	19	23	560	140
332)	3	54	1	2880	-1	-1	4770*	20956	1838	1	B	16	0.6	175	15	22	40	40
333)	3	54	2	2880	-1	-1	4770*	20956	1838	2	B	18	0.9	200	15	22	40	40
334)	3	54	3	2880	-1	-1	4770*	20956	1838	3	B	18	0.9	200	15	22	40	40
335)	3	54	4	4320	-1	-1	4770*	20956	1838	4	B	18	0.9	200	15	22	40	40
336)	3	55	1	0	-1	-1	0	0	0	1	A	10	0.5	-1	20	22	720	60
337)	3	56	1	4200	-1	-1	1224*	4709	707	1	A	20	0.3	-1	15	20	140	680
338)	3	57	1	6480	-1	-1	461*	1594	386	1	B	8	0.6	-1	19	23	560	740
339)	3	57	2	0	-1	-1	0	0	0	2	B	6	0.6	-1	19	23	560	740
340)	3	57	3	6480	-1	-1	13125*	5670	1802	3	B	15	0.8	-1	19	23	560	740
341)	3	58	1	0	-1	-1	0	0	0	1	A	10	0.5	-1	15	19	500	760
342)	3	59	1	0	-1	-1	0	0	0	1	B	10	0.5	230	14	22	420	500
343)	3	59	2	8448	-1	-1	3975*	35219	4516	2	B	10	0.7	170	14	22	420	500
344)	3	59	3	8448	-1	-1	795*	7037	880	3	B	10	0.5	-1	14	22	420	500
345)	3	59	4	8448	-1	-1	795*	7037	880	4	B	10	0.6	270	14	22	420	500
346)	3	60	1	2700	-1	-1	429*	1045	157	1	B	16	0.5	-1	17	18	240	460
347)	3	61	1	2400	-1	-1	1092*	294	95	1	A	18	0.6	-1	14	23	60	420
348)	3	62	1	4500	-1	-1	243*	20	106	1	B	5	9.9	-1	15	20	660	120
349)	3	62	2	4500	-1	-1	243*	20	106	1	B	5	9.9	-1	15	20	660	120
350)	3	62	3	4500	-1	-1	243*	20	106	1	B	5	9.9	-1	15	20	660	120
351)	3	63	1	2320	-1	-1	182*	21	71	1	B	18	0.5	-1	14	23	140	260
352)	3	63	2	0	-1	-1	0	0	0	2	B	5	9.9	-1	14	23	140	260
353)	3	64	1	2750	-1	-1	286*	414	105	1	B	12	0.3	-1	20	21	980	720
354)	3	64	2	2750	-1	-1	286*	414	105	2	B	12	0.3	-1	20	21	980	720
355)	3	64	3	2750	-1	-1	286*	414	105	3	B	12	0.3	-1	20	21	980	720
356)	3	65	1	2400	-1	-1	557*	1354	180	1	B	12	0.4	-1	14	22	280	960

LIST OF FACILITY (PATTERN 2)

SEQ)	COUNTY	FACTORY	FACILITY	OPE. HOUR (H)	ANNUAL PRODUC. (TON/Y)	EMITTED GAS RATING (NM3/H)	EMITTED GAS NORMAL (NM3/H)	ANNUAL SOX (NM3/Y)	ANNUAL NOX (NM3/Y)	STACK DATA SHA NO	PE	HEI (M)	DIA (M)	TEM (°C)	MX	MY	DX (M)	DY (M)
357)	3	66	1	4080	-1	-1	2100*	0	107	1	B	18	0.5	-1	19	23	120	160
358)	3	67	1	2440	-1	-1	1367*	3502	468	1	B	20	1.2	-1	14	25	940	300
359)	3	67	2	0	-1	-1	0	0	0	2	B	20	0.8	-1	14	25	940	300
360)	3	67	3	0	-1	-1	0	0	0	3	B	20	0.8	-1	14	25	940	300
361)	3	67	4	90	-1	-1	0*	0	0	4	B	20	0.4	-1	14	25	940	300
362)	3	68	1	7200	-1	-1	604*	4882	576	1	A	14	0.5	-1	14	19	740	260
363)	3	68	2	7200	-1	-1	604*	4882	576	2	B	10	0.3	-1	14	19	740	260
364)	3	69	1	7200	-1	-1	1590*	12007	1540	1	B	16	0.9	-1	17	23	120	220
365)	3	69	2	7200	-1	-1	1590*	12007	1540	1	B	16	0.9	-1	17	23	120	220
366)	3	70	1	4800	-1	-1	1320*	5813	873	1	A	25	0.5	-1	14	22	160	520
367)	3	70	2	2400	-1	-1	1320*	2907	436	2	A	25	0.3	-1	14	22	160	520
368)	3	71	1	4200	-1	-1	3307*	14575	1869	1	B	16	0.6	180	13	24	440	60
369)	3	71	2	4200	-1	-1	3307*	14575	1869	2	B	16	0.6	180	13	24	440	60
370)	3	72	1	4800	-1	-1	223*	1134	145	1	A	10	0.8	-1	18	23	480	160
371)	3	73	1	7200	-1	-1	4680*	3780	1334	1	A	20	1.0	200	18	23	520	540
372)	3	73	2	7200	-1	-1	7800*	6300	2223	2	A	20	0.8	200	18	23	520	540
373)	3	74	1	2208	-1	-1	1169*	2318	383	1	B	25	0.4	-1	15	19	560	880
374)	3	74	2	2208	-1	-1	1169*	2318	383	2	B	23	0.4	-1	15	19	560	880
375)	3	75	1	2400	-1	-1	18550*	15805	2844	1	B	5	9.9	40	16	23	500	840
376)	3	75	2	2400	-1	-1	18550*	15805	2844	1	B	5	9.9	40	16	23	500	840
377)	3	75	3	2400	-1	-1	18558*	15805	2844	1	B	5	9.9	40	16	23	500	840
378)	3	75	4	2400	-1	-1	18550*	15805	2844	1	B	5	9.9	40	16	23	500	840
379)	3	76	1	1095	-1	-1	541*	314	76	1	A	12	0.5	-1	13	20	320	640
380)	3	76	2	0	-1	-1	0	0	0	2	B	12	0.5	-1	13	20	320	640
381)	3	77	1	8448	-1	-1	207*	1584	238	1	B	9	0.5	-1	14	20	60	160
382)	3	78	1	6000	-1	-1	557*	3052	458	1	A	15	0.3	-1	14	22	240	80
383)	3	78	2	3000	-1	-1	477*	1308	196	2	A	15	0.3	-1	14	22	240	80
384)	3	79	1	5400	-1	-1	2115*	9483	1533	1	B	18	0.6	-1	15	20	60	580
385)	3	79	2	0	-1	-1	0	0	0	2	B	15	0.5	-1	15	20	60	580
386)	3	80	1	7200	-1	-1	100*	0	28	1	B	15	0.5	-1	16	19	520	420
387)	3	81	1	4800	-1	-1	75*	66	33	1	B	7	0.2	-1	16	18	940	840
388)	3	82	1	3600	-1	-1	3180*	10464	1571	1	B	15	0.5	-1	20	23	480	140
389)	3	82	2	3600	-1	-1	2385*	7848	1178	2	B	15	0.5	-1	20	23	480	140
390)	3	83	1	3000	-1	-1	763*	2603	307	1	B	12	0.5	-1	14	22	40	800
391)	3	84	1	2700	-1	-1	700*	1744	262	1	B	11	0.5	80	15	20	660	440
392)	3	85	1	2700	-1	-1	429*	610	148	1	A	15	0.5	-1	14	22	320	700
393)	3	85	2	0	-1	-1	0	0	0	2	A	15	0.5	-1	14	22	320	700
394)	3	86	1	1800	-1	-1	636*	948	153	1	A	12	0.8	-1	20	22	500	140
395)	3	87	1	7680	-1	-1	620*	5753	641	1	A	12	0.5	80	14	22	480	620
396)	3	87	2	7680	-1	-1	716*	6706	747	2	A	12	0.6	90	14	22	480	620
397)	3	89	1	3000	-1	-1	223*	596	89	1	A	20	0.4	-1	13	21	760	640
398)	3	90	1	2320	-1	-1	3021*	8018	972	1	B	10	0.8	-1	14	20	840	300
399)	3	91	1	1600	-1	-1	795*	678	164	1	B	10	0.6	-1	19	23	560	720
400)	3	93	1	300	-1	-1	74*	8	2	1	A	2	0.2	-1	15	20	320	440
401)	3	94	1	480	-1	-1	4638*	790	143	1	C	30	0.8	-1	16	19	540	660
402)	3	94	2	480	-1	-1	4638*	790	143	2	C	30	0.8	-1	16	19	540	660
403)	3	95	1	7200	-1	-1	473*	2001	279	1	B	7	0.4	-1	15	20	720	860
404)	3	95	2	7200	-1	-1	2449*	4002	549	2	B	7	0.3	-1	15	20	720	860
405)	3	96	1	270	-1	-1	5157*	314	85	1	B	5	9.9	-1	16	19	480	960
406)	3	96	2	270	-1	-1	5157*	314	85	1	B	5	9.9	-1	16	19	480	960
407)	3	96	3	810	-1	-1	9646*	1789	482	1	B	5	9.9	-1	16	19	480	960
408)	3	97	1	3590	-1	-1	67*	367	47	1	B	5	9.9	45	17	27	600	240
409)	3	97	2	3590	-1	-1	67*	367	47	1	B	5	9.9	45	17	27	600	240
410)	3	97	3	3590	-1	-1	67*	367	47	1	B	5	9.9	45	17	27	600	240
411)	3	97	4	3590	-1	-1	67*	367	47	1	B	5	9.9	45	17	27	600	240
412)	3	98	1	8400	-1	-1	550193*	0	310364	1	A	76	3.4	140	17	19	840	740
413)	3	98	2	8400	-1	-1	550193*	0	310364	2	A	76	3.4	140	17	19	860	760
414)	3	98	3	8400	-1	-1	1021788*	0	576391	3	A	84	5.0	135	17	19	880	780
415)	3	98	4	8400	-1	-1	1021788*	0	576391	4	A	110	5.0	135	17	19	900	840
416)	3	98	5	8400	-1	-1	828564*	918539	1050318	5	A	110	5.0	150	17	19	920	880
417)	3	99	1	4800	-1	-1	795*	4857	542	1	B	30	0.5	-1	19	15	940	600
418)	3	99	2	4800	-1	-1	795*	4857	542	2	B	30	0.5	-1	19	15	940	600
419)	3	99	3	4800	-1	-1	795*	4857	542	3	B	30	0.5	-1	19	15	940	600
420)	3	100	1	1098	-1	-1	1590*	1449	234	1	A	20	0.6	-1	16	18	920	740
421)	3	100	2	1098	-1	-1	0*	0	0	2	B	6	0.4	-1	16	18	920	740
422)	3	101	1	7920	-1	-1	795*	5104	839	1	B	10	0.4	-1	16	18	900	960

LIST OF FACILITY (PATTERN 2)

SEQ)	COUNTY	FACTORY	FACILITY	OPE. HOUR (H)	ANNUAL PRODUC. (TON/Y)	---EMITTED GAS--- RATING (NM3/H)	NORMAL (NM3/H)	ANNUAL SOX (NM3/Y)	ANNUAL NOX (NM3/Y)	-----STACK DATA----- NO	SHAPE	HEI (M)	DIA (M)	TEM (°C)	MX	MY	DX (M)	DY (M)
423)	3	102	1	720	-1	-1	4977*	4068	480	1	B	13	0.5	-1	17	17	340	940
424)	3	102	2	720	-1	-1	780*	63	22	2	A	15	0.5	-1	17	17	340	940
425)	3	102	3	720	-1	-1	289*	163	19	3	B	12	0.2	-1	17	17	340	940
426)	3	103	1	1400	-1	-1	223*	177	43	1	B	15	0.3	-1	16	17	500	640
427)	3	104	1	1200	-1	-1	50*	6	2	1	A	12	1.0	-1	17	18	180	280
428)	3	104	2	7200	-1	-1	22*	8	3	2	A	12	1.0	-1	17	18	180	280
429)	3	104	3	7200	-1	-1	22*	8	3	3	A	12	1.0	-1	17	18	180	280
430)	3	105	1	8760	-1	-1	46384*	123778	172563	1	A	50	3.4	300	18	18	60	880
431)	3	105	2	8760	-1	-1	92741*	247556	345125	2	A	90	5.0	300	18	18	140	800
432)	3	106	1	2400	-1	-1	32*	55	9	1	B	15	0.4	-1	17	18	220	340
433)	3	107	1	1055	-1	-1	970*	930	140	1	B	10	0.5	-1	17	18	340	740
434)	3	108	1	2920	-1	-1	135*	182	34	1	B	8	0.3	-1	16	18	700	380
435)	3	109	1	3600	-1	-1	2655*	14626	1283	1	B	15	0.5	-1	16	20	360	120
436)	3	109	2	3600	-1	-1	1988*	10970	962	2	B	12	0.4	-1	16	20	360	120
437)	3	110	1	0	-1	-1	0	0	0	1	B	6	0.5	-1	16	19	900	500
438)	3	110	2	1440	-1	-1	1193*	1801	231	2	A	10	0.3	-1	16	19	900	500
439)	3	110	3	6744	-1	-1	2430*	29505	2740	3	A	32	1.0	-1	16	19	900	500
440)	3	111	1	7200	68800	-1	40133*	0	11947	1	A	30	1.5	-1	17	23	480	20
441)	3	111	2	1296	6200	-1	20093*	0	1077	1	A	30	1.5	-1	17	23	480	20
442)	3	111	3	6000	-1	-1	13133*	92368	10052	2	A	22	1.2	-1	17	23	440	60
443)	3	111	4	7200	-1	-1	1813*	21707	2171	3	A	20	0.6	-1	17	22	360	920
444)	3	111	5	7200	-1	-1	2538*	21707	2171	4	A	30	0.9	-1	17	22	420	900
445)	3	112	1	2568	-1	-1	5279*	5491	1404	1	B	20	0.5	-1	17	18	200	40
446)	3	112	2	7200	-1	-1	0*	0	0	2	B	5	9.9	-1	17	18	240	40
447)	3	113	1	2120	-1	-1	3238*	4927	930	1	B	14	0.8	-1	21	21	100	520
448)	3	113	2	2120	-1	-1	3035*	4636	875	2	B	14	0.8	-1	21	21	100	520
449)	3	113	3	2120	-1	-1	809*	1235	233	3	B	14	0.6	-1	21	21	100	460
450)	3	113	4	2120	-1	-1	809*	1235	233	4	B	14	0.6	-1	21	21	100	460
451)	3	113	5	2120	-1	-1	1214*	1846	348	5	B	14	0.6	-1	21	21	60	560
452)	3	113	6	2120	-1	-1	809*	1221	230	6	B	14	0.6	-1	21	21	60	560
453)	3	113	7	2120	-1	-1	1336*	1846	277	7	B	13	0.4	-1	21	21	100	580
454)	3	113	8	2120	-1	-1	890*	1235	185	8	B	13	0.4	-1	21	21	100	580
455)	3	113	9	2120	-1	-1	890*	1235	185	9	B	13	0.4	-1	21	21	60	600
456)	3	114	1	1896	-1	-1	384*	600	97	1	B	11	0.2	-1	19	23	500	260
457)	3	114	2	1896	-1	-1	384*	600	97	2	B	11	0.2	-1	19	23	500	260
458)	3	114	3	1896	-1	-1	207*	400	51	3	B	11	0.4	-1	19	23	500	260
459)	3	114	4	1896	-1	-1	499*	0	40	4	B	5	9.9	-1	19	23	500	260
460)	3	114	5	1896	-1	-1	499*	0	40	4	B	5	9.9	-1	19	23	500	260
461)	3	115	1	4160	-1	-1	272*	1	99	1	B	5	0.3	-1	20	21	960	440
462)	3	115	2	4160	-1	-1	635*	1	107	2	B	15	0.6	170	20	21	960	440
463)	3	115	3	4160	-1	-1	635*	1	107	3	B	15	0.6	80	20	21	960	440
464)	3	115	4	4160	-1	-1	635*	1	107	4	B	15	0.6	80	20	21	960	440
465)	3	117	1	7920	12000	-1	6364*	0	2084	1	A	25	1.5	-1	19	21	440	900
466)	3	117	2	3960	-1	-1	8348*	32398	5058	2	B	15	0.8	-1	19	21	300	700
467)	3	117	3	1500	-1	-1	9275*	13635	2129	3	B	30	0.6	-1	19	21	360	740
468)	3	118	1	6480	35310	-1	22886*	0	6132	1	A	25	1.0	-1	16	24	160	60
469)	3	118	2	1080	-1	-1	4638*	8648	1245	2	B	25	0.6	-1	16	24	180	140
470)	3	118	3	1080	-1	-1	4638*	8648	1245	2	B	25	0.6	-1	16	24	180	140

2.3.2 Calculation of SO_2 emission volume

The emission volume of SO_2 from each factory was calculated by the equation (2-2) shown below. The sulphur content of the heavy fuel oil and kerosene, if not specified by retrieved questionnaire, was thought equal to that of sample fuels in use in Thailand analyzed which is shown in Table 2-10. Likewise, the sulphur content of other fuel as well as its specific gravity was thought similar to the Japanese average shown in Table 2-8.

$$\left.\begin{array}{l} \text{Solid fuel } Qs\ (\text{Nm}^3/\text{yr}) = \text{Annual fuel consump. } (\text{kg/yr}) \times \text{Surphur content } (\%) \times 0.007 \\ \text{Liquid fuel } Qs\ (\text{Nm}^3/\text{yr}) = \text{Annual fuel consump. } (\text{liter/yr}) \times \text{S.G.} \times \text{Surphur content } (\%) \times 0.007 \\ \text{Gaseous fuel } Qs\ (\text{Nm}^3/\text{yr}) = \text{Annual fuel consump. } (\text{Nm}^3/\text{yr}) \times \text{Surphur content } (\%) \times 0.01 \end{array}\right\} \cdots (2\text{-}2)$$

Table 2-10 Surphur content of heavy fuel oil and diesel oil in use in Thailand

Fuel type	Surphur content (%)
Heavy fuel oil No. 1, 2 *(A)	1.98 (value of No.1 class)
Heavy fuel oil No. 3, 4 *(B)	2.58 (value of No.4 class)
Heavy fuel oil No. 5, 6 *(C)	2.46 (Mean of No.5 (3.04%) and No.6 (1.88%))
Diesel oil	0.56 (mean of Shell (0.65%) and ESSO (0.46%))

Note : The *(A) to (C) is the symbol used in questionnaire.

The yearly SO_2 emission volume by each factory and by each facility was shown in Table 2-9, and that by county was shown in Table 2-11, which indicates characteristically that the emission volume of SO_2 from Phra Pradaeng area have much volume. The source distribution figure of SO_2 emission volume from stationary sources with the recovered questionnaire is shown in Fig. 2-1. And that by facility type in Table 2-12 indicates that the emission volume from boiler being significant. That by business category in Table 2-13 indicates that textile industry comes first and next is South Bangkok Thermal Plant. SO_2 emission volume by stack height in Table 2-14 indicates that the emission volume from the stacks in the range of the height from 10 to 40 m and those over 110 m being significant. When the top 20 largest of them are reviewed in Table 2-15, they mostly center around Phra Pradaeng area that has many factories.

Table 2-11 Emission volume by county

Name of county	Number of factories	Number of facilities	SO_2 emission volume (ton/year)	NO_x emission volume (ton/year)
1 Muang	63	145	3992.28	523.84
2 Bang Plee	28	47	314.66	76.94
3 Phra Pradaeng	117	278	9341.63	7507.25
TOTAL	208	470	13648.57	8108.03

Table 2-12 Emission volume by facility type

Code	Name of facility type	Number of faci-lities	SO_2 emission volume (ton/year)	NOx emission volume (ton/year)
101	Boiler (for electric power)	5	2624.40	5798.93
103	〃 (other)	267	7787.58	730.20
502	Metal fusion f. (alumi/smelt.)	6	109.36	15.49
503	〃 〃 (other/smelt.)	2	0.74	0.14
601	Metal rolling f. (steel/cont.)	16	836.78	77.80
602	〃 〃 (steel/batch)	4	144.77	16.33
603	〃 〃 (alumi/cont.)	2	0.03	1.88
607	Metal heat tre.f.(steel/cont.)	5	39.66	5.38
608	〃 〃 (steel/batch)	3	6.92	0.87
611	〃 〃 (other/cont.)	3	65.03	9.50
612	〃 〃 (other/batch)	5	0.00	0.00
613	Metal forging f. (steel/cont.)	1	5.72	0.57
702	Oil heating furnace (updraft)	2	40.21	3.61
703	〃 〃 (other)	6	22.09	3.66
915	Glass melting furnace (tank)	5	1497.61	1248.38
918	Other melting furnace	2	0.04	0.01
1001	Reaction furnace (chemicals)	1	0.00	0.00
1004	Direct heating furnace (food)	8	4.38	1.04
1105	Detergent drying furnace	1	4.56	1.06
1106	Other drying furnace	67	270.38	65.39
1201	Electric furnace (arc furnace)	8	55.45	90.62
1202	〃 〃 (three-phase)	1	0.00	12.59
1205	〃 〃 (three-phase)	1	0.00	4.28
1209	〃 〃 (low frequ.)	1	0.00	3.07
1302	Waste inciner. (domest./batch)	2	0.01	0.03
1303	〃 〃 (indust./cont.)	1	0.00	0.00
1304	〃 〃 (indust./batch)	3	0.99	0.11
1416	Fusion furnace (crucible/lead)	2	0.00	0.01
1419	〃 〃 (crucible/zinc)	1	11.43	1.13
1421	〃 〃 (other/zinc)	3	3.24	0.40
1423	Drying furnace (for lead)	3	0.01	1.97
1802	Activated carbon manu. reactor	1	0.15	0.03
2501	Fusion f. (lead stor. battery)	10	1.88	2.39
2603	Reactor (lead pigment)	1	0.00	0.00
1	Diesel generator	3	0.23	0.61
8	Other	18	114.92	10.52
TOTAL		470	13648.57	8108.03

Table 2-13 Emission volume by business category

Code	Name of business category	Number of factories	Number of facilities	SO_2 emission volume (ton/year)	NOx emission volume (ton/year)
2	Agricultural products	7	21	267.36	32.37
4	Meat products	3	5	58.98	6.95
5	Dairy industry	3	15	129.52	18.00
6	Vegetable or fruits products	3	3	32.25	2.67
7	Fish products	3	6	63.64	5.90
8	Fat and vegetable oil	5	11	428.66	38.50
9	Grain, seed or root processing	9	11	112.05	16.41
10	Food products made from flour	2	3	6.12	0.71
12	Tea, coffee, cocoa, chocolate	1	1	17.65	1.90
13	Flavoring	8	15	1075.43	110.79
15	Confined livestock feeding	5	11	111.19	11.14
22	Textile industry	53	100	2691.91	241.27
24	Clothing materials processing	2	2	4.14	0.48
26	Rope, net or bag-net	4	7	69.04	7.02
33	Shoes	1	2	9.88	1.72
34	Wood industry	3	5	32.05	8.46
38	Pulp and paper industry	4	8	1643.91	134.82
42	Chemical industry	4	11	76.80	11.34
43	Fertilizer and pesticide	1	1	0.98	0.11
44	Plastic materials & synthetics	3	11	613.16	53.94
46	Pharmaceutical	4	5	10.70	1.06
47	Soap, cosmetic	6	13	130.96	16.53
48	Chemical products	4	3	3.07	0.33
50	Petroleum, lignite products	1	4	10.01	0.96
51	Mobile tyre	3	6	239.72	15.26
52	Rubber	11	17	50.79	6.65
53	Plastic products	3	7	15.32	1.80
55	Glass products	3	7	1536.28	1255.55
58	Non-metal products	1	0	0.0	0.0
59	Iron and steel basic industry	11	32	1161.04	210.54
60	Non-ferrous metal basic indus.	5	14	93.62	15.26
64	Metal products	8	32	133.12	27.92
70	Machines (not use electricity)	2	2	0.64	0.15
71	Machines (use electricity)	1	2	0.02	2.04
72	Machines (electric parts)	1	6	3.75	2.31
74	Electric equipment industry	5	18	62.36	13.32
77	Automobile industry	9	34	93.03	15.38
78	Motor-bicycle, bicycle	3	13	18.57	17.61
88	Electric power generation	1	5	2624.40	5798.93
91	Goods packaging	1	0	0.0	0.0
98	Washing of clothing materials	1	1	16.48	1.92
TOTAL		208	470	13648.57	8108.03

Code	Name of business category	Number of factories	Number of facilities	SO_2 emission volume (ton/year)	NOx emission volume (ton/year)
1~21	Food industry	49	102	2302.84	245.35
22~33	Textile industry	60	111	2774.97	250.49
34~37	Wood industry	3	5	32.05	8.46
38~41	Pulp and Paper	4	8	1643.91	134.82
42~53	Chemical industry	40	78	1151.50	107.98
54~58	Ceramic industry	4	7	1536.28	1255.55
59	Iron and Steel	11	32	1161.04	210.54
60	Non-ferrous metal	5	14	93.62	15.26
61~83	Metal and Machine	29	107	311.49	78.73
84~99	Other manufactory	3	6	2640.88	5800.85
TOTAL		208	470	13648.57	8108.03

Table 2-14 Emission volume by stack height

Actual stack height (m)	Number of stacks	SO_2 emission volume (ton/year)	NOx emission volume (ton/year)
0 ~ 9	56	424.57	77.48
10 ~ 19	214	3646.49	524.09
20 ~ 29	75	3751.89	424.60
30 ~ 39	16	2140.27	219.82
40 ~ 49	0	0.0	0.0
50 ~ 59	1	353.65	354.37
60 ~ 69	0	0.0	0.0
70 ~ 79	2	0.0	1274.71
80 ~ 89	1	0.0	1183.66
90 ~ 99	1	707.30	708.74
100 ~109	0	0.0	0.0
110 ~119	2	2624.40	3340.56
TOTAL	368	13648.57	8108.03

Table 2-15 The top 20 largest of emission volume for each factory (in order of SO_2 emission volume)

SEQ)	County Code	Factory No.	Name of factory	Num. of facility	SO_2 emission volume (ton/year)	NOx emission volume (ton/year)
1)	3	98	SOUTH BANGKOK THERMAL PLANT	5	2624.40	5798.93
2)	3	105	THAI-ASAHI GLASS	2	1060.95	1063.11
3)	3	5	AJINOMOTO (THAILAND)	2	786.81	91.45
4)	1	55	THAI DEVELOPMENT PAPER	2	665.28	43.78
5)	1	68	THAI TRICOT	5	602.23	46.06
6)	3	14	THAI UNION PAPER	3	584.17	53.84
7)	1	12	THAI TEXTILE PRINTING	2	571.74	52.70
8)	1	70	UNION GLASS	4	475.26	165.56
9)	3	111	BANGKOK STEEL INDUSTRY	5	387.95	56.31
10)	1	20	LUCKYTEX (THAI)	4	371.65	36.34
11)	3	47	THAI PLASTIC AND CHEMICAL	2	367.97	32.06
12)	1	39	YIP YIN TUM	1	283.80	27.55
13)	3	2	THANAKORN VEGETABLE OIL	2	274.43	25.29
14)	3	54	THAI CHUROS	4	239.50	15.10
15)	3	51	THE BANGKOK IRON AND STEEL	4	235.03	43.50
16)	1	41	ASIA FIBER	4	233.13	20.31
17)	3	16	SIAM TYRE	4	230.96	14.56
18)	3	1	THAI STEEL BAR	3	182.48	30.64
19)	3	75	UNITED GRAIN	4	180.63	23.36
20)	3	59	CENTURIES TEXTILE	3	140.84	12.89

Rank	Emission volume SO_2 (Nm^3/H)	Number of mesh
	0.0 ~ 1.0	43
	1.0 ~ 10.0	34
	10.0 ~ 100.0	15
	100.0 ~	1

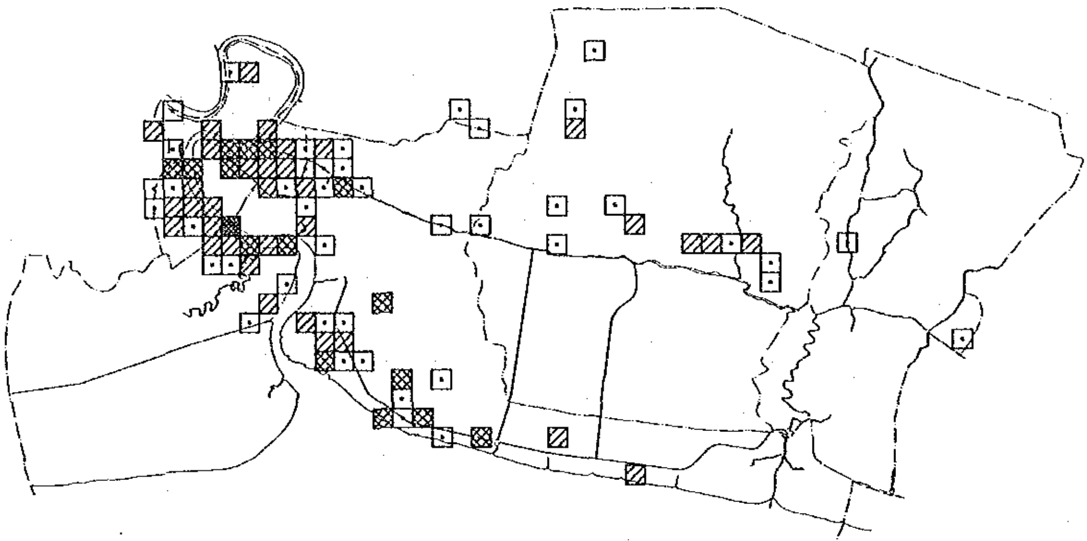

Fig. 2-1 Source distribution of SO_2 emission volume by stationary sources (point sources)

2.3.3 Calculation of NO_x emission volume

The NO_x emission volume of each facility except electric furnace and incinerator of non-and industrial wastes was calculated by the equation (2-3).

NO_x emission vol.	=	Annual fuel consump.	×	Thermal value
(kg/yr)		(liter/yr)		(kcal/liter)
		kg/yr		kcal/kg
		Nm^3/yr		kcal/Nm^3

$$\times \text{ Emission factor} \times 10^{-8} \quad \text{..............................} \quad (2\text{-}3)$$
$$(\text{kg}/10^8 \text{ kcal})$$

Where

No_x emission factor per carolific value is shown in Table 2-16. The table was prepared by referring to following sources.

① Ministry of International Trade and Industry, "Manual of Ambient SO_x and NO_x Prediction Method in Comprehensive Environmental Assessment" (1982)

② Japan Environment Agency, "Report of Atmospheric Emission Survey by Exhausted Gas Factories" (1981)

When these two sources disagree in the value of emission factor by facility type and by fuel type, the whichever larger was selected (Please note star * marked ones).

As for NO_x emission volume for electric furnace and incinerator of wastes, the value was estimated by following formula (2-4) (2-5) respectively.

(1) Electric furnace

$$\underset{(kg/yr)}{NO_x \text{ emission vol.}} = \underset{(ton/yr)}{\text{Annual production}} \times \underset{(kg/t\text{-product})}{NO_x \text{ emission factor}} \quad \cdots\cdots \quad (2\text{-}4)$$

where

NO_x emission factor per ton of product is 0.3566 (from the source ②)

(2) Incinerator for industrial wastes

$$\underset{(kg/yr)}{NO_x \text{ emission vol.}} = \underset{(ton/yr)}{\text{Annual production}} \times \underset{(kg/t\text{-waste})}{NO_x \text{ emission factor}} \quad \cdots\cdots \quad (2\text{-}5)$$

where

NO_x emission factor per ton of waste is 1.859 (non-industrial waste)
1.226 (industrial waste)

The values. were also taken from the source ②

The NO_x emission volumes by factory and by facility type was shown in Table 2-9, and NO_x emission volumes by county was shown in Table 2-11, those by facility in Table 2-12, those by business type in Table 2-13, those by stack height in Table 2-14 and those in increasing order in Table 2-17. The source distribution figure of NO_x emission volume from stationary sources with the recovered questionnaire is shown in Fig. 2-2.

Rank	Emission volume NOx (Nm^3/H)	Number of mesh
	0.0 ~ 1.0	74
	1.0 ~ 10.0	19
	10.0 ~ 100.0	1
	100.0 ~	1

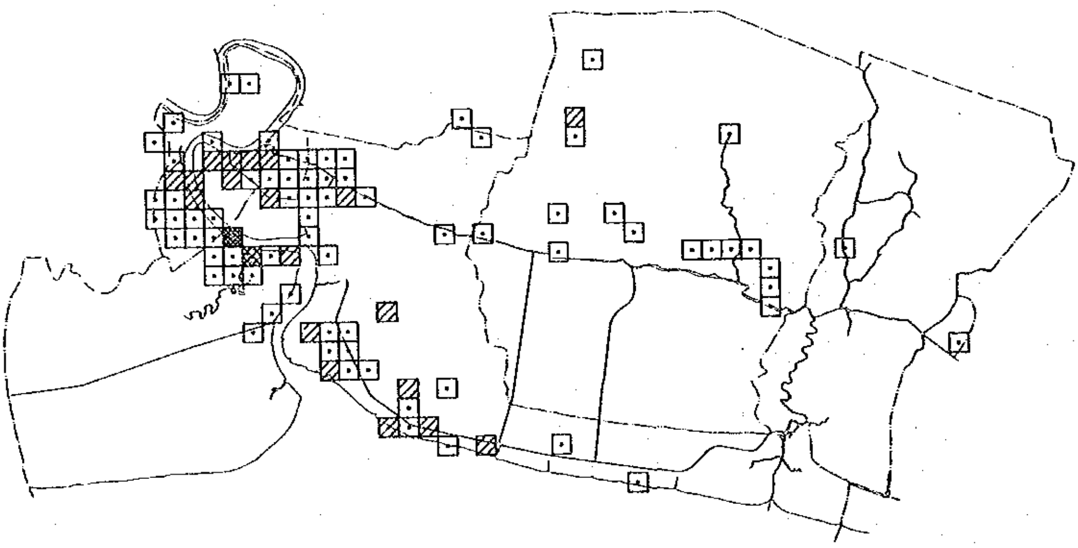

Fig. 2-2 Source distribution of NO_x emission volume by stationary sources (point sources)

Table 2-16 NO_x emission factor per carolific value

(※ : adopted)

Name of facility type		Name of fuel		NOx emission factor (kg/10⁶kcal) Source①	Source②	Remark
0101	Boiler (for electric power)	11~13	Heavy Oil	58.29※	44.50	
		34	L N G	23.31※	20.47	
0103	Boiler (other)	11~13	Heavy Oil	40.36	44.57※	
		14	Light Oil	10.02	29.69※	
		15	Kerosene	19.25	20.56※	
		19	Other liquid	40.96	44.57※	Note 5)
		21	General coal	53.01	91.03※	
		23	Lumber	—	13.28※	
		25	Paddy & Husk	—	13.28※	Note 1)
		26	Other solid	—	13.28※	
		35	L P G	20.80	32.40※	
0502	Metal fusion f. (alumi/smelt.)	11~13	Heavy Oil	69.34※	50.88	
		14	Light Oil	37.78※	33.19	
0503	〃 〃 (other/smelt.)	11~13	Heavy Oil	36.58	61.64※	Note 3)
0601	Metal rolling f. (steel/cont.)	11~13	Heavy Oil	48.49※	37.34	
		14	Light Oil	10.48	43.05※	
0602	〃 〃 (steel/batch)	11~13	Heavy Oil	42.75	57.40※	
		35	L P G	21.71	35.06※	
0603	〃 〃 (alumi/cont.)	35	L P G	17.56	21.96※	
0607	Metal heat tre. f. (steel/cont.)	11~13	Heavy Oil	43.13	56.03※	
0608	〃 〃 (steel/batch)	11~13	Heavy Oil	40.25	56.03※	
0611	〃 〃 (other/cont.)	11~13	Heavy Oil	43.13	56.03※	
0613	Metal forging f. (steel/cont.)	11~13	Heavy Oil	48.49※	39.36	
0702	Oil heating furnace (updraft)	11~13	Heavy Oil	31.65	43.44※	
0703	〃 〃 (other)	11~13	Heavy Oil	37.26	46.46※	Note 2)
		14	Light Oil	22.30	23.84※	Note 2)
		35	L P G	18.92	30.95※	Note 2)
0915	Glass melting furnace (tank)	11~13	Heavy Oil	256.52※	235.00	
		35	L P G	138.14	146.00※	
0918	Other melting furnace	23	Lumber	—	12.63※	Note 3)
1004	Direct heating furnace (food)	11~13	Heavy Oil	44.64※	31.88	
		14	Light Oil	24.32※	22.75	
		15	Kerosene	18.87	22.80※	
1105	Detergent drying furnace	14	Light Oil	25.53※	23.21	Note 4)
1106	Other drying furnace	11~13	Heavy Oil	46.87	49.60※	
		14	Light Oil	25.53	32.35※	
		25	Paddy & Husk	—	14.47※	Note 1)
		35	L P G	25.24	35.10※	
1416	Fusion furnace (crucible/lead)	35	L P G	31.59※	—	
1419	〃 〃 (crucible/zinc)	11~13	Heavy Oil	46.62	47.64※	
1421	〃 〃 (other/zinc)	11~13	Heavy Oil	46.62	47.64※	
		35	L P G	25.11	33.91※	
1423	Drying furnace (for lead)	35	L P G	—	58.74※	
1802	Activated carbon manu. reactor	15	Kerosene	0.90	1.21※	
2501	Fusion f. (lead stor. battery)	14	Light Oil	31.95	43.02※	
		15	Kerosene	24.79	31.38※	
		19	Other liquid	58.65	65.95※	Note 5)
		35	L P G	31.59	46.94※	
0001	Diesel generator	14	Light Oil	410.18※	274.41	
0008	Other	11~13	Heavy Oil	40.96	44.57※	Note 6)
		14	Light Oil	10.02	29.69※	Note 6)
		35	L P G	20.80	32.40※	Note 6)

Source① Ministry of International Trade and Industry (MITI), "Manual of Ambient SOx and NOx Prediction Method in Comprehensive Environmental Assessment", 290p, IPCAJ (in Japanese), (1982).

Source② Japan Env. Agency, "Report of atmospheric emission survey by exhausted gas from factories", 62p, (in Japanese), (1981).

Note 1) ② ······ Lumber is applied.
Note 2) ①② ······ Average of facility type 701 and 702 is applied.
Note 3) ① ······ Fusion furnace for copper is applied.
Note 4) ① ······ Other drying furnace is applied.
Note 5) ① Heavy Oil is applied.
Note 6) ①② ······ Boiler(other) is applied.

Table 2-17 The top 20 largest of emission volume for each factory (in order of NO_x emission volume)

SEQ)	Country Code	Factory No.	Name of factory	Num. of facility	SO_2 emission volume (ton/year)	NOx emission volume (ton/year)
1)	3	98	SOUTH BANGKOK THERMAL PLANT	5	2624.40	5798.93
2)	3	105	THAI-ASAHI GLASS	2	1060.95	1063.11
3)	1	70	UNION GLASS	4	475.26	165.56
4)	3	5	AJINOMOTO (THAILAND)	2	786.81	91.45
5)	3	111	BANGKOK STEEL INDUSTRY	5	387.95	56.31
6)	3	14	THAI UNION PAPER	3	584.17	53.84
7)	1	12	THAI TEXTILE PRINTING	2	571.74	52.70
8)	1	68	THAI TRICOT	5	602.23	46.06
9)	1	55	THAI DEVELOPMENT PAPER	2	665.28	43.78
10)	3	51	THE BANGKOK IRON AND STEEL	4	235.03	43.50
11)	1	20	LUCKYTEX (THAI)	4	371.65	36.34
12)	3	47	THAI PLASTIC AND CHEMICAL	2	367.97	32.06
13)	3	1	THAI STEEL BAR	3	182.48	30.64
14)	1	39	YIP YIN TUM	1	283.80	27.55
15)	2	12	MICRO FIBER INDUSTRY	1	0.07	26.88
16)	1	8	SIAM STEEL SYNDICATE	2	3.36	26.06
17)	3	2	THANAKORN VEGETABLE OIL	2	274.43	25.29
18)	3	75	UNITED GRAIN	4	180.63	23.36
19)	1	41	ASIA FIBER	4	233.13	20.31
20)	3	117	THAI PATHANA STEEL INDUSTRY	3	131.52	19.04

2.3.4 Exhaust gas Temperature

In order to calculate the effective height of the stack, the temperature of exhaust gas from each source has to be determined. Thus the temperature data reported in the questionnaire was referenced. But for those facilities missing them, the mean of reported data was employed. Table 2-18 summarizes the temperature data of various facilities.

Table 2-18 Temperature data by facility type

Code	Name of facility type	Number of all facilities	Operating facilities			
			all	Tem. blank	Tem. written	Ave. of temp. (℃)
101	Boiler (for electric power)	5	5	0	5	140
103	〃 (other)	267	228	149	79	189
502～503	Metal fusion furnace	8	8	6	2	80
601～603	Metal rolling furnace	22	20	12	8	223
607～612	Metal heat treatment furnace	16	16	16	0	—
613	Metal forging furnace	1	1	1	0	—
702～703	Oil heating furnace	8	7	5	2	320
915	Glass melting furnace (tank)	5	5	3	2	300
918	Other melting furnace	2	2	2	0	—
1001	Reaction furnace (chemicals)	1	1	1	0	—
1004	Direct heating furnace (food)	8	8	4	4	45
1105	Detergent drying furnace	1	1	0	1	350
1106	Other drying furnace	67	66	45	21	77
1201～1209	Electric furnace	11	10	5	5	84
1302～1304	Waste incinerator	6	6	5	1	150
1416～1421	Fusion furnace	6	6	6	0	—
1423	Drying furnace (for lead)	3	3	2	1	60
1802	Activated carbon manu. reactor	1	1	0	1	240
2501	Fusion f. (lead stor. battery)	10	10	7	3	90
2603	Reactor (lead pigment)	1	1	1	0	—
1	Diesel generator	3	3	3	0	—
8	Other	18	17	17	0	—
TOTAL		470	425	290	135	164

2.4 Emission volume of SO_2 and NO_X from factories without the questionnaire

2.4.1 Procedure of estimation for emission volume

However, there are 2,456 factories registered in Samut Prakarn prefecture, the questionnaire have been recovered only for 208 factories. Emission volume from factories without the questionnaire were estimated as a area source of 2 km×2 km, based on fuel consumption per employee for each category of industry, which were calculated from the master list of exhaust gas data and data of factories with the recovered questionnaire.

There are three methods for estimation of emission volume from factories without the questionnaire.

These methods are based on the following indices.

① Fuel consumption per employee

② Fuel consumption per area of factory

③ Fuel consumption per production amount

We reviewed these methods and adopted the first one finally, because there were no data about area of factory in the master list and production amount were not on the equal basis. To be concrete, fuel consumption per employee by business category were calculated from annual fuel consumption volume (heavy oil equivalent) and number of employee in each factory with the recovered questionnaire. Moreover, the figures of fuel consumption per employee (the unit consumption figures) were widely dispersed, we didn't adopt average value but medium value.

We estimated fuel consumption volume of each mesh for factories without the questionnaire as follows;

(Unit consumption figure)×(Number of employee in the master list)

Emission volume of SO_2 and NO_X of each mesh were calculated as follows;

(Fuel consumption volume of each mesh)×(Emission factor)

Procedure of estimation for emission volume in factories without the questionnaire are shown in Fig. 2-3.

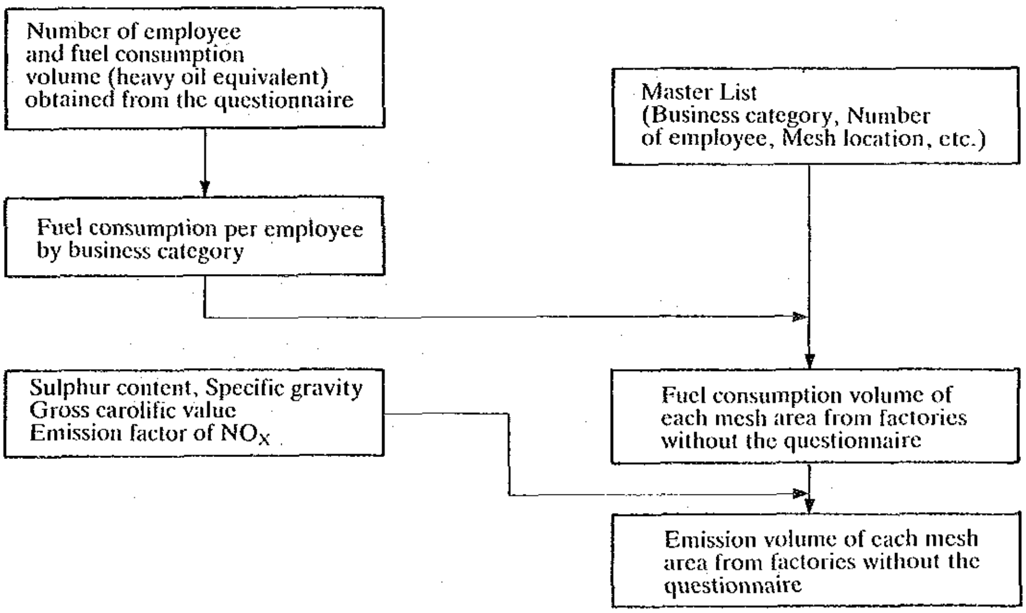

Fig. 2-3 Procedure of estimation for SO_2 and NO_X emission volume from factories without the questionnaire

2.4.2 Selection of factories to be investigated

Master List is rearranged to each category of industry in each district, the result is shown in Table 2-19. Table 2-20 shows relationship among the Table 2-19, questionnaire to have been sent (ONEB selected 577 factories) and questionnaire to have been recovered (208 factories). These results are rearranged to major categories of industry in each district, finally and shown in Table 2-21. Thus, number of factories, whose questionnaire were not recovered, is 369 (recovered ratio is 36%) and calculation result of pollutant emission volume should be uncertain, unless some estimation method was introduced. However, all the questionnaires for factories with exhaust gas source and whose employee are over 500 persons are confirmed to be recovered, resurvey for factories with less than 500 employees should be necessary.

Therefore, ONEB extracted the factories with less than 500 employees from the Master List again and reconfirmed whether pollutant emission facilities are existing or not, by telephone calling or visiting to the factories. These results are shown in Table 2-22 and Table 2-23.

As a result, the followings are clarified;

① Among the factories without recovered questionnaire (369 factories), 167 factories were confirmed to have pollutant emission facilities.

② Among the factories without recovered questionnaire (369 factories), 130 factories were found that it is uncertain whether they had pollutant emission facilities.

③ Among the factories with questionnaire not to have been sent, 275 factories were discovered to have pollutant emission facilities.

Thus, 572 factories without recovered questionnaire should be subject to estimate emission volume. Other discovered items as a result of resurvey and concept of estimation are shown in Table 2-24.

Table 2-19 Number of factories by business category by master list

Name of business category	Code	County 1	County 2	County 3	County Tot.
Food Industry	2		3	27	30
	3	1			1
	4	2	4	1	7
	5	3		4	7
	6	1		7	8
	7	12	3	4	19
	8	2		15	17
	9	8	43	25	76
	10	8	2	10	20
	11	3			3
	12	4		3	7
	13	19	2	21	42
	14	9	2	5	16
	15	11	4	10	25
	20		2	1	3
	21			1	1
Textile Industry	22	66	6	157	229
	23	4	1	8	13
	24	7		15	22
	25	1			1
	26	1	3	10	14
	27	3	2	4	9
	28	19	7	11	37
	29	135	1	1	137
	30		1	1	2
	31			2	2
	32	12	3	3	18
	33	9	2	5	16
Wood industry	34	44	17	40	101
	35	17	2	10	29
	36	10	4	8	22
	37	17	4	16	37
Pulp and Paper	38	4		4	8
	39	2	1	10	13
	40	8		5	13
	41	14	1	14	29
Chemical industry	42	13	3	9	25
	43	1		2	3
	44	2	1	3	6
	45	8	2	18	28
	46	6	6	8	20
	47	6	2	8	16
	48	11	4	12	27
	50			3	3
	51	6		7	13
	52	14	2	23	39
	53	31	6	53	93
Ceramic Industry	54	2	1	3	6
	55	2	2	9	13
	56	2		1	3
	57			1	1
	58	11	9	13	33
Iron Steel	59	13	3	57	73
Non-ferro.	60	14	4	17	35
Metal and Machine	61	4	3	5	12
	62	5	3	13	21
	63	36	7	54	97
	64	61	27	118	206
	65	70	11	62	143
	66	8	3	14	25
	67	8		19	27
	68	6	1	20	27
	69	2		1	3
	70	8	7	13	28
	71	7	3	8	18
	72	5	4	4	13
	73	2	2		4
	74	17	4	23	44
	75	18	7	4	29
	77	38	13	49	100
	78	12	10	24	46
	81	1	1	2	4
	83			1	1
Other manufactory	84	1	2	1	4
	86	3		1	4
	87	8	5	9	22
	88				0
	89	1		3	4
	90	1		1	2
	91	5	2	10	17
	92	10	2	1	13
	94	2		1	3
	95	32	3	24	59
	97		1	2	3
	98	2		4	6
TOTAL		974	286	1196	2456

Table 2-20 Number of factories by business category by each data

Name of business category	Code	by master list: all data	mail	return
Food industry	2	30	9	7
	3	1		
	4	7	6	3
	5	7	6	3
	6	8	3	3
	7	19	10	3
	8	17	16	5
	9	76	50	9
	10	20	6	2
	11	3	1	
	12	7	3	1
	13	42	21	8
	14	16		
	15	25	23	5
	20	3		
	21	1		
Textile industry	22	229	64	53
	23	13		
	24	22	2	2
	25	1		
	26	14	4	4
	27	9	1	
	28	37		
	29	137		
	30	2		
	31	2		
	32	18		
	33	16	1	1
Wood industry	34	101	80	3
	35	29		
	36	22	2	
	37	37	18	
Pulp and Paper	38	8	8	4
	39	13		
	40	13	2	
	41	29		
Chemical industry	42	25	7	4
	43	3	3	1
	44	6	4	3
	45	28		
	46	20	4	4
	47	16	15	6
	48	27	7	4
	50	3	1	1
	51	13	8	3
	52	39	29	11
	53	93	3	3
Ceramic industry	54	6	6	
	55	13	9	3
	56	3	3	
	57	1		
	58	33	3	1
Iron Steel	59	73	54	11
Non ferro.	60	35	32	5
Metal and Machine	61	12		
	62	21		
	63	97	4	
	64	206	15	8
	65	143	1	
	66	25		
	67	27	1	
	68	27	1	
	69	3		
	70	28	3	2
	71	18	1	1
	72	13	1	1
	73	4		
	74	44	8	5
	75	29		
	77	100	10	9
	78	46	3	3
	81	4		
	83	1		
Other manufactory	84	4		
	86	4		
	87	22		
	88	0	1	1
	89	4		
	90	2		
	91	17	3	1
	92	13		
	94	3		
	95	59		
	97	3		
	98	6	1	1
TOTAL		2456	577	208

Table 2-21 Number of factories by each data for each major business category

Code	Name of business category	by master list for each county: all data 1	2	3	Tot.	mail Tot.	re-turn Tot.
1~21	Food industry	83	65	134	282	154	49
22~33	Textile industry	257	26	217	500	72	60
34~37	Wood industry	88	27	74	189	100	3
38~41	Pulp and Paper	28	2	33	63	10	4
42~53	Chemical industry	101	26	146	273	81	40
54~58	Ceramic industry	17	12	27	56	21	4
59	Iron and Steel	13	3	57	73	54	11
60	Non-ferrous metal	14	4	17	35	32	5
61~83	Metal and Machine	308	106	434	848	48	29
84~99	Other manufactory	65	15	57	137	5	3
	TOTAL	974	286	1196	2456	577	208

Table 2-22 Number of factories which may have facilities but no questionnaire for each county (employee less than 500)

Name of county	② (questionnaire mailed but not return) (1) closed	(2) no faci-lity	(3) not answer	(4) no infor-mation	(5) cannot con-tact	(6) facil. excist fuel unknown	(7) facil. excist fuel known	total	① (ques. not mailed facil. excist)
1 Muang	6	29	4	7	40	19	20	125	69
2 Bang Bo	1	1			23	3		28	3
2 Bang Plee		9	1	2	12	8	2	34	42
3 Phra Pradaeng	16	4	2	4	28	43	44	141	134
3 Phra Samut Jedee	2	4	2	1	4	19	9	41	27
TOTAL	25	47	9	14	107	92	75	369	275

Table 2-23 Number of factories which may have facilities but no questionnaire for each major business category (employee less than 500)

Name of business category		② (questionnaire mailed but not return)								① (ques. not mailed facil. excist)
		(1) closed	(2) no facility	(3) not answer	(4) no information	(5) cannot contact	(6) facil. excist fuel unknown	(7) facil. excist fuel known	total	
1~21	Food industry	13	13	1	1	31	22	14	95	29
22~33	Textile industry				2		6	5	13	73
34~37	Wood industry	4	30		2	42	17	2	97	1
38~41	Pulp and Paper	1			2	1	1	1	6	3
42~53	Chemical industry	2	2	1	2	7	16	12	42	47
54~58	Ceramic industry	1	2	1	1	4	4	5	18	3
59	Iron and Steel	2		4		13	7	21	47	14
60	Non-ferrous metal			2	2	7	9	8	28	1
61~83	Metal and Machine	2			2	2	8	7	21	96
84~99	Other manufactory						2		2	8
TOTAL		25	47	9	14	107	92	75	369	275

Table 2-24 Methods for the estimation of emission volume

Mailed but not recovered Q.	(1) closed (2) no-facility	Not subjected to estimate
	(3) no-answer (4) no-information (5) cannot contact	Fuel consumption (Heavy Oil base) was estimated based on number of employee
	(6) facility exist and fuel type known but consumption unknown	Fuel consumption (Heavy Oil base) was estimated by using fuel consumption rate. After that these were converted to reported fuel type.
	(7) facility exist and fuel type and consumption known	Adopted reported data (fuel type and consumption)
not mailed but facility exist		Fuel consumption (Heavy Oil base) was estimated based on number of employee

2.4.3 To set up the fuel consumption rate by business category

As the indices of factory scale, it is used generally number of employee, area of factory, production amount and etc. To estimate the emission volume from factories without the questionnaire, we adopted the number of employee because that there were no data about area of factory in the master list and production amount were not on the equal basis.

Meanwhile, it became clear based on the returned questionnaire data that various kind of fuels was used in each factory. So, to calculate the fuel consumption per employee, it was multiplied various kind of fuel's consumption by the conversion coefficient (equivalent to heavy oil).

We adopted the conversion coefficients which is used generally in Japan and shown in Table 2-25. According to this table, 1 kℓ kerosene is equivalent to 0.9 kℓ heavy oil, and 1 ton lumber (gross carolific value 3500 kcal/kg) is equivalent to 0.35 kℓ heavy oil.

Based on the fuel consumption volume converted into heavy oil which was calculated from questionnaire data and the number of employee, we calculated the fuel consumption rate (per number of employee) by business category. But because of widely dispersive data, we didn't adopted average value but medium value. Fuel consumption rate per employee is shown in Table 2-26. Reviewing the result, the figures largely differ from ones available in Japan. This may be due to the small number of sample data. Thus the comsumption data shown in Table 2-27 are applied in place of those in Table 2-26 as consolidated figures.

Table 2-25 The conversion coefficients equivalent to Heavy Oil

Fuel type	Conversion coefficient
Heavy Oil	1.0 (ℓ/ℓ)
Light Oil	0.95 (ℓ/ℓ)
Kerosene	0.9 (ℓ/ℓ)
General coal	0.7 (ℓ/kg)
Coke	0.8 (ℓ/kg)
Lumber	0.35 (ℓ/kg) Carolific Value=3,500 kcal/kg
LNG	1.3 (ℓ/kg)
LPG	1.2 (ℓ/kg)
Other fuel	Convert into Heavy Oil (Carolific Value=10,000 kcal/ℓ)
Material, Waste Electricity	Exclude from conversion

Table 2-26 Fuel consumption rate (heavy oil equivalent) per number of employee by business category

Code	Name of business category	Number of factories	Generator of fuel consumption per number of employee (unit : 0.01kl/year/person)	
			Median	Each value
1~21	Food industry	45	438	13333,8200,7083,5689,3510,2983,2505, 2441,2270,2186,1329,1088,1002,995,973 893,833,600,588,584,550,500,438,400,369 357,352,333,327,324,276,232,218,206 203,180,140,106,105,100,87,80,54,25,1
22~33	Textile Industry	56	137	3000,2640,2469,2003,1860,1500,1148,1016 810,781,735,577,493,491,462,411,368,330 270,240,240,220,216,183,182,180,160,150 123,120,116,111,107,104,103,101,100,99 82,81,77,77,69,67,58,55,47,45,44,31,30 30,28,21,17,4
34~37	Wood industry	2	1065	1834,296
38~41	Pulp and Paper	4	2058	2759,2637,1479,722
42~53	Chemical industry	37	210	1840,1828,764,656,561,552,502,492,464 458,404,366,360,351,300,250,249,240 210,209,195,194,189,180,163,144,115 92,80,75,70,57,36,35,33,11,4
54~58	Ceramic industry	2	2387	3388,1385
59	Iron and Steel	11	587	1963,1246,1042,879,748,587,556,535,486 300,28
60	Non-ferrous metal	4	128	706,226,29,11
61~83	Metal and Machine	27	72	1693,809,407,404,370,360,339,334,231,214 105,93,76,72,63,49,44,44,33,30,28,26,26 24,18,18,6
84~99	Other manufactory	1	292	292

Table 2-27 Fuel consumption rate per number of employee used for estimation of fuel consumption

Name of business category	Generator of fuel consumption per number of employee (0.01 kℓ/year/person)
Food industry	438
Textile industry Wood industry	155
Pulp and Paper Chemical industry Ceramic industry	250
Iron and Steel Non-ferrous metal	556
Metal and Machine	72
Other manufactory	292

2.4.4 Estimation for the fuel consumption volume of each mesh area

We estimated the fuel consumption volume of each mesh area for factories registered in the master list and not reported by questionnaire but had emitting facility.

2.4.5 To set up the emission factor

To calculate the emission volume from factories without the questionnaire, we used as general rule the general value which was used in Japan as a data of sulphuric content, specific gravity, gross calorific value and emission factor of NO_X. However, we adopted the analytic result of fuel used in Thailand as the sulphur content of heavy oil and light oil.

2.4.6 Estimation for emission volume of SO_2 and NO_X

By multiplying the fuel consumption of each mesh area by emission factor, we presumed the emission volume of SO_2 and NO_X for each mesh area from factories without the questionnaire. Emission volume of SO_2 and NO_X is shown in Table 2-28, Table 2-29, respectively. The source distribution figure of SO_2 and NO_X emission volume from stationary sources without the questionnaire is shown in Fig. 2-4 and Fig. 2-5.

Table 2-28 SO_2 emission volume from factories without the questionnaire by business category in each county

Code	Name of business category	SO_2 emission volume (ton/year)			
		Muang	Bang Plee	Phra Pradaeng	TOTAL
1~21	Food industry	358.0	152.2	282.0	792.2
22~33	Textile industry	169.7	49.7	250.1	469.5
34~37	Wood industry	25.9	8.5	21.2	55.6
38~41	Pulp and Paper	3.1	19.5	2.4	25.0
42~53	Chemical industry	193.1	113.7	191.3	498.1
54~58	Ceramic industry	48.4	4.5	622.9	675.8
59	Iron and Steel	171.4	164.9	991.3	1327.6
60	Non-ferrous metal	91.9	3.4	201.1	296.4
61~83	Metal and Machine	100.5	79.2	324.7	504.4
84~99	Other manufactory	8.8	20.9	6.8	36.5
TOTAL		1170.8	616.5	2893.8	4681.1

Table 2-29 NO_X emission volume from factories without the questionnaire by business category in each county

Code	Name of business category	NOx emission volume (ton/year)			
		Muang	Bang Plee	Phra Pradaeng	TOTAL
1~21	Food industry	33.9	14.4	27.0	75.3
22~33	Textile industry	16.3	4.6	23.4	44.3
34~37	Wood industry	2.4	0.8	3.1	6.3
38~41	Pulp and Paper	0.3	1.8	0.4	2.5
42~53	Chemical industry	18.3	10.6	17.4	46.3
54~58	Ceramic industry	5.1	0.5	343.9	349.5
59	Iron and Steel	14.3	15.4	77.2	106.9
60	Non-ferrous metal	8.4	0.3	17.4	26.1
61~83	Metal and Machine	10.0	7.4	34.3	51.7
84~99	Other manufactory	0.8	2.0	0.6	3.4
TOTAL		109.8	57.8	544.7	712.3

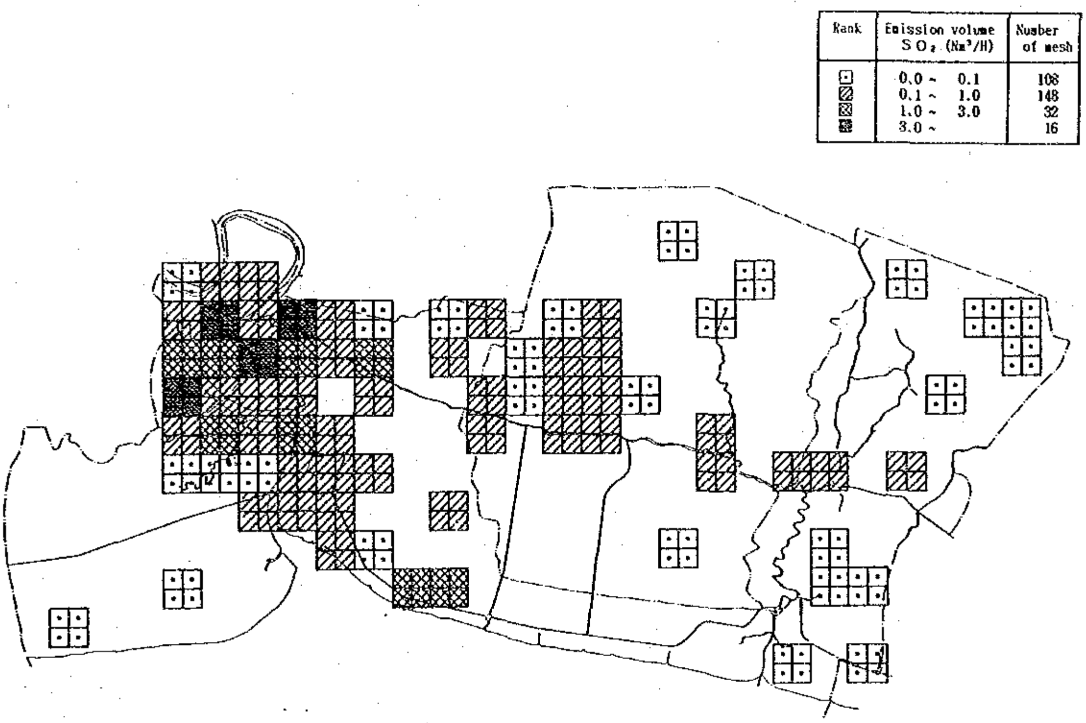

Fig. 2-4 Source distribution of SO_2 emission volume by stationary sources (area sources)

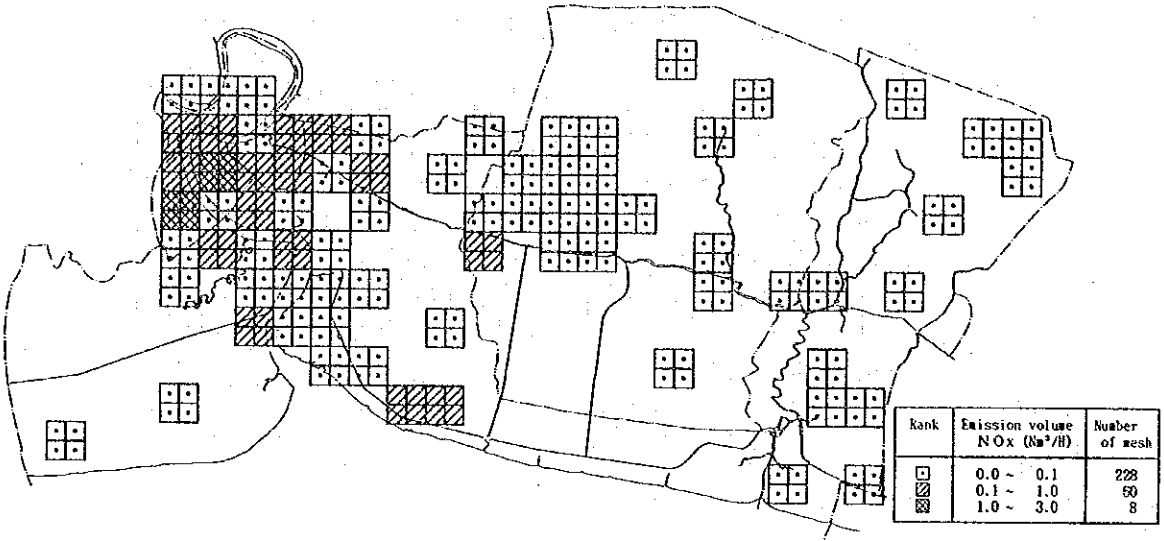

Fig. 2-5 Source distribution of NO_X emission volume by stationary sources (area sources)

2-5 Total emission volume of SO_2 and NO_X from stationary sources (point sources and area sources)

Total emission volume of SO_2 and NO_X from stationary sources located in Samut Prakarn prefecture was calculated by summing up those from factories with the recovered questionnaire (point sources) and without the questionnaire (area sources). The result is shown in Table 2-30 and the source distribution figure of SO_2 and NO_X emission volume from stationary sources is shown in Fig. 2-6 and Fig. 2-7.

From these table and figures it results in that emission volume of SO_2 from factories located in Samut Prakarn prefecture is 18,329.7 T/Y and those of NO_X is 8,820.5 T/Y, and emission volume of SO_2 and NO_X from Pra-Pradaeng in which many factories were located was conspicuous. And the number of factories with the recovered questionnaire was not so many (recovered rate; 27%), but emission volume of SO_2 and NO_X from these factories were 13,648.6 T/Y (74% of total SO_X) and 8,108 T/Y (92% of total NO_X) respectively.

As a result, it was clear that emission volume from large and middle class emission sources were ocupied considerably large part of them from stationary sources.

Table 2-30 Emission volume of SO_2 and NO_X from factories located in Samut Prakarn prefecture

Source	Number of factories	SO_2 emission volume (ton/year)	NO_X emission volume (ton/year)
Questionnaire return (point source)	208 (27%)	13649 (74%)	8108 (92%)
Questionnaire nothing (area source)	572 (73%)	4681 (26%)	712 (8%)
TOTAL	780 (100%)	18330 (100%)	8820 (100%)

Rank	Emission volume SO_2 (Nm³/H)	Number of mesh
⊡	0.0 ~ 1.0	244
▨	1.0 ~ 10.0	63
▩	10.0 ~ 100.0	18
■	100.0 ~	1

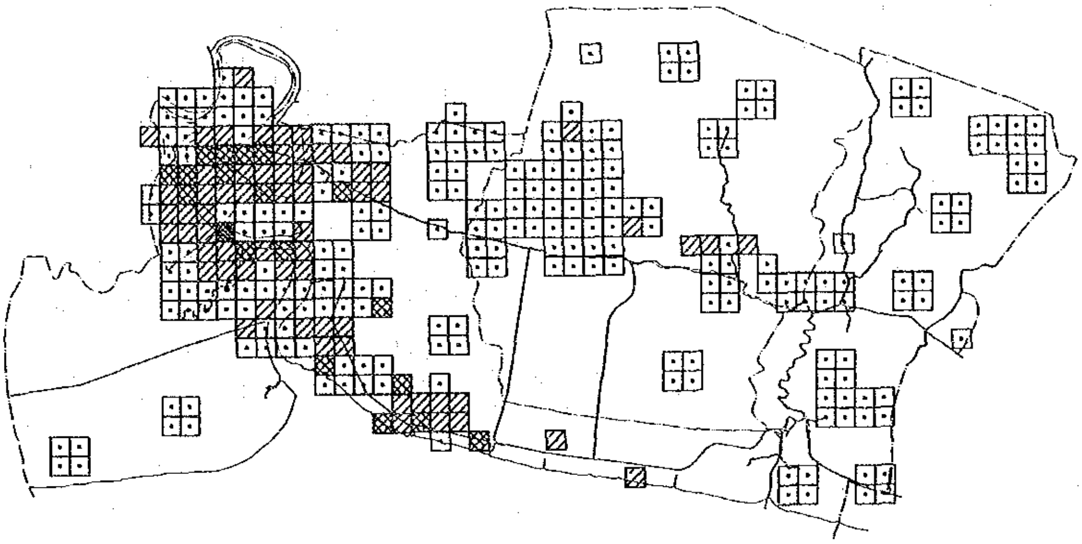

Fig. 2-6 Source distribution of SO_2 emission volume by stationary sources (total)

Rank	Emission volume NOx (Nm³/H)	Number of mesh
⊡	0.0 ~ 1.0	288
▨	1.0 ~ 10.0	29
▩	10.0 ~ 100.0	1
■	100.0 ~	1

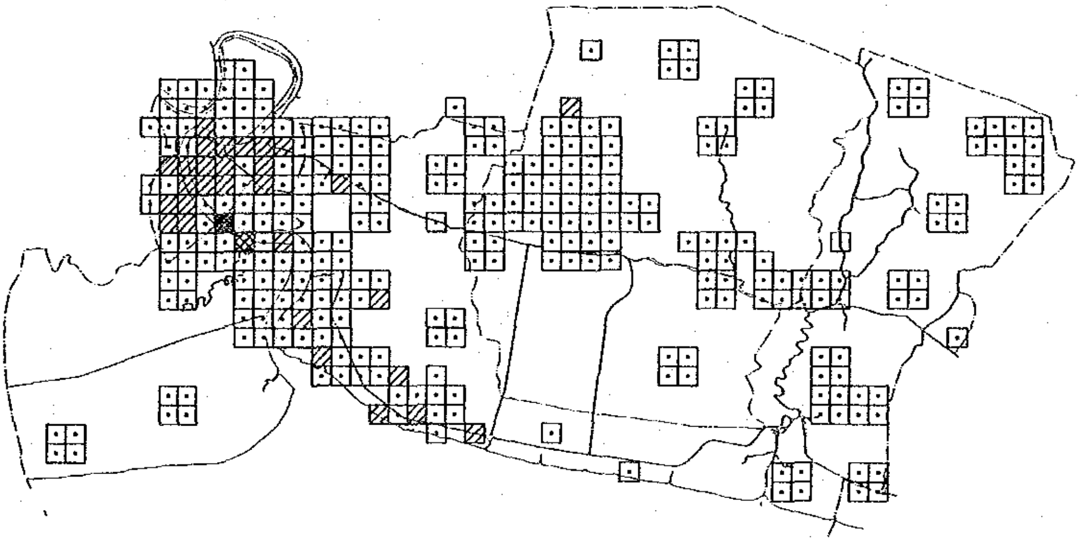

Fig. 2-7 Source distribution of NO_X emission volume by stationary sources (total)

3. Estimation of SO_2 and NO_x emission volume from roadways

3.1 Outline of the study

The SO_2 and NO_x emission factors separately set for varying types of vehicle and motorway were combined with actual traffic volumes investigated in this report, which then led to the estimation of emission volume of SO_2 as well as NO_x by daytime period and by type of motorways in Samut Prakarn district. In evaluation of exhaust emission volume, the trunk motorways as many as 31 and 243 km long in total were thought as line sources and other minor roadways as negligible sources. The NO_x emission factors of the car were not obtainable in Thailand and thus those of non regulated cars specified by Ministry of Construction, Japan were applied. As for SO_2 emission, the sulphur content of sample fuel was analyzed and the result obtained was referenced.

The following shows the work flow chosen for evaluation of emission volume exhausted from automobiles.

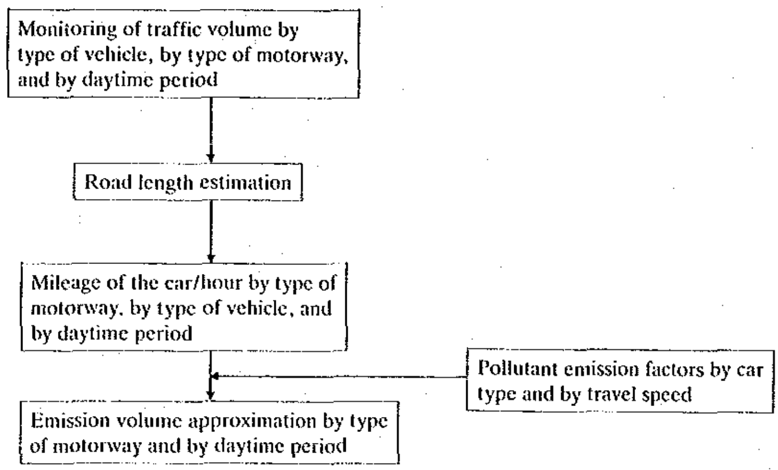

Fig. 3-1 Flow chart for estimation of SO_2 and NO_x emission volume from road way

3.2 Investigation of the traffic volume and drive speed

The traffic volume of Samut Prakarn district was monitored at nine points shown in Fig. 3-2 for 24 hours period. The types of vehicle subject to above survey are shown in Fig. 3-3 and consist of four groups (1) Diesel light vehicle (small truck equivalent), (2) Diesel heavy vehicle (regular size truck, passenger bus, special vehicle), (3) Gasoline car (regular car) and (4) Others (LPG driven car as well as motorcycle equivalent).

The traffic volume survey took place on January 13, 1988 at 4 points (during the first field survey period) and on July 13, 1988 at 5 points (during the third survey period). At MS-1 point, the additional survey was done for both periods in order to estimate the seasonal fluctuation.

The result of this effort is graphed in Fig. 3-4 which indicates the seasonal change of traffic volume is not significant. The traffic volume recorded during the survey periods is summarized in Table 3-1 and actual data at each survey point by type of vehicle and by daytime period in Table 3-2.

The Table 3-3 shows the drive speed of vehicles recorded during same survey period.

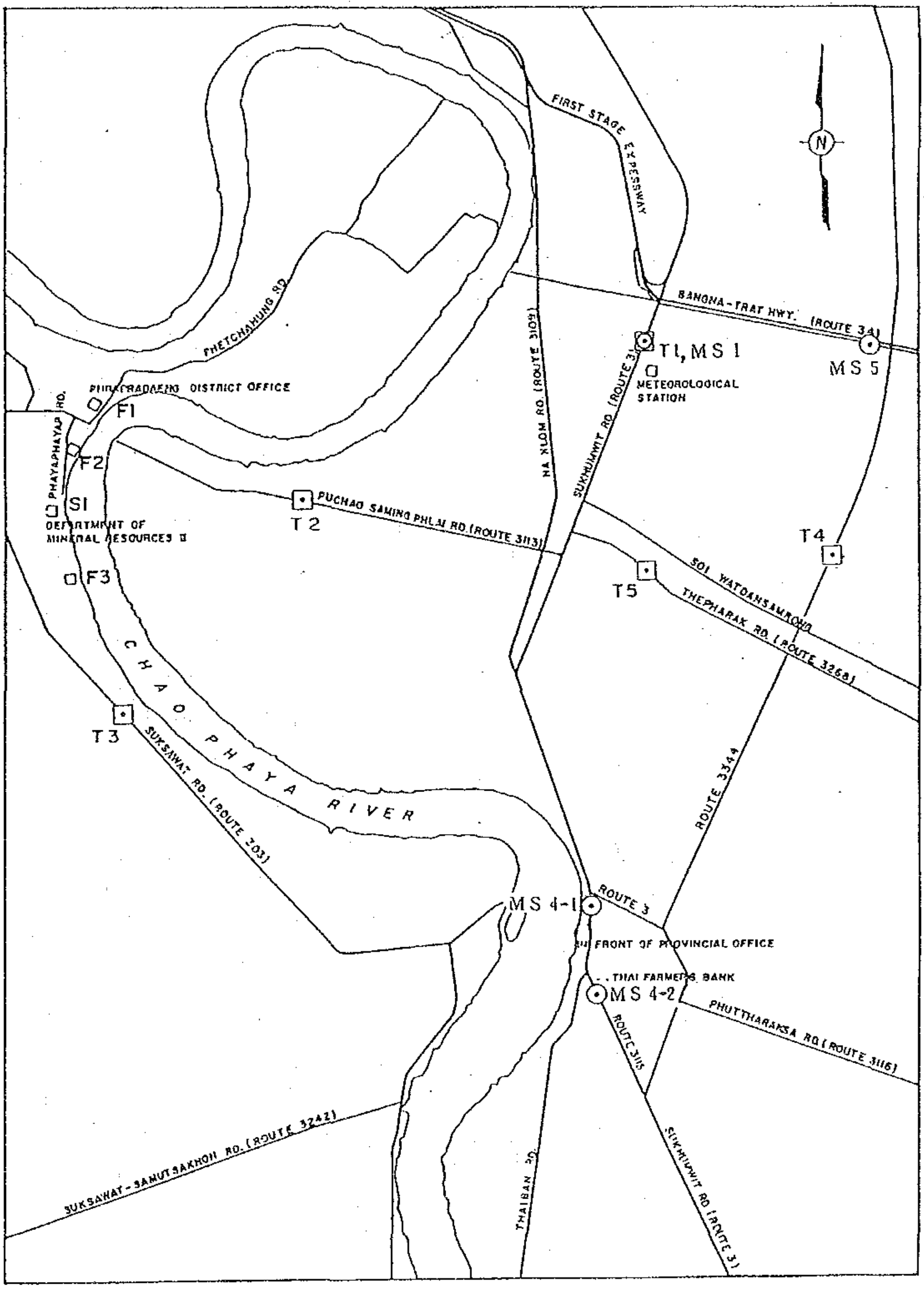

Fig. 3-2 Traffic survey points

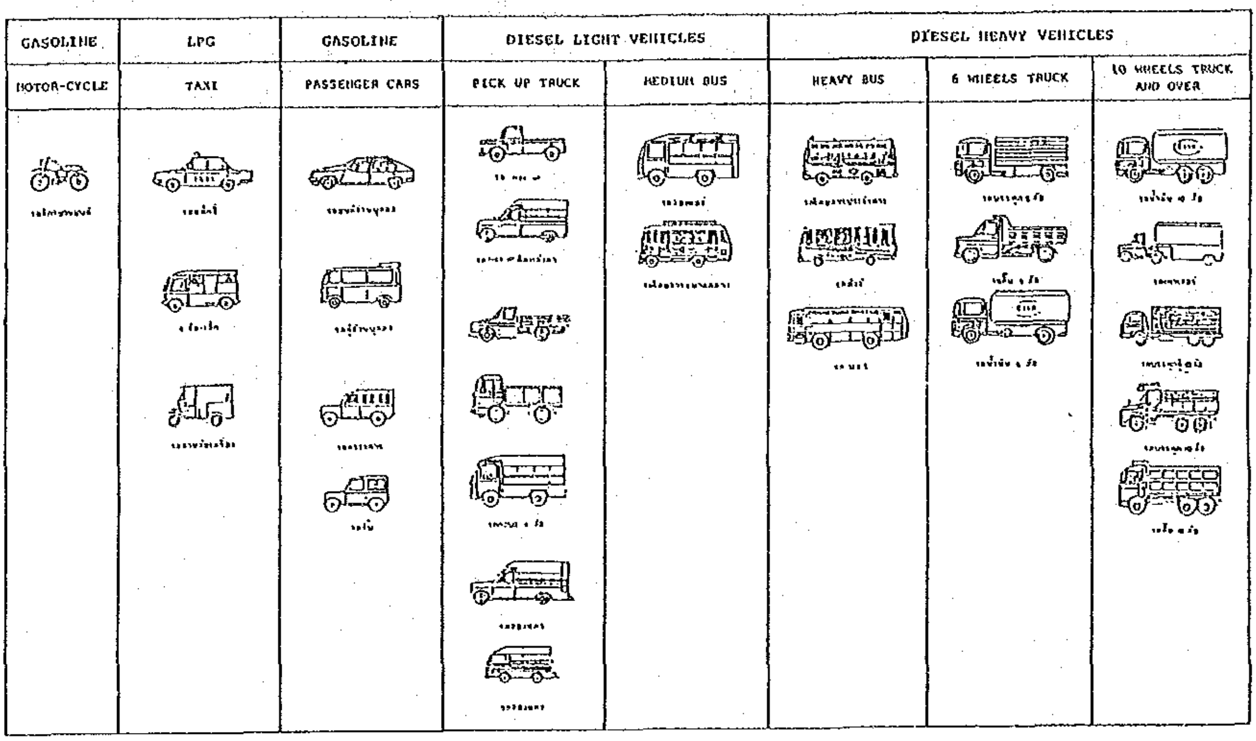

Fig. 3-3 Types of vehicle subject to traffic survey

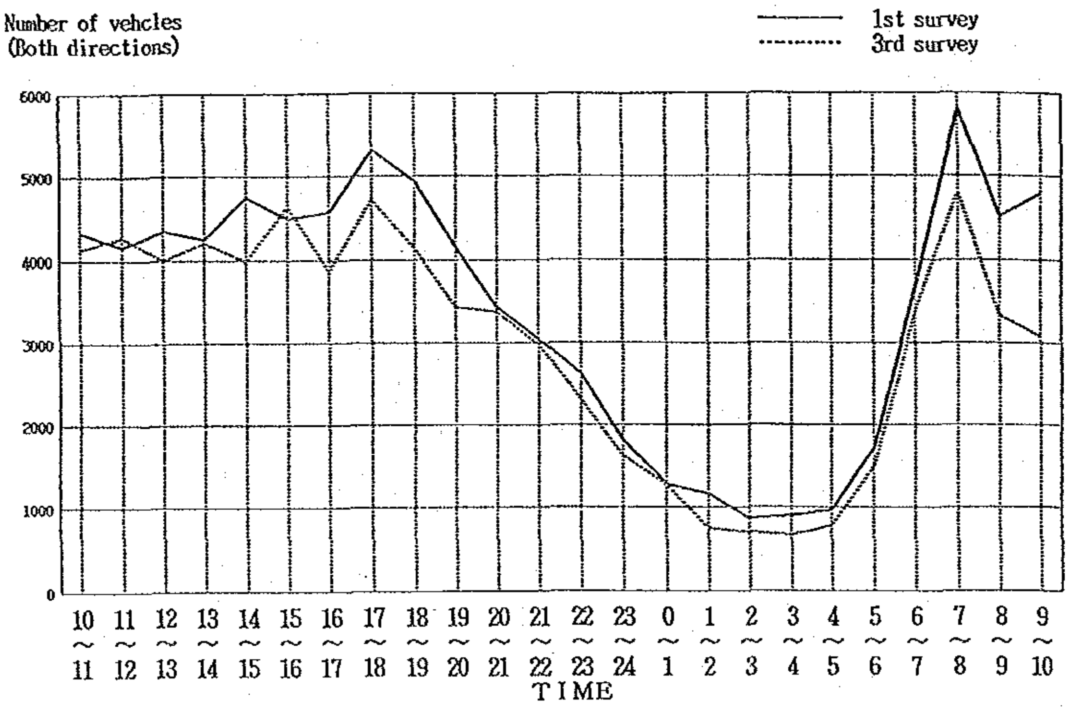

Fig. 3-4 (1) Comparison of traffic flow pattern at MS-1 between 1st and 3rd survey (Both directions)

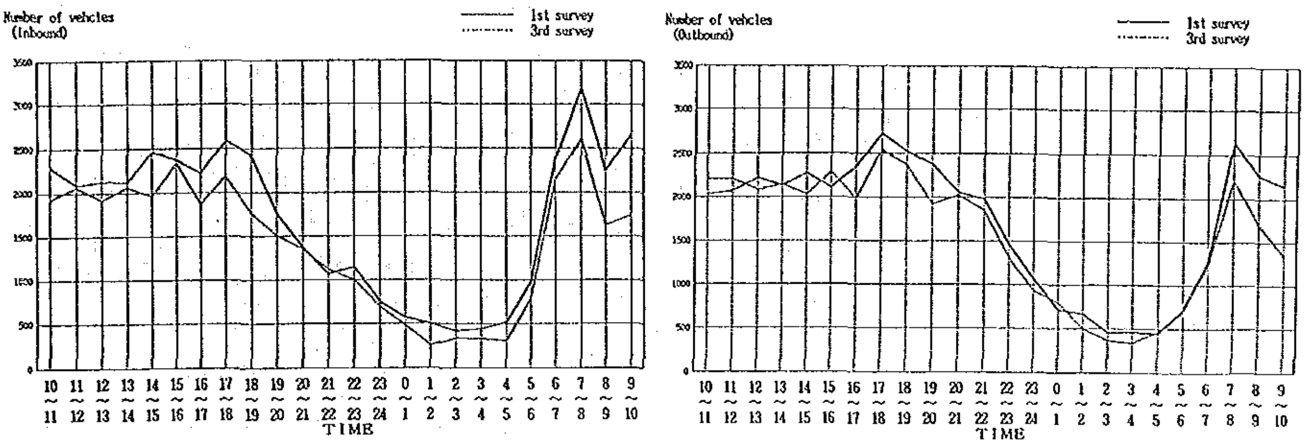

Fig. 3-4 (2) Comparison of traffic flow pattern at MS-1 between 1st and 3rd survey

Table 3-1 Summary of traffic survey

Survey	Station	Daily traffic flow volume for each vehicle type					Average speed
		Diesel LV	Diesel HV	Gaso-line	Others	Total	(km/h)
First Survey (1988/1/13)	MS-1	17,487 (21.3)	13,901 (17.0)	24,653 (30.1)	25,881 (31.6)	81,922 (100%)	47
	MS-4-1	10,358 (29.7)	6,593 (18.9)	6,527 (18.8)	11,371 (32.6)	34,849 (100%)	45
	MS-4-2	4,985 (29.2)	1,532 (9.0)	2,956 (17.3)	7,581 (44.5)	17,054 (100%)	56
	MS-5	9,692 (30.4)	11,158 (35.0)	8,814 (27.7)	2,203 (6.9)	31,867 (100%)	65
Third Survey (1988/7/13)	T-1	15,284 (21.2)	12,727 (17.7)	21,328 (29.7)	22,610 (31.4)	71,949 (100%)	47
	T-2	9,129 (28.4)	7,848 (24.4)	5,307 (16.5)	9,853 (30.7)	32,137 (100%)	30
	T-3	13,186 (23.7)	12,280 (22.0)	12,839 (23.0)	17,414 (31.3)	55,719 (100%)	34
	T-4	10,176 (29.4)	5,007 (14.4)	12,135 (35.0)	7,342 (21.2)	34,660 (100%)	40
	T-5	7,739 (31.9)	3,578 (14.7)	5,896 (24.3)	7,054 (29.1)	24,267 (100%)	30

Note) L V = Light Vehicle H V = Heavy vehicle

Table 3-2 (1) Results of the traffic survey

Station...HS1 Date...1988/1/13-14 Direction...Both

Time	Diesel			Gaso-line	Others	Total
	LV	HV	LV+HV			
10:00~11:00	879	1,077	1,956	1,190	1,182	4,328
11:00~12:00	974	1,070	2,044	1,081	1,041	4,166
12:00~13:00	1,029	940	1,969	1,190	1,191	4,350
13:00~14:00	1,138	765	1,903	1,165	1,176	4,245
14:00~15:00	1,160	963	2,123	1,310	1,311	4,744
15:00~16:00	1,141	962	2,103	1,295	1,095	4,493
16:00~17:00	1,053	717	1,770	1,493	1,310	4,573
17:00~18:00	924	592	1,516	2,195	1,608	5,319
18:00~19:00	906	681	1,587	1,708	1,640	4,935
19:00~20:00	843	629	1,472	1,324	1,353	4,149
20:00~21:00	721	424	1,145	1,124	1,156	3,425
21:00~22:00	646	318	964	979	1,107	3,050
22:00~23:00	525	229	754	826	1,031	2,611
23:00~24:00	361	159	520	467	829	1,816
0:00~1:00	264	98	362	318	609	1,289
1:00~2:00	243	111	354	233	588	1,175
2:00~3:00	238	101	339	153	385	877
3:00~4:00	255	144	399	130	378	907
4:00~5:00	255	229	484	120	369	973
5:00~6:00	433	538	971	259	482	1,712
6:00~7:00	620	780	1,400	1,052	1,215	3,667
7:00~8:00	831	667	1,498	2,363	1,951	5,812
8:00~9:00	891	572	1,463	1,588	1,459	4,510
9:00~10:00	1,157	1,135	2,292	1,089	1,415	4,796
Total	17,487	13,901	31,388	24,653	25,881	81,922

Notes : LV = Light Vehicle HV = Heavy Vehicle

Station...HS4-1 Date...1988/1/13-14 Direction...Both

Time	Diesel			Gaso-line	Others	Total
	LV	HV	LV+HV			
10:00~11:00	680	317	997	399	601	1,997
11:00~12:00	612	350	962	405	652	2,019
12:00~13:00	523	366	889	443	636	1,968
13:00~14:00	591	336	927	358	590	1,875
14:00~15:00	428	656	1,084	405	677	2,166
15:00~16:00	440	644	1,084	421	670	2,175
16:00~17:00	417	683	1,100	477	697	2,274
17:00~18:00	689	382	1,071	483	867	2,426
18:00~19:00	606	374	980	434	742	2,156
19:00~20:00	511	270	781	310	661	1,752
20:00~21:00	447	250	697	288	532	1,517
21:00~22:00	316	179	495	220	362	1,077
22:00~23:00	195	66	261	139	314	714
23:00~24:00	149	55	204	89	273	566
0:00~1:00	172	30	202	58	221	481
1:00~2:00	166	18	184	63	144	391
2:00~3:00	187	19	206	13	143	362
3:00~4:00	214	16	230	15	123	368
4:00~5:00	234	37	271	32	169	472
5:00~6:00	329	181	510	62	241	813
6:00~7:00	428	333	761	133	238	1,132
7:00~8:00	780	304	1,084	446	715	2,245
8:00~9:00	618	372	990	455	662	2,107
9:00~10:00	626	355	981	374	440	1,795
Total	10,358	6,593	16,951	6,527	11,371	34,849

Notes : LV = Light Vehicle HV = Heavy Vehicle

Station...HS4-2 Date...1988/1/13-14 Direction...Both

Time	Diesel			Gaso-line	Others	Total
	LV	HV	LV+HV			
10:00~11:00	350	113	463	191	503	1,157
11:00~12:00	316	71	387	574	402	1,363
12:00~13:00	282	88	370	181	439	990
13:00~14:00	279	94	373	155	394	922
14:00~15:00	319	102	421	192	413	1,026
15:00~16:00	289	89	378	156	392	926
16:00~17:00	322	82	404	157	429	990
17:00~18:00	324	87	411	165	555	1,131
18:00~19:00	330	95	425	166	504	1,095
19:00~20:00	208	79	287	128	422	837
20:00~21:00	208	80	288	95	377	760
21:00~22:00	106	46	152	76	267	495
22:00~23:00	78	24	102	43	267	412
23:00~24:00	54	23	77	27	101	205
0:00~1:00	69	9	78	18	116	212
1:00~2:00	56	2	58	18	75	151
2:00~3:00	47	3	50	6	48	104
3:00~4:00	65	4	69	5	55	129
4:00~5:00	99	15	114	9	34	157
5:00~6:00	115	36	151	19	121	291
6:00~7:00	155	101	256	65	257	578
7:00~8:00	236	97	333	153	477	1,018
8:00~9:00	306	100	406	186	450	1,042
9:00~10:00	322	81	403	190	432	1,025
Total	4,985	1,532	6,517	2,955	7,531	17,054

Notes : LV = Light Vehicle HV = Heavy Vehicle

Station...HS5 Date...1988/1/13-14 Direction...Both

Time	Diesel			Gaso-line	Others	Total
	LV	HV	LV+HV			
10:00~11:00	630	722	1,352	638	142	2,132
11:00~12:00	726	896	1,622	577	126	2,325
12:00~13:00	563	721	1,284	550	93	1,927
13:00~14:00	542	749	1,291	576	93	1,960
14:00~15:00	643	610	1,253	576	99	1,928
15:00~16:00	652	756	1,408	638	132	2,178
16:00~17:00	625	690	1,315	654	139	2,108
17:00~18:00	585	644	1,229	840	202	2,271
18:00~19:00	561	417	978	580	139	1,697
19:00~20:00	514	419	933	392	100	1,425
20:00~21:00	425	412	837	291	81	1,209
21:00~22:00	288	288	576	239	71	886
22:00~23:00	245	289	534	227	62	823
23:00~24:00	208	262	470	140	52	662
0:00~1:00	149	244	393	92	40	525
1:00~2:00	138	197	335	66	36	437
2:00~3:00	107	188	295	45	17	357
3:00~4:00	102	201	303	53	10	366
4:00~5:00	109	267	376	43	20	439
5:00~6:00	148	334	482	53	28	563
6:00~7:00	282	446	728	173	63	964
7:00~8:00	372	437	809	364	206	1,379
8:00~9:00	440	438	878	428	115	1,421
9:00~10:00	638	531	1,169	579	137	1,885
Total	9,692	11,158	20,850	8,814	2,203	31,867

Notes : LV = Light Vehicle HV = Heavy Vehicle

Table 3-2 (2) Results of the traffic survey

Station...T1 Date...1993/7/13-14 Direction...Both

Time	Diesel			Gaso-line	Others	Total
	LV	HV	LV+HV			
10:00~11:00	952	998	1,950	1,007	1,170	4,127
11:00~12:00	850	1,051	1,901	1,101	1,271	4,273
12:00~13:00	983	952	1,935	962	1,102	3,999
13:00~14:00	1,058	893	1,951	1,097	1,155	4,203
14:00~15:00	898	875	1,773	1,119	1,103	3,995
15:00~16:00	1,209	977	2,186	1,233	1,214	4,633
16:00~17:00	888	625	1,513	1,320	1,023	3,856
17:00~18:00	831	598	1,429	1,755	1,534	4,718
18:00~19:00	811	591	1,402	1,414	1,322	4,138
19:00~20:00	737	607	1,344	925	1,157	3,426
20:00~21:00	635	407	1,042	1,060	1,270	3,372
21:00~22:00	554	314	868	930	1,114	2,912
22:00~23:00	481	231	712	649	955	2,316
23:00~24:00	296	152	448	446	737	1,631
0:00~1:00	242	91	333	345	603	1,281
1:00~2:00	205	82	287	203	269	759
2:00~3:00	180	86	266	92	345	703
3:00~4:00	177	106	283	35	265	583
4:00~5:00	235	175	410	99	259	768
5:00~6:00	353	493	846	196	450	1,492
6:00~7:00	516	715	1,231	1,258	896	3,385
7:00~8:00	710	509	1,219	1,901	1,697	4,817
8:00~9:00	672	415	1,087	1,233	1,002	3,322
9:00~10:00	753	781	1,534	822	716	3,072
Total	15,284	12,727	28,011	21,329	22,610	71,949

Notes : LV = Light Vehicle HV = Heavy Vehicle

Station...T2 Date...1993/7/13-14 Direction...Both

Time	Diesel			Gaso-line	Others	Total
	LV	HV	LV+HV			
10:00~11:00	625	636	1,261	344	542	2,147
11:00~12:00	462	654	1,116	308	564	1,988
12:00~13:00	561	583	1,144	292	493	1,929
13:00~14:00	532	554	1,086	326	517	1,929
14:00~15:00	585	607	1,192	332	447	1,971
15:00~16:00	665	698	1,363	343	607	2,313
16:00~17:00	622	546	1,168	373	561	2,102
17:00~18:00	600	388	988	260	635	1,883
18:00~19:00	510	330	840	374	421	1,635
19:00~20:00	376	235	611	205	864	1,680
20:00~21:00	395	170	565	140	538	1,243
21:00~22:00	198	126	324	138	273	735
22:00~23:00	122	135	257	167	289	713
23:00~24:00	83	92	175	123	293	591
0:00~1:00	50	28	78	147	150	375
1:00~2:00	37	44	81	54	72	207
2:00~3:00	28	24	52	37	73	162
3:00~4:00	71	57	128	16	45	189
4:00~5:00	119	92	211	15	51	277
5:00~6:00	188	160	348	30	105	483
6:00~7:00	529	415	944	144	355	1,443
7:00~8:00	596	353	949	455	934	2,338
8:00~9:00	603	370	973	417	573	1,963
9:00~10:00	582	541	1,123	267	446	1,836
Total	9,129	7,848	16,977	5,307	9,853	32,137

Notes : LV = Light Vehicle HV = Heavy Vehicle

Station...T3 Date...1993/7/13-14 Direction...Both

Time	Diesel			Gaso-line	Others	Total
	LV	HV	LV+HV			
10:00~11:00	856	1,010	1,866	713	934	3,513
11:00~12:00	735	945	1,680	625	786	3,091
12:00~13:00	870	1,070	1,940	712	906	3,558
13:00~14:00	860	874	1,734	671	910	3,315
14:00~15:00	998	964	1,962	756	1,002	3,720
15:00~16:00	998	915	1,913	752	1,059	3,724
16:00~17:00	888	681	1,569	934	905	3,408
17:00~18:00	842	491	1,333	1,116	1,242	3,691
18:00~19:00	686	441	1,127	754	992	2,873
19:00~20:00	671	447	1,118	647	919	2,684
20:00~21:00	497	335	832	520	773	2,125
21:00~22:00	434	314	748	441	768	1,957
22:00~23:00	329	278	607	319	642	1,568
23:00~24:00	171	180	351	202	498	1,051
0:00~1:00	125	140	265	160	497	922
1:00~2:00	66	105	171	55	118	344
2:00~3:00	97	120	217	54	226	497
3:00~4:00	103	142	245	44	262	551
4:00~5:00	149	229	378	133	303	814
5:00~6:00	211	406	617	123	393	1,133
6:00~7:00	401	510	911	592	527	2,030
7:00~8:00	659	337	996	1,090	1,249	3,335
8:00~9:00	645	479	1,124	777	898	2,799
9:00~10:00	795	867	1,662	629	609	2,900
Total	13,185	12,280	25,465	12,839	17,414	55,718

Notes : LV = Light Vehicle HV = Heavy Vehicle

Station...T4 Date...1993/7/13-14 Direction...Both

Time	Diesel			Gaso-line	Others	Total
	LV	HV	LV+HV			
10:00~11:00	724	413	1,137	677	374	2,188
11:00~12:00	647	377	1,024	500	272	1,796
12:00~13:00	688	477	1,165	607	351	2,123
13:00~14:00	650	387	1,037	617	395	2,049
14:00~15:00	711	441	1,152	656	437	2,245
15:00~16:00	759	452	1,211	738	418	2,367
16:00~17:00	781	317	1,098	926	453	2,477
17:00~18:00	814	191	1,005	1,217	679	2,901
18:00~19:00	658	148	806	861	529	2,196
19:00~20:00	454	191	645	552	368	1,565
20:00~21:00	359	121	480	382	282	1,144
21:00~22:00	222	107	329	329	248	906
22:00~23:00	160	69	229	208	182	619
23:00~24:00	94	45	139	124	119	382
0:00~1:00	50	28	78	83	49	210
1:00~2:00	64	39	103	45	32	180
2:00~3:00	46	37	83	43	20	146
3:00~4:00	49	38	87	36	27	150
4:00~5:00	48	42	90	33	39	162
5:00~6:00	91	120	211	103	127	441
6:00~7:00	296	222	518	681	359	1,558
7:00~8:00	572	147	719	1,260	817	2,796
8:00~9:00	556	159	715	847	453	2,015
9:00~10:00	683	439	1,122	610	312	2,044
Total	10,176	5,007	15,183	12,135	7,342	34,660

Notes : LV = Light Vehicle HV = Heavy Vehicle