

Chapter 3

Results

The analytical results of this study are those of the Cu, Pb, and Fe contents in both dissolved and particulate form. The results can be divided into two main groups which are as follows ;

1. Results of field investigation (Table 1) and mixing experiment (Table 2) of dry season (February, 1986) together with the results of samples from the three dams upstream of the Mae Klong River (Table 3,4).

2. Results of field investigation (Table 5) and mixing experiment (Table 6) of wet season (October, 1986) together with the results of samples from the three dams upstream of the Mae Klong River (Table 7,8).

The supporting data on the water qualities were acquired from another co-ordinated research project sponsored by the Office of the National Environmental Board which has been carried out over the same period of time. The data included major elements (Na, K, Mg, Ca), pH, alkalinity, dissolved oxygen (DO) and dissolved organic carbon (DOC). The data of dry season's are shown in Table 9 to Table 14 while the data of wet season's are shown in Table 15 to Table 19.

Table 1 Concentrations of Metals (Cu, Pb, Fe) in Dissolved and Particulate forms in the Mae Klong River in Dry Season, 1986.

station	Salinity (ppt.)	($\mu\text{g/l}$)					
		Dissolved form			Particulate form		
		Cu	Pb	Fe	Cu	Pb	Fe
MK 1	27.5	0.93	1.38	18.6	0.24	0.56	83.6
MK 2	24.9	1.45	1.77	19.8	0.44	0.84	100.3
MK 3	20.0	1.23	1.12	12.1	0.37	1.88	212.7
MK 4	15.0	1.50	0.64	22.1	0.57	1.95	187.9
MK 5	9.9	1.70	1.10	25.6	0.68	3.03	487.8
MK 6	8.1	0.68	1.56	34.2	1.74	0.85	380.6
MK 7	5.5	0.92	2.73	91.0	0.88	4.34	223.6
MK 8	4.0	0.36	2.71	80.3	1.96	1.44	246.0
MK 9	1.7	0.23	1.80	31.4	2.14	1.85	132.2
MK10	0.0	0.96	0.39	24.3	3.09	2.67	103.8
Photharam	0.0	0.27	0.91	66.3	1.25	0.76	156.6
Ban Tha Rua	0.0	0.48	1.24	52.4	0.44	0.55	88.6
Vachiralongkorn	0.0	1.05	1.47	86.1	0.52	1.02	129.9

Table 2 Concentrations of Metals (Cu, Pb, Fe) in Dissolved and Particulate Forms from Mixing Experiment in Dry Season, 1986.
(Seawater from Off Si Chang Island).

station	Salinity (ppt.)	($\mu\text{g/l}$)					
		Dissolved form			Particulate form		
		Cu	Pb	Fe	Cu	Pb	Fe
MX1	0.7	-	-	-	0.56	0.72	125.3
MX2	2.3	2.75	0.51	62.4	0.74	0.33	167.5
MX3	3.7	0.95	0.37	33.6	0.96	1.38	364.3
MX4	6.0	1.36	0.56	40.1	0.84	0.76	472.6
MX5	8.3	0.74	0.18	20.3	1.07	0.92	238.4
MX6	9.9	0.44	0.26	31.9	1.31	0.37	92.7
MX7	16.0	0.32	0.14	38.7	0.96	1.54	85.3
MX8	21.1	-	-	-	1.57	0.33	98.7
MX9	24.7	-	-	-	0.67	0.91	41.5
MX10	33.5	-	-	-	0.74	0.91	40.7

Table 3 Concentrations of Metals (Cu, Pb, Fe) in Dissolved and Particulate Forms in the Srinakarindra Dam in Dry Season, 1986, at 1 m. and 10 m. depth.

station	($\mu\text{g/l}$)					
	Dissolved form			Particulate form		
	Cu	Pb	Fe	Cu	Pb	Fe
<u>SN1</u> 1 m.	0.28	6.73	37.6	1.14	4.64	136.4
10 m.	0.71	2.42	31.4	1.05	3.65	147.7
<u>SN2</u> 1 m.	0.41	0.86	46.3	1.32	1.97	222.8
10 m.	1.56	0.23	23.7	2.76	1.76	156.9
<u>SN3</u> 1 m.	3.38	0.24	21.9	0.98	2.53	134.5
10 m.	0.96	0.34	29.5	1.12	2.72	121.3
<u>SN4</u> 1 m.	0.42	0.57	40.8	1.53	2.64	315.4
10 m.	0.56	0.19	39.4	2.72	2.76	159.4
<u>SN5</u> 1 m.	0.72	0.45	25.0	1.98	0.91	178.2
10 m.	1.16	0.36	32.4	3.66	0.68	198.4
<u>SN6</u> 1 m.	0.96	0.21	46.9	0.24	1.74	242.5
10 m.	1.78	0.28	59.5	1.12	0.77	316.7
<u>SN7</u> 1 m.	0.42	0.13	28.7	1.77	0.58	305.1
10 m.	0.88	0.26	42.1	2.95	2.62	356.9

Table 4 Concentrations of Metals (Cu, Pb, Fe) in Dissolved and Particulate Forms in the Khao Laem Dam in Dry Season, 1986, at 1 m. and 10 m. depth.

station	($\mu\text{g/l}$)					
	Dissolved form			Particulate form		
	Cu	Pb	Fe	Cu	Pb	Fe
KL1 1 m.	0.56	0.74	56.1	0.75	1.72	273.6
10 m.	1.72	0.81	50.2	1.33	1.85	341.3
KL2 1 m.	1.86	0.97	20.9	1.48	1.08	498.3
10 m.	1.05	1.34	31.7	1.78	1.39	502.5
KL3 1 m.	0.96	1.52	47.3	0.99	1.97	372.9
10 m.	1.21	0.84	59.0	0.82	1.76	316.0
KL4 1 m.	0.23	0.96	41.3	1.26	2.10	298.1
10 m.	2.22	1.44	35.6	1.56	1.58	353.4

Table 5 Concentrations of Metals (Cu, Pb, Fe) in Dissolved and Particulate forms in the Mae Klong River in Wet Season, 1986.

station	Salinity (ppt.)	($\mu\text{g}/\text{l}$)					
		Dissolved form			Particulate form		
		Cu	Pb	Fe	Cu	Pb	Fe
MK1	26.27	0.73	0.34	31.5	0.36	0.99	88.9
MK2	22.26	0.68	0.45	20.0	0.75	0.68	230.7
MK3	17.35	0.54	0.42	62.7	5.52	1.27	196.3
MK4	14.97	0.84	0.73	37.4	1.32	1.00	237.8
MK5	5.09	0.73	1.80	93.2	3.88	3.68	167.1
MK6	5.06	0.42	2.66	53.8	0.61	2.54	443.5
MK7	2.42	0.23	1.69	84.9	2.18	3.11	472.4
MK8	1.15	0.53	1.71	81.2	0.43	1.87	492.3
MK9	0.0	0.66	2.62	57.4	0.87	1.95	188.9

Table 6 Concentrations of Metals (Cu, Pb, Fe) in Dissolved and Particulate Forms from Mixing Experiment in Wet Season, 1986.
(Seawater from Off Hua Hin Beach).

station	Salinity (ppt.)	($\mu\text{g}/\text{l}$)					
		Dissolved form			Particulate form		
		Cu	Pb	Fe	Cu	Pb	Fe
MX1	1.0	0.23	0.44	30.3	0.63	0.26	122.7
MX2	2.2	0.92	0.36	39.5	0.82	0.57	372.6
MX3	3.7	0.68	0.11	55.0	1.77	0.49	629.5
MX4	6.1	0.20	0.17	28.7	0.94	0.25	814.3
MX5	8.7	0.94	0.28	71.1	0.86	0.35	212.7
MX6	10.1	0.98	0.15	33.9	1.07	0.66	444.8
MX7	15.5	0.48	0.38	45.7	0.72	0.29	570.0
MX8	19.7	0.56	0.77	20.3	1.21	0.74	311.4
MX9	26.6	0.32	0.24	23.4	0.67	0.83	54.9

Table 7 Concentrations of Metals (Cu, Pb, Fe) in Dissolved and Particulate Forms in the Srinakarindra Dam in Wet Season, 1986, at 1 m. and 15 m. depth (All samples collected along the length of the dam)

station	($\mu\text{g/l}$)					
	Dissolved form			Particulate form		
	Cu	Pb	Fe	Cu	Pb	Fe
<u>SN1</u> 1 m.	0.73	0.18	21.4	1.26	2.55	87.6
12 m.	1.23	0.42	84.1	2.87	1.81	93.2
<u>SN2</u> 1 m.	0.50	0.23	52.6	1.77	2.73	71.8
15 m.	2.86	0.71	30.4	0.96	0.94	80.0
<u>SN3</u> 1 m.	1.10	0.42	32.1	0.68	0.68	112.1
15 m.	0.75	0.56	74.8	2.68	0.86	123.7

Table 8 Concentrations of Metals (Cu, Pb, Fe) in Dissolved and Particulate Forms in the Khao Laem Dam in Wet Season, 1986, at 1 m. and 10 m. depth. (All samples collected along the front of the dam).

station	($\mu\text{g/l}$)					
	Dissolved form			Particulate form		
	Cu	Pb	Fe	Cu	Pb	Fe
<u>KL1</u> 1 m.	1.26	0.27	23.5	1.43	0.87	173.0
10 m.	1.54	0.34	32.0	1.44	0.88	227.8
<u>KL2</u> 1 m.	0.58	0.40	19.3	1.12	0.98	213.4
10 m.	0.23	0.56	24.1	1.03	0.79	193.6
<u>KL3</u> 1 m.	0.46	0.23	29.5	0.68	0.69	275.0
10 m.	0.77	0.52	28.7	0.78	0.84	315.0
<u>KL4</u> 1 m.	0.63	0.37	32.8	1.05	0.90	187.4
10 m.	0.96	0.40	33.9	0.55	1.03	206.7

Table 9 Major Elements in the Mae Klong River in Dry Season, 1986.

station	(mg/l)			
	Na	K	Mg	Ca
MK1	11170.0	381.5	998.0	493.8
MK2	8830.0	314.8	883.0	481.3
MK3	6170.0	196.3	583.0	331.3
MK4	5150.0	159.3	513.0	300.0
MK5	3590.0	98.2	295.0	218.8
MK6	2620.0	87.0	238.0	212.5
MK7	2010.0	87.0	186.0	181.3
MK8	1290.0	62.0	138.0	140.6
MK9	620.0	23.5	54.0	71.3
MK10	61.1	4.7	11.0	50.0
Photharam	39.8	2.7	6.0	44.4
Ban Tha Rua	4.5	1.9	6.0	43.1
Vachiralongkorn	3.0	1.7	5.0	38.1

Table 10 Water Qualities of the Mae Klong River in Dry Season, 1986.

Station	Salinity (ppt.)	Temp. (°C)	pH	Alkalinity (meq/l)	DO (ml/l)	TOC (ml/l)
MK1	27.5	27.0	8.03	2.619	5.7	14.10
MK2	24.9	27.5	7.90	2.716	5.4	2.78
MK3	20.0	27.5	7.83	2.748	5.4	3.95
MK4	15.0	27.5	7.82	2.788	5.3	3.49
MK5	9.9	27.0	7.73	2.657	5.4	4.60
MK6	8.1	27.0	7.73	2.738	5.1	3.45
MK7	5.5	27.5	7.74	2.748	5.3	2.73
MK8	4.0	27.2	7.70	2.738	5.2	1.64
MK9	1.7	27.5	7.70	2.591	5.6	1.95
MK10	0.0	28.0	7.82	2.329	5.8	1.55
Photharam	0.0		7.81	2.120		
Ban Tha Rua	0.0		7.89	2.120		
Vachiralongkorn	0.0		7.71	2.120		

Table 11 Average Concentration of Major Elements of
the Srinakarindra Dam in Dry Season, 1986. (7 Stations)

	(mg/l)			
	Na	K	Mg	Ca
Mean 1 m.	2.69	1.85	10.30	44.43
Mean 10m.	2.74	1.75	10.15	44.52

Table 12 Average Concentration of Major Elements in the Khoa Laem Dam
in Dry Season, 1986. (8 Stations).

	(mg/l)			
	Na	K	Mg	Ca
Mean 1 m.	1.58	1.77	3.61	16.97
Mean 10m.	1.77	1.82	4.08	16.47

Table 13 Water Qualities of the Srinakarindra Dam in Dry Season, 1986.
(7 stations).

	Temperature (°C)	pH	Alkalinity (meq/l)	DO (ml/l)	DOC (ml/l)
Mean 1 m.	27.1	8.27	2.842	5.8	3.19
Mean 10 m.	24.9	7.79	2.885	0.0	-

Table 14 Water Qualities of the Khoa Laem Dam in Dry Season, 1986.
(8 stations).

	Temp. (°C)	pH	Alkalinity (meq/l)	DO (ml/l)	DOC (ml/l)
Mean 1 m.	28.6	8.20	3.897	6.3	3.20
Mean 10 m.	24.5	7.10	4.038	0.1	-

Table 15 Major Elements in the Mae Klong River in Wet Season, 1986.

station	(mg/l)			
	Na	K	Mg	Ca
MK1	5000.0	313.8	614.9	467.7
MK2	2130.0	194.8	470.4	403.2
MK3	1580.0	154.3	356.2	277.4
MK4	3520.0	178.4	445.2	317.7
MK5	1690.0	61.7	177.4	129.1
MK6	700.0	63.4	155.9	124.2
MK7	570.0	16.8	27.6	61.9
MK8	890.0	32.1	56.5	40.6
MK9	-	-	-	-

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Table 16 Water Qualities of the Mae Klong River in Wet Season, 1986.

Station	Salinity (ppt.)	Temp. (°C)	pH	Alkalinity (meq/l)	DO (ml/l)	DOC (ml/l)
MK1	26.2	31.9	8.05	2.325	2.33	5.77
MK2	22.3	31.3	7.90	2.300	3.56	5.99
MK3	17.3	31.2	7.90	2.088	4.35	3.01
MK4	15.0	31.2	8.00	2.225	3.22	3.03
MK5	5.1	30.8	7.30	1.875	3.77	2.82
MK6	5.1	30.2	7.60	1.863	3.58	3.10
MK7	2.4	29.9	7.10	1.500	3.93	3.30
MK8	1.2	30.1	7.10	2.037	4.00	4.09
MK9	0.0	29.4	6.70	1.125	6.33	3.41

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Table 17 Average Concentration of Major Elements of
the Srinakarindra Dam in Wet Season, 1986. (5 stations)

	(mg/l)			
	Na	K	Mg	Ca
Mean 1 m.	1.26	1.83	2.74	10.94
Mean 10m.	1.25	1.72	2.66	11.59

Table 18 Water Qualities of the Srinakarindra Dam in Wet Season, 1986.
(4 stations).

	Temperature (°C)	pH	Alkalinity (meq/l)	DO (ml/l)	DOC (ml/l)
Mean 1 m.	28.5	7.78	2.038	4.35	2.25
Mean 15 m.	27.5	7.30	2.618	1.18	-

Table 19 Average Concentration of Major Elements in the Khao Laem Dam
in Wet Season, 1986. (4 stations).

	(mg/l)			
	Na	K	Mg	Ca
Mean 1 m.	1.26	1.83	2.74	10.94
Mean 10m.	1.25	1.72	2.66	11.59

Water Qualities

1 The Mae Klong River

During dry season, seawater reached about 20 Kms. upstream. The pH range was 7.71 to 8.03 with an average of 7.80 indicating a more pronounced effect of salinity intrusion than in the wet season. The average alkalinity was about 2.54 meq/l. The dissolved oxygen showed a steady content along the river with values of 5.1 - 5.8 ml/l. However, it was likely that domestic waste discharging from Klong Dumnernsaduak, Klong Ampawa, and the municipal area of Samut Songkram province which were high in BOD and able to cause a slight decrease in dissolved oxygen value in the river. Once the Mae Klong River water reached its estuary, the dissolved oxygen was increased by the mixing with the relatively cleaner seawater. The total organic carbon (TOC) was between 1.55 - 14.10 mg/l with the highest value of 14.10 at the river mouth. This was probably because of domestic waste discharging from Samut Songkram province.

The Second sampling done in October, 1986 was during wet season. The water of 0 ppt. was found in front of Samut Songkram city which is 7.5 kms. from the river mouth. The effect of fresh water discharged was at its highest. pH and alkalinity were relatively lower than those of dry season. Again, the DOC value was at the highest at the river mouth indicating an impact from domestic waste discharging from Samut Songkram. The same trend of dissolved oxygen distribution along the river observed during dry season was also observed in this season. With the exception in the sample of highest salinity that did not show an increase in dissolved oxygen. This was probably because of relatively smaller volume of seawater diluting a large volume of river water.

2 The Srinakarindra and the Khao Laem Dams

In comparison between the Srinakarindra and the Khao Laem Dams during dry season, it was found that dissolved oxygen content of water collected from the Srinakarindra reservoir were relatively higher, it was likely that the Khao Laem Dam, a relatively younger dam, contained more organic matter than the Srinakarindra Dam. These organic matters originated from uncut free left at the bottom of reservoir. Thus, the extensive decomposition of organic matter should produce a large amount of CO_2 being dissolved in the water of the Khao Laem reservoir. This was clearly seen by the higher alkalinity found in the Khao Laem reservoir than those found in the Srinakarindra reservoir. During the wet season, higher amount of precipitation was able to dilute the water in both reservoirs, thus, pH and DOC were relatively lower than dry season.

Major elements dissolved in the Srinakarindra reservoir were found to be higher than those in the Khao Laem reservoir with exception in potassium. Dilution of these major elements during wet season was also observed.

The processes controlling water qualities of these two reservoirs were likely to be complicated and deserved further investigations.

Distribution and Speciation of Metals

The theoretical dilution curve and product approach were applied by plotting the data of Cu, Pb, and Fe in both dissolved and particulate forms against salinities. The behavior of these metals during estuarine mixing will be discussed in chapter 4.