NH_4-N was distributed in high concentrations (5.10-22.89 mg/l) at all stations. Generally, higher concentrations were found in the colder season and lower concentrations in the hotter season as found in COD(Mn) and BOD patterns, although the difference between the high and low values was not so great. Exceptionally low values were found at all stations in July 1990, which was brought about by unknown causes. Other lower values were recorded in June 1990, which was supposedly due to heavy rainfall which diluted the concentrations.

NO_2-N often recorded 0.000 mg/l after July, when NO_3-N was also zero, and range of variance was very large (0.000-0.735 mg/l). There was no seasonal systematic distribution found. In Anyang Chong, NH_4-N was very high, but it seemed that DO was constantly too low to oxidize NH_4-N to NO_2-N, then to NO_3-N.

Coli-form bacteria compared to other high pollutant concentrations were found in very small numbers until November, 1990 (90-2600MPN/100ml). However, a sudden increase from December, 1990 (3500-17000MPN/100ml) was discovered and the increase still seems to be continuing. Since the number at A-St. 7 was very high and this shows that much of human waste is mixing with the domestic waste water in Kaehwa Chong.

THg were not found at all stations throughout the sampling period.

Low concentrations of CN have been detected after January, 1991 (Table 3.1.2-1-7). In particular the values at A-St. 6 and A-St. 7, were found in higher than those at the other stations, which was thought to be the result of the mixture of waste water from industries up stream.

(2) Variations of other water qualities

Several quality items mentioned here were obtained from the bimonthly 24-hour-survey (Tables 3.1.2-8-14 and Tables A-3.1-1-42).

Table 3.1.2-8 Water Quality Obtained from 24-hour Survey in Anyang Chong, A-St. 1

A-St. 1, July 5-6, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.0	-	-	0.03	0.042	12.96	0.934	0.525	60.0	-	29.5	-	3.5	4.73	34.2	31.5	68	-
SD	0.0	-	-	0.01	0.044	1.59	0.142	0.137	10.1	-	4.2	-	0.2	1.42	13.7	26.3	12	-

A-St. 1, September 7-8, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	1.2	12.31	1.55	0.22	0.017	10.53	0.813	0.476	32.1	13.6	23.8	18.8	3.94	4.68	21.3	7.2	35	58
SD	0.5	1.93	0.48	0.09	0.041	1.95	0.201	0.14	12.5	3.3	6.7	4.6	0.13	1.33	4.8	2.9	17	38
																6.5	31	
																2.0	10	

A-St. 1, November 13-14, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	1.6	20.68	2.91	0.04	0.018	17.71	1.656	0.934	59.8	41.3	30.9	25.6	4.20	2.53	24.8	15.3	60	36
SD	0.4	1.37	0.7	0.04	0.004	0.88	0.183	0.104	2.9	7.9	3.0	2.5	0.13	0.36	8.4	7.1	11	3

A-St. 1, January 15-16, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Srttleable (mg/l)	matter (%)	Gauge (cm)
Mean	1.8	14.89	0.69	0.03	0.047	14.16	1.831	0.766	93.1	57.9	76.0	51.7	4.35	1.85	39.2	13.7	35	37
SD	0.5	1.02	0.32	0.00	0.050	0.98	0.281	0.157	20.0	18.7	11.7	2.5	0.14	0.28	4.5	2.1	4	4

A-St. 1, March 5-6, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.2	16.89	1.46	ND	0.031	15.39	2.600	0.761	70.9	49.5	53.6	44.9	4.13	5.81	41.9	19.9	47	35
SD	0.1	1.34	0.59	ND	0.006	1.21	0.612	0.158	2.1	6.5	4.7	5.0	0.20	0.62	2.8	2.7	5	5

A-St. 1, May 31-June 1, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.4	14.17	1.41	0.11	0.000	12.65	2.036	1.310	58.0	46.1	43.9	34.9	5.36	1.71	46.7	26.1	52	50
SD	0.1	1.11	0.41	0.06	0.000	0.01	0.276	0.153	8.0	5.4	5.1	4.3	0.14	0.46	13.5	12.4	13	11

Table 3.1.2-9 Water Quality Obtained from 24-hour Survey in Anyang Chong, A-St. 2

A-St.2, July 5-6, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Srttleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.0	-	-	0.00	0.000	13.01	0.820	0.400	63.0	-	35.7	-	3.4	3.89	77.6	69.4	89	37
SD	0.0	-	-	0.00	0.000	0.42	0.195	0.099	5.3	-	4.7	-	0.2	1.45	19.0	19.2	6	1
															72.8	64.4	88	
															9.9	9.1		

A-St. 2, September 7-8, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.3	13.35	1.39	0.00	0.007	11.81	1.232	0.539	23.9	15.7	15.7	21.7	4.13	3.90	49.8	38.3	79	44
SD	0.1	0.52	0.52	0.00	0.010	0.71	0.322	0.130	5.0	6.1	6.1	4.4	0.15	1.16	15.9	15.5	8	9

A-St. 2, November 13-14, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Srttleable (mg/l)	matter (%)	Gauge (cm)
Mean	1.9	19.08	2.51	0.13	0.019	16.43	1.574	0.871	46.6	47.2	34.1	30.1	4.21	1.98	20.0	10.8	53	27
SD	0.2	2.14	0.59	0.03	0.019	2.09	0.226	0.098	13.4	10.9	1.6	3.4	0.51	0.97	7.4	5.3	11	1
													4.07					
													0.21					

A-St. 2, January 15-16, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	3.0	16.92	1.06	0.16	0.044	15.64	1.415	0.881	92.7	56.3	68.5	68.5	4.38	1.19	42.2	14.7	35	20
SD	0.4	1.76	0.35	0.05	0.028	1.73	0.149	0.251	20.2	17.8	4.4	4.5	4.37	0.28	3.7	6.7	16	2

A-St. 2, March 5-6, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	2.0	16.53	1.21	0.00	0.036	15.28	1.397	0.715	74.8	52.1	56.5	43.0	4.22	4.42	33.1	13.4	40	18
SD	0.4	0.98	0.23	0.00	0.017	0.89	0.181	0.180	10.9	9.7	5.3	3.5	0.12	0.66	3.9	4.2	9	1

A-St. 2, May 31-June 1, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.4	11.77	0.80	0.04	0.000	10.97	1.874	1.213	26.8	23.2	29.1	25.5	5.22	1.95	20.4	8.0	42	11
SD	0.2	1.23	0.21	0.04	0.000	1.22	0.337	0.283	7.2	6.0	3.4	2.7	0.20	0.38	5.7	2.2	21	2

Table 3.1.2-10 Water Quality Obtained from 24-hour Survey in Anyang Chonng, A-St. 3

A-St. 3, July 5-6, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.1	-	-	0.09	0.059	9.67	1.050	0.615	106.4	-	36.3	-	2.8	3.3	87.8	82.0	93	56
SD	0.2	-	-	0.10	0.096	1.22	0.307	0.222	28.9	-	4.7	-	0.7	1.6	16.0	15.3	4	2
									100.0					2.9				
									19.2					0.7				

A-St. 3, September 7-8, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.2	13.68	1.07	0.00	0.042	12.59	1.833	0.807	51.0	32.6	29.5	22.7	3.24	3.39	70.6	60.7	77	50
SD	0.1	2.49	0.33	0.00	0.062	2.36	0.732	0.178	8.1	8.0	8.5	8.0	0.33	1.26	23.8	19.4	23	4
														3.07				
														0.51				

A-St. 3, November 13-14, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	2.2	16.07	2.3	0.14	0.034	13.60	1.547	1.042	62.8	37.6	45.0	33.5	4.11	2.51	39.8	27.7	66	43
SD	0.4	5.95	0.6	0.13	0.048	5.98	0.697	0.615	40.4	18.4	18.1	4.0	0.72	1.42	46.5	33.6	13	4
							1.390	0.884	39.5	33.5					28.0	19.6	70	
							0.456	0.290	0.7	12.3					22.8	19.4		

A-St. 3, January 15-16, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	3.5	13.59	2.00	0.30	0.367	11.19	1.518	0.900	53.4	34.6	47.2	36.3	4.15	2.06	44.2	20.6	47	17
SD	0.3	2.85	0.60	0.15	0.322	2.91	0.371	0.219	12.8	10.7	4.6	4.0	0.36	0.34	13.7	8.1	11	2

A-St. 3, March 5-6, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	2.5	8.36	0.90	ND	0.030	7.43	1.309	0.241	16.0	13.6	20.6	17.6	3.26	3.16	25.3	13.4	52	17
SD	0.4	1.44	0.22	ND	0.009	1.31	0.168	0.077	2.8	3.3	3.3	2.3	0.54	0.95	16.4	9.7	8	4

A-St. 3, May 31-June 1, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	2.3	6.89	0.84	0.00	0.126	5.85	0.750	0.409	11.6	8.1	10.3	9.6	3.50	1.18	18.8	7.9	42	14
SD	0.8	1.00	0.19	0.00	0.180	1.06	0.120	0.121	2.4	2.1	1.8	1.8	1.03	0.26	13.7	5.6	6	1

Table 3.1.2-11 Water Quality Obtained from 24-hour Survey in Anyang Chong, A-St. 4

A-St. 4, July 5-6, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (og/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.0	-	-	0.00	0.000	12.06	0.828	0.148	60.7	-	35.5	-	3.3	1.63	83.1	78.7	93	21
SD	0.1	-	-	0.00	0.000	0.70	0.248	0.076	15.8	-	6.8	-	0.3	0.2	46.0	45.2	4	2

A-St. 4, September 7-8, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.4	12.60	1.16	0.00	0.012	11.59	0.986	0.468	26.6	18.8	30.0	26.6	3.72	2.02	56.6	46.8	81	25
SD	0.4	1.60	0.52	0.00	0.016	1.51	0.278	0.117	3.1	6.0	11.3	9.5	0.15	0.35	27.9	25.5	6	3

A-St. 4, November 13-14, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (m /l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	2.2	20.92	2.76	0.16	0.021	17.90	1.588	1.161	47.0	25.8	36.4	29.4	4.14	2.34	26.4	12.0	45	19
SD	0.4	1.12	0.38	0.02	0.008	1.06	0.144	0.145	6.5	5.5	6.0	5.2	0.26	0.40	6.7	3.9	11	2

A-St. 4, January 15-16, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	3.2	16.64	1.11	0.05	0.031	15.49	0.000	1.053	81.3	63.6	62.2	54.6	4.21	2.26	42.7	17.6	40	11
SD	0.7	1.08	0.35	0.00	0.005	1.08	0.370	0.299	13.6	15.2	6.2	4.0	0.18	0.43	4.8	6.5	11	1

A-St. 4, March 5-6, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	2.2	17.17	1.54	ND	0.021	15.61	1.667	0.914	66.3	54.6	51.3	42.5	4.46	4.19	29.8	13.3	43	10
SD	0.4	0.64	0.28	ND	0.006	0.69	0.080	0.045	14.9	9.8	3.3	1.8	0.13	0.81	7.5	4.3	6	1

A-St. 4, May 31-June 1, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.6	11.21	1.2675	0.00	0.000	9.89	1.870	1.383	48.9	39.9	40.5	30.9	4.50	2.65	61.5	42.4	67	20
SD	0.3	1.72	0.38	0.00	0.000	1.37	0.299	0.203	6.3	4.6	5.7	3.8	0.65	0.90	55.1	39.1	9	3

Table 3.1.2-12 Water Quality Obtained from 24-hour Survey in Anyang Chong, A-St. 5

A-St. 5, July 5-6, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.7	-	-	0.00	0.033	11.56	0.718	0.256	56.0	-	28.6	-	3.2	1.62	58.6	52.9	90	39
SD	0.4	-	-	0.10	0.063	1.21	0.243	0.083	12.6	-	5.4	-	0.3	0.42	20.3	18.6	5	6
								0.260						1.53				
								0.078						0.29				

A-St. 5, September 7-8, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.2	14.80	1.16	0.00	0.075	13.45	1.006	0.512	26.1	15.9	27.2	21.7	3.76	1.82	52.0	42.9	79	43
SD	0.3	1.10	0.41	0.00	0.245	0.99	0.732	0.449	3.6	4.3	5.2	5.2	0.28	0.53	24.6	25.7	11	4
					0.004		0.803	0.386										
					0.013		0.208	0.114										

A-St. 5, November 13-14, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	1.7	19.93	2.54	0.07	0.011	17.31	1.461	1.080	44.9	43.1	43.4	36.2	4.22	3.10	32.8	19.2	55	38
SD	0.3	0.70	0.41	0.05	0.002	0.52	0.212	0.200	8.9	14.5	4.6	7.0	0.63	0.71	10.7	11.4	14	2
															27.8	15.2	55	
															9.5	7.9		

A-St. 5, January 15-16, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	2.1	19.31	1.15	0.00	0.020	18.14	2.026	1.163	79.1	59.1	71.3	54.0	4.14	1.65	42.8	17.9	41	30
SD	0.6	1.78	0.45	0.00	0.005	1.88	0.567	0.351	8.9	12.1	11.6	5.0	0.22	0.37	6.0	7.1	13	2

A-St. 5, March 5-6, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	4.0	15.62	1.21	0.00	0.016	14.39	1.663	0.798	83.9	68.8	55.3	47.4	4.47	4.57	33.1	14.5	44	20
SD	0.6	0.77	0.12	0.00	0.004	0.83	0.147	0.228	12.4	11.2	5.9	6.0	0.21	0.90	3.8	4.0	10	2

A-St. 5, May 31-June 1, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean		10.54	1.19	0.00	0.000	9.36	1.675	1.093	38.8	32.6	32.0	26.9	4.73	1.89	37.4	23.2	61	28
SD		0.66	0.15	0.00	0.000	0.68	0.205	0.130	9.4	8.7	3.0	2.7	0.23	0.23	9.2	8.4	9	3

Table 3.1.2-13 Water Quality Obtained from 24-hour Survey in Anyang Chong, A-St. 6

A-St. 6, July 5-6, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.0	-	-	0.07	0.040	10.84	0.733	0.168	50.2	-	33.3	-	3.4	2.25	61.4	56.0	89	61
SD	0.0	-	-	0.08	0.046	0.70	0.168	0.091	14.9	-	5.1	-	0.4	0.93	29.3	30.1	6	2
															54.7	49.2	90	
															17.0	17.6		

A-St. 6, September 7-8, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.3	13.81	0.97	0.00	0.079	12.76	0.911	0.476	27.2	11.6	24.2	20.9	3.53	2.38	46.2	34.5	72	42
SD	0.3	0.90	0.30	0.00	0.052	0.84	0.280	0.097	6.0	3.8	2.0	2.8	0.34	0.77	18.5	17.7	9	2
															42.1	30.5		
															12.3	11.3		

A-St. 6, November 13-14, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	1.2	25.70	2.64	0.14	0.027	22.89	1.589	1.073	38.9	34.2	51.4	44.0	3.98	3.70	19.0	9.1	46	33
SD	0.3	2.92	0.44	0.07	0.019	2.71	0.277	0.307	3.1	5.8	3.3	4.5	2.34	2.34	12.4	2.9	13	2
													3.87		19.5			
													0.30		1.7	-		

A-St. 6, January 15-16, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	2.2	16.62	1.31	0.00	0.024	15.23	1.931	1.135	89.7	63.0	69.3	58.0	4.07	2.06	42.0	19.3	45	17
SD	0.6	2.02	0.82	0.00	0.002	1.71	0.409	0.174	5.7	13.9	7.1	4.1	0.15	0.35	10.4	7.4	9	1

A-St. 6, March 5-6, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	3.7	18.07	1.51	0.00	0.022	16.53	1.678	0.824	93.9	84.1	52.5	45.9	4.41	3.99	28.8	10.4	36	15
SD	0.5	1.16	0.35	0.00	0.004	0.85	0.086	0.088	21.9	24.1	5.2	4.7	0.15	1.41	4.5	3.9	10	1

A-St. 6, May 31-June 1, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.5	9.39	1.04	0.00	0.000	8.10	1.500	1.061	28.6	21.5	29.3	21.5	4.80	1.37	14.0	5.7	39	25
SD	0.3	0.46	0.11	0.00	0.000	0.54	0.323	0.161	4.2	4.4	0.7	3.4	0.18	0.21	4.3	3.0	10	1

Table 3.1.2-14 Water Quality Obtained from 24-hour Survey in Anyang Chong, A-St. 7

A-St. 7, July 5-6, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.6	-	-	0.06	0.083	10.59	1.283	0.525	47.0	-	32.8	-	3.5	1.84	50.2	47.1	93	31
SD	0.2	-	-	0.05	0.119	1.28	0.400	0.243	10.2	-	9.1	-	0.3	0.49	17.7	17.0	4	3
											30.5				46.3			
											4.8				12.1			

A-St. 7, September 7-8, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.0	14.78	1.54	0.00	0.624	12.51	2.062	1.210	27.9	21.0	24.0	22.6	3.58	1.97	36.2	22.7	60	10
SD	0.0	1.76	0.31	0.00	0.366	2.08	0.818	0.605	5.3	3.9	2.1	2.7	0.20	0.48	15.4	13.5	15	2
					0.533		1.872	1.078										
					0.197		0.501	0.410										

A-St. 7, November 13-14, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	1.8	22.90	2.48	0.18	0.009	20.16	2.573	1.878	51.9	31.1	47.1	38.3	3.75	2.14	48.8	26.7	55	12
SD	0.4	3.23	0.55	0.05	0.006	2.85	1.159	0.955	11.6	9.7	5.9	5.9	0.22	0.98	8.9	5.7	9	2
		22.11				19.49												
		1.76				1.76												

St. 7, January 15-16, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	2.1	20.19	1.72	ND	0.035	17.65	2.327	1.389	53.6	42.2	67.2	56.2	4.12	2.22	79.2	37.9	47	25
SD	0.4	2.94	0.69	ND	0.006	2.00	0.378	0.307	12.5	11.6	11.9	5.8	0.23	0.38	22.7	19.8	15	2

St. 7, March 5-6, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	6.0	19.05	1.53	ND	0.022	17.49	2.086	0.985	92.6	66.8	44.2	33.8	4.55	2.75	51.5	24.2	47	9
SD	1.0	1.25	0.42	ND	0.004	1.17	0.510	0.220	7.2	13.0	3.3	2.7	0.53	0.76	12.1	8.1	8	2

St. 7, May 31-June 1, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	0.4	13.79	2.02	0.09	0.000	11.77	2.720	1.858	48.0	39.0	36.2	29.2	4.82	2.13	62.0	28.6	46	19
SD	0.2	1.89	0.30	0.07	0.000	1.75	0.868	0.571	7.4	8.3	5.8	5.4	0.13	1.08	38.7	18.5	10	2

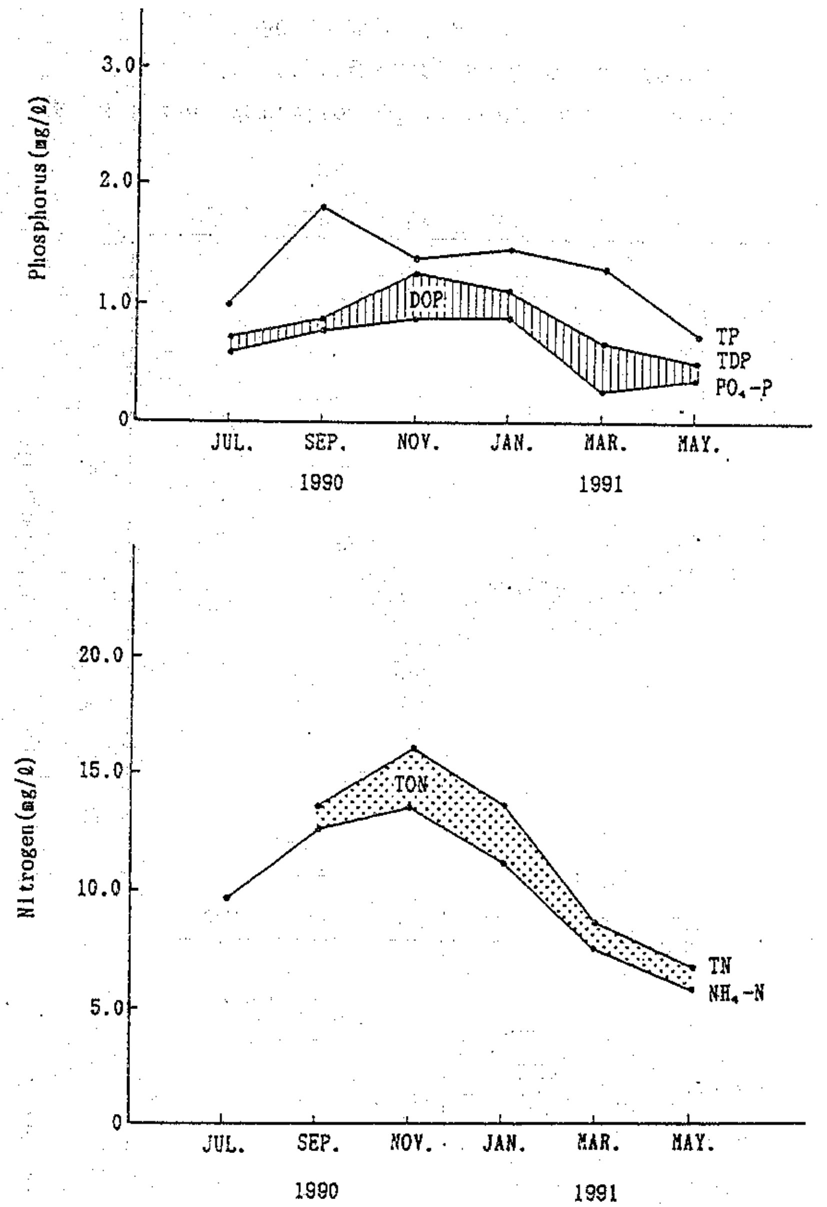


Fig. 3.1.2-4 Variation of Nitrogen and Phosphorus of Anyang Chong at A-St. 1 from July, 1990 to May, 1991

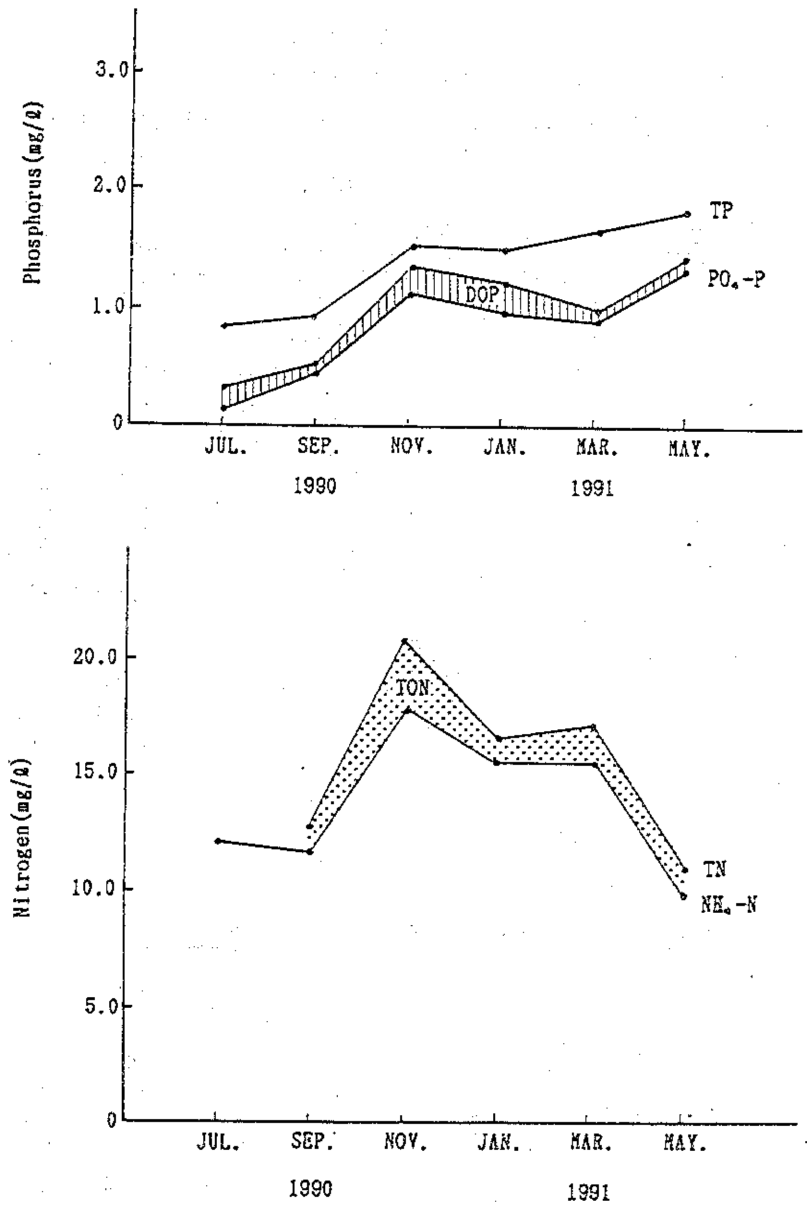


Fig. 3.1.2-5 Variation of Nitrogen and Phosphorus of Anyang Chong at A-St. 2 from July, 1990 to May, 1991

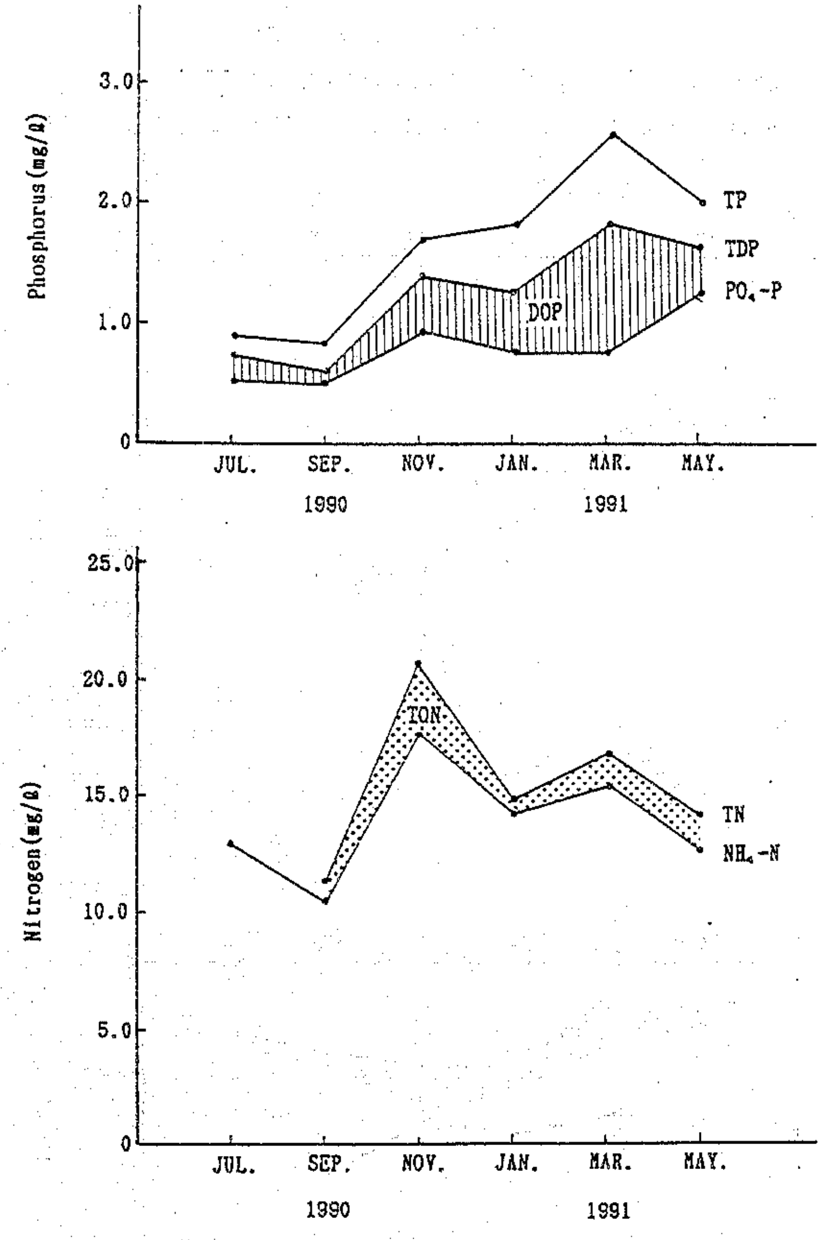


Fig. 3.1.2-6 Variation of Nitrogen and Phosphorus of Anyang Chong at A-St. 3 from July, 1990 to May, 1991

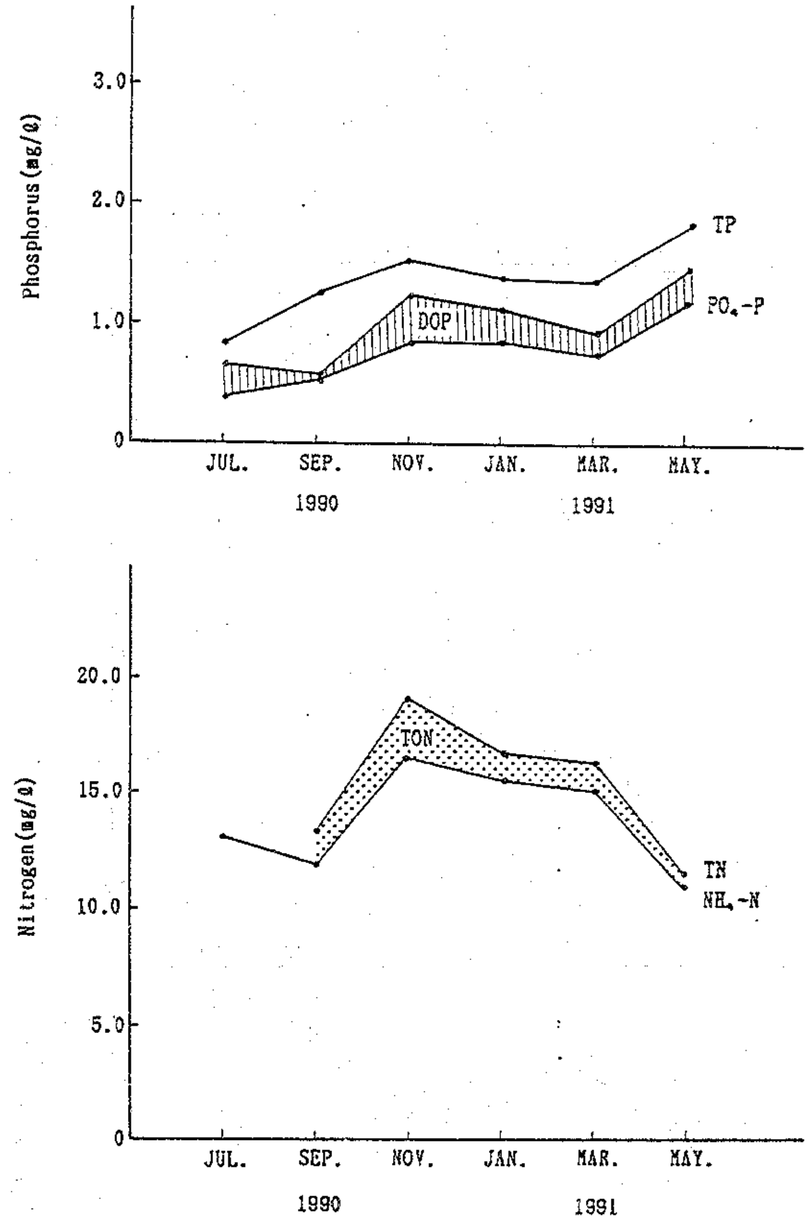


Fig. 3.1.2-7 Variation of Nitrogen and Phosphorus of Anyang Chong at A-St. 4 from July, 1990 to May, 1991

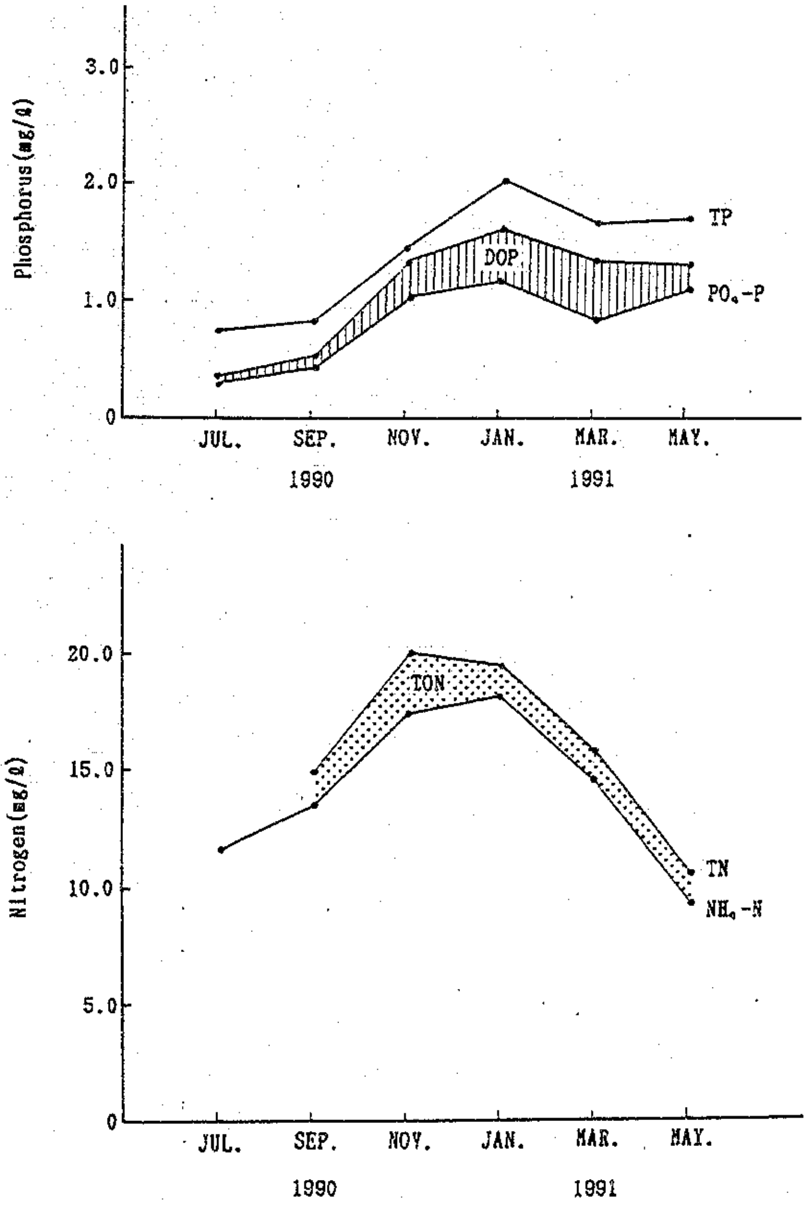


Fig. 3.1.2-8 Variation of Nitrogen and Phosphorus of Anyang Chong at A-St. 5 from July, 1990 to May, 1991

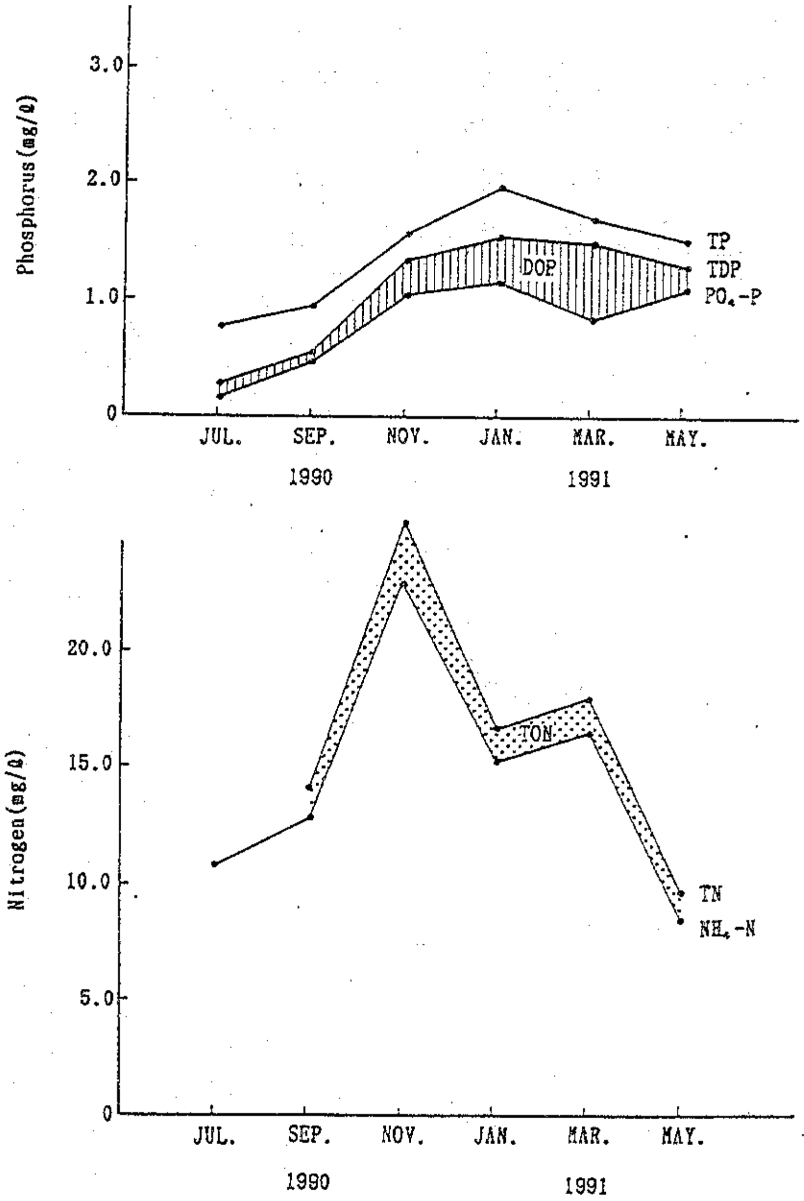


Fig. 3.1.2-9 Variation of Nitrogen and Phosphorus of Anyang Chong at A-St. 6 from July, 1990 to May, 1991

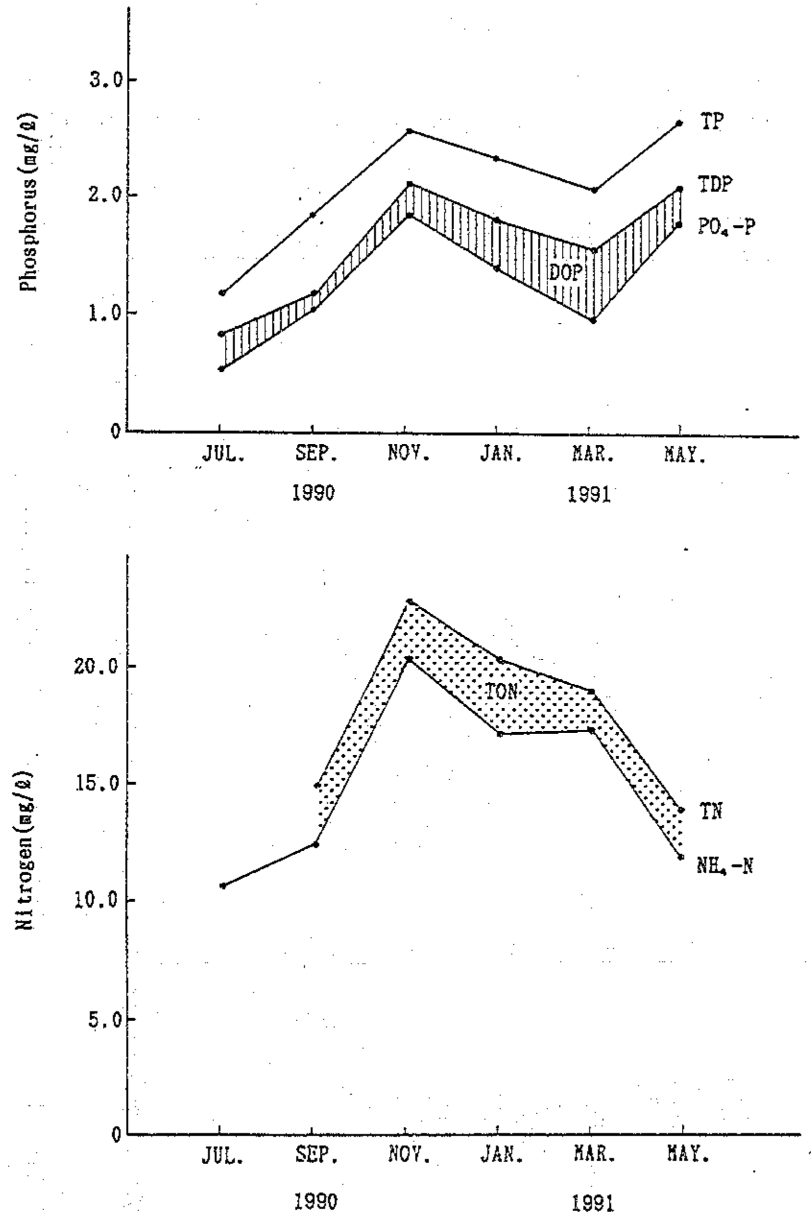


Fig. 3.1.2-10 Variation of Nitrogen and Phosphorus of Anyang Chong at A-St. 7 from July, 1990 to May, 1991

TN concentrations were very high at all stations throughout the sampling period (6.80-25.70 mg/l). These values range from 1/2 to 1/5 of the TN concentrations usually found in raw sewage in Japan. The higher values are almost of the same concentration as that found in the sewage in the intercepting pipe (18.8-2-.1 mg/l) in Seoul (Figs. 3.1.2-4-10).

The TN distribution pattern curve showed that the lower values occurred in July or September and the highest in November, followed by the abrupt or gradual drop of values to reach their lowest concentration in May. At A-St.3, after the construction in Torim Chong, TN concentrations maintained low values.

TON concentrations generally showed very low values (0.69-2.91 mg/l) at all stations, although these were found slightly higher when TN was high. The percentages of TON to TN were in a significant narrow range (5-15 %)(Table 3.1.2-15) at all stations throughout the sampling period.

NO3-N (0.00-0.30 mg/l) was constantly found in very low values, while NH4-N, main nitrogen part of TN (85-92 %) showed a similar variation pattern to TN (Table 3.1.2-15).

The results regarding various forms of nitrogen indicate that much of the content of the sewage gully inflows to Anyang Chong.

TP values generally showed a gradual increase (0.718-2.720 mg/l) from July to May with the exception of A-St. 3, where although small decreases were found in January and March, TP, like TN, decreased (Sept.:1.833 mg/l, May:0.750 mg/l) after the construction had been completed (Figs. 3.1.2-14-20).

TOP concentrations varied seasonally in relatively consistent values (0.341-1.061 mg/l) with the exception of A-St. 1, which showed a greater variance (0.337-1.839 mg/l).

PO_4-P concentrations ranged from 0.148-1.878 mg/l, and varied

Table 3.1.2-15 Each Form of Nitrogen of Anyang Chong

		July (mg/l)	(%)	September (mg/l)	(%)	November (mg/l)	(%)	January (mg/l)	(%)	March (mg/l)	(%)	May (mg/l	(%)
A-St 1	TN	-	-	12.30		20.70		14.89		16.89		14.17	
	TON	-	-	1.55	13	2.91	14	0.69	5	1.46	9	1.41	10
	NH4-N	12.96	-	10.53	86	17.71	86	14.16	95	15.39	91	12.65	89
A-St.2	TN	-	-	13.30		19.08		16.92		16.53		11.77	
	TON	-	-	1.39	10	2.51	13	1.06	6	1.21	7	0.80	7
	NH4-N	13.01	-	11.81	89	16.43	86	15.64	92	15.28	92	10.97	93
A-St.3	TN	-	-	13.70		16.07		13.59		8.36		6.80	
	TON	-	-	1.07	8	2.30	14	2.00	15	0.90	11	0.84	12
	NH4-N	9.67	-	12.59	92	13.60	85	11.19	82	7.43	89	5.85	86
A-St.4	TN	-	-	12.60		20.92		16.64		17.17		11.21	
	TON	-	-	1.16	9	2.76	13	1.11	7	1.54	9	1.33	12
	NH4-N	12.06	-	11.59	92	17.90	86	15.49	93	15.62	91	9.89	88
A-St.5	TN	-	-	14.60		19.93		19.31		15.62		10.54	
	TON	-	-	1.16	8	2.54	13	1.15	6	1.21	8	1.19	11
	NH4-N	11.56	-	13.45	91	17.31	87	18.14	94	14.39	92	9.36	89
A-St.6	TN	-	-	14.00		25.70		16.62		18.07		9.39	
	TON	-	-	0.97	7	2.64	10	1.31	8	1.51	8	1.04	11
	NH4-N	10.84	-	12.76	91	22.89	89	15.23	92	16.53	91	8.10	86
A-St.7	TN	-	-	14.80		22.90		20.19		19.05		13.79	
	TON	-	-	1.54	10	2.48	11	1.72	9	1.53	8	2.02	15
	NH4-N	10.59		12.51	85	20.16	88	17.65	87	17.49	92	11.77	85

Table 3.1.2-16 Phosphorus of Anyang Chong

Station		July (mg/l)	(%)	September (mg/l)	(%)	November (mg/l)	(%)	January (mg/l)	(%)	March (mg/l)	(%)	May (mg/l)	(%)
A-St.1	TP	0.934		0.813		1.656		1.831		2.600		2.036	
	PO4-P	0.525	56	0.476	59	0.934	56	0.766	42	0.761	29	1.310	64
A-St.2	TP	0.820		1.232		1.574		1.415		1.397		1.874	
	PO4-P	0.400	49	0.539	46	0.871	55	0.881	62	0.715	51	1.213	65
A-St.3	TP	1.050		1.833		1.547		1.518		1.309		0.750	
	PO4-P	0.615	59	0.807	43	1.042	66	0.900	59	0.241	18	0.409	55
A-St.4	TP	0.828		0.986		1.588		1.581		1.667		1.870	
	PO4-P	0.148	18	0.468	48	1.161	73	1.053	67	0.914	55	1.383	74
A-St.5	TP	0.718		0.803		1.461		2.026		1.663		1.675	
	PO4-P	0.326	36	0.386	48	1.080	74	1.163	57	0.798	48	1.093	65
A-St.6	TP	0.733		0.911		1.589		1.931		1.678		1.500	
	PO4-P	0.168	23	0.476	52	1.073	68	1.135	59	0.824	49	1.061	71
A-St.7	TP	1.283		1.872		2.573		2.327		2.086		2.720	
	PO4-P	0.525	41	1.078	58	1.878	73	1.389	60	1.052	50	1.858	68
	Mean	0.626	40.2	0.913	50.3	1.413	66.4	1.391	58.0	1.162	43.0	1.440	66.0
	SD	0.317	14.5	0.474	5.5	0.449	7.3	0.460	7.2	0.499	12.6	0.563	5.7

Table 3.1.2-17 Percentage of DBOD to TBOD and DCOD(Mn) to TCOD(Mn) of Anyang Chong

		July (mg/l)	September (mg/l)	(%)	November (mg/l)	(%)	January (mg/l)	(%)	March (mg/l)	(%)	May (mg/l)	(%)	Mean	SD
A-St. 1	TBOD	60.0	32.1		59.8		93.1		70.9		58.0			
	DBOD	-	13.6	67	41.3	69	57.9	62	49.5	70	46.1	79	69	6
	TCOD(Mn)	29.5	23.8		30.9		76.0		53.6		43.9			
	DCOD(Mn)	-	18.8	79	25.6	83	51.7	68	44.9	84	34.9	79	79	6
A-St. 2	TBOD	63.0	23.9		46.6		92.6		74.8		26.8			
	DBOD	-	15.7	66	40.2	86	56.3	61	52.1	70	23.2	87	78	11
	TCOD(Mn)	35.7	34.1		34.1		68.5		56.5		29.1			
	DCOD(Mn)	-	21.7	64	27.9	82	49.9	73	43.0	76	25.5	88	80	5
A-St. 3	TBOD	106.4	51.0		39.5		53.4		16.0		11.6			
	DBOD	-	32.6	64	33.5	85	34.6	65	13.6	85	8.1	70	78	9
	TCOD(Mn)	36.3	29.5		45.0		47.2		20.6		10.3			
	DCOD(Mn)	-	22.7	77	33.5	74	36.3	77	17.6	85	9.6	93	81	7
A-St. 4	TBOD	60.7	26.6		47.0		81.3		66.3		48.9			
	DBOD	-	18.8	71	25.8	55	63.6	78	54.6	82	39.9	82	70	13
	TCOD(Mn)	35.5	30.0		36.4		62.2		51.3		40.5			
	DCOD(Mn)	-	26.6	89	29.4	81	54.6	88	42.5	83	30.9	76	82	4
A-St. 5	TBOD	56.0	26.1		44.9		79.1		83.9		38.8			
	DBOD	-	15.9	61	43.1	96	59.1	75	68.8	82	32.6	84	87	8
	TCOD(Mn)	28.6	27.2		43.4		71.3		55.3		32.0			
	DCOD(Mn)	-	21.7	80	36.2	83	54.0	76	47.4	86	26.9	84	82	3
A-St. 6	TBOD	50.2	27.2		38.9		89.7		93.9		28.6			
	DBOD	-	11.6	43	34.2	88	63.0	70	84.1	90	21.5	75	82	8
	TCOD(Mn)	33.3	24.4		51.4		69.3		52.5		29.3			
	DCOD(Mn)	-	20.9	86	44.0	86	58.0	84	45.9	87	25.5	87	86	1
A-St. 7	TBOD	47.0	27.9		51.9		53.6		92.6		48.0			
	DBOD	-	21.0	75	31.1	60	42.2	79	66.8	72	39.0	81	70	9
	TCOD(Mn)	32.8	24.0		47.1		67.2		44.2		36.2			
	DCOD(Mn)	-	22.6	94	38.3	81	56.2	84	33.8	76	29.2	81	81	3

Table 3.1.2-18 SS and Settleable Mattewr of Anyang Chong

		July (mg/l)	(%)	September (mg/l)	(%)	November (mg/l)	(%)	January (mg/l)	(%)	March (mg/l)	(%)	May (mg/l	(%)
A-St. 1	SS	34.2		21.3		24.8		39.2		41.9		46.7	
	SM	31.5	92	7.2	34	15.3	62	13.7	35	19.9	47	26.1	56
A-St. 2	SS	77.6		49.8		20.0		42.2		33.1		20.4	
	SM	69.4	89	38.3	77	10.8	54	14.7	35	13.4	40	8.0	39
A-St. 3	SS	87.8		70.6		28.0		44.2		25.3		18.8	
	SM	82.0	93	60.7	86	19.6	70	20.6	47	13.4	53	7.9	42
A-St. 4	SS	83.1		56.6		26.4		42.7		29.8		61.5	
	SM	78.7	95	46.8	81	12.0	45	17.6	41	13.3	45	45.6	67
A-St. 5	SS	58.6		52.0		32.8		42.8		33.1		37.4	
	SM	52.9	90	42.8	82	19.2	59	17.9	42	14.5	44	23.2	62
A-St. 6	SS	54.7		42.1		19.0		42.0		28.8		14.0	
	SM	49.2	90	30.5	72	9.1	48	19.3	46	10.4	36	5.3	38
A-St. 7	SS	50.2		36.2		48.8		79.2		51.5		62.0	
	SM	47.1	94	22.7	63	26.7	55	37.9	48	24.2	47	28.6	46
	Mean		92		71		56		42		45		50
	SD		2		17		8		5		5		11

monthly showing a curve similar to TP. The PO_4-P concentration usually amounted to higher than half of TP concentrations (18-74 %) (Table 3.1.2-16).

The TN/TP ratio was quite low (5-15) and this shows that the proportion of domestic waste water to all sewage inflowing to Anyang Chong was high.

A great part of the organic matters were smaller than 1 um. This means that although DBOD concentrations varied with TBOD, the percentages showed considerably fixed and high values (55-96 %) at all stations throughout the sampling period. DCOD(Mn) was also found in high percentages in TCOD(Mn)(68-93%) (Table 3.1.2-17).

The percentages of settleable matter to SS at all stations on each month were in a narrow range (Table 3.1.2-18), showing decreases from September to January. These values increased again in March to May. The mean percentage of seven stations each month was 42 (January) - 92 % (September).

Concentrations of Sulfide at all stations showed increases from July to May, however, these were still in a narrow range (2.8-5.36 mg/l). Of these, A-St.3 was a lower increase than other stations (2.8-4.15 mg/l). While A-St.1 and A-St. 2 had higher ranges reflecting the pollutant accumulation down stream (3.5-5.36 mg/l at A-St. 1: 3.4-5.22 mg/l at A-St.2) (Tables 3.1.2-8-14).

A substantial amount of artificial detergents are assumed to be used in Seoul, because quite high values of MBAS were found (1.37-5.81 mg/l). Higher concentration was found downstream than upper stream, which indicates MBAS flow downstream without being decomposed.

3.1.3 Changes of Water Quality and Pollution Load from the upper to the lower stations

(1) Water quality in the upper stream

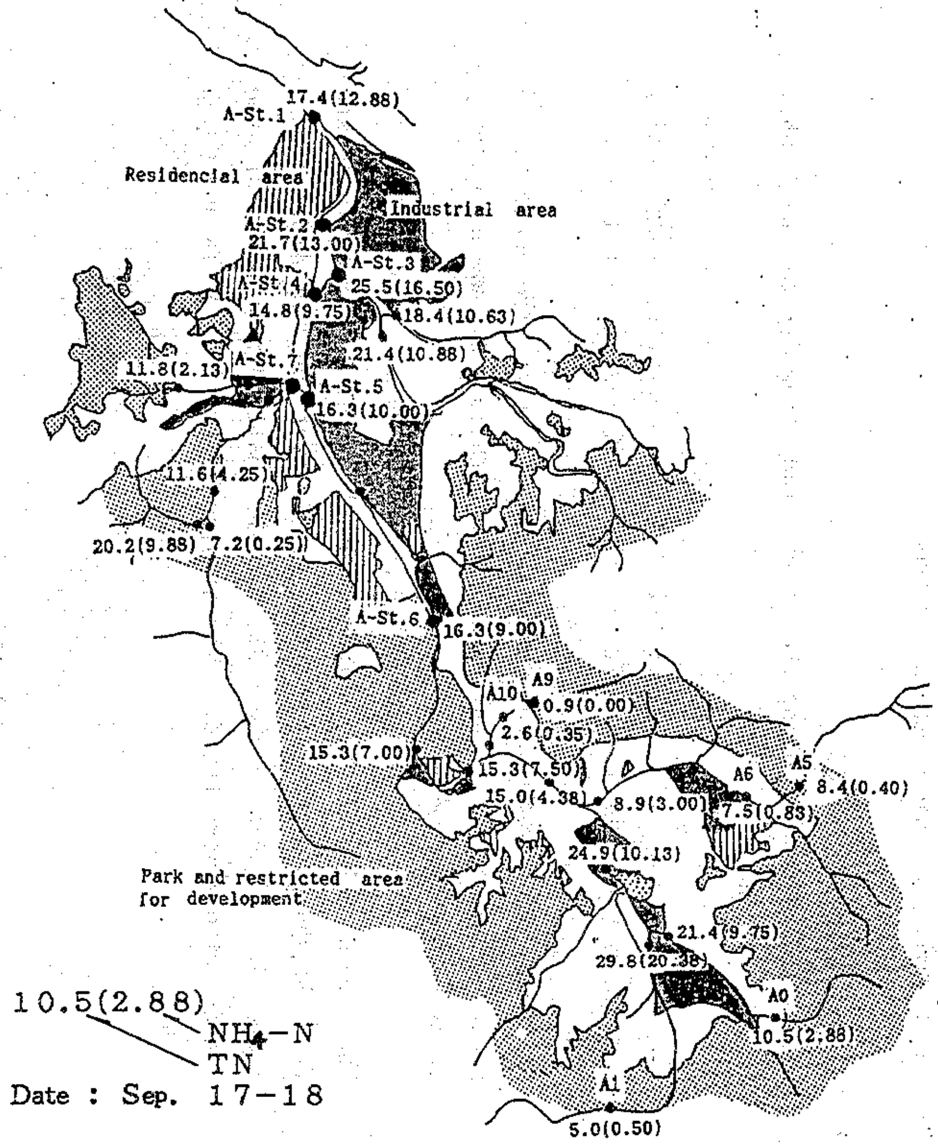


Fig. 3.1.3-1 TN and NH_4 -N in the Upper Stream and in the Study Area of Anyang Chong, September 17-18, 1990

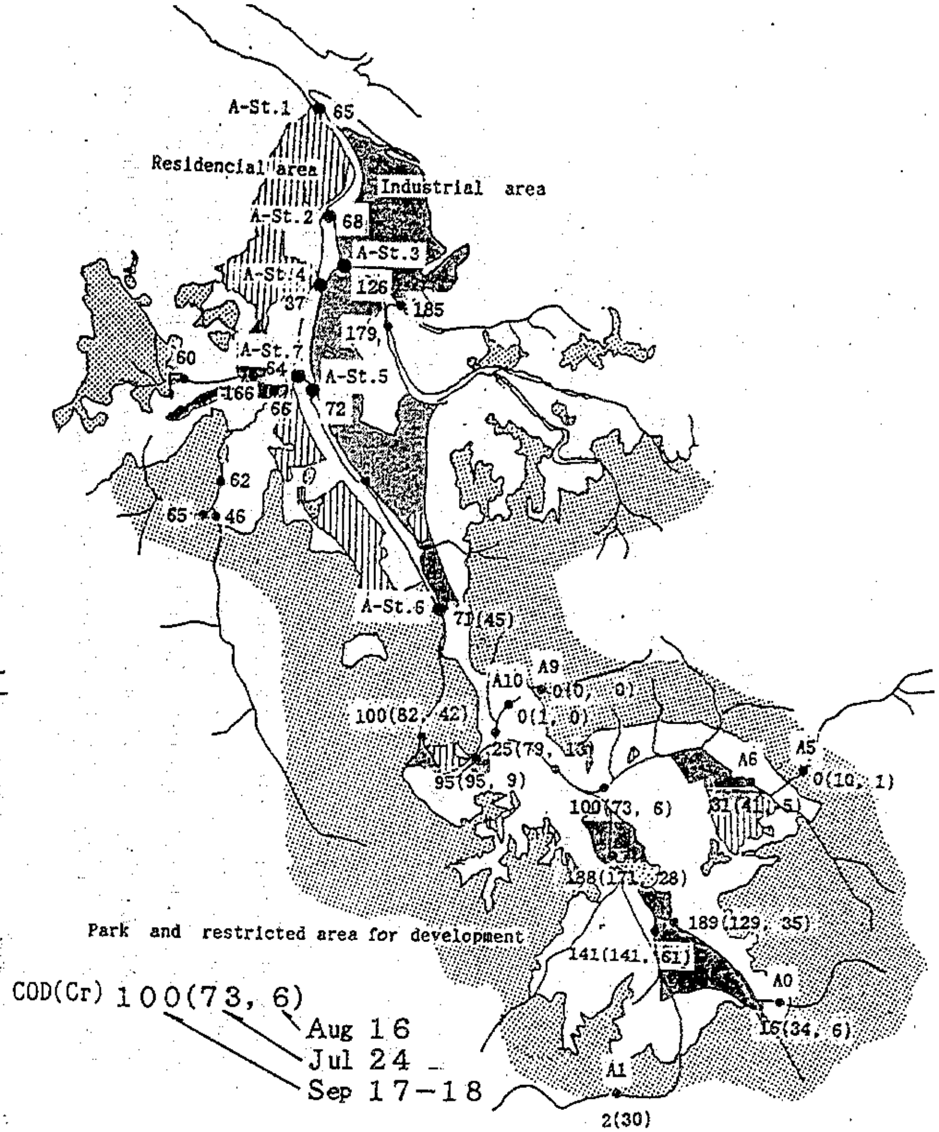


Fig. 3.1.3-2 COD(Cr) in the Upper Stream and in the Study Area of Anyang Chong, July 24, August 16 and September 17-18, 1990

COD(Cr), TN and NH_4-N values covering all of Anyang Chong are shown in Figs. 3.1.3-1 and 2.

Low concentrations of COD(Cr) and TN were obtained at Sts. A0, A1, A5, A9 and A10, which are located on the small branches. It was understood then that these sites have not yet been polluted by human activities, both domestic and industrial. The original water of Anyang Chong, therefore, seems to have these water quality levels.

It is thought that the domestic waste water flows down through many towns where sewage systems were not yet improved, therefore resulting in low quality downstream.

There are many industries on sides of this river from which untreated waste water are thought to be discarded. The results mentioned above clearly show that the untreated waste waters present serious pollution problems for the river, particularly, around Stns. AN2, AN3 and AN4, and T1 and D1. On those stations both COD(Cr) and TKN were recorded to be in significantly high concentrations.

(2) Water quality change in the study area

1) Changes in short period

The results obtained during the 17-day study from May to June, 1991, is discussed here.

Discharges were quite low at all stations, however, large daily variations were found at A-St. 4 and A-St. 7 (Tables 3.1.3-1-7).

The pollution load here was calculated using the practically measured values of discharges and concentrations of water quality items on the same occasion.

The concentration of each component of the water generally increased from the upper to the lower stations. However, between A-St. 4 and A-St. 5, and A-St.5 and A-St. 6, only small differences of the concentrations were found. The high concentrations of TR and NH_4-N

Table 3.1.3-1 Water Quality of Anyang Chong, A-St. 1, May-June, 1991
Discharge was practically measured on the same time.

Station	Date	COD(Mn) (mg/l)	COD(Cr) (mg/l)	SS-1 (mg/l)	SS-2 (mg/l)	SS-2(IL) (mg/l)	(IL)/ SS-2(%)	SS-2/ TR(%)	SS(IL)/ TR(%)	SS(IL)/ TR(IL)(%)	TR (mg/l)	TR(IL) (mg/l)	TR(IL)/ TR(%)	SM (mg/l)	SM(IL) (mg/l)	SM(IL)/ SM(%)	SM/TR (%)	SM/SS (%)	SM(IL)/ TR(IL)(%)	NH4-N (mg/l)	NO3-N (mg/l)	WT (°C)	DO (mg/l)	EC (mS/cm)	Discharge (m3/s)
A-St. 1-1	May 25	59.3	-	188	123.0	77.0	63	14	8	35	910	222.0	24	23.7	9.7	41	2.6	19	4.4	28.38	4.4	20.5	-	0.3	6.385
A-St. 1-2	"	70.1	-	267	167.0	87.0	52	16	8	36	1050	243.3	23	35.2	13.0	37	3.4	21	5.3	15.13	5.8	20.6	-	0.4	
A-St. 1-3	"	29.3	-	174	126.0	74.0	59	10	6	15	1286	478.0	37	33.2	11.7	35	2.6	26	2.4	16.13	7.0	20.3	-	0.4	
A-St. 1-1	May 30	30.1	114	85	46.7	31.4	67	9	6	12	545	254.0	47	12.7	2.0	16	2.3	27	0.8	20.63	1.5	22.8	-	0.5	7.094
A-St. 1-2	"	32.1	102	74	54.0	35.3	65	10	7	25	543	143.0	26	12.0	2.5	21	2.2	22	1.7	20.50	1.6	22.0	-	0.5	
A-St. 1-3	"	31.3	98	82	50.0	33.3	67	9	6	47	533	142.3	27	13.7	4.7	34	2.6	27	3.3	24.63	1.6	21.6	-	0.6	
A-St. 1-1	Jun. 8	46.6	157	98	75.3	52.6	70	11	8	44	701	157.0	22	6.6	3.6	55	0.9	9	2.3	29.13	0.6	25.2	1.8	0.1	3.696
A-St. 1-2	"	47.2	159	99	67.3	47.9	71	9	6	22	742	326.0	44	13.3	4.6	35	1.8	20	1.4	28.63	0.2	24.5	2.1	0.2	
A-St. 1-2	Jun. 24	-	109	97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.40	0.3	23.9	1.5	0.8	-
	Mea	43.3	123	129	88.7	54.8	64	11	7	30	788.8	245.7	31	18.8	6.5	34	2.3	22	2.7	21.95	2.6	22.4	1.8	0.4	
	SD	14.3	25	62	41.5	20.4	6	2	1	12	256.2	106.2	9	9.9	4.0	11	0.7	6	1.4	5.64	2.4	1.7	0.2	0.2	

Table 3.1.3-2 Water Quality of Anyang Chong, A-St. 2, May-June, 1991
Discharge was practically measured on the same time.

Station	Date	COD(Mn) (mg/l)	COD(Cr (mg/l	SS-1 (mg/l)	SS-2 (mg/l)	SS-2(IL) (mg/l)	(IL)/ SS-2(%	SS-2/ TR(%	SS(IL)/ TR(%)	SS(IL)/ TR(IL)(%)	TR (mg/l)	TR(IL) (mg/l)	TR(IL)/ TR(%)	SM (mg/l)	SM(IL) (mg/l)	SM(IL)/ SM(%)	SM/T (%)	SM/SS (%)	SM(IL)/ TR(IL)(%	NH4-N (mg/l	NO3-N (mg/l	WT (°C)	DO (mg/l)	EC (mS/cm)	Discharge (m3/s)
A-St. 2-3	May 24	66.8	-	120	74.7	51.3	69	9	6	16	845	319.3	38	29.8	14.0	47	3.5	40	39	18.38	7.3	21.8	-	0.1	1.958
A-St. 2-2	"	55.4	-	124	62.0	49.9	80	8	6	17	780	287.3	37	24.9	12.9	52	3.2	40	39	18.80	5.4	22.0	-	0.1	
A-St. 2-1	May 30	29.7	104	67	40.0	38.0	95	7	7	31	541	123.7	23	17.7	3.3	19	3.3	44	4	20.13	1.5	22.7	-	0.4	3.490
A-St. 2-2	"	30.1	114	66	36.0	26.7	74	7	5	15	546	178.0	33	7.2	2.5	35	1.3	20	6	20.75	1.2	22.5	7.0	0.5	
A-St. 2-3	"	27.7	102	65	43.3	33.9	78	7	6	18	588	185.3	32	16.8	4.3	26	2.9	39	6	19.50	1.0	22.9	-	0.4	
A-St. 2-2	Jun.	48.9	167	93	62.0	47.3	76	8	6	16	821	293.0	36	12.0	5.3	44	1.5	19	6	31.75	0.3	27.6	-	0.1	3.256
A-St. 2-2	Jun. 2	33.3	82	115	23.5	21.0	89	4	4	6	555	351.0	63	-	-	-	-	-	-	24.70	0.3	26.1	0.9	0.4	
	Mean	41.7	114	93	48.8	38.3	80	7	6	17	668	248.2	37	18	7	37	2.6	33.7	17	22.00	2.4	23.7	4.0	0.3	
	SD	14.2	29	25	16.6	10.9	8	1	1	7	130	78.9	12	8	5	12	0.9	10.1	16	4.42	2.6	2.1	3.1	0.2	

Table 3.1.3-3 Water Quality of Anyang Chong, A-St. 3, May-June, 1991
Discharge was practically measured on the same time.

Station	Date	COD(Mn) (mg/l)	COD(Cr (mg/l	SS-1 (mg/l)	SS-2 (mg/l)	SS-2(IL) (mg/l)	(IL)/ SS-2(%	SS-2/ TR(%	SS(IL)/ TR(%)	SS(IL)/ TR(IL)(%)	TR (mg/l)	TR(IL) (mg/l)	TR(IL)/ TR(%)	SM (mg/l)	SM(IL) (mg/l)	SM(IL)/ SM(%)	SM/T (%)	SM/SS (%)	SM(IL)/ TR(IL)(%	NH4-N (mg/l	NO3-N (mg/l	WT (°C)	DO (mg/l)	EC (mS/cm)	Discharge (m3/s)
A-St. 3-1	May 2	19.8	-	24	43.3	19.3	45	13	6	23	340	82.9	24	12.8	5.2	41	4	30	6	0.00	1.2	21.8	-	0.7	0.057
A-St. 3-1	"	19.0	-	20	30.7	18.0	59	6	6	47	323	38.7	12	15.3	5.7	37	5	50	15	0.00	1.0	21.7	-	0.7	
A-St. 3-1	May 3	13.4	26	77	82.7	20.0	24	6	6	36	338	55.3	16	44.2	18.0	41	13	53	33	10.50	1.9	22.2	-	0.8	0.040
A-St. 3-1	Jun.	16.7	62	41	46.3	37.6	81	7	7	14	510	270.0	53	17.7	12.0	68	3	38	4	11.75	0.2	27.4	7.0	0.75	0.096
A-St. 3-1	Jun. 2	12.4	(0)	65	20.0	10.0	50	4	4	4	256	236.0	92	-	-	-	-	-	-	9.60	0.5	26.6	-	0.7	
	Mean	16.3	44	45	44.6	21.0	52	7	6	25	353	136.6	40	23	10	47	6	43	14	6.37	1.0	23.9	7.0	0.7	
	SD	2.9	18	22	21.2	9.0	19	3	1	15	84	96.7	30	13	5	12	4	9	11	5.25	0.6	2.5	0.0	0.0	

Table 3.1.3-4 Water Quality of Anyang Chong, A-St. 4, May-June, 1991
Discharge was practically measured on the same time.

Station	Date	COD(Mn) (mg/l)	COD(Cr (mg/l	SS-1 (mg/l)	SS-2 (mg/l)	SS-2(IL) (mg/l)	(IL)/ SS-2(%	SS-2/ TR(%	SS(IL)/ TR(%)	SS(IL)/ TR(IL)(%)	TR (mg/l)	TR(IL) (mg/l)	TR(IL)/ TR(%)	SM (mg/l)	SM(IL) (mg/l)	SM(IL)/ SM(%)	SM/T (%)	SM/SS (%)	SM(IL)/ TR(IL)(%	NH4-N (mg/l	NO3-N (mg/l	WT (°C)	DO (mg/l)	EC (mS/cm)	Discharge (m3/s)
A-St. 4-3	May 2	57.4	-	113	68.0	48.7	72	8	6	17	847	279.9	33	28.4	15.1	53	3	42	5	18.50	4.6	21.9	-	0.1	1.565
A-St. 4-2	"	56.8	-	118	74.7	52.7	71	6	6	17	826	308.9	37	23.0	12.7	55	3	31	4	17.25	4.0	21.9	-	0.1	
A-St. 4-2	May 2	33.4	84	87	95.3	53.9	57	8	8	52	642	103.0	16	31.8	10.9	34	5	33	11	19.00	0.8	26.1	-	0.35	5.962
A-St. 4-1	"	49.1	113	108	204.0	71	35	11	11	56	673	127.6	19	153.0	43.0	28	23	75	34	18.75	0.8	26.9	-	0.3	
A-St. 4-1	Jun.	42.1	120	51	54.7	36.0	66	5	5	25	681	146.3	21	19.4	8.1	42	3	35	6	24.63	2.3	29.8	1.1	0.1	2.929
A-St. 4-2	"	41.7	114	52	40.0	29.3	73	4	4	16	687	181.7	26	6.3	2.0	32	1	16	1	25.25	2.4	29.5	1.7	0.1	
A-St. 4-3	"	40.9	148	49	45.3	31.3	69	4	4	10	747	304.3	41	9.3	3.0	32	1	21	1	25.50	2.2	30.2	1.8	0.1	
A-St. 4-5	Jun. 2	-	76	129	-	-	-		-	-	-	-	-	-	-	-	-	-	-	23.00	0.4	-	3.3	0.6	
	Mean	45.9	109	88	83.1	46.1	63	7	6	28	729	207.4	28	38.7	13.5	40	6	36	9	21.49	2.2	26.6	2.0	0.2	
	SD	8.2	24	31	52.3	13.8	13	2	2	17	74	81.6	9	47.4	12.8	10	7	18	11	3.22	1.4	3.3	0.8	0.2	

Table 3.1.3-5 Water Quality of Anyang Chong, A-St. 5, May-June, 1991
Discharge was practically measured on the same time.

Station	Date	COD(Mn) (mg/l)	COD(Cr (mg/l	SS-1 (mg/l)	SS-2 (mg/l)	SS-2(IL) (mg/l)	(IL)/ SS-2(%	SS-2/ TR(%	SS(IL)/ TR(%)	SS(IL)/ TR(IL)(%)	TR (mg/l)	TR(IL) (mg/l)	TR(IL)/ TR(%)	SM (mg/l)	SM(IL) (mg/l)	SM(IL)/ SM(%)	SM/T (%)	SM/SS (%)	SM(IL)/ TR(IL)(%	NH4-N (mg/l	NO3-N (mg/l	WT (°C)	DO (mg/l)	EC (mS/cm)	Discharge (m3/s)
A-St. 5-2	May 23	74.1	-	110	131.0	77.0	59	10	10	27	795	280.7	35	61.5	25.3	41	8	47	9	15.25	4.7	31	2.3	0.1	2.370
A-St. 5-2	May 29	32.1	108	63	74.0	29.3	40	5	5	21	583	139.0	24	36.0	11.0	31	6	49	8	17.50	1.3	24.6	-	0.3	4.598
A-St. 5-2	Jun. 7	40.5	120	45	43.3	28.0	65	4	4	11	706	266.0	38	8.0	2.5	31	1	18	1	25.25	2.3	30.0	0.6	0.1	3.072
A-St. 5-2	Jun. 2	35.3	103	108	39.5	30.0	76	5	5	7	566	408.0	72	-	-	-	-	-	-	26.20	0.3	-	0.9	0.2	
	Mean	45.5	110	82	72.0	41.1	60	6	6	17	663	273.4	42	35.2	12.9	34	5	38	6	21.05	2.2	26.5	1.3	0.2	
	SD	16.8	7	28	36.6	20.8	13	2	2	8	94	95.2	18	21.8	9.4	5	3	14	4	4.75	1.6	2.8	0.7	0.1	

Table 3.1.3-6 Water Quality of Anyang Chong, A-St. 6, May-June, 1991
Discharge was practically measured on the same time.

Station	Date	COD(Mn) (mg/l)	COD(Cr (mg/l	SS-1 (mg/l)	SS-2 (mg/l)	SS-2(IL) (mg/l)	(IL)/ SS-2(%	SS-2/ TR(%	SS(IL)/ TR(%)	SS(IL)/ TR(IL)(%)	TR (mg/l)	TR(IL) (mg/l)	TR(IL)/ TR(%)	SM (mg/l)	SM(IL) (mg/l)	SM(IL)/ SM(%)	SM/T (%)	SM/SS (%)	SM(IL)/ TR(IL)(%	NH4-N (mg/l	NO3-N (mg/l	WT (°C)	DO (mg/l)	EC (mS/cm)	Discharge (m3/s)
A-St. 6-1	May 23	60.1	-	84	68.0	56.9	84	11	9	18	640	314.3	49	13.9	8.3	60	2.2	20	3	14.00	4.6	31.5	1.6	0.2	2.460
A-St. 6-1'	"	(82.2)	-	(130)	(135	(86.9)	-	-	-	-	(823)	(251.6	-	(54.0)	(26.4)	-	-	-	-	11.50	6.5	34.2	5.3	0.1	
A-St. 6-2	"	53.4	-	66	77.0	55.9	73	11	8	28	694	202.6	29	30.8	14.2	46	4.4	40	7	15.38	4.4	30.8	0.3	0.1	
A-St. 6-1	May 29	32.6	88	41	42.7	26.7	63	8	5	24	527	109.7	21	16.7	10.0	60	3.2	39	9	15.63	1.7	24.8	-	0.4	5.051
A-St. 6-2	"	38.1	106	40	33.3	20.6	62	6	4	14	544	144.0	26	13.3	7.3	55	2.4	40	5	16.13	1.8	23.9	-	0.4	
A-St. 6-3	"	33.1	132	45	36.0	22.7	63	7	4	11	550	215.0	39	10.0	8.7	87	1.8	28	4	17.50	1.6	23.3	-	0.4	
A-St. 6-1	Jun.	34.1	114	55	38.0	28.0	74	6	4	18	648	154.7	24	4.5	2.5	56	0.7	12	2	20.88	1.3	26.8	2.6	0.2	3.673
A-St. 6-2	"	34.5	106	39	32.7	24.7	76	5	4	19	622	127.3	20	4.0	2.0	50	0.6	12	2	20.75	1.0	26.4	2.0	0.2	
A-St. 6-3	"	38.1	122	39	42.0	30.7	73	7	5	17	623	185.7	30	14.0	6.0	43	2.2	33	3	23.88	1.4	26.4	1.5	0.1	
	Mean	40.5	111	51	46.2	33.3	71	8	5	19	606.0	181.7	30	13.4	7.4	57	2.2	28	4	17.29	2.7	27.5	2.2	0.2	
	SD	9.7	14	15	15.7	13.7	7	2	2	5	55.3	60.7	9	7.9	3.7	13	1.2	11	2	3.66	1.8	3.5	1.5	0.1	

Table 3.1.3-7 Water Quality of Anyang Chong, A-St. 7, May-June, 1991
Discharge was practically measured on the same time.

Station	Date	COD(Mn) (mg/l)	COD(Cr (mg/l	SS-1 (mg/l)	SS-2 (mg/l)	SS-2(IL) (mg/l)	(IL)/ SS-2(%	SS-2/ TR(%	SS(IL)/ TR(%)	SS(IL)/ TR(IL)(%)	TR (mg/l)	TR(IL) (mg/l)	TR(IL)/ TR(%)	SM (mg/l)	SM(IL) (mg/l)	SM(IL)/ SM(%)	SM/T (%)	SM/SS (%)	SM(IL)/ TR(IL)(%	NH4-N (mg/l	NO3-N (mg/l	WT (°C)	DO (mg/l)	EC (mS/cm)	Discharge (m3/s)
A-St. 7-1	May 23	58.8	-	108	90.0	69.9	78	17	13	26	518	273.7	53	24.3	14.2	58	4.7	27	5	21.38	4.6	31.3	2.4	0.3	0.302
A-St. 7-2	"	59.5	-	109	89.0	72.4	81	18	15	39	497	184.1	37	29.3	16.4	56	5.9	33	9	21.00	4.4	30.5	1.6	0.4	
A-St. 7-2	May 29	80.2	375	300	262.0	130.0	50	39	19	65	679	199.0	29	80.0	22.0	28	11.8	31	11	27.82	1.7	26.9	-	0.4	0.511
A-St. 7-3	"	82.2	364	269	258.7	127.7	49	41	20	72	633	177.0	28	107.0	16.7	16	16.9	41	9	32.50	1.4	26.5	-	0.4	
A-St. 7-1	Jun.	41.6	126	70	59.3	41.9	71	13	9	28	462	149.3	32	10.0	4.7	47	2.2	17	3	25.88	2.0	29.3	1.3	0.6	0.033
A-St. 7-2	"	43.1	126	88	75.3	46.6	62	15	9	26	493	179.0	36	24.6	10.6	43	5.0	33	6	26.00	2.0	29.0	1.6	0.5	
A-St. 7-2	Jun. 2	38.6	91	159	44.0	39.5	90	12	10	15	377	257.0	68	-	-	-	-	-	-	25.30	0.4	-	3.5	0.6	-
	Mean	57.7	216	158	125.5	75.4	69	22	14	39	523	202.7	41	45.9	14.1	41	8	30	7	25.70	2.4	28.9	2.1	0.5	
	SD	16.7	126	85	86.6	35.8	15	11	4	20	95	42.1	14	35.1	5.4	15	5	7	3	3.62	1.4	1.7	0.8	0.1	

Table 3.1.3-8 Pollution Load of Anynag Chong in Short Period, May 23-June 8, 1991
Discharge: Actual measurement value

		COD(Mn) (ton/day)	BOD (ton/day)	SS (ton/day)	TR (ton/day)	NH4-N (ton/day)	NO3-N (ton/day)
May 23, '91	A-St. 5	15.2	21.5	26.8	162.8	3.12	0.96
	A-St. 6	12.1	21.9	15.4	141.8	2.90	1.20
	A-St. 7	1.6	2.3	2.3	13.3	0.56	0.12
May 24, '91	A-St. 2	10.4	20.9	11.6	137.6	3.15	1.70
	A-St. 3	0.1	0.07	0.18	1.6	-	0.54
	A-St. 4	7.7	11.9	9.6	112.7	2.41	0.58
May 25, '91	A-St. 1	28.2	43.7	74	577.3	10.61	3.06
May 29, '91	A-St. 4	21.2	27.7	77.1	338.6	9.72	0.41
	A-St. 5	12.8	11.0	29.4	231.7	6.96	0.52
	A-St. 6	15.1	18.6	16.3	235.8	7.17	0.74
	A-St. 7	3.6	5.9	11.5	29.0	1.33	0.69
May 30, '91	A-St. 1	21.1	28.3	34.1	366.3	14.86	1.06
	A-St. 2	8.8	7.1	12.0	168.4	6.07	0.37
	A-St. 3	0.05	-	0.29	1.2	0.04	0.01
June 7, '91	A-St. 4	10.5	13.8	11.8	178.4	6.40	0.58
	A-St. 5	10.7	11.5	11.5	187.3	6.70	0.61
	A-St. 6	11.3	14.3	11.9	200.1	6.90	0.39
	A-St. 7	0.1	0.2	0.2	1.4	0.07	0.06
June 8, '91	A-St. 1	18.6	27.9	28.3	283.2	11.50	0.16
	A-St. 2	13.8	24.0	76.7	231.0	8.90	0.08
	A-St. 3	0.14	0.04	0.38	1.4	0.10	0.02

Table 3.1.3-9 Mean Value of the Pollution Load of Anyang Chong during the Survey Period from November, 1990, to May, 1991

I Station	BOD (ton/day)	COD(Mn) (ton/day)	SS (ton/day)	NH4-N (ton/day)
A-St. 1	31.14	34.08	27.18	6.94
A-St. 2	35.48	43.12	33.42	8.83
A-St. 3	3.45	4.44	4.10	0.92
A-St. 4	23.88	27.6	29.41	5.60
A-St. 5	16.28	16.99	18.12	3.90
A-St. 6	22.07	21.25	18.18	4.70

were particularly found at A-St. 7. On the other hand, the all components of the water at A-St. 3 were observed in considerably lower values. This is in spite of both stations having the same conditions in terms of locations; on the mouth of small branches.

It is hard to discuss consistently from A-St. 6 to A-St. 1 including A-St. 7 and A-St. 3, for water quality results were obtained on the different dates and discharges varied every day. Therefore, only the pollution load calculated on each sampling date at several stations are discussed, here (Table 3.1.3-8).

There seemed an underground stream between A-St. 6 and A-St. 5, and A-St. 5 and A-St. 4, therefore, no differences of load between those stations were found. It is believed that during this time there was no additional load from side-inflow, or if any it was significantly small. Pollution load at A-St. 1 was constantly accumulated, and it was found in greater values than at A-St. 2.

Discharges at A-St. 3 and A-St. 7 were so small that the contributions of their pollution load to the total were negligible, in spite of the concentrations were quite high.

It became obvious that the survey of changes on water quality and pollution load from upper to lower streams should be conducted on the same dates and same time.

2) Changes during this survey period

COD(Mn) concentration tended to increase from the upper to the lower stations until May, 1990. However, results were not clear after that. According to the remarkably high COD(Mn) concentrations at A-St. 3 from January to May, 1990, it was believed that Torim Chong was seriously polluted before the sewer pipe construction. On the other hand, high COD(Mn) concentrations were found on many cases at A-St. 7 in 1991, which indicated it is progressing the pollution on Kaehwa Chong (Fig. 3.1.3-3).

The changes on BOD and SS showed similar patterns to COD(Mn). There

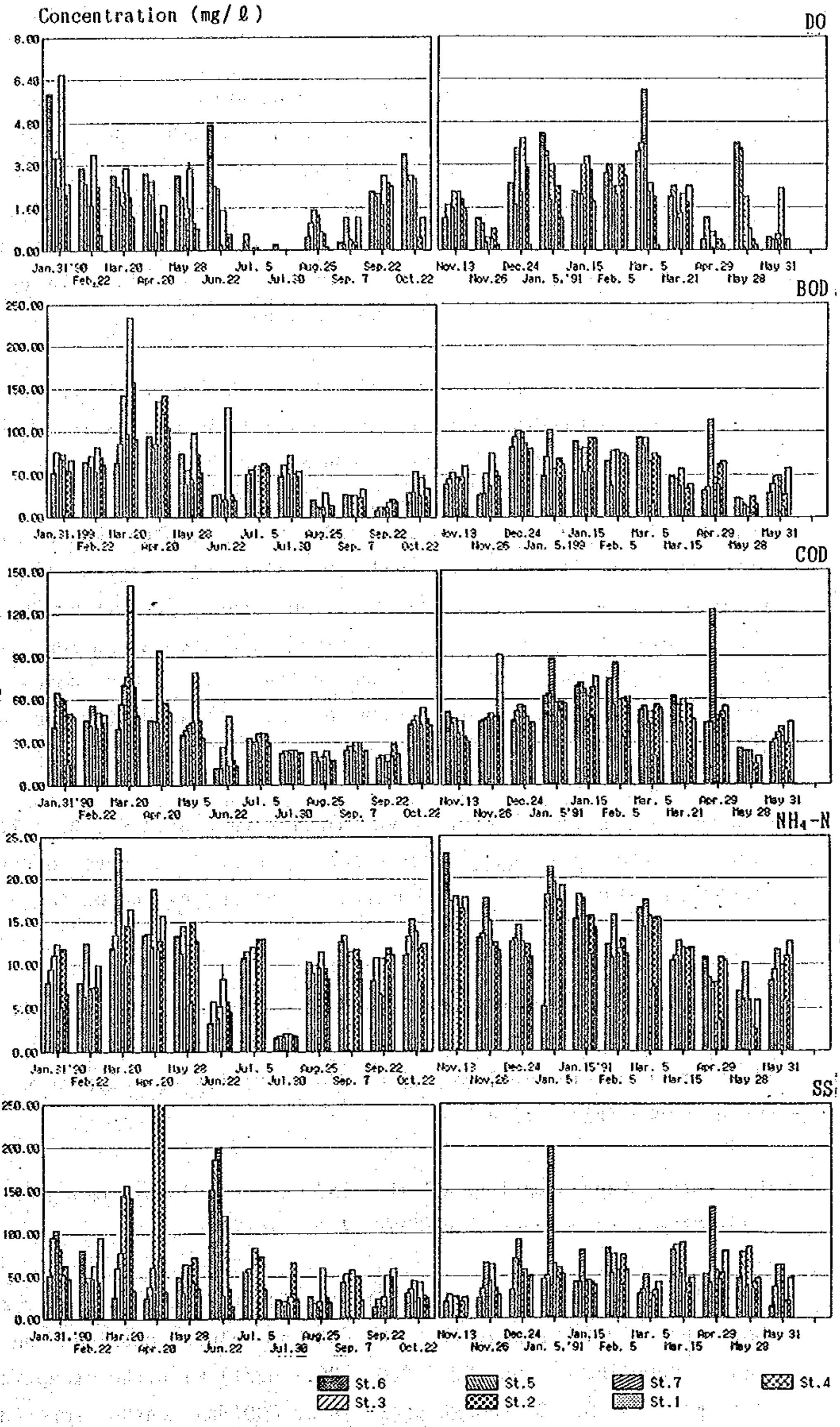


Fig. 3.1.3-3 Water Quality Change from the Upper to the Lower Stations of Anyang Chong

was no observed changes in NH_4-N concentrations. NH_4-N was also higher at A-St. 7 than at any other station after October, 1990. Table 3.1.3-9 shows the mean values from November , 1990, to May, 1991, of the pollution load of each station. During this time, the water levels were recorded by an automatic water level recorder, then the discharges were estimated more accurately than using the all values of gauge throughout the sampling period.

The load at A-St. 5 was lower than at A-St. 6 due to the underground stream between those stations. At A-St. 4 the load was increased by additional loads from side-inflow and Kaehwa Chong.

The variance of pollution load at A-St. 3 was greater than at other stations, and the values of load were relatively higher than the results obtained during the short period survey. For it was thought that this calculation also contained the concentration values before sewer pipe construction completion. It is considered that the present value is the same level of that obtained from the short period survey.

The pollution load at A-St. 1 was smaller than at A-St. 2. It is supposed that the back water effect by Hang Gang gave error on discharge values, and it was underestimated during the period.

3.1.4 Side-inflow into Anyang Chong

There are many side-inflows which flow directly or indirectly into Anyang Chong (Fig. 3.1.4-1).

The surveys and samplings of side-inflows into Anyang Chong in the study area were conducted on June 14-15, 1990.

COD(Mn) of the water from these direct side-inflows (16.0-78.2 mg/l) where relatively higher than the COD(Mn) values obtained on the regular sampling on June 22 (12.0 - 26.7 mg/l) with the exception of 48.1 mg/l at St. 3, though there is no COD(Mn) datum for Anyang

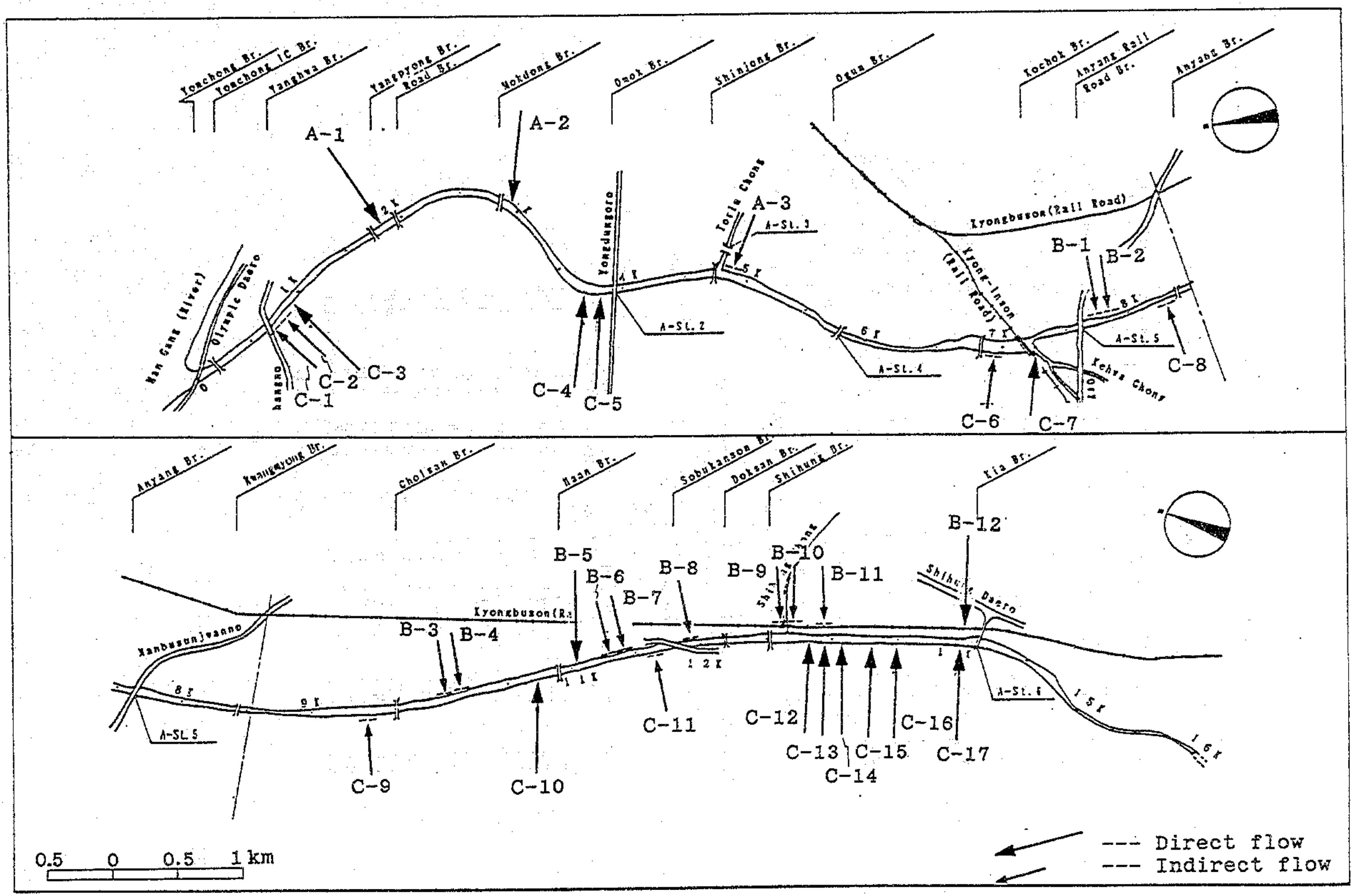


Fig. 3.1.4-1 Side-inflow into Anyang Chong

Table 3.1.4-1 Water Quality of Side-inflow into Anyang Chong

Date of survey: June 14-15, 1990,
Weather: 14- Cloudy and windy
15- Clear
AT: 14-23.3°C(10:40)

Item	WT (°C)	pH	DO (mg/l)	EC (mS/cm)	Turbid. (mg/l)	COD(Mn) (mg/l)	SS (mg/l)	Discharge (m3/s)	Load COD(Mn) (t/day)	Load SS (t/day)
Station										
A-1#	22.6	4.7	4.3	0.8	45	78.2	118	-		
A-2"	22.4	5.1	2.5	0.7	23	50.8	71	0.977	4.288	5.993
B-5	24.6	6.7	0.0	-	-	45.4	40	0.499	1.957	6.765
B-12	21.1	7.0	1.7	-	-	60.1	126	0.008	0.042	0.452
C-3	21.0	7.9	2.7	0.4	-	36.7	51	0.001	0.003	0.014
C-4"	24.0	7.9	0.1	0.8	-	39.4	56	-	-	-
C-5"	22.8	7.5	0.2	0.7	-	47.4	53	-	-	-
C-7	20.7	7.3	1.8	0.9	-	49.8	62	0.935	4.023	21.551
C-10	18.2	7.3	3.2	0.7	-	24.0	25	0.116	0.241	0.520
C-12	20.6	7.3	0.8	0.8	-	54.8	69	0.002	0.009	0.056
C-13	20.4	6.9	1.0	0.8	-	56.1	63	0.029	0.141	0.765
C-14	18.9	7.2	2.4	0.9	-	32.1	107	0.002	0.006	0.051
C-15	25.6	2.1	6.9	0.9	-	16.0	30	0.008	0.011	0.029
C-16	18.5	7.4	1.1	0.8	-	69.5	125	0.002	0.012	0.130
C-17	22.5	7.7	1.2	0.7	-	34.7	28	0.326	0.977	2.364
								Total(t/day)	11.71	38.69

": Pumping Station
#: Sewerage pype was under construction, therefore, the sewere was drained to Anyang Chong.

Table 3.1.4-2 Quality of Water from the Intercepting Sewer Installated on the Riverbed of Anyang Chong

Date of survey: June 14-15, 1990
Weather: 14-Cloudy and windy
15-Clear
AT: 23.3°C(10:40)

Item	WT (°C)	pH	DO (mg/l)	COD(Mn (mg/l)	SS (mg/l)	Discharge (m3/s)	Load COD(Mn (t/day	Load SS (t/day)
Station								
B-1	21.5	6.8	0.1	54.8	93	0.248	1.17	1.99
B-2	21.5	6.8	1.0	57.4	116	0.146	0.72	1.46
B-3	20.1	6.9	1.0	56.1	77	0.253	1.23	1.68
B-4	20.0	6.8	1.1	58.8	102	0.243	1.23	2.14
B-6	19.7	7.4	1.8	46.8	70	0.166	0.67	1.00
B-7	19.7	7.4	1.6	80.2	50	0.164	1.14	0.71
B-8	22.6	6.7	2.3	57.4	78	0.011	0.05	0.07
B-9	19.7	7.0	1.4	42.8	63	0.270	1.00	1.47
B-10	19.7	6.8	2.4	42.8	63	0.919	3.40	5.00
B-11	19.8	6.9	1.5	52.1	94	0.209	0.94	1.70
C-1	18.5	7.4	3.0	43.4	64	0.005	0.02	0.03
C-2	20.8	7.8	3.5	64.8	102	0.004	0.02	0.04
C-6	21.9	7.3	0.3	42.1	63	0.416	1.51	2.26
C-8	21.4	7.5	0.9	42.1	51	0.072	0.26	0.32
C-9	20.1	7.7	0.0	50.1	51	0.090	0.39	0.40
C-11	23.0	7.7	0.3	81.5	21	0.096	0.68	0.17
						Total(t/day)	14.44	20.45

Chong water on the same date (Tables 3.1.4-1 and 2). The total inflow load of COD(Mn) from direct side-inflow was 11.7 ton/day. Side-inflow of C-7, of which the load was 4.0 ton/day, was located between A-St. 4 and A-St. 5. This value plus the load from Kaehwa Chong, which was not estimated due to lack of discharge data, seems enough to increase the load level from A-St. 5 to the load level at A-St. 4.

On the other hand, the SS of the water from these side-inflows (28 mg/l- 126 mg/l) was in the same range as the Anyang Chong water on June 22. The total load of SS that inflowed directly was 38.7 ton/day.

The inflowing water in larger volume originated from the pumping stations, therefore, it is necessary to take account of inflowing from pumping stations.

The load of COD(Mn) from indirect side-inflows was greater (14.4 ton/day) than direct side-inflows, however, the load of SS was almost half of the direct one. It is clear that these additional loads occurs on rainy days.

3.1.5 Water Quality and Flow-out Load at Freshet Time

The survey was carried out on September 10 and 11, 1990.

The precipitation on 10th was 255.5 mm and on the 11th it was 102.0 mm around the Anyang Junior High School.

The survey and sampling started on September 10 at 16:00, which was 10 hours after the beginning of the rainfall. The survey and the sampling were continued for 11 hours during the rain. Water level readings increased during the sampling time (Tables 3.1.5-1-4, Fig. 3.1.5-1).

DO value (1.9 - 2.8 mg/l) was almost the same or slightly higher

Sampling date : Sep. 10-11, 1990

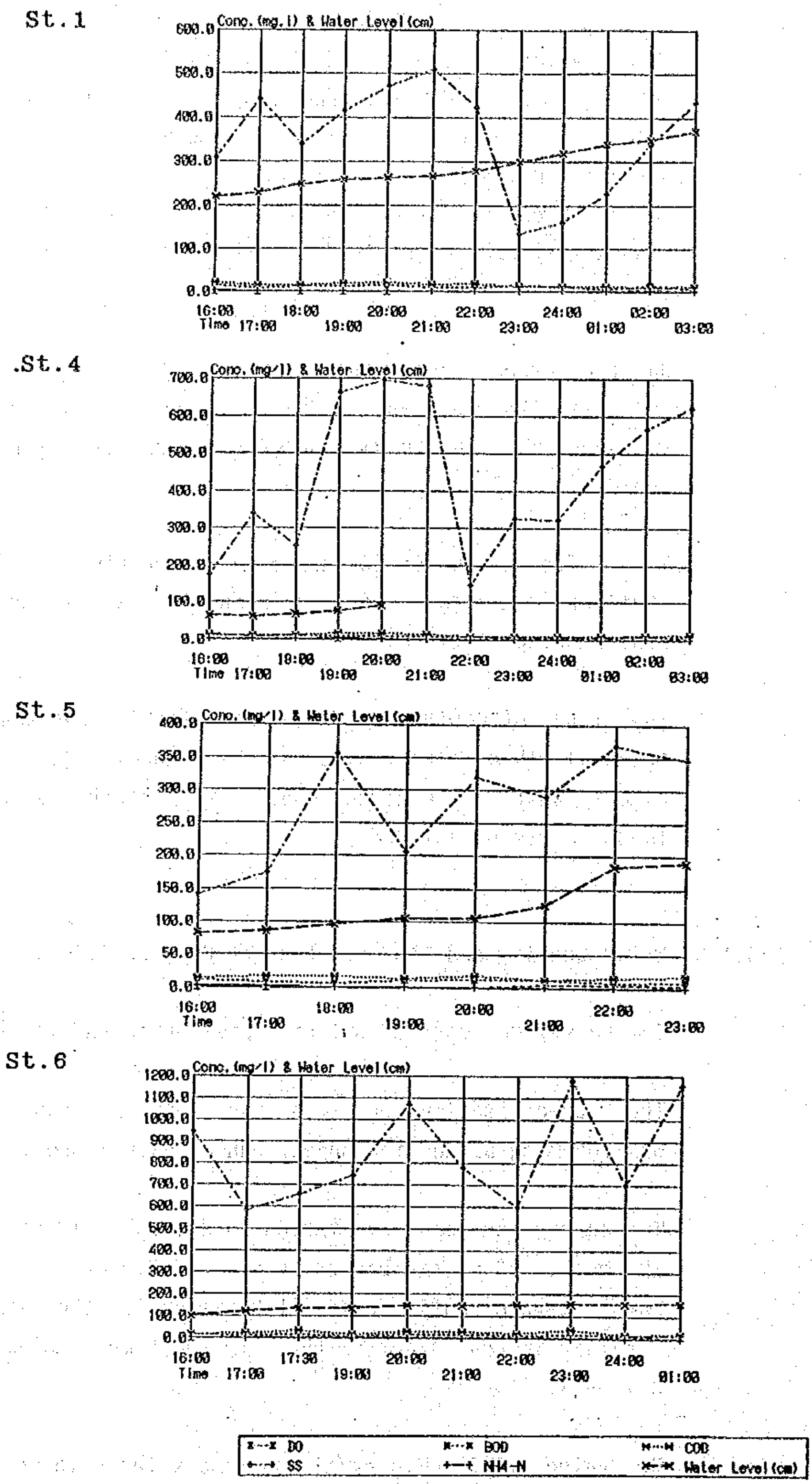


Fig. 3.1.5-1 Water Quality at Freshet Time of Anyang Chong, September 10-11, 1990

Table 3.1.5-1 Water Quality of Anyang Chong at Freshet Time, A-St.1
September 10-11, 1990
Precipitation: 255.5 mm (10th) and 102.0 mm (11th)

Item Time	WT (°C)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	SS (mg/l)	NH4-N (mg/l)	Coli- form (MPN/100ml)	Gauge (cm)	Discharge (m3/s)
16:00	24.2	0.6	15.7	22.0	309.7	3.92	420	220	212.880
17:00	24.1	0.5	8.4	15.5	442.7	2.97	560	230	228.376
18:00	23.8	0.4	12.9	15.1	339.0	2.92	480	250	260.629
19:00	23.8	1.0	12.3	18.6	415.9	2.22	620	260	277.387
20:00	23.2	1.0	14.5	21.6	472.5	2.35	980	265	285.923
21:00	23.1	1.6	11.4	17.3	508.4	2.21	820	268	291.096
22:00	22.2	3.1	11.5	18.6	425.0	1.48	750	280	312.164
23:00	21.8	3.0	15.0	12.9	135.1	2.08	720	300	348.624
24:00	22.0	3.0	12.6	12.5	159.7	1.73	680	320	386.766
01:00	21.8	2.7	7.5	12.6	226.4	1.60	650	340	426.591
02:00	21.6	3.3	14.6	11.7	339.3	1.43	620	350	447.135
03:00	21.3	2.6	5.7	12.1	435.8	1.32	580	370	489.484

Table 3.1.5-2 Water Quality of Anyang Chong at Freshet Time, A-St. 4
September 10-11, 1990
Precipitation: 255.5 mm (10th) and 102.0 mm (11th)

It Time	WT (°C)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	SS (mg/l)	NH4-N (mg/l)	Coli- form (MPN/100ml)	Gauge (cm)	Discharge (m3/s)
16:00	23.6	2.3	15.6	12.9	173.4	3.69	580	65	24.570
17:00	23.5	2.7	9.4	13.4	338.4	2.30	680	63	23.571
18:00	23.4	2.4	13.8	12.9	253.7	3.28	740	67	25.593
19:00	23.1	1.8	9.3	17.7	663.1	4.13	890	78	31.647
20:00	22.7	2.1	9.3	17.3	695.1	1.87	920	90	39.076
21:00	22.4	3.0	9.9	16.0	680.9	1.38	1100	-	
22:00	22.0	3.4	10.8	11.2	147.1	0.67	980	-	
23:00	21.6	2.8	8.1	9.1	325.1	1.44	920	-	
24:00	21.0	3.0	8.1	10.4	323.2	1.53	870	-	
01:00	21.0	3.2	8.4	9.1	467.6	0.86	820	-	
02:00	20.9	2.9	9.6	12.1	566.0	1.62	760	-	
03:00	21.7	3.8	10.2	14.2	621.0	2.01	640	-	

Table 3.1.5-3 Water Quality of Anyang Chong at Freshet Time, A-St. 5
September 10-11, 1990
Precipitation: 255.5 mm (10th) and 102.0 mm (11th)

It Time	WT (°C)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	SS (mg/l)	NH4-N (mg/l)	Coli- form (MPN/100ml)	Gauge (cm)	Discharge (m3/s)
16:00	23.5	0.1	11.1	14.7	141.6	2.63	520	83	22.273
17:00	23.5	0.1	9.0	16.8	174.2	2.35	480	85	22.964
18:00	23.4	1.2	6.9	17.3	354.8	2.10	620	96	26.979
19:00	23.3	1.6	11.7	14.2	205.9	1.89	740	105	30.537
20:00	23.1	1.4	12.9	18.1	319.0	1.88	890	106	30.947
21:00	22.8	5.1	13.2	13.4	290.8	1.22	920	125	48.933
22:00	21.6	6.0	8.4	15.5	368.8	0.75	980	185	116.535
23:00	21.4	4.7	10.5	18.1	346.8	1.24	810	190	122.978

Table 3.1.5-4 Water Quality of Anyang Chong at Freshet Time, A-St. 6
September 10-11, 1990
Precipitation: 255.5 mm (10th) and 102.0 mm (11th)

It Time	WT (°C)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	SS (mg/l)	NH4-N (mg/l)	Coli- form (MPN/100ml)	Gauge (cm)	Discharge m3/s)
16:00	23.5	2.0	15.9	18.6	943.1	2.16	480	100	92.097
17:00	23.4	3.8	12.9	21.1	583.9	1.57	520	120	125.027
17:30	24.0	4.0	18.3	34.1	659.3	1.59	590	136	152.373
19:00	23.2	4.3	9.6	16.0	743.0	1.73	620	136	152.373
20:00	23.0	3.7	17.1	30.6	1070.0	1.58	650	146	169.915
21:00	22.8	4.2	17.7	30.8	779.0	1.42	780	148	173.465
22:00	22.7	5.7	12.3	20.3	602.4	1.12	820	150	177.029
23:00	22.5	4.9	18.9	37.1	1177.0	1.19	800	155	186.001
24:00	22.4	5.2	12.9	18.6	702.1	0.77	740	157	189.613
01:00	22.1	4.8	15.3	20.7	1158.0	1.25	720	162	198.706

than the clear day values. However, they were 2-3 times higher at A-St. 6 (4.3 mg/).

BOD (10.2 - 11.8 mg/l) was also approximately the same as the clear day values measured in September. At St. 6 , however, the values (15.1 mg/l) were about twice the clear day values. A-St. 6 is settled at the highest location in the study area on Anyang Chong. Therefore, it appeared that the water in this station was first influenced by the rain in comparison to the other stations.

COD(Mn) at all of the sampling stations was barely lower than the clear day levels (13.0 - 24.8 mg/l).

SS during the freshet were much higher than the clear day values measured in September (8-9 times at St. 1; 20-40 times at St. 4; 15-20 times at St. 5 and 40-80 times at St. 6). This is supposed to be caused by the erosion from both of the river beds.

The number of coli-forms was 30-70 % of the number measured on a clear day in September.

3.1.6 Self-purification Capacity

DO in Anyang Chong were constantly found in incredibly low values. It is clear that under these conditions any self-purification did not occur. The survey, therefore, was not conducted.

3.1.7 Correlation between Water Qualities

High positive correlation existed between BOD and COD(Mn) at all stations (r=0.574-0.840). Also high positive correlation were found between COD(Mn) and SS, COD(Mn) and NH_4-, BOD and SS, and BOD and NH_4-N at several stations (Table 3.1.7-1).

DO had correlation with NH_4-N at A-St. 2 and A-St. 4, although those

Table 3.1.7-1 Correlation between Water Qualities Obtained from Regular Monthly Survey, Anyang Chong

A-St. 1

	DO	COD	BOD	SS	NH4-N
DO	1				
COD	0.181	1			
BOD	0.165	0.609	1		
SS	0.118	0.306	0.215	1	
NH4-N	0.247	0.450	0.503	0.077	1

A-St. 2

	DO	COD	BOD	SS	NH4-N
DO	1				
COD	0.600	1			
BOD	0.390	0.743	1		
SS	-0.005	0.295	0.636	1	
NH4-N	0.490	0.670	0.405	0.097	1

A-St. 3

	DO	COD	BOD	SS	NH4-N
DO	1				
COD	0.104	1			
BOD	0.010	0.840	1		
SS	-0.024	0.578	0.797	1	
NH4-N	0.001	0.220	0.220	0.291	1

A-St. 4

	DO	COD	BOD	SS	NH4-N
DO	1				
COD	0.359	1			
BOD	0.154	0.840	1		
SS	-0.111	0.686	0.649	1	
NH4-N	0.472	0.657	0.398	0.381	1

A-St. 5

	DO	COD	BOD	SS	NH4-N
DO	1				
COD	0.480	1			
BOD	0.259	0.675	1		
SS	0.295	-0.096	0.007	1	
NH4-N	0.202	0.614	0.334	-0.248	1

A-St. 6

	DO	COD	BOD	SS	NH4-N
DO	1				
COD	0.179	1			
BOD	0.246	0.574	1		
SS	0.383	0.008	-0.012	1	
NH4-N	-0.194	0.464	0.360	-0.352	1

A-St. 7

	DO	COD	BOD	SS	NH4-N
DO	1				
COD	0.096	1			
BOD	0.323	0.764	1		
SS	0.136	0.542	0.374	1	
NH4-N	0.308	0.421	0.538	0.097	1

were not so high (r=0.490 and 0.472).

3.1.8 Sediment Quality

The surveys and the samplings were done on December 5, 1990.

Due to heavy rain and flood in Seoul, in September, 1990, it was thought that the river bottom was not representing the ordinary condition.

(1) Particle-size distribution

Particle-size distributions showed that this river bed were mainly composed of sand (smaller than 4.76 mm) (Table 3.1.8-1, Fig. 3.1.8-1). However, all particles at A-St. 1 were smaller than medium sized sand (2.0 mm >), which led the distribution on the smallest particle side of all stations. Unlike the other stations, smaller than 0.074 mm particles (silt and clay) were found at A-St. 5 making up 16 % of this total composition. At A-St. 5', particles ranged from silt to coarse gravel (0.005-73.5 mm), which was composed mainly of sand.

(2) Chemical content

Chemical content of Anyang Chong sediment was shown in Table 3.1.8-2.

Almost the same items of this river sediment were analyzed twice at 43 stations in 1987. Table 3.1.8-3 shows the values obtained from 14 stations which were located within the same area as this time. CN, As, Cr(6+) and Pb in 1987 were higher, while Cd in 1987 was only slightly higher than those observed this time.

Organic-P was found only at A-St. 5', which was little higher than those in 1987.

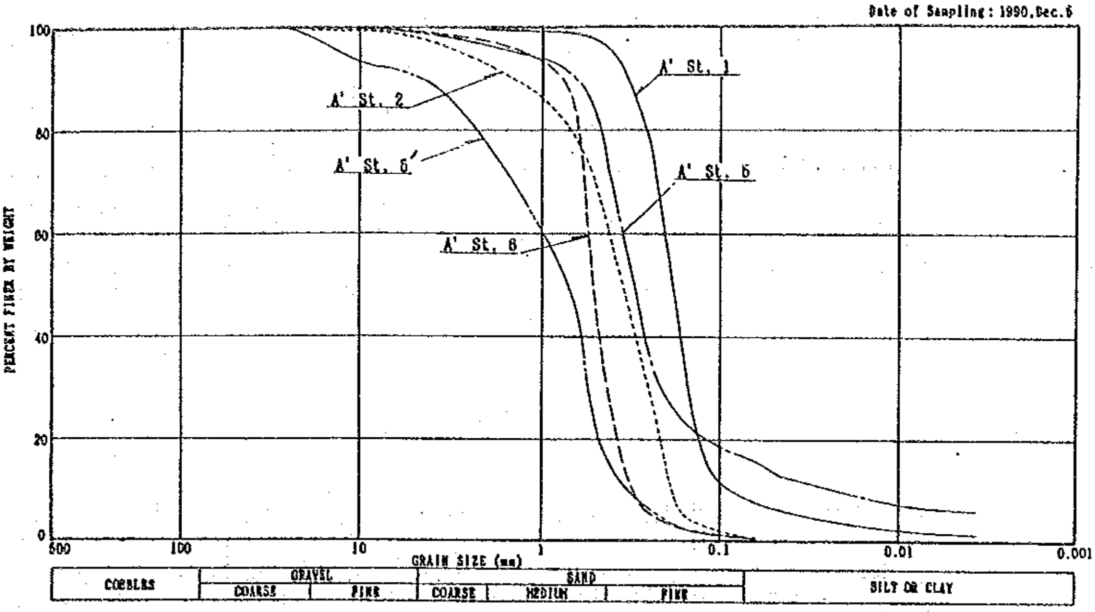


Fig. 3.1.8-1 Particle-size Distribution of Sediment of Anaygn Chong, December 5, 1990

Table 3.1.8-1 Particle-size Distribution of Sediment of Anyang Chong (Accumulated Percent in Weight)

	Classification						
	Gravel		Sand			Silt	Clay
Size(mm)	Coarse 73.5-18.38	Fine 18.38-4.76	Coarse 4.76-2.00	Medium 2.00-0.42	Fine 0.42-0.074	0.074-0.005	0.005>
Station							
A-St.1				100.0	95.5	8.0	1.5
A-St.2		100.0	98.0	92.5	60.0	1.0	0.0
A-St.5		100.0	99.0	91.5	73.0	16.5	1.5
A-St.5'	100.0	98.5	90.5	76.0	15.5	0.5	0.0
A-St.6		100.0	99.5	97.5	28.0	0.5	0.0

Table 3.1.8-2 River Sediment Quality of Anyang Chong, December 5, 1990

Item	CN (mg/kg)	As (mg/kg)	THg (mg/kg)	Cr(6+) (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Sulfide (mg/kg)	PCB (mg/kg)	Org-P Malathion (mg/kg)	Org-P PAP (mg/kg)	DL (%)	IL (%)
Station												
A-St. 1	0.193	0.068	0.012	ND	0.167	1.730	5.68	ND	ND	ND	39.6	42.1
A-St. 2	0.136	0.100	0.035	ND	0.162	1.400	5.46	1.102	ND	ND	36.2	37.9
A-St. 5	0.466	0.133	0.035	ND	0.200	2.100	5.57	1.881	ND	ND	41.2	44.5
A-St. 5'	ND	0.146	0.037	ND	0.150	0.240	6.01	4.038	0.090	0.108	25.6	27.0
A-St. 6	0.477	0.227	0.025	ND	0.150	1.187	6.23	1.585	ND	ND	28.9	29.7

Table 3.1.8-3 River Sediment Quality of Anyang Chong measured in 1987
14 out of 43 results, which located in the same area as this time, were adopted.

Item	CN (mg/kg)	As (mg/kg)	THg (mg/kg)	Cr(6+) (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Org-P (mg/kg)
Min.	1.3	0.1	0.006	1.8	0.23	5.11	0.088
Max.	2.9	6.6	0.024	7.1	0.91	12.42	0.169
Mean	1.9	3.5	0.013	3.6	0.55	8.64	0.125

Table 3.1.8-4 Macro-benthos Appeared in Sedieent of Anyang Chong (December 5, 1990)

Species \ Station	A-St. 1	A-St. 2	A-St. 5	A-St. 5'	A-St. 6
Class Oligochaeta					
Order Haplotaxida					
Family Tubificidae					
Limnodrilus socialis		1	5		
Class Insecta					
Order Diptera					
Family Phycodidae					
Phycoda Kua		2			
Total species number/m2	0	2	1	0	0
Total individual number/m2	0	3	5	0	0
Diversity Index	0	0.92	0	0	0
Biological Pollution Class	-	ps	ps	-	-

ps: polysaprobic

THg, on the other hand, showed almost the same values as in 1987.

Heavy metals in the sediment of several rivers near Tokyo, Japan, were quite higher (Table A-3.8-1) than those taken this time, particularly, Pb (4.3-39 mg/kg). THg, were almost the same in both results. Ignition Loss in Anyang Chong was very high compared to (27.0 - 44.5 %) those found in Japanese rivers (2.3 - 7.9 %).

The present values in Anyang Chong found lower than the past, may show that the flood still had an effect on the river bottom conditions even after three months. Or the completion of the sewage system around this river had a substantial effect of the waste water on the river bottom.

The high IL means Anyang Chong sediment has been heavily polluted organically, and even after the big flood organic pollution on the bed quickly progressed.

(3) Macro-benthos

Table 3.1.8-4 shows the species and individual numbers that appeared in the sediment samples taken from the surface. Very small numbers of both species and individuals were found only two stations (A-St. 2 and A-St. 5).

The river bed of those two stations belong to polysaprobic water areas by biological pollution classification.

3.2 Yangjae Chong

3.2.1 Hourly Change of Water Quality

There were no hourly changes in the water qualities of Yangjae Chong, although some items fluctuated on several occasions.

The mean value of the results of the same analytical items as measured on the regular monthly surveys were included for discussion.

3.2.2. Seasonal Variation of Water Quality

(1) Water quality variation obtained from monthly survey

DO concentrations showed the opposite distribution pattern to that of temperature, i.e. the highest DO of each station was found in January (Y-St. 1) or February, the lowest from May to August. Generally, lower DO were observed at Y-St. 1 (3.0 -6.8 mg/l) and higher DO values at Y-St. 2 (4.7-8.4 mg/l) and Y-St. 4 (3.7-8.8. mg/l) (Tables 3.2.2-1-4) (Fig .3.2.2-1).

BOD concentrations were observed from 2.3 to 53.4 mg/l showing the curves with lower values from June to September, in the hotter months, then increased to show the peak in December or January, the colder months. This variation pattern seems to show the inverse proportion of distribution to discharge at Y-At. 1 and Y-St. 2 (Fig. 3.2.2-2). This contrary relation, however, was not found at Y-St. 3 and Y-St. 4.

COD(Mn) concentrations (5.0-48.7 mg/l) also had a similar curve to BOD. The lowest value was found in the same month as BOD, however, the peak months varied among the different stations. The monthly variances at Y-St. 4 (5.0-21.2 mg/l) was found to be smaller than at the other stations.

Table 3.2.2-1 Water Quality of Yangjae Chong, Y-St. 1

Date \ Item	WT (°C)	pH	EC (mS/cm)	DO (mg/l)	COD(Mn) (mg/l)	BOD (mg/l)	SS (mg/l)	NH4-N (mg/l)	NO2-N (mg/l)	Coli-form (MPN/100ml)	CN (mg/l)	Hg (mg/l)	Gauge (cm)
Jan. 31, 1990	6.2	7.2	-	5.0	47.6	36.0	82.1	10.01	0.046	-	-	-	4
Feb. 22, 1990	7.2	7.5	-	5.6	22.4	27.8	36.0	4.73	0.026	-	-	-	26
Mar. 20, 1990	14.0	6.9	-	4.9	21.2	23.6	11.0	7.54	0.078	-	-	-	17
Apr. 20, 1990	21.0	7.1	-	5.8	17.4	14.2	22.3	6.70	0.131	-	-	-	11
May 28, 1990	23.1	7.7	-	5.2	16.7	14.2	15.2	5.27	0.416	-	-	-	4
Jun. 22, 1990	18.7	7.0	0.8	3.0	11.0	4.0	2.0	2.34	-	84	-	-	40
Jul. 13, 1990	22.4	6.8	-	6.0	6.3	6.9	88.4	1.87	0.361	-	-	-	64
Jul. 30, 1990	26.8	6.9	-	3.2	8.0	8.4	15.5	0.38	0.013	72	ND	ND	30
Aug. 25, 1990	22.9	6.9	-	5.0	6.4	8.2	50.0	2.08	0.041	230	ND	ND	42
Sep. 13, 1990	18.6	7.3	-	6.1	8.9	7.2	83.2	1.07	0.827	-	-	-	47
Sep. 22, 1990	21.0	7.2	-	5.5	5.8	4.4	12.8	2.83	0.410	560	-	-	42
Oct. 22, 1990	17.9	7.1	-	6.0	13.5	15.4	22.5	4.46	0.424	820	-	-	38
Nov. 6, 1990	13.0	7.3	-	4.9	16.5	17.6	120.1	4.25	0.031	-	-	-	32
Nov. 26, 1990	13.1	7.2	-	4.2	45.1	33.6	48.0	13.85	ND	5400	ND	ND	33
Dec. 24, 1990	6.2	7.3	-	6.2	30.0	53.4	92.0	10.87	0.579	4300	-	-	29
Jan. 5, 1991	5.8	7.3	-	6.8	23.6	21.6	48.7	12.17	0.099	3400	ND	ND	27
Jan. 17, 1991	2.6	7.6	-	6.7	20.8	13.4	44.2	11.78	0.058	-	-	-	23
Feb. 5, 1991	5.5	7.2	-	7.2	37.4	21.5	48.0	9.42	ND	5200	0.016	ND	24
Mar. 5, 1991	9.9	7.2	-	6.2	14.6	35.5	41.8	7.36	0.028	-	-	-	31
Mar. 21, 1991	5.8	7.4	-	5.2	12.8	8.3	105.0	6.41	0.042	2800	0.003	ND	38
Apr. 29, 1991	13.0	7.3	-	4.2	14.5	14.4	198.7	5.98	0.033	3800	0.004	ND	28
May 28, 1991	18.2	7.2	-	5.4	9.0	8.5	42.0	3.75	0.192	3500	0.014	ND	26
May 31, 1991	21.2	7.4	-	3.3	13.0	17.3	44.0	3.62	1.451	-	-	-	22

Table 3.2.2-2 Water Quality of Yangjae Chong, Y-St. 2

Date \ Item	WT (°C)	pH	EC (mS/cm)	DO (mg/l)	COD(Mn) (mg/l)	BOD (mg/l)	SS (mg/l)	NH4-N (mg/l)	NO2-N (mg/l)	Coli-form (MPN/100ml)	CN (mg/l)	Hg (mg/l)	Gauge (cm)
Jan. 31, 1990	4.7	7.2	-	7.9	13.0	5.2	14.0	5.09	0.017	-	-	-	-8
Feb. 22, 1990	7.5	7.0	-	8.4	10.0	6.3	19.5	3.51	0.024	-	-	-	14
Mar. 20, 1990	13.0	7.1	-	6.2	16.0	11.8	1.2	4.70	0.080	-	-	-	-2
Apr. 20, 1990	22.3	7.3	-	7.8	15.0	10.2	8.4	5.26	0.175	-	-	-	0
May 28, 1990	22.5	7.6	-	7.2	12.0	8.4	15.6	4.24	0.553	-	-	-	4
Jun. 22, 1990	18.0	7.4	0.7	6.8	5.0	4.8	32.4	1.02	-	120	-	-	9
Jul. 13, 1990	18.2	6.9	-	6.5	7.1	5.9	72.1	1.97	0.290	-	-	-	24
Jul. 30, 1990	27.2	7.0	-	6.8	6.4	6.8	22.5	0.43	0.036	150	ND	ND	22
Aug. 25, 1990	21.9	7.1	-	6.7	8.0	4.9	7.2	6.02	0.057	330	ND	ND	30
Sep. 13, 1990	19.2	7.1	-	6.3	10.0	4.7	163.2	0.16	0.068	-	-	-	24
Sep. 22, 1990	20.2	7.2	-	6.5	8.2	3.8	8.2	2.26	0.080	420	-	-	23
Oct. 22, 1990	16.2	7.3	-	7.1	13.6	11.3	18.2	4.36	0.520	670	-	-	17
Nov. 6, 1990	13.1	7.2	-	5.3	34.8	27.0	227.6	5.19	0.049	-	-	-	19
Nov. 26, 1990	11.7	7.4	-	5.2	15.0	3.0	55.5	6.35	0.092	2100	ND	ND	18
Dec. 24, 1990	6.8	7.1	-	6.8	11.4	5.1	76.0	7.61	0.105	2800	-	-	14
Jan. 5, 1991	6.2	7.1	-	6.2	12.4	8.4	32.8	9.24	0.092	2600	ND	ND	13
Jan. 17, 1991	2.6	7.6	-	6.7	20.8	13.4	44.2	11.78	0.058	-	-	-	23
Feb. 5, 1991	5.9	7.8	-	6.9	20.5	15.0	32.0	7.42	TR	3800	0.020	ND	11
Mar. 5, 1991	10.0	7.3	-	6.1	14.7	34.6	40.4	10.91	0.029	-	-	-	31
Mar. 21, 1991	6.0	7.3	-	4.9	20.0	28.5	371.7	6.98	0.046	2400	0.004	ND	21
Apr. 29, 1991	12.0	7.2	-	4.8	14.0	11.4	178.7	6.16	0.029	3200	0.007	ND	20
May 28, 1991	19.4	7.8	-	4.7	20.7	27.6	448.0	2.04	0.342	5400	0.007	ND	15
May 31, 1991	20.5	7.4	-	5.9	12.6	12.5	30.0	3.24	1.720	-	-	-	38

Table 3.2.2-3 Water Quality of Yangjae Chong, Y-St. 3

Date \ Item	WT (°C)	pH	EC (mS/cm)	DO (mg/l)	COD(Mn) (mg/l)	BOD (mg/)	SS (mg/)	NH4-N (mg/l)	NO2-N (mg/l)	Coli-form (MPN/100ml)	CN (mg/l)	Hg (mg/l)	Gauge (cm)
Jan. 31, 1990	2.7	7.2	-	7.1	42.6	29.5	92.2	6.12	0.033	-	-	-	-6.
Feb. 22, 1990	8.2	7.0	-	7.1	48.7	26.7	72.0	6.82	0.028	-	-	-	10
Mar. 20, 1990	11.0	7.0	-	6.8	17.0	14.2	6.0	4.58	0.067	-	-	-	5
Apr. 20, 1990	20.8	7.1	-	6.7	12.0	6.3	5.1	2.95	0.114	-	-	-	3
May 28, 1990	22.9	7.2	-	7.5	16.0	15.0	12.0	5.11	0.645	-	-	-	7
Jun. 22, 1990	17.5	7.0	0.6	7.2	5.5	3.5	24.0	1.73	-	130	-	-	6
Jul. 13, 1990	20.7	6.9	-	4.3	5.0	4.2	20.1	0.72	0.053	-	-	-	29
Jul. 30, 1990	27.0	6.9	-	5.3	5.6	7.4	20.5	0.13	0.037	120	ND	ND	4
Aug. 25, 1990	22.6	6.9	-	3.4	7.2	7.0	6.0	3.91	0.039	310	ND	ND	2
Sep. 13, 1990	19.0	6.9	-	4.6	7.0	3.2	5.5	1.15	0.386	-	-	-	91
Sep. 22, 1990	20.5	7.0	-	6.2	9.6	4.2	11.8	2.39	0.054	610	-	-	28
Oct. 22, 1990	15.1	7.1	-	6.8	10.0	6.4	30.4	3.67	0.566	580	-	-	21
Nov. 6, 1990	13.6	7.2	-	6.2	8.1	6.0	20.3	1.61	0.054	-	-	-	14
Nov. 26, 1990	12.6	7.3	-	3.8	19.0	3.0	15.5	7.81	0.053	1800	ND	ND	22
Dec. 24, 1990	4.1	7.3	-	7.7	6.3	4.7	9.2	3.12	0.079	2400	-	-	19
Jan. 5, 1991	4.2	7.3	-	7.4	9.8	5.1	3.5	3.85	0.079	1900	ND	ND	17
Jan. 17, 1991	1.5	7.2	-	5.4	10.3	4.6	4.3	4.51	0.054	-	-	-	22
Feb. 5, 1991	5.4	7.6	-	7.8	25.1	14.1	11.0	4.58	0.026	2100	0.003	ND	15
Mar. 5, 1991	7.9	7.3	-	6.4	11.8	8.0	8.4	12.50	0.026	-	-	-	14
Mar. 21, 1991	5.2	7.5	-	6.3	12.7	2.6	23.0	3.29	0.032	1900	0.003	ND	26
Apr. 29, 1991	10.0	6.9	-	5.9	12.0	7.8	14.0	2.33	0.024	2900	0.008	ND	7
May 28, 1991	21.0	7.4	-	6.2	27.6	42.0	295.0	5.66	0.039	5400	ND	ND	8
May 31, 1991	19.9	7.4	-	5.3	10.5	5.5	8.3	0.65	1.428	-	-	-	13

Table 3.2.2-4 Water Quality of Yangjae Chong, Y-St. 4

Date \ Item	WT (°C)	pH	EC (mS/cm)	DO (mg/l)	COD(Mn) (mg/l)	BOD (mg/l)	SS (mg/l)	NH4-N (mg/l)	NO2-N (mg/l)	Coli-form (MPN/100ml)	CN (mg/l)	Hg (mg/l)	Gauge (cm)
Jan. 31, 1990	5.4	7.2	-	7.9	14.3	7.2	22.6	7.04	0.027	-	-	-	6
Feb. 22, 1990	6.8	5.9	-	8.8	11.1	6.6	20.5	2.12	0.017	-	-	-	22
Mar. 20, 1990	10.0	7.2	-	7.0	12.4	24.5	9.0	4.68	0.820	-	-	-	9
Apr. 20, 1990	20.5	7.3	-	6.0	14.2	9.3	8.9	5.27	0.157	-	-	-	10
May 28, 1990	22.4	7.0	-	7.0	12.0	9.0	22.4	3.58	0.842	-	-	-	8
Jun. 22, 1990	17.4	7.1	0.8	6.5	5.0	4.3	20.0	0.94	-	150	-	-	16
Jul. 13, 1990	22.1	6.9	-	4.3	13.1	6.4	101.9	1.76	0.391	-	-	-	21
Jul. 30, 1990	27.1	7.1	-	5.5	6.6	5.3	47.0	0.59	0.030	180	ND	ND	18
Aug. 25, 1990	24.0	7.1	-	5.3	6.0	5.8	2.0	4.30	0.047	210	ND	ND	100
Sep. 13, 1990	17.6	7.0	-	5.7	17.3	26.0	28.8	0.71	0.564	-	-	-	45
Sep. 22, 1990	20.6	7.2	-	6.0	5.8	2.3	9.3	1.43	0.039	380	-	-	25
Oct. 22, 1990	16.9	7.4	-	6.4	12.0	8.3	11.5	1.70	0.724	550	-	-	20
Nov. 6, 1990	13.3	7.1	-	6.0	21.0	21.0	151.5	4.04	0.025	-	-	-	28
Nov. 26, 1990	12.8	7.3	-	5.7	15.0	4.5	4.5	2.50	0.134	1400	ND	ND	24
Dec. 24, 1990	5.8	7.1	-	7.2	14.0	9.4	35.1	9.42	0.083	3500	-	-	20
Jan. 5, 1991	5.1	7.1	-	6.9	13.2	6.9	43.0	9.67	0.092	2500	ND	ND	18
Jan. 17, 1991	4.1	7.3	-	5.9	18.0	7.9	36.5	9.74	0.055	-	-	-	13
Feb. 5, 1991	5.2	7.5	-	7.5	19.5	11.0	34.7	7.83	ND	2800	0.003	ND	16
Mar. 5, 1991	10.7	7.4	-	5.8	17.3	35.4	27.4	3.49	0.023	-	-	-	28
Mar. 21, 1991	5.7	7.2	-	6.0	11.5	3.5	28.5	6.98	0.005	1500	0.005	ND	11
Apr. 29, 1991	12.0	7.2	-	6.2	20.0	15.0	66.0	8.33	0.068	2400	0.010	ND	19
May 28, 1991	18.2	7.3	-	5.4	6.9	4.2	6.7	0.42	0.328	2800	ND	ND	19
May 31, 1991	18.3	7.4	-	3.7	21.2	30.8	46.4	5.77	ND	-	-	-	30

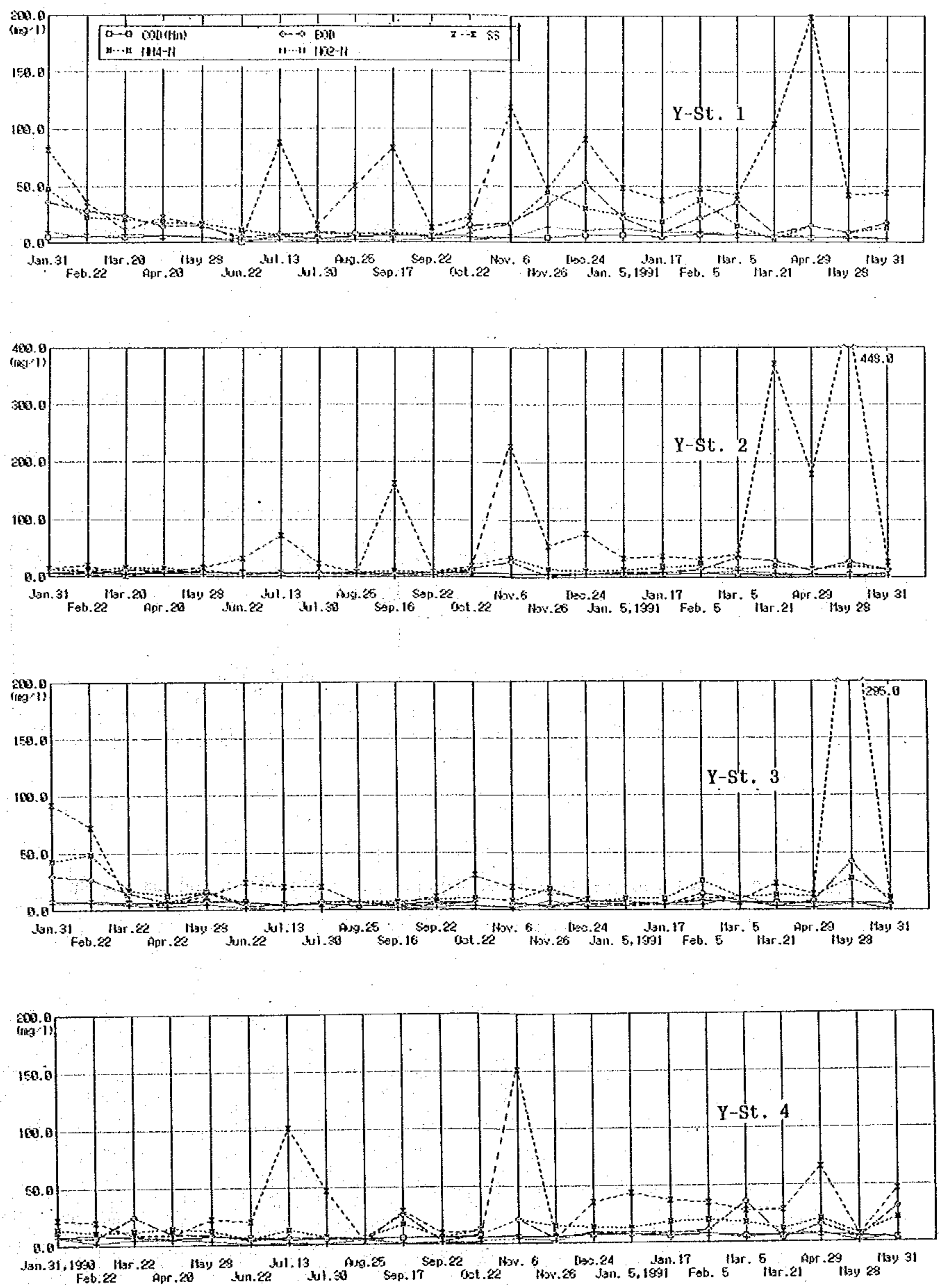


Fig. 3.2.2-1 Monthly Variation of Water Quality of Yangjae Chong, Y-St. 1 - Y-St. 4, from January, 1990, to May, 1991

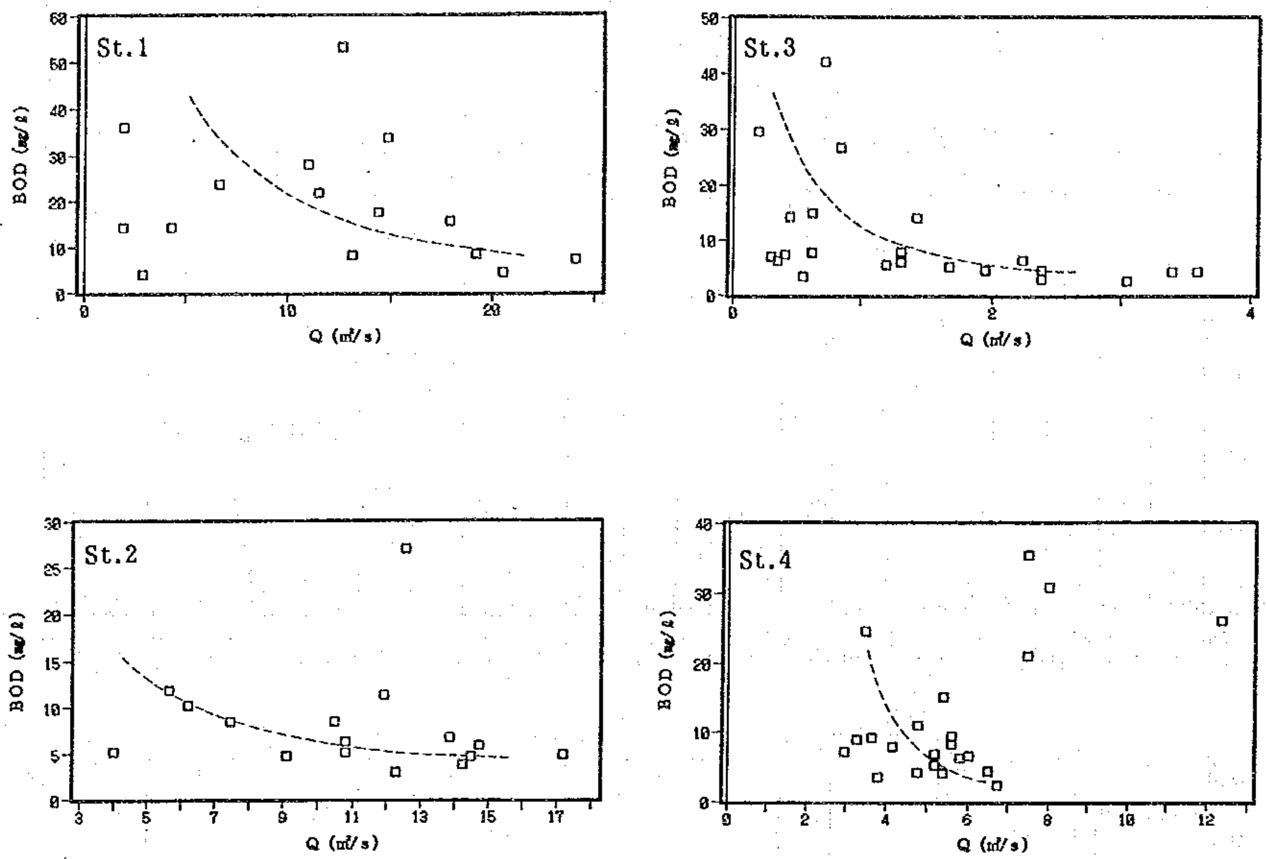


Fig. 3.2.2-2 Relation between Water Quality and Discharge of Yangjae Chong

NH_4-N concentrations showed the extremely great monthly variances (0.13-13.85 mg/l). These variation curves were similar to that of BOD. At Y-St. 4, in particular, The typical curve mentioned above was seen. The higher NH_4-N indicated that this river has been polluted seriously by human waste.

SS concentrations were from 1.2 to 92.0 mg/l, often found in extremely high values (72.0-448.0 mg/l) and were assumed to be the effects of rainfall or construction work done on the riverbed. From the distribution according to the curve, it is possible to say that the lower values were found from March to October, the hotter months, while slightly higher values were obtained in the other months.

Y-St. 3 is located on the mouth of Nyoi Chong. Water qualities this station were lower and DO was higher than at any other station, indicating that Nyoi Chong was less polluted than the main river.

NO_2-N concentrations were usually found in very low values at all stations. Occasionally great values were obtained (0.000-1.720 mg/l), but usually lower than 0.820 mg/l.

Coli-form bacterial numbers increased abruptly in 1991 and is still continuing to increase (72-5400 MPN/100ml). This may indicate that the volume of the human waste in this river has recently increased.

Fortunately THg was not detected at all stations throughout the sampling period.

CN was not found at all stations until January, 1991. From February, 1991 to May, 1991, however, low concentrations were detected (0.003-0.014 mg/l). It is assumed therefore that the activities of the plating or chemical industries have increased, and waste water from these industries have discarded without any treatment.

(2) Variation of other water qualities

TN concentrations (3.89-14.99 mg/l) showed lower values in the hotter months and higher values in the colder months as found in BOD and others, peaking in the months of January or March. Although there were variations from month to month, these concentrations were quite high. Among the stations, TN at Y-St. 3 was lower than at any other station (Figs. 3.2.2-3-6, Tables 3.2.2-5-8).

TON concentrations at all stations generally varied monthly with TN (0.28-2.59 mg/l). The TON proportions to TN were constantly lower than 1/5 of TN with two exceptional cases; TIN, consequently, takes main part of TN, especially NO_3-N and NH_4-N (75-95 % of TN), because NO_2-N were constantly low. Usually, NH_4-N was mainly found in TIN (Table 3.2.2-9).

TP concentrations were 0.138-1.183 mg/l, showing a similar distribution pattern as TN at Y-St. 1 and Y-St. 2 (Figs. 3.2.2-3-6). TP at Y-St. 3, however, had a high value in November, and at Y-St. 4 it continued to increase from July. Low TP concentrations at Y-St. 3 resulted in the higher values of TN/TP (TN/TP: 15-41) than at other stations (9-26). This seems to indicat that the ratio of waste water from farms around Y-St. 3 to domestic waste water was alightly higher than at the other three stations.

TDP concentrations at all stations were quite high and constantly showed similar distribution patterns to TP. This means that particulate phosphorus was constantly found in the same level of concentration throughout the survey period. The main part of TDP was inorganic phosphorus, PO-P, which showed a similar distribution pattern to TP. The percentages of PO_4-P to TP ranged from 33 to 75 % (Table 3.2.2-10).

DBOD was also measured (2.2-25.7 mg/l). These percentages of concentration to TBOD ranged from 49-94 %, but did not differ among stations and months (Table 3.2.2-11).

Table 3.2.2-5 Water Quality Obtained from 24-hour Survey on Yangjae Chong, Y-St. 1

Y-St. 1, July 13-14, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	(%)	Gauge (cm)
Mean	6.0	-	-	1.89	0.399	1.87	0.259	0.168	0.133	6.9	-	6.6	-	2.6	1.49	88.4	76.1	85	64
SD	0.4	-	-	0.21	0.161	0.56	0.065	0.029	0.024	2.4	-	1.4	-	0.6	0.18	61.0	52.8	8	3
					0.361							6.3							
					0.097							0.9							

Y-St. 1, September 17-18, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	(%)	Gauge (cm)
Mean	6.1	5.35	0.50	2.95	0.827	1.07	0.377	0.220	0.195	7.2	3.6	8.9	7.0	3.37	1.61	83.2	71.1	84	47
SD	0.3	1.56	0.23	0.40	1.257	1.07	0.087	0.027	0.021	1.5	1.4	1.3	2.8	0.26	0.29	53.4	47.2	10	4
						0.50													
						0.19													

Y-St. 1, November 6-7, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	(%)	Gauge (cm)
Mean	4.9	5.33	0.51	0.71	0.031	4.25	0.329	0.235	0.143	17.6	16.5	16.5	24.3	3.02	2.11	120.1	91.7	73	32
SD	0.4	0.65	0.17	0.51	0.013	1.10	0.102	0.071	0.050	13.5	14.4	16.0	19.6	0.56	0.58	163.1	130.9	7	1
										10.3		7.3							
										5.4		1.9							

Y-St. 1, January 17-18, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	(%)	Gauge (cm)
Mean	6.7	14.44	1.93	0.83	0.058	11.78	0.841	0.611	0.578	13.4	11.7	20.8	18.0	4.12	1.25	44.2	28.5	63	23
SD	0.4	0.59	0.39	0.08	0.010	0.85	0.153	0.123	0.124	1.6	3.6	2.7	2.7	0.23	0.21	11.2	10.0	10	1

Y-St. 1, March 5-6, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	(%)	Gauge (cm)
Mean	6.2	8.83	1.19	0.00	0.028	7.36	0.937	0.796	0.616	35.5	23.5	14.6	12.0	3.92	1.26	41.8	19.2	44	31
SD	0.6	0.94	0.24	0.00	0.010	0.82	0.073	0.042	0.075	2.4	9.7	1.5	1.6	0.12	0.18	24.6	13.1	8	1

Y-St. 1, May 31-June 1, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	(%)	Gauge (cm)
Mean	3.3	7.87	1.18	1.62	1.451	3.62	0.320	0.254	0.175	17.3	11.5	13.0	10.9	2.69	1.15	44.0	23.5	52	22
SD	0.9	0.56	0.22	0.50	0.458	0.79	0.110	0.091	0.040	2.4	2.3	2.3	1.9	0.32	0.25	11.2	6.4	18	2

Table 3.2.2-6 Water Quality Obtained from 24-hour Survey in Yangjae Chong, Y-St. 2

Y-St. 2, July 13-14, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	(%)	Gauge (cm)
Mean	6.5	-	-	1.68	0.290	1.97	0.214	-	0.130	5.9	-	7.1	-	3.3	1.82	72.1	63	83	24
SD	0.4	-	-	0.12	0.127	0.26	0.040	-	0.031	1.2	-	1.0	-	0.3	0.17	51.2	50	10	2

Y-St. 2, September 17-18, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	(%)	Gauge (cm)
Mean	6.3	3.46	0.28	2.96	0.068	0.16	0.449	0.180	0.148	4.7	2.3	10.0	6.6	3.47	1.57	163.2	120.7	85	24
SD	0.5	0.21	0.05	0.11	0.112	0.06	0.129	0.022	0.027	2.7	1.0	0.9	2.1	0.23	0.18	89.0	75.2	5	1

Y-St. 2, November 6-7, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	(%)	Gauge (cm)
Mean	5.3	6.70	0.53	0.94	0.049	5.19	0.468	0.344	0.163	27.0	22.5	34.8	38.6	2.59	2.25	287.7	192.0	68	19
SD	0.7	0.78	0.13	0.77	0.015	0.93	0.127	0.068	0.078	14.1	11.1	28.5	27.1	0.37	1.26	277.1	197.3	15	1
										20.0		19.7				227.6			
										8.3		12.9			1.88	221.6			

Y-St. 2, January 17-18, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	(%)	Gauge (cm)
Mean	5.4	12.32	2.36	1.08	0.052	8.83	0.661	0.540	0.456	9.2	7.4	18.3	14.7	4.13	2.09	37.5	25.5	66	26
SD	1.2	1.14	0.45	0.13	0.008	0.99	0.079	0.058	0.052	3.2	2.4	3.5	2.0	0.17	0.51	10.5	9.8	13	1

Y-St. 2, March 5-6, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	(%)	Gauge (cm)
Mean	6.1	13.19	2.25	0.89	0.029	10.91	1.043	0.828	0.672	34.6	25.7	14.7	13.6	3.74	0.99	40.4	21.4	47	31
SD	1.3	1.10	0.37	0.20	0.007	0.80	0.109	0.070	0.044	4.8	7.2	2.6	1.9	0.20	0.16	24.8	17.2	13	1

Y-St. 2, May 31-June 1, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	(%)	Gauge (cm)
Mean	7.4	8.14	3.18	2.28	1.720	3.24	0.471	0.367	0.289	12.5	11.7	12.6	12	2.44	1.29	26.4	19.9	66	38
SD	0.1	0.92	1.14	0.99	0.561	1.08	0.054	0.046	0.033	3.2	3.8	1.6	2.0	0.54	0.13	11.6	11.7	13	2

Table 3.2.2-7 Water Quality Obtained from 24-hour Survey in Yangjae Chong, Y-St. 3

Y-St. 3, July 13-14, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD(Mn) (mg/l)	DCOD(Mn) (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	Settleable matter (%)	Gauge (cm)
Mean	4.3	-	-	0.89	0.053	0.72	0.138	0.114	0.087	4.2	-	5	-	3.5	1.46	23.9	18.5	78	29
SD	0.8	-	-	0.81	0.022	0.26	0.039	0.027	0.023	1.7	-	1.1	-	0.2	0.06	17.1	11.8	12	1
																20.1			
																11.3			

Y-St. 3, September 17-18, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD(Mn) (mg/l)	DCOD(Mn) (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	Settleable matter (%)	Gauge (cm)
Mean	4.6	4.36	0.63	2.18	0.386	1.15	0.156	0.101	0.085	3.2	2.2	7.0	5.4	3.92	1.50	5.5	3.8	62	91
SD	0.7	0.98	0.37	0.35	0.339	0.84	0.049	0.023	0.021	1.2	0.6	0.7	1.2	0.48	0.14	4.0		20	1
							0.146	0.096	0.081										
							0.034	0.017	0.015										

Y-St. 3, November 6-7, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD(Mn) (mg/l)	DCOD(Mn) (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	Settleable matter (%)	Gauge (cm)
Mean	6.2	3.89	0.50	1.73	0.054	1.61	0.293	0.250	0.174	6.0	7.1	8.1	13.7	2.45	1.33	32.2	24.7	71	14
SD	0.3	0.39	0.16	0.72	0.026	0.92	0.196	0.164	0.129	2.5	6.9	2.1	15.1	0.32	0.19	53.6	41.1	12	1
											5.5		10.3			20.3	15.5		

Y-St. 3, January 17-18, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD(Mn) (mg/l)	DCOD(Mn) (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	Settleable matter (%)	Gauge (cm)
Mean	5.4	8.30	2.47	1.33	0.054	4.51	0.22	0.167	0.136	4.6	3.9	10.3	9.9	4.23	1.31	4.3	2.2	50	22
SD	1.3	1.71	0.29	0.11	0.006	1.67	0.070	0.055	0.041	0.9	1.1	0.5	1.3	0.12	0.28	1.4	0.9	9	1

Y-St. 3, March 5-6, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD(Mn) (mg/l)	DCOD(Mn) (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	Settleable matter (%)	Gauge (cm)
Mean	6.4	14.99	2.47	0.88	0.026	12.50	0.362	0.267	0.169	8.0	8.2	11.8	10.6	3.96	1.39	8.4	3.8	44	14
SD	0.6	1.30	0.35	0.23	0.014	1.38	0.136	0.083	0.051	1.7	2.4	1.2	1.3	0.13	0.26	4.1	2.2	13	1

Y-St. 3, May 31-June 1, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD(Mn) (mg/l)	DCOD(Mn) (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable matter (mg/l)	Settleable matter (%)	Gauge (cm)
Mean	5.3	4.76	0.53	2.14	1.428	0.65	0.309	0.173	0.134	5.5	4.4	10.5	8.9	2.93	1.29	8.3	3.0	39	13
SD	0.6	1.06	0.27	0.86	0.671	0.54	0.195	0.068	0.068	1.0	1.0	1.2	1.0	0.36	0.13	3.9	1.8	12	1

Table 3.2.2-8 Water Quality Obtained from 24-hour Survey in Yangjae Chong, Y-St. 4

Y-St. 4, July 13-14, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD(Mn) (mg/l)	DCOD(Mn) (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	4.3	-	-	1.59	0.391	1.76	0.286	0.152	0.124	6.4	-	13.1	-	3.1	1.42	101.9	91.2	89	21
SD	1.1	-	-	0.46	0.186	0.59	0.050	0.036	0.034	1.2	-	10.3	-	0.5	0.23	25.1	22.9	2	3

Y-St. 4, September 13-14, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD(Mn) (mg/l)	DCOD(Mn) (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	5.7	4.54	0.42	2.85	0.564	0.71	0.367	0.260	0.202	26.0	12.8	17.3	13.9	3.31	1.49	28.8	24.0	80	45
SD	0.8	0.68	0.20	0.24	0.690	0.30	0.059	0.046	0.040	5.2	8.4	3.3	4.0	0.25	0.21	26.0	22.4	11	1
																19.1	15.5	81	
																13.1	11.1		

Y-St. 4, November 6-7, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD(Mn) (mg/l)	DCOD(Mn) (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	5.9	5.60	0.48	1.05	0.025	4.04	0.401	0.351	0.232	21.0	21.0	20.6	20.6	2.43	1.43	151.5	117.3	74	28
SD	0.3	0.63	0.20	0.57	0.018	0.35	0.082	0.091	0.101	13.9	13.9	10.8	10.8	0.45	0.52	120.2	100.2	11	1
																79.9	89.2		
																59.8	83.4		

Y-St. 4, January 17-18, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD(Mn) (mg/l)	DCOD(Mn) (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	5.9	13.76	2.59	1.36	0.055	9.74	0.799	0.685	0.586	7.9	7.2	18.0	12.4	4.19	0.93	36.5	25.3	69	13
SD	0.8	1.12	0.22	0.09	0.010	1.18	0.073	0.102	0.082	3.3	2.6	2.3	1.5	0.20	0.09	11.2	9.0	8	1

Y-St. 4, March 5-6, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD(Mn) (mg/l)	DCOD(Mn) (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	5.8	5.63	2.12	0.86	0.023	3.49	1.183	1.183	0.889	35.4	25.2	17.3	13.1	3.54	1.17	27.4	113.2	49	28
SD	0.7	0.41	0.13	0.09	0.012	0.44	0.224	0.093	0.095	6.7	5.7	3.1	1.2	0.36	0.47	6.9	4.5	12	2

Y-St. 4, May 31-June 1, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	3.7	6.17	0.30	0.10	0.000	5.77	1.645	0.973	1.159	30.8	21.1	21.2	16.1	2.92	2.16	46.4	30.3	49	30
SD	0.8	0.70	0.16	0.08	0.000	0.76	0.526	0.093	0.588	4.7	5.6	3.5	3.3	0.44	0.85	19.6	18.3		2

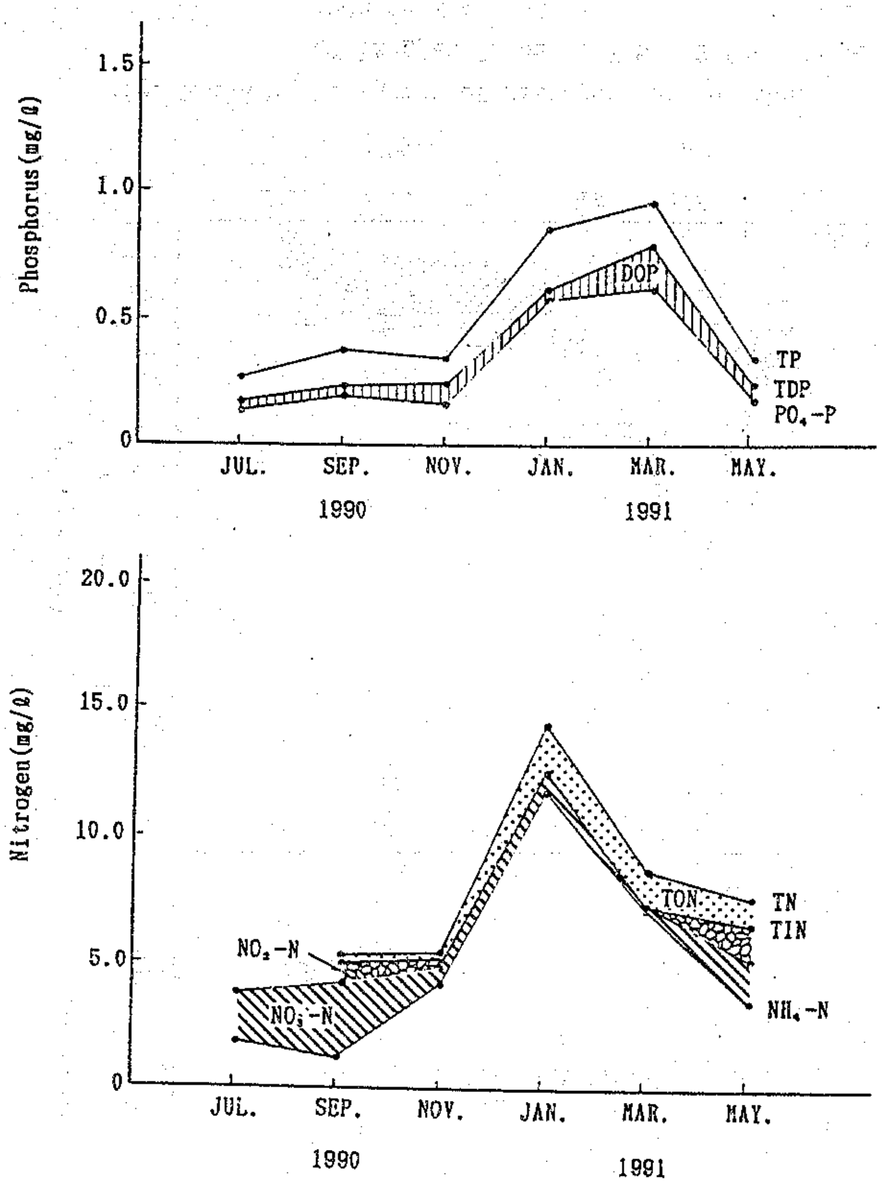


Fig. 3.2.2-3 Variation of Nitrogen and Phosphorus of Yangjae Chong at Y-St. 1 from July, 1990 to May, 1991

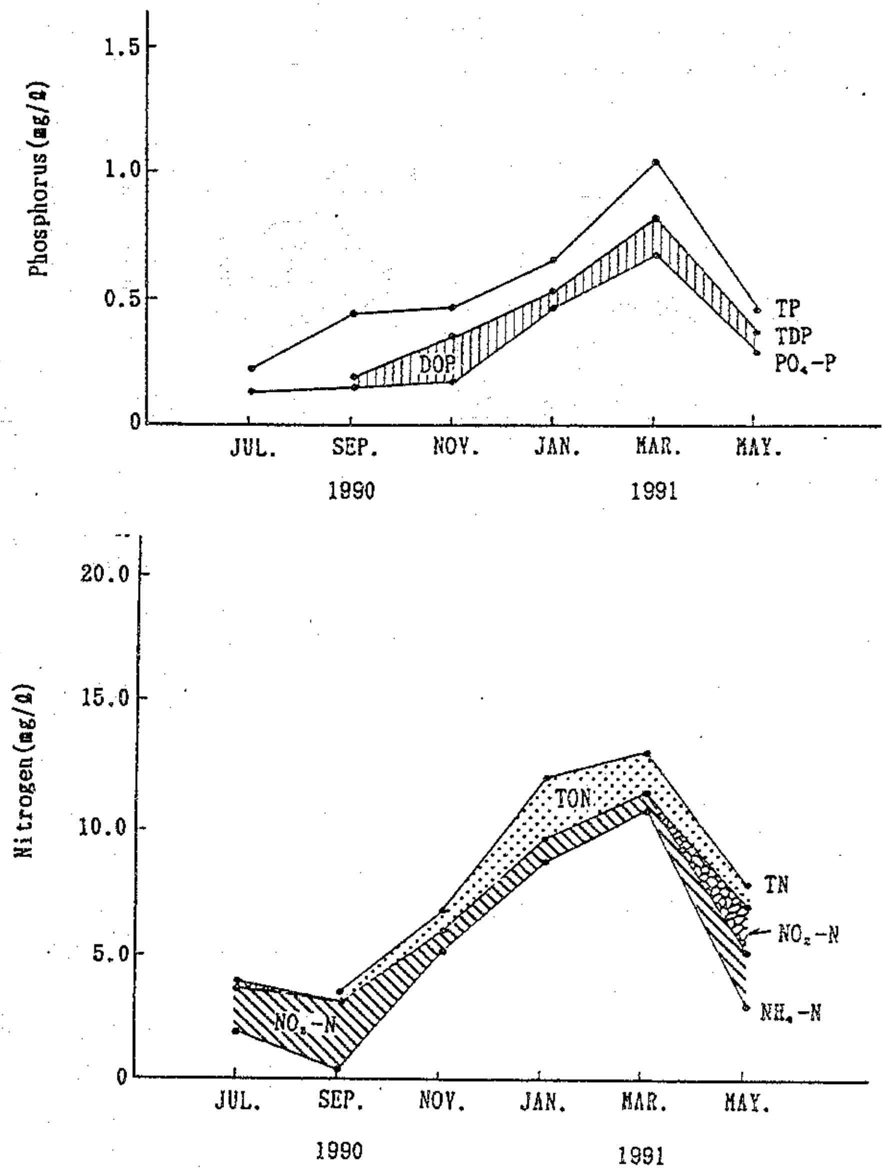


Fig. 3.2.2-4 Variation of Nitrogen and Phosphorus of Yangjae Chong at Y-St. 2 from July, 1990 to May, 1991

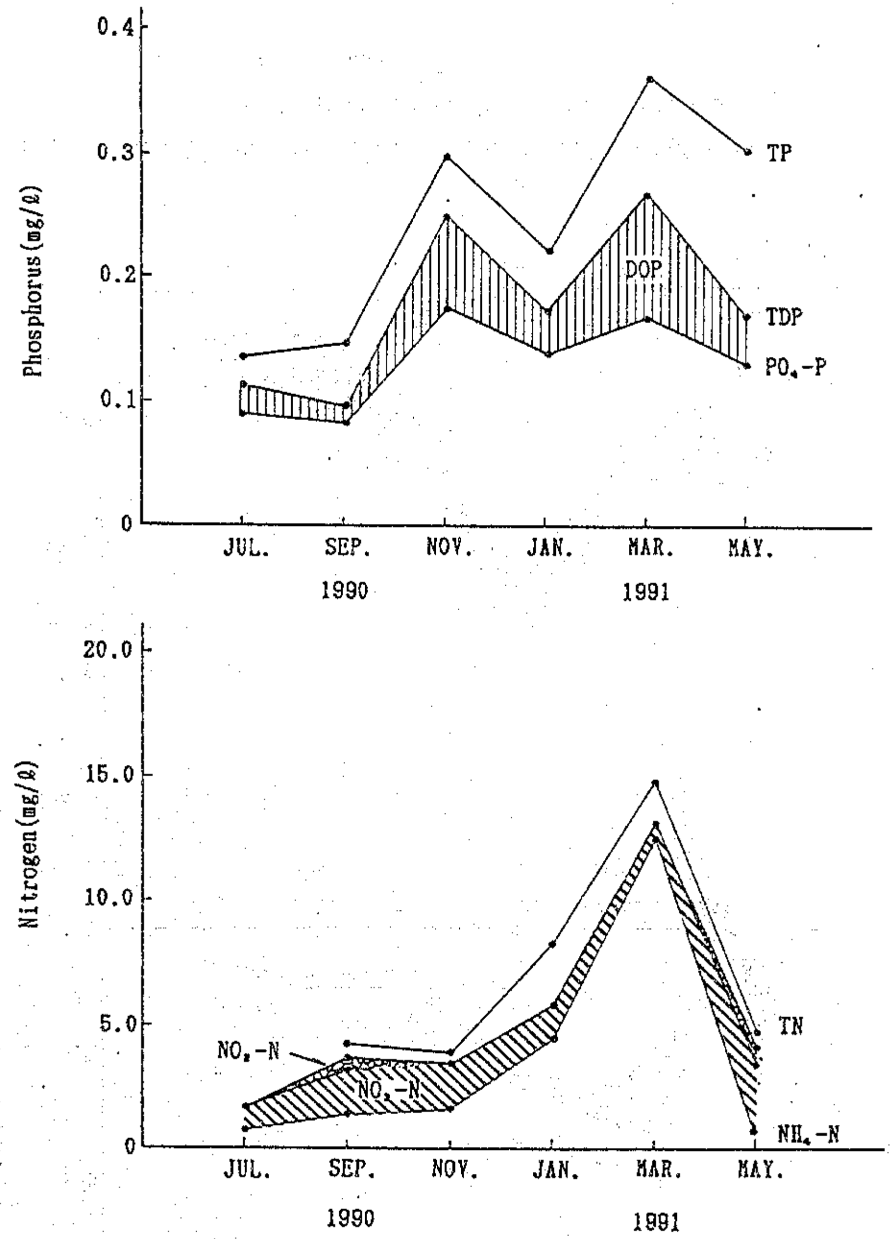


Fig. 3.2.2-5 Variation of Nitrogen and Phosphorus of Yangjae Chong at Y-St. 3 from July, 1990 to May, 1991

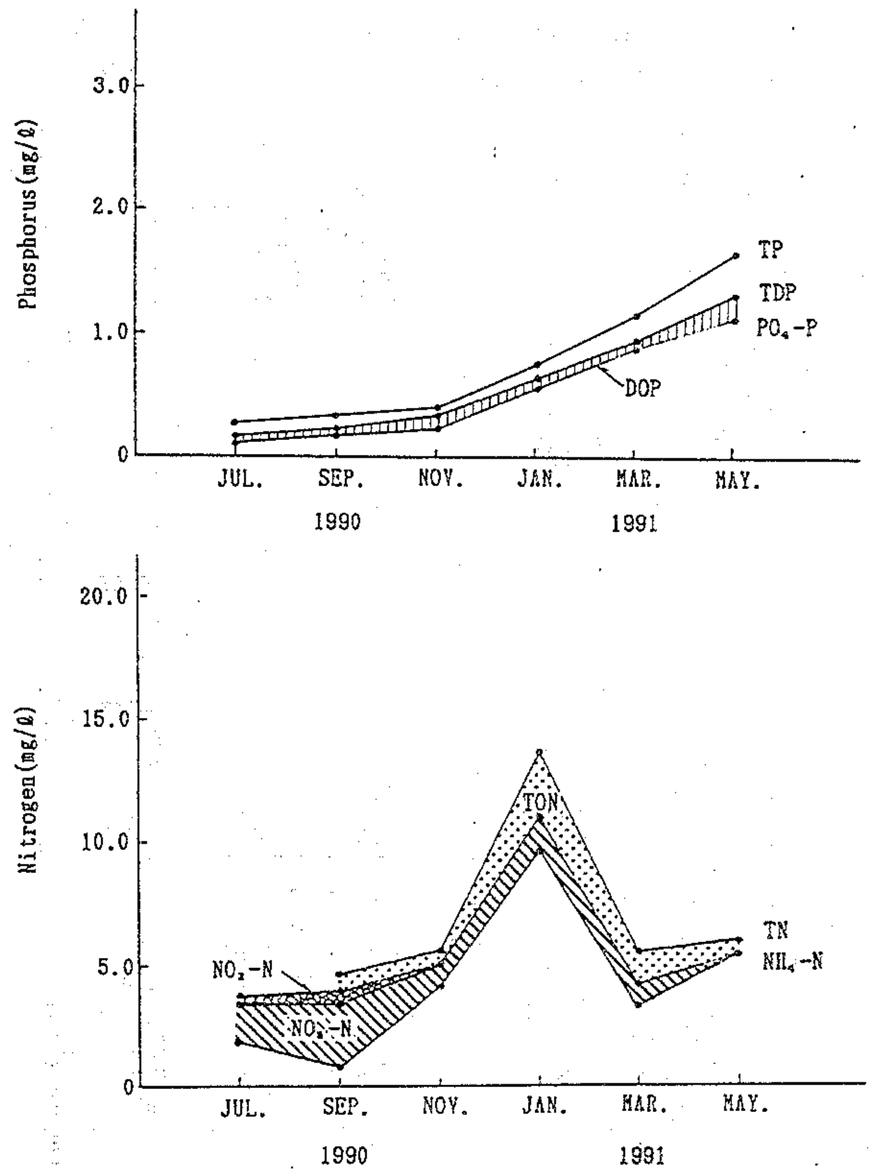


Fig. 3.2.2-6 Variation of Nitrogen and Phosphorus of Yangjae Chong at Y-St. 4 from July, 1990 to May, 1991

Table 3.2.2-9 Each Form of Nitrogen of Yangjae Chong

		July	September		November		January		March		May	
		(mg/l)	(mg/l)	(%)	(mg/l)	(%)	(mg/l)	(%)	(mg/l)	(%)	(mg/l)	(%)
Y-St. 1	TN	-	5.35		5.33		14.44		8.83		7.87	
	TON	-	0.47	8.8	0.51	9.6	1.93	13.4	1.19	13.5	1.18	15.0
	NO3-N	1.89	2.95	55.1	0.71	13.3	0.83	5.7	0.00	0.0	1.62	20.0
	NH4-N	1.87	1.07	20.0	4.25	79.7	11.78	81.6	7.36	83.4	3.62	46.0
Y-St. 2	TN	-	3.46		6.70		12.32		13.19		8.14	
	TON	-	0.28	8.1	0.53	7.8	2.36	19.2	2.25	17.1	3.18	39.1
	NO3-N	1.68	2.96	85.5	0.94	14.0	1.08	8.8	0.89	6.7	2.28	28.0
	NH4-N	1.97	0.16	4.6	5.19	77.5	8.83	71.7	10.91	82.7	3.24	39.8
Y-St. 3	TN	-	4.36		3.89		8.3		14.99		4.76	
	TON	-	0.63	14.4	0.50	12.9	2.47	29.8	2.47	16.5	2.68	56.3
	NO3-N	0.89	2.18	50.0	1.73	44.5	1.33	16.0	0.88	5.9	2.14	45.0
	NH4-N	0.72	1.15	26.4	1.61	41.4	4.51	54.3	12.5	83.4	0.65	13.7
Y-St. 4	TN	-	4.54		5.60		13.76		5.63		6.17	
	TON	-	0.42	9.3	0.48	8.6	2.59	18.8	2.12	37.7	0.40	6.5
	NO3-N	1.59	2.85	62.8	1.05	18.8	1.36	9.9	0.86	15.3	0.10	1.6
	NH4-N	1.76	0.71	15.6	4.04	72.1	9.74	70.8	3.49	62.0	5.77	93.5

Table 3.2.2-10 Phosphorus of Yangjae Chong

		July	September	November	January	March	May
Y-St. 1	TP(mg/l)	0.259	0.377	0.329	0.841	0.937	0.320
	PO4-P(mg/l	0.133	0.195	0.143	0.578	0.616	0.175
	(%)	51	52	43	69	66	55
Y-St. 2	TP(mg/l)	0.214	0.449	0.468	0.661	1.043	0.471
	PO4-P(mg/l	0.13	0.148	0.163	0.456	0.672	0.289
	(%)	61	33	35	69	64	61
Y-St. 3	TP(mg/l)	0.138	0.146	0.216	0.220	0.362	0.309
	PO4-P(mg/l	0.087	0.081	0.145	0.136	0.169	0.134
	(%)	63	55	67	62	47	43
Y-St. 4	TP(mg/l)	0.286	0.367	0.401	0.799	1.183	1.645
	PO4-P(mg/l	0.124	0.202	0.232	0.586	0.889	1.159
	(%)	43	55	58	73	75	70

Table 3.2.2-11 BOD and COD of Yangjae Chong

		July	September	November	January	March	May	Mean	SD
Y-St. 1	TBOD(mg/l)	6.9	7.2	17.6	13.4	35.5	17.3	16.3	9.6
	DBOD(mg/l)	-	3.6	16.5	11.7	23.5	11.5	13.4	6.5
	(%)	-	50	94	87	66	66	73	15.8
	TCOD(mg/l)	6.3	8.9	16.5	20.8	14.6	13.0	13.4	4.8
	DCOD(mg/l)	-	7	13.1	17	12	10.9	12.0	3.2
	(%)	-	79	79	82	82	84	81	1.9
Y-St. 2	TBOD(mg/l)	5.9	4.7	27.0	9.2	34.6	12.5	15.7	11.2
	DBOD(mg/l)	-	2.3	22.5	7.4	25.7	11.7	13.9	8.9
	(%)	-	49	83	80	74	94	76	15.0
	TCOD(mg/l)	7.1	10.0	34.8	18.3	14.7	12.6	16.3	9.0
	DCOD(mg/l)	-	6.6	28.8	14.7	13.6	12.0	15.1	7.4
	(%)	-	66	83	80	93	95	83	10
Y-St. 3	TBOD(mg/l)	4.2	3.2	6.0	4.6	8.0	5.5	5.3	1.5
	DBOD(mg/l)	-	2.2	4.0	3.9	7.5	4.4	4.4	1.7
	(%)	-	69	67	85	94	80	79	10
	TCOD(mg/l)	5.0	7.0	8.1	10.3	11.8	10.5	8.8	2.3
	DCOD(mg/l)	-	5.4	7.3	9.9	10.6	8.9	8.4	1.9
	(%)	-	77	90	96	90	85	88	6
Y-St. 4	TBOD(mg/l)	6.4	26.0	21.0	7.9	35.4	30.8	21.3	10.9
	DBOD(mg/l)	-	12.8	17.1	7.2	25.2	21.1	16.7	6.3
	(%)	-	49	81	91	71	69	72	14
	TCOD(mg/l)	13.1	17.3	20.6	18.0	17.3	21.2	17.9	2.6
	DCOD(mg/l)	-	13.9	18.5	12.4	13.1	16.1	14.8	2.2
	(%)	-	80	90	69	76	76	78	7

Table 3.2.2-12 Percent of Settleable Matter to SS of Yangjae Chong

		July	September	November	January	March	May
Y-St. 1	SS(mg/l)	88.4	83.2	120.1	44.2	41.8	44.0
	SM(mg/l)	76.1	71.1	91.7	28.5	19.2	23.5
	(%)	85	84	73	64	46	53
Y-St. 2	SS(mg/l)	72.1	163.2	227.6	37.5	40.4	26.4
	SM(mg/l)	63	120.7	192	25.5	21.4	19.9
	(%)	83	85	68	68	53	75
Y-St. 3	SS(mg/l)	20.1	5.5	20.3	4.3	8.4	8.3
	SM(mg/l)	11.3	3.8	15.5	2.2	3.8	3.0
	(%)	78	62	76	51	45	36
Y-St. 4	SS(mg/l)	101.9	28.8	151.5	36.5	27.4	46.4
	SM(mg/l)	25.1	24.0	117.3	25.3	13.2	30.3
	(%)	89	80	74	69	48	65

DCOD(Mn) concentrations were obtained from 5.4-28.8 mg/l. The percentage to TCOD(Mn) was a little higher (66-96 %) than that of DBOD. High proportions of both DBOD and DCOD(Mn) indicate that the water in this river will possibly be treated biologically and efficiently.

The concentrations of settleable matter were obtained with great variance from 2.2 to 192.0 mg/l. The higher values were usually obtained from the 24-hour servys with great standad deviations. The high limit of the range was possibly 76.1 mg/l, instead of the value noticed above. The percentages to SS, however, fell within a narrow range from 45 to 89 %, showing a decrease from July to March at all stations (Table 3.2.2-12). However, even when the concentrations of both SS and settleable matters were extremely high, affected by the rainfall and construction work, the proportions fell within the range given. The percentages at Y-St. 3, however, were slightly lower than those of the other stations.

Sulfide was found in fairly narrow ranges in each station each month (Tables 3.2.2-5-8 and A-3.2.-1-24). Highest mean values (4.12-4.23 mg/l) were obtained in January, 1991, at all stations and lowest values (2.43-2.6 mg/l) in July, November and March.

Small quantities of MBAS were found (0.99 - 2.25 mg/l). These values seem to result from detergent. Concentrations higher than 0.5 mg/l cause froth on the river. It is advisable, therefore, to use natural soap rather than detergent.

3.2.3 Changes of Water Quality and Pollution Load from the Upper to the Lower Stations

COD(Cr), TN and NH_4-N on the upper stream of the study area and in the study area of Yangjae Chong were analyzed by the JICA team using HACH Water Analyzer

(1) Water quality in the upper stream of the study area

COD(Cr) in the above Y-St. 3 was slightly higher or almost same as that of Y-St. 3. NH_4-N was relatively higher than that of Y-St. 3 (Fig. 3.2.3-1).

The study area which included both sides of this river, is mainly used for housing, while the area outside of the study area is mainly used for farming. It is assumed that high NH_4-N was caused by the fertilizers on these farms.

COD(Cr) at Y-St. 4 and the area above it, on the other hand, showed same level of concentrations.

In Yangjae Chong, extremely high purification coefficients were recorded, therefore, it is assumed that purification may have occurred between Y-St. 3 and YG1, and between Y-St. 4 and the upper stream, and brought about the lower values to these stations.

(2) Water quality change in the study area

1) Change in short period

The results obtained from the survey conducted four times from May to June, 1991, are discussed here. Discharge values were practically measured on the same dates (Tables 3.2.3-1-4).

Discharges at all stations showed great daily variations. It increased on the main river from the upper to the lower stations. Y-St. 3 constantly had small discharges due to the location, which is on the mouth of Nyoi Chong.

	Y-ST. 1:	0.42-3.28 m^3/s
Discharge	Y-St. 2:	0.73-2.91 m^3/s
	Y-St. 3:	0.05-0.32 m^3/s
	Y-St. 4:	0.67-1.94 m^3/s

The results obtained on the 27th of May indicate that the pollution

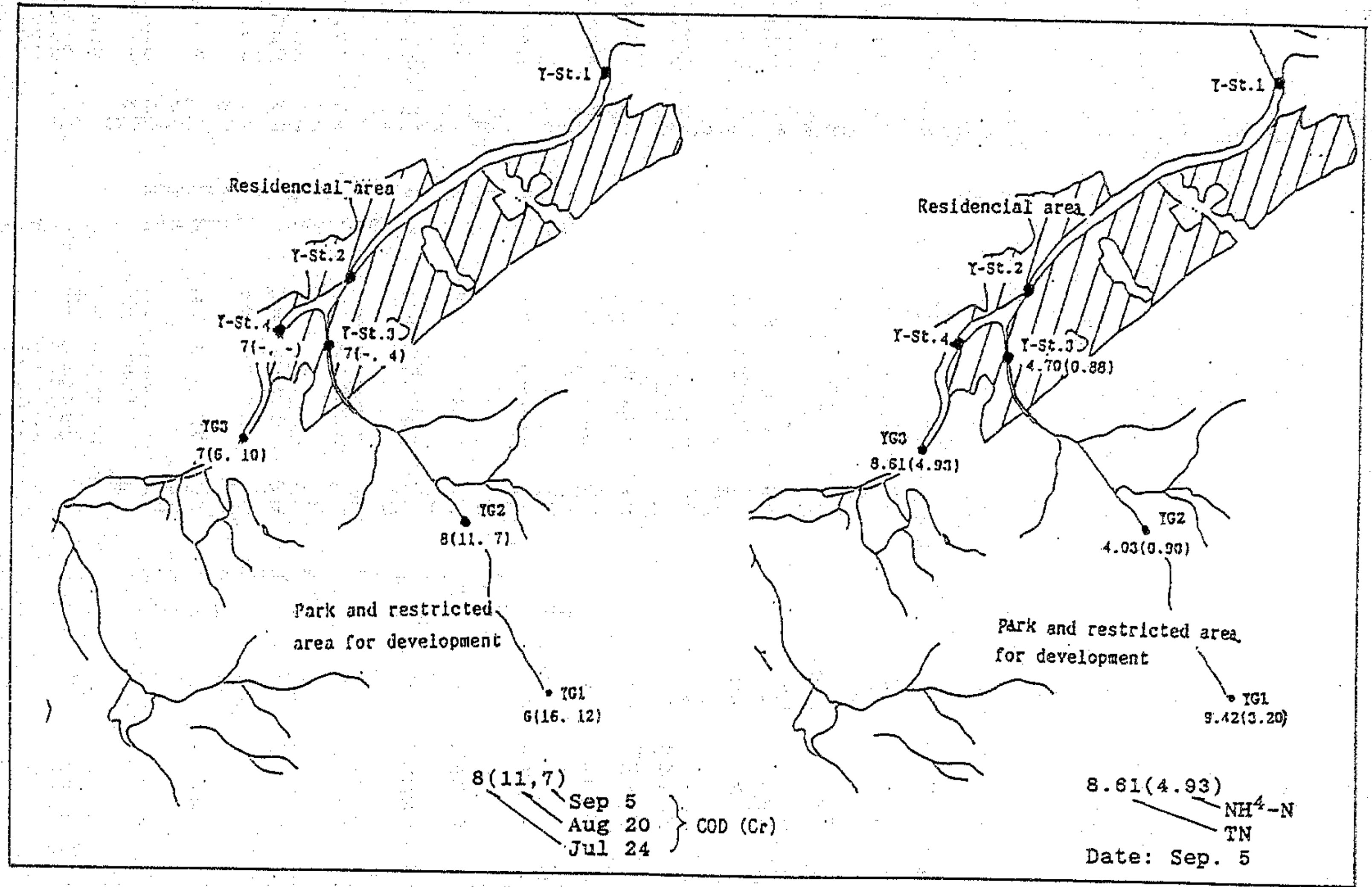


Fig. 3.2.3-1 TN, NH_4-N and COD(Cr) in the Upper Stream and in the Study Area
Yangjae Chong, July 24, August 20 and September 5, 1990

Table 3.2.3-1 Water Quality of Yangjae Chong, Y-St. 1, May-June, 1991

Discharge was practically measured on the same time.

Station	Item / Date	COD(Mn) (mg/l)	COD(Cr) (mg/l)	SS-1 (mg/l)	SS-2 (mg/l)	SS-2(IL) (mg/l)	(IL)/ SS-2(%)	SS-2/ TR(%)	SS(IL)/ TR(%)	SS(IL)/ TR(IL)(%)	TR (mg/l)	TR(IL) (mg/l)	TR(IL)/ TR(%)	SM (mg/l)	SM(IL) (mg/l)	SM(IL)/ SM(%)	SM/TR (%)	SM/SS (%)	SM(IL)/ TR(IL)(%)	NH4-N (mg/l)	NO3-N (mg/l)	WT (°C)	DO (mg/l)	EC (mS/cm)	Discharge (m3/s)
Y-St. 1-1	May 27	8	28	40	58.0	19.0	33	27	9	84	217	22.7	10	23.3	5.1	22	11	40	22	4.66	3.7	16.6	-	0.8	3.277
Y-St. 1-3	May 27	6.8	30	58	64.0	20.0	31	31	10	56	205	35.7	17	23.4	3.9	17	11	37	11	4.86	4.3	15.7	-	0.8	
Y-St. 1-3	Jun. 10	16	44	36	40.7	12.0	29	13	4	12	319	101.0	32	12.7	1.5	12	4	31	1	9.17	1.2	26.0	6.3	0.8	1.009
Y-St. 1-2	Jun. 14	10.8	0	65	53.5	15.0	28	20	6	22	268	69.3	26	-	-	-	-	-	-	10.9	2.4	23.7	6.2	0.9	0.919
Y-St. 1-2	Jun. 26	11	103	53	34.5	11.7	34	13	4	6	275	205.3	75	-	-	-	-	-	-	9.8	2.6	23.3	5.2	0.7	
	Mean	10.5	51	50	50.1	15.5	31	21	6	36	257	86.8	32	19.8	3.5	17	9	36	12	7.9	2.8	21.1	5.9	0.8	1.735
	SD	3.2	31	11	10.9	3.4	2	7	2	30	41	65.2	23	5.0	1.5	4	3	4	9	2.6	1.1	4.1	0.5	0.1	1.091

Table 3.2.3-2 Water Quality of Yangjae Chong, Y-St. 2, May-June, 1991

Discharge was practically measured on the same time.

Station	Item	COD(Mn) (mg/l)	COD(Cr) (mg/l)	SS-1 (mg/l)	SS-2 (mg/l)	SS-2(IL) (mg/l)	(IL)/ SS-2(%)	SS-2/ TR(%)	SS(IL)/ TR(%)	SS(IL)/ TR(IL)(%)	TR (mg/l)	TR(IL) (mg/l)	TR(IL)/ TR(%)	SM (mg/l)	SM(IL) (mg/l)	SM(IL)/ SM(%)	SM/TR (%)	SM/SS (%)	SM(IL)/ TR(IL)(%)	NH4-N (mg/l)	NO3-N (mg/l)	WT (°C)	DO (mg/l)	EC (mS/cm)	Discharge (m3/s)
Y-St. 2-1	Mat 27	6.1	22	41	36	12.3	34	21	7	80	169	15.3	9	-	-	-	-	-	-	3.45	3.9	17.2	-	0.8	2.914
Y-St. 2-2	Mat 27	6.6	21	45	67.3	15.3	23	31	7	78	217	19.7	9	43.3	7.7	18	20	64	39	3.95	3.9	16.9	-	0.9	
Y-St. 2-1	Jun. 10	14.8	-	-	48	12.7	26	15	4	13	329	101.0	31	25.3	4.5	18	8	53	4	-	-	24.4	7.5	0.8	1.352
Y-St. 2-2	Jun. 10	14.5	47	24	59.3	16.0	27	15	4	11	392	140.0	36	40.6	8.0	20	10	68	6	8.17	1.8	24.8	7.6	0.85	
Y-St. 2-2	Jun. 14	30.7	79	77	(857.5	(115)	(13)	-	(11)	(69)	(1079)	(167)	(15)	-	-	-	-	-	-	12.2	5.4	27.6	4.3	0.9	0.715
Y-St. 2-2	Jun. 26	11.5	54	46	21.0	11.5	55	8	4	6	257	190.7	74	-	-	-	-	-	-	11.3	2.1	23.1	6.0	0.7	
	Mean	15.6	50	48	48.9	13.9	33	17	5	27	298.8	112.9	37	36.4	6.7	19	13	62	16	8.9	3.3	23.4	6.4	0.8	1.660
	SD	8.1	21	19	17.5	1.8	13	8	1	29	67.2	62.5	23	7.9	1.6	1	5	6	16	3.2	1.5	3.5	1.3	0.1	0.924

Table 3.2.3-3 Water Quality of Yangjae Chong, Y-St. 3, May-June, 1991

Discharge was practically measured on the same time.

Station	Item / Date	COD(Mn) (mg/l)	COD(Cr) (mg/l)	SS-1 (mg/l)	SS-2 (mg/l)	SS-2(IL) (mg/l)	(IL)/ SS-2(%)	SS-2/ TR(%)	SS(IL)/ TR(%)	SS(IL)/ TR(IL)(%)	TR (mg/l)	TR(IL) (mg/l)	TR(IL)/ TR(%)	SM (mg/l)	SM(IL) (mg/l)	SM(IL)/ SM(%)	SM/TR (%)	SM/SS (%)	SM(IL)/ TR(IL)(%)	NH4-N (mg/l)	NO3-N (mg/l)	WT (°C)	DO (mg/l)	EC (mS/cm)	Discharge (m3/s)
Y-St. 3-1	May 27	6.6	24	41	41.0	17.0	41	23	10	84	176	20.3	12	36.1	5.9	16	21	88	29	2.63	5.1	18.7	-	0.85	0.318
Y-St. 3-2	May 27	7.1	25	42	32.0	13.3	42	6	6	73	215	18.3	9	32.0	7.2	23	15	100	39	2.61	5.5	18.0	-	0.9	
Y-St. 3-3	May 27	7.6	35	47	39.3	19.3	49	10	10	58	197	33.0	17	22.3	4.7	21	11	57	14	2.58	5.2	18.1	-	0.85	
Y-St. 3-2	Jun. 10	10.4	43	7	11.3	7.3	65	3	3	11	284	67.0	24	2.0	1.3	65	1	18	2	1.79	0.8	23.8	7.6	0.85	0.059
Y-St. 3-2	Jun. 14	9.3	(0	7	5.5	4.0	73	1	1	2	327	179.0	55	-	-	-	-	-	-	5.4	2.5	28.1	9.9	0.9	
Y-St. 3-2	Jun. 26	11.0	16	15	5.0	3.5	70	2	2	2	233	165.3	71	-	-	-	-	-	-	6.5	0.9	22.6	8.0	0.7	0.047
	Mean	8.7	28.6	27	22.4	10.7	57	7	5	38	239	80.5	31.0	23.1	4.8	31	12	66	21	3.6	3.3	21.6	8.5	0.8	0.130
	SD	1.7	9.4	17	15.5	6.2	13	8	4	34	52	66.9	23.5	13.2	2.2	20	7	32	14	1.7	2.0	3.7	1.0	0.1	

Table 3.2.3-4 Water Quality of Yangjae Chong, Y-St. 4, May-June, 1991

Discharge was practically measured on the same time.

Station	Date	COD(Mn) (mg/l)	COD(Cr) (mg/l)	SS-1 (mg/l)	SS-2 (mg/l)	SS-2(IL) (mg/l)	(IL)/ SS-2(%)	SS-2/ TR(%)	SS(IL)/ TR(%)	SS(IL)/ TR(IL)(%)	TR (mg/l)	TR(IL) (mg/l)	TR(IL)/ TR(%)	SM (mg/l)	SM(IL) (mg/l)	SM(IL)/ SM(%)	SM/TR (%)	SM/SS (%)	SM(IL)/ TR(IL)(%)	NH4-N (mg/l)	NO3-N (mg/l)	WT (°C)	DO (mg/l)	EC (mS/cm)	Discharge (m3/s)
Y-St. 4-2	May 27	7.3	19	53	67.3	22.9	34	27	9	89	247	25.7	10	66.3	10.4	16	27	99	40	5.1	4.1	19.3	-	0.9	1.940
Y-St. 4-2	Jun. 10	48.6	40	40	127.0	69.0	54	27	15	52	471	132.3	28	70.4	25.0	36	15	55	19	10.4	1.7	23.9	7.5	0.8	1.031
Y-St. 4-2	Jun. 14	10.0	(0	84	83.0	14.5	17	31	5	11	271	131.0	48	-	-	-	-	-	-	7.2	2.7	28.5	8.9	0.9	0.674
Y-St. 4-1	Jun. 26	10.7	33	26	10.5	8.0	76	4	3	5	237	148.0	62	-	-	-	-	-	-	10.5	2.8	23.1	7.3	0.7	
Y-St. 4-2	Jun. 26	10.7	24	12	21.5	8.0	37	9	3	4	252	190.7	76	-	-	-	-	-	-	10.9	3.0	22.9	6.4	0.7	1.215
	Mean	17.5	29	43	61.9	24.5	44	20	7	32	296	125.5	45	68.4	17.7	26	21	77	30	8.8	2.9	23.5	7.5	0.8	0.533
	SD	15.6	8	25	42.4	22.9	20	11	4	33	88	54.4	23	2.0	7.3	10	6	22	11	2.3	0.8	2.9	0.9	0.1	

Table 3.2.3-5 Pollution Load of Ynagjae Chong in Short Period, May 27-June 26, 1991
Discharge: Actual measurement value

		COD(Mn) (ton/day)	BOD (ton/day)	SS (ton/day)	TR (ton/day)	NH4-N (ton/day)	NO3-N (ton/day)
May 27, '91	Y-St. 1	2.1	1.3	17.3	59.8	1.35	1.14
	Y-St. 2	1.6	0.6	13.0	48.5	0.93	0.98
	Y-St. 3	0.05	0.1	1.0	5.4	0.07	0.15
	Y-St. 4	1.2	-	11.3	41.4	0.86	0.69
June 10,'91	Y-St. 1	1.4	1.6	3.6	27.8	0.80	0.19
	Y-St. 2	1.7	1.7	6.3	42.1	0.95	0.34
	Y-St. 3	0.05	0.03	0.06	1.4	0.02	0.01
	Y-St. 4	4.3	-	11.3	41.9	0.42	0.16
June 14,'91	Y-St. 1	0.9	0.8	4.3	21.3	0.87	0.19
	Y-St. 2	1.9	2.4	-	-	0.76	0.34
	Y-St. 3	0.05	0.03	0.02	1.4	0.02	0.01
	Y-St. 4	0.6	-	4.8	15.7	0.42	0.16
June 26,'91	Y-St. 1	0.4	0.4	1.3	10.0	0.36	0.09
	Y-St. 2	0.7	0.6	1.3	16.2	0.71	0.13
	Y-St. 3	0.05	0.03	0.02	1	0.03	0.004
	Y-St. 4	-	-	-	-	-	-

Table 3.2.3-6 Mean Value of the Pollution Load of Yangjae Chong during the Survey Period
January, 1990, to January, 1991 : Y-St. 1 and Y-St. 2
January, 1990, to May, 1991 : Y-St. 3 and Y-St. 4

Station \ Item	BOD (ton/day)	COD(Mn) (ton/day)	SS (ton/day)	NH4-N (ton/day)
Y-St. 1	18.18	17.38	64.07	5.28
Y-St. 2	7.38	11.38	52.06	3.81
Y-St. 3	1.13	2.13	3.21	0.55
Y-St. 4	7.04	7.40	17.97	2.46

load gradually increased from the upper to the lower stations caused by over-flow from theinterceptin sewer pipe or side-inflow (Table 3.2.3-5).

On the other dates, however, no consistent pattern was noticed. It is supposed that the construction work on the river bed often affected the results.

Due to the low concentration of water quality and small discharges, the pollution load at Y-St. 3 was considerably low. Therefore, it gives less contribution to the total pollution load on the main river.

2) Changes during this survey period

It was found that COD(Mn) concentrations gradually increased from the upper to the lower stations in the colder months except in January and February, 1990, when extremely high values were found at all stations. On the contrary, lower values were found at all stations in the hotter months and these fell within a smaller range. It was noticed, however, that Y-St. 3 maintained the same level of COD(Mn) even after the hotter months of 1990, and Y-St. 1 contained the highest level of COD(Mn) when compared to the other stations (Fig. 3.2.3-2).

NH_4-N distribution pattern showed the same pattern as found in COD(Mn). However, after the hotter months, Y-St. 3 maintained lower levels of COD(Mn).

Distribution patterns of BOD and SS concentrations from the upper to the lower stations showed similar patterns to COD(Mn). However, the SS concentration at Y-St. 3 stood out in lower values than at other stations. This may be because of the effect of the construction work on the other stations. The construction work affects, particularly, the SS concentrations observed at Y-St. 1 and Y-St. 2 from March to May in 1991.

Great monthly variations on the load of each quality item were

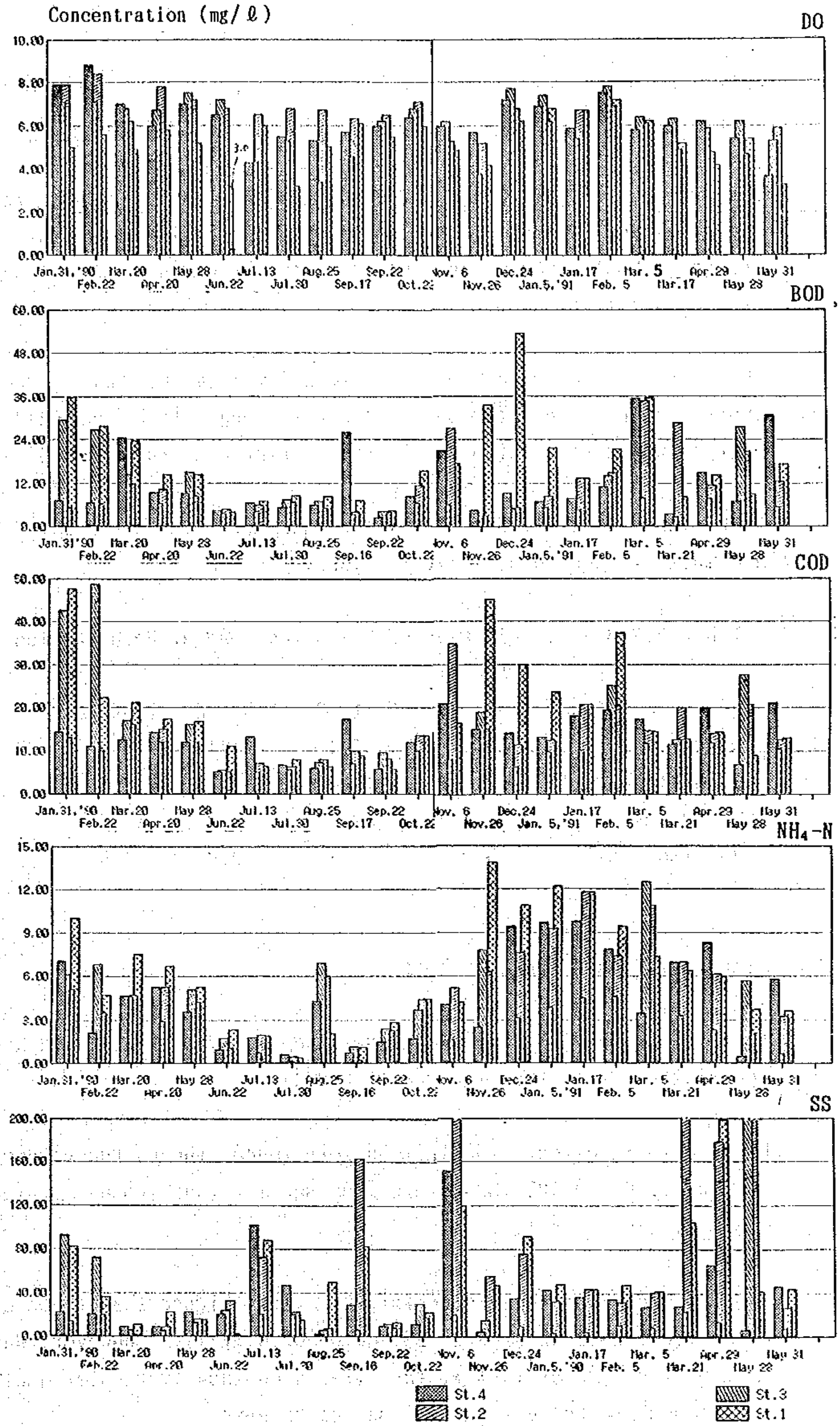


Fig. 3.2.3-2 Water Quality Change from the Upper to the Lower Stations of Yangjae Chong

obtained at all stations, and the variance of the SS load was noticeably very large.

The values of the load of BOD and COD(Mn) showed tendencies of having lower values in the hotter months, which may have been brought about by the quick decomposition of organic matters due to high temperature and higher DO.

The load estimated based on each quality item increased from the upper to the lower stations. This was thought to be caused by the over-flow and side-inflow with great variations (Table 3.2.3-6).

Each load at Y-St. 3 was very low therefore it contributed very minimally to the total pollution load.

Table 3.2.3-6 Yearly Mean of Pollution Load at Each Station

Item Station	Y-St. 1	Y-St. 2	Y-St. 3	Y-St. 4
BOD(ton/day)	18.2	7.4	1.1	7.0
COD(Mn)(ton/day)	17.4	11.4	2.1	7.4
SS(ton/day)	64.1	52.1	3.2	18.0
NH_4-N(ton/day)	5.3	3.8	0.6	2.5

3.2.4 Side-inflow into Yangjae Chong

There are many side-inflows in the study area, most of which are on the right side of the river (Fig. 3.2.4-1).

Five of main direct side-inflows were found, though the volumes of inflow (0.001-0.135 m3/s) were much smaller than those of Yangjae Chong (Table 3.2.4-1).

COD(Mn) and SS of these side-inflows were higher than those of the river (COD: 28.1-42.0 mg/l; SS: 40.0-162.0 mg/l). However, due to the small volume of inflow, the effects on the river water qualities are thought to be very minimal on clear days.

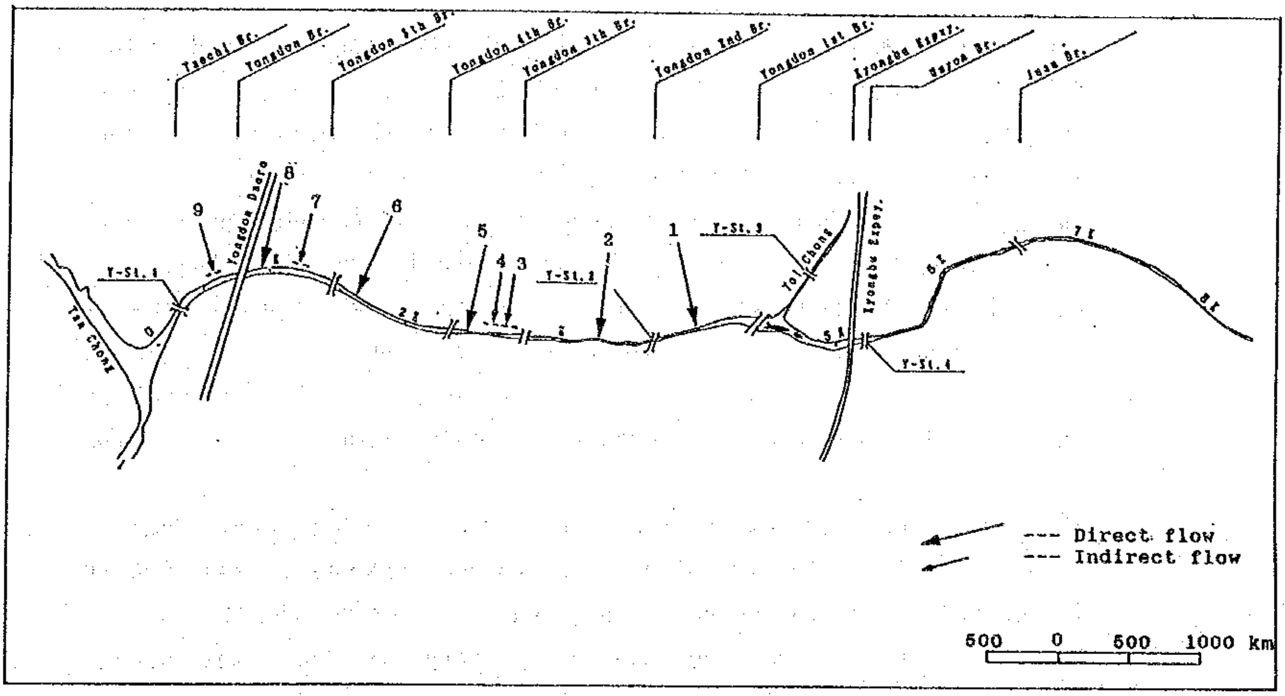


Fig. 3.2.4-1 Side-inflow into Yangjae Chong

Table 3.2.4.-1 Water Quality of Side-inflow into Yangjae Chong

Date: June 12, 1990
Weather: Cloudy, later clear
AT: 22.5°C(10:15), 25.4°C(12:30)
Sampling time: 10:20-16:40

Item / Station	WT (°C)	pH	DO (mg/l)	EC (mS/cm)	Turbid. (mg/l)	COD(Mn) (mg/l)	SS (mg/l)	Discharge (m3/s)	Load COD(Mn) (kg/day)	Load SS (kg/day)
1	19.1	7.9	3.4	0.9	50	46.1	70.4	0.135	537.7	821.1
2	18.9	7.7	-	0.8	28	28.1	40.0	0.050	121.4	172.8
3"	-	-	-	-	-	-	-	0.131	-	-
4"	20.7	7.8	2.7	0.8	30	36.1	48.7	0.075	233.9	315.6
5	21.5	7.9	4.6	0.8	20	42.0	162.0	0.021	76.2	293.9
6	16.6	7.5	7.6	0.8	0	-	-	0.001>	-	-
7"	21.2	7.6	3.0	0.8	25	34.1	46.0	0.054	159.1	214.6
8	19.3	7.8	5.5	0.9	30	32.1	56.0	0.001	2.8	4.8
9"	20.5	7.8	2.9	0.8	25	-	-	0.020	-	-
								Total(t/day)	1.13	1.82

": Water from these side-inflow sewer systems is carried to Tang Chong Sewage Treatment Plant by the intercepting sewers.

The inflow loads from 1, which is located between Y-St. 2 and Y-St. 4 have the largest side-inflow, of COD(Mn): 0.54 ton/day, SS: 0.82 ton/day. These values were quite smaller than the mean load of the main river, although the date they were measured were different. The sum of all other inflows of COD(Mn) was 0.52 ton/day and SS was 0.37 ton/day, and these inflows were located lower than Y-St. 2. When the total loads from inflows and the main river's are compared roughly, the former was considerably lower than the latter on a clear day. However, on rainy days it is supposed that very much of the pollution load would be added to the main river.

The water quality results, however, obviously show that Yangjae Chong has been seriously polluted due to some unknown causes, but it may be mainly dou to domestic waste water. Most of the area around Yangjae Chong is used for housing and they say that the sewage system in the area is completed. It is assumed, therefore, that large amounts of waste leak through some routes causing river pollution.

3.2.5 Water Quality and Flow-out Load at Freshet Time

Survey on freshet time was conducted at Y-St. 1 from 10 to 14, June 1991, when the precipitation was 5 mm on 9th and 46 mm on 11th. It continued to rain for 12 hours with interval on 11th. The main survey on this freshet time was conducted on 11th

The water level increased quickly and reached the maximum level within 5 hours. Then it decreased slowly and it returned the normal water level in about 72 hours (Fig. 3.2.5-1).

Several items of water qualities of COD(Cr), SS and TN showed the maximum concentrations during this freshet time within 10 minutes after the water level started to increase (Table 3.2.5-1), in particular TON concentration abruptly increased.

Of water qualities, the inflow quantities of TN, TON and SS stood

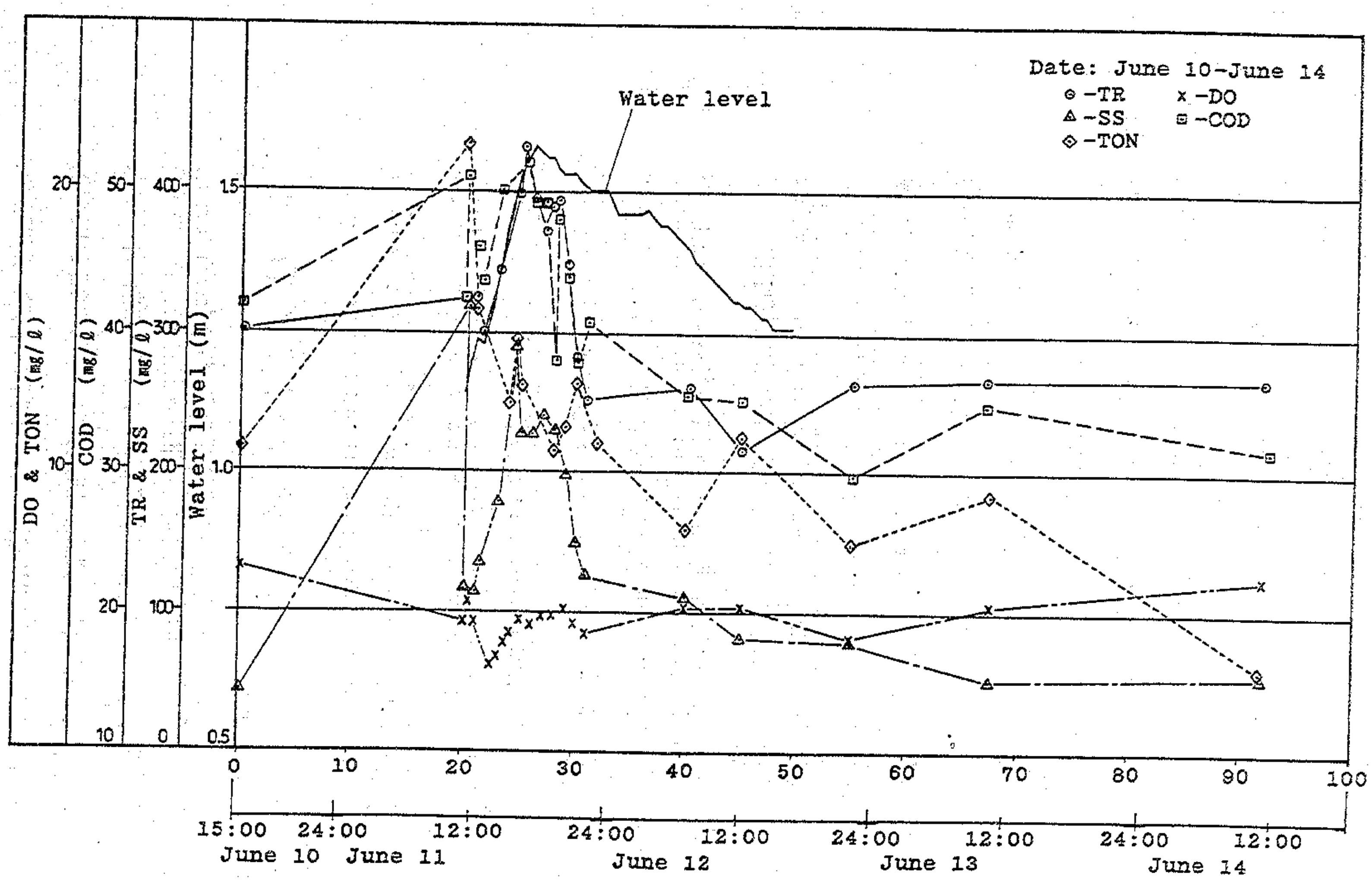


Fig. 3.2.5-1 Water Quality at Freshet Time of Yangjae Chong,
June 11-14, 1991

Table 3.2.5-1 Water Quality at Freshet Time of Yangjae Chong, Y-St. 1, June 11-14, 1991

Date	Item / Time	WT (°C)	pH	DO (mg/l)	EC (mS/cm)	Turbidi. (mg/l)	Velocity (m/s)	COD(Cr) (mg/l)	COD(Mn) (mg/l)	TN (mg/l)	T-KN (mg/l)	TON (mg/l)	TON/TN (%)	NO2-N (mg/l)	NO3-N (mg/l)	NO3-N /TN(%)	NH4-N (mg/l)	NH4-N /TN(%)	TR (mg/l)	TR(IL) (mg/l)	TR(IL) /TR(%)	SS-1 (mg/l)	SS-2 (mg/l)	SS-2(IL) (mg/l)	SS-2(IL) /SS-2(%)	SS-2 /TR(%)	SS(IL) /TR(%)
June 10	15:20	26.0	7.7	6.3	0.8	15	-	44	16.0	-	-	-	-	-	1.2	-	9.2	-	319	114.3	36	36	40.7	12.0	29	12.8	3.8
June 11	11:00	22.5	6.7	4.8	0.7	53-70	-	35	16.0	18.5	15.4	5.9	31.8	0.345	2.8	15.1	9.5	51.2	-	-		-	116	25.0	22	-	-
	11:10	22.5	7.0	4.8	0.8	143-167	-	81	20.5	20.2	20.0	10.8	53.5	0.185	-	-	9.2	45.6	-	-		-	320	54.3	17	-	-
	11:20	22.6	7.5	5.2	0.8	135-160	-	27	-	16.1	13.3	5.0	31.0	0.225	2.6	16.1	8.3	51.5	-	-		231	-	-		-	-
	11:30	22.7	7.6	5.2	0.8	109-125	-	23	-	17.0	14.2	6.2	36.4	0.240	2.6	15.3	8.0	46.9	-	-		-	-	-		-	-
	11:40	22.7	7.6	4.7	0.8	76-85	-	151	-	17.8	15.0	6.9	38.8	0.300	2.5	14.0	8.1	45.5	-	-		103	-	-		-	-
	12:00	22.9	7.5	4.7	0.8	71-76	-	71	18.0	19.3	16.3	8.1	41.9	0.220	2.8	14.5	8.2	42.4	325	58.3	18	-	114	26.7	23	35.1	8.2
	12:30	23.1	7.6	4.5	0.8	95-108	-	41	16.4	12.7	10.8	3.7	29.2	0.280	1.6	12.6	7.1	56.0	301	45.0	15	-	136	32.0	24	45.2	10.6
	13:30	23.2	7.5	3.1	0.8	95-104	-	48	-	15.2	13.3	6.6	43.4	0.415	1.5	9.9	6.7	44.0	-	-		189	-	-		-	-
	14:00	23.1	7.7	3.4	0.9	145-167	1.00	37	20.0	12.3	10.4	4.3	35.0	0.270	1.6	13.0	6.1	49.7	343	111.0	32	-	179	32.0	18	52.2	9.3
	14:30	23.1	7.7	3.9	0.9	152-161	1.18	26	-	14.7	11.7	5.2	35.4	0.180	2.8	19.1	6.5	44.3	-	-		240	-	-		-	-
	15:00	22.9	7.5	4.2	0.9	169-185	-	24	-	14.6	12.1	5.7	39.0	0.205	2.3	15.7	6.4	43.8	-	-		-	-	-		-	-
	15:30	22.8	7.6	4	0.9	145-177	0.79	25	20.0	14.9	12.1	5.5	37.0	0.150	2.6	17.5	6.6	44.4	397	73.0	18	-	289	33.8	12	72.8	8.5
	16:00	22.7	7.5	4.7	0.9	158-177	1.01	23	21.0	14.9	12.1	5.4	36.3	0.160	2.6	17.5	6.7	45.1	431	65.7	15	256	227	34.0	15	52.7	7.9
	16:30	22.7	7.7	4.7	0.9	155-175	0.94	26	-	14.8	12.1	5.5	37.2	0.175	2.5	16.9	6.6	44.7	-	-		-	-	-		-	-
	17:00	22.7	7.6	4.5	0.9	155-175	-	29	19.0	-	-	-	-	0.160	2.2	-	6.4	-	393	110.3	28	315	227	40.0	18	57.8	10.2
	17:30	22.7	7.6	4.9	0.9	155-180	1.00	29	19.0	13.7	10.8	3.8	27.7	0.212	2.7	19.7	7.0	51.1	352	78.7	22	250	227	40.0	18	64.5	11.4
	18:00	22.6	7.5	4.8	0.9	156-185	1.15	24	17.5	14.0	11.3	4.4	31.5	0.150	2.5	17.9	6.9	49.5	369	121.0	33	-	240	41.0	17	65.0	11.1
	18:30	22.7	7.5	4.9	0.9	155-190	-	21	-	-	-	-	-	0.165	2.8	-	6.7	-	-	-		-	-	-		-	-
	19:00	22.6	7.5	4.9	0.9	154-188	1.04	33	14.0	13.8	10.8	4.2	30.5	0.175	2.8	20.3	6.6	47.9	392	132.0	34	213	229	36.0	16	58.4	9.2
	19:30	22.5	7.5	4.9	0.9	142-160	-	32	-	-	-	-	-	0.175	2.8	-	6.6	-	-	-		225	-	-		-	-
	20:00	22.5	7.5	5.1	0.9	130-148	0.94	-	17.0	14.2	11.3	4.7	33.2	0.150	2.7	19.1	6.6	46.6	349	135.2	39	236	197	34.0	17	56.4	9.7
	20:30	22.5	7.5	4.8	0.9	127-148	-	-	-	-	-	-	-	0.185	2.5	-	6.7	-	-	-		-	-	-		-	-
	21:00	22.4	7.7	4.6	0.9	117-145	0.90	-	14.0	14.6	11.7	5.3	36.3	0.205	2.7	18.5	6.4	43.8	283	88.3	31	185	149	30.0	20	52.7	10.6
	21:30	22.3	7.4	4.9	0.9	101-120	-	25	-	-	-	-	-	0.210	2.8	-	6.7	-	-	-		185	-	-		-	-
	22:00	22.2	7.5	4.6	0.9	108-120	0.88	-	15.4	13.1	10.4	4.2	32.0	0.240	2.5	19.0	6.2	47.2	252	84.0	33	153	127	26.0	20	50.4	10.3
	22:30	22.1	7.5	5.6	0.9	91-106	0.87	-	-	-	-	-	-	0.215	2.2	-	6.2	-	-	-		190	-	-		-	-
June 12	07:20	21.1	7.7	5.2	0.9	89-102	-	-	13.0	11.2	8.3	2.9	25.9	0.190	2.7	24.1	5.4	48.3	260	100.0	38	153	111	23.0	21	42.7	8.8
	12:30	24.0	7.7	5.2	0.9	45-51	0.78	20	12.5	13.0	10.0	4.2	32.2	0.230	2.8	21.5	5.8	44.5	215	49.7	23	152	81	16.5	20	37.7	7.7
	21:05	23.4	7.8	4	0.9	57-67	0.69	-	9.8	14.5	11.3	3.6	24.8	0.190	3.0	20.7	7.7	53.1	264	53.3	20	140	78	20.0	26	29.5	7.6
June 13	10:10	20.9	7.6	5.2	0.9	37-41	0.40	-	12.4	13.8	10.8	3.9	28.3	0.265	2.7	19.6	6.9	50.1	267	71.0	27	138	50	16.0	32	18.7	6.0
June 14	11:20	23.7	6.5	6.2	0.9	27-35		-	10.8	15.9	13.3	2.4	15.1	0.245	2.4	15.1	10.9	68.4	268	69.3	26	65	53.5	15.0	28	20.0	5.6

out. Since inflowed organic nitrogen was a great part of the total (usual TON: 7-34 % of TN, freshet 25-55 %), the concentration of the inflowed organic form of SS was only a little higher than the usual (usual SS(IL): 28-34 % of SS, freshet: 12-32 %). Overflow of the sewage from the intercepting pipe resulted in high TON values at freshet time. High concentration of the inorganic part of SS was due to the construction work done on the riverbed, therefore, it is not clear whether inorganic SS will be constantly found even at freshet time.

The total flow-out load during this freshet time from 11:00 of 11, June, to 11:20 of 14, June, was estimated (Table 3.2.5-2).

Table 3.2.5-2 Flow-out Load at Freshet Time during 72.17 Hours (June 10-14, 1991)

COD(Mn)	10.0 ton	(3.1)
BOD	*8.6 ton	(-)
TN	9.3 ton	(3.6)
NH_4-N	4.9 ton	(1.7)
SS	75.3 ton	(17.0)

*This value was estimated using the formula:COD(Mn)=0.650 BOD + 4.378, which was obtained form the correlation between COD(Mn) and BOD measured in the monthly survey.
Values in the parentheses were the load on an ordinary day.

Another survey at freshet time was conducted on November 3, 1990, when rain continued for 11 hours, and the precipitation was 4 mm.

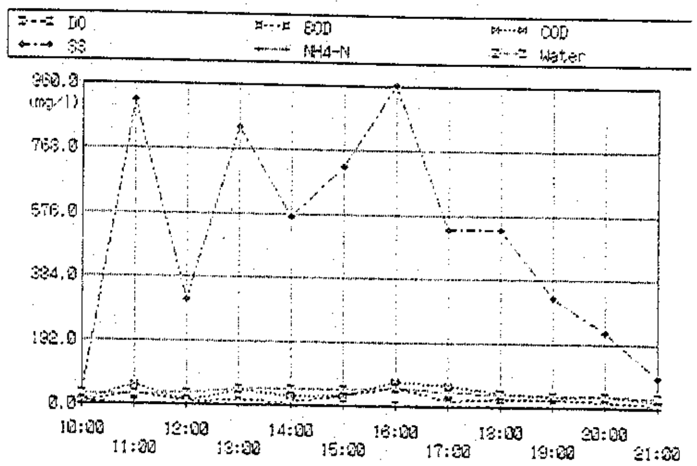
The curve of water level and discharge with time seem to show that this survey covered the period of effect on the river condition by freshet (Tables 3.2.5-3 and 4, Fig. 3.2.5-2). And the lowest water level observed on November 6-7 had the same results with the one value measured during the freshet. Therefore, the pollution load on an ordinary day was based on the water qualities obtained during freshet time, of which the water level was the same as found on

Table 3.2.5-3 Water Quality of Yangjae Chong at Freshet Time, Y-St. 1
November 3, 1990, Precipitation: 4 mm

Item / Time	WT (°C)	pH	DO (mg/l)	BOD (mg/l)	COD (mg/l)	SS (mg/l)	NH4-N (mg/l)	Coli-form (MPN/100ml)	Water level (cm)	Discharge (m3/s)
10:00	15.7	7.3	5.4	6.4	9.2	28.0	0.89	980	30	13.099
11:00	15.4	7.4	3.1	35.1	60.1	910.0	1.40	2400	32	14.240
12:00	15.2	7.4	4.0	12.0	10.5	314.0	0.54	870	36	16.642
13:00	15.0	7.3	4.2	14.2	46.1	835.0	0.88	1100	48	24.812
14:00	14.8	7.4	4.7	11.3	28.1	570.0	1.20	1400	49	25.559
15:00	14.5	7.4	3.2	32.4	30.1	720.0	1.14	2200	50	26.315
16:00	14.3	7.3	3.0	54.0	72.2	965.0	1.15	2600	54	29.441
17:00	14.0	7.3	3.8	16.0	61.1	533.3	1.17	1500	43	21.232
18:00	13.9	7.2	3.6	24.6	42.1	535.0	0.85	1800	37	17.267
19:00	13.6	7.2	3.4	24.4	30.1	328.3	1.25	2100	34	15.421
20:00	13.4	7.2	3.1	17.0	34.1	224.0	2.23	1800	33	14.825
21:00	13.7	7.2	4.0	12.0	22.1	91.7	0.73	1500	31	13.664

Table 3.2.5-4 Water Quality of Yangjae Chong at Freshet Time, Y-St. 3
November 3, 1990, Precipitation: 4 mm

Item	WT (°C)	pH	DO (mg/l)	BOD (mg/l)	COD (mg/l)	SS (mg/l)	NH4-N (mg/l)	Coli-form (MPN/100ml)	Water level (cm)	Discharge (m3/s)
10:00	13.7	7.0	3.2	30.5	64.2	380.0	0.73	2900	32	6.049
11:00	13.5	7.1	2.8	26.2	35.4	346.0	0.52	2700	34	6.819
12:00	13.1	7.0	3.8	11.6	42.6	228.0	0.45	1700	35	7.204
13:00	13.0	7.0	3.1	15.4	45.3	222.0	0.44	2100	37	7.937
14:00	12.7	7.1	3.4	16.0	27.4	218.0	0.42	2200	39	8.742
15:00	12.5	7.1	3.7	15.6	18.6	94.0	0.33	2100	42	9.894
16:00	12.3	7.2	4.0	10.4	16.4	108.0	0.32	1800	43	10.277
17:00	12.0	7.1	4.2	11.0	16.4	102.0	0.36	1500	41	9.510
18:00	11.8	7.2	3.9	10.4	15.0	68.0	0.33	1700	39	8.742
19:00	11.7	7.0	4.5	9.8	16.4	70.0	0.25	1100	36	7.589
20:00	11.4	7.0	5.8	7.5	12.4	40.0	0.32	1900	33	6.434
21:00	11.6	7.1	6.0	7.6	10.5	24.0	0.25	920	31	5.663



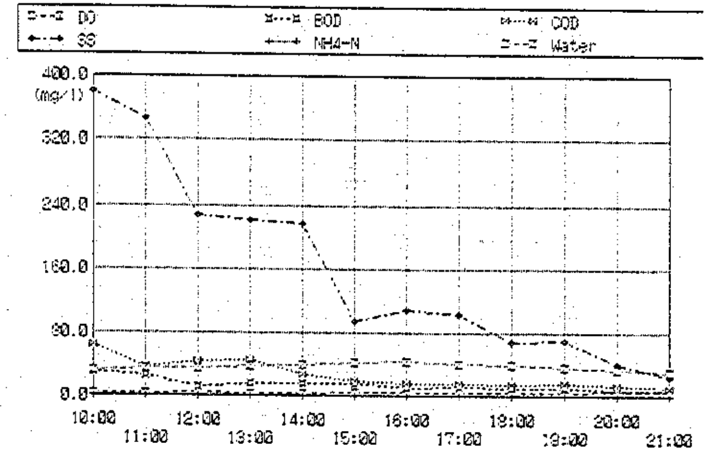


Fig. 3.2.5-2 Water Quality at Freshet Time of Yangjae Chong, November 3, 1990

November 6-7.

The total flow-out load brought about by the freshet this time were calculated, BOD: 19.0 ton/11hs, COD(Mn): 32.5 ton/11hs, SS: 479.4 ton/11hs and NH4-N: 0.90 ton/11hs, respectively. Extremely high SS load was assumed to be caused by construction.

The pollution load on an ordinary day, on the other hand, was assumed to contain BOD: 3.3 ton/11hs, COD: 4.8 ton/11hs, SS: 14.5 ton/11hs, and NH4-N: 0.36 ton/11hs.

It is possible to say that when precipitation reached 4 mm in 11 hours of rain, 83 % of the total load amount of BOD, 85 % of COD(Mn), 97 % of SS and 60 % of NH4-N were brought about by freshet.

3.2.6 Self-purification Capacity

Although the survey on self-purification was conducted only once on September 19, 1990, between the Yong Dong Second Bridge and the Yong Dong Fifth bridge. The time of flow down were 0.049 day and 0.056 day, respectively.

Remarkably high self-purification coefficients based on TKN were observed(4.20 and 5.21 1/day), in the selected sections. Self-purification based on BOD, however, was not detected.

This self-purification coefficient seems extraordinarily high when considering concentrations of other qualities and river conditions. However, there may be some causes of these high self-purification, i.e. great part of SS were large particles (the percentage of settleable matter to SS: 62-89 %) and velocity was small, therefore, the particles can easily escape from the water by settling to the bottom. These may have bought about quite high apparent self-purification capacity.

To obtain more accurate figures for self-purification, additional surveys need to be done.

3.2.7 Correlation between Water Qualities

COD(Mn) and BOD showed relatively high correlations at all stations (r=0.631-0.798)(Table 3.2.7-1).

SS showed high positive correlations with COD(Mn) and BOD at Y-St. 2 and Y-St. 3, and between COD(Mn) and SS at Y-St.3 where it was particularly high at 0.852.

NH_4-N between COD(Mn) (0.814) and BOD (0.681) at Y-t. 1, and between NH_4-N and COD(Mn)(0.510) at Y-St. 4 showed positive relatively high correlations.

High negative correlation coefficients were obtained at Y-St. 2 between DO and three items of COD(Mn), BOD and SS (r= COD(Mn): -0.426, BOD: -0.507, SS: -0.712). These results may have been brought about by the high purification that occurred around this station, which was recorded once in 1990.

3.2.8 Sediment Quality

(1) Particle-size distribution

The bottom survey was conducted on December 5, 1990.

Table 3.2.8-1 shows the particle-size distribution of sediments of Yangjae Chong. This river bed is composed of particles ranging from clay to fine gravel (0.001-18.38 mm) but consisting, mainly of silt and coarse sand (0.005-4.76 mm).

(2) Chemical content

Ignition Loss values of this river sediment were very high at all

Table 3.2.7-1 Correlation between Water Qualities obtained from Regular Monthly Survey, Yangjae Chong

Y-St. 1

	DO	COD	BOD	SS	NH4-N
DO	1				
COD	0.178	1			
BOD	0.228	0.732	1		
SS	0.032	0.077	0.128	1	
NH4-N	392	0.814	0.681	0.094	1

Y-St. 2

	DO	COD	BOD	SS	NH4-N
DO	1				
COD	-0.426	1			
BOD	-0.507	0.685	1		
SS	-0.712	0.504	0.611	1	
NH4-N	-0.087	0.410	0.370	-0.092	1

Y-St. 3

	DO	COD	BOD	SS	NH4-N
DO	1				
COD	0.324	1			
BOD	0.300	0.798	1		
SS	0.092	0.500	0.852	1	
NH4-N	0.168	0.494	0.369	0.203	1

Y-St. 4

	DO	COD	BOD	SS	NH4-N
DO	1				
COD	-0.071	1			
BOD	-0.237	0.631	1		
SS	-0.236	0.488	0.236	1	
NH4-N	0.247	0.510	0.046	0.121	1

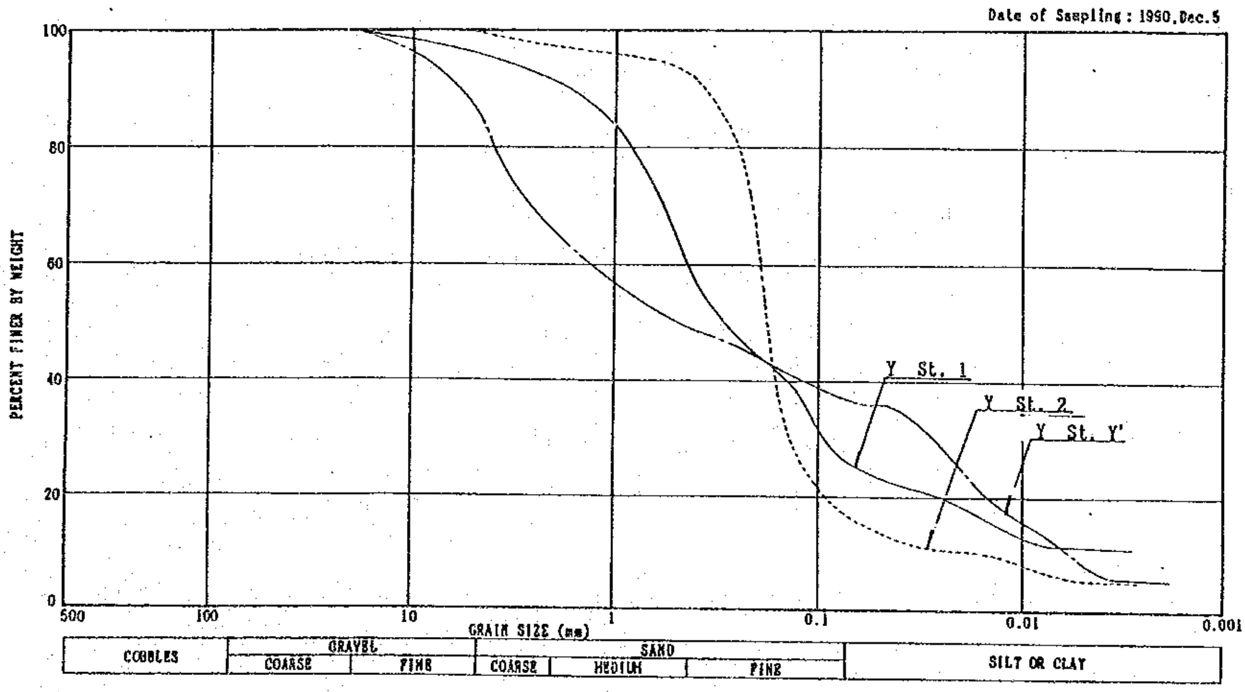


Fig. 3.2.8-1 Particle-size Distribution of Sediment of Yangjae Chong, December 5, 1990

Table 3.2.8-1 Particle-size Distribution of Sediment of Yangjae Chong (Accumulated Percent in Weight)

	Classification						
	Gravel		Sand			Silt	Clay
	Coarse	Fine	Coarse	Medium	Fine		
Size(mm)	73.5-18.38	18.38-4.76	4.76-2.00	2.00-0.42	0.42-0.074	0.074-0.005	0.005>
Station							
Y-St.1		100.0	96.0	91.5	58.0	26.0	11.5
Y-St.2			100.0	97.5	92.5	17.0	5.5
St.Y'		100.0	86.0	65.5	49.0	37.0	8.5
St.YA			100.0	98.5	90.5	80.0	19.5

Table 3.2.8-2 River Sediment Quality of Yangjae Chong, December 5, 1990

Item	CN (mg/kg)	As (mg/kg)	THg (mg/kg)	Cr(6+) (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Sulfide (mg/kg)	PCB (mg/kg)	Org-P Malathion (mg/kg)	Org-P PAP (mg/kg)	DL (%)	IL (%)
Station												
Y-St. 1	0.114	0.068	0.009	ND	0.149	1.267	5.54	ND	ND	ND	40.4	43.2
Y-St. 1'	0.057	0.213	0.028	ND	0.177	1.520	6.01	ND	ND	ND	40.9	63.0
Y-St. 2	ND	0.072	0.394	ND	0.152	0.973	5.46	ND	ND	ND	50.5	43.5

Table 3.2.8-3 Macro-benthos Appeared in Sediemnt of Yangjae Chong (December 5, 1990)

Species \ Station	Y-St. 1	Y-St. 2	St. Y'
Class Oligochaeta			
Order Haplotaxida			
Family Tubificidae			
Limnodrilus socialis		132	
Total species number/m2	0	1	0
Total individual number/m2	0	132	0
Diversity Index	0	0	0
Biological Pollution Class	-	ps	ps

ps: polysaprobic

stations (43.2-63.0 %)(Table 3.2.8-2). These high IL values mean that this river has significantly been polluted organically. There was heavy flooding in September, 1990 around Seoul and it is supposed that most of the materials which had been sedimented were flushed out by the big flood. It is surprising that within less than three months the river bed was once again terribly organically polluted.

In spite of this river bed being organically polluted very quickly, concentrations of heavy metals, and CN, As, Sulfide, Organic-P and PCB in sediment were not found in high values. When these values are compared to those measured in the rivers in Saitama Prefecture and in many other rivers in Japan, only THg at St. 2 was a little higher than the mean value in Japan. Other values were quite lower than those from Japan, particularly As from 1/20 to 1/70 and Pb from 1/4 to 1/40.

It is therefore believed that this river water is mainly polluted by domestic waste water, although there is a sewerage system in the basin. Organic pollution in Yangjae Chong is serious, but pollution by heavy metals, CN and As caused by industries are not yet significantly present.

(3) Macro-benthos

Fauna was considerably poor on this river bed. Only Limnodrilu sociali, which usually appears in heavily polluted water area, were counted in $132/m^2$ at Y-St. 2.

All stations are defined to be polysaprobic water area by biological pollution classification.

3.3 Ui Chong

3.3.1 Hourly Change of Water Quality

It seems that hourly change in Ui Chong at both stations were not detected on water qualities.

SS, however, showed a slight change with the time on the sampling date. Lower values were found around midnight.

Generally, larger values of TP, PO_4-P, DBOD, DCOD(Mn), SS and settleable matters were found early in the sampling day rather than later at both stations.

The mean values of several items taken from the 24-hour-surveys were included in the results from the regular monthly survey to be discussed.

Results obtained from the 24-hour-surveys were sited in Tables A-3.1-1-12.

3.3.2 Monthly Variation of Water Quality

(1) Water quality variation obtained from the regular monthly survey

DO in this river showed lower concentrations from March to September (3.9-7.8 mg/l), and higher concentrations from the end of September to early March (4.6-9.7 mg/l). The maximum values of 9.7 mg/l (U-St.1) and 9.5 mg/l (U-St. 2) were recorded in February (Tables 3.3.2-1 and 2, Fig. 3.3.2-1).

This river water was generally clear. Constant low turbidity at 1-3 mg/l was found with exceptional values of 13 mg/l at U-St. 1 and 14 mg/l at U-St. 2 (in Table 3.3.4-1).

Table 3.3.2-1 Water Quality of Ui Chong, U-St. 1

Date \ Item	WT (°C)	pH	EC (mS/cm)	DO (mg/l)	COD(Mn) (mg/l)	BOD (mg/l)	SS (mg/l)	NH4-N (mg/l)	NO2-N (mg/l)	Coli-form (MPN/100ml)	CN (mg/l)	Hg (mg/l)	Gauge (cm)
Jan. 31, 1990	3.6	6.9	-	4.6	5.1	1.4	5.1	0.47	0.016	-	-	-	-2
Feb. 22, 1990	5.5	6.9	-	9.7	4.2	0.9	5.0	2.42	0.017	-	-	-	17
Mar. 20, 1990	12.0	7.8	-	5.8	7.6	4.0	8.0	1.05	0.101	-	-	-	3
Apr. 20, 1990	18.0	7.0	-	6.4	8.7	4.9	8.4	0.41	0.059	-	-	-	8
May 28, 1990	22.1	7.8	-	7.7	6.8	3.5	2.4	0.27	0.236	-	-	-	-1
Jun. 22, 1990	17.5	7.4	0.5	5.4	7.5	18.8	28.8	4.94	-	14	-	-	80
Jul. 26, 1990	23.5	7.4	0.7	6.8	4.3	3.5	3.4	0.61	0.014	-	-	-	29
Jul. 30, 1990	28.8	7.1	-	7.4	5.0	2.6	6.5	0.11	0.004	18	ND	ND	14
Aug. 25, 1990	22.8	6.9	-	5.1	4.2	2.8	2.0	1.50	0.014	170	ND	ND	14
Sep. 13, 1990	20.3	7.0	-	5.3	8.2	9.0	7.9	0.08	0.000	-	-	-	43
Sep. 22, 1990	23.9	7.0	-	7.0	8.0	2.6	3.4	0.22	0.016	240	-	-	15
Oct. 22, 1990	17.9	7.4	-	7.4	10.0	2.5	6.0	1.34	0.076	320	-	-	-5
Nov. 6, 1990	13.3	7.1	-	6.2	15.3	13.2	17.3	4.91	0.051	-	-	-	12
Nov. 26, 1990	12.8	7.2	-	5.2	12.0	10.9	22.0	1.67	0.408	1200	ND	ND	0
Dec. 24, 1990	4.9	7.8	-	6.9	10.0	8.0	19.3	2.52	0.113	950	-	-	2
Jan. 5, 1991	6.6	7.2	-	6.9	5.8	1.2	5.6	0.15	0.055	420	0.004	ND	0
Jan. 24, 1991	2.3	7.3	-	8.0	3.0	1.3	11.6	0.47	0.054	-	-	-	30
Feb. 5, 1991	0.3	7.6	-	9.6	4.6	1.7	0.5	0.04	0.045	540	0.007	ND	28
Mar. 7, 1991	8.4	7.5	-	7.1	8.7	3.0	5.7	0.87	0.017	-	-	-	26
Mar. 21, 1991	6.1	7.6	-	5.4	5.2	2.1	6.0	0.25	0.014	1000	ND	ND	32
Apr. 29, 1991	15.0	7.2	-	4.2	7.9	7.1	31.0	0.13	ND	1500	ND	ND	0>
May 14, 1991	19.7	7.4	-	6.3	4.5	1.4	8.3	0.02	0.038	-	-	-	22
May 28, 1991	17.2	7.3	-	6.2	2.8	1.5	8.0	0.33	0.237	1700	ND	ND	21

Table 3.3.2-2 Water Quality of Ui Chong, U-St. 2

Date \ Item	WT (°C)	pH	EC (mS/cm)	DO (mg/l)	COD(Mn) (mg/l)	BOD (mg/l)	SS (mg/l)	NH4-N (mg/l)	NO2-N (mg/l)	Coli-form (MPN/100ml)	CN (mg/l)	Hg (mg/l)	Gauge (cm)
Jan. 31, 1990	1.9	7.0	-	7.5	4.2	1.0	1.2	0.98	0.025	-	-	-	-5
Feb. 22, 1990	5.7	7.1	-	9.2	5.5	3.3	4.5	1.03	0.116	-	-	-	-1
Mar. 20, 1990	10.0	7.0	-	7.2	7.7	4.2	1.0	0.52	0.070	-	-	-	-5
Apr. 20, 1990	17.6	7.4	-	6.0	12.2	6.6	42.5	1.00	0.055	-	-	-	-5
May 28, 1990	22.6	7.5	-	7.4	9.2	4.5	4.1	0.43	0.213	-	-	-	-9
Jun. 22, 1990	16.1	7.5	0.7	4.3	7.0	10.0	9.2	0.80	-	20	-	-	31
Jul. 26, 1990	20.6	7.4	0.2	6.3	3.6	3.0	13.2	0.38	0.009	-	-	-	35
Jul. 30, 1990	26.3	7.1	-	7.0	5.2	2.0	3.0	0.04	0.005	25	ND	ND	-2
Aug. 25, 1990	24.7	7.2	-	5.6	4.4	2.5	2.5	1.12	0.013	110	ND	ND	-6
Sep. 13, 1990	19.7	7.1	-	6.0	5.0	4.9	1.6	0.26	0.140	-	-	-	11
Sep. 22, 1990	22.5	7.2	-	7.8	5.0	2.8	6.6	0.88	0.011	180	-	-	15
Oct. 22, 1990	16.6	7.2	-	7.9	6.0	1.8	1.0	0.23	0.666	240	-	-	-
Nov. 6, 1990	11.8	7.1	-	7.1	6.2	3.6	9.1	0.90	0.030	-	-	-	5
Nov. 26, 1990	10.2	7.4	-	7.4	9.0	2.3	18.0	0.07	0.045	840	ND	ND	7
Dec. 24, 1990	3.1	7.6	-	7.9	5.5	11.4	23.2	0.57	0.129	700	-	-	4
Jan. 5, 1991	4.2	7.3	-	8.2	3.0	0.9	0.8	0.00	0.042	350	0.004	ND	7
Jan. 24, 1991	4.0	7.5	-	7.9	1.5	0.5	6.2	0.21	0.013	-	-	-	
Feb. 5, 1991	0.5	7.9	-	9.5	3.2	1.6	0.5	0.00	0.021	620	0.007	ND	3
Mar. 7, 1991	6.5	7.3	-	7.8	6.6	5.4	54.7	0.03	0.013	-	-	-	0>
Mar. 21, 1991	5.0	7.5	-	6.2	5.0	2.0	5.2	0.19	0.014	800	ND	ND	1
Apr. 29, 1991	13.0	7.4	-	3.9	6.6	2.4	26.5	0.03	0.013	1200	ND	ND	0>
May 14, 1991	19.7	7.3	-	5.3	7.5	3.5	6.6	0.02	0.783	-	-	-	0>
May 28, 1991	16.8	7.6	-	6.5	4.0	1.8	1.3	0.10	0.145	1400	ND	ND	0>

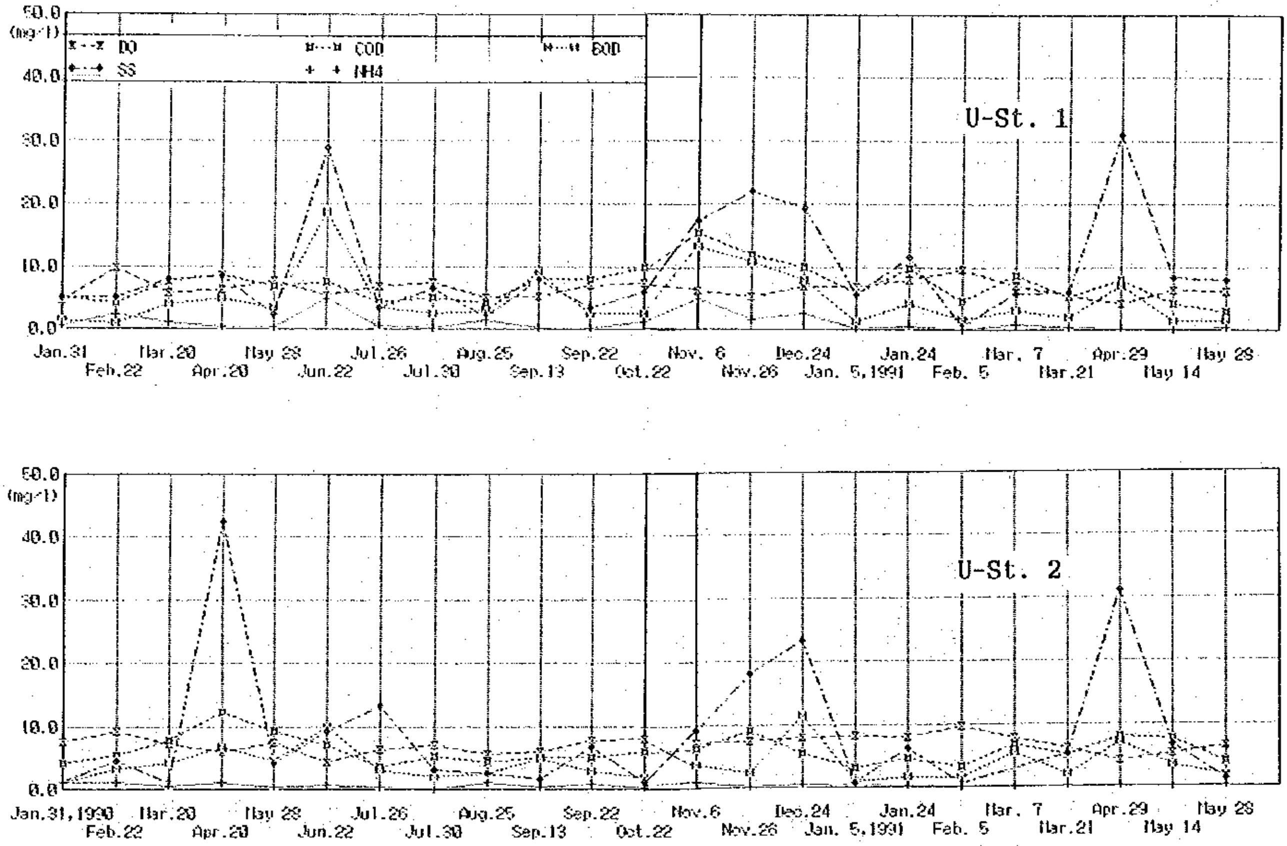


Fig. 3.3.2-1 Monthly Variation of Water Quality of Ui Chong, U-St. 1 and U-St. 2, from January, 1990, to May, 1991

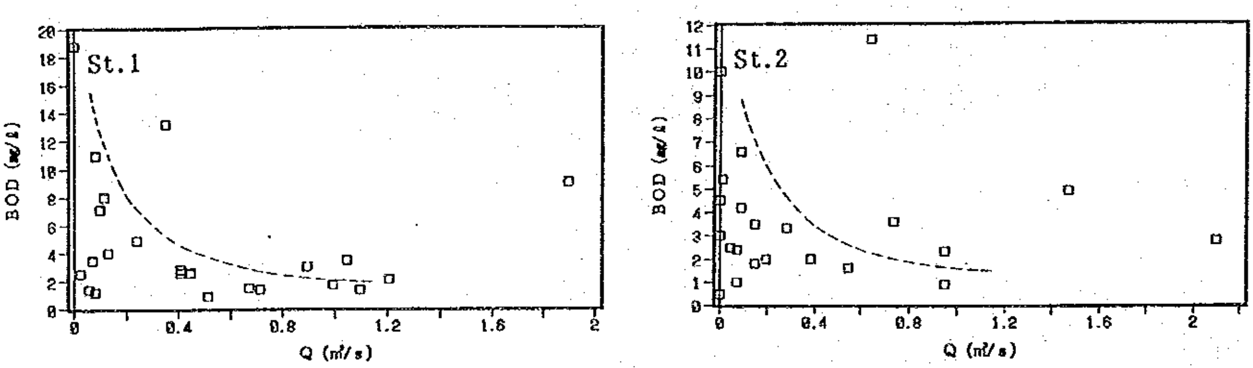


Fig. 3.3.2-2 Relation between Water Quality and Discharge of Ui Chong

similar curves with two peaks a year in April or May, and November or December. It is possible that low concentrations of these water quality items were found when the discharges were high in the hotter months from June to September, while higher concentrations were obtained with low discharges in the colder months (Fig. 3.3.2-2).

In spite of the similarity of distribution patterns at both stations, the concentration of COD(Mn) at U-St. 1 (2.8-15.3 mg/l) was much higher than at U-St. 2 (1.5-9.0 mg/l) after September, 1990.

On the other hand, when BOD at U-St. 1 was considerably high (10.9 and 13.2 mg/l), BOD at U-St. 2 was quite low (2.3 and 3.6 mg/l). On the other cases, however, the differences of BOD values between two stations were small.

The above mentioned facts may be attributed to the following reasons: first the high self-purification measured on this river, may not have occurred due to low water temperature, second, the place where survey on self-purification being done was not consistent, third, the waters at U-St. 1 were often stagnant and it is supposed the settlement of pollutants accumulated there. Fourth, there is a direct side-inflow between U-St. 1 and U-St. 2, from which sewerage water flowed into the river, and fifth the overflow from the intercepting pipe to the river may have occurred.

However, BOD was lower than 5 mg/l, usually around 3 mg/l, which indicates this river is not very polluted yet.

COD(Mn) was generally two times higher than BOD values, which is the ratio usually found in natural rivers.

Contrary to the three items motioned above, NH_4-N distribution did no clearly show a systematic pattern. At U-St. 1, however, there was a tendency for higher values to be found in the colder months. On the other hand, this trend was not found at U-St. 2. The value at both stations in 1991 was very low (0.00-0.87 mg/l). NH_4-N at U-St. 1 generally was higher (0.02-4.94 mg/l) than those at U-St. 2 (0.00-1.12 mg/l) on many cases.

NO_2-N concentrations were usually found in low values, however, high values were occasionally obtained, so that the variances were great (0.000-0.783 mg/l)(Tables 3.3.2-1 and 2).

Coli-form bacterial numbers were not high in the first stage, however, it gradually increased (14-1700 MPN/100 ml at U-St. 1, 20-1400 MPN/100 ml at U-St. 2). It is supposed inflow of human waste was increasing.

THg was not detected at both stations throughout the survey period.

CN was detected in January and February, 1991, at both stations, despite the of concentrations being low (0.004 mg/l at U-St. 1 and U-St. 2 in January, and 0.007 mg/l at both stations in February).

(2) Variations of other water qualities

TN concentrations were found in relatively higher values from 1.94 to 6.24 mg/l, compared to be other low values of BOD or COD(Mn). Although there was a lack of TN on July, 1990, it is possible to assume that values were lower after July (Figs. 3.3.2-3 and 4, Tables 3.3.2-3 and 4).

TN at both stations started to increase from July, 1990 until September, 1991, then maintained the same level until May at U-St. 2, and until March at U-St. 1 with a sudden drop in May.

TON concentrations were constantly low at both stations (0.29-0.50 mg/l at U-St. 1; 0.23-0.60 mg/l at U-St. 2) throughout the sampling period. The percentages of TON to TN were in the small range of 5-15 %. It means that TIN concentrations were found in high values and accounted for the high proportions to TN (Table 3.3.2-5).

Table 3.3.2-3 Water Quality Obtained from 24-hour Survey on Ui Chong, U-St. 1

U-St. 1, July 26-27, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	6.8	-	-	1.53	0.016	0.61	0.138	0.081	0.074	3.5	-	4.3	-	3.4	1.63	2.9	2.7	88	29
SD	0.3	-	-	0.32	0.006	0.27	0.068	0.025	0.018	0.7	-	0.9	-	0.5	0.34	2.3	2.2	13	3
					0.014														
					0.004											3.4	3.2		
																2.2	2.1		

U-St. 1, September 13-14, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	5.3	4.37	0.32	3.68	0.000	0.37	0.328	0.24	0.210	9.0	7.0	8.2	7.5	2.8	1.94	7.9	6.5	78	73
SD	0.8	1.05	0.14	0.88	0.000	0.69	0.082	0.061	0.048	2.1	2.9	0.9	2.3	0.3	0.47	4.5	4.2	9	5
			0.29	3.47			0.306	0.228											
			0.08	0.53		0.08	0.033	0.039											
						0.06													

U-St. 1, November 6-7, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	6.2	6.25	0.50	0.80	0.051	4.91	0.570	0.365	0.193	13.2	14.3	15.3	21.1	2.14	1.15	38.9	23.9	65	42
SD	0.4	1.00	0.28	0.56	0.037	0.43	0.203	0.083	0.074	5.8	10.0	4.8	17.5	1.3	0.15	52.3	29.3	13	3
																27.6			
							0.469		0.204		9.1		13.9			35.9	11.9		
							0.071		0.067		3.6		5.1			17.3	9.3		
																13.9			

U-St. 1, January 24-25, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	8.0	5.40	0.39	4.53	0.054	0.47	0.122	0.039	0.028	4.2	3.3	9.8	8.1	2.98	0.89	11.6	7.3	61	30
SD	0.9	0.70	0.10	0.69	0.003	0.08	0.166	0.014	0.008	0.7	0.9	1.8	0.8	0.34	0.21	11.6	7.8	8	1
							0.052									9.0	4.0		
							0.023									7.7	0.7		

U-St. 1, March 7-8, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	7.1	6.39	0.46	5.04	0.017	0.87	0.067	0.042	0.019	3.0	2.4	8.7	7.2	4.31	2.03	5.7	2.7	49	26
SD	0.5	0.44	0.16	0.19	0.013	0.37	0.021	0.02	0.005	0.4	0.6	0.9	0.7	0.28	0.11	1.9	1.0	14	1
	7.2				0.013									4.39		5.3			
	0.3				0.001									0.07		1.2			

U-St. 1, May 14-15, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	6.3	1.94	0.32	1.58	0.038	0.02	0.118	0.114	0.086	1.4	1.2	4.5	4.2	4.40	1.41	9.7	6.5	58	22
SD	0.6	0.27	0.13	0.22	0.049	0.01	0.064	0.038	0.043	0.5	0.4	1.0	0.6	0.20	0.32	6.2	6.0	18	2
															1.34	8.3	5.1	58	
															0.20	4.3	3.8	18	

Table 3.3.2-4 Water Quality Obtained from 24-hour Survey on Ui Chong, U-St. 2

U-St. 2, July 26-27, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	6.3	-	-	0.86	0.011	0.44	0.137	0.111	0.102	3.0	-	3.6	-	3.44	1.80	13.2	11	83	35
SD	0.9	-	-	0.16	0.007	0.22	0.035	0.02	0.023	0.6	-	0.7	-	1.15	0.27	13.9	11.7	7	2
					0.009	0.39													
					0.004	0.13													
														3.65					
														0.92					

U-St. 2, September 13-14, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	6.0	2.77	0.24	2.20	0.043	0.28	0.139	0.109	0.080	4.9	3.4	5.0	4.7	3.9	1.90	1.6	1.0	59	11
SD	0.5	0.24	0.08	0.16	0.087	0.08	0.036	0.034	0.027	1.2	1.5	0.4	1.4	0.22	0.25	0.5	0.4	15	3
					0.140														
			0.26		0.055														
			0.06																

U-St. 2, November 6-7, 1990

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	7.0	4.83	0.22	3.65	0.058	0.90	0.191	0.159	0.098	3.6	5.0	6.2	9.9	2.39	1.40	28.9	23.3	74	5
SD	0.3	0.85	0.11	0.81	0.073	0.58	0.077	0.077	0.058	0.6	3.8	1.0	9.4	0.76	0.19	50.4	43.3	10	1
	7.1				0.039								7.6			15.9	11.7		
	0.2		0.23		0.032						3.0		5.0			23.4	16.9		
			0.11								0.5								
													5.7			9.1	6.8		
													1.5			7.8	6.5		

U-St. 2, January 24-25, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	7.9	4.28	0.28	3.79	0.013	0.21	0.050	0.041	0.036	1.7	1.5	4.5	3.9	3.35	1.03	6.2	3.1	48	
SD	0.8	0.25	0.06	0.19	0.005	0.02	0.017	0.014	0.014	0.6	0.5	1.1	0.9	0.21	0.16	2.9	1.7	12	
					0.012									3.39					
					0.004									0.14					

U-St. 2, March 7-8, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	7.8	4.34	0.24	4.06	0.013	0.03	0.118	0.023	0.013	5.4	3.0	6.5	4.4	4.62	1.40	54.7	30.0	50	0>
SD	0.5	0.47	0.03	0.44	0.002	0.02	0.056	0.009	0.001	4.8	2.5	1.3	0.6	0.21	0.31	57.2	36.6	10	0>
						0.02								4.56		40.6	20.6		
						0.01								0.11		30.8	17.7		
																32.2	16.3		
																14.2	10.7		

U-St. 2, May 14-15, 1991

Item	DO (mg/l)	TN (mg/l)	TON (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	NH4-N (mg/l)	TP (mg/l)	TDP (mg/l)	PO4-P (mg/l)	BOD (mg/l)	DBOD (mg/l)	COD (mg/l)	DCOD (mg/l)	Sulfide (mg/l)	MBAS (mg/l)	SS (mg/l)	Settleable (mg/l)	matter (%)	Gauge (cm)
Mean	5.3	4.22	0.60	2.82	0.783	0.02	0.195	0.117	0.076	3.5	2.9	7.5	7.3	4.48	1.65	6.6	3.0	46	0>
SD	0.8	0.64	0.29	0.34	0.770	0.004	0.066	0.058	0.04	1.0	0.2	1.4	0.8	0.20	0.29	1.2	1.3	15	0>

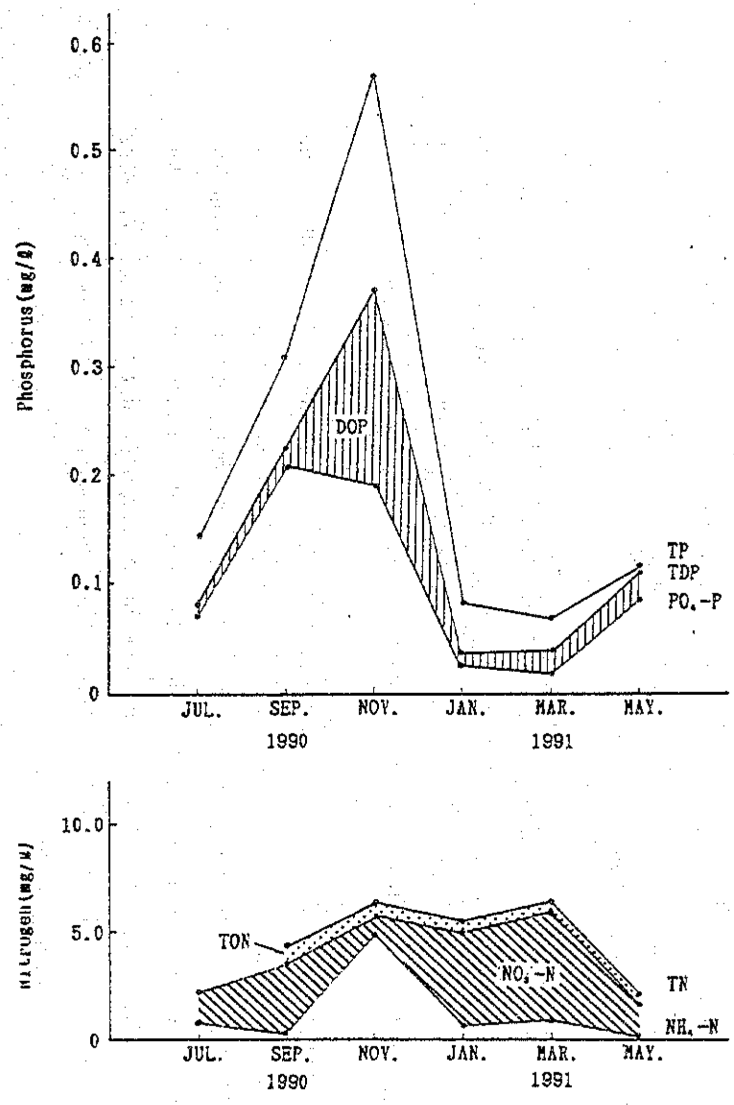


Fig. 3.3.2-3 Variation of Nitrogen and Phosphorus of Ui Chong at U-St. 1 from July, 1990 to May, 1991

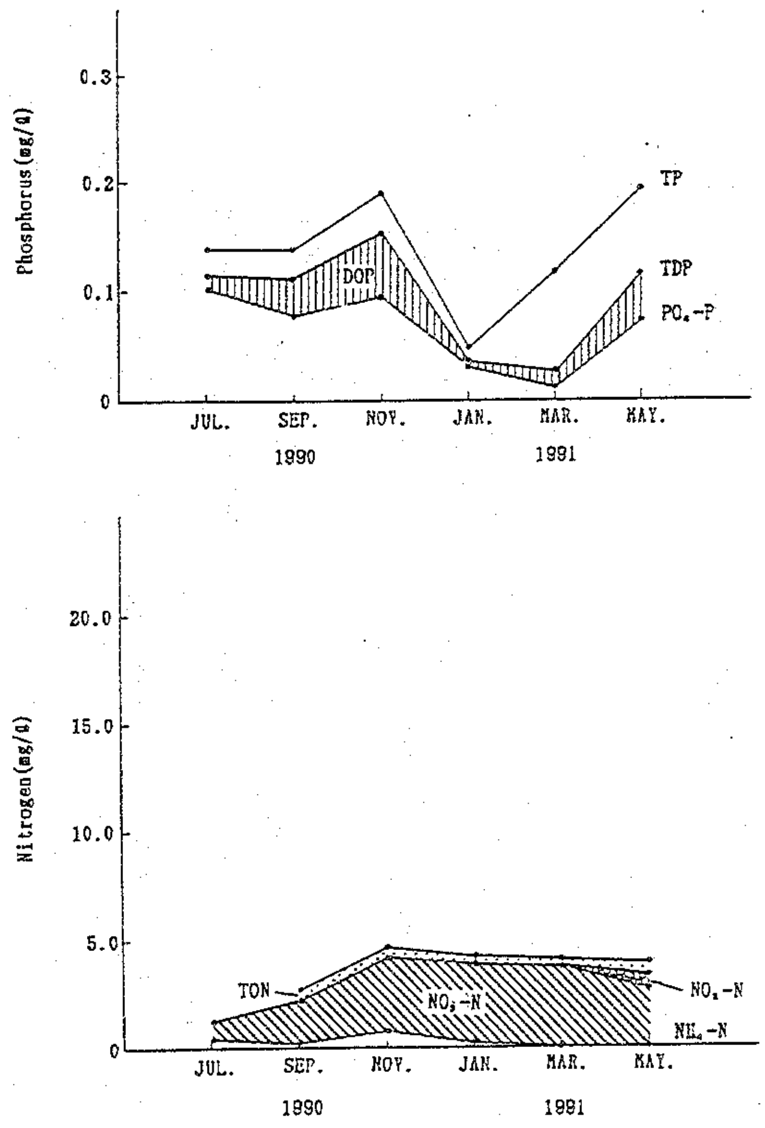


Fig. 3.3.2-4 Variation of Nitrogen and Phosphorus of Ui Chong at U-St. 2 from July, 1990 to May, 1991

NO_3-N concentrations in this river were constantly obtained in very high values and showed very singular distribution patterns at both stations (0.80-5.04 mg/l at C-St. 1; 0.86-4.06 mg/l at C-St. 2). The main part of TIN was consequently NO_3-N. The experiment using the river soil, although other river's, showed that nitrification progressed quickly under the sufficient DO concentrations (Table A-1.1-1). Ui Chong water constantly contained high DO, therefore, it is supposed that nitrification this river have produced these high NO_3-N.

TP concentrations, on the other hand, were obtained with great variations, greater at U-St. 1 (0.067-0.469 mg/l) than U-St. 2 (0.050-0.195 mg/l). TP started to increase from July until November, but decreased suddenly in January and March, of which values were particularly low comparing to TN values (0.050, 0.052 and 0.067 mg/l)(Figs. 3.3.2-3 and 4, Tables 3.3.2-3 and 4)).

Extraordinarily high N/P was recorded in January (104 at U-St. 1 and 86 at U-St.2) and in March (95 at U-St. 1), which resulted from the low TP concentrations mentioned above. It was supposed that phophorus during this time was adsorbed by the soil on the bottom. However, during most cases the ratio showed 13-37, which was the values usually found in domestic waste water and sewerage.

PO_4-P was also in quite low values at 0.013-0.469 mg/l (Figs. 3.3.2-3 and 4). The proportion of PO_4-P to TP was almost half, which means the organic part of phosphorus was obtained in relatively higher ratios than that of nitrogen (Table 3.3.2-6).

Whatever the concentrations, the percentages of DBOD to TBOD, and DCOD(Mn) to TCOD(Mn) were in quite narrow ranges (DBOD: 56-88 %, DCOD(Mn): 73-97 %) (Table 3.3.2-7). The concentration of COD(Mn) was usually higher than BOD. It showed, therefore, that the concentrations, which could easily be decomposed biochemically, were constantly quite higher than the concentrations which were decomposed chemically.

Table 3.3.2-5 Each Form of Nitrogen of Ui Chong

		July (mg/l)	July (%)	September (mg/l)	September (%)	November (mg/l)	November (%)	January (mg/l)	January (%)	March (mg/l)	March (%)	May (mg/l)	May (%)
U-St. 1	TN	-	-	4.37		6.25		5.40		6.39		1.94	
	TON	-	-	0.29	6.6	0.50	8.0	0.39	7.2	0.46	7.2	0.30	15.5
	NO3-N	1.53	-	3.47	79.4	0.80	12.8	4.53	83.9	5.04	78.9	1.58	81.4
	NH4-N	0.61	-	0.08	1.8	4.91	78.6	0.47	8.7	0.87	13.6	0.02	1.0
U-St. 2	TN	-	-	2.77		4.85		4.28		4.34		4.22	
	TON	-	-	0.26	9.4	0.23	4.7	0.28	6.5	0.24	5.5	0.60	14.2
	NO3-N	0.86	-	2.20	79.4	3.65	75.3	3.79	88.6	4.06	93.5	2.82	66 8
	NH4-N	0.38	-	0.28	10.1	0.90	18.6	0.21	4.6	0.03	0.7	0.02	0.5

Table 3.3.2-6 Phosphorus of Ui Chong

		July	September	November	January	March	May	Mean	SD
U-st. 1	TP(mg/l)	0.138	0.306	0.469	0.052	0.067	0.118	0.192	0.149
	PO4-P(mg/l)	0.074	0.210	0.204	0.039	0.019	0.086	0.105	0.075
	(%)	54	69	43	75	28	73	57	17
U-St. 2	TP(mg/l)	0.137	0.139	0.191	0.050	0.118	0.195	0.138	0.049
	PO4-P(mg/l)	0.102	0.082	0.098	0.036	0.013	0.076	0.068	0.033
	(%)	74	59	51	72	11	39	51	22

Table 3.3.2-7 BOD and COD of Ui Chong

		July	September	November	January	March	May	Mean	SD
U-St. 1	TBOD(mg/l)	3.5	9.0	13.2	4.2	3.0	1.4	5.7	4.1
	DBOD(mg/l)	-	7.0	9.1	3.3	2.4	1.2	3.8	3.2
	(%)	-	78	69	79	80	86	65	30
	TCOD(mg/l)	4.3	8.2	15.3	9.8	8.7	4.5	8.5	3.7
	DCOD(mg/l)	-	7.5	13.9	8.1	7.2	4.2	6.8	4.2
	(%)	-	91	91	83	83	93	74	33
U-St. 2	TBOD(mg/l)	3.0	4.9	3.6	1.7	5.4	3.5	3.7	1.2
	DBOD(mg/l)	-	3.4	3.0	1.5	3.0	2.9	2.3	1.2
	(%)	-	69		88	56	83	59	32
	TCOD(mg/l)	3.6	5.0	6.2	4.5	6.6	7.5	5.6	1.3
	DCOD(mg/l)	-	4.7	5.7	3.9	4.4	7.3	4.3	2.2
	(%)	-	94	92	87	67	97	73	34

Table 3.3.2-8 Percent of Settleable Matter to SS in Ui Chong

		July	September	November	January	March	May	Mean	SD
U-St. 1	SS(mg/l)	3.4	7.9	17.3	7.1	5.3	8.3		
	SM(mg/l)	3.2	6.5	11.9	4.0	2.7	5.1		
	(%)	94	82	69	56	51	61	69	15
U-St. 2	SS(mg/l)	13.2	1.6	9.1	6.2	32.2	6.6		
	SM(mg/l)	11.0	1.0	6.8	3.1	16.3	3.0		
	(%)	83	63	75	50	51	45	61	14

The mean of Sulfide was found from 2.14 mg/l (November at U-St.1) to 4.62 mg/l (March at U-St. 2), which was constantly were higher at U-St. 2 than at U-St. 1 (Tables 3.3.2-3 and 4).

The mean concentrations of MBAS ranged from 0.89 mg/l (January at U-St. 1) to 2.03 mg/l (March at U-St. 1)(Tables 3.3.2-3 and 4). MBAS higher than 0.5 mg/l is said to be the cause of froth. It is recommended, therefore, natural soap rather than detergents which is the causes of MBAS be used.

3.3.3 Change of Water Quality and Pollution Load from the Upper to the Lower Stations

(1) Water quality in the upper-stream of the study area

Although the results of the water quality analysis in the upper stream of the study area were very few, they showed that the water quality in the upper part of Ui Chong were still good (Ui-1 in Fig. 3.3.4-1, Table 3.3.4-1). TN at St. Green Hotel, which was located higher than St. Ui-1, was relatively higher than the ordinary values of this river (3.3 mg/l). COD(Cr), however, was quite low at 1 mg/l even after the heavy rainfall of September 11-12. At St. Ui-1, COD(Cr) was 0 mg/l and TN was 5.22 mg/l. TON was high on both stations, which brought about the high TN concentrations.

Turbidity at St. Green Hotel were 0 and 1 mg/l, and DO was quite high at 9.3 mg/l.

It is possible to say that the water of Ui Chong originally had high quality based on COD(Cr), Turbidity and DO. Nitrogen, on the other hand, was found in high values even at the upper part of the river, which showed that this river was affected by human activities.

(2) Quality change in the study area

1) Change in the short period

Water quality change and change of pollution load measured within two weeks from May to June, 1991, are discussed here.

Daily variations of discharge even in the short period at both stations were great, U-St. 1: 0.055-0.350 m^3/s, U-St. 2:0.013-0.285 m^3/s. However, on the same date the discharge was larger at U-St. 1 than at U-St. 2 (Tables 3.3.3-1 and 2).

Concentrations of water quality items at U-St. 1 were usually higher than at U-St. 2, and that U-St. 1 contained the greater load. Great variations of the load were found even in the short periods (Table 3.3.3-3).

2) Change during this survey period

Great differences of DO concentrations were not found at both stations. There were, however, tendencies for higher DO to be found at U-St. 1 from April to August, while it was higher at U-St. 2 on the other months (Fig. 3.3.3-1).

COD(Mn) distribution patterns at both stations were similar with two peaks in March or April and November. COD(Mn) concentrations at U-St. 1 from November to April were relatively higher than at U-St. 2.

The distribution patterns of BOD and SS concentrations at both stations showed similar patterns as COD(Mn), although the peaks were not so clear.

The change of pollution load was estimated based on the mean concentrations of water qualities during the survey period and the HQ curves on both stations (Table 3.3.3-4).

The value of load varied monthly, except the values which were obviously affected by rainfall and were exceptionally high. However, the variance was not as large as the values found on other

Table 3.3.3-1 Water Qaulity of Ui Chong, U-St. 1, May-June, 1991
Discharge was practically measured on the same time.

Station	Date	COD(Mn) (mg/l)	COD(Cr) (mg/l)	SS-1 (mg/l)	SS-2 (mg/l)	SS-2(IL) (mg/l)	(IL)/ SS-2(%)	SS-2/ TR(%)	SS(IL)/ TR(%)	SS(IL)/ TR(IL)(%)	TR (mg/l)	TR(IL) (mg/l)	TR(IL)/ TR(%)	SM (mg/l)	SM(IL) (mg/l)	SM(IL)/ SM(%)	SM/TR (%)	SM/SS (%)	SM(IL)/ TR(IL)(%)	NH4-N (mg/l)	NO3-N (mg/l)	WT (°C)	DO (mg/l)	EC (mS/cm)	Discharge (m3/s)
U-St. 1-1	May 28	5.9	20	6	4.5	1.5	33	3	1	9	140	16.3	12	2.1	0.7	33	1.5	47	4.3	1.55	2.3	21.6	-	0.8	0.347
U-St. 1-2	"	4.2	15	4	5.0	3.0	60	3	2	15	152	20.0	13	3.4	1.4	41	2.2	68	7.0	1.48	2.2	22.1	-	0.8	
U-St. 1-3	"	3.9	-	5	8.5	2.0	24	7	2	23	123	8.7	7	3	1.0	33	2.4	35	11.5	1.48	2.4	20.8	-	0.8	
U-St. 1-1	Jun. 5	4.2	3	4	4.0	2.8	70	1	1	2	465	120.0	26	2	1.6	80	0.4	50	1.3	0.48	2.2	21.7	-	0.6	0.055
U-St. 1-2	"	4.3	8	1	3.5	2.5	71	1	0	1	545	230.3	42	0.5	0.3	60	0.1	14	0.1	0.40	1.3	21.1	-	0.7	
U-St. 1-1	Jun. 10	7.7	33	7	10.7	6.2	58	3	1	3	421	205.0	49	1.4	1.0	71	0.3	13	0.5	2.16	1.3	22.6	9	0.7	
U-St. 1-2	"	8.4	36	7	11.3	9.3	82	2	2	4	525	261.0	50	1.3	0.8	62	0.2	12	0.3	2.58	1.4	22.3	9.1	0.7	0.116
U-St. 1-3	"	9.0	40	8	11.3	8.6	76	2	2	3	565	293.0	52	1.7	0.6	35	0.3	15	0.2	2.39	1.0	22.5	9.2	0.7	
U-St. 1-2	Jun. 26	-	4	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.70	3.0	25.9	14.8	0.6	
	Mean	6.0	19.9	5.6	7.4	4.5	59.3	2.7	1.3	7.5	367.0	144.3	31.3	1.9	0.9	52.0	0.9	31.7	3.2	1.6	1.9	22.3	10.5	0.7	
	SD	2.0	13.9	2.2	3.2	2.9	19.5	1.8	0.5	7.3	182.2	110.5	17.7	0.9	0.4	17.4	0.9	20.1	3.9	0.7	0.6	1.4	2.5	0.1	

Table 3.3.3-2 Water Qaulity of Ui Chong, U-St. 2, May-June, 1991
Discharge was practically measured on the same time.

Station	Date	COD(Mn) (mg/l)	COD(Cr) (mg/l)	SS-1 (mg/l)	SS-2 (mg/l)	SS-2(IL) (mg/l)	(IL)/ SS-2(%)	SS-2/ TR(%)	SS(IL)/ TR(%)	SS(IL)/ TR(IL)(%)	TR (mg/l)	TR(IL) (mg/l)	TR(IL)/ TR(%)	SM (mg/l)	SM(IL) (mg/l)	SM(IL)/ SM(%)	SM/TR (%)	SM/SS (%)	SM(IL)/ TR(IL)(%)	NH4-N (mg/l)	NO3-N (mg/l)	WT (°C)	DO (mg/l)	EC (mS/cm)	Discharge (m3/s)
U-St. 2-2	May 28	4.0	19	5	8.5	4.0	47	6	3	33	132	12.0	9	5.8	2.3	40	4.4	68	19	1.45	2.4	21.8	-	0.8	0.285
U-St. 2-1	Jun. 5	5.5	8	2	6.5	3.5	54	2	1	2	363	212.3	58	1.0	0.8	80	0.3	15	0.4	0.03	1.9	25.1	-	0.8	0.034
U-St. 2-2	"	5.9	-	1	7	5.0	71	2	2	3	298	185.0	62	1.5	1.0	67	0.5	21	0.5	0.03	2.5	24.9	-	0.8	
U-St. 2-2	Jun. 10	5.4	26	4	8.7	2.7	31	2	1	1	483	263.0	54	1.4	0.6	43	0.3	16	0.2	0.21	3.5	21.3	12.9	0.8	0.013
U-St. 2-2	Jun. 26	-	3	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10	7.5	25.5	14.1	0.8	
	Mean	5.2	14	3	7.7	3.8	51	3	2	10	319	168	46	2.4	1.2	57.4	1.4	30	5.0	0.36	3.6	23.7	13.5	0.8	
	SD	0.7	9	2	0.9	0.8	14	2	1	14	127	94	22	2.0	0.7	16.7	1.8	22	8.1	0.55	2.0	1.8	0.6	0.0	

Table 3.3.3-3 Pollution Load of Ui Chong in Short Period, May 28-June 10, 1991
Discharge: Actual measurement value

Date	Station	COD(Mn) (kg/day)	BOD (kg/day)	SS (kg/day)	TR (t/day)	NH4-N (kg/day)	NO3-N (kg/day)
May 28, '91	U-St. 1	141.1	-	181.4	4.2	45.5	69.6
	U-St. 2	98.5	-	209.3	3.3	35.7	59.1
June 5, '91	U-St. 1	20.2	1.4	17.8	2.4	2.1	8.3
	U-St. 2	16.7	8.0	19.8	1.0	0.1	6.5
June 10, '91	U-St. 1	86.7	71.6	150.1	5.2	2.5	12.8
	U-St. 2	6.1	2.4	9.8	0.5	0.2	3.9

Table 3.3.3-4 Mean Value of the Pollution Load of Ui Chong during the Survey Period, January, 1990 - May, 1991

Station / Item	BOD (ton/day)	COD(Mn) (ton/day)	SS (ton/day)	NH4-N (ton/day)
U-St. 1	0.54	0.41	0.88	0.13
U-St. 2	0.43	0.45	0.83	0.04

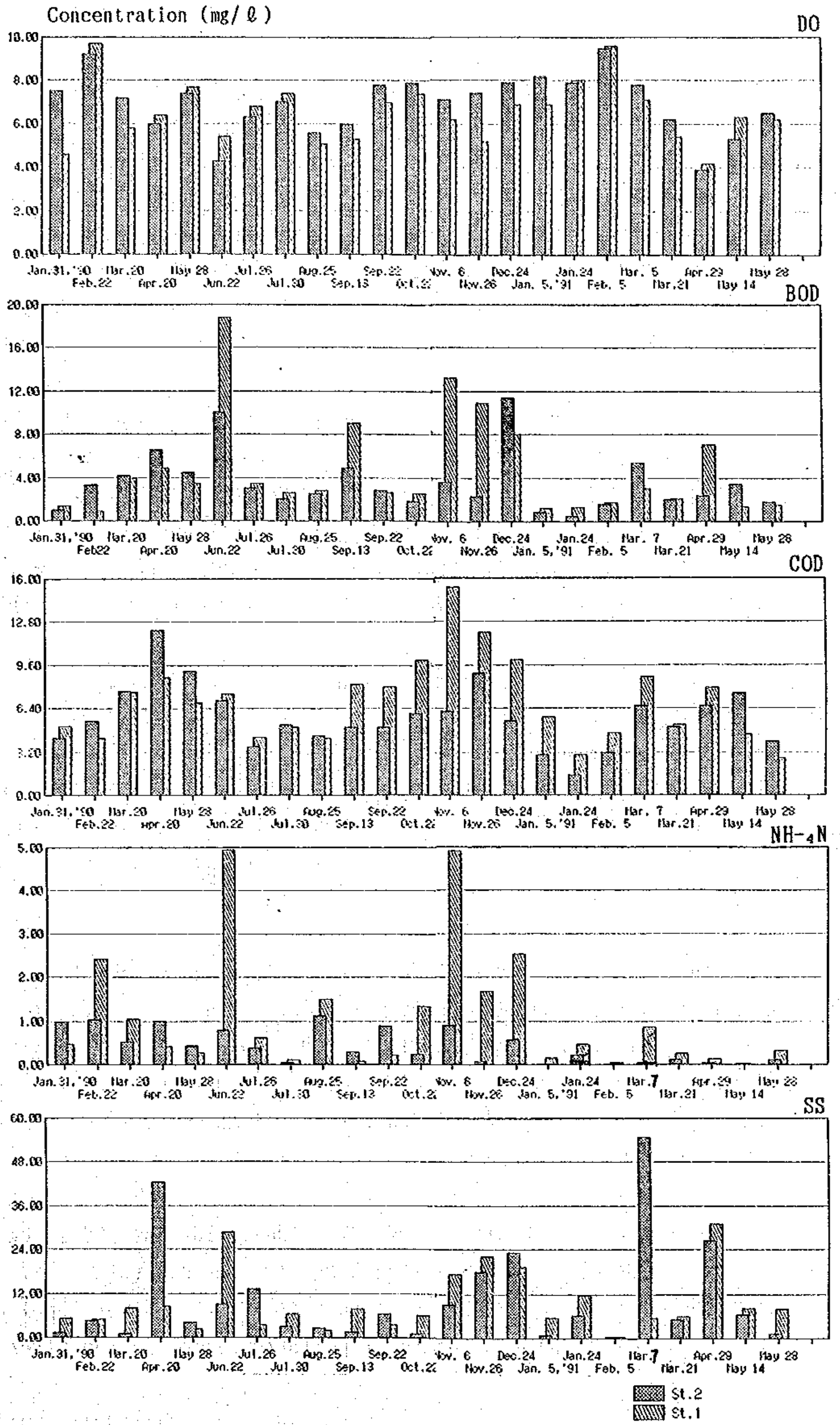


Fig. 3.3.3-1 Water Quality Change from the Upper to the Lower Stations of Ui Chong

rivers. The range of variance at U-St. 1 was smaller than at U-St. 2.

The mean values of pollution load of BOD and SS at U-St. 1 were slightly higher (BOD: 0.54 ton/day, SS: 0.88 ton/day) than at U-St. 2 (BOD: 0.43 ton/day, SS:0.83 ton/day). COD(Mn) at U-St. 2, however, was greater than at U-St. 1 (U-St. 1: 0.41 and U-St. 2: 0.45 ton/day).

Generally the concentrations at U-St. 1 were higher than at U-St. 2. The discharge of this river was very small, and it is supposed that an underground stream existed between both stations. It is thought, therefore, that the values of load at both stations would be almost the same, although overflow from intercepting sewer pipe and direct inflow to the river may have affected the water quality.

3.3.4 Side-inflow into Ui Chong

There are many side-inflowing sewers on the riverbed of Ui Chong. However, water from only one of them flows directly into the river (Ui-9 in Fig. 3.3.4-1) and its inflowing volume was low at 0.035 m3/s (Table 3.3.4-1).

The water from this direct inflowing sewer was thought to be the domestic sewage and its quality was quite bad. In spite of the volume of inflowing being small, it might have polluted the water of Ui Chong. COD(Cr) value, in particular, was much higher (100 mg/l) than that in the water of Ui Chong (31 mg/l at U-St. 1 and 9 mg/l at U-St. 2) (Table 3.3.4-1).

The inflow load of COD(Cr) from this side-inflow was 302.4 kg/day, TN was 56.8 kg/day and TON was 22.5 kg/day, respectively. Although the concentrations were higher than that of the river, pollution loads contribute less to the total pollution loads in the river.

The inflowing water from the left side was extremely polluted

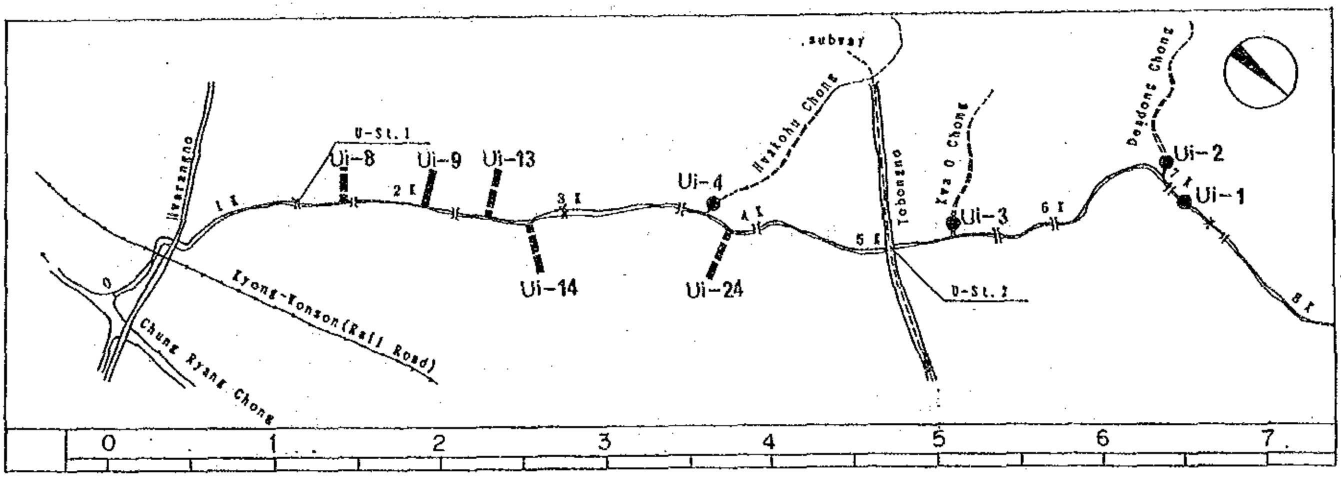


Fig. 3.3.4-1 Side-inflow into Ui Chong

Table 3.3.4-1 Direct and Indirect Side-inflow into Ui Chong

Date: September 4, 1990
Weather on the day: Slightly cloudy
Weather on the previous day: Clear and cloudy
AT: 24.4 °C (11:20)

Item / Station	WT (°C)	pH	EC (mS/cm)	Turbid. (mg/l)	COD(Cr) (mg/l)	TKN (mg/l)	NO2-N (mg/l)	NO3-N (mg/l)	NH4-N (mg/l)	TN (mg/l)	TON (mg/l)	Discharge (m3/s)	Inflowing Load COD(Cr) (kg/day)	Inflowing Load TN (kg/day)	Inflowing Load TON (kg/day)
U-St. 1	23.1	6.8	0.8	13	31	4.58	0.064	3.4	1.01	8.04	3.57	-			
U-St. 2	24.4	7.2	0.7	14	9	3.33	0.016	2.4	0.37	5.75	2.96	-			
Ui-1!	21.4	6.4	0.7	0	2	3.21	0.007	2.0	0.23	5.22	2.98	2.333	403.14	1052.20	600.68
Ui-2	24.7	7.4	0.8	2	19	4.58	0.010	1.5	2.24	6.09	2.34	-			
Ui-3	22.6	7.2	0.8	16	16	12.92	0.302	2.5	6.63	15.72	6.29	-			
Ui-4	23.5	7.4	0.9	25	63	17.5	0.446	2.3	9.75	20.25	7.75	-			
Ui-8	-	-	-	-	63	10.83	0.088	3	5.75	13.92	5.08	-			
Ui-9"	23.6	7.1	0.8	20	100	17.08	0.388	1.3	9.63	18.77	7.45	0.035	302.40	56.76	22.53
Ui-13#	20.4	6.6	0.7	42	18	3.75	0.054	4.7	2.09	8.50	1.66	-			
Ui-14	27.3	7.4	0.8	8	25	17.08	0.030	3.1	11.25	20.21	13.98	-			
Ui-24	-	-	-	-	122	20.83	0.239	1.2	11.63	22.27	9.20	-			

": water from this sewer is direcrly inflowing to Ui Chong.
#: Water form this drain is originated from the under-constructing area.
!: Water was samples from the upper Ui Chong, outside study area.