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A Study on Water Quality after Proper Maintenance of the Stream

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Abstract : This study was conducted to investigate water quality after construction of straightened concrete block at Tongbok stream and difference of water quality between natural stream and municipal stream artificially straightened. In Tongbok upstream which was natural block having a variety of sand, there was ability to purify pollutants by microorganism and filtration. There was ability to purify pollutants in natural section of the natural midstream which have a diversity and a plenty of sands. In Tongbok upstream BOD concentration was lower than that of reservoir, but in midstream which was straightened concrete block without sand, BOD and NH_3-N concentration was higher than that of upstream and deteriorated water quality.

Key words : BOD, NH-N, Stream

Introduction

Tongbok stream flowing into Pyongtaek reservoir has been deteriorated by the rapid Growth of population and industrialization. Tongbok stream had lost environmental functions stream such as ecological habitat, scenery and so on. Tongbok stream is located in Pyongtaek city of Gyonggi province and Ganpa stream is located in agricultural area of Yonchun county. As a result of construction of straightened concrete block in stream, the diversity of vegetation was lower than that of any other sites and color of water became dark because of anaerobic decomposition. Many industrialized nations made efforts to change the straightened concrete block streams to near-to-nature state for the restoration of ecological state. This study was conducted to investigate water quality after construction of straightened concrete block at Tongbok stream and the difference of water quality between natural stream and municipal stream artificially straightened.

Material and Methods

To determine the characteristics of the streams in both areas, water temperature, pH, dissolved oxygen, BOD, NH_4-N, NO_2-N, NO_3-N, T-P and T-N concentration were tested. Water temperature and dissolved oxygen were measured using a YSI DO meter(Model 58). Wingkler-Azide modification method was used for the measurement of BOD. pH was measured using Orion pH meter(FISHER pH Meter). Nutrient concentrations(NO_3-N, NH_4-N) were determined using ion chromatography by filtering with 0.45 Whatman glass fiber filters(GF/C). Alkalinity was determined using a titration method. Chlorophyll a was determined spectrophotometrically using a monochrometric method. Sampling sites for physico-chemical parameter and vegetation of Tongbok stream are natural upstream, midstream showing straightened concrete block, downstream without sand from February to October. Sampling sites of Ganpa stream which was natural stream were upper stream flowing down to the effluent of industrial wastewater treatment, midstream and downstream having a variety of sand and vegetation.

Results and Discussion

In both areas, annual mean precipitation was 1,200-1,555 and over 60% of rainfalls were concented in summer(June-August) in 1997-1998. The average pH of upper stream, midstream and downstream of Tongbok was 7.4, 7.4, and 7.2, respectively. The range of pH among five sites at

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Ganpa stream were 7.2-7.3 except 6.7 of G1 which flowed into the effluent of industrial wastewater treatment. The upper stream of Ganpa was deteriorated when the effluent of industrial wastewater flows into stream.

Dissolved Oxygen (DO)

The mean of dissolved oxygen of Tongbok stream was 9.9 ppm(6.9-13.3) in upper stream, 8.0 ppm(3.9-10.5) in midstream, 5.8 ppm(2.6-9.2) in downstream showing low leuets in straightened concrete block, but high in natural upstream in May and August. Low dissolved oxygen during the monthsy May and August was related with decomposition of organic matters derived from floating plants and sewage wastes in straightened concrete block. In Tongbok midstream which was straightened concrete block, There was no ability to restore dissolved oxygen. But in Tongbok upper stream which was natural block, there was ability to restore dissolved oxygen. In Ganpa stream which was natural stream, The mean dissolved oxygen was 6.3-7.5 ppm in upper stream, 9.3 ppm in midstream, 9.53 ppm in downstream. The mean of dissolved oxygen increased at the lower areas of the Ganpa stream from June to August. The reason why the mean of dissolved oxygen was lower in upper stream was that the effluent of industrial wastewater treatment flowed into upper stream in July. There was ability to restore dissolved oxygen in Ganpa natural downstream which had a diversity.

Biochemical Oxygen Demand (BOD)

The mean of BOD of Tongbok stream was 9.8 ppm(2.2-18.4) in reservoir, 9.1 ppm(2.4-17.3) in upper stream, 20.1 ppm(7.0-31.2) in midstream showing straightened concrete block, 26.3 ppm (7.3-55.9) in downstream from February to October. The average BOD of upper stream from February to May was higher than that of August but the average BOD of midstream from February to May was lower than that of August. Higher BOD for August was related to decomposition of organic matters derived from floating plants, suspended solids and sewage wastes coming from city in to straightened concrete block. In Tongbok midstream which was straightened concrete block without sands, there did not here ability to purify pollutants. Reduction of DO in straightened concrete block of midstream brought out anaerobic conditions and deteriorated water quality. But in Tongbok upper stream which was natural block having a variety of sand, there was ability to purify pollutants by microorganism and filtration. In Ganpa stream The BOD was 4.47-5.17 ppm in upper stream, 3.06 ppm in midstream, 4.99 ppm in downstream. Inflow of the effluents of industrial wastewater treatment into upstream during dry season deteriorated water quality of BOD. The BOD of upstream decreased flowing toward midstream of the Ganpa from June to August. The stream had ability to purify pollutants in natural section of the Ganpa downstream which have a diversity and a plenty of sands. The reason why the BOD was higher in downstream rather than midstream was that many people discharged wastes at downstream during summer vacation(July).

Ammonium (NH-N) and Nitrate (NO-N)

The mean of NH_3-N of Tongbok stream was 0.8 ppm(0.3-2.8) in reservoir, 0.9 ppm(0.4-1.4) in upstream, 4.8 ppm(1.9-8.7) in midstream, 4.3 ppm (1.28-8.7) in downstream. The average NH_3-N of midstream from February to May was lower than that of August. In upper stream NH_3-N concentration was lower than that of reservoir, but in midstream which was straightened concrete block without sands, NH_3-N concentration was higher than that of upper stream and deteriorated water quality. Higher NH_3-N in August was related with to decomposition of organic matters derived from floating plants and anaerobic condition of sediment of straightened concrete block. The mean of NO_3-N of Tongbok stream was 0.3 ppm(0.15-0.55) in reservoir, 0.9 ppm(0.3-1.59) in upstream, 1.5 ppm (0.05-3.82) in midstream and 1.7 ppm(0.19-5.08) in downstream. Higher NH_3-N and NO_3-N at downstream in May was related to decomposition of effluents derived from sewage wastewater. But in Tongbok upstream which was natural block having a variety of sand, the stream had ability to purify pollutants by microorganism and filtering. In Ganpa stream, The NH_3-N was 0.33-14.1 ppm in upper stream, 0.28 ppm in midstream, 0.20 ppm in downstream. Inflow of the sewage wastewater into

Table 1. Water Quality at Tongbok Stream in 1998 (unit : ppm)

Sites / Items	Reservoir						Station 1 (Upstream)						Station 2 (midstream)						Station 3 (Downstream)					
	FEB	APR	MAY	AUG	OCT	AVE	FEB	APR	MAY	AUG	OCT	AVE	FEB	APR	MAY	AUG	OCT	AVE	FEB	APR	MAY	AUG	OCT	AVE
Temp.(℃)	1.2	15.8	24.4	28.6	18	17.6	1.0	19.7	26.6	26.8	14.8	17.8	4.0	18	25.8	25.1	16	17.8	2.5	15.6	24.9	24.7	17.6	17.1
pH	7.61	8.4	9.08	9.69	8.34	8.6	7.46	7.42	7.33	7.31	7.62	7.4	7.47	7.34	7.28	7.13	7.54	7.4	7.26	7.15	7.1	7.19	7.42	7.2
DO (/)	12.5	10.8	14.9	12.4	11.3	12.4	11.6	8.9	8.9	6.85	13.3	9.9	9.0	8.6	8.1	3.9	10.5	8.0	6.4	5.8	2.6	4.7	9.2	5.8
CODMn (/)	7.8	10.0	17.3	7.9		10.8	6.3	9.0	8.5	7.9	6.5	7.6	14.6	20.7	24.7	19.1	13.6	18.5	13.7	42.0	27.3	8.6	13.6	21.1
BOD5 (/)	18.4	7.3	14.6	6.6	2.2	9.8	17.3	9.4	10.9	5.2	2.4	9.1	15.5	19.7	27.3	31.2	7.0	20.1	14.1	48.6	55.9	7.3	5.6	26.3
NH-N (/)	2.8	0.4	0.3	0.29	0.42	0.8	1.4	0.4	1.4	0.46	0.68	0.9	7.0	1.9	2.6	8.70	3.7	4.8	5.6	2.6	8.7	1.28	3.3	4.3
NO_2-N (/)	0.01	0.04	0.04	0.00	0.09	0.0	0.24	0.28	0.49	0.01	0.15	0.2	0.50	0.92	0.46	0.05	0.48	0.5	0.18	1.12	0.51	0.10	0.30	0.4
NO-N (/)	0.31	0.55	0.15		0.18	0.3	1.43	1.59	0.92	0.30	0.42	0.9	1.83	3.82	0.99	0.05	0.63	1.5	1.25	5.08	0.62	0.19	0.61	1.7
TP (/)	1.68	0.37	0.36	0.63	0.24	0.7	0.89	0.41	0.96	0.95	1.29	0.9	2.01	0.41	0.87	2.58	1.85	1.5	2.17	2.28	0.79	1.09	1.80	1.6
Cl- (/)	12.4	28.4	26.2	9.2		19.0	38.2	48.2	41.8	19.1		36.8	47.1	78.0	54.6	33.7		53.3	57.9	87.9	90.8	24.4		65.3
Alkalinity (/)		44	54	25	36.5	39.9		50	52	53.4	68	55.9		58	68	93.4	86	76.4		64	80	56	84	71.0

Table 2. Water Quality at Ganpa Stream in 2000 (unit : ppm)

Sites / Items	G1 (Upstream)				G2 (Upstream)				G3 (Upstream)				G4 (midstream)				G5 (Downstream)			
	June	July	Aug.	AVE	June	July	Aug.	AVE	June	July	Aug.	AVE	June	July	Aug.	AVE	June	July	Aug.	AVE
Temp.	22.7	26.0	27.6	25.4	29.3	30.2	32.3	30.6	27.1	30.8	33.1	30.2	22.6	25.1	28.7	25.5	25.4	27.2	28.1	26.9
pH		5.9	7.5	6.7		6.9	7.5	7.2		7.0	7.5	7.3		7.3	7.3	7.3		7.1	7.4	7.3
DO	3.9	10.0	8.2	7.4	7.8	9.9	4.8	7.5	4.4	8.6	5.9	6.3	8.6	9.9	9.5	9.3	6.7	11.3	10.6	9.53
BOD	13.6	0.60	1.21	5.14	7.55	3.02	4.95	5.17	9.06	3.02	1.33	4.47	9.06	0	0.12	3.06	6.04	8.46	0.48	4.99
Chl.a		2.10	2.72	2.41		7.06	8.94	8.0		4.22	7.13	5.68		6.5	5.93	6.22		17.4	7.23	12.3
TP	0.60	0.19	0	0.36	2.60	0.79	0.25	1.21	3.27	0.49	0.07	1.28	0.41	0	0.05	0.15	0.60	0.49	0.05	0.38
NH_4-N		0.3	0.36	0.33		1.9	0.55	1.23		12.3	15.9	14.1		0.2	0.36	0.28		0.18	0.22	0.20
NO_2-N	0.63	0.24	0.48	0.45	0.47	0.26	0.28	0.34	0.55	0.42	0.31	0.43	0	0.2	0.39	0.20	0.17	0.22	0.32	0.24
NO_3-N	2.27	1.72	2.23	2.07	1.29	2.40	1.89	1.86	1.92	0.22	1.62	1.25	3.32	4.0	4.59	3.97	0.91	2.82	3.95	2.56

upstream(G3) during rainy season deteriorated water quality of NH_3-N. The T-N and NH_3-N of upstream were decreased flowing toward natural midstream and downstream of the Ganpa which have a diversity and a plenty of sands. In Ganpa stream, The NO_3-N was 1.25-2.07 ppm in upper stream, 3.97 ppm in midstream, 2.56 ppm in downstream. The NO_3-N of upper stream increased flowing toward midstream of the Ganpa.

Phosphorus (T-P)

The mean of T-P of Tongbok stream was 0.7 ppm(0.24-1.68) in reservoir, 0.9 ppm(0.4-1.3) in upper stream, 1.5 ppm(0.4-2.58 in midstream and 1.6 ppm(0.8-2.28) in downstream. The average T-P of midstream and downstream was higher than that of upper stream in February, August and October. Higher T-P concentration in midstream straightened concrete block without sand was related to decomposition of organic matters and released phosphorus in anaerobic condition of straightened concrete block sediment soils. Higher T-P for April was related to decomposition of effluents derived from sewage wastewater treatment at downstream. In Ganpa stream, the T-P was 0.36-1.28 ppm in upper stream, 0.15 ppm in midstream, 0.38 ppm in downstream. Inflows of the effluent of industrial wastewater treatment system and sewage wastewater into upstream(G2, G3) for June deteriorated water quality of T-P. But The T-P of upstream decreased flowing toward natural midstream and downstream of the Ganpa which had a diversity and a plenty of sands. The chlorophyll a was 2.41-5.68 ppm in upstream, 6.22 ppm in midstream and 12.3 ppm in downstream. The chlorophyll a of upstream increased flowing toward natural downstream of the Ganpa which have a diversity.

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