

The Evaluation of Eutrophic State on Paldang Water Reservation Area using Chloride to Sulfate Ratio by On Site Ecotest and IC

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The environment of the river has been influenced by the sources of nutrient discharge and industrial wastewater. In this sense, the commonly present anions are suppositious to be contaminated involved species. Combining with ion chromatography, the evaluation of eutrophic situation in water reservation area around Paldang using this test kit was carried out. Monthly collected data on the water of Paldang Drinking Water Reservation Area have been shown the relatively well-protected water at mainstream while severe contamination from side streams in term of COD. With the scale of investigation, chloride to sulfate ratio appeared to be sound represent to COD value at each site. Therefore, water quality is possible to be generally estimated through this ratio. In order to obtain sufficient estimation on water quality around Drinking Water Reservation Area, constant monitoring is required.

Key words: Paldang Drinking Water Reservation, eutrophic, chloride to sulfate ratio, COD

1. Introduction

There is no such thing as naturally pure water. In nature, all water contains some impurities. As water flows in streams, sits in lakes, and filters through layers of soil and rock in the ground, it dissolves or absorbs the substances that it touches. Some of these substances are harmless. In fact, some people prefer mineral water precisely because minerals give it an appealing taste. However, at certain levels minerals, just like man-made chemicals, are considered contaminants that can make water unpalatable or even unsafe to aquatic system and of course human being is included. Some contaminants come from erosion of natural rock formations. Other contaminants are substances discharged from factories, applied to farmlands, or used by consumers in their homes and yards. Especially, in the time of social development, along with the increase of living standard, water sources have been polluted gradually and drastically in various scales. Sources of contaminants might be in your neighborhood or might be many miles away.

With all of these above, water sources must be reserved from contamination as an aspect of life

protection. In order to get the view about of water body quality, detection and evaluation methods for environmental samples have been developed. This work is lying in four stages of environmental remediation including monitoring for quality evaluation, planning process for facility reconstruction, treatment modeling and then prevention. With the certain object like Han river water, a source of drinking water, the monthly sampling and data become necessary. For the gradual evaluation, prompt and onsite test is a helpful tool in term of data collection. As one of beginning steps, a homemade test kit named Ecotest is researched and launched to meet this need. Five common criteria in water are possible to determined by Ecotest: NO_3^- , NO_2^- , PO_4^- , NH_4^+ and COD. With these parameters, in the comparison and combination with the data from IC such as Cl^- and SO_4^{2-} , with the term of index of domestic wastewater, water quality could be estimated. The considered area here covered Paldang area with main river as well as side streams with 16 and 40 sampling sites, respectively. As the results obtained in June, the main river showed relatively satisfactory data; that of side streams near Bukhan river and almost Nam Han

river also reasonable but few bad at the later. Kyungahn, a side stream, was considered to be at risky situation of contamination with the results collected in June. Therefore, a constant monitoring is necessary on the way to set up a policy of water source reservation.

2. Experiment

2.1. Sampling

The water samples were collected at 56 sites of the river and side streams and stored in plastic sampling bottles. All samples were kept in refrigerator at 4°C. The measurement with Ecotest and IC was directly implemented onsite and laboratory, respectively.

2.2. Measurement with Ecotest

Ecotest determination is a simple procedure and easy to implement. All reagents are contained in small tubes, which each drop from them is approximately counted as 0.2 ml. The order in number and amount in drop of reagents addition are carefully described on the label of each tube. The required volume of sample is 5 ml for one test. Short intervals in these tests need to be mentioned. All samples were taken picture and colorimetric compared with standard solutions.

2.3. Instrumentation and experimental conditions

The chromatography was performed using Dionex DX-80 ion chromatography consisted of one IonPac® AG14A anion guard column (3×30 mm) and IonPac® AS14A (3×150 mm) separator column.

3. Results and discussion

3.1. River water analysis

Water samples were obtained from 40 sites along the river branches as well as its streams in and around Seoul in the duration of one month, from the end of August to end of September. Chloride and sulfate, the remaining items such as ammonia, nitrate, nitrite, phosphate and COD were determined with IC and Ecotest, respectively. The anion contamination levels

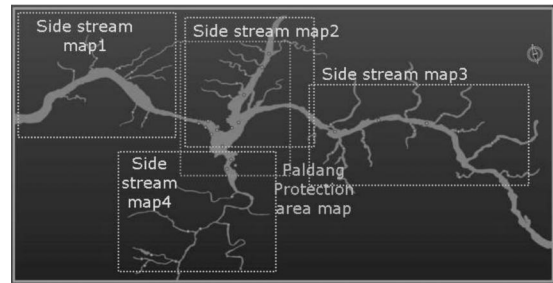


Fig. 1. Map of paldang reservation area.

were almost not severe in comparison with the mandatory Korea Drinking Water Norm (fluoride: 1.5 mg/L, chloride: 250 mg/L, nitrate: 10 mg/L, sulfate: 200 mg/L), however there were some exceeded concentrations of contaminants at several sites.

Analytical tests on over 40 sites in triple sampling including several chemical parameters were conducted in the monitoring study with Ecotest and IC. The results collected in the study indicated that the amounts of chloride, sulfate and COD concentration in and 40 sampling sites from five different areas ranged from 10-150 ppm, 5-50 ppm and 1-13 ppm, respectively. Some of checked parameters were in the unusual ranges of contaminated surface water and comparisons between meaningful values of the analytical data show degradation of water quality at some sampling sites. Table 1 and Fig. 2 summarise values of river water sample at five sampling areas mentioned above. In common view, water at all sites are contaminated but with various levels. As the results showed in Table 1, the water quality in the area of Bukhan is possibly considered relatively satisfactory in comparison with the others. In term of terrain, Bukhan and after Paldang areas are the up streams among the remains. However, water quality at Paldang is in the risky situation with remarkable high COD. That showed the eutrophic blooming state in the area has been developed while Bukhan regared relatively clean.

Besides, the down streams as Yangji, Gwangju, Namhan areas commonly performed to be contaminated. With mentioned high values of criteria such as COD and nitrate, water is bringing pollutants from main rivers to side streams following flow direction. There

Table 1. Results of Han river sample with Ecotes and IC determination

Area	Sample	August 30 th		September 14 th		September 28 th	
		COD	Cl/SO ₄ -S	COD	Cl/SO ₄ -S	COD	Cl/SO ₄ -S
G	G1	8	2.75	6	2.39	10	4.38
	G2	2	0.82	9	3.40	8	2.03
	G3	2	0.83	2	1.20	7	4.67
	G4	?	0.80	?	0.73	11	4.01
	G5	3	1.61	1	1.68	7	2.89
	G6	1	1.65	1	2.30	6	2.80
	G7	5	2.41	5	3.02	13	4.21
	G8	2	1.85	2	2.74	5	2.78
	G9	2	1.43	2	1.54	2	2.94
	G10	2	0.88	1	0.91	1	0.62
SH	SH1	1	2.13	8	2.63	3	4.52
	SH2	1	1.34	1	1.84	4	3.59
	SH3	4	2.15	3	1.77	8	3.60
	SH4	1	2.10	1	1.90	4	3.83
	SH5	1	1.67	1	1.77	5	4.09
	SH6	1	1.31	1	1.22	1	1.78
	SH7	1	1.37	9	4.50	1	1.80
	SH8	5	2.31	1	1.39	2	1.89
	SH9	1	1.30	1	1.48	1	2.21
	SH10	1	1.46	1	1.38	1	2.12
	SH11	1	1.14	1	1.20	1	1.74
AP	AP1	3	1.51	5	2.70	7	2.08
	AP2	2	1.65	3	2.11	5	2.64
	AP3	10	3.44	9	3.01	8	3.80
	AP4	3	1.80	3	1.65	5	2.08
	AP5	8	3.72	9	2.57	8	5.23
	AP6	5	2.59	6	2.50	7	2.82
	AP7	7	2.54	8	3.20	8	3.98
	AP8	5	2.39	3	1.62	5	2.93
NH	NH1	1	1.30	1	1.33	4	3.04
	NH2	5	2.27	1	1.55	1	2.12
	NH3	1	1.24	1	1.33	4	3.97
	NH4	1	1.19	1	1.27	1	1.82
	NH5	1	1.05	1	1.09	2	1.42
	NH6	1	1.12	3	1.28	2	1.8
Y	Y1	2	1.81	2	1.88	6	3.20
	Y2	8	2.93	6	2.97	8	4.89
	Y3	2	2.78	3	2.71	6	2.81
	Y4	5	2.34	2	1.55	6	3.93
	Y5	6	2.44	3	2.60	8	3.10

AP: After Paldang; NH: North Han river (Bukhan river); SH: South Han river (Namhan river); G: Gwangju; Y: Yangji

are some previous research indicated that the existence proportion of anions in water may present quality itself. As being indicated in Table 1, the trend of ratio between chloride to sulfate in these sites is correspondingly

proportional to the COD values. Three plots of data collected from August to September indicated the increasing trend of that relationship.

As the plots showed, collected data appeared to be

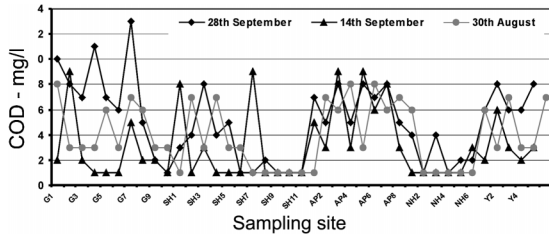


Fig. 2. Relation between COD and Cl to SO_4 ratio in 30th of August.

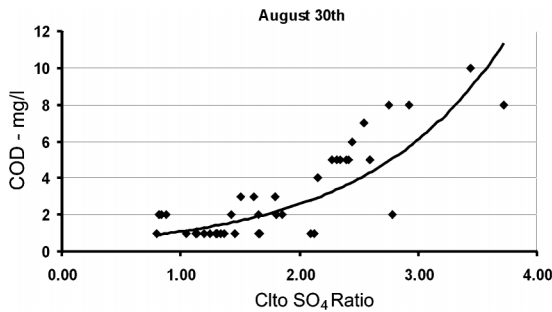


Fig. 3. Relation between COD and Cl to SO_4 ratio in 14th of September.

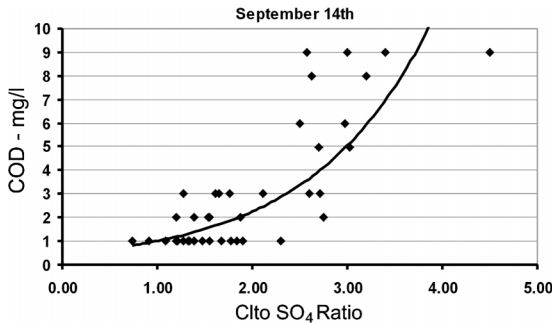


Fig. 4. Relation between COD and Cl to SO_4 ratio in 28th of September.

scattered and unprincipled. But in regarding to the trend line of curve, relation of COD versus ratio is acknowledged to be sound clear, except some random and exemption. These graphs revealed that the suppositious value of chloride to sulfate ratio in order to evaluate clean and slight contaminated water is 2. The higher value will show the larger range of corresponding COD. The idea that chloride and sulfate are commonly presented in improperly treated waste and wastewater released from dense industrial zones as well as population inhabitation might be thought to be the explanation for the reason. In addition to that,

topology and characteristic of each area also contribute to the contamination process.

4. Conclusion

The study applied an easy and comfortable test kit method name Ecotest in combination with powerful laboratory instrument IC in monitoring water quality of Han River. Common pollutants in water such as NO_3^- , NO_2^- , PO_4^- , NH_4^+ , COD and Cl, SO_4^{2-} were determined by the mean of Ecotest and IC, respectively. In the scale of research, the plot data figured out that COD, a pollution criterion in water evaluation, is correspondingly proportional to the ratio of chloride to sulfate. The value 2 of this ratio was also suppositiously assigned to be water index. Results presented the area after Paldang have been in potentially risky contamination as well as its side streams. A systematically constant monitoring need to be carried out right now, in order to assess every sources of drinking water and to identify potential sources of contaminants in an effort to help community protect drinking water supply from contamination.

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