

The Trend of Water Quality of Han River at Side Stream after Paldang Dam in Spring Season with Feasible Method for Surface Water Evaluation

Jae Seong Rhee, Nguyen Viet Tung, and Suwon Lee

*Korea Institute of Science and Technology, Div. Environment or Engineering,
39-1 Hawulgok-dong, Sungbuk-gu, 136-791 Seoul, Korea*

The problem of contamination at water supply resources is well environmental recognized. Besides, the issue of drinking water quality has risen as community consideration. With the role of main source of water supply, Han river are playing an important role not only in daily life of Seoul habitants but also industrial and agricultural activities of city. Therefore, the needs of monitor and evaluate water quality have been paid attention so far. Samples were collected monthly started through March to the end of June, from branches in Han river. Different testing methods were applied in order to classify water quality in the lab in that, simultaneous determination of environmentally interesting inorganic anions is carried out by suppressed ion chromatography. The results of sampling site after Paldang (AP), the area drinking water is up taken, performed in presence of anions that commonly occur in real samples (Cl^- , NO_3^- , SO_4^{2-}). In this research, the concentration of chloride and sulfate amount in surface water was regarded to be relative with the municipal wastewater effluent and pollution level. In the same way, COD measured with the test kit is to primarily evaluate the quality of water. Data showed the fluctuation in anion amount through months, but reached the highest values in May and lower by the end of the spring quarter. The study is being continued in the next period to keep a view on Han river quality.

Key words: drinking water quality, Han river, ion chromatography, Paldang dam

1. Introduction

Han river in Seoul, with high density of residence and industrial areas located on both sides, has being a main stream supporting drinking water and receiving discharge flows from all sources such as domestic, industrial, agricultural life. This river basin generally constitute as with a high population density owing to favorable living conditions such as the availability of fertile land, water for irrigation, industrial, drinking or fishing purposes and efficient means of transportation. Therefore, Han river is annually received a large amount of known and unknown wastewater sources. Along with the non-stopped development and upgrading of society the quality of water is gradual degraded. Because of its important role in water supply source, living environment of both human and animal, the standing concern about the

fate of the river has been emerged as social common issue.

The nitrogen, phosphorus and sulfur cycles are of particular significance to a number of biological and non-biological process in the environment.¹⁾ Natural and anthropogenic effects can cause localized inter-related changes to the cycles. For example, nitrite is produced during the biodegrading of organic substances containing nitrogen and the reaction of nitrite with secondary amines affords carcinogenic nitrosamino compounds.²⁾ Moreover, the illegal exploitations of the river such as net fishing, untreated discharge of wastes and wastewater from riverside habitants have contributing into the pollution situation of the water. Paldang and the area after Paldang in Han river are the place where water is overflowed and pumped to drinking water plans. In this work, the water samples were collected by months from the beginning of spring

through June based on sampling map that all sampling site is divided into 5 areas including Paldang. Thus, it is an essence for effective and efficient water management to have reliable information of water quality.

This study, a number of samples that cover a large area of Han river were determined by ion chromatography and test kit. In the scope, the results about Paldang reservoir and site after Paldang were far more considered because of the importance of the area.

2. Experimental

2.1. Sampling

The water samples were collected at 54 sites of the river and river streams and stored in plastic sampling bottles. The measurement with IC was directly implemented by filtration through 0.45 mm PVDF filter tip from 2 ml syringe.

2.2. Reagents for ion chromatography

Deionized ultra pure distilled water produced by Millipore Milli Q reagent system with conductivity of 18.2 M Ω cm was used to prepare eluent and reagent. Sodium carbonate and sodium bicarbonate (Kanto, Tokyo Japan) of reagent grade were used as the eluents.

All the anion standards were prepared using analytical grade reagents (Kanto, Tokyo, Japan and Samchun, Korea).

2.3. Instrumentation and experimental conditions

The chromatography was performed using Dionex DX-80 ion chromatography with 10 μ l loop. The system components consisted of one IonPac[®] AG14A anion guard column (3 \times 30mm) and IonPac[®] AS14A (3 \times 150mm) separator column are used for simultaneous separation of anions. The eluent delivered to the column at isocratic flow rate of 2 ml.min⁻¹ was prepared at concentration of 8 mM Na₂CO₃ and 0.1 mM NaHCO₃. The

Table 1. The ion chromatographic conditions

Eluent	8mM Na ₂ CO ₃ & 1mM NaHCO ₃ (under nitrogen)
Regenerant	26.3mM H ₂ SO ₄
Flow rate	2 ml.min ⁻¹
Separation column	Ion pack AS14A (Dionex) 3 \times 150 mm
Guard column	IonPac [®] AG14A (Dionex) 3 \times 30 mm
Injection volume	10 μ l loop
Detector	DS5 Detection Stabilizer (Dionex)

regenerant was the solution of 28mM H₂SO₄ 98%.

3. Results and discussions

3.1. Sampling date

Water samples were collected in spring season from March to the end of June, in this month, a duplicate sampling was undertaken due to the beginning of rainy season.

3.2. Sampling site

As mentioned above, all sampling area is divided into 5 zones basing on the branches, areas and streams of the river.

3.3. Data of analysis

In this research, the major inorganic anions such as chloride, nitrite, nitrate, phosphate and sulfate in water sample were analyzed with IC and their contamination level and sources are discussed.

Statistical data showed the unsystematic variation of anion amount in water sample from after Paldang Dam through months. Generally, there are the most disappearance of ions nitrite and phosphate in water samples. The interval between sample collecting point and analysis were long enough for these unstable pollutants decomposed, besides, the key point is of the aerobic as well as opening conditions of surface water explains to that rare existence.

Basing on the data sheet, the monthly variation of major anions at each site was exhibited to make a clear look on the water quality of area

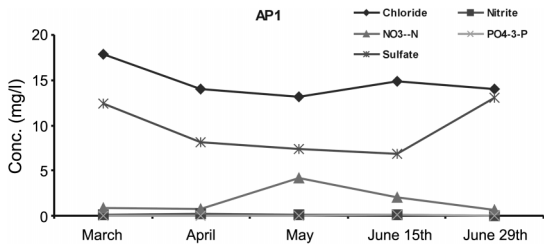


Fig. 1. The monthly variation of concentration of major anions at AP1 sampling site

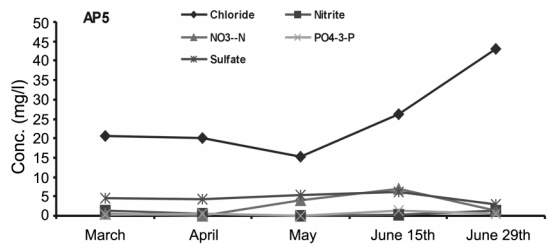


Fig. 5. The monthly variation of concentration of major anions at AP5 sampling site

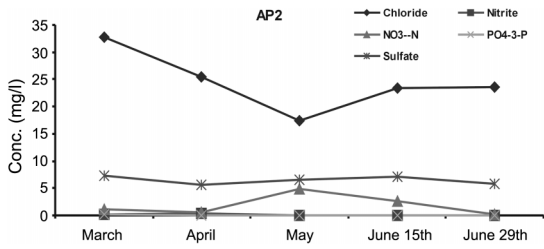


Fig. 2. The monthly variation of concentration of major anions at AP2 sampling site.

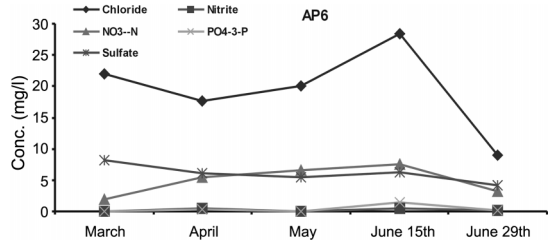


Fig. 6. The monthly variation of concentration of major anions at AP6 sampling site.

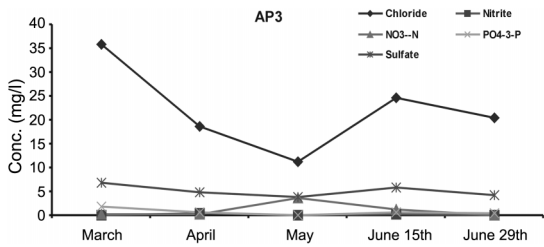


Fig. 3. The monthly variation of concentration of major anions at AP3 sampling site.

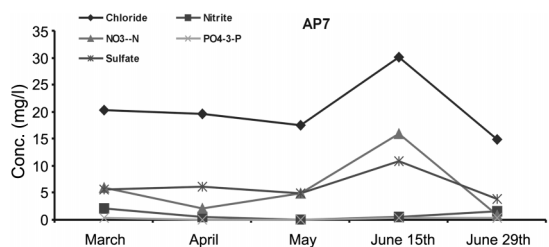


Fig. 7. The monthly variation of concentration of major anions at AP7 sampling site.

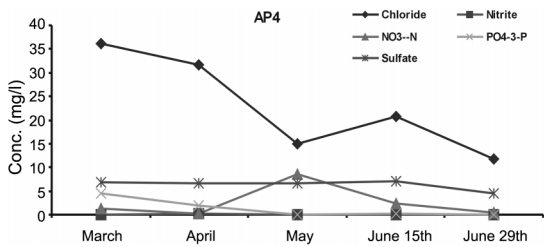


Fig. 4. The monthly variation of concentration of major anions at AP4 sampling site.

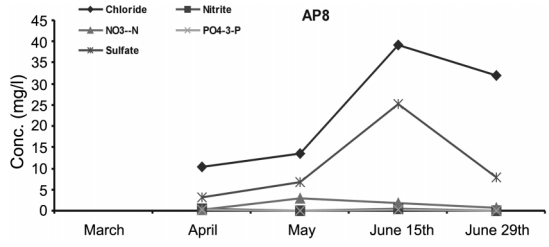


Fig. 8. The monthly variation of concentration of major anions at AP8 sampling site.

fter Paldang Dam. In the beginning of spring, the content of analytes that cause nutrient such as nitrate, nitrite, phosphate were low and have the trend increasing in May and mid June. Through March to end of June, the nitrate amount in water sample rose gradually, but reached the highest point in May (8.6 mg/l) and somewhat in

the mid June (15.93 mg/l) (Fig. 1~Fig. 8).

Being surrounded by rock mountains on both sides, Han river has specific features as thought to be one caused nitrate contamination. Geologic nitrogen, a term referring to nitrogen incorporated into the matrix of rock during diagenesis or through secondary alteration, has been implicated

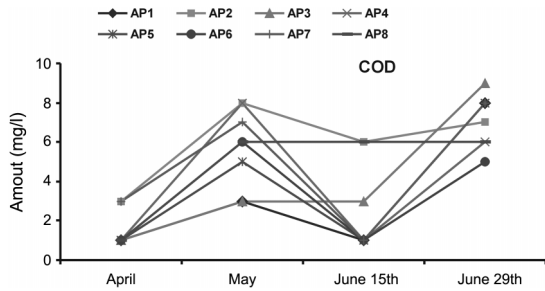


Fig. 9. The variation of COD in samples from side stream after Paldang Dam.

as a potential source of elevated nitrate concentrations in surface waters of Han river in the beginning of rain season. Runoff water carries organic matters from both sides of the river that also increases the nitrate content itself. Therefore, geologic nitrogen, a non point source of nitrate contamination to surface water is supposed as a potential source of nitrogen to the terrestrial nitrogen cycle.

The amount of sulfate and chloride are other criteria to recognize the contamination level of

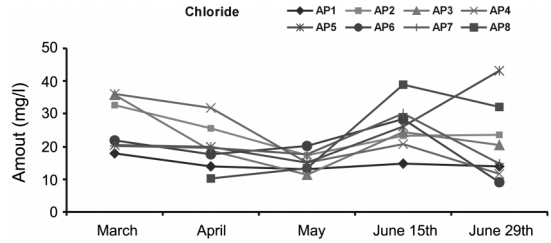


Fig. 10. The variation of chloride in samples from side stream after Paldang Dam.

water. If the ratio of chloride to sulfate more than 2, there might be the intrusion of sea water and contamination by discharge flows to the river. In this result, the average concentration of chloride and sulfate were around 30 mg/l and 8 mg/l (Table 1), respectively. Chloride content moderately increased in the duration from May to of mid June and fall in the end of this month while sulfate stayed almost straightly. In term of anion content, site AP6 (Fig. 6) and site AP7 (Fig. 7) were observed to be more contaminated than the others with high level of nitrate,

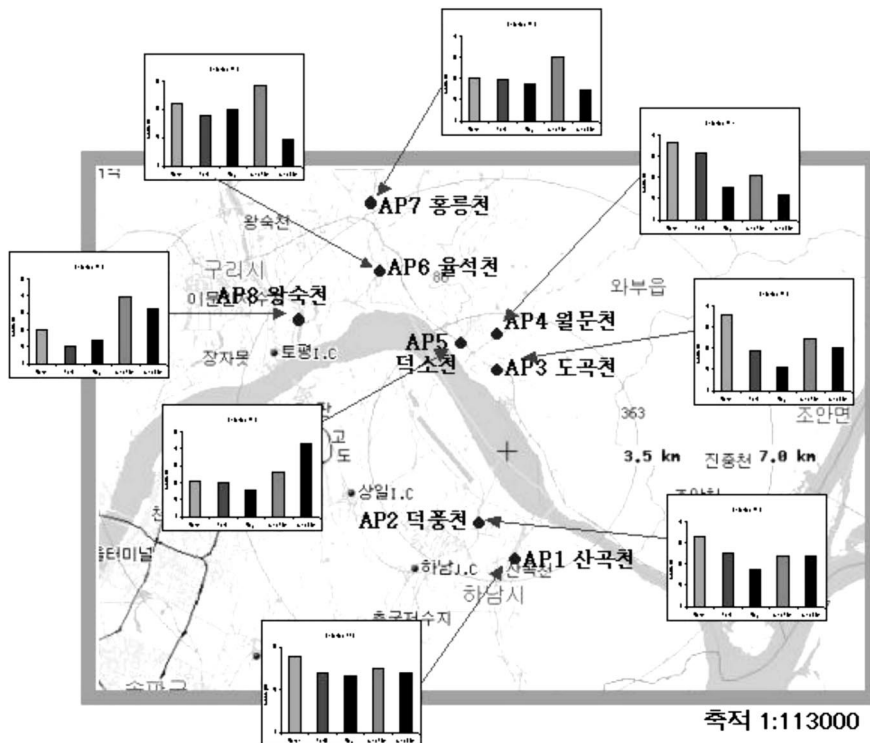


Fig. 11. The distribution of chloride amount in area after Paldang Dam.

chloride and sulfate but in aspect of COD, site AP2 and AP8 had higher chemical oxygen demand. This can be understood with the chloride to sulfate ration at these sites almost reached high value from 2 to 4.5 (Fig. 9).

Chloride, the product of domestic wastewater as well as seawater intrusion was seen rising in mid June. At the end of side stream (AP1, AP2, AP5), chloride content was an upward trend along the down stream of Paldang but still did not exceed the mandatory Korea guideline for drinking water (chloride: 250 mg/l, sulfate: 200 mg/l) (Fig. 10). That indicated the cleaner level of up stream area than down stream where is closer to high population density and industrial locations. Fig. 11 also presented chloride distribution in side stream after Paldang reservoir

4. Conclusions

In the spring and summer season, a large amount of water samples were monthly collected from side stream after Paldang in order to investigate the variation and the suitable evaluation method of water quality at this area. In this study, the results showed the unsystematic fluctuation of anion content but

generally, the trend of increase of nutrient anion and waste related anions such as nitrate and chloride, sulfate, respectively. In short, the contamination level was not so serious but precautionary measurement should be launched to prevent water from pollution thread.

References

- 1) Ali A. Ensafi, A Kazemzadeh, *Analytical Chimica Acta*, **1999**, 382, 15-20.
- 2) Colin Neal, Helen P. Javie, Andrew J. Wade, Paul G. Whitehead, *The Science of the Total Environment*, **2002**, (282-283), 471-490.
- 3) Damian Connolly, Brett Paull, *Analytical Chimica Acta*, **2001**, 441, 53-62.
- 4) Elisabeth Salhi and Urs Von Gunten, *Wat. Res.*, **1999**, 33(15), 3239-3244.
- 5) Hyun Mee Park, Young Man Kim, Dai Woon Lee, Su Won Lee and Kang Bong Lee, *Analytical Sciences (Japan)*, **2002**, 18, 343-346.
- 6) Jae Seong Rhee, Suwon Lee, Nguyen Viet Tung, *J. Soc. Korea Env. Ana.*, **2002**, 5(1), 69-72.
- 7) Jo Ann M. Holloway, Randy A. Dahlgren, William H. Casey, *Chemical Geology*, **2001**, 174, 403-414.
- 8) M. Colina and P.H.E. Gardiner, *J. Chromatogr. A*, **1999**, 847, 285.
- 9) Y. Miura and H. Hamada, *J. Chromatogr. A*, **1999**, 859, 153.