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Water Quality Monitoring of Total Pollution Load Management System in Busan, South Korea

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***Abstract*:** *From 2015, Total Pollution Load Management System was come into force and this was included in a I step target area as the Suyeong bay. So it will be continuedly investigated in a characteristic discharge and basin environment in the Suyeong bay. Now is the time for water quality improvement of the Suyeong bay as a target area and this is caused by Article 2 and Article 27 of the basic policy of Total Pollution Load Management System in the specific management bay. From a point sources and non-point sources spread out the target area, a sewage has been continuedly flowed into the target area. So a systematic and scientific water quality improvement measurement is needed.*

This study was looked into the influence of each pollution source on Suyeong bay. It is included to investigate the pollution concentration and pollution load of the five streams and five coast seawater points.

Keywords: *Total Pollution Load Management System, Suyeong bay, non-point sources*

1. Introduction

Because of taking effect the total pollution load management system around Busan coastal area from 2015, it's necessary to conduct research on a management of water environment and an analysis of a pollutant emission characteristics [1]. Considering the basic policies of the total pollution load management system, it is urgent to improve the water quality and expand the sewage treatment plant near Suyeong Bay in Busan(Fig. 1). Furthermore, there were various water pollution sources and non-point sources near Suyeong Bay. This study is intended to find out the water quality of Suyeong river and the water pollution load from the five branches near Suyeong Bay in Busan to present improvement measure.

2. Materials and Methods

2.1. Monitoring Area and Items

Water quality monitoring was conducted at five points on Suyeong river and five points on coastal area around Suyeong Bay. The water quality of stream was measured once a month except for September to December where the water quality was measured twice a month. The seawater quality was measured quarterly but twice a month from June to August. The locations of monitoring point show as below (Fig. 1, Table 1).

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TABLE I: Location and Coordinate of Water Quality in the Stream and Coast Seawater Points

Items	point name	latitude	longitude
Stream water	A (Oncheon stream)	35.19970	129.07979
	B (Nam stream)	35.14843	129.09193
	C (Chun stream)	35.16969	129.17347
	D (Udong stream)	35.17070	129.13960
	E (Suyeong river)	35.21075	129.12101
Coast seawater	F (Gwanganri beach)	35.14962	129.12088
	G (Heaundae beach)	35.15592	129.16334
	H (Heaundae)	35.14841	129.15347
	I (Suyeong bay)	35.15626	129.13776
	J (Namcheon bay)	35.12510	129.12867

The measurement items in this study were divided into two categories such as onsite items and general water quality items. 14 items including the flow, the water temperature, the salinity, BOD, COD, and TOC were measured at five points on Suyeong river. 13 items such as the water temperature, the salinity, COD, TSS, VSS were measured at five points on coastal area around Suyeong Bay.

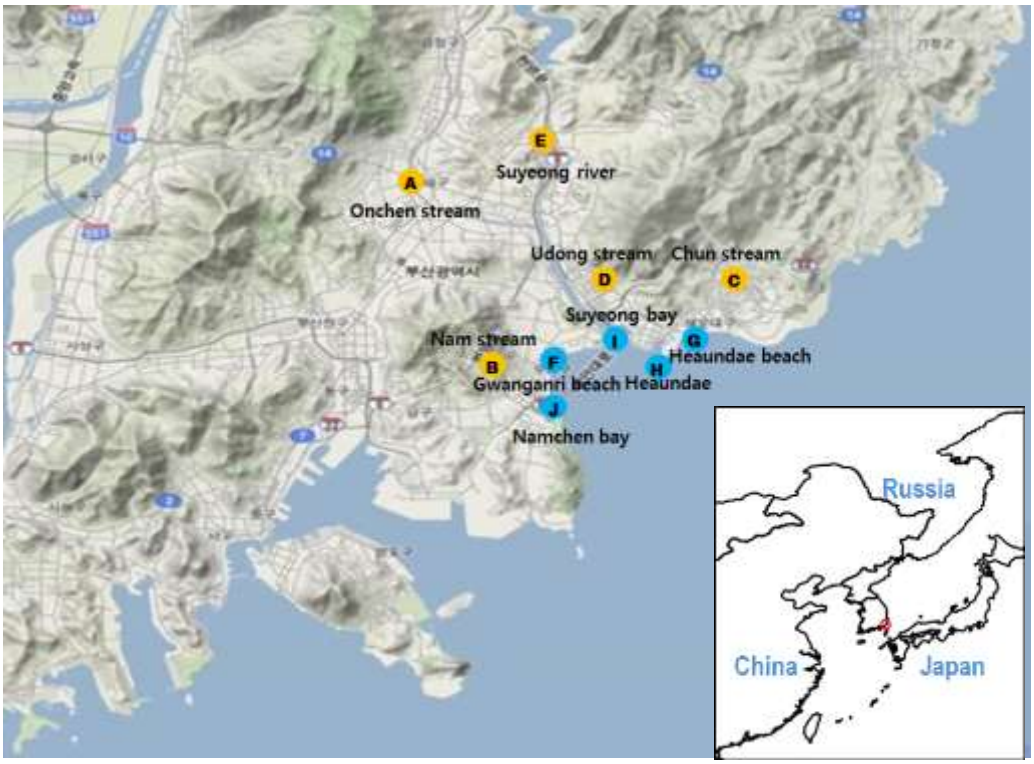

Fig. 1: Location map in stream and coast seawater points.

3. Result and Discussion

3.1. Water Quality in Stream

BOD concentrations on the five branches were 2.7(C: point name) to 49.9(B) mg/L according to the points. Udong stream(D), Oncheon stream(A), and Chun stream(C) showed the similar variation of concentration. The high BOD concentration could be seen at Nam stream(B) and the highest BOD was 92.0 mg/L on November. The COD concentrations at five branches ranged from 3.3(C) to 29.7 mg/L(B). Variations of COD concentration were similar to those of BOD, showing the similar patterns at Udong stream(D), Oncheon stream(A), and Chun

stream(C). The slight increase in Suyeong river was considered influence from upper source of water. The highest COD was 57.3 mg/L on March. Comparing to BOD, COD showed a lower monthly variation and the similar patterns except for Nam stream.

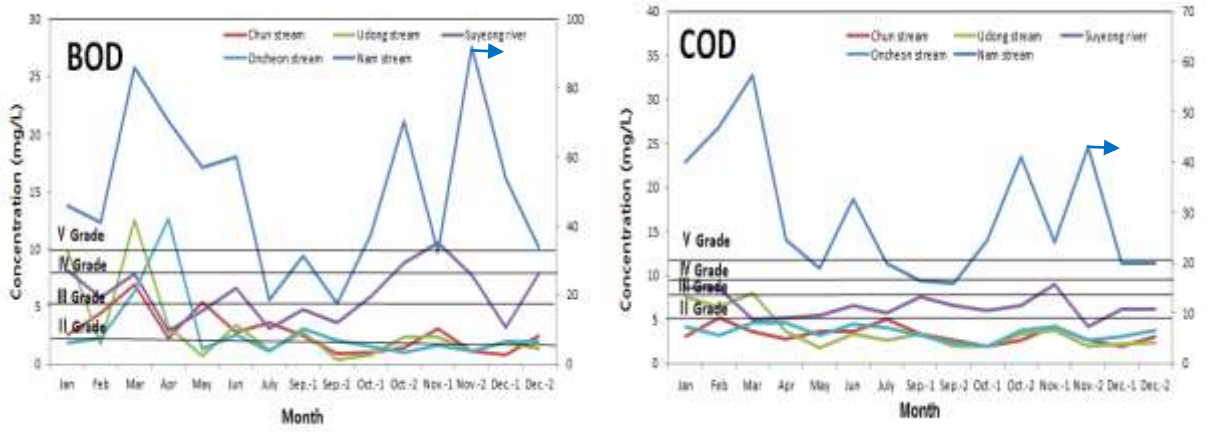

Fig. 2: Concentration variation of BOD and COD in the stream.

T-N which is the direct cause of the green tide and eutrophication, ranged from 1.508(C) to 22.205 mg/L(B). The highest T-N could be seen at Nam stream because of the wastewater and unknown water pollutant emitted from a residential area. Also we could find out the influence of upper source of water in Suyeong river and raw water of Nakdong river being inpoured to maintain water quality in Oncheon stream. T-P ranged from 0.060(C) to 1.889 mg/L(B). Comparing to T-N, T-P showed a significant monthly change because of the surrounding environments and the differences of sampling time.

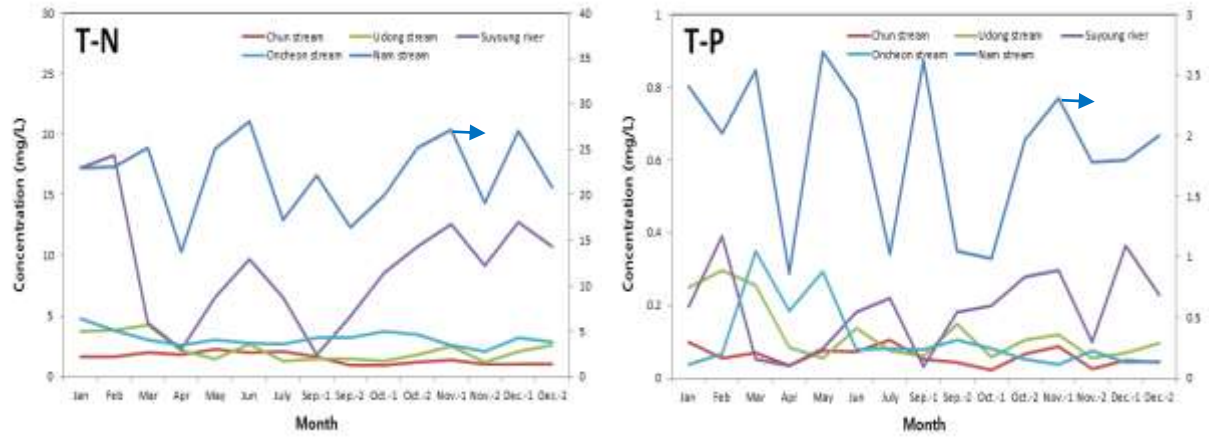

Fig. 3: Concentration variation of T-N and T-P in the stream.

3.2. Water Pollution Load

The average discharge of stream water flowing into Suyeong bay was from 1,547(D) to 160,386 m^3/day(E). The differences of the average discharge at each stream showed from three to ten times higher according to the locations like 42,223 to 313,596 m^3/day in Suyeong river(E), 23,095 to 108,035 m^3/day in Oncheon stream(A), 6,404 to 36,599 m^3/day in Chun stream(C), 4,353 to 15,365 m^3/day in Nam stream(B), and 366 to 7,829 m^3/day in Udong stream(D). There were large amounts of inflow from Suyeong river(E) and Oncheon stream(A) in the case of rainfall.

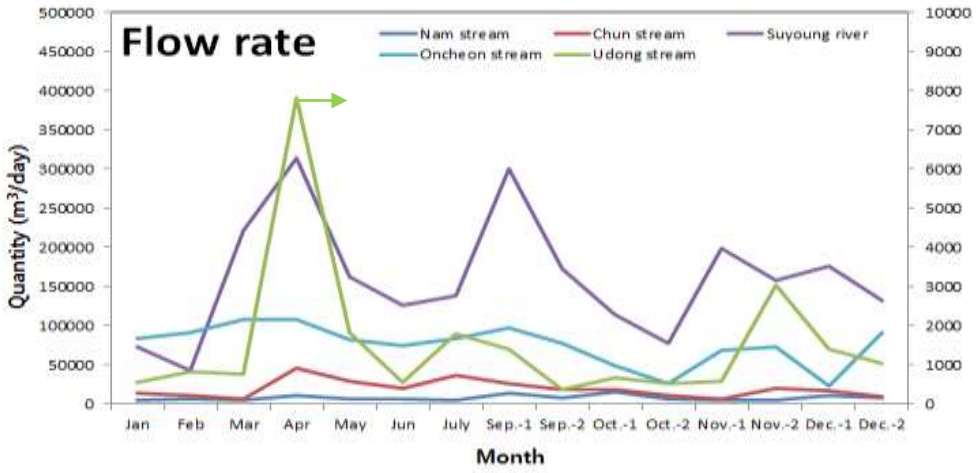

Fig. 4: Monthly flow variation in each stream.

The water pollution load can be obtained by multiplying the concentration by the flow rate. Daily average pollution load of each item ranged from 4.7(D) to 975.1(E) kg/day on BOD, 5.6(D) to 1,043.6(E) kg/day on COD and TOC 3.0(D) to 544.2(E) kg/day on T-N, and from 0.192(D) to 30.302(E) kg/day on T-P. The highest water pollution load on BOD was 975.1 kg/day in Suyeong river(E) and the second was 391.2 kg/day in Nam stream(B). But in the case of COD, the highest water pollution load on COD was 1043.6 kg/day in Suyeong river(E) and the second was 269.0 kg/day in Oncheon stream(A). Among five branches flowing into Suyeong Bay, water pollution load was high in Suyeong river(E), Oncheon stream(A), and Nam stream(B). Because pollution concentration level was high in Nam stream(D), the water pollution load showed a high value despite the low average discharge.

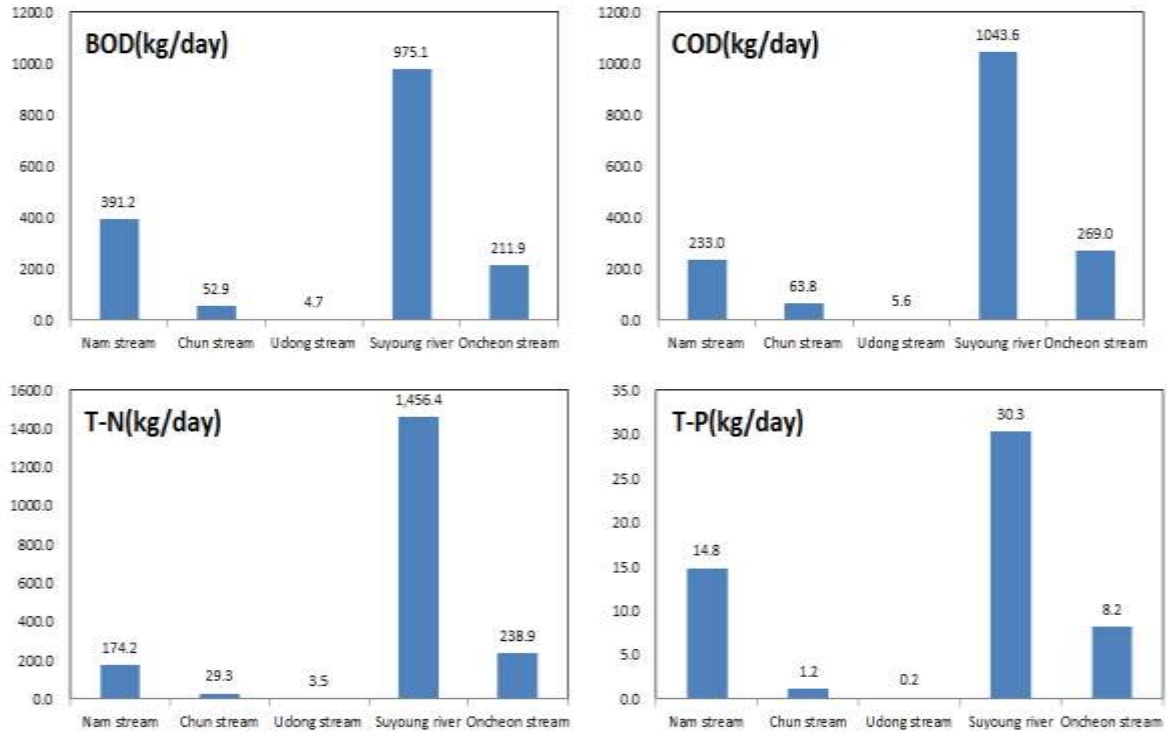

Fig. 5: Water pollution load in each stream.

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3.3. Seawater Quality in the Coast

COD of seawater at five points on coastal area around Suyeong bay ranged from 0.9(G, The first Grade) to 1.6 mg/L(I, The second Grade). The stream water flowing into Suyeong river(E) had an effect on the seawater quality in Suyeong bay(I), Namcheon bay(J), and Gawnganri bearch(F). TOC concentrations were from 1.0(G) to 1.6(I) mg/L and Namcheon bay(J). The high concentration in Namcheon bay came from the increase of pollution resulted from the reclaiming work near Namcheon bay.

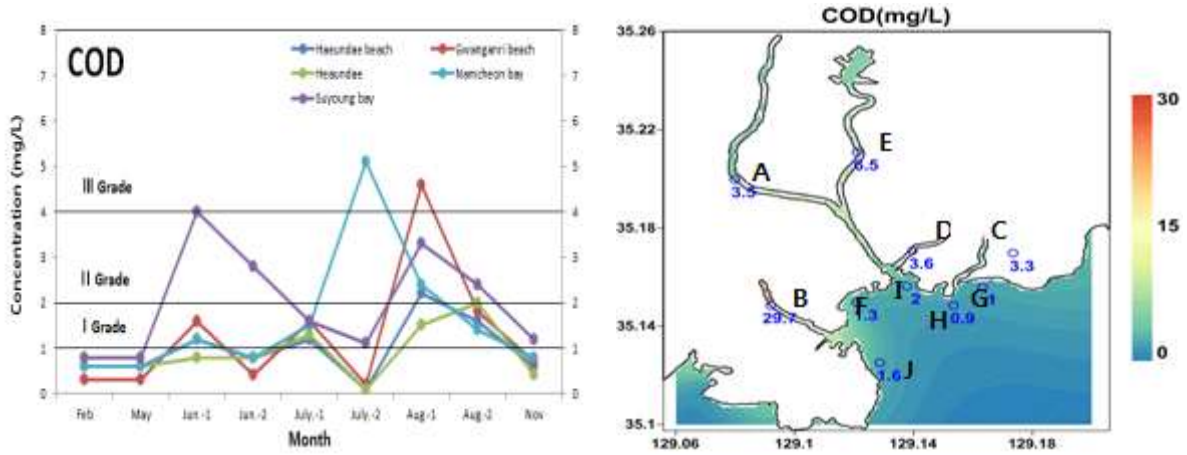

Fig. 6: COD variation in Suyeong bay.

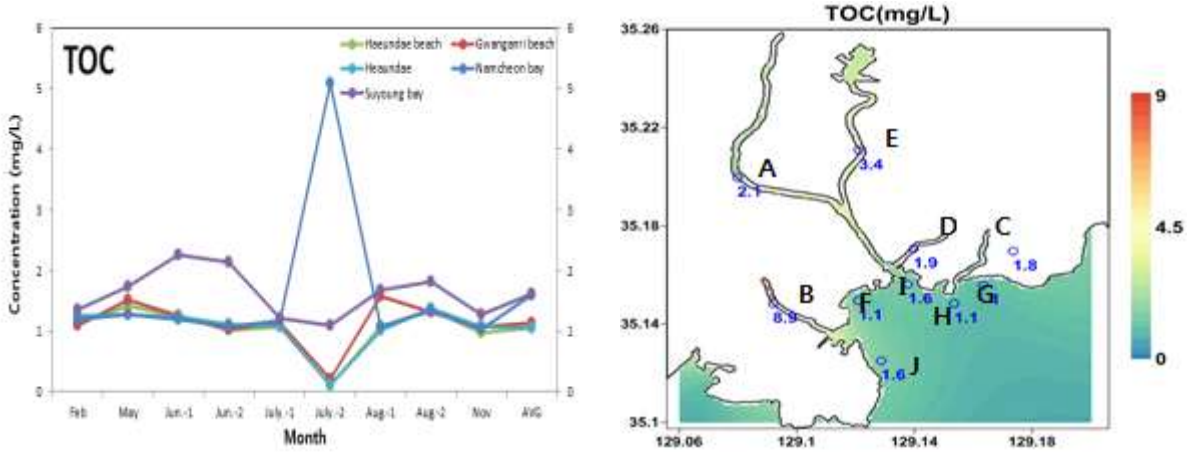

Fig. 7: TOC variation in Suyeong bay.

T-N concentrations were from 1.169(G, The first Grade) to 1.632 mg/L(I, The third Grade) by the locations. T-N was also high in Namcheon bay(J) because of the reclaiming work near area. T-P concentration ranged from 0.018(G, The first Grade) to 0.130 mg/L(I, The third Grade). T-P was somewhat low in almost all points except for Suyeong bay.

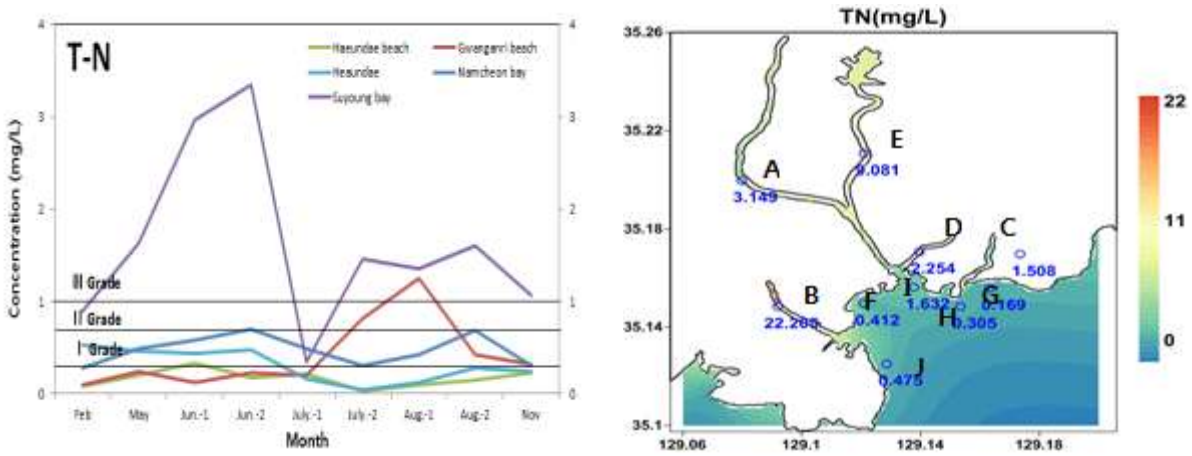

Fig. 8: T-N variation in Suyeong bay.

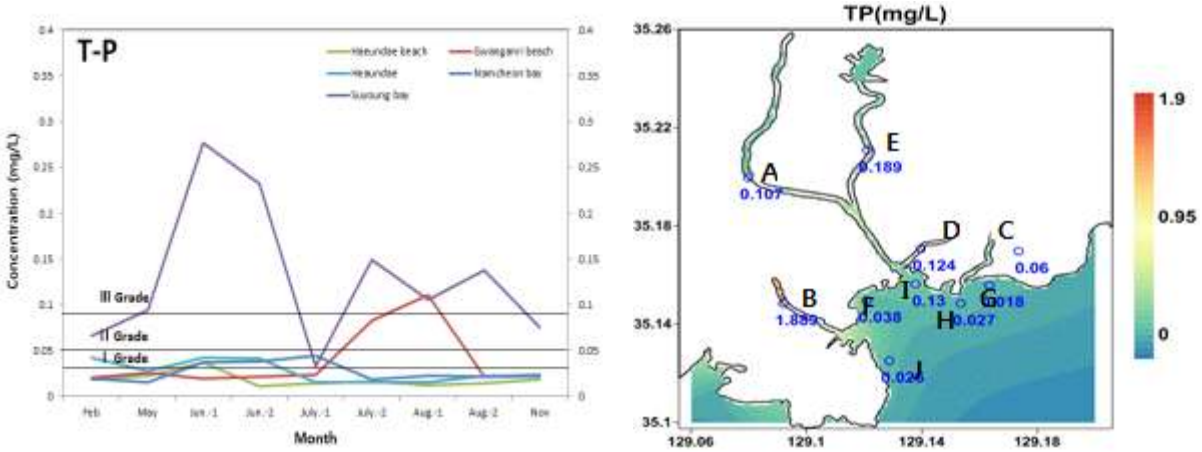

Fig. 9: T-P variation in Suyeong bay.

4. Conclusions

In investigation results of pollution load(kg/day) in five streams around Suyeong bay, in the case of BOD, the pollution level was Suyeong river(E) 〉 Oncheon stream(A) 〉 Nam stream(B) 〉 Chun stream(C) 〉 Udong stream(D), in the case of COD, Suyeong river (E) 〉 Oncheon stream(A) 〉 Nam stream(B) 〉 Chun stream(C) 〉 Udong stream(D). The stream affected water pollution in Suyeong bay(I) was Suyeong river(E) and the average concentration of BOD(under 5 mg/L) and COD(under 7 mg/L) was investigated in the third (Ⅲ) grade. Nam stream was the second lowest water discharge in five stream and the average concentration of BOD(under 8 mg/L) and COD(under 9 mg/L) was investigated in the fourth (Ⅳ) grade which had the highest level of water pollution.

Around Suyeong bay, the result of water pollution in five coast was investigated in Suyeong bay(I) 〉 Namcheon bay(J) 〉 Gwanganri beach(F) 〉 Haeundae(H)·Haeundae beach(F) in case of COD. A steam water getting into Suyeong bay was investigated to affect on the water qualty of Suyeong bay(I), Namcheon bay(J) and Gwangri bearch(F) and to improve the water quality of Suyeong bay, the water quality improvement of Suyeong river must be a priority and the next thing a sewage and non-points sources scatted around Nam stream should be separated to intercept in the existing conduit system.

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5. Acknowledgements

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