Water Quality and Diffusion Characteristics in the Eastern Sea of the Geoje Island

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In order to provide the basic data required for setting up the proper strategies to minimize the future marine pollution in the vicinity sea area of the Geoje Island, the general water quality parameters and dye diffusion experiment were carried out from January to March, 1983.

Although TSS and COD level in the investigated sea area showed still slightly lower than the area of Seaside Industrial Complex Zones, seriously increasing due to the construction of heavy industrial plants.

Dissolved oxygen showed more than 8 ppm, and inferred still enough for the reservation of the investigated sea area.

The dye patches moved south-eastward with forming an elliptical shape and then turned slowly to the area of Kujora during flood tide, and it moved northwestward and then blocked the entrance of Jangseungpo during ebb tide,

The diffusibility in the area may be assessed to be quite better than other coastal areas.

Introduction

Geoje Island is the second largest island in Korea. The coastal area of this island is connected with Jinhae Bay and the estuary of Nakdong River to North and north-east side and also the starting point of Hanreo National Marine Park. *Many* marine farms culturing oyster, ark-shell and sea mustard gethered so that this area is very important for fishing industry. In addition, recently so many heavy industrial plants are being constructed that the population in this area is increased rapidly, and the water quality is getting worse day by day.

Therefore, it is need to investigate the present marine conditions of this area in order to provide the basic data required for the proper assessment on the future marine environment.

Enen though many investigations concerning marine environment have been made, some of them have emphasized on the biological aspect: Yoo and Lee (1976) on Masan Bay, Shim (1980) on Yeoja Bay, and Choi and Koh (1984) on Kwangyang Bay, and the others dealt with the physical and water quality aspects: Yoo et al. (1974) on Kwangyang Bay, Lee (1981) on the seveal coastal areas and Yang et al. (1983) on Onsan Bay.

The authors carried out an investigation of general water quality parameters, circulation pattern and dye diffusion experiment in order to provide the bata required for setting up good strategies to minimize future marine environmental pollution in the vicinity sea area of Geoje Island.

Materials and Methcds

The water circulation pattern needed for this study is estimated by use of the data which made by the Fisheries Reserach and Development Agency

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(FRDA, 1978) on the surrounding sea of Geoje Island.

Among the water quality parameters, TSS, VSS, DO and COD level were investigated from Jaunary to March, 1983 by authors. The water samples required for the water analysis were collected from the sea surface at 17 stations according to the tides (Fig. 1.). Samples kept in the polyethylene bottles analyzed in the laboratory according to the standard methods.

Dissolved oxygen at sea surface and 5 meter depth was checked *in situ* by a DO-meter.

Rhodamine B was used *for* dye material. In order to match the density of dye solution with that of sea water, Rhodamine was mixed with methanol and prepared 100 liters of dye solution in every experiment. The dye solution was released instantaneously at the sea surface of point A during flood tide on January 28 and point B during ebb tide on January 29, 1983 (Fig. 4.). Dye patches were tracked by a small boat, and dyed water was sampled with the DC-pump (3V). Fluoro-spectrophotometer was used to determine the concentration of samples. Position of the boat was checked by use of a sextant and a magnetic compass. Variance, apparent diffusibility and elongation rate of patches were computed to know the diffusion characteristics by the standard statistical method.

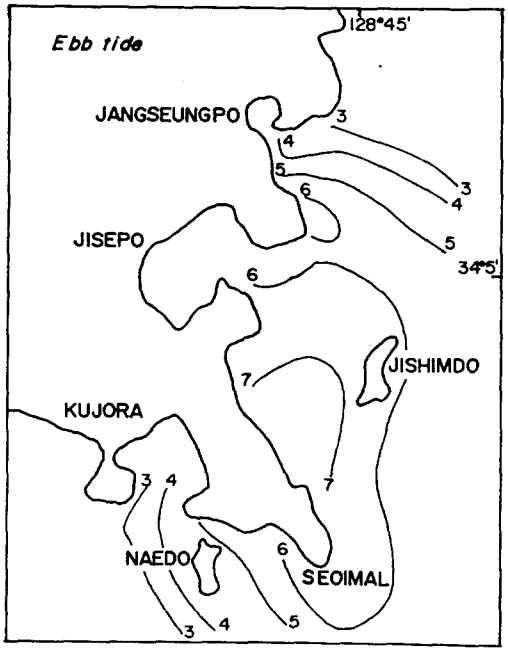

Fig. 1. Map showing sampling stations in the study area.

Results and Discussion

A. Current

The water in the investigated sea area flowed southward from the east side of Jangseungpo to the east-west side of Jishimdo at a speed of 0.6-1.0 knot during flood tide (Fig. 2), while the water near around the coast flowed a little slowly (at a speed of slower than 0.5 knot) than the east side of Jishimdo (at a speed of 0.5 to 1.0knot).

The pattern of current, as a whole, was simple and the maximum speed during flood tide was slightly stronger than that during ebb tide.

The current during ebb tide circled counter-clockwisely at near around Jishimdo, that is, flowed southward at the east-west area of Jishimdo, northward at the area between Jisepo and Seoimal at a speed of 0.04 to 1.0 knot, south-eastward at the far eastern area of Jishimdo and south-westward at near around Seoimal.

B. Water Quality

The TSS level in lhe investigated sea area ranged 1.93 to 11.49ppm and averaged 5.77ppm during flood tide, 2.97 to 13.00 ppm and averaged 6.73 ppm during ebb tide, and wholly averaged 6.73ppm. The tendacy of high level is appeariug around the southern area of Kujora can be inferred by the effect of topography and tidal current.

The VSS level ranged 0.86 to 9.42ppm and averaged 3.98 ppm during flood tide, 2.13 to 9.50ppm and averaged 4.76ppm during ebb tide, and conspicuously varied by stations.

The containing rate of VSS in the TSS showed approximately 0.7, similiar to that of Onsan Bay of 0.84.

The value of COD, determined by use of $KMnO_4$ are shown in Fig. 3. The figure shows COD ranges

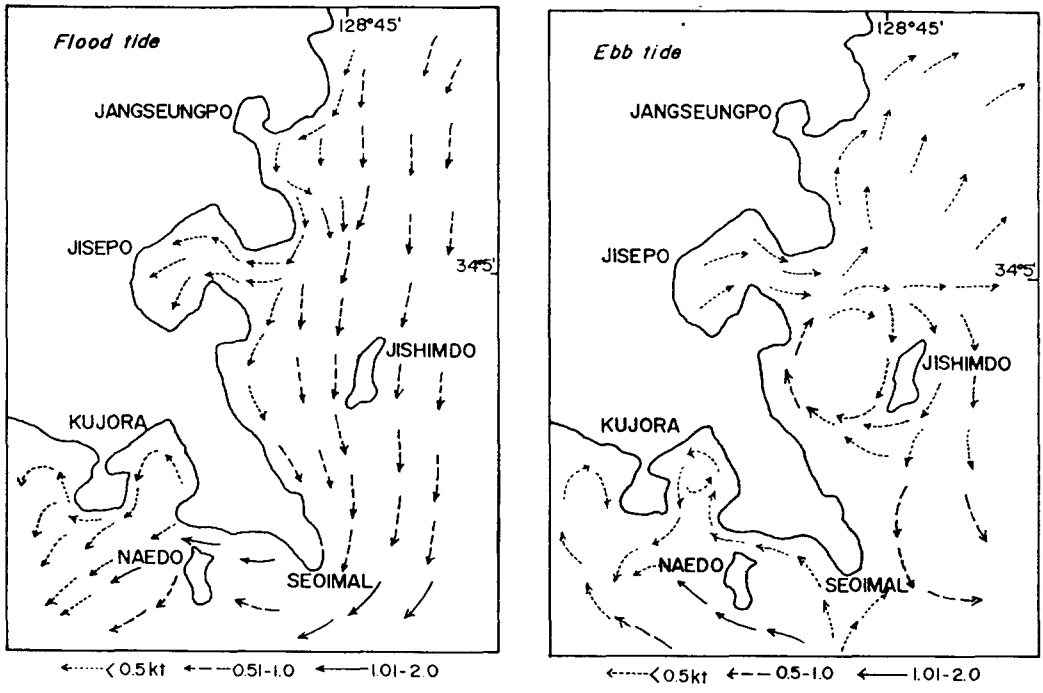

Fig. 2. Tide current pattern.

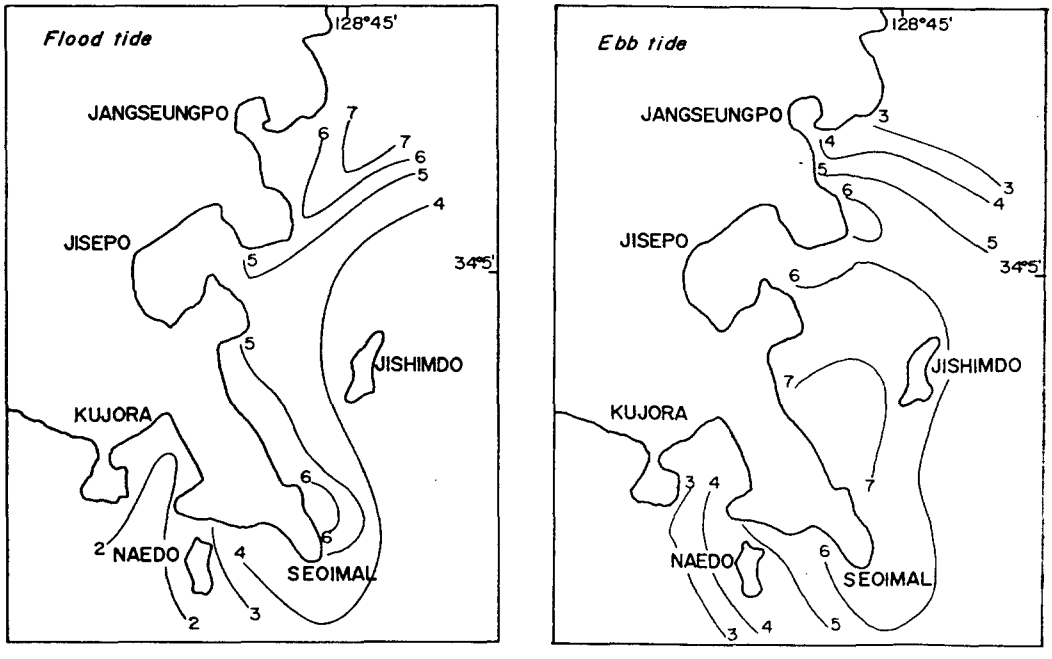

Fig. 3. Distribution of COD.

Table 1. Results of SS and DO level according to tides

Station	Flood			Ebb		
	TSS	VSS	DO	TSS	VSS	DO
A	4.22	2.48	8.2	4.40	4.20	8.8
B	3.23	2.73	8.1	5.88	5.46	8.8
C	6.14	3.93	8.3	2.97	2.18	8.8
D	4.51	2.56	8.1	3.56	2.93	8.3
E	5.26	4.01	8.2	4.92	4.51	8.3
F	3.70	1.56	8.2	6.95	6.53	8.1
G	4.73	2.58	8.3	7.23	5.98	8.4
H	4.09	1.75	8.5	5.85	4.39	8.5
I	1.93	0.86	8.3	10.87	8.10	8.6
J	11.49	9.42	—	6.15	3.24	—
K	6.42	3.98	—	6.16	3.20	—
L	4.74	3.75	—	7.79	3.77	—
M	9.38	9.18	—	13.00	9.50	—
N	6.89	5.71	—	10.83	5.54	—
O	6.29	3.65	—	6.73	4.24	—
P	10.83	7.09	—	7.96	4.98	—
Q	4.17	2.50	—	3.19	2.13	—
average	5.77	3.98	8.24	6.73	4.76	8.51
range	1.93—11.49	0.86—9.42	8.1—8.5	2.97—13.00	2.13—9.50	8.1—8.8

2 to 7ppm, and it is a little higher in the area from Janseungpo to Seoimal than in the area of Kujora around.

Assuming that the standard level of the cleanliness of the sea area by the value of COD should be less than 3ppm, pollution of the investigated is considerably growing up.

C. Dye Diffusion Experiment

The dye patch moved to the south-eas tward from the discharged position with forming an elliptical shape during flood tide (Fig4), and than the patch slowly turned toward the area of Kujora at the cape of Seoimal according to the tidal current. It moved to north-eatward at the first, and remarkably elongated and them blocked the entrance of Jangseungpo.

Table 2 shows the results of diffusion experiment. Apparent diffusibilities after an hour of discharging was $1.1\times10^4 cm^2$/sec during flood tide $4.5\times10^4 cm^2$/sec during ebb tide, and somewhat greater than that in the Jinhae Bay (Ahn et al, 1982) and in the Suyeong Bay (Kim and Han, 1982).

The elongation rates should 0.53 during flood tide and 0.38 during ebb tide.

From the results, it can be inferred that the diffusion power in the investigated sea area is greater than that in the other coastal areas, in some extent. But so many heavy industrial plants are being constructed and the population also increasing rapidly, that the pollution problem in the investigated sea area will be serious in the near future.

Table 2. Results of the dye experiment

Tide	Elapsed time(min)	σ_{rc}^2 (m^2)	Ka (cm^2/sec)	Elongation rate
Flood	20	540	1.1×10^3	0.67
	40	2318	2.4×10^3	0.40
	60	15494	1.1×10^4	0.53
Ebb	20	238	5.0×10^2	0.70
	40	5412	5.6×10^3	0.41
	60	6494	4.5×10^4	0.03

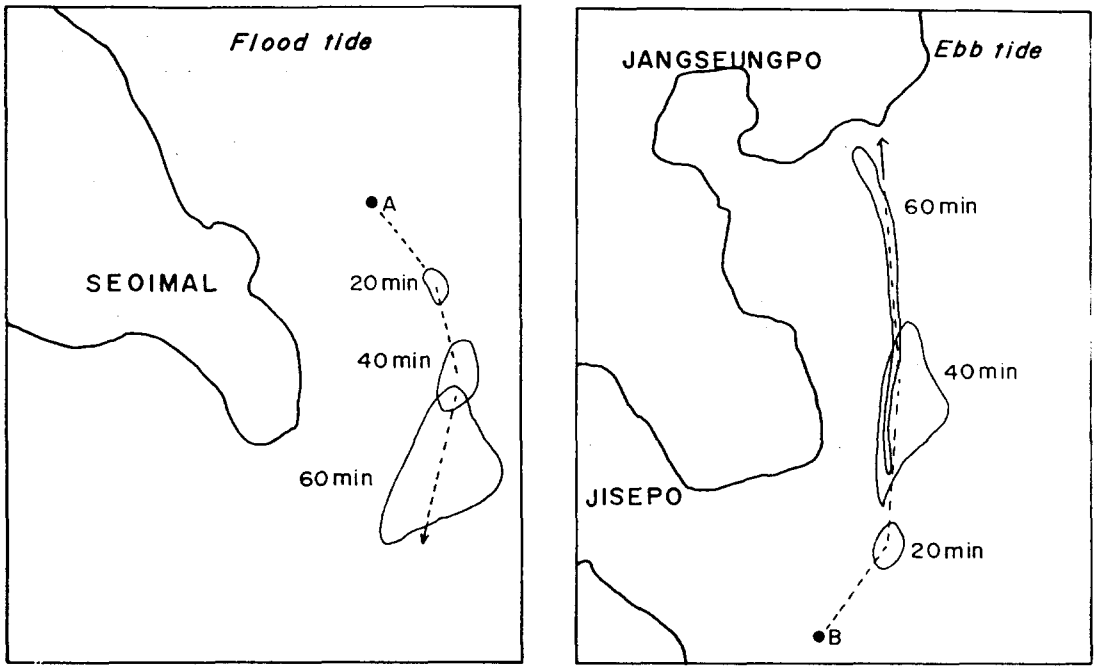

Fig. 4. Dye discharged points (A: flood tide, B:ebb tide) and patch diagrms.

Conclusions

The investigation of some water quality parameters and the dye diffusion experiment were carried out in the vicinity sea area of Geoje Island from January to March, 1983.

The water at flood tide runs southward from the east side of Jangseungpo to the east side of Jishim-Do with speed of 0.6—1.0 knot. The current of ebb tide shows a ciculating pattern at near Jishim-Do, with speed of 0.4-1.0 knot.

The TSS in this area is about 6.25ppm, somewhat low compared with that of Banweol and Changwon seaside industrial complex zones, and a little higher in the south of Kujora than in the east side of Seoimal.

The value of VSS/TSS showed approximately 0.7. Dissolved oxygen shows more than 8ppm at all stations.

COD showed 2-7 ppm and a little high in the area from Jangseungpo to Seoimal compared with in Kujora area.

The dye patch moved south-eastward from the discharging point with forming an elliptical shape at flood tide, and then moved north-eastward with forming a long belt shape and blocked the entrance of Jangseungpo at ebb tide. Apparent diffusibilities after an hour of discharging are $1.1\times10^4 cm^2$/sec at flood tide and $4.5\times10^4 cm^2$/sec at ebb tide.

References

Ahn, Y.S., Kim, Y.S. and Y.H. Han (1982): Oceanic diffusion characteristics in Jinhae Bay. Bull. Korean Fish. Tech. Soc. 18, 1-10.

Choi, J. W. and C. H. Koh(1984): Heavy metals in mussels in the Korean coastal waters. J. Oceanol. Soc. Korea, 19, 153-162.

Fisheries Research and Development Agency(1978): Hand book of the tide current pattern in the coastal growing and heavy industrial areas of Korea. Fish. Res. Dev. Agency, Pusan, 110-101.

Kim, Y. S. and Y. H. Han(1982): A study on the characteristics of the circulation and diffusion in Suyeong Bay. Bull. Korean Fish. Tech. Soc. 18, 55-61.

Lee, K. W(1981): Water quality monitaring in the coastal areas of Banweol, Ulsan, Changwon

and Yeocheon. Korea Ocean Research and Development Institute. Seoul, Korea, BSPI-00023-46-4.

National Fisheries University of Pusan (1982): Studies on marine environment on Onsan Bay. 44-107.

Shim, J. H. (1980): Biological oceanography of the Gamagyang Bay the Yeoja Bay water system (1). J. Oceanol. Soc. Korea, 15, 89-99.

Yang, B. S., Kim, J. M. and I. S. Kim(1983): Water quality survey on Onsan Bay(Ⅱ). Bull. Korean Fish. Tech. Soc. 19, 130-135.

Yoo, K. I., Hong, S.W., Hah, Y.C., and J. H. Lee (1974): Environmental baseline survey of the Kwangyang Bay, Korea-water qualysis and oceanographic ecological survey V-2. On the studies of plankton and primary productivity in the Kwangyang Bay. MOST Rept. STF-74-6, 120-135.

Yoo, K. I. and J.W. Lee (1976): Environmental studies on Masan Bay. 2. Annual cycle of phytoplankton. J. Oceano. Soc. Korea, 11, 3-38.

巨濟島 近海의 水質과 擴散特性

韓 英 鎬·金 榮 燮

장차 巨濟島 近海의 海洋汚染을 최소로 하기 위한 계획을 세우는데 필요한 基礎資料를 제공하기 위하여, 이 海域의 몇가지 項目의 水質調査 및 染料에 의한 擴散實驗을 1983年 1月부터 3月 사이에 실시하였다. 이 海域의 總浮遊固形物質 濃度는 평균 6.25ppm정도로 다른 臨海工業團地 海域보다 다소 낮긴 하지만, 많은 重工業工場들이 建設되고 있고 人口도 급격히 增加하고 있어 앞으로 급격히 높아질 것으로 예상된다.

調査結果 溶存酸素濃度는 8ppm이상으로 충분 하였으며, COD濃度는 2~7ppm정도로 나타났다.

밀물때 染料域은 南東쪽으로 移動하다가 나중에 舊助羅쪽으로 흘렀으며, 썰물때는 北東쪽으로 이동하여 長承浦入口를 가로막았다. 이 海域의 擴散能力은 다른 沿岸域에 비해 양호한 것으로 나타났다.