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Sediment Transport Study in Haeundae Beach using Radioisotope Labelled Compound

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1. Introduction

Haeundae beach is one of the most famous resorts in Korea and plays an important role as a special tourism district. However, the length and width of the beach are being reduced continuously, which would have bad influence on the regional economy and be the financial burden to the local authority considering that a large amount of budget is spent in the beach nourishment annually. Hence, it is necessary to understand the dynamic behavior of sediments in the coast for the systematic preservation plan of coastal environment.

Lately a monitoring system using radioactive isotope as tracers is considered as a novel technique in understanding the dynamic transport of sediments. The objective of this study is to investigate the possible variations in sedimentary distribution and quantify the characteristics of sediments using radiotracer.

2. Experimental

The experiments of radiotracer were performed at two areas. One is near Dongbaek island (IP.A; N 35° 9′ 23.0″ , E 129° 9′ 26.5″) and the other is near Mipo port (IP.B; N 35° 9′ 26.6″ , E 129° 9′ 47.1″). The experimental areas are shown below in Fig.1. With an effort to delineate the behavior of field sediments, the preliminary sieving test was performed on the sediments in the seabed. The radiotracer should have identical physico-chemical properties and hydro dynamic behavior as of natural sediment. The radiotracer labeled with ^{192}Ir in the form of 0.3wt% iridium glass having the same specific gravity(2.6) and particle size distribution(D_{50}= 025mm) similar to that of natural sediment was prepared. The crystalline material doped with iridium was produced by the oxide-rout method(0.5Ci, 30g)[1]. A radioisotope container was specially designed to inject the radiotracer from 1m above the seabed without radioactive contamination during the conveyance from the nuclear reactor at KAERI[2]. The position data from a DGPS and the radiation measurement data were collected concurrently and stored by means of the application software programmed with the LabVIEW of the National Instrument.

The time dependency of the spatial distribution of the sediment was studied in the area through the tracking measurements after the iridium glass was injected. After subtraction of natural radiation counts from the results, decay correction was performed. And the position data was reprocessed to represent the real position of the radiation detector under water using the following equation because the antenna of DGPS was located on not the seabed but the boat.

$$E_{CD} = E_{CB} - L_C \times \sin\theta \qquad \theta = \tan^{-1}\left(\frac{E_{CB} - E_{PD}}{N_{CB} - N_{PD}}\right)$$
$$N_{CD} = N_{CB} - L_C \times \cos\theta$$

Where, E_{CD} and N_{CD} are the present latitude and longitude respectively. E_{PD} and N_{PD} stand for the previous latitude and longitude. And L_C is the length of a cable between a boat and a radiation detector. After tracer was injected into the sea, the transport and the dispersion of the tracer patch was monitored .

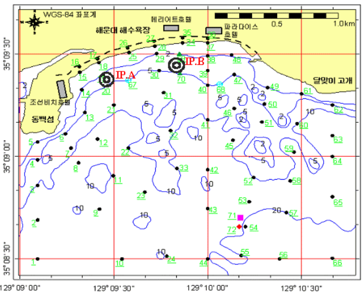

Fig.1 Map showing study areas and the location of injection points; A and B.

3. Result and Discussions

The radiotracer experiments were carried out during period May-Aug. 2005. The representative results practiced(1st and 3rd scans) are shown below in Fig. 2 and 3 respectively displaying the distribution pattern of radiotracer. In IP.A, the initial behavior of radiotracer migration didn't show a remarkable direction. However the main direction has a tendency of moving northeastwardly after the 2th scan. The initial migration direction of IP.B was to the east and west and then changed to the north predominantly that was toward the seashore. These are partially corresponded to the fact from residents that sediments on the seabed moves onshore in summer whereas moves offshore in winter.

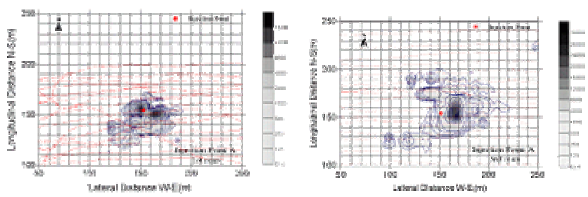

Fig.2 Isocount contour map in IP.A(1st and 3rd scans)

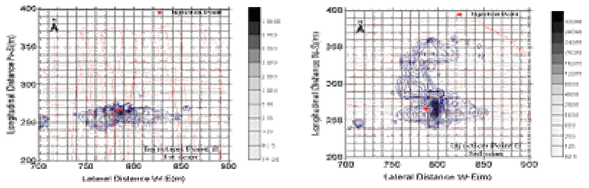

Fig.3 Isocount contour map in IP.B(1st and 3rd scans)

The transport diagram is expressed as radiation counts times dispersive distance of tracer according to the east-west and north-south on a rectangular coordinate, which is featured by the center of gravity(mean transport distance) shown below in equation[3]. Results from the summation of measured counts multiplied by a transport distance are shown directionally with a grid space of 20m in Fig.4 and 5.

$$\bar{x} = \frac{\int c \cdot x \, dx}{\int c \, dx}$$

where, $\bar{x}$ is the center of gravity and c is the measured counts and x is the dispersive length of lateral spread.

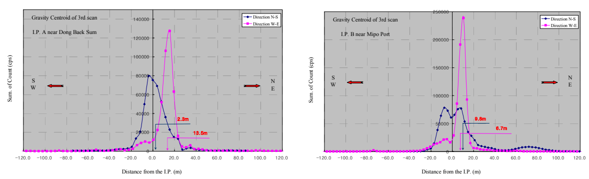

Fig.5 Transport diagram of radiotracer in 3rd scan(IP.A and IP.B)

From the results of transport diagrams, the directional mean transport distances and velocities of tracer are listed in Table 1.

Table. 1 The mean transport distance and velocity of tracer

Scan No.	Elapsed days	IP. A				IP. B			
		Distance(m)		Velocity(m/d)		Distance(m)		Velocity(m/d)	
		W-E	S-N	W-E	S-N	W-E	S-N	W-E	S-N
1st	D+6	5.1	-5.3	0.9	-0.9	-2.5	-4.8	-0.4	-0.8
2nd	D+17	5.1	1.9	0.3	0.1	2.3	18.2	0.1	1.1
3rd	D+28	13.5	2.3	0.5	0.1	6.7	9.8	0.2	0.4
4th	D+45	12.9	2.4	0.3	0.1	-2.3	7.4	-0.1	0.2
5th	D+85	-12.1	26.9	-0.1	0.3	0.2	50.5	0.0	0.6

In the results of IP.A, the initial transport velocity of tracer was relatively fast as 0.9m/d in W-E and -0.9m/d in S-N direction compared to the others results. And radiotracer in IP.B moved fast too at first with a velocity of -0.4m/d in W-E and -0.8m/d in N-S. However the transport velocities of tracer were decreased gradually after the 1st scan. This phenomenon was resulted from the fact that tracer particles with small grain size move far away preferentially at the beginning of the experiment and dispersed away below the detection limit eventually. Later on, the transport velocity of residual tracers with large particle size decreased with time, which resulted in the reduced velocity of the gravity center of tracer.

In the 5th scan, the mean transport distance of IP.A moved 25m further to the west compared to that of 4th scan, and 24.5m to the north. The mean transport distance of IP.B moves 2.5m further to the east and 43.1m to the north markedly. The main hydrodynamic parameters influencing on the sediment transport are wind, wave and current[4]. From this point of view, the exceptional transport distances in 5th scan results were considered to be derived from the drastic changes in climate after a couple of storms had passed. The sedimentary distribution pattern of tracer is varied continuously with time. Therefore it should be examined over the subsequent seasons by additional experiments.

4. Conclusion

After the injection of radiotracer, 5 scans were performed for 85days and still going on. The main patterns of distribution of tracer in near Dongbaek island and Mipo port are identical each other at first. But the characteristics of distribution pattern were changed continuously with time and were subjected to the temporal variation of climate such as storms. Therefore it is necessary to investigate the distribution pattern in sediment transport for a long term considering other surveys on waves and tides comprehensively.

ACKNOWLEDGEMENT

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