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Environmental Dynamic Value of Substance in Marine Bay

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Abstract: We proposed the definition and structural model of environmental dynamic value of substance in marine bay, and defined the variables of basic background value, environmental background value, input value and environmental dynamic value. Based on these definitions and the structural model, we could define the changing processes, changing regions and structural variables of the substance contents, and provide scientific basis for defining the standards of the substance contents, as well as the changing degree of the substance contents. Furthermore, we provided a case study on Cr in Jiaozhou Bay to demonstrate the performance of these definitions and structural model based on investigation data on Cr in May and August 1979. Results showed that the changing processes and trends of Cr contents could be well defined, as well as the standards and the changing degree.

Keywords: Substance content, Environmental dynamic value, Definition, Structural model, Marine bay

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1. INTRODUCTION

A large amount of environmental pollutants have been generated since industrial revolution and have caused many environmental issues. Marine is the sink of various pollutants and many marine bays have been heavy polluted [1-2]. Hence, defining the standards of the substance contents and the changing degree of the substance contents are essential to marine environment protection and the maintaining of ecological sustainable development.

In this paper, we proposed the definitions and structural model of environmental dynamic value of substance in marine bay, and defined the variables of basic background value,

environmental background value, input value and environmental dynamic value. Furthermore, we provided a case study on Cr in Jiaozhou Bay to demonstrate the performance of these definitions and structural model based on investigation data on Cr in May and August 1979.

2. MATERIAL AND METHOD

2.1 Definitions and structural model

In according to the environmental background structure proposed bay Yang [6-9], we further established the structural model of environmental background value of substances. The model is described as

$$H = B + L + M \tag{1}$$

where, B is the basic background value, represents the substance in waters. L is the input amount of runoff, represents the substance input from river runoff. M is the input amount of marine current, represent the substance input from marine current. H is the environmental background value of substance.

The structural model of environmental dynamic value of substances was further improved and established as

$$D = B + H + \sum Mi \quad (i=1, 2, \cdots, N) \tag{2}$$

where, B is the basic background value, represents the substance in waters in case of no external input. H is the environmental background value, represents the smallest substance in case of there are external inputs. M_i is the input of the ith source. N is the number of the sources. D is the environmental dynamic value, represents the dynamic value in this waters.

2.2 Case study

Jiao Zhou Bay is located in the south of Shandong Province, eastern China (35°55′-36°18′ N, 120°04′-120°23′ E), which is connected to the Yellow Sea in the south. This bay is a typical of semi-closed bay, and the total area, average water depth and bay mouth width are 446 km^2, 7 m and 3 km, respectively. There are a dozen of rivers, and the majors are Dagu River, Haibo Rriver, Licun Rriver, and Lushan Rriver etc., all of which are seasonal rivers [3-4]. The investigation on Cd in Jiao Zhou Bay was carried on in May and August 1979 in eight investigation sites namely H34, H35, H36, H37, H38, H39, H40 and H41, respectively (Fig. 1). Cr in surface waters was sampled and monitored follow by National Specification for Marine Monitoring [5].

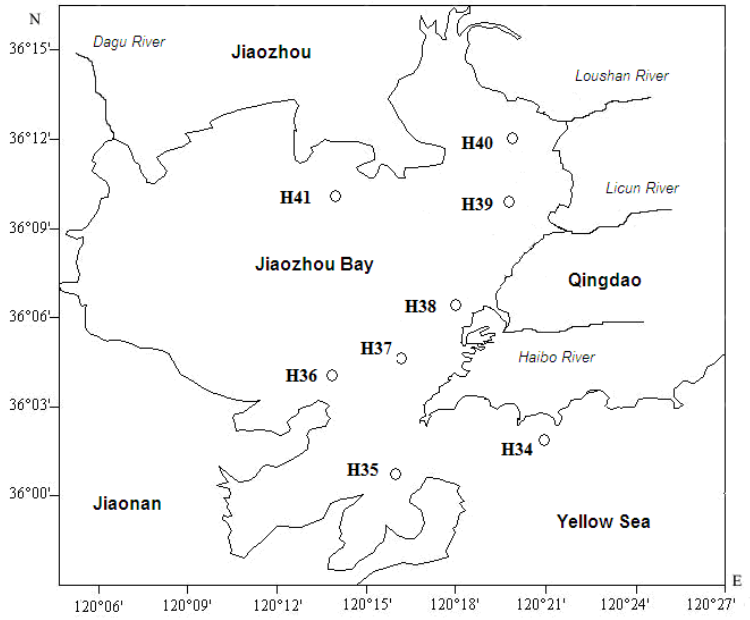

Fig.1 Investigation sites in Jiao Zhou Bay

3. RESULTS

3.1 Contents and sources of Cr

The contents of Cr in May and August 1979 in Jiao Zhou Bay were 0.20-112.30 μg L^{-1} and 0.10-1.40 μg L^{-1}, respectively. In May 1979, there was a high value region between the estuaries of Lushan River and Licun River in the northeast of the bay, and Cr contents were decreasing from the high value center to the bay mouth in the south of the bay. In August 1979, there was a high value region closed the estuaries of the major river in the east of the bay, and Cr contents were decreasing from the high value center to the coastal waters in the west the bay. Tt could be concluded that river flow was the major source of Cr in Jiao Zhou Bay in 1979.

3.2 Homogeneity of Cr

In August 1979, there was a high value (1.40 μg L^{-1}) in Site H34, H37 and H38 closed the estuaries of the major river in the east of the bay, and Cr contents were decreasing from the high value center to the costal waters in the west the bay. However, Cr contents were only ranging from 0.10-1.40 μg L^{-1} in August 1979. Meanwhile, Site H34, H37 and H38 were far away, yet in where the high value of Cr contents in August were all 1.40 μg L^{-1}. In generally, substances in the ocean were tending to be homogenous as time going by.

4. DISCUSSION

4.1 Basic background value of Cr

There was no external Cr sources in August 1979, and Cr contents in Jiao Zhou Bay were only 0.10-1.40 μg L^{-1}, and were indicating that the contents were relative low and the horizontal variations were very small. Site H34, H37 and H38 were far away, yet in where the high value of Cr contents in August 1979 were all 1.40 μg L^{-1}, indicated that Cr contents in waters were inhomogeneous in August 1979. Hence, it could be found that the basic background value of Cr in Jiao Zhou Bay was 0.10-1.40 μg L^{-1}.

4.2 Environmental background value of Cr

River slow was the only major external Cr sources in May 1979, and the source strength was as high as 112.30 μg L-1. Cr contents in May 1979 were decreasing from the sources to the south of the bay mouth along with the flow direction of the rivers, and were decreasing to as low as 0.20 μg L-1. It could be found that in case of there was external input, the lowest Cr content value was 0.20 μg L-1. Hence, it could be found that the environmental background value of Cr in Jiaozhou Bay was 0.20 μg L-1.

4.3 Environmental dynamic value and the structural model of Cr

Cr is mainly sourced from industrial point-source, and the rivers are playing roles of input channels. In generally, Cr in Jiao Zhou Bay was mainly inputted via stream flow, whose source strength was as high as 112.30 μg L-1. Once there was little Cr input from rivers, the highest Cr content value was 1.40 μg L-1, and the basic background value of Cr in Jiao Zhou Bay was 0.10-1.40 μg L-1. Once there was Cr input from rivers, the lowest Cr content value was 0.20 μg L-1, and the highest Cr content value was 112.30 μg L-1. Therefore, the strength of the Cr input from rivers was 112.30-0.20=112.10 μg L-1. Based on the structural model of environmental dynamic value, the environmental dynamic value of Cr in Jiao Zhou Bay was 0.20-112.30 μg L-1 (Table 1).

Table 1 Environmental dynamic value, basic background value, environmental background value and river input of Cr in Jiao Zhou bay /μg L^{-1}

Environmental dynamic value	Basic background value	Environmental background value	River input
0.20−112.30	0.10-1.40	0.20	0.00−112.10

In according to basic background value, environmental background value, and river input of Cr in Jiaozhou bay, the environmental dynamic value could be constructed. Hence, the changing process and trend of Cr in Jiaozhou Bay could be defined.

5. CONCLUSION

We proposed the definition and structural model of environmental dynamic value of substance in marine bay, and defined the variables of basic background value, environmental background value, input value and environmental dynamic value. These definitions and the structural model were useful to define the changing processes, changing regions and structural variables of the substance contents, and to provide scientific basis for defining the standards and the changing degree of the substance contents.

Based on investigation data on Cr in May and August 1979, and by means of these definitions and the structural model, we defined that the environmental dynamic value, basic background value, environmental background value and river input of Cr in Jiaozhou bay were 0.20−112.30 μg L^{-1}, 0.10-1.40μg L^{-1}, 0.20μg L^{-1} and 0.00−112.10μg L^{-1}, respectively. In according to basic background value, environmental background value, and river input of Cr in Jiaozhou bay, the environmental dynamic value could be constructed, and the changing process and trend of Cr in Jiaozhou Bay could be defined.

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