Content and Distribution of Cr in Bottom Waters in Jiaozhou Bay 1989

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Abstract. Jiaozhou Bay is a semi-closed bay located in Shandong Province, China. Using investigation data on Chromium (Cr) in bottom waters in April and July 1989, this paper analyzed the contents and distributions of Cr. Results showed that Cr contents in bottom waters April and July were 1.18-1.38 μg L⁻¹ and 1.08 μg L⁻¹, respectively. These contents were much lower than the Grade I (50 μg L⁻¹) for Cr in Sea Water Quality Standard (GB 3097-1997). The pollution level of Cr in bottom waters in Jiaozhou Bay in 1989 was very slight. By means of vertical water’s effect, there was a relative high value region in bottom waters in April 1989. In general, Cr contents in bottom waters would be relative high/low in case that Cr contents in surface waters were high/low. During the migration process of Cr in marine bay, in any time or in any region, Cr is firstly inputted to surface waters, and then is transporting through water body and finally arriving at sea bottom. By means of vertical water’s effect, Cr is settling to sea bottom rapidly.

1. Introduction
Cr has been widely used in various industries of metallurgy, electroplating, chemical industry, aviation industry, etc. [1-6]. A large amount of Cr-containing waste gas, water and slag, or flames and smoke were discharged along with the rapid development of industry in the past several decades [7-10]. Marine is the sink of pollutants, and many marine bays have been polluted by Cr by means of vertical water’s effect [11-18]. Jiaozhou Bay is a semi-closed bay located in Shandong Province, China. Using investigation data on Chromium (Cr) in bottom waters in April and July 1989, this paper analyzed the contents and distributions of Cr. Results showed that during the migration process of Cr in marine bay, in any time or in any region, Cr is firstly inputted to surface waters, and then is transporting through water body and finally arriving at sea bottom [19-21]. By means of vertical water’s effect, Cr is settling to sea bottom rapidly. The outcome of the paper is providing scientific basis for pollution control of Cr.

2. Materials and method
Jiaozhou Bay (35°55′-36°18′ N, 120°04′-120°23′ E) is located in the south of Shandong Peninsula, eastern China. The area, bay mouth width and average water depth and average water depth are 390
km$^2$, 2.5 km and 7.0 m, respectively (Fig. 1). This bay is surrounding by cities of Qingdao, Jiaozhou and Jiaonan in the east, north and south, respectively. The bay mouth is located in the south of the bay, and is connected with the Yellow Sea. There are more than ten inflow rivers such as Loushan River, Licun River and Haibo River [22-23].

The investigation on Cr in surface waters in Jiaozhou Bay was conducted by North China Sea Environmental Monitoring Center in April and July 1989. There were two sampling sites in April (i.e., Site 89 and Site 90) and one sampling site in July (i.e., Site 90) (Fig. 1). The investigation and measurement of Cr were followed by National Specification for Marine Monitoring [24].

3. Results

3.1 Contents of Cr. Cr contents in bottom waters April and July 1989 were 1.01-3.29 μg L$^{-1}$ and 1.08 μg L$^{-1}$, respectively. These contents were much lower than the Grade I (50 μg L$^{-1}$) for Cr in Sea Water Quality Standard (GB 3097-1997). The pollution level of Cr in bottom waters in Jiaozhou Bay in 1989 was very slight.

3.2 Horizontal distributions of Cr. In April 1989, Cr contents were relative high in Site 85 in the center of the bay, and Cr contents were decreasing from the center of the bay (1.38 μg L$^{-1}$) to the south of the bay (1.18 μg L$^{-1}$). However, the horizontal distribution of Cr in July 1989 was unclear since there was only one sampling site.

4. Discussion

4.1 Pollution level of Cr. Cr in Jiaozhou Bay was mainly sourced from atmosphere deposition. During the migration process, Cr was firstly arriving at surface waters, and then was transporting through water body, and was finally arriving sea bottom. Therefore, the contents and distributions of Cr in bottom waters were forming by means of vertical water’s effect [12-14]. In general, the pollution level of Cr in bottom waters in Jiaozhou Bay 1989 was still very slight.
4.2 High sedimentation region of Cr. In April 1989, Cr contents were relative high in Site 85 in the center of the bay, and Cr contents were decreasing from the center of the bay to the south of the bay. Hence, it could be defined that there was a high value region around this sampling site. In April 1989, Cr content in surface waters in the center of the bay was relative high (1.90 μg L⁻¹), and in bottom waters was also relative high (1.38 μg L⁻¹). In July 1989, Cr content in surface waters in the bay mouth in the south of the bay was relative low (1.64 μg L⁻¹), and in bottom waters was also relative low (1.08 μg L⁻¹). This was indicating that there was high sedimentation process of Cr in Jiaozhou Bay.

4.3 Vertical migration process of Cr. In general, Cr contents in bottom waters would be relative high/low in case that Cr contents in surface waters were high/low. During the migration process of Cr in marine bay, in any time or in any region, Cr is firstly inputted to surface waters, and then is transporting through water body and finally arriving at sea bottom. By means of vertical water’s effect, Cr is settling to sea bottom rapidly. The outcome of the paper is providing scientific basis for pollution control of Cr.

5. Conclusion
Cr contents in bottom waters April and July 1989 were 1.18-1.38 μg L⁻¹ and 1.08 μg L⁻¹, respectively. These contents were much lower than the Grade I (50 μg L⁻¹) for Cr in Sea Water Quality Standard (GB 3097-1997). The pollution level of Cr in bottom waters in Jiaozhou Bay in 1989 was very slight.

There was a high value region in the center of the bay and there was high sedimentation process of Cr in this region. In general, Cr contents in bottom waters would be relative high/low in case that Cr contents in surface waters were high/low. During the migration process of Cr in marine bay, in any time or in any region, Cr is firstly inputted to surface waters, and then is transporting through water body and finally arriving at sea bottom. By means of vertical water’s effect, Cr is settling to sea bottom rapidly. The outcome of the paper is providing scientific basis for pollution control of Cr.

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