Analysis of sediment variation trend and genesis in Jinzhou Port Sea area

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Abstract—This paper collected the monitoring data of jinzhou sea in July 2008, September 2013 and September 2016, and analyzed in detail the variation trend of main pollutants (copper, lead, zinc, cadmium, mercury, arsenic, chromium, petroleum, sulfide, and organic carbon) in the sediment in Jinzhou sea. The results show that the regional Marine sediment environment before the implementation of reclamation (July 2008) is general, the regional Marine sediment environment during the implementation of reclamation (September 2013) and at the present stage (September 2016) is good, and the Marine sediment shows a good trend after the implementation of reclamation project. With the construction of the port area, large-scale dredging and backfilling, the contaminated surface layer sediments in the port area have been effectively removed and controlled.

1. INTRODUCTION

Marine sediment is the habitat of many aquatic organisms and an important part of Marine ecosystem. Sediment is mainly composed of mineral and organic matter particles, which are at different decomposition stages and have different particle sizes. Sediments are the main site of biogeochemical cycling of biogenic materials\(^{[1]}\).

Notably, the sediment is also a major reservoir of stable and toxic chemical pollutants released into the environment. Heavy metals widely exist in different components of aquatic ecosystems, and the contents of various heavy metals in different water bodies are not the same\(^{[2]}\). They are eventually
deposited in water sediments through physical, chemical and biological actions. Sediments are known as sources and sinks of heavy metals in water bodies, and the metal elements in sediments exist in different binding states. Changes in environmental conditions determine the morphological transformation of heavy metals and their distribution in solid and liquid phases [3-5]. Therefore, the content of heavy metals in sediments is an important evaluation index of water environmental quality [6].

The ocean, especially the coastal waters, is an effective buffer zone for land pollutants to enter the water body. Under natural conditions, heavy metals in sediments are relatively stable [7]. However, due to the influence of human activities, unstable components in sediments increase. Under the influence of human factors, heavy metals also enter the water body, causing pollution to the water environment.

2. TECHNIQUES AND METHODS

2.1 Monitoring data
In this study, the monitoring data of Jinzhou sea area from Jinzhou Environmental monitoring Center station in July 2008 were collected as the sediment environment before the construction of Jinzhou Port. The sediment monitoring data collected by Dalian Marine Environmental Monitoring Center of State Oceanic Administration in Jinzhou sea area from September 15 to 17, 2013 are regarded as the sediment environmental status during the construction of Jinzhou Port. USES the fujian China shipping inspection technology co., LTD., in 2016 September 02 ~ 3 day (lunar August 2 to August 3 spring tide) and sep 2016 8 ~ 9, (lunar August 8 to August 9th in neap tide) as the sediment environment of present situation of monitoring data. The sediment data of these three years were compared to study the sediment variation trend of jinzhou sea in recent 10 years.

The monitoring points referenced in this article are listed in Table 1.

| Monitoring station | Latitude | Longitude | Time          |
|--------------------|----------|-----------|---------------|
| 1                  | 40°46'53.34" | 121° 1'38.51" | In September 2016 |
| 2                  | 40°46'9.35"  | 121° 1'17.15" | In September 2013 |
| 3                  | 40°46'11.46" | 121° 4'25.68" |              |
| 4                  | 40°48'19.05" | 121° 1'16.94" | In July 2008     |
| 5                  | 40°39'33.86" | 121° 7'17.40" |              |

2.2 Evaluation index category
The Technical Rules for Comprehensive Evaluation of Marine Sediment Quality (Trial) (October 2015) is for comprehensive evaluation of Marine sediment quality. The evaluation index of sediment can be divided into physical and chemical property index, general pollution index and special pollution index. Among the evaluation indexes, copper, lead, zinc, cadmium, mercury, arsenic, chromium and petroleum are general pollution indexes, while sulfide and organic carbon are physical and chemical property indexes.

| EVALUATION CATEGORY | INDEX                     | Name of evaluation index | Function                        |
|---------------------|---------------------------|--------------------------|---------------------------------|
| Physical and chemical property index | Sulphide, organic carbon | Used for comprehensive quality evaluation |
| General pollution index | copper, lead, zinc, cadmium, mercury, arsenic, chromium and petroleum | Used for comprehensive quality evaluation |
2.3 Evaluation standard
The grading criteria for evaluating various indicators of sediment quality are listed in Table 3. If the content of the evaluation index is better than “Quality standards for Marine sediments (GB 18668-2002)” the index is classified as good. The content of evaluation index is between the first and the third standard value, then the index is classified as general. If the content of the evaluation index is worse than the third standard value, the index is classified as poor.

| Evaluation index category | good   | general | poor   |
|---------------------------|--------|---------|--------|
| General pollution index   | latitude |
| Cu                        | ≤35.0  | 35.0–200 | >200   |
| Cd                        | <0.50  | 0.50–5.00 | >5.00  |
| Pb                        | ≤60.0  | 60.0–250.0 | >250.0 |
| Zn                        | ≤150.0 | 150.0–600.0 | >600.0 |
| Cr                        | <80.0  | 80.0–270.0 | >270.0 |
| petroleum                 | ≤500.0 | 500.0–15600.0 | >1500.0 |
| Physical and chemical property index | organic carbon | ≤2.0 | 2.0–4.0 | >4.0 |

3. THE CALCULATION RESULTS

3.1 Monitoring results
The sediment status monitoring results are listed in Table 4. The concentration of organic carbon, is smaller in September 2013, while the concentration of Cr, Cd, Zn, petroleum is smaller in July 2008.

| Time          | organic carbon | petroleum | Cu  | Pb   | Zn   | Cd   | Cr   |
|---------------|----------------|-----------|-----|------|------|------|------|
| In September 2016 | 2.15 2.15 | 257.59 257.59 | 49.51 | 19.57 | 357.42 | 1.62 1.62 | 34.57 34.57 |
| In September 2013 | 0.415 0.318 | 0.415 0.318 | 0.415 0.318 | 126.4 126.4 | 9.81 9.81 | 7.34 7.34 | 61.56 61.56 | 0.01 0.01 | 3.44 3.44 |

3.2 Analysis method and results
According to the technical rules for comprehensive assessment of Marine sediment quality, the regional Marine sediment environment before the implementation of reclamation (July 2008) is general, while the regional Marine sediment environment during the implementation of reclamation (September 2013) and at the present stage (September 2016) is good.

In order to better analyze the evolution of the Marine sediment environment before and after the construction of the project, the change trend of organic carbon, petroleum and cadmium at the point closest to the project location was selected for this assessment to further explain the change of the Marine sediment environment. According to the above-mentioned monitoring point diagram, the nearest monitoring point to the project location was 1 and 5 points in July 2008. In September 2013, the monitoring points were 2 and 3. The monitoring point position in September 2016 was 1 point. The average value of station No. 4 and 5 in July 2008 was used as the background value before reclamation implementation, the average value of station No. 2 and 3 in September 2013 was the monitoring value
during reclamation implementation, and the value of station No. 1 in September 2016 was the current value. It can also be seen from Figure I that with the construction of the project, large-scale dredging and backfilling, the contaminated surface layer sediments in the port area have been effectively removed and controlled.
Figure 1 The trend chart of sediment variation before and after the construction of this project

With the construction of the port area, large-scale dredging and backfilling have effectively removed and controlled the contaminated surface layer sediments in the port area. According to lakes, published in science of the environmental behavior of organic matter in sediments and research progress of [4], the source of the organic matter of sediment input is divided into endogenous and exogenous input two kinds, the endogenous organic matter is mainly water productivity of animal and plant residues, plankton and microbes such as sedimentation and exogenous input is mainly carried through the external water supply process incoming particles and dissolved organic matter and heavy metals. Sediment is both of water pollutants, could become the source of water pollutants, jinzhou port areas due to poor water quality, water pollution is serious, in the past these years, Marine sediments are mainly as the water pollution in exist, and with the large-scale construction of jinzhou port areas in recent years, a lot of port dredging and backfilling, surface pollution heavier sediments were a large number of clear or backfill, caused as wai reclamation construction, large-scale dredging and backfill, layer upon layer sediment contaminated area of surface has been effectively remove and control.
4. CONCLUSION
With the construction of the port area, large-scale dredging and backfilling have effectively removed and controlled the contaminated surface layer sediments in the port area. The main reason is that the two aspects on the one hand, with the effective control of terrigenous input, the heavy metal in sea water has been effectively controlled. Jinzhou port with a few years ago a massive dredging and reclaiming land from the sea, dredging cleared surface pollution heavy sediment layer, reclaiming land from the sea to make table room pollution heavy sediment layer has been effectively controlled, the comprehensive effect, lead to the decline in the average pollution index content in the sediment of the trend.

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