

Pollution and Protection of Bohai Bay

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Bohai Bay is one of the important enclosed coastal sea in China, and situated in the west Bohai Sea and coast of Tianjin city, Hebei and Shandong provinces. It has an area of 16000 km². Owing to the Beijing-Tianjin area's rivers are polluted by effluent and storm runoff, a lot of waste water is discharged into the Bohai Bay per year. The main pollution problems were analyzed. The results indicated that despite the Bohai Bay had greater environmental assimilation and dilution capacity for pollutants, the pollution had led to higher eutrophication state, happening of fish and shellfish burst death phenomena in Bohai Bay. Several protection measures were also put forward here.

The research on the pollution and environmental management of enclosed coastal sea is one of the important questions for study. This problem has been paid a good deal of attention all over the world. Bohai Bay is a typical semi-enclosed coastal sea in China and situated in the west Bohai Sea and near the coast of city of Tianjin, Hebei and Shandong provinces (1985). The area of the Bohai Bay is about 20% of the whole Bohai Sea, and has the mean depth of 12.5m. The Bohai coast is a typical mud one which is formed of the quaternary period friable deposits. The main rivers which flow into the Bohai Bay are Yellow river, Hai river, Ji canal, Luan river and Daqing river (Fig.1).

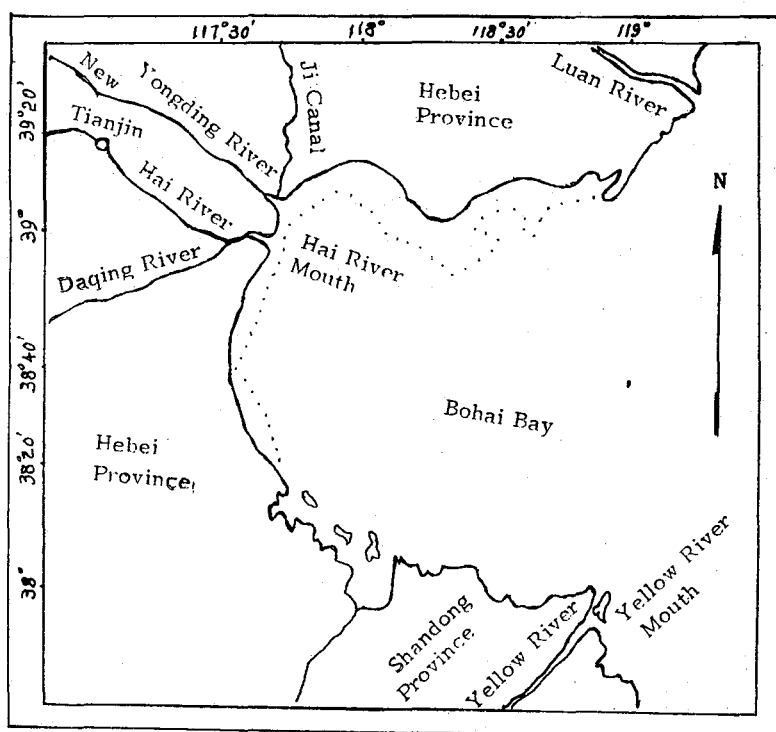


Fig.1 Geographical location of Bohai Bay

It is the key district for industrial construction in China that there are a temperate climate, rich resources and good transport in the Bohai coastal area. In this area, the industrial system has been characteristic of heavy chemical and energy industries, and depends on heavy-duty machinery and textile industries at the present. So, the district has very important status of economic strategy.

Since the 1970's, water quality of the Bohai Bay has been worse than before along with economic development, pollution increase and city expansion in the Bohai coastal area. The eutrophication phenomena and the red tide occurred once in 1977, the amount of *prorocentrum minimum* *Ehranberg* was $1.6 \times 10^8 - 7.2 \times 10^8$ / ml in summer, 1977. Since the end of the seventies, pollution problems of Bohai Bay have been studied widely. Our discussion in this paper will centre on the pollution and protection of the Hai river mouth and its adjacent sea area. Owing to the Beijing-Tianjin area's rivers are polluted by effluent and storm runoff, 7.8 hundred million tons waste water are discharged into the Bohai Bay per year and led to pollution of the sea area near Hai river mouth (1986).

Main Pollution Problems

In the Hai river mouth and its adjacent sea area, the main environmental pollution problems are organic pollution formed with sewage and industrial waste water, such as eutrophication and red tide phenomena.

The water quality profile of the Bohai Bay near Hai river mouth is given in Table 1.

Table 1. Water quality profile of the Bohai Bay

Water quality parameters	Rivers empty into the Bay		Sea area near the river mouth	
	Mean concentration	Overstanding probability (%)	Mean concentration (mg/l)	Overstanding probability (%)
Dissolved oxygen	1.75	92	5.7	
COD	23.12	100	2.3	83
BOD	21.80	82	0.7	12
TOC	87.70	no standard	1.8	no standard
Total nitrogen	5.950	52	1.412	no
Total organic nitrogen	4.810	no	1.151	no
Total inorganic nitrogen	1.140	no	0.270	89
Total phosphorus	0.415	no	0.038	no
Total organic phosphorus	0.262	no	0.013	no
Total inorganic phosphorus	0.153	72	0.025	no
Oil	0.455	100	0.026	no

From the Table 1, it can be found that the rivers empty into the Bohai Bay are bad in water quality, for example, DO, BOD, and oil have the overstanding probability of 92%, 82%, and 100% respectively, and mainly are organic pollutants. However, the water quality parameters in the sea area near the river mouth are mostly not over the national standard because there has greater dilution and exchange capacity in Bohai Bay. In addition, the mean contains of Hg, As, Ca, Pb, Cr, Zn, Cu, Ni, Fe, Mn, oil and organic matter in the bottom sediments of Bohai Bay are 0.088, 19.2, 0.13, 22.4, 49.5, 74.4, 24.7, 35.0, 35000, 500, 166 ppm and 1.15% respectively.

Investigation shows that the average concentration of COD , inorganic nitrogen , inorganic phosphorus and chlorophyl-a in the Bohai Bay in May were 2.15 , 0.24 , 0.56mg/l and 1.69 mg/m³ respectively. These concentrations belong to eutrophication bay range, and the range of eutrophication is extending (1983) . It is clear that besides nitrogen and phosphorus which were carried by rivers into the bay, organic substances accumulated in sediments are the important reason for eutrophication in Bohai Bay. Despite the Bohai Bay has greater environmental assimilation and dilution capacity for pollutants, the pollution has led to the happening of fish and shellfish burst death phenomena.

Although the red tide only occurred one time in 1977 , the potential danger of the red tide is still existence because of the eutrophication in Bohai Bay, especially in the summer. Investigation indicated that there are many species of microorganisms caused red tide in it , such as *prorocentrum mimimum Ehranberg* , *Noctiluca miliaris suriay*.

To sum up , rapid increase of inorganic nitrogen and phosphorus is main reason for eutrophication. The pollution with waste discharge plays a key role in eutrophication for Bohai Bay.

Protection Measures

For the Bohai Bay, in order to control the further development of pollution and eutrophication in the future, the measures must be taken to reduce the amount of inorganic nitrogen, inorganic phosphorus and organic pollutant which are discharged into the Bohai Bay. Since the 1980's, several pollution protection measures have been taken to improve the water quality of the Bohai Bay, such as construction of sewage works for municipal waste water treatment in Tianjin (has a treatment capacity of about 2.5×10^5 T/d) , the primary waste water treatment plant in Beijing and oxidation pond treatment system in Changzhou , Hebei province . Despite all these measures will play an important part in controlling the pollution of Bohai Bay , and make the water quality better , but the water quality has not been improved at all , because new pollution increase rate is faster than that of the old pollution (including both point and non-point pollution).

In view of the above-mentioned facts , we wish to make the following further protection measures for improving the water quality in Bohai Bay.

Strengthen management to control the volume of waste water discharged into the bay . Besides developing and perfecting municipal sewage works system , domestic sewage should be used for agricultural irrigation and this is of great importance to dried north China. The total amount control system also perhaps is an important way for preventing sea water from pollution. The dilution capacity of sea water for waste water and well distributed way should be applied to reducing the sudden pollution loading.

It is a good orientation for controlling non-point pollution that the natural conditions of coastal area near the Bohai Bay are made use of. There has about 84 pounds which have an area of 136000ha. These pounds can be used as a natural oxidation pond or wetland treatment system which may be a cheap method for water pollution control. Table 2 shows the treatment efficiency in Hangu waste water pond in Tianjin area for some pollutants. From the table 2 , it can be seen that the remove proportion for oil and nutrients can come up to more than 60%. These pounds mostly are in alkali flat that do not require of groundwater higher quality and need not to meet higher technological conditions for preventing from percolation.

Table 2. Treatment efficiency of pound for some pollutants

Pollutants	Concentration of the pollutants		Remove percentage (%)
	Input water (mg/l)	Output water (mg/l)	
NH ₃ -N	3.28	1.15	65.2
PO ₄ -P	12.59	3.54	75.7
COD	423.60	285.90	36.5
Phenol	0.037	0.021	34.9
Oil	2.012	0.374	84.4

The effective administrative organization is also very important for protecting Bohai Bay. The Bohai Bay comes within the jurisdiction of the National Ocean Agency of China, but the different parts of coastal area of Bohai Bay are under Heibei province, Tianjin city and Shandong province respectively in administrative divisions. Under this management system, it is difficult to integrate resources utilization with environmental protection for Bohai Bay. For this reason, we think that an effective administrative organization should be set up to manage unitedly resources developing and environmental protection both in Bohai Bay and its coastal area.

Conclusion

From the studies on pollution and protection measures of Bohai Bay, we can come to the conclusion that freshwater with proper nutrients should be kept entering into the Bay to meet the growing of sea organisms, but water quality must be prevented from pollution; total control amount system should be used for controlling pollution in the bay; the methods of controlling pollution should be used with local conditions, such as the application of pounds in the coast of Bohai Bay; effective administrative organization and management measures are very important to environmental protection of Bohai Bay.

Reference

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