Investigation and Analysis of Pollution Source Status in Shaanxi Section of Weihe River Basin

Haiou Zhang [1,2,3,*]

[1] Shaanxi Provincial Land Engineering Construction Group Co., Ltd., Xi'an 710075, China

[2] Institute of Land Engineering and Technology, Shaanxi Provincial Land Engineering Construction Group Co., Ltd., Xi'an 710021, China

[3] Key Laboratory of Degraded and Unused Land Consolidation Engineering, the Ministry of Land and Resources, Xi'an 710021, China

* Corresponding Author Email: 244254409@qq.com

Abstract. Building ecological civilization has become a consensus of the whole society. However, problems caused by water pollution and shortage of water resources cause huge economic losses every year. Over the years, the issue of water pollution in the Weihe River has attracted widespread attention from all walks of life. The premise of controlling the water pollution of the Weihe River is to find out the sources of pollution and the amount of pollutants discharged. Therefore, this study takes the Shaanxi section of the Weihe River Basin as the research section, and conducts a basic survey of the water pollution status of the main stream and tributaries of the Weihe River, and analyzes the sources, types and discharges of major wastewater pollutants, so as to provide the basis and basic data for the comprehensive management of the Weihe River Basin.

Keywords: Weihe river basin, pollution sources, type, discharge amount.

1. Introduction

Water is an irreplaceable and indispensable natural resource for human life, social stability and economic development, as well as an important part of the ecological environment. In the last century, human society has paid a heavy environmental price while obtaining huge material wealth. The global freshwater resources available for human use are seriously insufficient, and the water quality continues to deteriorate. The loss of water functions caused by water pollution further aggravates the situation of water resources crisis. The wastewater discharged into lakes and rivers around the world every year pollutes more than 14% of the total water resources in the world [1]. The scarcity of water resources and increasing pollution have become "bottlenecks" restricting social and economic development in many regions. The increase of water pollution incidents affects the development and stability of society. Every year, problems caused by water pollution and shortage of water resources will cause huge economic losses. However, an important cause of water pollution is the unreasonable use of water pollution capacity. The rational use of environmental resources and the reduction and control of environmental pollution have become one of the main issues that should be considered in the economy and development of various countries [2]. The rapid and effective control of water pollution is of great significance for protecting the quality of water resources and supporting the sustainable development of society and economy with the sustainable development and utilization of water resources [3].

The water resources in the Weihe River Basin are in short supply, and water pollution in some urban river sections is serious. Water pollution is a serious problem due to the low rate of urban domestic sewage treatment and poor industrial emission control [4]. In 2009, the Ministry of Water Resources proposed to implement the strictest water resources management system, scientifically verify the pollutant-accepting capacity of water areas, establish a management system for limiting pollutant-acceptance in water function zones, and strictly control the discharge of pollutants into rivers. In 2011, the Central No. 1 document proposed the establishment of a water function zone restriction system. Therefore, it is very necessary to carry out basic data investigation on the current situation of Weihe water pollution. In this study, the Shaanxi section of the Weihe River Basin was

used as the research section, and the investigation and water quality monitoring of sewage outfalls into the river were carried out, and the discharge of main industrial wastewater pollutants in the main stream and tributaries of the Weihe River was analyzed; According to the water function zoning of the Weihe River, the discharge of pollutants in the Shaanxi section of the Weihe River Basin is investigated, so as to provide a basis for the comprehensive management of the Weihe River Basin, and at the same time provide basic information for the management of the water function area's limited pollution acceptance red line and water quality supervision and management.

2. Analysis of main industrial wastewater pollutant discharge

2.1. Discharge of main industrial wastewater pollutants in the main stream of the Weihe River

The Weihe River Basin is an important industrial and agricultural, scientific research and production base in Shaanxi Province, with a dense population. However, the water quality of the main and tributaries of the Weihe River is deteriorating day by day, which seriously affects the living and production water of urban residents. Therefore, water pollution prevention and control is urgent. According to statistics, the amount of waste water entering the Weihe River accounts for about 80% of the Yellow River Basin in Shaanxi [5]. After investigation and research, data on pollution sources of industrial enterprises in four cities along the main stream of the Weihe River, including Baoji, Xianyang, Xi'an, and Weinan, were collected. According to statistics, there are 36 sewage outlets along the main stream of Weihe River between Linjia Village and Tongguan Suspension Bridge. Along the way, it receives industrial sewage from four major cities of Baoji, Xianyang, Xi'an and Weinan. The discharge amount is shown in Table 1.

Table 1. Emissions of major industrial wastewater pollutants of Weihe River

area	Number of companies (number)	Wastewater discharge (m^3/a)	COD emissions (t/a)
Baoji	143	39756593	23961.3
Xianyang	182	40149698	29783.0
Xi'an	26	10891126	7015.4
Weinan	14	6341502	539.7
Total	365	97138919	61299.4

2.2. Discharge of main industrial wastewater pollutants in Weihe tributaries

The water pollution in the Weihe River Basin mainly comes from industrial wastewater and urban domestic sewage, and the serious lack of ecological water prevents the pollution from being effectively degraded. During the dry season, almost all of the Weihe River is industrial wastewater and domestic sewage. Before 2010, the Weihe River was called "Shaanxi Guanzhong Sewer". It can be seen from Table 2 that the weihe River tributaries are seriously polluted, especially those near the city, which are even more polluted than the main stream of weihe River. Therefore, the Weihe River tributaries have become a veritable sewer.

Table 2. Emissions of major industrial wastewater pollutants of Weihe River tributaries

tributary	companies (number)	Wastewater discharge(t/a)	COD emissions(t/a)	tributary	companies (number)	Wastewater discharge(t/a)	COD emissions(t/a)
Jinling River	4	5236	1.63	Shichuan River	54	5352904	7429.30
Qian River	9	247521	2.55	Caoyun Canal	131	14423569	3167.98

Baoxia Main Canal	18	2079482	7095.92	Xin river	18	8105951	5647.90
Qishui River	5	509600	126.55	You River	29	2709841	5083.79
Feng River	18	5018639	3764.73	Chishui River	4	1275753	331.48
Jing River	21	371864	1311.63	Luofu River	2	8167893	1293.73
Hei River	19	13174523	4277.03	Xianyu River	8	350796	2099.41
Laoyu River	15	8805894	5084.33	Lin River	8	1456945	467.59
Zao River	133	24539678	10817.49	Luo River	87	9865751	16316.98
Ba River	77	9656441	8193.34	total	660	116118281	82513.36

2.3. Investigation and analysis of pollution sources in the main stream of Weihe River in Shaanxi

The pollutant-holding capacity of a river is a quantity with the characteristics of temporal dynamic changes. The dynamic changes of the river hydrological process and other natural conditions are the basis for the dynamic characteristics of the river's pollutant-holding capacity. At the same time, the dynamic change of the river's pollutant-holding capacity also reflects the temporal dynamic characteristics of the pollution load [6]. The pollution sources entering the natural water body mainly include non-point sources and point sources. In the dry season, the pollution sources are mainly point sources, while in the wet season, it is mainly non-point source pollution. In order to effectively control water pollution, point sources and non-point sources should be Unified management [7-8]. Therefore, in the process of river management, non-point source pollution should also be fully considered. The investigation and analysis of pollutant discharge in the water function area of the main stream of the Weihe River in Shaanxi are shown in Table 3. The total amount of wastewater discharge in the Shaanxi section of the Weihe River is 502.4013 million t/a, the total COD emission is 1739.886 million t/a, and the total ammonia nitrogen discharge is 161.4897 million t/a.

Table 3. Discharge amount of pollutants of water function area in Shaanxi section of Weihe River

Weihe main stream water functional area	Wastewater discharge(m^3/s)			COD emissions (t/a)			Ammonia nitrogen emission(t/a)		
	Industrial	City	Non-point source	Industrial	City	Non-point source	Industrial	City	Non-point source
Baoji Agricultural Water Area	0.28	0.10	0.11	3029.8	473.3	269.4	223.2	83.5	18.0
Baoji Landscape Recreational Water Area	0.52	0.14	0.15	1163.7	1320.8	919.0	132.0	233.1	61.3
Baoji	0.30	0.4	0.49	2535.4	140.0	100.5	137.4	24.7	6.7

Sewage Control Area		4							
Baoji Transition Area	0.28	0.05	0.05	652.2	686.7	452.6	56.6	121.2	30.2
Baomei Industrial Agricultural Water Area	0.18	0.23	0.26	5172.9	1387.4	995.8	224.0	244.8	66.4
Yangling Agricultural and Landscape Water Area	0.64	0.46	0.52	3377.7	1686.2	1210.3	120.1	297.6	80.7
Xianyang Industrial Water District	0.37	0.56	0.63	13624.1	13.5	8.9	1307.4	2.4	0.6
Xianyang Landscape and Recreational Water Area	1.12	0.00	0.01	13155.4	430.8	309.2	361.0	76.0	20.6
Xianyang Sewage Control Area	1.66	0.14	0.16	60951.9	16946	12162.7	5553.5	2990.5	810.9
Xianyang Xi'an Transition Area	8.70	5.64	6.30	16753.4	1421.8	1493.2	1424.6	250.9	99.5
Lintong Agricultural Water Area	2.77	0.69	0.77	3438.5	1428.2	1025.1	304.1	252.0	68.3
Weinan Agricultural Water Area	0.32	0.48	0.53	4808.0	258.3	185.4	407.1	45.6	12.4
Yellow River Entrance	0.36	0.09	0.10	0.0	0.3	0.2	0.0	0.06	0.01
total	17.5	9.02	10.08	128663	26193.3	19132.3	10251	4622.36	1275.61

According to the analysis, CODcr is mainly polluted by industrial types in the Weihe River Basin, and the pollution of CODcr is mainly due to the paper industry, and its CODcr emissions account for about 60% of the total; The CODcr emissions of the top five industrial types accounted for 81% of

the total. Therefore, effective control of CODcr emissions from papermaking enterprises will be the key to the governance of the Weihe River.

Through the analysis of the regional pollution sources in each section of the watershed, it is believed that the non-point source pollution of the watershed is the main cause of ammonia nitrogen pollution, and the amount of ammonia nitrogen discharged accounts for 76.54%, while the ammonia nitrogen discharged by point sources only accounts for 23.46% [9]. With the acceleration of urban expansion and the sharp increase of urban population, the pollution pressure from urban domestic sewage in the Weihe River Basin is increasing year by year. In 2007, the urban sewage treatment rate in the Weihe River Basin was still less than 40%, and 60% of the untreated urban domestic sewage was directly or indirectly discharged into the Weihe River. Even if all domestic sewage is discharged up to the standard, the treated water is still inferior to Class V (COD60mg/L) according to the environmental quality standard of surface water [10-11].

3. Conclusions

According to statistics, the main pollutants in the 13 monitoring sections of the Weihe River are COD and ammonia nitrogen. Shaanxi Guanzhong has developed agriculture, paper industry with wheat straw as resource, and beer brewing industry with agricultural products as raw material. Since the reform and opening up, the rapid development of city and county enterprises and township enterprises, especially the paper industry, has made COD and ammonia nitrogen in the Weihe River become the main pollutants. Paper-based organic pollution determines the main industries, factors and countermeasures for Weihe River pollution control.

At the end of 2011, Shaanxi launched a three-year action plan for the prevention and control of water pollution in the Weihe River Basin. After three years of hard work, although the water quality of the Weihe River has improved, it is still far from the goal of building an ecological river. In 2015, Shaanxi Province implemented a new round of systematic governance on the Weihe River, consolidating and improving the three-year action plan (2015-2017), At present, the Shaanxi section of the Weihe River Basin has completely improved the water quality of the Weihe River according to the principle of integrated management of mountains, rivers, forests, fields and lakes. The total amount of chemical oxygen demand and ammonia nitrogen emissions in the basin has reached the national control target, and the function of the river ecosystem has been restored. The Weihe River has been built into a Guanzhong Ecological Corridor that integrates water resources utilization and leisure and entertainment, and where people and water live in harmony.

References

[1] LI Jingyi. Analysis on the Main Environmental Problems in the Weihe River Basin in Shaanxi Province[J]. Arid Zone Research, 2011,28(6):967-973.

[2] Wang C F, Edwin D O. Transjurisdictional water pollution management: The Huai River example [J]. Water International, 2004,29(3):290-298.

[3] Hughes R M, Larsen D P. Ecoregions: An approach to surface water protection [J]. Journal of the Water Pollution Control Federation, 1988, 60:486-493.

[4] Wang Jucui, Wu Yanqing, Ding Hua, et al. The primary estimation of ecological water requirement of Weihe River in Guanzhong region, Shaanxi Province, China [J]. Journal of Arid Land Resources and Environ-ment, 2009, 23(6) :91-94.

[5] Barnwell J T O, Brown L C, Whittemore R C. Importance of field data in stream water quality modeling using QUAL2E-UNCAS [J]. Journal of Environmental Engineering, 2004, 103(6):643-647.

[6] Ecker J G. A Geometric programming model for optimal allocation of stream dissolved Oxygen [J]. Management Science, 1975, 21(6):658-668.

[7] Li S Y, Morioka T. Optimal allocation of waste loads in a river with probabilistic tributary flow under transverse mixing [J]. Water Environment Research, 1999, 71 (2):156-162.

[8] Li Jingyi, Shi Changwei, Fu Zhijun, et al. Evaluation of potential of floodwater utilization in the middle and lower reaches of the Weihe River[J]. Geographical Research, 2008, 27(5) :1203-1 211.

[9] Fujiwara O, Gnanendran S K, Ohgaki S. River quality management under stochastic streamflow [J]. Journal of Environmental Engineering, 1986, 112 (2):185-198.

[10] Donald H B, Barbara J L. Comparison of optimization formulations for waste~load allocations [J]. Journal of Environmental Engineering Division, 1992, 188 (4):597~612.

[11] Zhang Rongzhen, Zhang Xing. The evolution of the ecological environment in Shaanxi part of Weihe River basin in recent 50 years[J]. Journal of Arid Land Resources and Environment, 2008, 22(2) :37-43.