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Influence of Qujiang Iron and Steel Plant on Surface Water Environment in Fuxing Town

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Abstract

The iron and steel industry is an important basic industry of the national economy, and it is also a major water and wastewater discharger. It not only consumes a large amount of groundwater resources, but the sewage and waste residue it discharges poses a huge threat to the surrounding environment, especially the groundwater environment in arid areas. In this paper, by measuring the contents of ammonia nitrogen, COD (chemical oxygen demand), and heavy metals in the surface water around Qujiang Iron and Steel Plant (hereinafter referred to as "Qugang"), the impact of its production process on the water environment around Fuxing Town is evaluated. The results show that the content of heavy metals in the surface water around Qugang is much higher than that of natural water, and the content of Fe is much higher than that of other industrial wastewater. Membrane extraction method improves the removal rate of COD and ammonia nitrogen. It has certain guidance and reference significance for the prevention and control of surface water pollution in the iron and steel industry.

Keywords

Iron and steel industry; Heavy metals; Surface water environment; Environmental impact.

1. Introduction

The iron and steel industry is an important basic industry of the national economy. It not only provides strong support for urban infrastructure construction, but also provides huge profits and taxes and a large number of jobs for urban development. However, the steel industry also has serious environmental pollution and is an industry sector with greater pollution hazards. Its environmental pollution is mainly reflected in the three aspects of water, gas, and slag. The fluidity and diffusibility of water bodies are more serious than those of soil and solid waste. Strong [1], it is very important to analyze the regional transmission process of water pollutants in the steel industry [2-3]. Moreover, water is an essential resource for human survival, and water environmental pollution will directly endanger human life and health. Therefore, how to accurately assess the scope and extent of environmental impact of construction projects in water environmental impact assessment is particularly important [4-5].

Qugang was founded in 1939 and is located in Fuxing Town, Dazhou City. It mainly produces and operates pig iron and steel products. It is the second largest iron and steel enterprise in Dazhou City. It has greatly promoted the social and economic development of Fuxing Town and even Dazhou City. However, the production activities of iron and steel enterprises are often accompanied by serious environmental pollution [6-7]. In recent years, the traditional development of urban construction at the expense of the environment has proved undesirable, and the coordinated development of ecological environmental protection and urban construction has become more and more important. Received the attention of the government

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[8-9], since the "13th Five-Year Plan", a series of powerful measures have been introduced from the central to the local level to tighten ultra-low emissions throughout the entire process of the steel industry [10]. Reports on the impact of the steel industry on the local ecological environment have also become a former research hotspot [11-13]. Therefore, evaluating the impact of Qugang Steel on the water environment of Fuxing Town can provide a scientific basis and direction for the scale and layout of the next economic and environmental construction of Fuxing Town, and has important practical significance.

2. Research Area Overview and Methods

2.1. Research Area Overview

Fuxing Town is located in the western suburbs of Dazhou City, on the side of Tieshan Mountain, 9 kilometers away from the city, with an area of 40.69 square kilometers. The geographical coordinates are 107°20′37.5″~107°39′22.5″ east longitude and 30°07′30″~31°27′30″ north latitude. At the end of 2018, the total population was 25,336. It has a subtropical monsoon climate with four distinct seasons and a long frost-free period. Rainfall is concentrated from May to October each year, with the most in July. The largest river in the territory is the Shuanglong River, which flows through the territory from northwest to southeast, with a length of 9.5 kilometers, a drainage area of 26 square kilometers, and an average annual flow of 20.4 cubic meters per second. Fuxing Town is a newly-built industrial park in Dazhou District, with convenient transportation and developed logistics. It belongs to the key planning and construction area of Dazhou City Government in the "14th Five-Year Plan" and has great development potential.

Dazhou carries major national strategies such as the construction of the Chengdu-Chongqing double-city economic circle and the Yangtze River Economic Belt. However, due to years of disorderly utilization and excessive development, the ecological environment has deteriorated and ecological functions were once overwhelmed. Traditional backward production capacity such as Dagang Group and Qugang Group has caused serious environmental pollution, which has become a major concern of the municipal government and the people. First, in recent years, the Dazhou Municipal Government has incorporated environmental protection measures such as "three lines and one order", Dagang relocation, unit management and control into the important work of the municipal government, and regards ecological environmental protection as one of the important indicators of the government's assessment. There are still few research reports on environmental pollution in the iron and steel industry in the city. Therefore, in this article, Qu Steel is taken as an example. By measuring the types and contents of pollutants in the surface water around Qu Steel, the concentration changes in different ranges are analyzed, and the surface water environmental protection is proposed. Effective measures are expected to provide a reference for Dazhou City to carry out water environment assessment work for steel industry projects.

2.2. Research Methods

This article mainly measures the contents of ammonia nitrogen, COD (chemical oxygen demand), and heavy metals in the surface water around Qugang, analyzes the concentration ratio of each measurement factor in the water and the distribution characteristics of changes with the sampling distance. Emission Standards" (GB13456-2012) stipulate the comparison of the existing enterprise water pollutant discharge concentration limits to determine whether the wastewater discharge of the Qujiang Iron and Steel Plant meets the standards, and the impact assessment on the water environment around Fuxing Town.

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3. Sample Collection and Analysis

3.1. Sample Collection

Sampling points were arranged in accordance with the "Technical Specifications for Surface Water and Sewage Monitoring" (HJ/T 91-2002) and other relevant technical specifications. Water samples were collected from the water-containing environment around the canal steel. The specific sampling conditions are shown in Table 1.

Table 1. Basic situation of sampling points

Sample number	Distance to plant (m)	Sampling point characteristics	North latitude	East longitude	Altitude
1	100	Next to the plant power station, Vegetable field ditches	31.232039	107.415747	323
2	100	Slag dumping point, reservoir	31.231538	107.411899	327
3	500	Upstream ravine of the plant	31.234774	107.406951	371
4	100	Upstream of the plant, ravine	31.232724	107.419081	307
5	100	Downstream of the plant, drainage ditch	31.232724	107.419081	308
6	200	Downstream of the plant, drainage ditch	31.232283	107.419353	298
7	400	Downstream of the plant, drainage ditch	31.231238	107.419672	312
8	600	Downstream of the plant, drainage ditch	31.230105	107.421569	304
9	800	Downstream of the plant, drainage ditch	31.230105	107.421569	302
10	1100	Downstream of the plant, drainage ditch	31.229965	107.424988	291

Table 2. Test methods and standards for various test items

Number	Test items	Detection method	Method standard number
1	Ammonia	Water quality Determination of ammonia nitrogen Salicylic acid spectrophotometric method	HJ 536-2009
2	COD	Water quality determination of chemical oxygen demand potassium dichromate method	GB/T 11914-1989
3	Iron	Water quality Total metal digestion Microwave digestion method	HJ 678-2013
4	Zinc		
5	Arsenic		
6	Chromium		
7	Lead		
8	Nickel		
9	Cadmium		

3.2. Experimental Method

According to the "Water Pollutant Discharge Standard for the Iron and Steel Industry" (GB 13456-2012), the detection factors are determined to be ammonia nitrogen, chemical oxygen demand (COD), and heavy metals such as iron, zinc, copper, arsenic, chromium, lead, nickel, and

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cadmium. The samples to be tested were collected from the surrounding area of Qujiang Iron and Steel Plant in Fuxing Town, and transported to the laboratory of Chengdu University of Information Science and Technology for testing. The specific test methods are shown in Table 2 [14-15].

4. Results and Discussion

The test results show that the ammonia nitrogen, COD, and heavy metal concentrations of the water samples are shown in Table 3.

Table 3. The measured concentration of each heavy metal element in the sample (unit ug/L)

Concentration sample	**As**	**Cd**	**Cr**	**Cu**	**Ni**	**Pb**	**Zn**	**Fe**	Ammonia	**COD**
1	83.840	0	70.770	0.076	9.146	3.726	212	72.414	0.2478	62.7
2	79.674	0	54.840	0	1.844	0	136	129.618	1.8312	65.9
3	49.734	0.138	52.280	0	1.810	0	290	0	0.0859	91.2
4	8.596	0	64.610	0	15.054	20.192	230	254.208	0.098	65.2
5	3.066	0	60.40	0	0.382	38.676	454	444.54	0.746	66.4
6	51.56	1.534	58.170	0	5.742	11.072	502	69.070	0.2668	70.4
7	34.614	33.494	57.750	1.100	12.488	106.816	776	247.536	2.796	73.6
8	0.978	35.240	70.890	0	29.210	106.346	678	87.922	2.323	74.4
9	2.060	37.946	64.990	6.590	33.130	59.668	668	86.820	2.395	73.6
10	23.358	14.024	55.240	0	24.316	71.274	390	423.256	1.119	64.0

It can be seen from Table 3 that among the heavy metal elements, the concentration of Zn is larger, the concentration of Fe is the second, and the concentration of Cu and Cd is the smallest. Except for Fe, the concentration of each heavy metal ion increases from 100 to 600 meters downstream from the factory building compared to the upstream concentration, but generally decreases sharply after 600 meters, indicating that the maximum migration distance of pollutants produced by Qu Steel is 600 meters. The emission concentration increased during the factory building, and then it was diluted due to mixing. The metal pollutants discharged from the plant are Zn, Pb, Fe, Cu, Ni and Cd in order. Compared with the existing enterprise water pollutant discharge concentration limits (as shown in Table 4) stipulated in the "Water Pollutant Discharge Standards for the Iron and Steel Industry" (GB13456-2012), the heavy metal concentration discharge of all samples meets the standard. The amount of ammonia nitrogen increased significantly when passing through the plant, indicating that the plant emitted a large amount of ammonia nitrogen, while the COD content was in a slow downward trend, indicating that the emission of organic compounds was relatively small.

Table 4. Existing iron and steel enterprise water pollutant discharge concentration limits specified in the "Water Pollutant Discharge Standard for Iron and Steel Industry" (GB13456-2012)

Metal element	As	Cd	Cr	Cu	Ni	Pb	Zn	Fe
Limit concentration (ug/L)	**500**	100	1500	500	1000	1000	2000	10000

5. Summarize

This paper analyzes the content of ammonia nitrogen, COD, and heavy metals in the surface water around Qugang, and the results show that:

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(1) The concentration of ammonia nitrogen, COD, and heavy metals in the sample increased from 100 to 600 meters downstream of the plant compared with the upstream concentration. After 600 meters, the surface water within 600m2 around the plant will be continuously affected by pollutants. The surface water environment in other areas of Fuxing Town is less affected by Qugang.

(2) The content of Zn, Cr, and As in the sample is much higher than that of natural water, and the content of Fe is much higher than that of other industrial wastewater, and the proportion of Zn, Cr, and Fe in the concentration of heavy metals is also the largest, indicating that the discharged wastewater is mainly composed of Zn and Cr. , Fe-based.

(3) Combining the analysis of the concentration of heavy metal elements in the water sample and the conclusions (1) and (2), it is obtained that the concentration of the detection factors at the sampling point are all within the water pollution of existing enterprises specified in the "Water Pollutant Discharge Standard for Iron and Steel Industry" (GB13456-2012) Although the concentration of COD and ammonia nitrogen is up to the limit, the concentration of COD and ammonia nitrogen still increases significantly when passing through the plant boundary. Iron and steel plants can use ozone oxidation-circulating spray method[16] and liquid membrane extraction when treating wastewater. Method [17] etc. improve the removal rate of COD and ammonia nitrogen.

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