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Three industries and wastewater and COD discharge of Beijing

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Abstract: With the swift development of economy, the water quality of Beijing is becoming worse day by day and hampers the sustainable development obviously. In this paper, the current conditions of the municipal wastewater structure in the industrial sectors are analysed and discussed in terms of the indicators, such as direct wastewater-discharge coefficient, complete wastewater-discharge coefficient, direct discharge coefficient of COD and complete discharge coefficient of COD, by taking a year of 1990s as the base year. Some countermeasures are studied and the corresponding recommendations are put forward in order to improve the water environment in Beijing. This provides a scientific ground for coordinating the relationship between the aquatic environment and economic growth in this city.

Key words: direct wastewater-discharge coefficient (DWDC); complete wastewater-discharge coefficient (CWDC); direct discharge coefficient of COD (DDC of COD); complete discharge coefficient of COD (CDC of COD)

Recently, with the swift development of economy and the improvement of people's living standard, the water use amount and waste water discharge become bigger and bigger, and the water quality is getting worse and worse. Soil and agricultural products have been polluted by the wastewater, and people's daily life has also been affected by it. The shortage of water resources has become an important factor that may well hamper the future sustainable development. So the study of the present condition of wastewater discharge will improve water environment quality, and bring about a great benefit to industrial and agricultural production.

1 Analysis of direct wastewater discharge coefficient (DWDC) of each sector

In the past years the annual total amount of wastewater discharge (industrial and domestic wastewater) was 9.82×10^8 t, and the total COD discharge amount was 2.74×10^5 t. The wastewater discharge amount and COD discharge amount of each sector are shown in Table 1.

Table 1 Wastewater discharge and COD discharge

Item	Total	The secondary industry	The tertiary industry	Household
Wastewater discharge amount, 10^8 t	9.82	5.44	3.02	1.36
COD discharge amount, 10^4 t	27.38	18.51	4.10	4.77
Wastewater discharge percentage, %	100	55.40	30.75	13.85
COD discharge percentage, %	100	67.60	14.97	17.42

1.1 Analysis of wastewater discharge coefficient in each sector

Wastewater produces almost in all sectors. Some sectors, though not producing wastewater directly, produce wastewater indirectly by keeping in contact with other sectors, which calls indirect wastewater discharge. The total amount of direct wastewater discharge and indirect wastewater discharge means complete wastewater discharge. The direct wastewater discharge coefficient is the wastewater discharge amount of output value per unit. The complete wastewater discharge coefficient is also an important index of measuring wastewater discharge amount of

certain sector. The complete wastewater discharge coefficient reflects not only the total wastewater discharge amount, but also the accumulating wastewater discharge of each sector.

The direct wastewater discharge coefficient and complete wastewater discharge coefficient in 32 sectors are indicated in Table 2.

Table 2 DWDC and CWDC of each sector, $m^3/10^4$ RMB Yuan

	Sector	DWDC	CWDC
1	Administrative department	242.1	607.0
2	Electric power and steam heating	236.5	395.9
3	Chemical industry	205.0	414.2
4	Education, hygienics and scientific research	186.7	536.5
5	Metal mining industry	173.8	299.6
6	Coal and gas product industry	131.9	430.1
7	Coal mining	119.5	246.6
8	Building material and non-metal product	91.6	348.5
9	Metal smelting and processing	83.8	295.4
10	Public affairs and household	73.1	446.4
11	Cargo transportation, post and telecommunication	66.9	320.3
12	Textile industry	64.3	272.8
13	Food processing industry	60.2	172.3
14	Commerce	42.7	167.4
15	Metal manufacturing	42.2	446.5
16	Instrument and meter making industry	36.7	407.1
17	Other industries	36.6	265.3
18	Passenger transportation	36.4	451.9
19	Timber processing and furniture	35.6	250.0
20	Machinery maintenance	35.3	486.3
21	Catering trade	34.1	150.2
22	Mechanical industry	27.6	387.5
23	Electric machinery and equipment manufacturing	24.7	487.6
24	Papermaking and stationery manufacturing	21.2	195.6
25	Transportation equipment manufacturing	16.3	403.5
26	Sewing machine and leather processing	14.8	334.2
27	Electron and communication equipment manufacturing	13.3	250.4
28	Building material and non-metal mining industry	7.9	187
29	Construction	5.0	470.5
30	Finance and insurance	4.3	54.8
31	Petroleum processing	3.3	60.8
32	Agriculture	0	0

It will be seen from Table 2 that the DWDC and CWDC in administrative, educational, hygienic and scientific research sectors are fairly high. From the viewpoint of CWDC, administrative department, education, hygienics and scientific research, construction, passenger transportation, public affairs and household, and metal manufacturing are the highest eight sectors of wastewater discharge amount of output value per 10 thousand RMB Yuan.

In the tertiary industry, finance and insurance, catering trade and commerce are the last three sectors of CWDC, and the wastewater discharge amount of output value per 10^4 RMB Yuan is lower than $170 m^3$.

In the secondary industry, the wastewater discharge amount of output value per 10^4 RMB Yuan in six sectors is lower than $300 m^3$. They are petroleum processing, food processing, building material and non-metal mining, papermaking and stationery manufacturing, electron and communication equipment manufacturing and textile industry. The wastewater discharge amount of output value per 10^4 RMB Yuan in the four sectors, such as electric power and steam heating, mechanical industry, building material and non-metal product and sewing machine and leather processing, is lower than $400 m^3$. They all belong to the sectors where have a lighter wastewater

pollution.

1.2 Analysis of COD discharge coefficient in each sector

DDC of COD and CDC of COD in each sector of the tertiary industry are presented in Table 3. DDC of COD and CDC of COD in each sector of the secondary industry are shown in Table 4.

Table 3 DDC of COD and CDC of COD in each sector of the tertiary industry (kg/10⁴ RMB Yuan)

Sector		DDC of COD	CDC of COD
1	Education hygienics and scientific research	28.0	102.6
2	Administrative department	21.8	112.8
3	Public affairs and household	14.6	101.6
4	Cargo transportation and post and telecommunication	8.0	50.1
5	Catering trade	6.8	45.3
6	Commerce	5.1	32.9
7	Passenger transportation	1.8	89.4
8	Finance and insurance	0.3	9.8

From Table 3 it can be seen that DDC and CDC of COD of finance and insurance are the lowest in all sectors. Finance and insurance is a low pollution sector. Some other sectors, such as commerce, catering trade, passenger transportation, cargo transportation and post and telecommunication also belong to the low pollution sectors. Otherwise, administrative department, education hygienics and scientific research, public affairs and household stand in the forefront of pollution sectors. Some measures must be taken to reduce the COD discharge amount of these sectors.

In the secondary industry, DDC and CDC of papermaking and stationery manufacturing and sewing machine and leather processing stand at the first two places of all the secondary industries (Table 4). The COD discharge amount is also very high for timber processing and furniture making, food processing industry and chemical industry. DDC and COD is over 40 kg/10⁴ RMB Yuan and CDC of COD is over 80 kg/10⁴ RMB Yuan. These sectors have negative effects on the environment, leading to environment pollution. Some measures must be taken to restrict these sectors' development and improve the technology of reducing the COD discharge amount.

Table 4 DDC of COD and CDC of COD in each sector of the secondary industry (kg/10⁴ RMB Yuan)

Sector		DDC of COD	CDC of COD
1	Papermaking and stationery manufacturing	71.3	139.5
2	Sewing machine and leather processing	63.0	140.7
3	Food processing industry	58.2	100.7
4	Timber processing and furniture making	53.1	101.3
5	Chemical industry	42.7	86.4
6	Coal and gas product industry	32.5	68.8
7	Textile industry	15.6	61.3
8	Non-metal mining industry	6.7	54.6
9	Metal smelting and processing	6.3	31.8
10	Instrument and meter making industry	5.9	60.3
11	Electric power and steam heating	5.2	24.3
12	Mining industry	5.2	23.5
13	Machinery maintenance	3.6	69.5
14	Mechanical industry	2.6	50.6
15	Coal mining	2.5	19.7
16	Metal manufacturing	2.5	57.7
17	Transportation equipment manufacturing	2.4	58.5
18	Electric machinery and equipment manufacturing	2.4	74.2
19	Electron and communication equipment manufacturing	1.9	39.5
20	Construction	0.3	71.7
21	Petroleum processing	0.2	9.5
22	Other industries	0.1	51.9
23	Building material and non-material	0	29.8

2 The products' transferring and distributing of water resources and pollutants

The products' transferring among districts affects the redistribution of water resources and pollutants. Reasonable arrangement of products' transferring, equals the adjustment of water resources allocation and exporting pollutants. So water resources would be saved and water pollution would be reduced.

Each sector will discharge pollutants in the process of production. While it exports products, the pollutants stay in its production area. This area accepts the pollutants of other area. On the contrary, importing some products equals the reduction of the pollutants of this area; the pollutants are kept in its own production area and the pollutants were exported indirectly.

From the point of reducing the water pollutants, products of some sectors, whose CWDC or CDC of COD are greater, should be imported. In the secondary industry, the following sectors' products should be imported: electric machinery and equipment manufacturing, machinery maintenance, metal manufacturing, timber processing and furniture making and food processing industry. So the products of these sectors should be imported, or these sectors transferred to other places. Thus, the pollution of this area will be reduced.

Some sectors with great CWDC are very important for Beijing. Some strategies should be made to reduce the export. The following sectors have great export amounts: textile industry, sewing machine and leather processing, chemical industry, mechanical industry, transportation equipment manufacturing and public affairs and household. Of these sectors, public affairs and household and sewing machine and leather processing belong to the sectors whose CWDC are larger, and the exporting of these sectors' products should be reduced.

3 Conclusion and countermeasures

In the tertiary industry, CWDC and CDC of COD of finance and insurance, catering trade, commerce, cargo transportation and post and telecommunication are smaller. They are the sectors with high product value and low pollutant production. From the water environment point of view, they are the sectors which fit well for Beijing's development, and would be better to pay great efforts for it.

Some sectors with low CDC of COD (lower than 60), such as mining industry, electric power and steam heating, electron and communication equipment manufacturing, mechanical industry, transportation equipment manufacturing, metal smelting and processing, also have low CWDC. The local government should lay stress to develop these sectors.

There are two sectors with great CDC of COD, such as sewing machine and leather processing, papermaking and stationery manufacturing. There is great exportation amount for the sector of sewing machine and leather processing, which equals indirectly accepting the pollutants from other areas. The sectors with great water use amount and great pollutants discharge amount such as sewing machine and leather processing should be transferred to other places. Otherwise, the products of these sectors should be transferred to Beijing, which means drawing water of other areas to Beijing. So the wastewater and COD will be remained in other areas.

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