CO2 emission on the process of sewage treatment during “11th Five-Year Plan” period

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Abstract: China established a national level of principle pollutions emission that 10 percent reduction of SO2 and COD discharges by priority projects, structural adjustment, and environmental management during the “11th Five-Year plan” period. This paper focused on the induced effect to CO2 emission on the process of urban sewage treatment. CO2 emission related to two parts of treatment process: municipal wastewater treatment plant construction and operation. Energy consumption play an important role when calculate CO2 emission on the process of urban sewage treatment construction and operation by using input-output model. It came up with that 30.95 tons CO2 emission when reduce 1ton COD on average during the “11th Five-Year plan” period.

Key words: CO_2 emission, sewage treatment, input-output method, priority projects

I. INTRODUCTION

Global climate change is considered an important problem to influent global economic, policy and international relations. China, as a responsible and large developing country, though without the emission caps engagement, still reduces greenhouse gas emission through set goals and established plans of energy-saving and emission-reduction. According to the objectives put forward in the 11th Five-Year plan for national economy and social development, china will achieve the target of 10 percent reduction of COD discharge to curb the development of water pollution during the “11th Five-Year plan” period (2006-2010). To fulfill the goal, china established key basins plans for preventing and controlling water pollution and national municipal sewage treatment and recycling facilities construction plan in the 11th Five-Years, which presented to reduce COD discharge by priority projects, structural adjustment, and environmental management.

The priority projects not only increase the capacity of Chinese water pollution prevent and control, but also spur economic growth. In this paper, we shall first analyses the induced effect on economy from urban sewage treatment projects during the “11th Five-Year plan” period. Both treatment plants construction and operation all discharge carbon dioxide （CO_2） directly or indirectly because of using lots of energy and resources. This paper will analyses the influence on CO_2 emission from new sewage treatment plants based on the analysis above. We can not only realize the co-benefit action between COD reduction and CO_2 emission, but also provide scientific basis for CO_2 emission minimization during traditional pollution reduction, on the process of quantitative analysis on influence on CO_2 emission from COD reduction.

II. PROPOSE INPUT-OUTPUT MODEL

According to national industry classification (GB/T4754-2002) and the requirement of the analysis of SO_2 emission reduction by major project, we built a SO_2 emission reduction model as 13×13 sections, such as agriculture, coal excavating and washing, oil and gas mining, cottonocracy, paper making and paper product industry, Chemical industry, metal smelting and rolling processing industry, other special equipment manufacturing, electricity and thermal force producing and supplying, other industry, building industry, environmental resource and public facility management, other

service industry and so on. These sections include energy sectors, significant SO_2 emission sectors, environmental protection facilities construction sections, environment control sections. The paper will update to 2005 input-output table from 2002 input-output table by using RAS measure to adapt the analytical period. When the input-output model is basically equilibrium after a few calculations of iteration, R＝ [1.45, 2.15, 1.70, 1.37, 3.09, 4.50, 3.25, 0.04, 2.38, 2.52, 2.52, 1.80, 1.71], S＝[0.46, 0.88, 0.62, 0.62, 0.44, 0.37, 0.42, 10.29, 0.81, 1.97, 0.42, 0.51, 0.57]. $\hat{R}$ is substitute matrix, and $\hat{S}$ is manufacture matrix. The figured interdependence coefficient of 2005 input-output table is included in the appendix.

III. THE INDUCED EFFECT TO ECONOMICS FROM SEWAGE TREATMENT PORJECTS

During the "11th five-year plan" period, the sewage treatment projects include two parts: the first is to invent RMB 208.5billion on constructing the sewage conduit system so as to enhance sewage collection efficiency, and second is to invent RMB 81billion on constructing urban sewage treatment plants and updating the existing sewage treatment plants. These projects will reduce 3 million tons COD by a new addition of urban waste water treatment capacity of 45 million tons per day.

Pollution control facilities investments play a very important role to the economic development. During the sewage treatment plants construction, sewage conduit system belongs to investment in fix assets, and 30 percent of sewage treatment plant (exclusive of sewage conduit system) construction cost is belongs to other special equipment manufacturing and 70% percent of the cost belongs to investment in fix assets. China has to invest RMB 265.2bn on fix assets and RMB 24.3bn on treatment equipment. And china has to invest RMB 28.678bn on daily operation if we suppose that the average cost of the secondary sewage treatment plants on normal operation is RMB 0.582 per ton sewage discharge.

Basic on the formula of induced factor K=[I-（I-M^）A]-1[(I-M^)S+E], , the induced effect to major sectors from investment in fix assets shown in the following table. From the table 1 we can see that building industry is most affected by investment in fix assets.

Table1 THE INDUCED EFFECT TO MAJOR SECTORS FROM DESULPHURIZATION CONSTRUCTION AND OPERATION

	the induced effect to major sectors from desulphurization construction/RMB 100 million
1	313.73
2	72.13
3	72.93
4	71.34
5	67.36
6	368.36
7	467.02
8	6.10
9	149.31
10	1374.80
11	1438.71
12	3.18
13	941.99

1:agriculture; 2:coal excavating and washing; 3:oil and gas mining; 4:cottonocracy; 5:paper making and paper product industry; 6:Chemical industry; 7:metal smelting and rolling processing industry; 8:other special equipment manufacturing; 9:electricity and thermal force producing and supplying; 10:other industry; 11:building industry; 12:environmental resource and public facility management; 13:other service industry the same below.

According to GB/T4754-2002, sewage treatment plants construction belongs to other special equipment manufacturing and sewage treatment plants operation is main subject in environmental resource and public facility management. Basic on the fundamental principle of input-output model, the induced effect to major sectors from sewage treatment plants construction and operation respectively to shown in the following table. From the table 2 we can see that metal smelting and rolling processing industry is most affected by sewage treatment plants(exclusive of sewage conduit system) construction and chemical industry is affected the most by sewage treatment plants operation.

Table2 THE INDUCED EFFECT TO MAJOR SECTORS FROM SEWAGE TREATMENT CONSTRUCTION AND OPERATION

	the induced effect to major sectors from sewage treatment	**the induced effect to major sectors from sewage treatment**

	construction/RMB 100 million	operation/RMB 100 million
1	23.81	27.82
2	14.24	13.19
3	11.37	11.79
4	13.54	11.13
5	11.28	10.01
6	52.51	49.64
7	129.35	33.04
8	2.55	0.46
9	28.82	23.72
10	210.27	219.16
11	2.77	12.99
12	0.39	3.18
13	106.92	98.54

IV. THE IMPACT TO CO2 EMISSION FROM SEWAGE TREAMENT PORJECTS

Energy consumption play an important role when calculate CO_2 emission on the process of desulphurization facilities construction and operation. The energy sector is usually the most important sector in greenhouse gas emission inventories, and typically contributes over 90 percent of the CO_2 emission and 75 percent of the total greenhouse gas emission in developed countries.[2] CO_2 emission depends on the major energy consumption, because CO_2 come from carbon combustion, including coal, oil and natural gas. We can calculate the relevant energy consumption showed in table 3, according to the major sector energy consumption coefficients, as well as the previous induced effect to major sectors from sewage treatment plants construction and operation during the "11th Five-Year plan" period.

Table3 THE INDUCED EFFECT TO MAJOR ENERGY FROM SEWAGE TREATMENT CONSTRUCTION AND OPERATION

	Coal consumption/10,000t	Oil consumption/10,000t	Gas consumption/100 million m3
1	36.67	0.00	0.00
2	422.00	0.00	0.14
3	6.31	25.87	1.56
4	59.30	0.01	0.02
5	218.84	0.04	0.04
6	1122.42	251.65	15.46
7	2181.82	0.04	1.52
8	2.31	0.00	0.01
9	3483.32	0.30	0.62
10	3246.69	1495.06	4.28
11	86.63	0.00	0.21
12	0.00	0.00	0.00
13	38.29	2.00	0.52
tatal	10904.59	1774.96	24.39

We can determine Chinese special CO_2 emission factors to be shown in the table 4 based on effective CO_2 emission factors from IPCC and the Chinese special standard coal coefficient corresponding major energy.

Table4 CO_2 EMISSION FACTORS FOR MAJOR ENERGY

	EFcoal/t/t	EFoil/t/t	EFgas/t/10,000m3
CO_2 emission factors	2.055	3.065	0.218

Coal CO_2 emission= $EF_{煤炭}$×coal consumption

Oil CO_2 emission= $EF_{石油}$×oil consumption

Gas CO_2 emission= $EF_{天然气}$×gas consumption

V. CONCLUSION

It will discharge 30.95 tons CO_2 when reduce 1ton COD on average during the "11th Five-Year plan" period. In other words, it will discharge 279 million tons CO_2 during the process of urban sewage treatment plants from 2006 to 2010, 90percent of which from sewage treatment plants construction and 10 percent of which from sewage treatment plants operation.

As the end treatment measure to air pollution control, sewage treatment projects reduced lots of traditional pollutions, but discharge more greenhouse gas into the atmosphere, especial CO_2 emission which arouse public attention just recently. Cleaner production, energy-saving and other treatment measure to reduce pollutions at the source, are the better measure for enterprises to reduce traditional pollutions, as well as ultimately reduce greenhouse gas.

This paper only considered the CO_2 emission on the process of sewage treatment construction and operation which can be analyses by using input-output model, without

considered different influence in different condition and other greenhouse gas emission(e.g. methane) on the process of sewage treatment, which will arise in developing my research approach.

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Appendix interdependence coefficient of 2005 input-output table

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0.1931	0.0775	0.0390	0.3411	0.1373	0.0923	0.0929	0.0980	0.0738	0.1791	0.1676	0.0970	0.0842
2	0.0257	0.0876	0.0363	0.0482	0.0564	0.0857	0.0853	0.0586	0.2657	0.0573	0.0453	0.0460	0.0309
3	0.0207	0.0326	0.0291	0.0356	0.0365	0.0656	0.0483	0.0468	0.0432	0.0889	0.0461	0.0411	0.0295
4	0.0178	0.0299	0.0181	0.3770	0.0417	0.0366	0.0409	0.0557	0.0317	0.0794	0.0439	0.0388	0.0380
5	0.0194	0.0297	0.0172	0.0393	0.4255	0.0518	0.0399	0.0464	0.0318	0.0700	0.0403	0.0349	0.0424
6	0.2169	0.1501	0.0970	0.2955	0.3772	0.7193	0.1999	0.2161	0.1387	0.3077	0.2321	0.1731	0.1324
7	0.0492	0.1907	0.0874	0.0829	0.0868	0.1188	0.6549	0.5323	0.1123	0.2073	0.3162	0.1152	0.0775
8	0.0008	0.0042	0.0032	0.0047	0.0021	0.0027	0.0033	0.0105	0.0028	0.0025	0.0039	0.0016	0.0019
9	0.0515	0.1610	0.0921	0.1088	0.1145	0.1678	0.1526	0.1186	0.1228	0.1104	0.0935	0.0827	0.0645
10	0.3501	0.5954	0.3457	0.5920	0.6017	0.7239	0.8566	0.8653	0.6385	0.7703	0.8718	0.7642	0.5574
11	0.0073	0.0130	0.0066	0.0104	0.0110	0.0110	0.0113	0.0114	0.0119	0.0107	0.0119	0.0453	0.0305
12	0.0015	0.0015	0.0008	0.0018	0.0017	0.0023	0.0017	0.0016	0.0022	0.0017	0.0016	0.0111	0.0042
13	0.2132	0.4084	0.2208	0.3844	0.4389	0.4145	0.4246	0.4400	0.4211	0.4088	0.4369	0.3436	0.4030