

# 北京市排污结构现状分析与对策研究

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**摘要** 近年来, 由于经济的迅速发展, 北京地区水污染日趋严重, 降低了水资源的使用价值, 使本已严峻缺水的形势进一步恶化, 极大地制约着首都社会经济及城市的发展。本文以1991年为报告期, 采用污水直接排放系数、污水完全排放系数、COD直接排放系数、COD完全排放系数等指标对本市行业排污结构的现状进行了全面的分析和讨论, 提出了相应的对策与建议, 为改善本市水环境状况, 缓解水资源短缺的压力, 协调本市水环境与经济发展的关系提供依据。

**关键词** 污水直接排放系数, 污水完全排放系数, COD直接排放系数, COD完全排放系数。

近年来, 由于经济的迅速发展, 人民生活水平的大幅度提高, 北京地区的工业、生活用水和污水排放大量增加, 污染日趋严重, 降低了水资源的使用价值, 污染了土壤与农产品, 继而严重影响到首都人民的生产与生活, 同时, 使本已严峻缺水的形势进一步恶化, 极大地制约着首都的社会经济及城市发展。因此, 对北京地区部门、行业的排污现状进行分析, 将经济现象同水的问题结合起来研究, 提出相应对策, 对于改善本市水环境状况, 缓解水资源短缺的压力, 促进北京地区经济的持续发展是十分必要和有意义的。

## 1 各部门排污系数分析

1991年全市工业与城市生活(建筑业、第三产业、居民生活)共排放污水 $9.82 \times 10^8$  t, 排放COD  $2.74 \times 10^5$  t。污水与COD的排放情况见表1<sup>[1]</sup>。

### 1.1 各行业排放污水的分析<sup>[2-4]</sup>

各个行业在生产过程中要产生污水, 一些行业虽然不直接产生污水, 但通过与其他行业的联系, 也会间接产生污水, 这就形成了对污水的间接排放, 直接排放与间接排放之和构成了对污水的完全排放。污水直接排放系数反映

了某一产品部门创造单位产值排放的污水量。污水的完全排放系数亦是衡量产品部门排放污水的一个重要指标, 是从最终排污角度考察各部门间存在的多级、间接的复杂联系, 把这种联系反映在排放污水上的关系用定量的形式表示出来, 同时它还反映了各个部门对污水的累积排放。

表1 北京市1991年污水及COD排放情况

项 目	全市 总计	第二 产业	第三 产业	居民 生活
污水排放量( $10^8$ t)	9.82	5.44	3.02	1.36
COD排放量( $10^4$ t)	27.38	18.51	4.10	4.77
各行业污水比重(%)	100	55.40	30.75	13.85
各行业COD比重(%)	100	67.60	14.97	17.43

32个部门的污水直接、安全排放系数见表2。

由表2可知, 行政机关、文教卫生科研事业的污水直接排放系数、完全排放系数都是很高的。从污水的完全排放系数来看, 行政机关、文教卫生科研事业、建筑业、旅客运输业、公用事业和居民服务业、金属制品业是前8个万元产值污水排放量最高的行业。

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表2 各部门的污水直接、完全排放系数(t/10<sup>4</sup>元)

序号	部 门	污水直接 排放系数	污水完全 排放系数
1	行政机关	242.1	607.0
2	电力蒸汽热水业	236.5	395.9
3	化学工业	205.0	414.2
4	文教卫生科研事业	186.7	536.5
5	金属矿采选业	173.8	299.6
6	炼焦、煤气煤制品业	131.9	430.1
7	煤炭采选业	119.5	246.6
8	建材及非金属矿物制品业	91.6	348.5
9	金属冶炼压延加工业	83.8	295.4
10	公用事业居民服务业	73.1	446.4
11	货运邮电业	66.9	320.3
12	纺织业	64.3	272.8
13	食品制造业	60.2	172.3
14	商业	42.7	167.4
15	金属制品业	42.2	446.5
16	仪器仪表计量器具制造业	36.7	407.1
17	其他工业	36.6	265.3
18	旅客运输业	36.4	451.9
19	木材加工、家具制造业	35.6	250.0
20	机械设备修理业	35.3	486.3
21	饮食业	34.1	150.2
22	机械工业	27.6	387.5
23	电气机械及器材制造业	24.7	487.6
24	造纸文教用品制造业	21.2	195.6
25	交通运输设备制造业	16.3	403.5
26	缝纫及皮革制品业	14.8	334.0
27	电子及通信设备制造业	13.3	250.4
28	建材及非金属矿采选业	7.9	187
29	建筑业	5.0	470.5
30	金融保险业	4.3	54.8
31	石油加工业	3.3	60.8
32	农业*	0	0

\* 因资料等因素，将农业的污水直接排放系数记0处理

在第三产业中，金融保险、饮食业、商业都是污水完全排放系数最小的部门，万元产值完全排放污水不足170 t，货运邮电业也属于完全排放污水较少的部门。

第二产业中，石油加工、食品制造、非金属矿采选、造纸及文教用品制造、电子、纺织等部门的万元产值污水完全排放量在300 t以下，电力蒸汽热水业、机械工业、建材及非金属矿物制品业、缝纫皮革制品业的万元产值污水完全排放量亦不足400 t，也属于污水完全排放量较小的部门。

1.2 各行业 COD 排放量分析

第三产业与第二产业的 COD 直接、完全排

放系数分别见表3和表4(COD 直接、完全排放系数其意义与污水直接、完全排放系数类似)。

表3 第三产业各部门的 COD 直接、完全排放系数(kg/10<sup>4</sup>元)

序号	部 门	COD 直接 排放系数	COD 完全 排放系数
1	文教卫生科研事业	28.0	102.6
2	行政机关	21.8	112.8
3	公用事业居民服务业	14.6	101.6
4	货运邮电业	8.0	50.1
5	饮食业	6.8	45.3
6	商业	5.1	32.9
7	旅客运输业	1.8	89.4
8	金融保险业	0.3	9.8

由表3可见，金融保险业的 COD 直接、完全排放系数都是最低的，属于污染小的行业，商业、饮食业、旅客运输业、货运邮电业创造万元产值对 COD 的直接与完全排放量亦不大。而行政机关、文教卫生科研事业、公用事业和居民服务业 COD 的直接与完全排放系数均居于前列，作为首都建设事业不可缺少的行业，应当采取适当措施，努力降低这些部门 COD 的排放量。

在第二产业中，缝纫皮革制品业、造纸及文教用品制造业创造万元产值的 COD 直接与完全排放量均居前2位(见表4)。木材加工及家具制造业、食品制造业、化学工业 COD 的排放量也是相当大的，万元产值 COD 的直接与完全排放量分别在40 kg 与80 kg 以上，这些部门对环境造成的污染较为严重，应适当限制其发展，并努力提高工艺，减少 COD 的排放量。

表4 第二产业各部门的 COD 直接、完全排放系数(kg/10<sup>4</sup>元)

序号	部 门	COD 直接 排放系数	COD 完全 排放系数
1	造纸及文教用品制造业	71.3	139.5
2	缝纫皮革制品业	63.0	140.7
3	食品制造业	58.2	100.7
4	木材加工家具制造业	53.1	101.3
5	化学工业	42.7	86.4
6	炼焦煤气煤制品业	32.5	68.8
7	纺织业	15.6	61.3
8	建材及非金属矿物制品业	6.7	54.6
9	金属冶炼压延加工业	6.3	31.8

续表4

序号	部 门	COD 直接 排放系数	COD 完全 排放系数
10	仪器仪表计量器具制造业	5.9	60.3
11	电力蒸汽热水业	5.2	24.3
12	金属矿采选业	5.2	23.5
13	机械设备修理业	3.6	69.5
14	机械工业	2.6	50.6
15	煤炭采选业	2.5	19.7
16	金属制品业	2.5	57.7
17	交通运输设备制造业	2.4	58.5
18	电气机械及器材制造业	2.4	74.2
19	电子及通信设备制造业	1.9	39.5
20	建筑业	0.3	71.7
21	石油加工业	0.2	9.5
22	其它工业	0.1	51.9
23	非金属矿采选业	0	29.8

## 2 产品的调入、调出对水资源和污染物分配的影响

地区间产品的调出、调入对水资源和污染物的再分配有着间接的影响。因此,合理安排最终使用结构中的调出、调入,也就是间接地调整了水资源的分配和间接输出污染物,以达到节约首都水资源和减少水污染,改善水环境的目的。

各个部门在进行生产,创造新价值的同时,一般还要排放污染物,在向其它地区输出经济产品的同时,却把污染物留在本地,也就等于在本地区间接承受了其它地区的污染。反之,接受调入产品,就相当于减少了本地区污染物的承受量,而将污染留在了产品的产地,即间接输出污染。

从减少本市水污染的角度考虑,应调入那些污水和 COD 完全排放系数大的部门的产品。在第二产业中,应当调入产品的部门有:电气机械及器材制造业、机械设备修理业、金属制品业、木材加工及家具制造业、食品制造业。所以,应适当增加这些部门产品的调入,或将这些部门的生产转移到本市以外的地区,也就等于间接减少了本地区的污染。

有一些部门完全用水量,而对于本地区的发展又必不可少,则应适当减少其对外地区产品的输出量。本市向其它地区调出产品量较

大的部门有:纺织业、缝纫及皮革制品业、化学工业、机械工业、交通运输设备制造业、公用事业居民服务业。在这些调出产品的部门中,公用事业居民服务业、缝纫及皮革制品业属于完全用水较大的部门,应适当减少调出,减轻本市的水环境压力。

## 3 结论与对策

(1) 在第三产业中,金融保险业、商业、饮食业、货运邮电业的污水完全排放系数、COD 完全排放系数均较小,属于产值高,污染轻的部门,并且存在着很大的需求潜力。从水环境保护的角度看,是最适合首都经济发展的行业,这4个行业应大力发展。

(2) 采矿业、电力蒸汽热水业、电子及通信设备制造业、机械工业、交通运输设备制造业、金属冶炼及压延加工业等部门对 COD 的完全排放量较小,COD 的完全排放系数低于60,并且其污水完全排放系数亦较小,这几个产业部门可以作为适合首都经济建设的行业进行重点发展。

(3) 缝纫及皮革制品业,造纸工业是 COD 完全排放系数最大的2个工业部门,而且目前缝纫及皮革制品业还有着较大的调出量,这就等于间接承受了其它地区的污染物。应将缝纫及皮革制品业(主要是其中的皮革制品业)这样的耗水大,污染大的工业部门转移到其它地区生产,而从其它地区调入该产品,这样就等于从外地区间接调水进北京。同时也将 COD 和污水留在了北京以外的地区,对缓解本市的水环境压力有积极作用。

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with a RSD of 6.2%.

**Key words:**  $\beta$ -correction, spectrophotometry, silver, malachite green, real absorbance.

**Study on a Synthetical Index Method for Air Quality Assessment.** Wu Limin et al. (Fuxin College of Mining, Fuxin 123000); *Chin. J. Environ. Sci.*, 16(3), 1995, pp. 58–60

A synthetical index method for air quality was developed, where the principles followed are: ① each of pollution factors has an equal contribution to the synthetical assessment index; and ② the air pollution becomes heavier when multiple pollution factors exist simultaneously. Finally, the rationality of the method is proven based on an assessment prototype.

**Key words:** air pollution, environmental quality assessment, synthetical index.

**Preliminary Study on the Pollution Assessment of Cd in Soil by the Concentration of Cd in Plant Seedling.** Yang Linshu et al. (Resources and Environ. College, Beijing Agriculture Univ., Beijing 100094); *Chin. J. Environ. Sci.*, 16(3), 1995, pp. 61–63

Pot experiments were conducted to study the feasibility for the pollution assessment of Cd in soil by the concentration of Cd in seedlings of *Triticum aestivum* L., *Glycine max* L. and *Brassica campestris* L. The results show that Cd concentrations in the three plant seedlings were higher than those of their later growth stages or harvested parts. The seed Cd concentrations of *Triticum aestivum* L. and *Glycine max* L. were highly positively correlated to Cd concentrations in their seedlings, respectively. Cd concentration in harvested *Brassica campestris* L. was also highly correlated to its seedling Cd concentration. According to the National Criterion for Public Health, the critical Cd concentrations for three-leave *Triticum aestivum* L., seedlings of *Glycine max* L. and *Brassica campestris* L. were 0.72 mg/kg, 0.5 mg/kg and 0.16 mg/(kg · fw) respectively.

**Key words:** Cd concentration in seedlings, soil Cd pollution, *Triticum aestivum* L., *Glycine max* L., *Brassica campestris* L..

**Study on the Information System for Management of Solid Waste Exchange.** Wang Jue et al. (Institute of Environ. Sci., Beijing Normal Univ., Beijing 100875); *Chin. J. Environ. Sci.*, 16(3), 1995, pp. 64–67

An information system has been developed for the

management of solid waste exchange which is a means of waste recycling and recovery and a kind of exchange between waste generators and potential waste users, based on the relativity of waste. Based on the analysis of solid waste exchange patterns, the exchange types were classified and their effects were summarized. By expounding the links of waste exchange and using the method of system analysis, the basic functions and components of such an information system were analyzed. Computer technology system design and system implement action were used to set up the information system for management of solid waste exchange by using a modern database as its system core. According to the basic demands of waste exchange, this system realizes functions such as data input, output, transport, retrieval and statistics. A theoretical discussion on system intellectualization was made based on the development of the system.

**Key words:** waste exchange, system analysis, information system.

**Criteria of Centralization or Decentralization for Use in a Regional Planning of Wastewater Treatment System.** Wang Yonghang and Fu Guowei (Dept. of Environ. Eng., Tsinghua Univ., Beijing 100084); *Chin. J. Environ. Sci.*, 16(3), 1995, pp. 68–71

A simple and efficient methodology was developed for use in a regional planning of wastewater treatment systems. The criterion for eliminating nonoptimal treatment plant sites for every wastewater source in a region took into account the critical distance parameter derived from the interrelation between the lower limit of transportation cost and the upper limit of regionalization efficiency. The developed method was able to significantly reduce the number of candidate locations of shared facilities for regionalized wastewater treatment. In addition, a case study was given. Enhancement of regional systems management would be a principal benefit of the suggested methodology.

**Key words:** wastewater treatment, critical distance, centralization, decentralization.

**Investigation on the Current Status of Sewage Discharge from Beijing and the Response Strategy.** Wang Yan et al. (Beijing Municipal Research Academy of Environment Protection, Beijing 100037); *Chin. J. Environ. Sci.*, 16(3), 1995, pp. 72–74

With the rapid development of economy, surface and ground waters in Beijing area have been polluted much more seriously in recent years, causing the situation of shortage in water resources to be steadily deteriorated and the sustainable development of economy in Beijing to be restricted greatly. Based on the socio-economic conditions and water environment in 1991 in Beijing, direct sewage discharge coefficient, complete sewage discharge coefficient, direct COD discharge coefficient and complete COD discharge coefficient were used to comprehensively analyse the current status of sewage discharge from Beijing. Appropriate measures have been suggested for improving the water environment condition.

**Key words:** sewage discharge coefficient, COD coefficient, water pollution, water diversion.

**Direct Thermochemical Liquefaction Technology for Treatment of Municipal Sewage Sludge.** He Pinjing et al. (School of Environ. Eng., Tongji Univ., Shanghai 200092); *Chin. J. Environ. Sci.*, **16**(3), 1995, pp. 75–78

The direct thermochemical liquefaction technology developed in the 1980s was used in the treatment of sewage sludge and resource recovery. Over 40% of organic matter in sewage sludge were converted into a fuel oil with a caloric power of  $\geq 33$  MJ/kg while TOC being converted at a rate of up to about 90%. The whole process was found to be a net energy exporting process. A review was also given on the development, current status and prospect of this process.

**Key words:** sludge treatment, direct thermochemical liquefaction, conversion of sludge to fuel oil.

**Nonlinear Theory in Environmental Sciences and It's Implication.** Ye Changming (Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085); *Chin. J. Environ. Sci.*, **16**(3), 1995, pp. 79–82

A nonlinear theory in environmental science was suggested with an integrated analysis and theoretical judgement based on previous work. The implication of nonlinear theory for environmental

scientific research and pollution control was discussed by taking several examples.

**Key words:** multimedia environment, nonlinear theory, interface effect, pollution control.

**Mechanism of Wastewater Treatment in Constructed Wetlands.** Wu Xiaolei (Dept. of Environ. Eng., Tsinghua Univ., Beijing 100084);

*Chin. J. Environ. Sci.*, **16**(3), 1995, pp. 83–86

A detailed investigation was made on the configuration and mechanism of constructed wetlands. It was concluded that the high efficiencies of removing nitrogen, phosphorus and organics are mainly due to the synchronization of physical, chemical and biological processes, and due to the alteration of aerobic, anoxic and anaerobic conditions. For municipal wastewater containing less COD, BOD<sub>5</sub> and COD removal rates are greater than 80%, and BOD<sub>5</sub> in effluent is around 10 mg/L. The removal rates of total nitrogen and total phosphorus are greater than 60% and 90%.

**Key words:** constructed wetlands, wastewater treatment, organics, nitrogen removal, phosphorus removal.

**Physiological Properties of Luminescent Bacteria and Its Application in Environmental Monitoring.**

Huang Zheng and Wang Jialing (Institute of Environmental Medicine, Tongji Medical Univ., Wuhan 430030); *Chin. J. Environ. Sci.*, **16**(3), 1995, pp. 87–90

A review was made on the following three respects: the physiological properties of luminescent bacteria, the utilization of luminescent bacteria toxicity test (L. B. T test) in environmental monitoring and the new progress of this technique. The advantages of L. B. T test were evaluated and its trends of future were suggested. It was predicated that L. B. T test would become an important method in environmental monitoring.

**Key words:** luminescent bacteria, toxicity test, environmental monitoring.