Journal of Environmental Sciences Vol. 8, No. 3, pp. 313—320, 1996 ISSN 1001-0742

An overview on industrial waste management in China

Yang Yanru, Nie Yongfeng, Li Guoding

Department of Environmental Engineering, Tsinghua University, Beijing 100084, China

Abstract——The article is a summary of the industrial waste management in China during the recent years. An overall description of industrial waste was given from generation, treatment, disposal and emission and comprehensive utilization. In spite of the serious situation of industrial waste, China has realized it and made great progress in establishing corresponding legislation system, taking a series of administrative measures and developing effective treatment and disposal technologies. However, there still exist many problems, and it is of great urgency to take countermeasures in industrial waste management.

Keywords: industrial waste; management; China.

1 Introduction

Industrial waste management has become an increasingly serious problem in the world. As a developing country, China is also confronted with it without exception. Every year large quantities of industrial wastes are generated from its growing industries. However, there is not adequate treatment and disposal facilities for them. More worse is the lack of qualified personnel. All these have seriously hindered the development of industry.

In the last decades, much attention has begun to be paid to the control of industrial waste, and significant strides have been made in establishing corresponding management legislation, developing treatment and disposal technologies and turning the research results into industrial practice. As a result, the serious situation has been alleviated but not completely changes. There are still many problems to be solved in the management of industrial waste.

2 Present state of industrial waste control in China

2.1 Generation

China is a country generating a large amount of industrial waste each year. And with the development of industry, the annual quantity is growing rapidly, which reached 0.62 billion tons in 1993 (Fig. 1). It is estimated that the total amount of industrial waste a year will be over 1.0 billion tons up to the year of 2000 (Nie, 1994).

These wastes come from almost all the industries. Fig. 2 illustrates the proportions of 6 main industries in waste generation in 1993. It is shown that mining, electricity and heat supply, ferrous metal industry are the major contributors of industrial wastes.

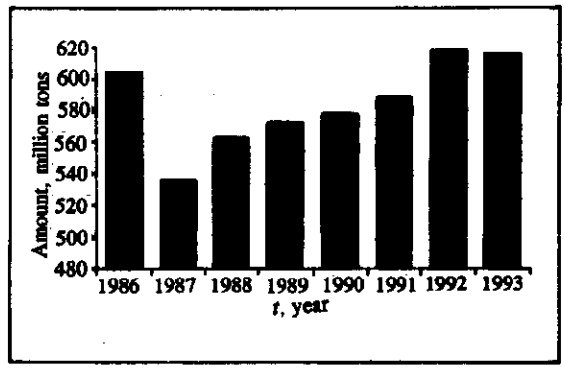

Fig. 1 Total amount of industrial waste in China
(Almanac of China's Environment, 1990; 1991; 1992; 1993; 1994)

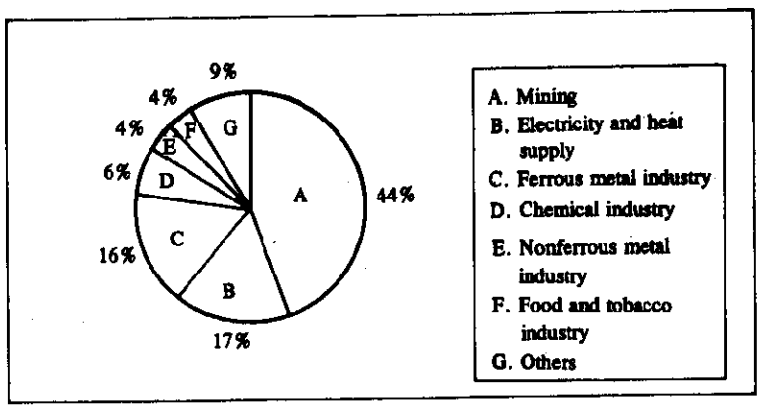

Fig. 2 Generated amounts of industrial wastes by industries
(in FY 1993; Almanac of China's Environment, 1994)

According to the source, there are mainly seven kinds of industrial wastes: tailings, coal gangue, powdered coal ash, slag, smelting waste, chemical industrial waste and radioactive waste. Generated quantities of these wastes in 1993 are shown in Fig. 3 (ordered by their general quantities from large to small).

The generation of industrial waste is related with many factors. It seems that the level of industrial development and technical progress are two of major ones. As shown in Table 1, with the increase of total industrial output value, the annual amount of industrial waste is also increasing, but its increasing margin is quite lower than that of the former. As a result, waste generation coefficient (here defined as the annual amount of industrial waste per unit of total industrial output value) tends to decrease, which to a certain degree manifests the level of technical progress. This could be contributed to the great attention paid by Chinese government to industrial waste control and the effect of corresponding prevention measures.

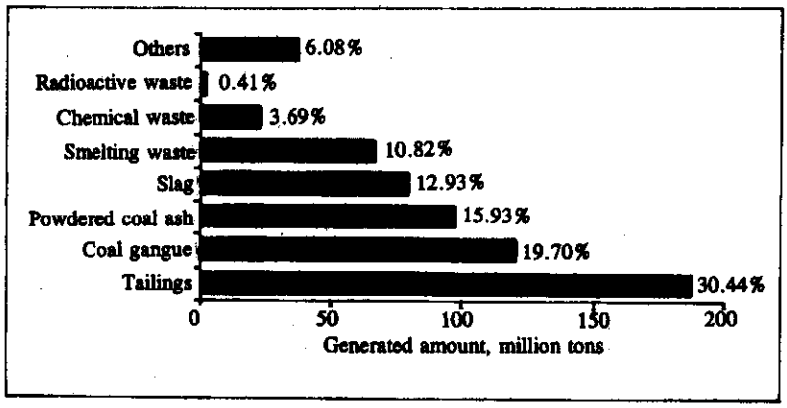

Fig. 3 Classification of industrial waste and their generated amounts (in FY 1993; Almanac of China's Environment, 1994)

Table 1 Waste generation coefficient

Time	Total amount of industrial waste, million tons	Total industrial output value#, billion RMB	Waste generation coefficient (milli on tons/billion RMB)
1986	603.64	1119.4	0.539
1987	535.41	1317.4	0.406
1988	561.32	1591.3	0.353
1989	571.73	1727.1	0.331
1990	577.97	1861.2	0.311
1991	587.59	2136.7	0.275
1992	618.84	2724.3	0.227

Notes: source: Almanac of China's Environment, 1990; 1991; 1992; 1993; Almanac of China's Economy, 1993

Total industrial output value is calculated according to the fixed price of 1986

2.2 Treatment, disposal and emission

The generated industrial waste has four outlets: disposal, storage, comprehensive utilization and emission. As shown in Fig. 4, only 53.3% of industrial waste generated in 1993

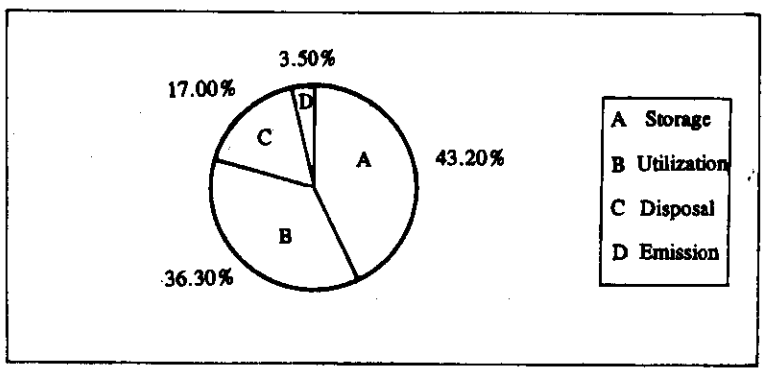

Fig. 4 Outlets of industrial waste (in FY 1993; Almanac of China's Environment, 1994)

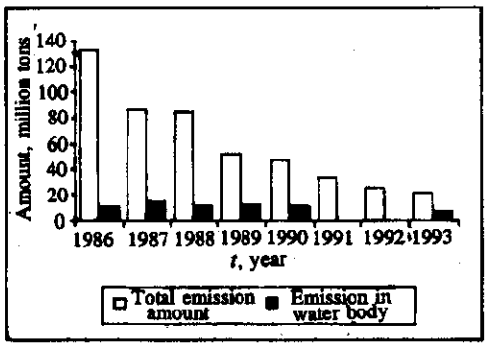

Fig. 5 Situation of industrial waste emission (Almanac of China's Environment, 1990; 1991; 1992; 1993; 1994)

was removed from the environment, while the other 46.7% (0.3 billion tons) was still kept in it. Because of the late start of solid waste pollution control, the low level in treatment and disposal technology and lack of funds and experience, most of this part were simply piled up without any control of leaking, spreading and running off, which caused potential pollution to water and air. Up to 1993, the total accumulated amount of industrial waste has reached 6.0 billion tons, which occupied an area of 52 km^2, including arable land 41 km^2 (Almanac of China's Environment, 1994). Encouragingly, the amount of emission was greatly reduced in the past few years (Fig. 5). However, there was still 7.4 million tons of industrial waste discharged into the water body, which seriously polluted the water and led to the reduction of lake area.

This situation resulted in contamination of ground and surface water, and endangers the human health and the environment. As a result, pollution accidents frequently happen, more than 100 accidents every year, which caused great loss to national economy (Nie, 1994). For example, the chromium residual storage site in Jinzhou City has caused ground water pollution in an area of about 12.5 km long by 1 km wide, and made more than 1800 surrounding wells undrinkable in the 1980s.

2.3 Comprehensive utilization

Owing to the strengthened macro-management and a series of incentives for comprehensive utilization, conspicuous progress has been made in this respect (Table 2). Since 1980, the total amount of comprehensively utilized industrial waste is steadily increasing, and the utilization ratio has exceeded 35% since 1991. Comprehensive utilization of industrial waste not only alleviated the crisis of pollution, but also produced great economic benefits.

Table 2 Comprehensive utilization of industrial waste

Time	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Total amount, Mtons	95.3	121.1	147.3	137.1	147.1	161.3	169.4	222.9	255.5	248.3
Utilization rate, %	22.0	26.2	24.4	25.6	26.2	28.2	29.3	37.9	37.0	36.3

Source: Almanac of China's Environment, 1990; 1991; 1992; 1993; 1994; Nie, 1994

However, the utilization ratio is still quite low compared with the developed countries. And the current technologies adapted to this field still limited to the production of building materials, road construction materials and agricultural use with some kinds of industrial waste such as slag, powdered coal ash, coal gangue and tailings (Nie, 1994). It is very urgent to develop high technologies for industrial waste utilization.

3 Progress in industrial waste management in China

Industrial waste management is a complicated system involving in administration, finance, legislation, planning, science and technology. Although industrial waste in China started late, Chinese government has realized that it is very important to rely on the legislation system, the scientific and technological progress and the economic measures to improve it. At the beginning of the 1990s, the principle of industrial pollution prevention was established, which emphasized the basic strategic change from end-of-pipe control to overall process management, and proposed the implementation of clean production. From then on, great strides have been made.

3.1 Establishing legislation system as the foundation of industrial waste management

From the beginning of the 1990s, Chinese government has paid more and more attention to the prevention of solid waste pollution. Up to now, a series of laws, regulations and standards have been issued (NEPA, 1994), as listed below: regulation on the pollution control of PCBs in electric power and their waste; regulation on the pollution control during the manufacture of chromium compounds; management measures for the pollution control of tailings; regulation on declaration and registration of pollution emission; standards on the pollution control of waste in non-ferrous metal industry; standards on the pollution control of waste containing PCBs; standards on the pollution control of power fly ash used in agriculture; standards on the pollution control of waste containing cyanide;

China is also one of the signatory of the Basel Convention. In order to fulfill the international obligations of China, "the Notice on Strict Control of Hazardous Waste Import from Abroad in China" has been issued, which stipulated that hazardous waste is prohibited being transferred into China to dispose, and some special materials import must be ratified by the NEPA.

In addition, the law of prevention and control of solid waste pollution has been drawing up and will be issued in the near future, the regulation on hazardous waste management and other laws and regulations are being drafted.

In a nutshell, the legislation system is becoming more completed and strengthened.

3.2 Taking administrative measures to consummate industrial waste management system

In order to take control of industrial waste from generation, collection, storage, utilization, treatment to final disposal, three main administrative measures are being taken: declaration and registration system, waste exchange, and manifest tracking system.

3.2.1 Declaration and registration system

From 1991, China EPA has started the trial project of solid waste declaration and registration in 17 cities including Beijing, Tianjin and Shanghai and so on. 10688 enterprises have taken part in the project and the registered waste accounted for 15.6% of the total generated solid waste in China (NEPA, 1994).

Through the trial, the waste sources and waste distribution in these cities were learned

clearly, which made a great step forward for the exchange, recycling, treatment and disposal of solid waste, and laid a good basis for the overall process management of solid waste.

3.2.2 Waste exchange

According to more than 20 years practice abroad, the waste exchange system has many advantages: reducing the waste disposal cost, saving raw materials, recovering resources and preventing environmental pollution. So the NEPA and the local authority have actively conducted the work of waste exchange. At present, some special organizations for waste exchange have been developed and achieved good economic and environmental benefits in Shenyang City, Shanghai City, Shenzhen City and Beijing City. For example, a waste acid and alkali exchange center of Shanghai was established in 1989. There has been 20000 tons waste acid and alkali being exchanged and comprehensively utilized so far (NEPA, 1994; Ma, 1994).

3.2.3 Manifest tracking system

In order to improve environmental management and develop an efficient management system for hazardous waste adapted to the situation of China, the NEPA selected Shanghai as an experimental city implementing the manifest tracking system for hazardous waste management (NEPA, 1994). The system record and track the whole waste management process from waste generation, exchange, transportation, utilization, treatment to final disposal, so as to ensure environmental safety. As it can provide the local EPA with a clear description of waste, it has become one of the key components of waste management.

3.3 Developing effective technologies for industrial waste treatment, disposal and recycling

It is of great necessity to develop economic and effective technologies for industrial waste treatment, disposal and reuse. Being aware of it, Chinese researchers are taking active measures.

In the Eighth Five-year Plan of the National Science and Technology Research Project, the treatment and disposal technologies are accentuated. Some technologies, including treatment of electroplating sludge and the wastes containing chromium, PCBs, solidification and security landfill have been listed in it. Research and construction of demonstration engineering of hazardous waste landfill were carried out in Shenyang City and Wuxi City. Owing to the World Bank's loan and partial domestic funds, several centralized disposal facilities of hazardous waste will be constructed in Shanghai City, Beijing City, Shenyang City and Southern Jiangsu Province (Nie, 1994).

At present, several demonstration projects on centralized utilization of hazardous waste have been established in Shanghai City, Beijing City and Shenzhen City to reuse waste oil, waste solvent, waste acidic and basic solutions, electroplating waste solution and sludge, chromium residue, mercury compounds and so on. In addition to this, some other demonstration engineering will be established in the next few years (Ma, 1994): producing charmium steel from chromic slag; producing building materials from electroplating sludge; producing chemical industrial materials from salt bath residue in heat treatment; recovering arsenic from arsenic slag and roasting slag in non-ferrous smeltery; using flammable wastes as fuel

of cement pit and so on.

It is no doubt that all these will greatly facilitate the industrial waste management in China.

4 Problems and countermeasures

4.1 Problems

Despite the fact that China has made a lot of progress in industrial waste management, there still exist many problems. With the rapid development of economy, the amount of industrial waste has tended to increase year after year, which makes the control of industrial wastes more difficult and urgent.

4.1.1 The production process in lagging behind and the waste quantity of unit product is much more than that in the advanced countries.

For a long time, the development mode of Chinese economy is characterized by large amounts of resource consuming, which results in high investment, high consumption, high pollution and large quantities of solid waste generation. This not only causes waste of resource, but also bring much trouble in controlling industrial waste pollution.

4.1.2 The laws, regulations and standards on industrial waste management are incomplete.

At present, the existing laws are not systematic, far from meeting the demand of management. This directly hinders the implementation of the concrete management systems and control measures.

4.1.3 The basic situation of industrial waste is not mastered clearly.

Except some special wastes (e.g. PCBs) and the cities that have implemented the waste declaration and registration system, many regions have no clear knowledge on the kinds, generation, treatment and disposal of their industrial wastes yet.

4.1.4 Technical and economic policies for industrial waste control cannot meet the demand of management.

There is no complete set of technical and economic policies for industrial waste pollution control. And it is urgent to research the environmental economic policies under market economy.

4.1.5 There is a lack of treatment and disposal facilities and high technologies.

So far there has been almost no waste treatment and disposal facilities reaching the environmental protection standards in China. Most of the current technologies are in a low level and secondary pollution problems are still very serious.

4.2 Countermeasures

In order to change the out-of-date situation of industrial waste management in China, the following measures will be taken as quickly as possible:

(a) to establish a complete environmental legislation system on industrial waste management;

(b) to transform end control into integrated management of industrial waste, and to promote cleaner production to minimize the waste quantity;

(c) to strengthen comprehensive utilization of industrial waste;

(d) to carry out waste declaration and registration system, waste exchange and manifest tracking system in a national scale;

(e) to develop and popularize economical and effective technologies suitable for the situation of China for industrial waste treatment and disposal;

(f) to facilitate the cooperation with other countries to refer to their advanced technologies and experience.

References

Almanac of China's Environment 1990, Chinese Environmental Science Press, 1990

Almanac of China's Environment 1991, Chinese Environmental Science Press, 1991

Almanac of China's Environment 1992, Chinese Environmental Science Press, 1992

Almanac of China's Environment 1993, Chinese Environmental Science Press, 1993

Almanac of China's Environment 1994. Chinese Environmental Science Press, 1994

Almanac of China's Economy 1993. Economic Management Press, 1993

Nie YF, Hu SR. Hazardous waste management and disposal in China, Proceedings of the 2nd China and German symposium on environmental protection. Beijing, 1994:120

NEPA, Final report of the economic analysis and management research for the regional hazardous waste centralized disposal. China, 1994. March

Ma HC. Centralized Utilization of hazardous waste in China. Proceedings of the international workshop on hazardous waste management. Beijing, Shanghai. December, 1994:104

(Received March 23, 1995)