ENVIRONMENTALLY SOUND MANAGEMENT OF SOLID WASTES

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Summary

Because of obsolete production equipment and old technology, the generation of industrial solid wastes in China is very high. The rates of treatment, disposal and comprehensive utilization of industrial solid wastes are relatively low, so that a large volume goes to landfill. On the other hand, since the late 1970s, the urbanization process in China has speeded up; the numbers of cities and the urban population has increased rapidly, leading to substantial increase in municipal solid wastes. The funds used for solid waste pollution control are woefully inadequate, so sound control of solid wastes is at a low level, leading to serious environmental problems.

In order to prevent and control solid waste pollution, the state has issued a set of related laws and regulations, especially Solid Waste Pollution Prevention and Control Law issued in 1995. Furthermore, the state has taken several measures to promote minimization, recycling and decontamination of solid wastes, and has made great achievements. For example, the generation of industrial solid wastes trends to stability, and the comprehensive utilization of solid wastes has continuously increased. In addition, many cities have substantially increased investments in environmental sanitation work. All these lay a fine foundation for environmentally sound management of solid wastes.

1. Definition and Classification of Solid Wastes

Solid wastes refer to all kinds of solid-state and semi-solid-state wastes generated from industrial, domestic and other activities. Solid-state wastes refer to wastes with certain forms, volumes and occupying certain spaces, such as industrial waste residues, tailings and municipal solid wastes. Semi-solid-state wastes refer to sludges which do not come within the management of waste gases or water. These include various industrial oily sludges, water treatment sludge, human and animal feces and urine from urban and rural areas, and so on. For convenience of environmental management, hazardous waste liquids, such as waste acid liquor, waste alkali, and waste gases held in containers come under the management category of solid wastes. Solid waste can be classified in various ways according to different standards and perspectives, but there are two main classifications that are of significance to solid waste management and control:

According to their sources, solid wastes can be classified as industrial wastes, agricultural solid wastes and municipal solid wastes. According to harmfulness and hazard degree, they can also be classified as either general wastes or hazardous wastes. General solid wastes refer to all solid wastes with no special harmfulness generated from production, domestic and other activities. Hazardous solid wastes refer to wastes which are potentially explosive, inflammable, toxic, corrosive, chemically reactive, radioactive, or infectious.

2. Characteristics of Solid Wastes

The kinds of solid wastes are numerous, and their compositions are complex. Many solid wastes with the same properties as some natural materials can be used as substitutes for natural resources. In addition, most solid wastes have certain shapes, so handling is usually simpler than waste water and gases. This means that it is easier to collect and transport solid wastes, and they are more convenient for storage, utilization, treatment and disposal.

Solid wastes may cause air, water and land pollution. The impact of solid wastes on the environment mainly depends on the management policies applicable to them. Through comprehensive utilization, solid wastes could become valuable and inexhaustible resources.

3. Situation of Solid Wastes in China

3.1. Industrial Solid Wastes

Large quantities of industrial solid wastes are generated in China. The current overall utilization rate is only about 45%, and the cumulative stack-up volume over the years now exceeds 6 billion tons, with an, and a relatively low disposal rate. Most industrial solid wastes are simply piled up, causing serious pollution of surface and ground water.

Management and macro-control of industrial solid wastes in China is the overall responsibility of the State Environmental Protection Administration (SEPA). Environmental management departments in various provinces, municipalities and autonomous regions are responsible for management of industrial solid wastes within areas under their jurisdiction. Statistics of generation amount, comprehensive utilization, discharge and other parameters of industrial solid wastes are produced annually. The situation of industrial solid wastes in China for recent years is shown in Table 1.

Years	Generation amount	Comprehensive utilization amount	Compre-hensive utilization rate	Stack-up volume	Cumulative stack-up volume	Area of land occupied	Discharge amount	Treatment Amount
	million tons	million tons	%	million tons	billion tons	(km^2)	million tons	million tons
1982	383.69	97.88	24.0		3.64	/	/	/
1985	484.09	121.10	23.0		5.07	/	/	/
1990	603.64	170.00	28.2	275.88	6.48	/	47.67	/
1991	587.59	222.84	36.6	275.88	5.96	505.38	33.76	116.96
1995	645.10	285.11	42.9	247.79	6.64	554.40	22.42	142.04
1997	657.49	300.09	45.6	279.80	6.47	506.50	15.49	108.76

Table 1. Situation of industrial solid wastes in China (1982 to 1997)

3.1.1. Total Generation Amount Trending towards Stability

In the past, a mode of high input and low output production had prevailed for a long time. Raw coal was used as the main energy source; its efficiency was only 30%, and most of it became ash and cinder which then had to be discharged. The iron and steel industry used 10 tons of ore to produce 1 ton of steel, so nearly 9 tons of tailings and slag were discharged. Other industries also used crude materials for production, and the generation of solid wastes increased in line with production. As shown in Table 1, the quantity of industrial solid wastes generated in 1982 was 383.69 million tons, it reached 484.09 million tons in 1985, increasing by more than 100 million tonsI, It then reached 603.64 million tons in 1990, another increase of more than 100 million tons.

Since the mid 1990s, in pace with deepgoing development of the national reform policy, the generation amount of solid wastes per unit product was substantially reduced, particularly in relation to the gross national product (GNP). For example, the quantity of waste per 10 000 yuan RMB of output value sharply reduced from 7.22 tons in 1982 to 2.36 tons in 1995. Since 1990, the annual average growth rate of the national economy has been 9.8%, but the annual quantity of solid wastes generated has been stabilized at about 600 million tons. On one hand, this is related to the reform of national industrial structure, such as development of tertiary and high-tec industries, and on the other hand, it has a close relation with industrial technical transformation. For example, the amount of slag generated by producing 1 ton of steel has reduced from 1 ton to about 0.5 ton. We can expect the amount of waste per unit product to further reduce as clean production and industrial ecology become more commonplace.

3.1.2. Relatively Big Development of Comprehensive Utilization

Since the late 1950s, slag, gangue, powered coal ash, etc. have been used to produce construction materials or have been directly used for construction projects. The quantity of industrial waste residue used was 97.88 million tons in 1982, with a utilization rate of 24%, of which, the utilization rate of blast furnace slag was 83%. In recent years, comprehensive utilization of solid wastes has developed rapidly in the wake of economic and technical development. It may be seen from Table 1 that the utilization amount of solid wastes in 1997 was more than three times of that in 1982. From 1986 to 1997, about 2 billion tons of various kinds of industrial solid wastes have been utilized, representing an equivalent saving of natural resources, and making a useful contribution to national sustainable development.

Among comprehensive utilization of various kinds of wastes, the utilization of blast furnace slag and powered coal ash have been the greatest. In particular, the utilization of powered coal ash has developed rapidly. The generating production in 1995 was twice that of the early 1980s, but the utilization amount of powered coal ash from power plants with generating capacity of more than 6MW increased from 7.81 million tons/year to 41.45 million tons/year, an increase of more than five times. The utilization rate increased from 20.7% to 41.6%. The national utilization rate of powered coal ash was even higher, reaching 51.1%, being equal to 64.41 million tons.

From 1991 to 1995, the total amount of industrial solid wastes utilized in the whole country was 1 164 290 million tons, resulting in considerable economic benefit. For example, blast furnace slag has become an essential raw material for the cement industry. Utilizing 1 ton of watered slag is equivalent to increasing production of 1 ton of cement and a saving of 0.2 TCE. Furthermore, use of this material improves sulfate resistance and long-term strength of concrete. Another example is that producing 100 million lumps of clay bricks by traditional methods needs to excavate 6.67 hectares of good land. If 80% of powered coal ash, slag or gangue is used to make bricks, it will not only save soil, but also save more than 50% of the energy, and improve heat insulation properties of walls. Using powered coal ash, cinder and slag to build highways will not only save sand and soil, but also improve durability and wearability of highways.

3.1.3. Annual Stack-up Volume Trending towards Stability

In the past, industrial solid wastes mainly piled up, occupying a lot of land. As industrial production developed, more and more industrial solid waste was stacked. After 1990, comprehensive utilization developed relatively rapidly, and the generation rate of wastes per unit product reduced. Many enterprises set up treatment facilities for solid wastes, and the annual stack-up volume of solid wastes reduced from about 400 million tons in the 1980s to 250~280 million tons at present. Around 120~180 million tons of solid wastes are treated by methods of simple landfill, etc. The environmental pollution caused by industrial solid wastes has, to some extent, been checked.

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Bibliography

China Encyclopedia Press (1983). Volume of Environmental Sciences of China Encyclopedia. *This is a reference book on environmental sciences.*

China Environmental Science Press (1985). China’s Environmental Impact Projection and Countermeasure Studies in the Year 2000. *This presents the study report on China’s environment in the year 2000.*

China Environmental Science Press (1991). China’s Environmental Yearbook (in Chinese). *This provides the comprehensive environmental information in China in 1990.*

China Environmental Science Press (1992). China’s Environmental Yearbook (in Chinese). *This provides the comprehensive environmental information in China 1991.*

China Environmental Science Press (1994). China’ Agenda 21 (in English). *This is the white paper on China’s population, environment and development in the 21st century.*

China Environmental Science Press (1996). China’s Environmental Yearbook (in Chinese). *This provides* *the comprehensive environmental information in China 1995.*

China Environmental Science Press (1998). China's Environmental Yearbook (in Chinese). *This provides the comprehensive environmental information in China 1997.*

China Environmental Science Press (1998). Countermeasures for Environmental Pollution Control in China (in Chinese). *This presents the policy, management and technical measurements for controlling environmental pollution in China.*

The National Environmental Protection Agency (1983). Environmental Statistics (in Chinese). *This provides the environmental statistics in China in 1982.*

The National Environmental Protection Agency (1986). Environmental Statistics (in Chinese). *This provides the environmental statistics in China in 1985.*

Biographical Sketches

Qing Shi, Senior Engineer. She graduated from Tsinghuan University in 1955. She was engaged in research into industrial waste residue in the Academy of Construction Research of Ministry of Metallurgical Industry from 1955 to 1981. She carried out research entitled 'Environmental Impact Projection and Countermeasure Studies for Solid Wastes in the Year 2000', in the Chinese Academy of Environmental Sciences during the period of 1981~1984. Since 1985, she has been engaged in management of solid wastes in the former National Environmental Protection Agency (now the State Environmental Protection Administration).

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