

Industrial Waste Management in Taiwan

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Abstract

With the growth of its increasingly industrial economy, Taiwan now finds itself struggling with the plague of developed countries—what to do with all that trash. Scant data on actual volumes of various types of solid waste, including hazardous materials and infectious medical waste, make waste-management planning a daunting challenge for this island country. Compounding the absence of data is the absence or inadequacy of treatment facilities and final disposal sites. This article discusses the current status of solid waste management in Taiwan and some of the ways the government of Taiwan, through the Taiwan Environmental Protection Administration (Taiwan EPA), is dealing with the problem. By encouraging waste source reduction and minimization, resource recycling, and corporate responsibility, as well as making state-of-the-art technological upgrades, the Taiwan EPA is striving for significant reductions in the volumes of solid waste produced. These efforts will, in turn, increase handling capacity and raise the percentage of properly treated and disposed solid waste.

Background and Current Status

With Taiwan's economic growth and technical advancement, the nature of the domestic economy is moving from agricultural to industrial. An increase in the production of solid waste has been a significant part of this shift. Industry is now the source of most waste production in the country. This new waste contains multiple substances and exists in quantities many times greater than municipal waste. Consequently, problems caused by industrial waste are far more complex than those encountered during the agricultural era.

The waste produced by industrial factories, agriculture, medicine, and other business organizations, is collectively called enterprise waste. It is estimated that 28.92 mil-

lion tons of enterprise waste is produced each year in Taiwan. Table 1 shows how this total is divided between industrial waste, medical waste, and agricultural waste. This article concerns itself mainly with the industrial waste component: 18.21 million tons of industrial waste are produced annually, of which 1.47 million tons are hazardous waste.

Taiwan's topography and the location of its major cities are shown in Figure 1. The country has an area of 35,980 sq. kilometers (14,000 sq. miles) and a population of 21.9 million people. Most of Taiwan's inhabitants live along the western coast and the northern tip of the island. Figure 2 and Table 2 show how much industrial waste is produced in each of Taiwan's major regions. Nearly half of the 18.21 million tons of industrial waste produced throughout the country each year is generated around the southwestern coastal cities of Tai-nan, Kang-shan, Kaohsiung, and Feng-shan. At the northern tip of Taiwan, the capital city of Taipei follows by generating approximately 5 million tons of solid waste annually.

Of major concern is the proper handling of waste generated. Note from Table 1 that, while approximately 90% of infectious medical waste is being disposed of properly, only about 62% of industrial waste is handled appropriately. Thus, there are approximately 7 million tons (38% of the 18.21 million tons) that are in urgent need of proper handling.

What is happening to this waste that is not being properly handled? In recent years, short production cycles and ineffective methods for tracking the production of this waste have led industry to create its own unauthorized or illegal solid waste dump-

sites. Such sites have been discovered at locations such as San-Ying Bridge, Tashu Hsiang, and Laonong Creek, to name a few. These unmonitored, illegal sites may contain hazardous materials, which make them toxic and dangerous to both humans and the environment.

How the Current Situation Arose

There are many reasons for the problems Taiwan is experiencing in dealing with its solid waste, and all of them have contributed to making solid industrial waste management a major challenge in protecting Taiwan's environment.

Industries in Taiwan are predominantly small to medium-sized and often lack not only the knowledge of how to properly dispose of their waste products, but also the technology, space, personnel, and financial resources for doing so. Indeed, many businesses do not even realize that proper disposal of their waste products is their responsibility. To make matters worse, most of these industries are unconvinced of the benefits of waste management, with only a small percentage of them being willing to take on proper waste management practices. Many of these industrial companies refuse to act in a responsible manner, choosing instead to dump illegally or contract with a low-budget waste handling service that may not follow appropriate treatment and disposal protocols. And, because Taiwan's waste handling industry is still in its infancy, the regulatory structure for handling such situations is likewise not yet mature.

Hindering the development of a waste handling service industry are huge quantities of waste and a wide diversity of waste types, as well as ineffective monitoring methods

Table 1. Status of enterprise waste management in Taiwan

	Total Waste (thousands of tons)	Hazardous Waste (thousands of tons)	% Properly Handled
Industrial Waste	18,210	1,470	62%
Medical Waste	90	13.5 (infectious)	90%
Agricultural Waste	10,620		
TOTAL	28,920	1,483.5	



Figure 1. The topography and major cities of Taiwan. The eastern two-thirds of Taiwan is mountainous country with dense jungle covering most of its interior territory. The mountains slope gently into flatlands along the island's western coast. Only 24% of the island is arable and the climate is maritime subtropical. Most of Taiwan's 21 million inhabitants live along the western coast and northern tip of the island (1998 CIA World Factbook, www.cia.gov). Map layout by Susan Harris from original map by CIA, taken from Perry-Castañeda Library Map Collection, The University of Texas at Austin, www.lib.utexas.edu/Libs/PCL/Map_collection/Map_collection.html

and poor technology. Moreover, an enormous discrepancy exists between waste handling capacity and the volumes of waste actually produced. Difficulty in obtaining land for landfills, few financial incentives, high financial risk, and the protests of local communities are the principle reasons for this discrepancy.

What Is Being Done

In an effort to bring waste disposal problems under control, the government of Taiwan, through the Taiwan EPA, is implementing a number of programs. These programs include elements of education, monitoring and regulation, tax incentives, and financial assistance.

In an attempt to decrease illegal dumping, a Pollution Audit Enforcement Plan, aimed at large enterprises has been created and will be implemented in phases. Its efforts will be prioritized according to the degree of hazard posed by the waste of a particular business. At the same time, existing data from various entities will be collected, workshops and seminars held, and media campaigns undertaken to announce the Plan's measures. Additionally, the Taiwan EPA has established a task force for the prevention of illegal dumping. This task force is charged with assisting local environmental protection offices to efficiently analyze and handle pollution problems arising from illegal dumping.

It is only recently that an awareness of the waste management issues in Taiwan has brought about legislation to deal with the problem. However, now the Solid Waste Disposal Law imposes serious penalties on those who cause harm to the environment or death or serious injury to humans through capricious dumping or inappropriate clean up and treatment methods. The law states that criminal charges will be levied against offenders.

In addition to providing financial incentives to cooperating waste-handling service operators in the form of reduced taxes and similar measures, the *Five-year Industrial Waste Management Plan*, put out by the Taiwan EPA and the Ministry of Economic Affairs, provides technical guidance and

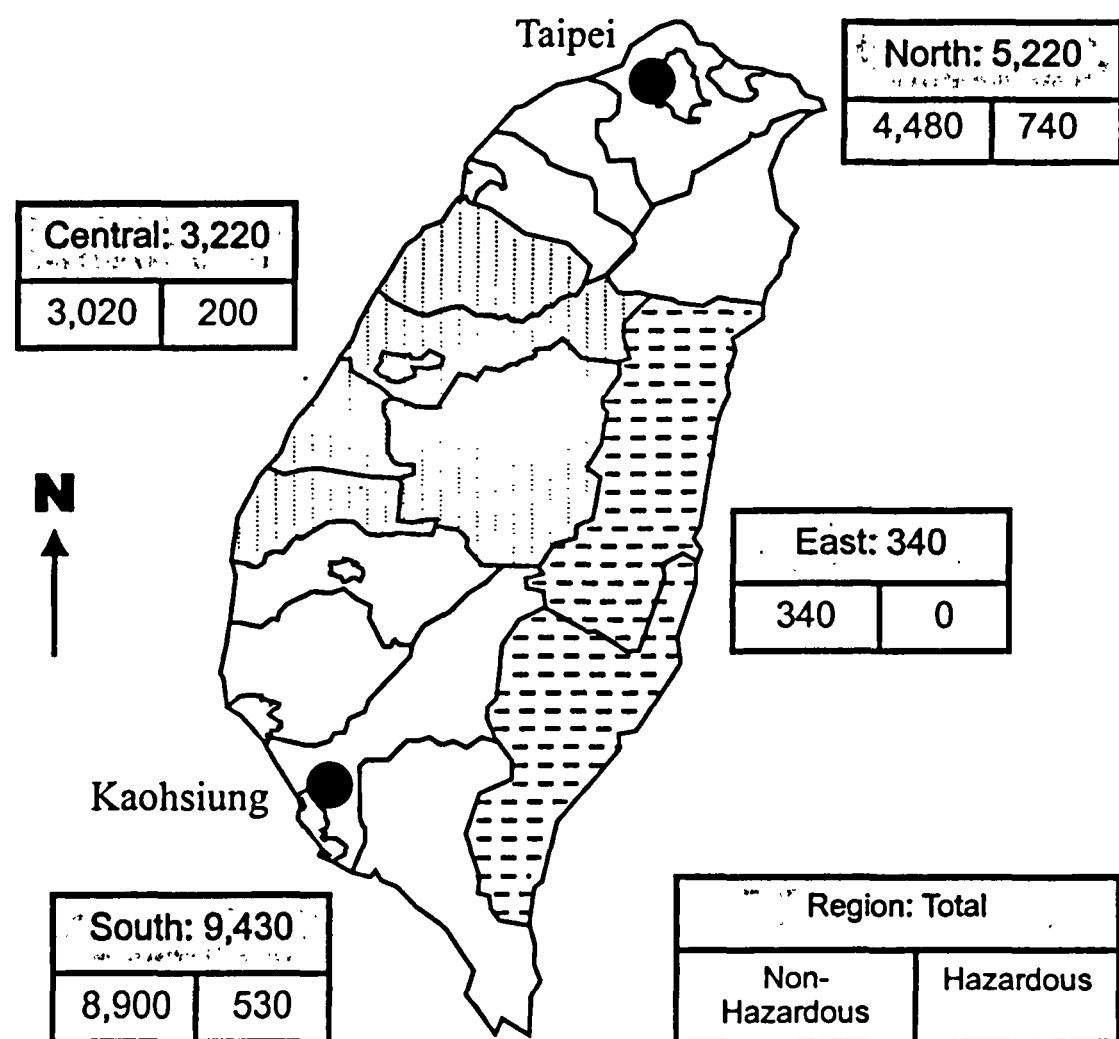


Figure 2. Industrial waste generated in various regions of Taiwan (thousands of tons per year).

Table 2. Status of industrial waste management by region in Taiwan (thousands of tons per year)

	North	Central	South	East	Total
Non-hazardous	4,480	3,020	8,900	340	16,740
Hazardous	740	200	530	0	1,470
TOTAL	5,220	3,220	9,430	340	18,210

training to assist and encourage waste producers to cooperate in proper waste handling protocols. Installation of treatment centers within industry- and science-based parks is promoted and guidance on the proper siting for treatment and final disposal sites within the parks is provided to industry to help it effectively manage industrial waste.

Major efforts are being directed toward waste reduction, or minimization. These efforts include education on recycling and ways to reduce waste production, as well as the reuse of industrial waste. The reuse of industrial waste as raw material would not only relieve pressure on the waste treatment systems in Taiwan, but also make bet-

ter use of resources. To promote waste reduction and reuse, the Taiwan EPA recommends implementation of the following measures:

- planning and publicizing general industrial waste reuse types and procedures;
- simplification of approval for reuse of non-promulgated resource categories;
- promotion of industrial waste exchange information services; and
- guidance to industry on waste minimization and appropriate clean up methods.

The *Five-year Industrial Waste Management Plan* gives an estimate of the growth rates and rates of waste minimization for

various industries. It is expected that with a waste minimization rate of 4.55%, Taiwan will be producing 18.36 million tons of industrial waste annually by 2001, and 19.44 million tons by 2006. Without waste minimization efforts, the total will rise to 21.22 million tons by 2001 and 28.1 million tons by 2006.

Categories and types of industrial waste are extremely complex. The government of Taiwan is working with waste handling service operators to establish joint or unified treatment systems and to coordinate, within its own industry, ways to solve the problem of land acquisition for disposal sites. Prior to completion of these waste treatment centers, waste-handling services will be encouraged to construct temporary holding areas while construction of permanent treatment facilities is completed.

Determining the sites of facilities for final disposition of waste is of extreme urgency. Due to the low rate of return on investment and the long time needed to recoup that investment, the high risk involved, and the protests of citizen groups, it is difficult to find such sites.

The Taiwan EPA initially plans to use a privately owned, privately operated model to promote siting of such facilities. If private enterprises have difficulty making the investment, public entities may provide assistance in obtaining land, and government funds may be provided to assist with the cost.

To help reduce the discrepancy between treatment/disposal capacity and the huge volumes of waste being produced, the Taiwan EPA has simplified its application procedures and simultaneously raised financial incentives and tax breaks. Through June 1997, 1175 private and public Type One and Type Two haulers were in operation, along with 78 treatment firms, with a total annual capacity for treating and disposing of 3.2 million tons of solid waste. Type One haulers are those permitted to handle hazardous waste, while Type Two haulers are those permitted to handle only general industrial waste.

To further assist in bringing waste management under control in Taiwan, a Waste

Control Center is being established. The Center will use Internet-based application and control systems to monitor industrial waste clean-up in real-time, and plans are underway to research the use of a satellite geographical positioning system to improve tracking of industrial waste clean up.

Prospects for the Future

With vigilant monitoring and the participation of industry, citizens, and private waste management groups, illegal dumping can be prevented and the goal of proper treatment of all industrial waste can be achieved. The Taiwan EPA is using the Industrial Waste Control Center to improve its enforcement structure, and to provide guidance to private investors who establish waste cleanup and treatment organiza-

tions, industrial waste storage centers, and final disposition sites. The Taiwan EPA hopes to encourage sustainable management for those enterprises whose business is environmental protection; to effectively manage waste clean up; and to raise the percentage of waste treated appropriately. Keeping environmental protection and economic development at the forefront will help Taiwan accomplish these goals, which, in turn, will improve the image of Taiwan's business enterprises and raise the competitiveness of Taiwanese products.

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