JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
DEPARTMENT OF INDUSTRIAL WORKS
MINISTRY OF INDUSTRY
THE KINGDOM OF THAILAND

THE STUDY ON MASTER PLAN ON INDUSTRIAL WASTE MANAGEMENT IN THE BANGKOK METROPOLITAN AREA AND ITS VICINITY IN THE KINGDOM OF THAILAND

REPORT OF THE STUDY ON THE USE OF WASTE BLENDERS IN JAPAN WITH PARTICULAR ATTENTION TO REGULATIONS

NOVEMBER 2002

KOKUSAI KOGYO CO., LTD.
EX CORPORATION

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The Study on Master Plan on Industrial Waste Management In the Bangkok Metropolitan Area and its Vicinity In the Kingdom of Thailand

List of Volumes

Volume I	Summary
Volume II	Main Report
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Volume IV	Report of the Study on the Use of Waste Blenders in Japan with Particular Attention to Regulations

This is the Report of the Study on the Use of Waste Blenders in Japan with Particular Attention to Regulations.

Exchange Rate Used in the Report
US$ 1.0 = 43 Bahts、1 Yen = 0.3 Bahts

The Study on the Use of Waste Blenders in Japan with Particular Attention to Regulations

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LIST OF ABBREVIATIONS

A/P	Action plan
BMA	Bangkok metropolitan administration
C/P	Counterpart
DB	Database
DF/R	Draft final report
DIW	Department of industrial works
FIRR	Financial internal rate of return
F/R	Final report
FTI	The Federation of Thai industries
GIS	Geographic information systems
HW	Hazardous waste
IC/R	Inception report
IEAT	Industrial estate authority of Thailand
ISIC	International standard industrial classification
IT/R	Interim report
IW	Industrial waste
IWM	Industrial waste management
JICA	Japan international cooperation agency
LC	Local consultant
M/M	Minutes of meetings
M/P	Master plan
MOI	Ministry of industry
MOPH	Ministry of public health
MOSTE	Ministry of science, technology and environment
MW	Municipal waste
MWM	Municipal waste management
NSEDP	National Social and Economic Development Plan
NGO	Non-Governmental organization
Non-HW	Non-hazardous waste
NPV	Net present value
OEPP	Office of Environmental Policy and Planning
O&M	Operation and maintenance
P/P	Pilot project
P/R	Progress report
PCD	Pollution control department
POS	Public opinion survey
S/W	Scope of work
TEI	Thai Environment Institute
TSIC	Thailand standard industrial classification
WUDC	Waste Utilization Data Center

1 Introduction

1.1 Background and Objectives

1.1.1 Background

The pressing issue in hazardous waste management (HWM) in the study area is how to make up for the current shortage of capacity to appropriately reuse, recycle, treat or dispose of HW off-site. The issue is particularly critical for the export-oriented industries which are required to strictly follow ISO14000. Besides, according to the questionnaire survey conducted by Japanese Chamber of Commerce, Bangkok (JCCB) to Japanese manufacturers in Thailand, HWM is the most serious issue they confront.

Under such a present condition, the team strongly recommended the DIW to promote the use of cement factories for the following reasons.

- The use of cement factories, which use waste as alternative raw material or fuel, promotes waste reuse/recycling and compensates the shortage of HW management facilities.
- Since existing cement factories can be used, it is unlikely to face protest by the local people.

Recognizing in this way, DIW has already approved the registration of two cement factories as a factory of Code 101 "central waste treatment". Nevertheless, HW received at the cement factories is still limited in volume. It is because the cement factories only receive waste whose quality and quantity are guaranteed not to hamper cement production.

Waste from one factory may not satisfy the requirement of the cement factories, but waste from several factories, if appropriately blended, can be accepted by them. Technology and facilities to blend waste and adjust its quality and quantity is necessary to construct a recycling system with the cement industry in the center. In order to promote waste reuse/recycling at the cement factories, DIW needs to urgently foster the blending industry.

The blending industry which serves for the cement factories has just emerged in Thailand and its function is still limited. To promote their activities, DIW requested the team to study the situation of waste blenders in Japan paying attention to regulations, prepare a report, and examine how to improve legislation in Thailand to strengthen the blending industry.

1.1.2 Objectives

This study component has the following objectives.

- Compilation of the information in a report on the waste blenders in Japan with particular attention to regulations.

- Presentation of proposals to improve regulations of Thailand through discussion with the C/P based on the aforementioned report for the purpose of the encouragement of waste reuse/recycling at the cement factories.

1.2 Work Plan

1.2.1 Procedure

a. The Fifth Study Work in Japan (until May 19)

The team studied how waste blenders in Japan are used to promote waste reuse/recycling at the cement factories without hampering cement production with particular attention to regulations.

b. The Fifth Study Work in Thailand (May 20 to June 28)

Based on the result of the fifth study work in Japan, the team prepared this progress report in both English and Thai, and explained the report to the DIW in order to examine the applicability of Japanese regulations to Thailand.

The work followed the process below.

1. Preparation of the progress report by the team on the use of waste blenders in Japan with particular attention to regulations.
2. Explanation of the report, discussion, and consensus making.
3. Examination of the necessity for the DIW personnel to carry out a study to confirm the report content.
4. On the acknowledgement of the necessity of the DIW's study, formulation of a study plan, discussion, and consensus making.

c. The Sixth Study Work in Japan (June 29 to September 10)

The team reviews the comments from the DIW in regard to the report on the use of waste blenders in Japan and their applicability to Thailand, and carries out supplemental studies. In case where the DIW's study to confirm the report content is recognized necessary, the team arranges the study.

Based on the results of these works, the team prepares a draft final report in English and Thai.

d. The Sixth Study Work in Thailand (September 11 to 19)

The team presented the draft final report on the blending industry, and discusses with the C/P. The C/P and the team signed the minutes of meeting to clarify the discussed issues.

1.2.2 Schedule

The work schedule is as follows.

Table 1-1: Schedule of the Study on Regulations related to the Use of Waste Blenders in Japan and their Applicability to Thailand

Item	Schedule
1. Study on the use of the waste blenders in Japan with particular attention to regulations	From the middle of April to the middle of May
2. Preparation of the progress report on regulations related to the use of waste blenders in Japan	In the beginning of June
3. Report presentation and discussion	In the middle of June
4. Study by the DIW personnel to confirm the report content, if the study is necessary.	In the beginning of July
5. Preparation of the draft final report	In the middle of August
6. Presentation and discussion of the draft final report	In the middle of September
7. Submission of the final report	In the beginning of November

2 The Use of Waste Blenders in Japan and Related Laws

2.1 The Use of Waste Blenders in Japan

2.1.1 Waste Reuse at Cement Factories

Cement factories in Japan have been utilizing waste from other industries as alternative fuel or raw material for more than 100 years, since this brings economic benefit compared with the use of coal or raw minerals. Waste conventionally used at the cement factories mainly include gypsum in flue gas, blast furnace slag, and fly ash.

Since the 1980s, waste reused at cement factories as alternative fuel or raw material has been diversified to include waste tires, plastic waste and sludge from sewage treatment plants in order not only to save the cost for cement production but also to extend its business to industrial waste treatment.

The table below shows the amount of waste used at the cement factories in Japan. As shown here, the total amount of waste received at cement factories from the other industries is 27 million tons annually (in fiscal year 2000 in Japan). This means that 6% of industrial waste generated in Japan (400.54 million tones from April 2000 to March 2001) substituted for fuel or raw material of the cement industry.

Table 2-1: Amount of Waste Used by the Cement Industry

Waste	Utilization	1996.04 - 1997.03	1997.04 - 1998.03	1998.04 - 1999.03	1999.04 - 2000.03	2000.04 - 2001.03	Increase over the previous year's
Blast Furnace Slag	Raw Material	13,892	12,684	11,353	11,449	12,162	106.2
Coal Ash	Raw Material	3,402	3,517	3,779	4,551	5,145	113.0
By-product Gypsum	Raw Material	2,522	2,524	2,426	2,567	2,643	103.0
Sludge	Raw Material	930	1,189	1,394	1,744	1,906	109.2
Non-iron Slag	Raw Material	1,430	1,671	1,161	1,256	1,500	119.5
Revolving Furnace Slag	Raw Material	1,246	1,207	1,061	882	795	90.1
Soot & Dust	Raw Material	441	543	531	625	734	117.4
Low Quality Coal from Mine	Raw Material, Fuel	1,772	1,772	1,104	902	675	74.9
Molding Sand	Raw Material	434	542	454	448	477	106.4
Used Tire	Fuel	259	258	282	286	323	113.1
Reclaimed Oil	Fuel	137	159	187	250	239	95.6
Waste Oil	Fuel	126	117	131	88	120	136.1
Spent Activated Clay	Raw Material, Fuel	68	76	90	109	106	96.9
Waste Plastics	Fuel	13	21	29	58	102	176.8
Others	—	313	319	388	367	433	118.0
Total	—	26,985	26,599	24,370	25,582	27,360	106.9

Source: Yorimasa Uemori in "Environmental Facilities (Kankyo Shisetsu)" No.86 (2001)

2.1.2 The Use of Waste Blenders in Japan

In the 1980s, cement factories in Japan started to make positive effort to reuse waste. In parallel, waste blenders began to grow as a supporting industry of the cement industry. The burst of the economic bubble in Japan was an impetus to make the cement industry affirmatively expand its activity to waste business as a survival strategy. For cement companies, the role of the waste blenders, with whom waste mixing and adjustment expertise has been accumulated, is increasingly important.

The main business of the waste blenders is supplying alternative fuel and raw material to the cement industry, but they also supply their products to non-ferrous smelters depending on the types of waste. The waste amount reused/recycled by the non-ferrous smelting industry in Japan is shown in Table 2-2.

As the table shows, the non-ferrous smelting industry receives waste not only as raw material but also for treatment purposes. Some waste may be supplied to the smelters without involvement of waste blenders, but not a few types of waste are once blended and adjusted by waste blenders before supplied to the smelters. It is obvious that metal smelting is the main business of the smelters and waste treatment is merely the secondary business. It is worth noting, however, that waste treated by the smelters is twice as much as waste used as raw material.

Table 2-2: Waste Amount Reused/Recycled by the Non-Ferrous Smelting Industry in Japan (1999)

(Unit: thousand tons/year)

		Amount	Items
Input	Waste used as raw material	389	Waste copper, copper slag, zinc slag, lead slag, lead battery, precious metal slag, waste photographic sensitive material, waste electric parts, etc.
	Waste treated	855	Soot, sludge, waste oil, waste acid, waste alkali, waste plastics, metal scrap, contaminated soil, electric arc furnace dust, infectious waste, etc.
Output	Material recovered	358	Copper, zinc, gold, silver, cadmium, mercury, nickel, tin, ferrite material, etc.

Source: The Mining and Mineral Processing Institute of Japan

2.2 Regulations Related to Waste Blenders

2.2.1 Regulations Related to Industrial Waste

a. Waste Treatment Law and Relevant Regulations

The Waste Management and Public Cleansing Law (referred as Waste Management Law hereafter) is the primary law regarding waste management in Japan. This not only controls industrial waste but also prescribes the entire picture of regulations in regard to waste. The relationships of the Waste Management Law and other relevant regulations are as follows.

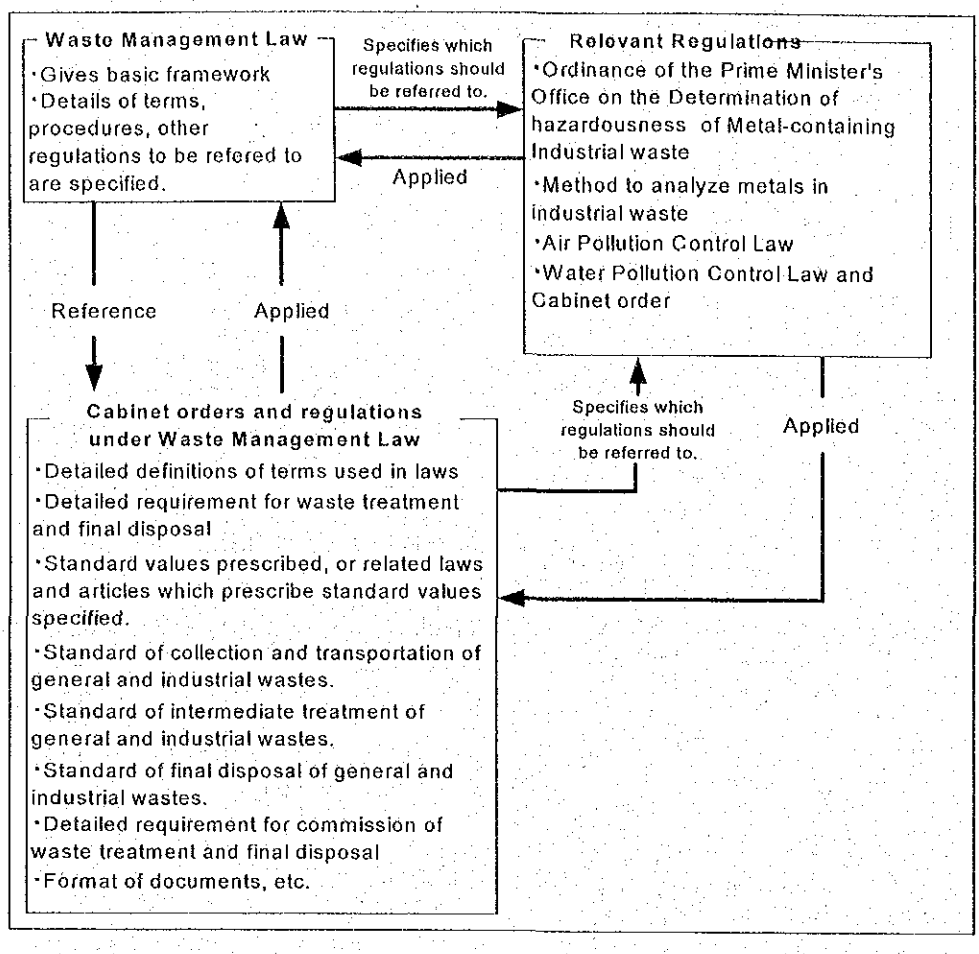


Figure 2-1: Relationships of Waste Management Law and Other Relevant Regulations

b. Definition of Industrial Waste

In Japan, waste is classified into two from the viewpoint of the generation manner and characteristics: industrial waste and general waste. The classification is stipulated by Waste Treatment Law, which controls waste from generation to final disposal. The waste classification is as shown in the next figure.

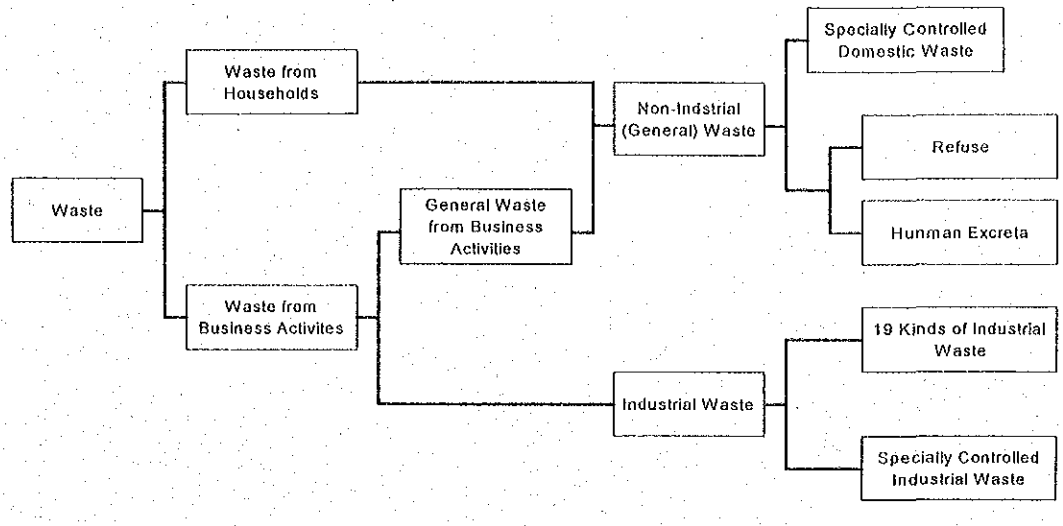


Figure 2-2: Classification of Waste

Among the wastes generated from business activities, kinds of waste stipulated in a cabinet order such as cinder and sludge are designated as industrial waste, and waste other than industrial waste is general waste. Waste that is explosive, toxic, infectious, or likely to harm human health or living environment is particularly called "specially controlled general waste" or "specially controlled industrial waste".

The concept of dividing waste into "industrial waste" and "general waste" is that waste that is generated from business activities, has potential risk to affect human health and the environment due to its quantity or quality, and is difficult for municipalities to appropriately treat is considered as "industrial waste", whereas "general waste" is the rest of waste. Therefore, "general waste" can include waste that comes from business activities and is treatable with the capacity of municipalities.

The classification of "specially controlled industrial waste" is shown in Table 2-4. Industrial waste is those which are listed not in Table 2-4 but in Table 2-3.

Table 2-3: 19 Classifications of Industrial Waste

Industrial Waste	Example
1 Ash	Coal ash, coke ash, incineration ash, etc.
2 Sludge	Residue sludge resulting from activated sludge wastewater treatment, carbite sludge and calcium sludge and calcium carbonate sludge from pulp waste liquid, other types of sludge either organic or inorganic.
3 Waste Oil	Lubricant oil, insulting oil, cutting oil, turpentine, etc.
4 Waste Acid	Sulfuric and Hydrochloric acid, etc.
5 Waste Alkali	Ammonia, Caustic soda, etc.
6 Waste Plastics	Plastic container, Synthetic fiber waste, Used tires, etc.
7 Waste Paper *	Paper, Cardboard, etc. from: • Paper, Pulp and Paper product manufactures, Printing, Publishing, Book binding and Newspaper industries • Construction industries
8 Waste Wood *	Wood ends, Saw waste, Bark, etc. from: • Lumber and lumber product manufactures, Furniture, Pulp and Lumber importing industries

	• Construction industries
9 Textile Waste *	Natural fiber waste such as cotton, silk, wool and flax, etc. from: • Textile industry (excluding apparel industry) • Construction industries
10 Animal and Plant Residues *	Candy pomace, Brewery waste, Animal and Fish bones, etc. from: • Food, pharmaceutical and Cosmetic industries
11 Waste Rubber	Natural rubber waste
12 Waste Metal	Steel, Tin plate, Zinc plate, Lead pipe, etc.
13 Waste Glass and Waste Ceramic	Bottles, Pottery, Brick, etc.
14 Slag	Furnace residue, Casting sand, Low-grade ore, etc.
15 Construction Waste	Broken pieces of Concrete, Brick, Tile and Asphalt from new construction, Reconstruction and Removal of Structures, etc.
16 Animals waste *	Urine and Dung from Livestock from Livestock industry)
17 Animals corpses *	Dead pigs, Cattle and Chickens from Livestock industry
18 Dust and Soot	Soot collected by dust collection equipment
19 Items in the above list that have been treated for disposal that are not referred to. Items encased in concrete.	

Note: Waste with * only concerns the waste from specific industrial sectors.

Table 2-4: Specially controlled industrial waste

Waste Oil	Volatile oils, Kerosene and Light oil (inflammable oils with flashpoint 70°C or below)
Waste Acid	Acidic waste having a pH of 2.0 or below
Waste Alkali	Alkaline waste having a pH of 12.5 or above
Infectious waste	Waste from medical facilities that contain or may contain infectious agents.
PCB waste and PCB-contaminated materials	Waste oil containing PCB, waste paper coated with PCB and metal waste containing PCB, etc.
Waste materials containing Asbestos	Airborne asbestos and asbestos insulation material collected from demolition sites, and plastic sheeting taken out during asbestos removal projects. Airborne asbestos, etc. which is collected by dust collecting equipment at work sites where dust identified by the Air Pollution Prevention Law is Generated.
Hazardous industrial waste	Sewage sludge specified by the Sewage Law, and slag, dust, acidic waste, alkali waste, sludge and waste oil (solvents containing designated substance such as trichloroethylene) that do not comply with the Ministry of Health and Welfare regulations and materials used to treat these.
Soot	Soot subject to the provisions of the law is particulate collected from any incinerator with an hourly capacity of 200 kg or more or with a grate area of 2 m2 or more, and which has a precipitator for separating cinders from soot.

2.2.2 Regulations Related to Waste Blenders

Waste blending business is not legally designated as an independent business category but considered as a business engaged in intermediate treatment and, in some cases, waste collection/transport.

a. Regulations Related to Industrial Waste Management

Rules related to industrial waste management business are regulated by the Waste Management Law. At each stage of waste management, the waste generators or the waste management business operators need to follow particular standards, as shown in Table 2-5 as for industrial waste and in Table 2-6 for specially controlled industrial waste. The colored lines concern waste blenders.

Table 2-5: Main Standards Regarding Industrial Waste Management

	Stage of Waste Management	Target Agents	Name of Standard Applied
1	Commission for transport and disposal	Waste generators	• Standards on commissions for transport and disposal of industrial wastes • Matters to be covered by commission contract
2	Storage prior to transport	Waste generators	• Industrial waste storage standards
3	Collection and transport	Industrial waste collection and transport agents	• Standards on the collection, transport and disposal (including recycling) of industrial wastes
4	Intermediate treatment (including recycling)	Industrial waste disposal agents	• Standards on the collection, transport and disposal (including recycling) of industrial wastes • Technical standards on industrial waste treatment plant • Technical standards on the operation and maintenance of industrial waste treatment plant • Storage period
5	Landfill disposal	Industrial waste disposal agents	• Standards on the collection, transport and disposal (including recycling) of industrial wastes • Requirement to make disaster prevention plan • Technical standards on final disposal • Technical standards on the operation and maintenance of industrial waste final disposal

Table 2-6: Main Standards Regarding the Management of Specially Controlled Industrial Waste

	Stage of Waste Management	Target Agents	Name of Standard Applied
1	Commission for transport and disposal	Waste generators	• Standards on commissions for transport and disposal of specially controlled industrial wastes
2	Storage till transport	Waste generators	• Specially controlled industrial waste storage standards
3	Collection and transport	Specially controlled industrial waste collection and transport agents	• Standards on the collection, transport and disposal of specially controlled industrial wastes
4	Transfer and storage	Specially controlled	• Standards on the transfer of specially controlled industrial waste

		industrial waste collection and transport agents	• Standards on necessary practices of waste transfer
5	Intermediate treatment (including recycling)	Specially controlled industrial waste disposal agents	• Standards on the collection, transport and disposal of specially controlled industrial wastes • Method specified by the Minister of health and welfare • Storage period
6	Landfill disposal	Specially controlled industrial waste disposal agents	• Standards on the collection, transport and disposal of specially controlled industrial wastes

b. Licenses Required to Industrial Waste Business Operators

Licenses required to industrial waste business operators are listed in the table below. Waste blenders need to obtain appropriate licenses depending on whether they deal with industrial waste or specially controlled industrial waste, and what kinds of services they provide. Licenses are issued by the prefecture governments or specific 32 cities that have a public health center and valid only within the administrative boundary of the issuer. Therefore when the waste blenders are to expand their activities in neighboring prefectures of cities, they have to apply for another license. Furthermore, every facility of waste blenders must comply technical standards according to its size and type, and be given an operation permit.

Table 2-7: Licenses Required for Industrial Waste Business

Services provided	Industrial Waste	Specially controlled industrial waste
Collection and Transport	Industrial waste collection and transportation business license	Specially controlled industrial waste collection and transportation business license
Treatment and Final Disposal (including waste recycling)	Industrial waste treatment/final disposal business license	Specially controlled industrial waste treatment/final disposal business license

To obtain the licenses, the waste blenders have to meet requirement of the Waste Management Law and other regulations. Examination prior to the issue of licenses pays attention to the following points.

- Standards concerning the ability of the applicants to operate the facility.
- Standards concerning the performance of the waste treatment facility.

The former, "standard concerning ability to operate the facility", requires the applicants not only to bear sufficient knowledge and technology but also to have a solid financial base to continue proper operation.

2.3 Survey of Waste Blenders in Japan

2.3.1 Selection of Waste Blenders for Survey

The waste blending industry is a business sector that relatively newly emerged in Japan. There is no system to issue a specific license or to register them as a waste blender. For these reasons, information is not available about the number of them or the state of their activities. To provide the waste blending service for industrial waste, the waste blenders in Japan need a license for waste collection/transport and another for intermediate waste treatment issued by relevant local authorities. In 1998, then Ministry of Health and Welfare reported that the numbers of waste collection/transport companies and intermediate treatment companies were 132,000 and 8,400, respectively. It is not possible to specify which among these large number of companies are waste blenders.

Consequently, the team could not select waste blenders for the survey in a logical way. Therefore, the team asked Taiheiyo Cement Corporation, a leading cement company in Japan, for the introduction of waste blenders and was provided with information about waste blenders which have business ties with Fujiwara Plant, the cement factory of Taiheiyo Cement that is the most actively receiving waste. Based on the information provided, the team requested the permission of visit to the following waste blenders and actually visited three of them except Daiseki, which refused the acceptance of the team stating that the plant was under rehabilitation.

- S.N.K. Techno Co., Ltd.
- Daiseki Co., Ltd.
- Kinki Environmental Industry Co., Ltd.
- Sumieito Co., Ltd.

2.3.2 Result of Survey

The study team visited three waste blenders as explained above in order to understand the current status of waste blenders in Japan.

The team was also given an opportunity to visit Taiheiyo Cement Fujiwara Plant and Mitsui-Miike Smelting Co., Ltd., non-ferrous smelter, both of which receive product of waste blenders.

The location of these factories is shown in Figure 2-3, followed by the findings of the visits to those factories.

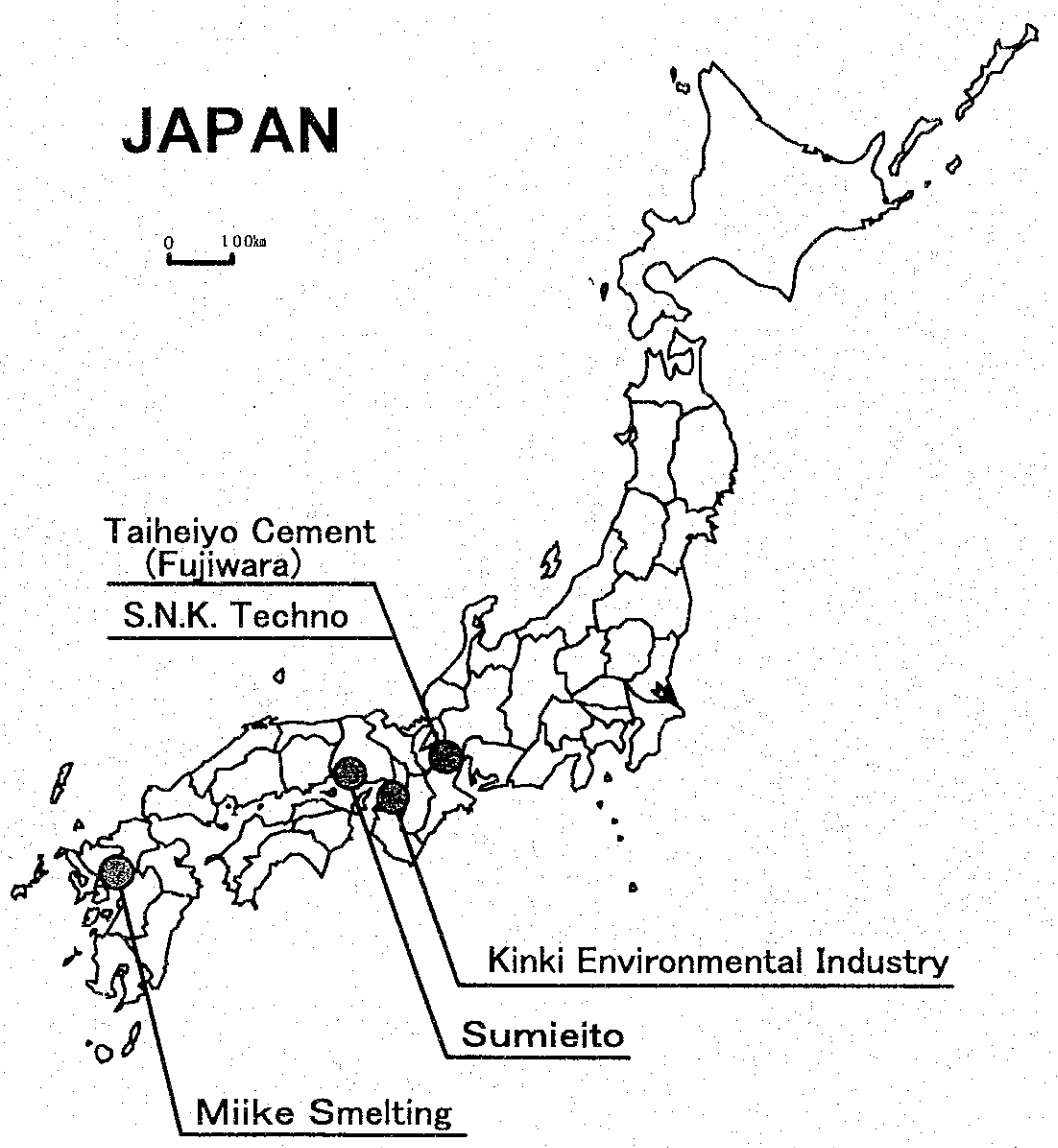


Figure 2-3: Location of Factories Visited

a. Waste Reuse at Cement Factories

The outline and operation flow of Fujiwara Plant of Taiheiyo Cement Corporation are in Table 2-8 and Figure 2-4.

Located in a mountainous area, product transportation costs the Taiheiyo Cement Fujiwara Plant more than the other factories of the company. In order to save production cost for unit weight of production, the plant has aggressively tried to use waste as alternate fuel or alternate raw material. Consequently the plant has foremost waste reuse technology.

At cement factories including Fujiwara plant, such waste as waste tires and waste plastics which is chemically stable and does not need pre-treatment can be accepted as it is and the cement factories themselves manage the waste. The photos of the storage conditions of waste tires and waste plastics at the Fujiwara Plant are presented in Figure 2-5.

Burnable waste which has small calorific value or contains compounds that may work against cement production can not be accepted by itself. However, the cement factories can receive wastes in the case where their quality is adjusted by waste blenders to the acceptance standard of the cement factories.

The example of the acceptance standard of burnable wastes as alternative fuels set by a cement factory is as follows.

- Calorific value: 5,000 kcal/kg or more
- Chlorine content: Less than 1,000 ppm
- Solid content: Less than 15%

Table 2-8: Outline of Taiheiyo Cement Fujiwara Plant

Factory	**Taiheiyo Cement (Fujiwara plant)**	
Place	Fujiwara, Inabe-Gun, Mie	
Profile	Total area	525,224 m^2
	Number of employees	168
	Number of cement kilns	2
	Number of another use kilns	1
	Annual Production capacity	~ 2,750,000 ton/year
Used Waste	as Fuel material	• Waste oil
		• Reclaimed oil (Recycled fuels)
		• Waste tires
		• Waste rubber etc.
		• Waste Plastics
		• Sludge
	as Material	• Concrete sludge
		• Sewage sludge
		• Fly ash
		• Blast-furnace slag
		• By-product gypsum etc.

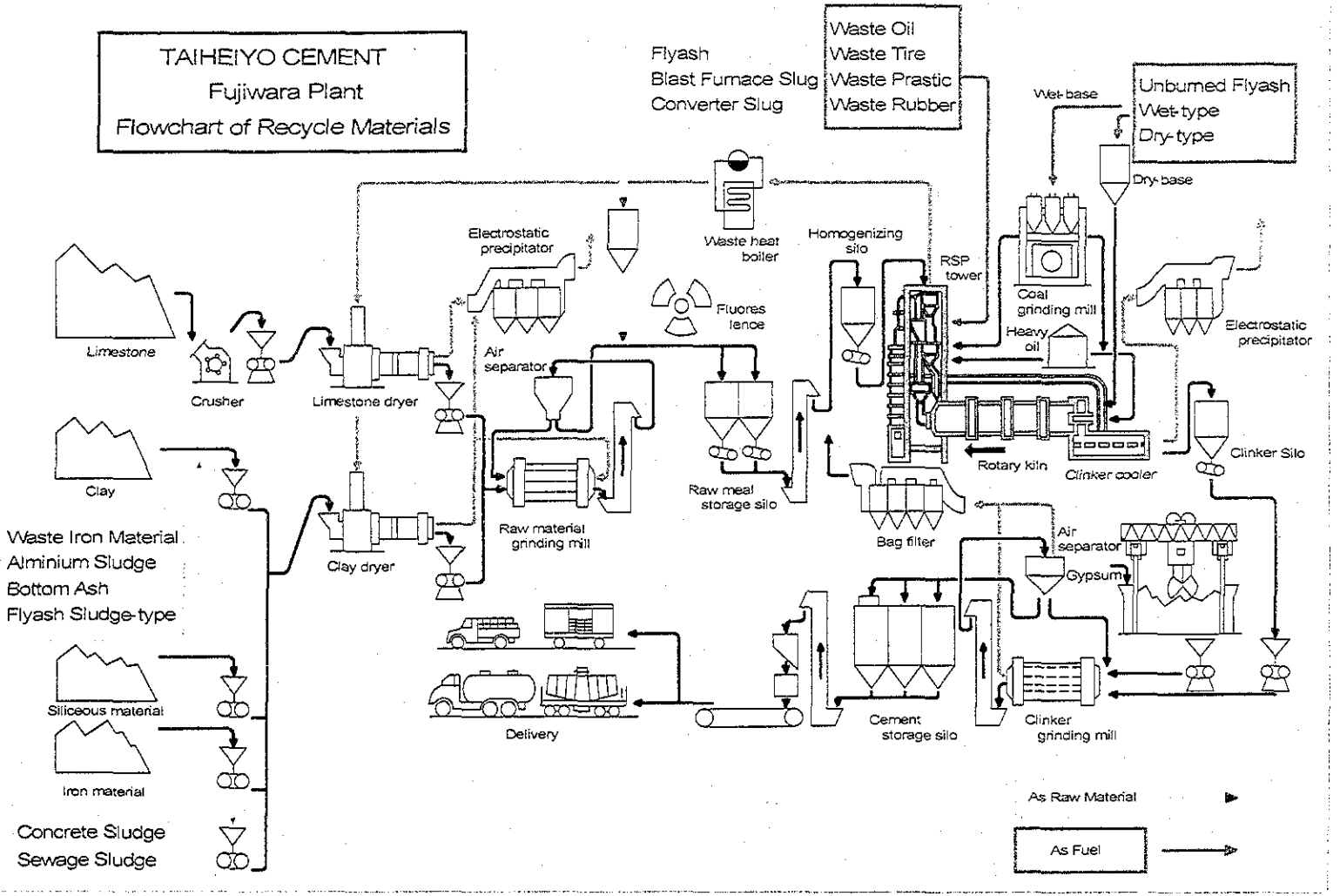
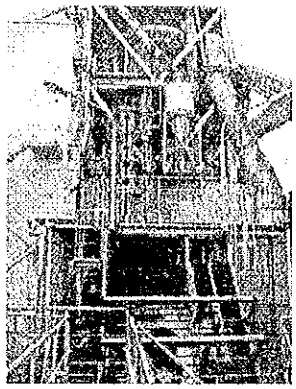
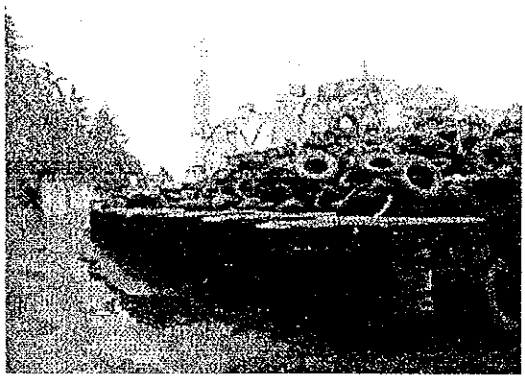


Figure 2-4: Production Flow of Taiheiyo Cement Fujiwara Plant

Cement Kiln



Feeding Point of Waste Tires



Storage of Waste Tires

Storage of Waste Plastics

Waste Plastic Crusher

Figure 2-5: Photos of Taiheiyo Cement Fujiwara Plant

b. Survey of Waste Blenders

b.1 S.N.K. Techno

The outline of S.N.K. Techno and its process flow are in Table 2-9 and Figure 2-6. The panoramic view of the company is in Figure 2-7.

The main process of S.N.K. Techno is mixing and quality adjustment of waste oil, sludge, waste acid and waste alkali. It collects waste from about 150 factories including relatively small to big-scaled ones.

The blending method employed is fairly simple. Waste oils are stored separately depending on calorific value and/or chlorine content and those with different properties are mixed to comply with the standard of the cement factories for acceptance. Waste acid and waste alkali are neutralized and mixed with waste oil. The final products are supplied to Taiheiyo Cement Fujiwara Plant, located in neighborhood.

Table 2-9: Outline of S.N.K. Techno

Factory	S.N.K. Techno Co., Ltd.		
Place	Fujiwara, Inabe-Gun, Mie Prefecture		
Description of Business	Collection, Transportation, Intermediate treatment and Recycling of Waste oil and sludge		
License	• Industrial waste collection and transportation business license • Industrial waste treatment/final disposal business license • Specially controlled industrial waste collection and transportation business license • Specially controlled industrial waste treatment/final disposal business license		
Processing Object	Intermediate Treatment	Industrial Waste	• Sludge (without Hazardous substance) • Dust (without Hazardous substance) • Waste Oil • Waste Acid • Waste Alkali • Waste Plastics
		Specially controlled Industrial Waste	• Flammable Waste Oil • Corrosive Waste Acid • Corrosive Waste Alkali
	Collection/ Transport	Industrial Waste	• Ash (without Hazardous substance) • Sludge (without Hazardous substance) • Waste Oil • Waste Plastics • Waste Acid • Waste Alkali • Slag (without Hazardous substance) • Waste Glass, Waste Ceramic • Waste Wood • Animal and Plant Residues • Waste Metal • Dust • Construction wastes
		Specially controlled Industrial Waste	• Flammable Waste Oil • Corrosive Waste Acid • Corrosive Waste Alkali
Production Capacity	• 126 ton/8h		

Condition for Cement Factory	• Heat Value > 5,000 kcal/kg • Solid Content < 5% • Ignition Point > 70 oC • Chlorine (Cl) Content < 2,000 mg/kg • Fluorine (F) Content < 1,000 mg/kg • Viscosity < 1,000 cp (centipoises)
Analyzed Substance	• Heat Value • Chlorine content • pH • Flash point • Reaction test by mixing with other wastes

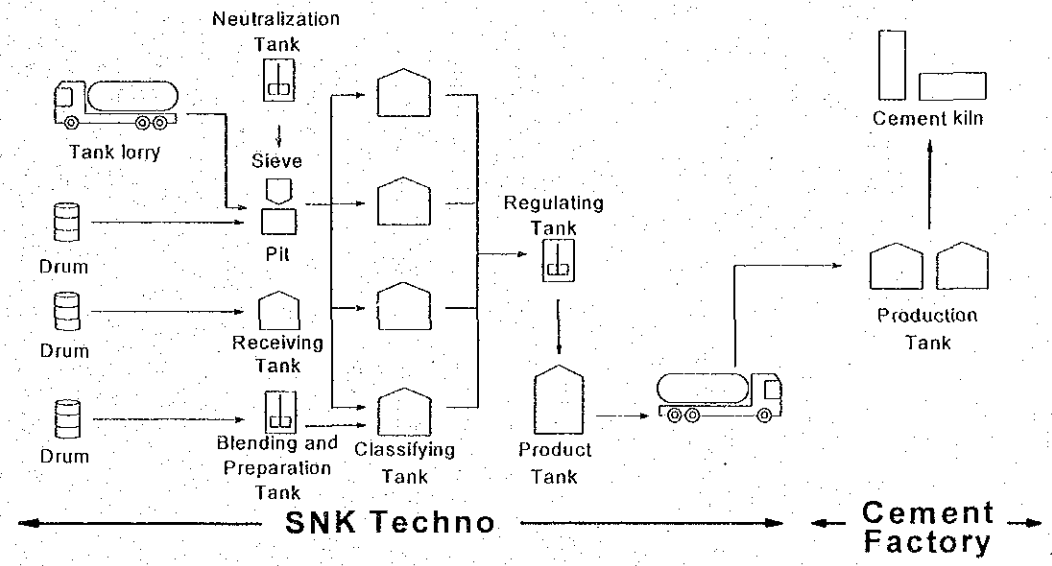


Figure 2-6: Process Flow of S.N.K. Techno

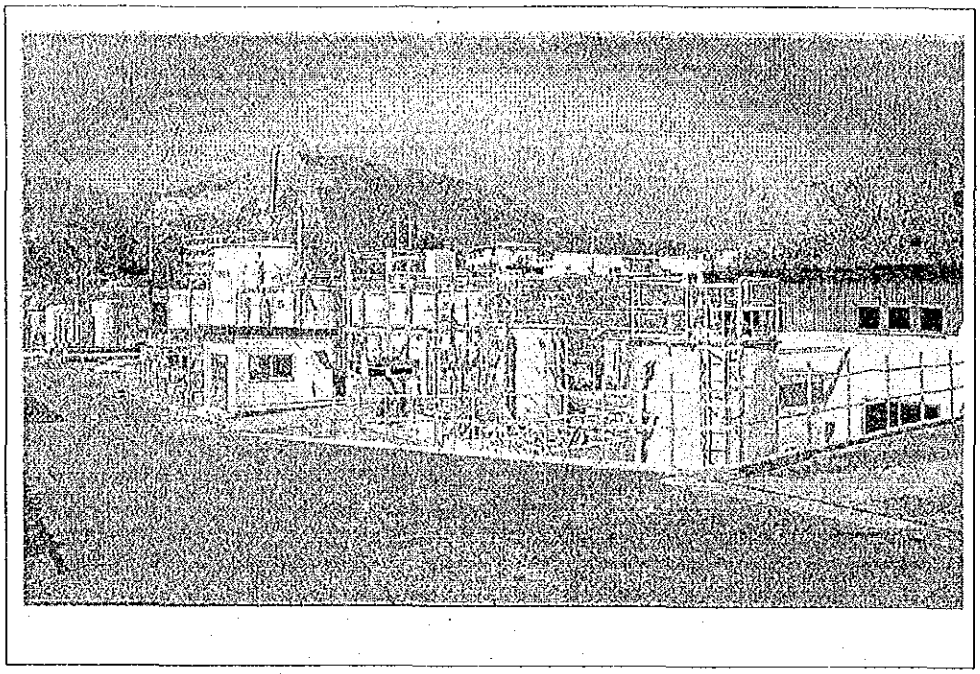


Figure 2-7: Photo of S.N.K. Techno

b.2 Kinki Environmental Industry Co., Ltd.

The outline of Kinki Environmental Industry and its process flow are shown in Table 2-10 and Figure 2-8.

The company has two plants in Osaka and Kyushu and each supplies mixed waste to cement factories. It is one of the biggest waste blenders, collecting waste from 2,000 factories.

The ratio of liquid waste and solid waste it deals with is 7 to 3. Solid waste includes electro precipitator dust and sludge (either organic or inorganic, including sludge from wastewater treatment works and sludge from food processing factories).

The company has highly developed its waste blending technology and transferred it to a petrochemical plant of S.K. Corporation in Korea and another factory in Taiwan. The fundamental of waste blending business is to output waste consistent with the standard for acceptance of cement factories. In order to make sure the quality of output, Kinki Environmental Industry carefully analyses waste received prior to the blending process.

Table 2-10: Outline of Kinki Environmental Industry

Factory	Kinki Environmental Industry Co., Ltd.
Place	Kishiwada-city, Osaka Prefecture
Description of Business	Production of alternatives for fossil fuels from Industrial wastes
License	• Industrial waste treatment/final disposal business • Specially controlled Industrial waste treatment/final disposal business

Processing Object	Osaka Plant	Industrial Waste	• Ash (only Waste Activated carbon) • Sludge • Waste Oil • Waste Acid • Waste Alkali • Waste Plastics • Animal and Plant Residues • Dust
		Specially controlled Industrial Waste	• Sludge (only Sludge including Benzene) • Waste Oil (only Inflammable oil and sludge including Benzene) • Waste Alkali (excluding alkali containing specially controlled industrial waste other than Benzene)
	Kyusyu Plant	Industrial Waste	• Ash • Sludge • Waste Oil • Waste Alkali • Waste Plastics • Waste Glass and Waste Ceramics • Slag
		Specially controlled Industrial Waste	• Sludge • Waste Oil • Waste Acid • Waste Alkali
Production Capacity	Alternative Fuel Production for Cement Production • Osaka Plant 200 ton/8h • Kyusyu Plant 150 ton/day		
Condition for Cement Factory	• Heat Value > 5000 kcal/kg • Solid Content < 15%		
Analysis Substance	• Heat Value • Chlorine content • Inflammation point		

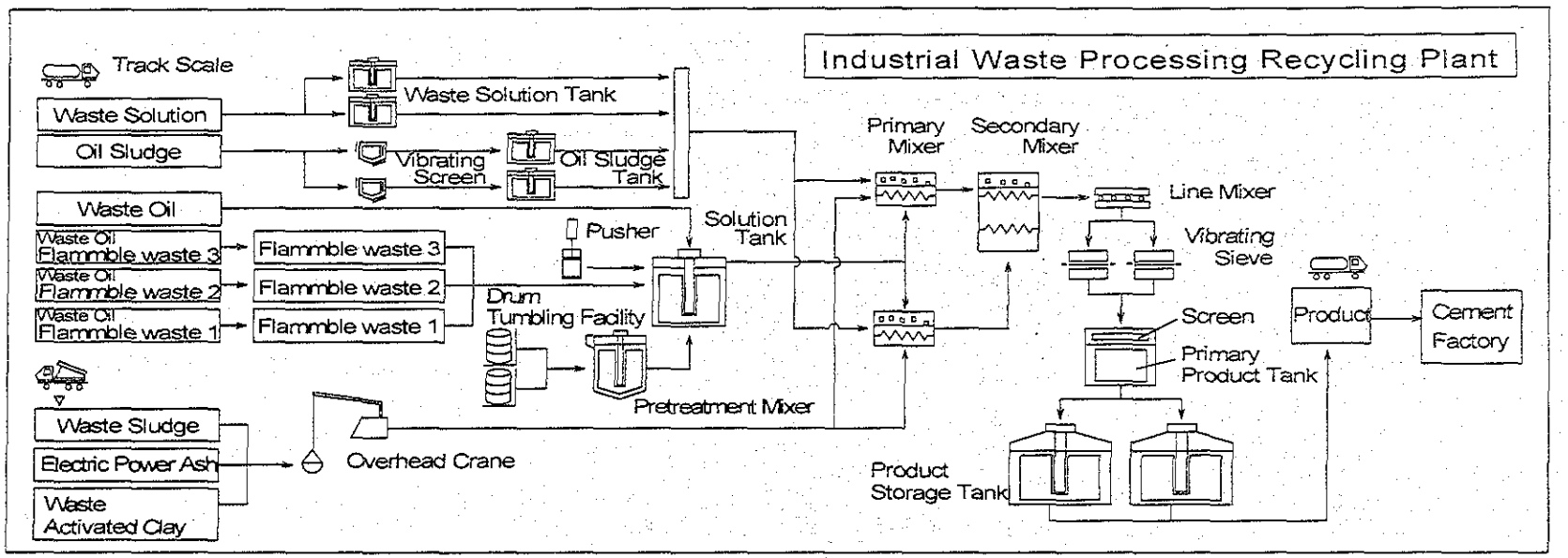


Figure 2-8: Process Flow of Kinki Environmental Industry Osaka Plant

b.3 Sumicito

The outline of Sumieito and its process flow are shown in Table 2-11 and Figure 2-9.

The company has two plants in Ibaraki and Hyogo. The plant in Ibaraki produces alternative fuel and raw material for a cement factory, whereas the plant in Hyogo supplies its products not only to the cement industry but also to non-ferrous smelters which receive waste with high metal concentration for the production of metal such as nickel. The number of factories from which Sumieito collects waste is not very large (it is 200 in the case of Hyogo plant), but the sectors of their clients vary.

The production amount of Sumieito Hyogo Plant is as follows.

- Alternative raw material for the cement industry 1,500 tons/month

This is produced by blending different types of sludge so that the product meets the standard for acceptance of the cement factories.

- Fuel 1,500-1,800 tons/month

Waste oil and oil-containing sludge delivered to the plant are classified into several types, stored, and blended to make alternative fuel.

- Material for nickel production 300 ton/month

Sludge and dust containing nickel are blended to adjust the nickel concentration to 8 % or more, which is the condition set by the non-ferrous smelters to accept, and sold as material for nickel production.

Table 2-11: Outline of Sumieito (Waste Blender)

Factory	Sumieito Co., Ltd.
Place	Himeji-city, Hyogo
Description of Business	Collection, Transportation, Intermediate treatment and Recycling of Industrial waste and sales of recycled material. • Blending and pre-treatment of liquid wastes for alternatives fuel • Blending and pre-treatment of solid wastes for alternatives raw materials of Cement industry • Non-ferrous metal recycling from heavy metal containing industrial wastes (e.g. Ni)
License	• Industrial waste treatment/final disposal business license • Specially controlled industrial waste treatment/final disposal business license
Processing Object	1. Fuel recycling • Sludge contaminated oil • Sludge • Waste oil • Waste solvent • Waste Alkali • Others 2. Material recycling Raw Material for Cement factory

	• Sludge contaminated oil • Sludge • Ash • Dust • Used catalytic agent • Mineral dust • Waste plastics • Others Raw Material for Non-ferrous refining factory • Sludge • Dust • Used catalytic agent • Mineral dust • Waste metals	
Production Capacity	Fuel recycling • 100 ton/day	
	Material recycling • Raw Material for Cement Factory • Raw Material for Non-ferrous refining factory	120 ton/day 144 ton/day
Condition for Cement Factory	• Heat Value > 5,500 kcal/kg • Particle size < 0.1 mm	

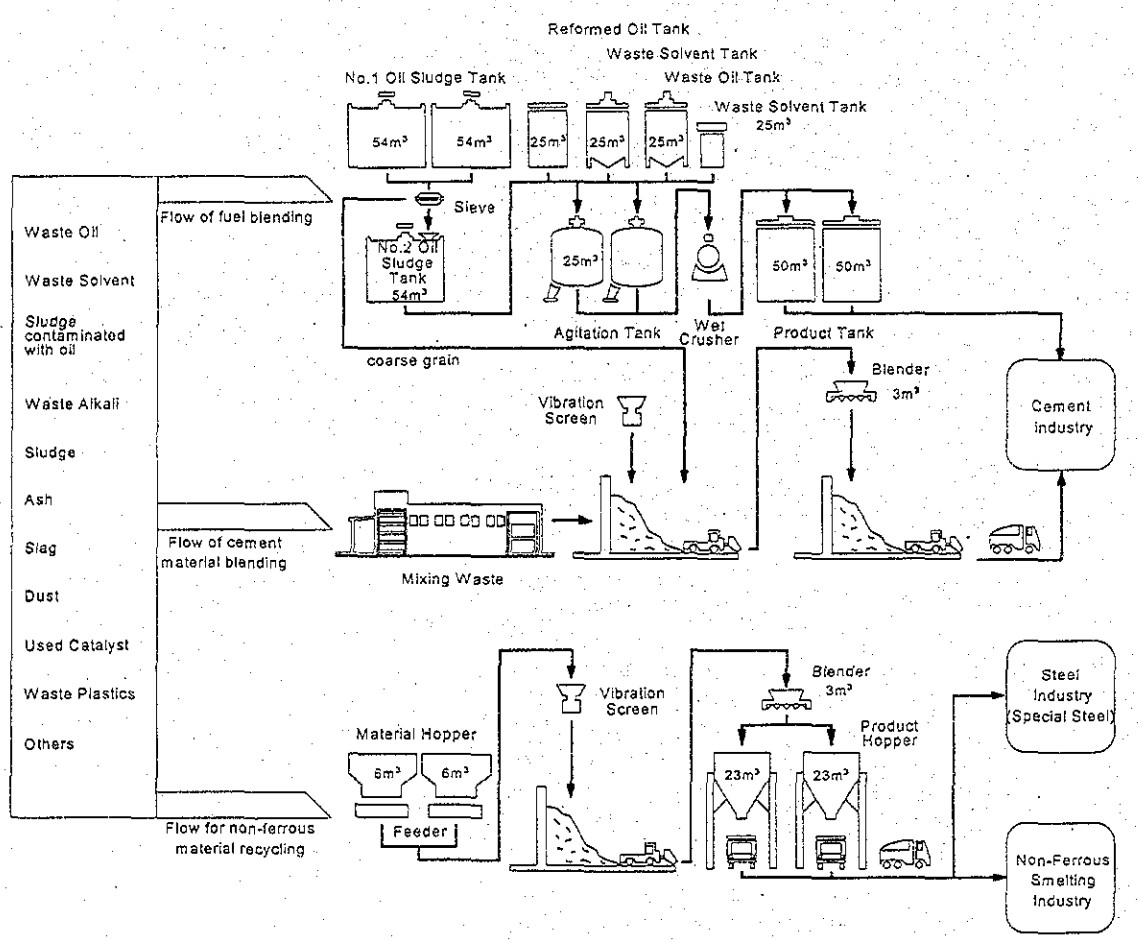


Figure 2-9: Process Flow of Sumieito Himeji Plant

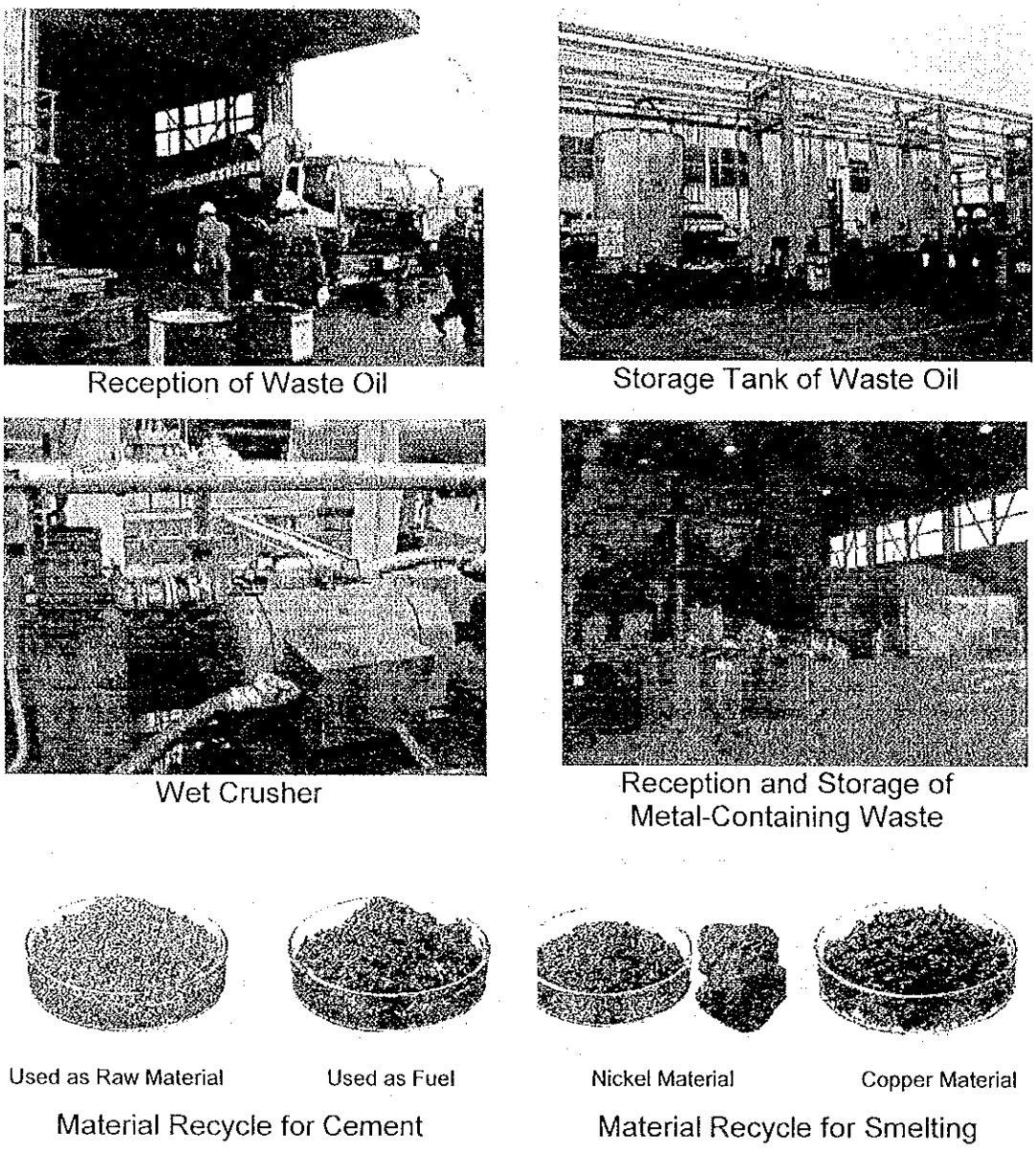


Figure 2-10: Photos of Sumieito Himeji Plant

c. Miike Smelting

Miike Smelting does not use any raw mineral ores but use only waste from the other industries to produce crude zinc oxide. The outline of the company and its process flow are shown in Table 2-12 and Figure 2-11. The company employs what is called Mitsui Furnace (MF) technology, as illustrated in Figure 2-12.

Waste processed mainly includes electric arc furnace (EAF) dust, zinc smelting residue and copper smelting dust, but other types of waste such as sludge and silica sand containing heavy metals can be used. It also receives burnable waste such as waste plastics and infectious waste, which are put to the furnace and undergo thermal treatment. The process produces not only crude zinc oxide but also slag as waste, which is also used as raw material of the cement industry.

Table 2-12: Outline of Miike Smelting

Factory	Miike Smelting Co., Ltd.	
Place	Omuta-city, Fukuoka	
Description of Business	Refining of Non-Ferrous metal (Production of Zinc Oxide)	
License	• Industrial waste treatment/final disposal business license • Specially controlled industrial waste treatment/final disposal business license	
Processing Object	• Electric arc furnace dust • Zinc smelting residue • Copper smelting dust • Cu & Precious metal residue • Industrial wastes (Wastewater treatment sludge, Combustible industrial wastes like waste plastics, Medical wastes and so on)	
Amount of Waste for Raw Material	Electric arc furnace dust Zinc smelting residue Copper smelting dust and others Others residues and waste	65,000 ton/year 20,000 ton/year 65,000 ton/year (including Coal and Silica) 10,000 ton/year
Production Capacity	500 ton/day (1 Line)	
Product	• Crude zinc oxide (Zn 65%, Pb 10%) • Matte (Cu 45%, Ag 2000g/ton) • Slag (Fe 40%, SiO_2 22%)	35,000 ton/year 300-400 ton/year 65,000 ton/year
The Features of MF Process	1. Wide Application The half shaft blast furnace process can be applied for many kinds of wastes and sludge regardless of their form, including lumps, fine dust and moisture. Moreover, combustible plastic, tire and glass wastes can be incinerated. 2. Recovery of Metal Values Zinc and lead are recovered in the crude zinc oxide. Copper, nickel and precious metals are recovered in the matte. 3. Non-Toxic slag which is insoluble and non-toxic can be used as raw materials of cement industry. 4. Recovery of Waste Heat Wastes heat is recovered efficiently as high pressure steam in the boiler for the power generation or the other heat source	

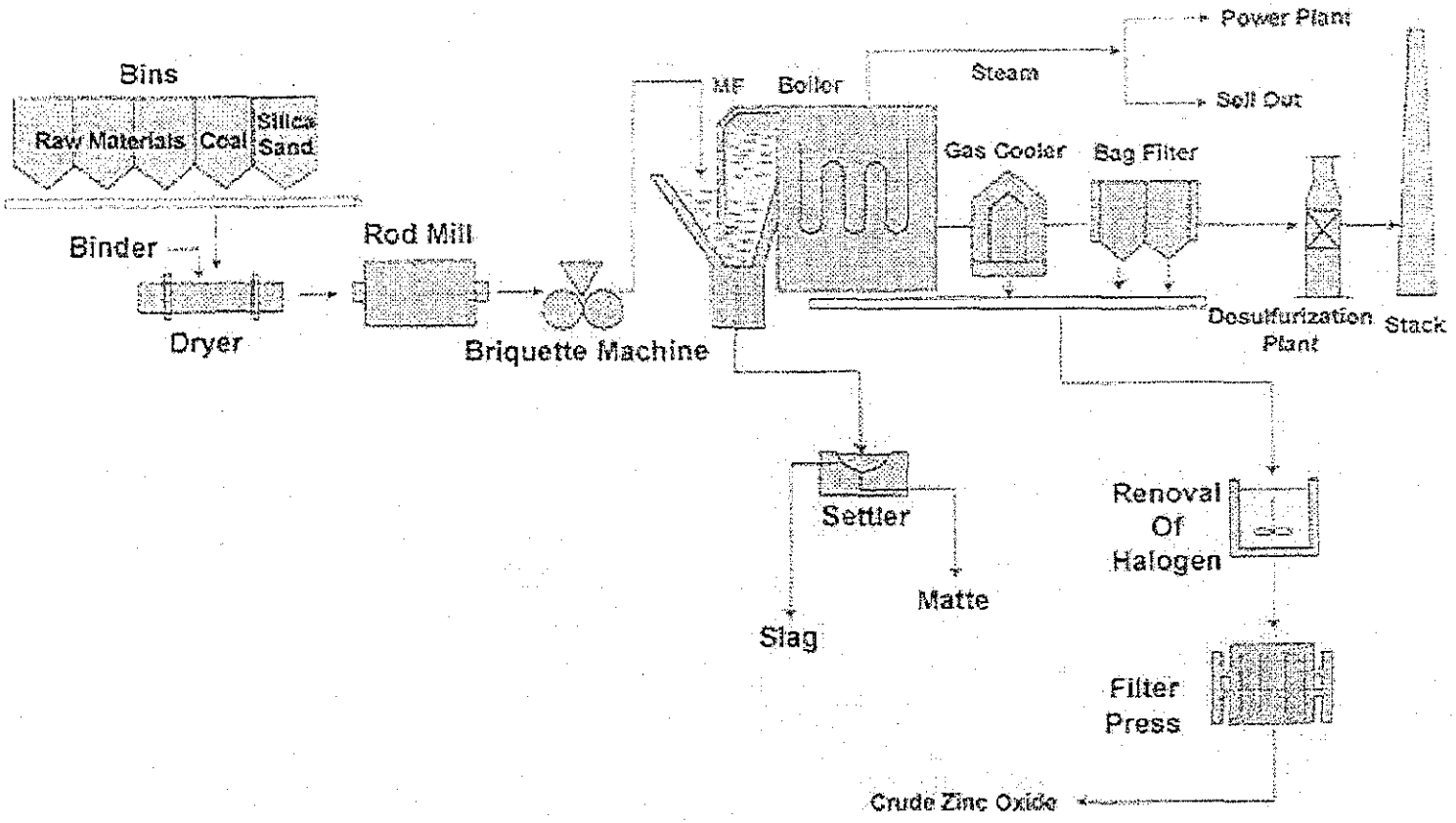


Figure 2-11: Process Flow of Miike Smelting

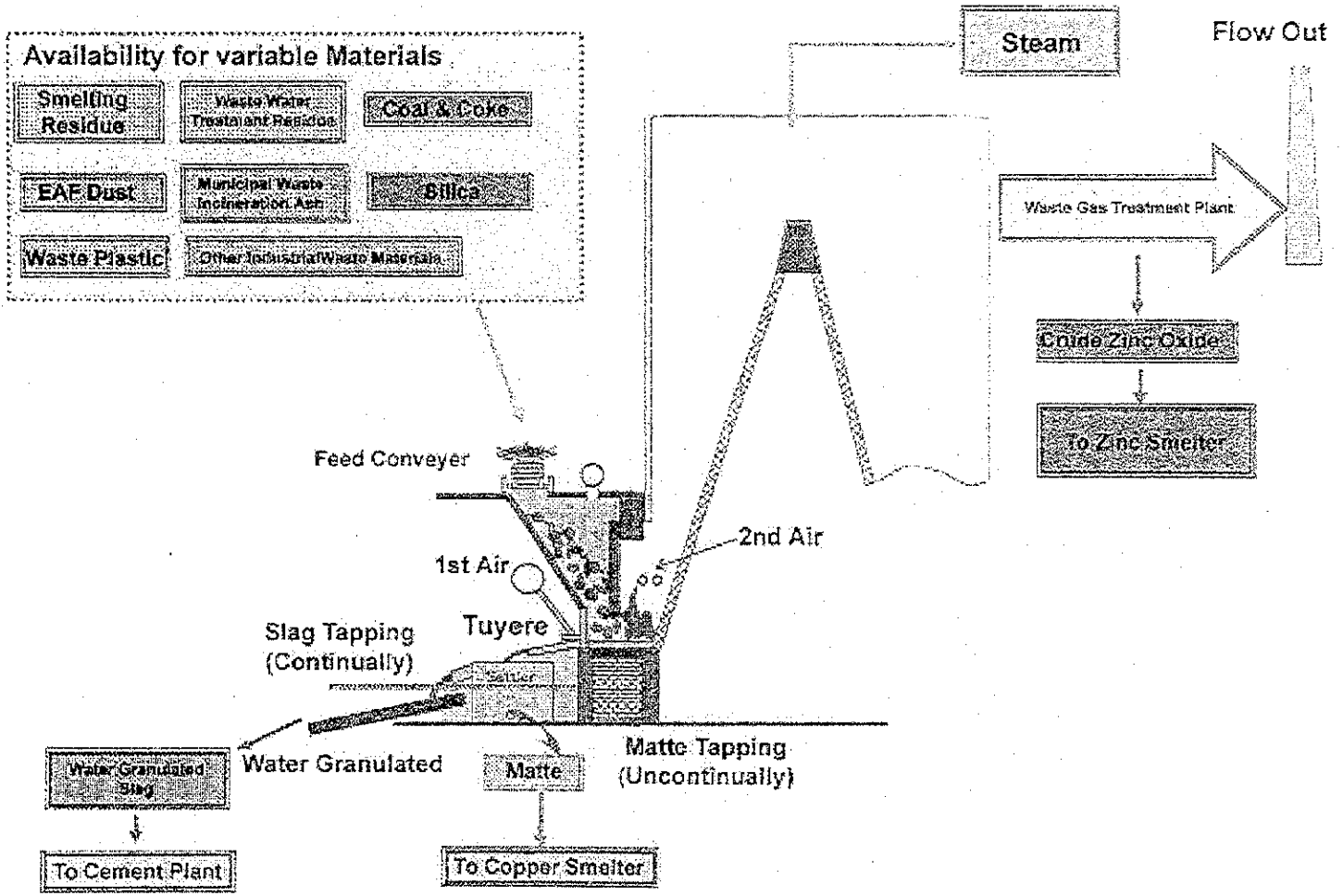
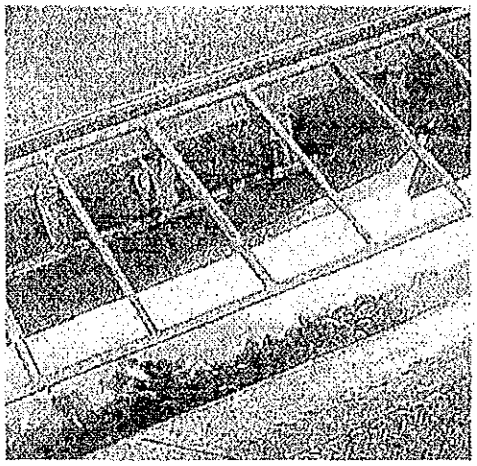
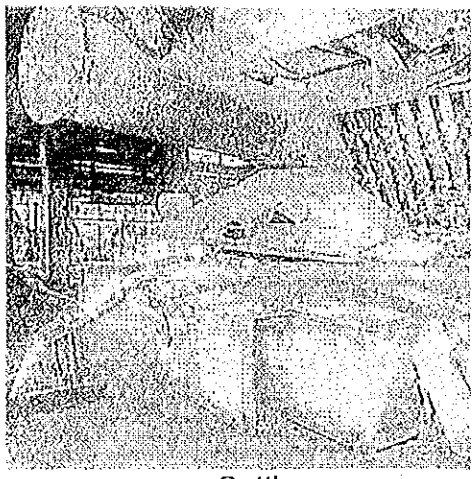


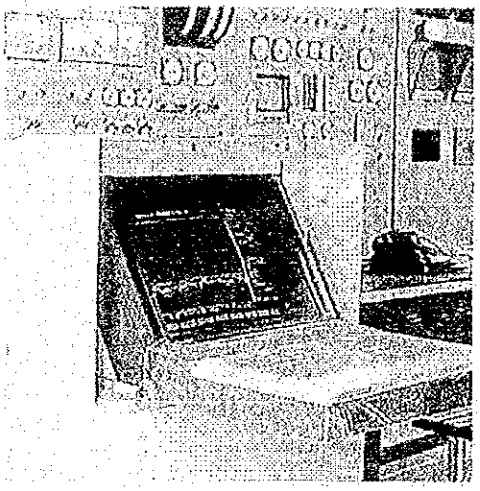
Figure 2-12: Schematic Illustration of the MF System



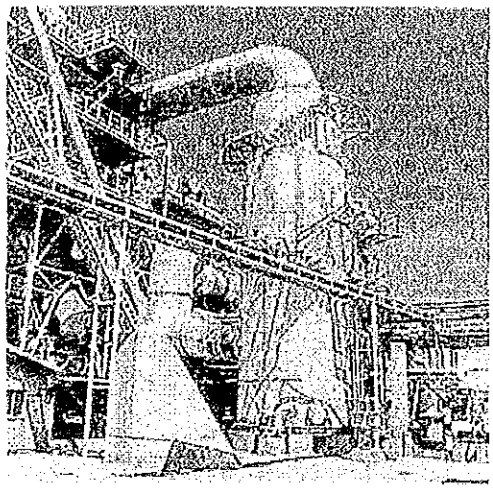
Charging Chute of Furnace



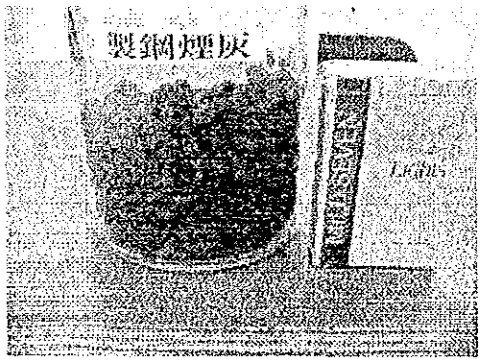
Settler



Computer System



Desulfurization Plant



Raw material

(Electric arc furnace dust)

Product

(Crude zinc oxide)

Figure 2-13: Photos of Miike Smelting

3 Examination of Application to Thailand

3.1 Team's Proposal

3.1.1 Teams Recognition about the Current Situation of Waste Blenders

a. Situation in Japan

The team recognized the state of the utilization of waste blenders in Japan as described in the previous chapters. The following is some of what the team recognized important for the promotion of waste recycling at cement factories and other facilities in Thailand.

1. In case of slag, coal ash and others which are discharged from one factory in large quantity, the cement factories directly trade with the dischargers to use waste as alternative fuel and/or raw material. Waste has been supplied in this way for more than one century and such waste has been the major part of total waste supplied to the cement factories.

2. On the other hand, the history of recycling of waste which many factories discharge but one factory discharges in small quantity started as recently as in the 1980s. Such waste includes various types such as waste oil, sludge, waste alkali and waste acid. The recycling of such waste has become especially active since the 1990s when the cement industry encountered difficulty to raise profit only from the sale of cement products due to the burst of bubbles. The cement factories had to save the cost for raw material and to explore a new business style.

3. Meanwhile, the social environment changed in favor of waste recycling. The repeated amendment of Waste Management and Public Cleansing Law in 1991, 1997 and 2000 has been imposed increasingly heavy responsibility on waste dischargers. The general public has become more environmentally sensitive and required industries to manage waste more stringently. They have been valuing zero emission and appreciating factories which recycle waste more than factories which properly treat and dispose of waste. In response to such changes, the cement industry began to see itself as a contributor to zero emission society who accepts waste, and factories of other industrial sectors started to find out recyclers.

4. It was the waste blenders who linked the cement industry and other industries. Therefore, the history of the waste blenders is not long. The cement industry wants waste of a certain quality and quantity on a regular basis which does not affect cement production, and the waste supplying factories want to discharge waste without bothering about its quantity or quality. The waste blenders fulfilled wishes of the both. Waste from the waste supplying factories can be in a small quantity, but various. For the cement factories, direct trade with such factories is not practical. The presence of the waste blenders is thus essential to deliver waste which meets the requirement of the cement factories in terms of quantity and quality.

5. In order to supply waste that satisfies the cement factories, it is sometimes necessary for the waste blenders to add crude oil or others to improve waste

quality. They also developed the technology to enhance the thixotropy of waste so that it is easy to handle when stored, transported, loaded, unloaded, and supplied to the cement production lines. In this way, what the waste blenders do is not simple concoction, but chemical and physical transformation of waste into alternative fuel and/or raw material which requires experience and specific expertise.

6. Nowadays, the cement industry is not the only destination of the products of the waste blenders. They blend waste containing heavy metals such as sludge and catalysts, which the cement factories do not accept, to the ferrous and non-ferrous smelting factories.

7. There are no regulations which control the waste blenders as they are. They are considered part of waste treatment business and come under the control of Waste Management Law. Therefore, they need to obtain a license from the prefectural governments in order to collect/transport waste or to treat/dispose of waste. If they are to handle hazardous waste, they need a separate license to collect/transport hazardous waste or to treat/dispose of hazardous waste.

8. When they apply for a license, they have to clarify the types of waste that they are going to collect/transport or treat/dispose of, and the license to be issued is valid only to those types of waste.

What is important with a licensing system is that all the blenders should have one or more licenses depending on their business conditions, and the authority has a power to withdraw the license when they fail to meet the license requirements. In other words, the licensing system gives an official approval to the ability of the waste blenders, and factories can discharge waste to them without unnecessary worries.

b. Utilization of waste blenders in Thailand

In comparison with the situation in Japan, the team recognizes the current utilization of waste blenders in Thailand as follows.

1. In Thailand, some companies such as GENCO and Sita Thai is running waste blending business, supplying waste to cement factories authorized by DIW as a HW treatment facility of Code 101.

2. What they supply is, however, mostly waste oil and not in large amount. The activity of the Thai waste blenders is therefore limited in terms of quantity and quality compared to that of the Japanese waste blenders.

3. One of the reasons for this is that the cement factories in Thailand had been reluctant to receive waste as the cement factories in Japan before the 1990s were. However, the burst of the economic bubble in 1997 in Thailand also hit the cement industry and it started to seek for the reduction of production cost and the survival in another business area. As of August 2002, the four major cement factories were authorized as a HW treatment facility and two other factories, which completed test operation, are waiting for authorization. The role that the waste blenders will play should be very active.

4. On the other hand, the team knows that there are many waste discharging factories which are eager to supply waste to the cement factories. Although they approached to the cement factories, they refused to accept their waste.

Those waste dischargers are expecting for the emergence of the waste blenders.

5. Nevertheless, it seems that the importance of the waste blenders in waste recycling at the cement factories is not well acknowledged either by the cement industry or by the government. If the cement factories wish to extend their business as a waste recycler, and if the government intends to support their activities, the both should positively support the waste blending industry to flourish.

6. One of the important roles of the waste blenders is to collect various waste of small quantity from many factories. In Thailand, however, they cannot collect waste from factories as they like due to the transport permit system. Factories must have transport permits when they are going to discharge waste, and DIW issues the transport permit only when the waste receiver is an authorized waste treatment facility. Since the waste blenders are not authorized as the waste treatment facilities, they can collect waste only from factories that have the transport permits to discharge waste to the cement factories. In other words, the factories can give their waste to the waste blenders only when they succeed to let the cement factories accept their waste. The problem is that the cement factories do not negotiate with individual factories. Not a small number of JCCB members stated that their requests to the cement factories for receiving waste were turned down. In order to resolve this problem, (i) DIW should authorize the waste blenders as a waste treatment facility, or (ii) DIW should establish a licensing system of waste collectors/transporters and issue licenses to them.

7. As shown above, the waste blending industry in Thailand has to be developed further. The team considers that the understanding of the current status of the waste blenders in Japan and Japanese technologies and regulations applicable to Thailand should contribute to the progress in waste recycling at the cement factories in Thailand.

3.1.2 Team's Proposal

The team considers that waste recycling at the cement factories is still limited in Thailand. In order to foster the recycling of large quantity of various waste at kilns, promotion of the waste blending industry is the key. The team is also convinced that the waste blenders can contribute waste recycling not only at the cement factories but also at the non-ferrous smelters, who have not yet been involved in waste recycling in Thailand.

The development of the waste blending industry requires the governmental authorities in charge of IWM to understand their significant roles. Accordingly, the team proposed that the officers of DIW should visit Japan to study the use of waste blenders in Japan and to examine how it could be applied to Thailand.

In response to this proposal, DIW requested the team to assist their study visit to Japan. The team prepared the study plan shown below that should meet their request.

3.2 Study in Japan

3.2.1 Study Plan

The team arranged the study visit to the following factories for DIW.

- Cement factory (Taiheiyo Corporation Fujiwara Plant)
- Waste blenders (S.N.K. Techno Co., Ltd., Kinki Environmental Industry Co., Ltd., Sumicito Co., Ltd.)
- Non-ferrous smelter (Miike Smelting Co., Ltd.)

The table below shows the outline of these factories.

Table 3-1: Outline of the Factories Visited by DIW

Factory Types	Factory Names	Outline
Cement factory	Taiheiyo Corporation Fujiwara Plant	Utilization of waste as alternative fuel and raw material
Waste blenders	S.N.K. Techno Co., Ltd.	Blending of waste oil, waste acid, waste alkali and others to be supplied to the cement industry.
	Kinki Environmental Industry Co., Ltd.	Blending of waste oil, waste acid, waste alkali, sludge, waste plastics and others to be supplied to the cement industry.
	Sumieito Co., Ltd.	Blending of waste oil, waste acid, waste alkali, sludge, waste plastics and others to be supplied to the cement industry. Blending of waste containing non-ferrous material to be supplied to non-ferrous smelters.
Non-ferrous smelter	Miike Smelting Co., Ltd.	Non-ferrous smelting using various industrial waste

3.2.2 Result of the Study by DIW

The following DIW officers including the Director General carried out the study as scheduled by the team from August 29 to September 6, 2002.

Mr. Virah Mavichak, Director General
Mr. Kosol Jairungsee, Director of Industrial Technology Bureau
Dr. Jullapong Thaveesri, Head of Waste Management Division
Mr. Baworn Sattayawuthiphong, Mechanical Engineer

Through the study tour in Japan, the DIW officers recognized the important role of the waste blenders and that they contribute to waste recycling not only at the cement factories but also at the non-ferrous smelters. The DIW officers prepared a report, "Field Trip Report from Study Tour on Waste Blenders in Japan" as shown in Annex 1 of this report.