Chapter 11

Cimsa Site Development

11 Cimsa Site Development

11.1 Selection of the Priority Projects

11.1.1 Selection of the Priority Projects

Following the selection of the best scenario by Mersin GMs, the priority projects were decided and agreed upon by both the Turkish counterpart, and the team, as described below.

- Introduction of a separate collection system
- Construction of a sorting plant
- Construction of a compost plant
- Construction of Cimsa MSW disposal site
- Construction of Cimsa medical waste disposal site

11.1.2 Targets of the Priority Projects

The priority projects aim to conduct Phase 1 (2000 - 2005) improvement of the SWM M/P. The targets between 2000 and 2005 are summarised in the table below.

Table 11-1: The Targets of the Priority Projects for Mersin GM

Components / Phase	1998	2002	2003	2004	2005
1. MSW Generation					
Population in Mersin GM	**634,850**	**718,412**	**741,141**	**764,660**	**788,999**
Akdeniz DM	255,516	276,579	282,111	287,753	293,508
Troslar DM	234,024	268,548	277,947	287,675	297,744
Yenisehir DM	145,310	173,285	181,083	189,232	197,747
MSW Amount (ton/year)					
Generation	162,790	204,035	216,080	228,125	241,995
Discharge	155,125	196,892	209,250	221,243	235,060
Collection	148,555	192,654	205,595	218,171	232,572
2. Separate Collection					
Separate collection rate to refuse collection (%)	0	30	30	30	30 %
Separately collected amount (ton/year)	0	57,796	61,678	65,451	69,772
3. Sorting plant					
Treated amount (ton/year)	0	23,696	26,522	28,798	32,095
Recovered amount (ton/year)	0	5,687	6,365	6,912	7,703
Residue amount (ton/year)	0	18,009	20,157	21,886	24,392
4. Compost plant					
Treated amount (ton/year)	0	34,100	35,156	36,653	37,677
Compost amount (ton/year)	0	6,138	6,328	6,598	6,782
Residue amount (ton/year)	0	1,364	1,406	1,465	1,507
5. MSW Final Disposal					
Disposal amount (ton/year)	143,262	160,799	172,780	183,736	196,729
Landfill volume (m^3/year)	214,893	241,199	259,170	275,604	295,094
6. Medical Waste Final Disposal					
Disposal amount (ton/year)	548	694	730	767	803
Landfill volume (m^3/year)	1,409	1,785	1,877	1,972	2,065

11.2 Preliminary Design of Cimsa Site Development

11.2.1 Overall Site Development Plan

a. Fundamental Issues

The important issue on the planning of the site development is that no one in the world likes to have SWM facilities, especially a landfill, because of the NIMBY (Not In My Back Yard) syndrome. In case of Mersin the situation is worse because an awful open dumping, currently operating at the compost plant landfill, is a general impression of the people. Although the Mersin City Development Master Plan (City M/P) designated the site as a final disposal site, the Mersin GM should pay careful attention to ease the surrounding people, i.e., giving a new image of a sanitary landfill, construction of a greenbelt along the site, etc.

Further, the overall site development plan should fully consider other development projects, such as industrial complex development, etc., in the surrounding areas. In addition, this site is still currently in use as a quarry of raw materials of CIMSA cement factory. So that the topography of the site will be changed when the site development works will commence.

b. Overall Site Development Plan

A overall site development plan is presented in the figure below. The plan is summarised as follows:

- A 30m wide buffer zone (trees, plants) will be constructed along the boundary of the proposed CIMSA site to isolate the disposal site from the surrounding residents, and thereby ease resident opposition to the operation of the site.
- Basically the landfill operation will be carried out at the cavity of the CIMSA quarry (15 ha). The compost and sorting plant will be constructed outside the cavity.
- Because the target site slopes from north to south and south-west to north-east, the leachate treatment facility will be constructed at the south-easternmost end.
- The sorting and compost plant will be constructed outside the south-eastern boundary of the quarry, in consideration of the plant space required and wastewater treatment.

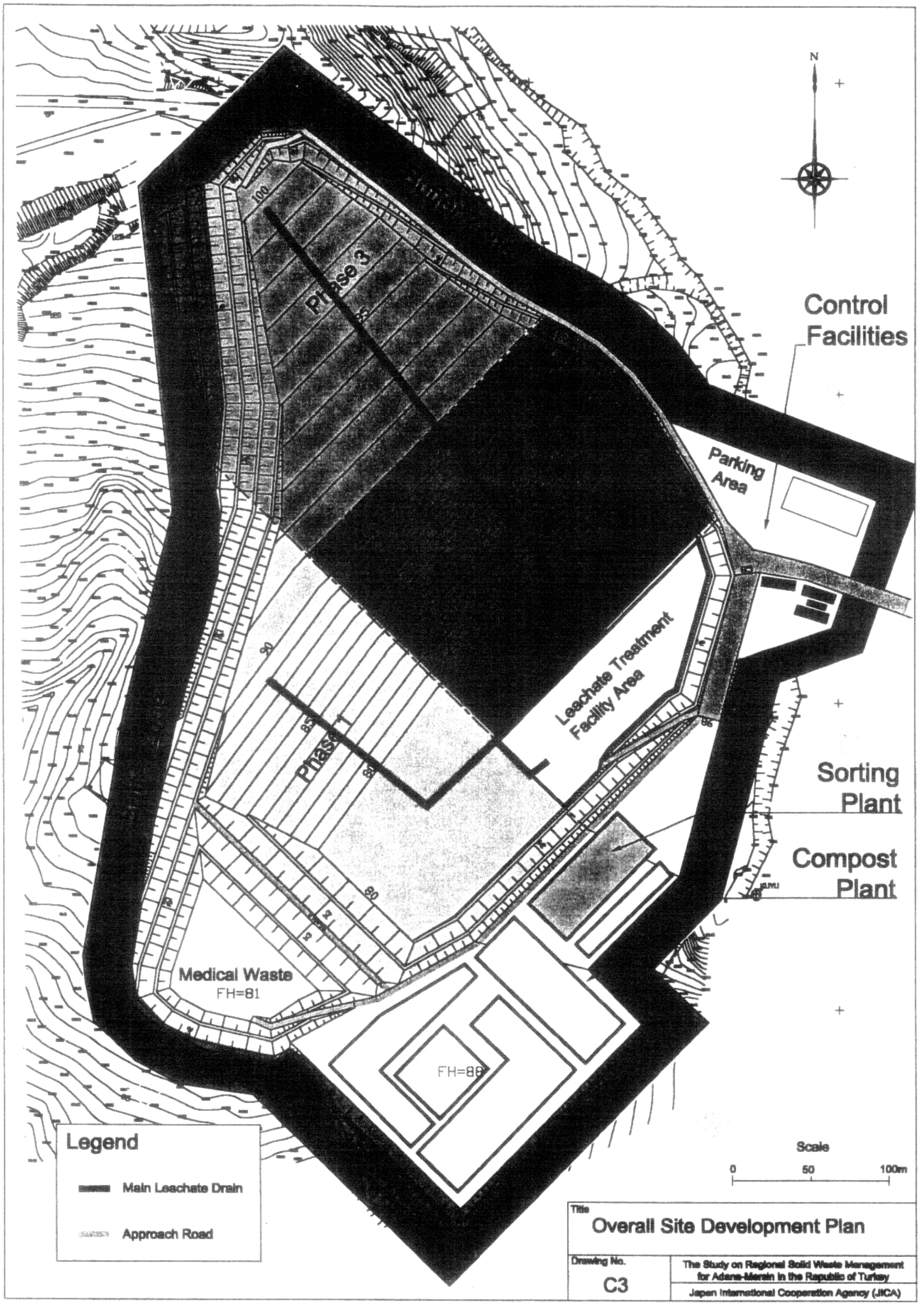

Figure 11-1: Overall CIMSA Site Development Plan

11.2.2 Design of a Separate Collection System

a. Examination of Technical Alternatives

Conditions to execute a separate collection system are as follows.

- The current collection amount (780t/day) is assumed to be constant during the F/S study period. If volume increases, collection vehicles shall be purchased by the city, and this is not included in this F/S.
- The collection efficiency will drop if the separate collection system is introduced. The reduction shall be assumed to be 20%, and this condition is considered for the required number of vehicles in this F/S.
- Containers (800lit.) used for the separate collection system is included in this F/S.
- 30% of the collection amount shall be collected by the container as separated waste.
- Annual collection days shall be assumed to be 300 days.
- The number of separate collection days is five times a week.

b. Preliminary Design

b.1 Planned Waste Collection Amount

Planned waste collection amount for 1999 and from 2002 until 2005 are shown in Table 11-2.

Table 11-2: Waste Generation, Discharge and Collection Amount in Cimsa

	1998	2002	2003	2004	2005
Generation (ton/day)	446	559	592	625	663
Discharge (ton/day)	425	540	574	607	644
Collection (ton/day)	407	528	563	597	637
Coverage Ratio (%)	96	98	98	98	99

b.2 Productivity of Collection Vehicles

The productivity of collection vehicles (16m^3 compactor truck) is shown in the table below.

Table 11-3: Productivity of Collection Vehicles in Cimsa

Number of trips per day			
working time	t1	hr	8
Daily inspection and fuelling time before working	t2	hr	0.5
Daily inspection and washing time after working	t3	hr	0.5
Loading time	t4	hr	1.5
Unloading time	t5	hr	0.2
travel distance	D	km	40
Velocity	V	km/hr	40
Number of trips per day	Tr. = (t1-(t2+t3))/(D/V+t4+t5)	times	2
Amount of waste carried per day			
Volume capacity of a vehicle	q	m^3	16
Efficiency of lading capacity	e	-	0.8
Reserve rate of vehicle	r	-	0.1
AGS of waste	d	t/m^3	0.5
Amount of waste carried per day(ton/day/truck)	Qd=qxexTr/(1+r)xd	t/day/unit	11.6

b.3 Required Number of Collection Vehicle

The targeted collection amount and required number of collection vehicle are shown in Table 11-4.

Table 11-4: Required Number of Collection vehicle in Cimsa

	formula	2002	2003	2004	2005
Collection amount (ton/day)	a	528	563	597	637
Increasing collection amount(ton/day)	b=ax1.2-407	227	269	309	357
	c=bx365/350	237	281	322	372
Required number of vehicle	d =c/Qd	21	25	28	33

b.4 Required Number of Container

Thirty percent of the collection amount shall be collected by the container as a separate waste. The separate waste amount and required number of container are shown in Table 11-5.

Table 11-5: Required Number of Container in Cimsa

	formula	2002	2003	2004	2005
Collection amount(ton/day)	a	528	563	597	637
Increasing collection amount(ton/day)	b=ax30%	158	169	179	191
Increasing collection amount(m^3/day)	c=bxASG	546	582	618	659
required number of container	d=c/0.8x7/n	956	1,019	1,081	1,153

Note: ASG=0.3(ton/m^3)
n: the number of separate collection days in a week=5days

11.2.3 Design of a Sorting Plant

a. Basis for Preliminary Design

a.1 Compositions of Non-compostable Wastes

The composition of non-compostable wastes applied to the plant design, based on the JICA study team's data, is assumed as shown in the table below. Basic assumptions for the establishment of this design waste composition are as follows:

- The average of waste composition in the AGM and in the MGM is applied to the plant design.
- Organic waste (compostable wastes) comprises 30% of non-compostable waste.

Table 11-6: Composition for Non-Compostable Wastes in Cimsa

		Composition	Moisture	Average		Composition			
		Average	Average	Water	Dry Solid	Non-compostable waste	Water	Dry Solid	Dry Base
		%	%	%	%	%	%	%	%
Combustibles	Kitchen Waste	53.7	77.7	41.7	12.0	**30.0**	23.3	6.7	15.1
	Paper	22.8	57.3	13.1	9.7	34.4	19.7	14.7	33.2
	Textile	2.9	50.3	1.5	1.4	4.4	2.2	2.2	5.0
	Grass and Wood	2.0	61.1	1.2	0.8	3.0	1.8	1.2	2.7
	Plastics	8.6	41.1	3.5	5.1	13.0	5.3	7.7	17.4
	Leather and Rubber	0.4	32.2	0.1	0.3	0.6	0.2	0.4	0.9
Incombustibles	Metal	1.8	19.8	0.4	1.4	2.7	0.5	2.2	5.0
	Glass	4.3	11.9	0.5	3.8	6.5	0.8	5.7	12.8
	Ceramic and Stone	1.5	30.4	0.5	1.0	2.2	0.7	1.5	3.4
	Miscellaneous	2.0	37.5	0.8	1.2	3.2	1.2	2.0	4.5
Total				63.3	36.7	100.0	55.7	44.3	100.0

a.2 Items to be Recovered

Taking these factors into account, this study revealed that it would be feasible to recycle the following materials at the proposed sorting plant, to be located in Cimsa, Mersin city.

- Paper (mainly cardboard)
- Plastics (film and PET bottles)
- Glass (bottles and cullet)
- Ferrous metals
- Non-ferrous metals (mainly aluminium cans)
- Textile

a.3 Sorting Methods

The sorting plant is planned to recover ferrous metals by using a magnetic separator, and all the other materials by manual sorting on a belt conveyor. In order to raise the work efficiency of manual sorting, a plastic bag breaker will open the bags before the hand-sorting conveyor. Moreover, the possibility to pay the workers at piecework rates should be studied since it could raise workers' motivation and in turn recovery ratio. A sorting plant in Mexico City provides a good example.

b. Preliminary Design

b.1 Outline

b.1.1 Location

The sorting plant is planned to be located within southern section of Cimsa site. The area is about 23 hectares.

b.1.2 Treatment Capacity

The treatment capacity of the proposed sorting plant is designed to be 100 ton/day as the non-compostable wastes to be handled at this plant in 2005 (target year of the F/S), is projected at 32,095 ton/year.

b.1.3 Working Hours

The work schedule of the plant is as follows.

- The proposed plant operates 350 days a year.
- Mondays - Sundays 7:00 - 23:00 (16 hour/day)
- National Holidays Closed
- Waste received time 16 hour/day
- Equipment operation hours 13 hour/day

b.2 Sorting Plant Design Parameters

b.2.1 Design Principles

- The treatment capacity of the sorting plant is 100 ton/day, assuming that 30 % of all MSW will be separately collected from the waste sources to the plant, and the plant operates 350 days in a year.
- The sorting plant will operate from 2002.
- The sorting plant will be constructed at southern section of the Cimsa site and next to the compost plant. The site will be surrounded by a buffer zone (green belt).

b.2.2 Summary of Design Parameters

The table below summarises the design parameters based on the above design assumptions.

Table 11-7: Design Parameters of Sorting Plant in Cimsa

Raw Material			
	Amount	32,095 ton/year (2005)	
	Moisture content	55.7 %	*1
	Bulk density	300 kg/m^3	*1
Plant Specification			
	Type	Manual-sorting + a magnetic separator	
	Treatment line	One line	
	Treatment Capacity	100 ton/day	
	Operation	350 day/year 16 hour/day by two shifts	
	Recovered Material	(1) Paper (mainly Cardboard) (2) Plastics (Film and PET bottles) (3) Glass (Bottles and Cullet) (4) Ferrous metal (5) Non-ferrous metal (mainly Aluminium cans) (6) Textile	

Note: *1:Estimates from the pilot project

b.3 Plant Process Flow

Figure 11-2 shows the plant process flow.

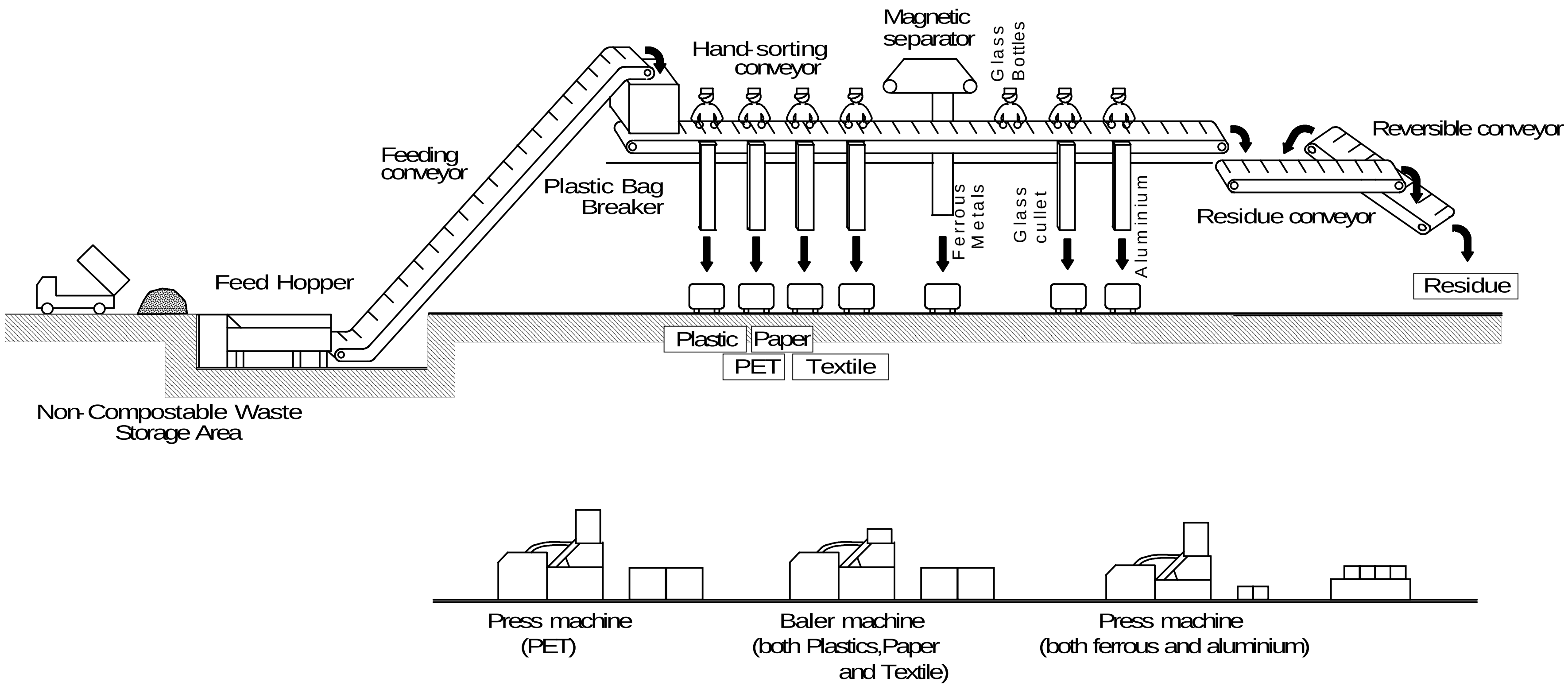

Figure 11-2: Process Flow Diagram of the Sorting Plant in Cimsa

b.4 Material Balance

The figure below shows the material balance at the proposed sorting plant.

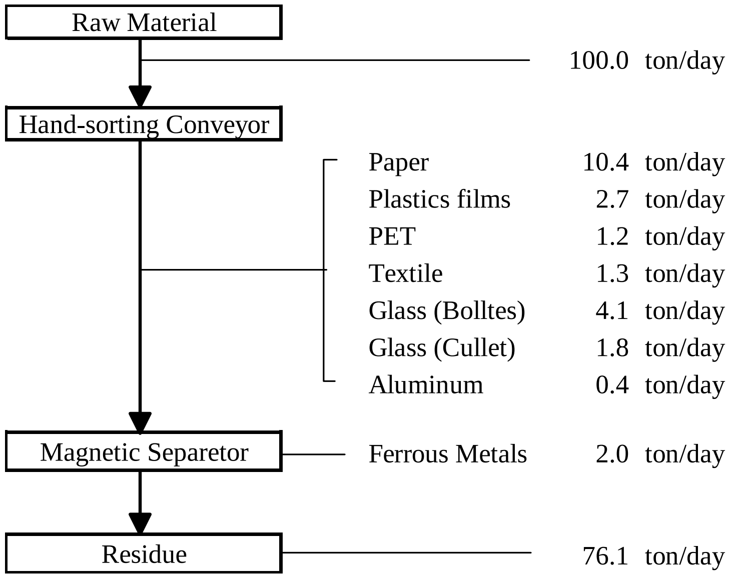

Figure 11-3: Material Balance of the Sorting Plant in Cimsa

b.5 Layout of Proposed Sorting Plant

The layout of the proposed sorting plant is presented in Figure 11-4.

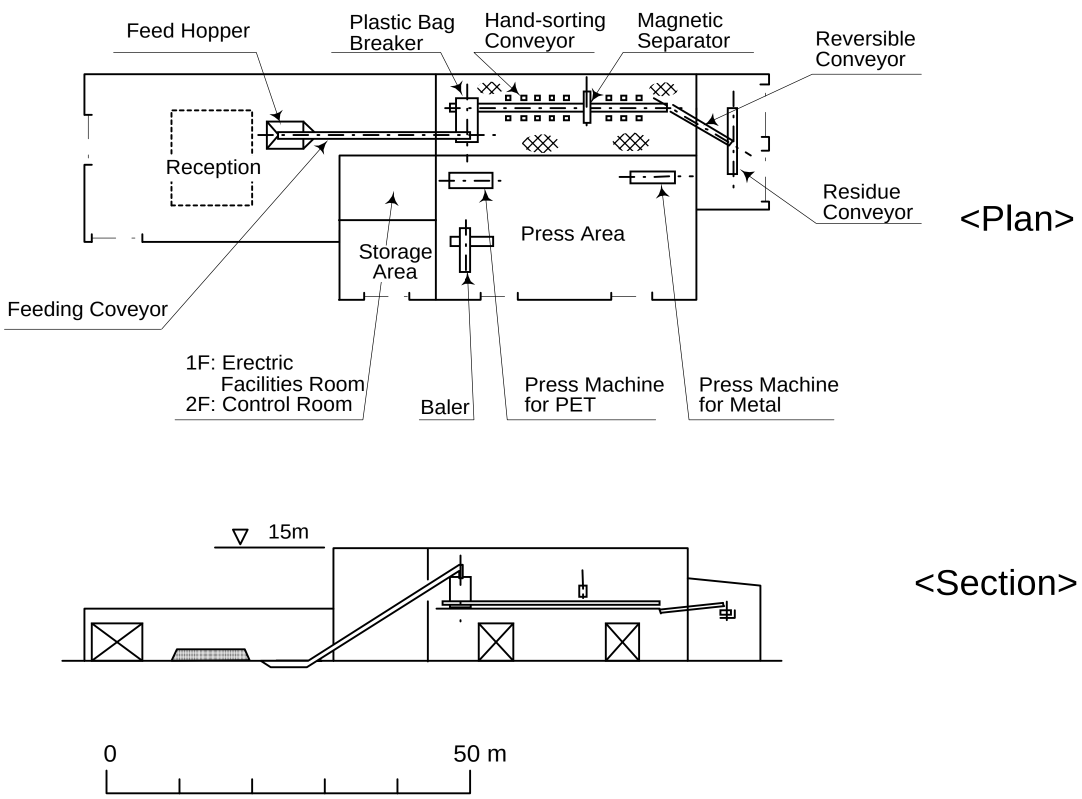

Figure 11-4 : Layout of the Sorting Plant in Cimsa

c. Design Concept Summary of a Sorting Plant

The process flow diagram and the plant layout presented in Figure 11-2 and Figure 11-4, respectively, are designed for mechanical sorting of ferrous metal and hand sorting of the other materials. The reasons for choosing such sorting methods are as follows.

- Theoretically it is possible to design a fully mechanised sorting plant but it is expensive both in construction, and in operation and maintenance (O&M).
- In addition mechanical sorting is less efficient in terms of recovery quality than manual sorting except for ferrous metal recovery.
- Unlike mechanical sorting, manual sorting is flexible to the fluctuation of incoming wastes in terms of quantity as well as quality.
- The labour cost in the Mersin GM is relatively cheap, thus labour intensity of manual sorting is not necessarily disadvantage.

11.2.4 Design of a Compost Plant

a. Examination of Technical Alternative

a.1 Composition of Compostable Waste

Composition of compostable waste applied to the plant design is assumed as shown in the table below, based on JICA study team data. The design waste composition is assumed as follows:

- The average of waste composition in the AGM and in the MGM are applied to the plant design.
- Non-compostable waste make up 10% of compostable waste.
- The average moisture content of compostable waste is 74.5%, while the moisture content of the waste separately collected by the pilot project was 68%. It is assumed to be 70% for design purposes.
- Water will be extracted from the delivered waste, under the pressure of its own weight, while they are in the reception area and the feed hopper. As a result, the moisture content will drop to about 65%. The figure was obtained from the data of the JICA study team.

Table 11-8: Composition of the Compostable Waste

		Composition	Moisture	Average		Composition			
		Average	Average	Water	Dry Solid	Compostable waste	Water	Dry Solid	Dry Base
		%	%	%	%	%	%	%	%
Combustibles	Kitchen Waste	53.7	77.7	41.7	12.0	**90.0**	69.9	20.1	78.8
	Paper	22.8	57.3	13.1	9.7	4.9	2.8	2.1	8.2
	Textile	2.9	50.3	1.5	1.4	0.6	0.3	0.3	1.2
	Grass and Wood	2.0	61.1	1.2	0.8	0.4	0.2	0.2	0.8
	Plastics	8.6	41.1	3.5	5.1	1.9	0.8	1.1	4.3
	Leather and Rubber	0.4	32.2	0.1	0.3	0.1	0.0	0.1	0.4
Incombustibles	Metal	1.8	19.8	0.4	1.4	0.4	0.1	0.3	1.2
	Glass	4.3	11.9	0.5	3.8	0.9	0.1	0.8	3.1
	Ceramic and Stone	1.5	30.4	0.5	1.0	0.3	0.1	0.2	0.8
	Miscellaneous	2.0	37.5	0.8	1.2	0.5	0.2	0.3	1.2
Total				63.3	36.7	100.0	74.5	25.5	100.0

a.2 Selection of Composting System

The JICA study team recommends to apply the static pile system as composting method for the new plant. The reasons are:

- Taking proximity to the residential area (about one km or less) into consideration, it is indispensable to have an odour control facility.
- For operation in rainy season it is necessary to have a roof for the composting process in order to avoid leachate generation by rain water.
- The windrow system can neither control odours nor leachate.
- The in-vessel system is expensive both in investment, and in O&M.
- The static system is relatively cheap both in investment, and in O&M. It can control both odours and leachate.

a.3 Pre-treatment Process

The proposed composting plant needs a pre-treatment process for the following reasons.

- The raw materials separated at source as compostable can still contain non-compostable materials. To prevent product quality deterioration, they should be removed. The removal method may allow material recovery from the removed materials.
- Size reduction will result in a larger surface area of waste fractions. The larger the surface area is, the more oxygen can be supplied, and aerobic decomposition is facilitated.

a.3.1 Non-compostable Material Mixed in the Raw Materials

When manual sorting is applied, the work environment will be highly unhygienic. Furthermore, the pilot project revealed that there was little incentive for the workers to sort recyclable materials. The team, therefore, did not plan to apply manual sorting to the proposed plant.

a.3.2 Size Reduction

The selective crushing separator (SCS) was applied to the design by the JICA study team, by which size reduction and the rejection of unsuitable materials can be achieved. As shown in the following figure, the SCS consists of a perforated, rotating drum screen and a rotating scraper at different speed within the drum screen.

The features of the SCS are as follows.

- Its functions include crushing and separating.
- Although the compostable wastes received by this plant has a high moisture content, the SCS will face less troubles of screen blockage which is often caused by such wastes
- It reduces the size of kitchen waste to 50mm.
- It tears plastic bags.

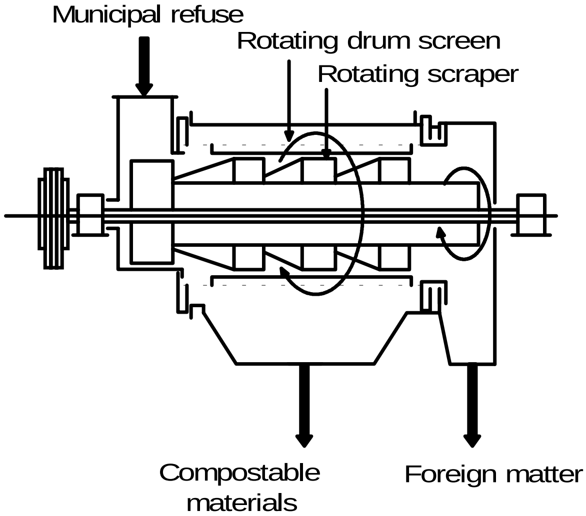

Figure 11-5: Selective Crushing Separator in Cimsa

a.4 Screening Section

The proposed compost plant is planned to be equipped with the following separators.

- trommel screen (size separation for raw compost and mature compost)
- ballistic inertial separator (density separation for small glass cullet and gravel)
- magnetic separator (ferrous metals)

b. Preliminary Design

b.1 Location

The compost plant is planned to be located within southern section of Cimsa site. The area is about 23 hectares.

b.2 Treatment Capacity

The treatment capacity of the proposed compost plant is designed to be 110 ton/day as the compostable wastes to be processed at this plant in 2005 (target year of the F/S), is projected at 37,677 ton/year.

b.3 Working Hours

The work schedule of the plant is as follows.

- The proposed plant operates 350 days a year.
- Mondays - Sundays 7:00 - 23:00 (16 hour/day).
- National Holidays Closed.
- Waste received time 16 hour/day
- Equipment operation hours 13 hour/day

c. Compost plant Design Parameters

c.1 Design Principals

- The plant capacity is calculated to be 110 ton/day by assuming that 30% of MSW will be separately collected and that the plant operates 350 days in a year.
- It is planned that the compost plant starts operating in the year 2002.
- The compost plant will be constructed at southern section of the Cimsa site and next to the sorting plant. The site will be surrounded by a buffer zone (green belt).

c.2 Summary of Design Parameters

The table below summarises design parameters based on the design assumptions established above.

Table 11-9: Design Parameters of Compost Plant at Cimsa

Composting section				
	Type	Aerated Static Pile		
	Raw Material	Amount	100 ton/day	
	(Compostable Waste)	Compostable Content	20.3 % by Dry weight	*1
		Moisture Content	70 %	
		Apparent Specific Gravity (ASG)	500 kg/m^3	*2
	Operation		350 day/year 16 hour/day	
	Treatment Capacity		110 ton/day	
	Composting Period		28 days	
	Pile Temperature		>55^{o}C	
Maturation (Curing) section				
	Operation		350 day/year 16 hour/day	
	Treatment Capacity	Mature compost product	~ 20.0 ton/day	
		Moisture Content	~ 40 %	
		Apparent Specific Gravity (ASG)	500 kg/m^3	*2
	Maturation Period		60 day	
Final Separation section				
	Type	Trommel screen		
	Operation Time		350 day/year 16 hour/day	
	Treatment Capacity	Fine compost product	~ 16.2 ton/day	
		Coarse compost product	~ 3.8 ton/day	
		Moisture Content	~ 40 %	
		Apparent Specific Gravity (ASG)	500 kg/m^3	*2

*1 : Obtained from Table 11-18 (composite of kitchen waste, grass and wood)
*2 : Estimates from the pilot project.

d. Quantity and Quality of Compost Product

Table 11-10 shows the target quality and quantity of the compost product in the preliminary design.

Table 11-10: Quantity and Quality of Compost Product in Cimsa

Quantity	Fine Compost	~ 16.2 ton/day ~ 5,670 ton/year
Quality	Moisture Content	40 %
	Apparent Specific Gravity (ASG)	500-700 kg/m^3
	C/N ratio	< 25

e. Flow of Compost Plant Process

Figure 11-6 shows the flow of the proposed compost plant process.

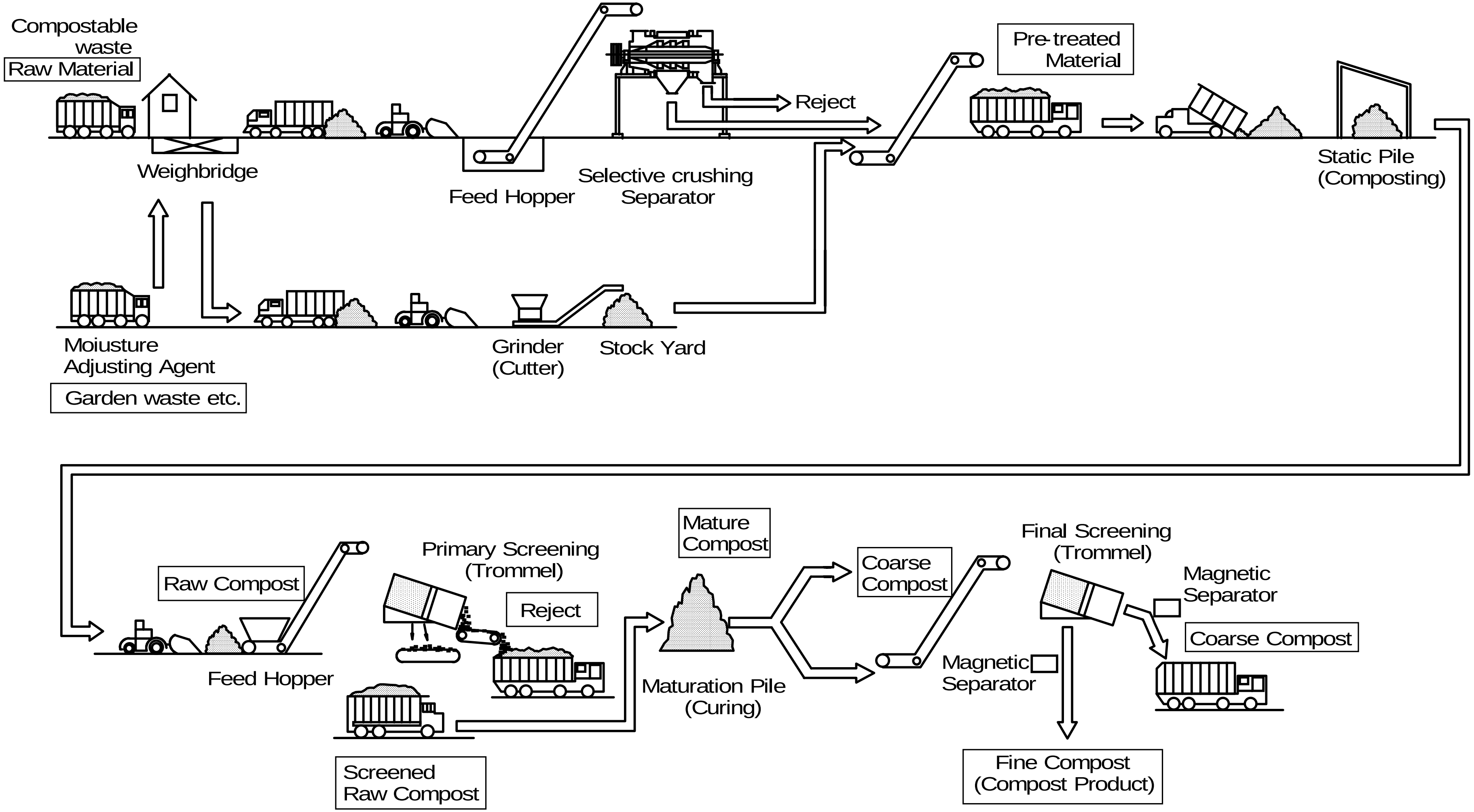

Figure 11-6: Process Flow Diagram of the Compost Plant in Cimsa

f. Material Balance

The figure below shows the material balance in the proposed plant process in the case of 70% moisture content.

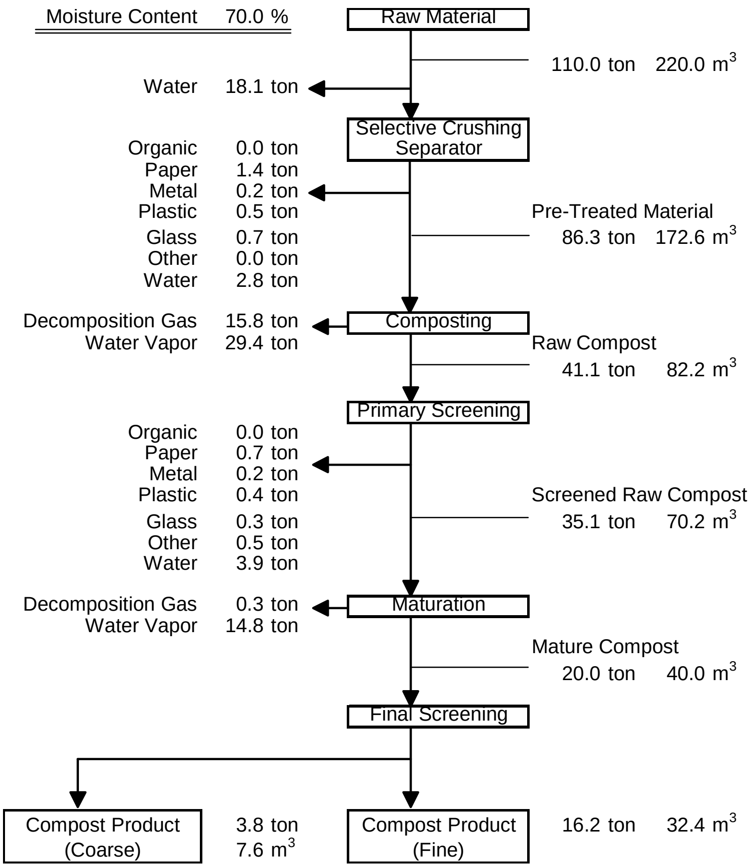

Figure 11-7: Material Balance of the Compost Plant in Cimsa

g. Layout of Proposed Compost Plant

Figure 11-8 shows the proposed layout of the compost plant.

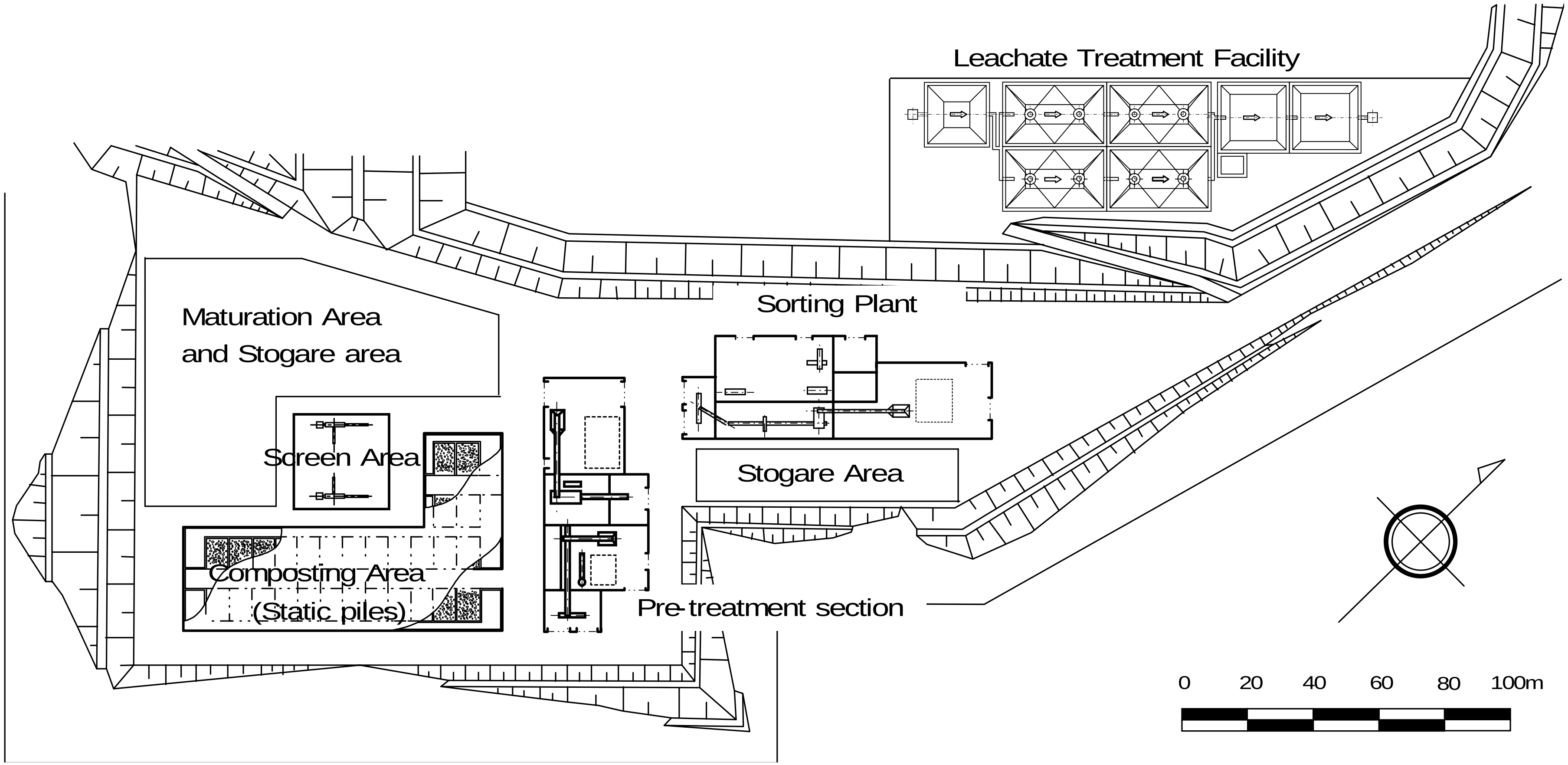

Figure 11-8: Layout of Proposed Compost Plant in Cimsa