CHAPTER 2. FINDINGS

2.1 Generation and Discharge of Solid Waste

2.1.1 Generation of Solid Waste

If all the generated solid waste was transported to the disposal sites, it would be relatively easy to determine the amount of solid waste in the city. However, areas of inadequate collection services, areas of no collection services and independent service, i.e. Zabaleen channel, have been observed. The amount of solid waste transported to the disposal sites cannot, therefore, be regarded as the total solid waste amount generated in Alexandria.

In a case like this, the most authodox method to calculate the total solid waste amount is to carry out separate estimates for each of the generating sources, i.e. domestic waste, commercial waste and street rubbish.

It would, however, be difficult to employ this method in Alexandria. One reason for this is that the indicators of commercial activities are unavailable although the types and numbers of commercial enterprises are available. Neither are sufficient statistics concerning the total street length available.

The available data concerning the generated solid waste amount is the generation rate for domestic waste, the generation rate of main street rubbish and the number of vehicles disposing of solid waste at the two disposal sites.

The method of calculation on the total generated solid waste amount is given in Fig. 2-1-1.

(1) Calculation Based on the Amount of Waste Transported to the Disposal Sites

The amount of solid waste disposed of at the disposal sites, the amount of solid waste collected by Zabaleens and the amount of solid waste generated in areas of inadequate collection services were estimated in order to calculate the total solid waste amount generated in the last 10 days of September.

The amount of solid waste at the disposal sites was calculated, based on the number of vehicles coming to the sites and their respective loading weights. Table 2-1-1 and Table 2-1-2 show the loading weights of the different vehicles and calculation results of solid waste amount hauled from each district to disposal site, respectively.

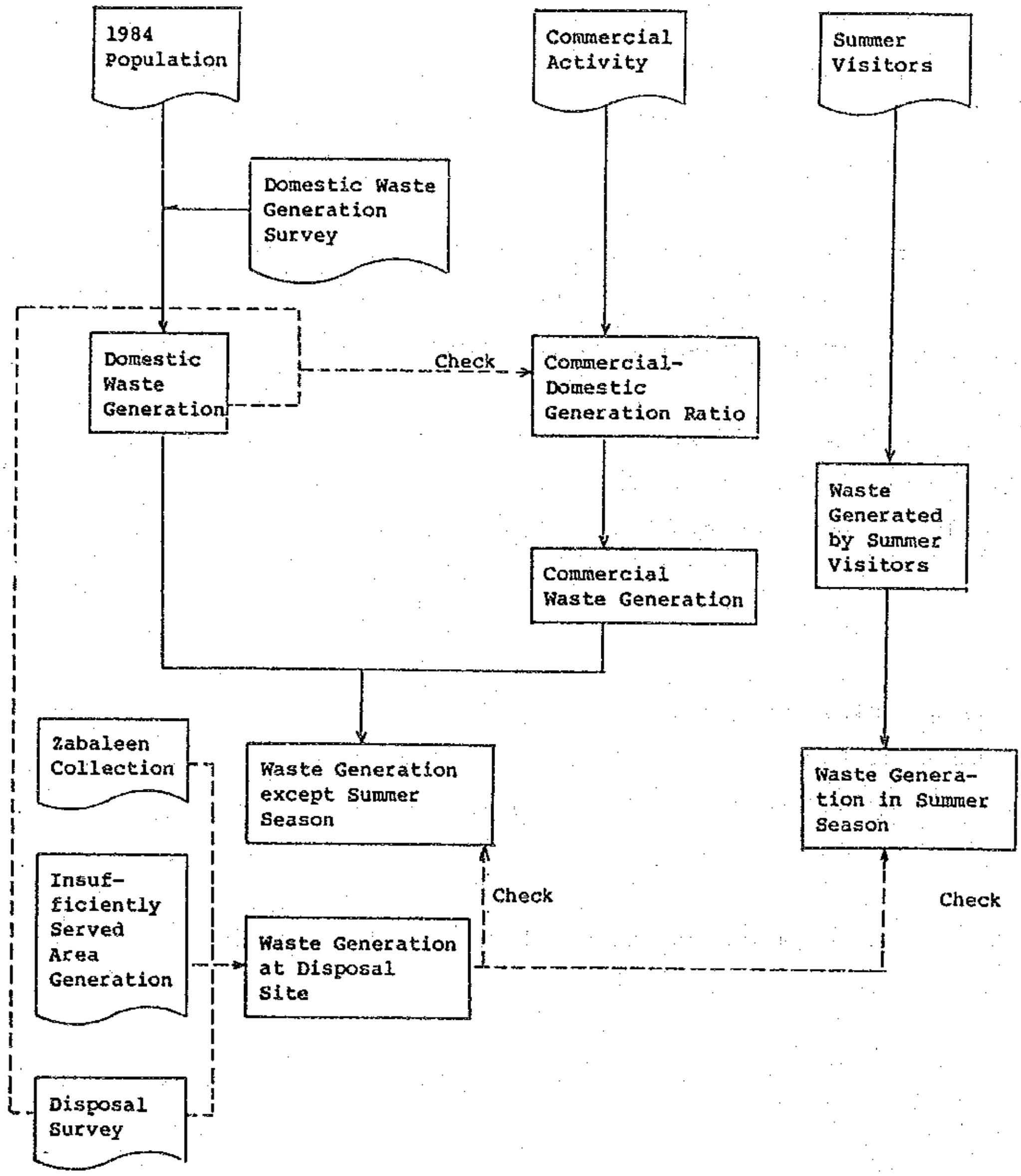


Fig. 2-1-1 Calculation Procedure of Urban Solid Waste Generation in Alexandria

Table 2-1-1 Results of Vehicle Scale Survey

	Load Capacity m^3	Loading Weight Ton	Density kg/m^3	Average Loading Weight Used ton
Truxmore*	16.1	6.35	395	6.5
Fiat*	11.2	6.27	560	6.3
Leach*	9.1	4.00	460	4.0
Isuzu	(6.0)	2.44	407	2.5
Mitsubishi	(6.0)	2.68	447	2.5
Nissan	(4.0)	1.62	405	1.2
Daihatsu	(3.5)	1.17	334	1.2

* Compactor vehicle

Table 2-1-2 Solid Waste Amount Hauled from Each District to Disposal Sites (ton/day)

District	Day/Month							Average
	16/9	17/9	18/9	19/9	20/9	21/9	22/9	
Montazah	45.6	43.3	41.4	41.6	49.8	37.8	60.1	45.7 (85.7)
East	191.6	166.9	187.2	163.2	189.1	105.2	202.1	172.9
Middle	376.8	384.7	386.5	427.2	340.7	342.3	345.6	372.0
Gomrok	201.0	186.8	196.8	195.7	223.6	82.5	194.9	183.2
West	150.6	125.4	158.2	146.2	154.5	121.1	171.1	146.9
Ameriya	50.3	46.3	52.7	50.1	36.6	42.3	53.3	47.1
Total	1015.7	953.4	1022.8	1024.0	994.3	732.2	1027.4 (1007.1)	967.1

Note: * Survey results effectuated at Disposal Site, from 16 to 20 Sept., 1984.

* Disposal amount carried by ADS is included.
* ( ) show the reference value; some 40 ton/day of waste discharged from Montazah district is disposed at the other places.

Table 2-1-3 Solid Waste Amount Accounted for in the Inadequately Serviced Areas

District	Number of Inhabitants (10^3 person)	Expected Amount of Solid Waste (ton/day)	Amount of Solid Waste Collected by Zabaleens (ton/day)
Montazah	267	100	26
East	333	70	45

Note: * The generation rate at low income inhabitants (0.221 kg/person/day) was used.

** The capacity of donkey carts was given at 0.6 tons/cart.

*** Number of inhabitants was obtained through the interview to the general supervisor of each district.

(2) Calculation Based on the Generation Rate of Domestic Waste

The formula used for the calculation of the total solid waste amount in Alexandria, based on the generation rate of domestic waste, is as follows.

$$S = \text{Population} \times \begin{matrix}\text{Domestic}\\ \text{Generation}\\ \text{Rate}\end{matrix} \times \begin{matrix}\text{C-D}\\ \text{Ratio}\end{matrix} + \begin{matrix}\text{Summer}\\ \text{Visitors}\end{matrix} \times \begin{matrix}\text{Generation}\\ \text{Rate}\end{matrix}$$

Note: Commercial-Domestic Generation Ratio is hereinafter expressed as C-D ratio.

The population figures used are given in Table 2-1-4. With regard to the domestic generation rate, the results of the domestic waste generation survey (Table 2-1-5) were used.

The current proportional population by different income levels in each district was next determined in order to establish the domestic waste generation rate for each district. The total domestic waste generated was then calculated using these rates (Table 2-1-6).

Table 2-1-4 Population and Summer Visitors in Alexandria Governorate

District	Population (10^3 persons)	Summer Visitors (10^3 persons)
East	666	350
Mid	718	50
Gomrok	306	0
West	506	0
Ameriya	107	100
Total	1,659	1,000

* Number of summer visitors is referred to the results effectuated by the Bureau of Tourism.

Table 2-1-5 Domestic Waste Generation Rates and Waste Density

	Low Income	Middle Income	High Income	Mean*
Generation Rate (g/capita/day)	221	344	362	284
Density (kg/m^3)	254	224	192	236

* Weighted Arithemetic Mean ... Population ratios for low, middle and high income levels are assumed to be 50%, 40% and 10% respectively. This assumption was based on Mr. Hussein's 1978 report.

** Sampling areas of low, middle and high income household were selected by counterpart.

*** The survey was executed in following manners:

1 Plastic bags were distributed to sampling households every day.

2 Plastic bags filled with waste were collected by survey staff next day.

3 Each plastic bag collected was weighed.

4 Generation rate was calculated by using following formula.

$$\text{Genration rate} = \frac{\sum_{i=1}^{n} \sum_{n=1}^{n} (\text{weight of each plastic bag})}{\text{Total number of persons}} \times 1/7$$

i: Number of days surveyed

n: Number of sampling households

5 Survey was implemented for 8 days from 15th to 22nd Sept. Data of Sept. 15th was not counted, since the day was considered as preparatory.

Table 2-1-6 Domestic Waste Amount and Calculated Domestic and Commercial Solid Waste Amount

District	Population	Generation Rate g/capita	Domestic Waste Amount (A) ton/day	Amount of Disposal Waste (B) ton/day	B/A	C-D Ratio	Total Amount (I) ton/day
Montazah	355,585	260	93	*86	0.925	IV 1.350	125
East	665,946	280	187	172	0.290	III 1.500	280
Middle	718,888	304	219	372	1.700	I 1.700	372
Gomrok	305,796	306	94	183	1.947	I 1.940	183
West	506,215	272	138	147	1.065	II 1.200	165
Ameriya	106,534	246	26	47	1.808	II 1.200	31
Total	2,648,964	285	757	967	1,277		1,156

District	Low %	Middle %	High %
Montazah	70	22	8
East	52	36	12
Middle	35	51	14
Gomrok	32	58	10
West	59	37	4
Ameriya	55	36	9

Note: 1) Repartition of population corresponding to each income level is assumed taking into consideration the situation of low, middle and high income area.

2) I, II, III and IV in Table shows the following characteristics;

I is the concentrated commercial and business area.

II is the residential area, where many houses are concentrated.

III is the area where commercial activity is dominant.

IV represents the intermediate area between II and III.

3) Calculation Conditions

In the area II, the solid waste generation amount is experimentally 20% more than that of the normal residential area. Therefore, C-D ratio is taken to 1.20.

4) In the area III, the solid waste generation amount is supposed to be intermediate between those of Middle and Gomrok Districts. C-D ratio is assumed to be 1.50.

5) C-D ratio of the area IV is assumed to be 1.35, corresponding to the mean value of those of the area II and III.

In addition, the generation rates of commercial waste and domestic waste in each district were determined as C-D ratios using the proportions of commercial as well as office activities and of ordinary household activities in the districts (Table 2-1-6). The ratio between the estimated total generated amount of waste at the disposal sites and the domestically generated amount of waste was referred to, when these C-D ratios were being determined. Using these rates and the domestically generated waste amount, the commercially generated amount of waste was calculated.

As many tourists visit Alexandria during the summer, the influence of these tourists on the generated waste volume was separately calculated based on the assumption that one million tourists are visiting Alexandria, and each generating 200g of waste per capita per day.

The calculated amount of solid waste generated in each district is given in Table 2-1-7. The quantities of domestic waste, commercial waste and waste generated by summer tourists were 757, 399 and 200 tons/day respectively, totalling 1,356 tons/day. This total amount is not far from the figure, 1,211 tons/day, obtained from suming up the amount of the solid waste measured at the disposal sites, one collected by Zabaleens and generated and one generated in areas of inadequate collection services.

Tab. 2-1-7 Amount of Solid Waste Generation in Each District

District	Domestic Waste	Commercial Waste	Summer Visitor Waste	Total	Ref. Value*
Montazah	93	32	100	225	171
East	187	93	70	350	291
Middle	219	153	10	382	372
Gomrok	94	89	0	183	183
West	138	27	0	165	147
Ameriya	26	5	20	50	47
Total	757	399	200	1,356	1,211

Note: * Reference value represents value from the survey results effectuated at disposal site.

** Generation rate due to summer visitors is to be assumed 2,00g/capita/day, corresponding to that of low income household.

2.2 Composition Analysis of Solid Waste

2.2.1 Outline

Physical composition analysis was made for the following wastes:

- Domestic (household) wastes
- Street garbage collected by sweepers
- Wastes dumped at dump site

In addition, chemical composition analysis was made for the wastes dumped at dump sites, as this analysis may be necessary for the planning of intermediate treatment and final disposal.

2.2.2 Composition of domestic waste

Physical composition analysis was carried out using samples taken from wastes discharged from general household in Middle district according to the income level (high, middle and low income areas).

Tab. 2-2-1 shows the method of survey.

Tab. 2-2-2 Shows the results, and

Tab. 2-2-3 shows the data of the past survey made in 1978 for reference.

Wastes composition is summarized as follows on the average value:

	SURVEY MADE BY JICA TEAM %	SURVEY MADE BY MR. HUSSEIN (1978) %	SURVEY MADE BY FOLLOW-UP DEPT. %
Combustibles	92.5	92.8	90.8
Most waste	Garbage	Garbage	Garbage
	59.9	76.6	67.6
Second most	Paper	Paper	Paper
	19.5	14.9	23.0
Least waste	Leather	Grass, wood	Plastics
	0.1	0.7	0.2
Difference observed in average	Plastics	Plastics	
	4.1	0.4	

According to the survey made by JICA Study Team, garbages share more and paper and plastics share less than those found by the survey made by Mr. Hussein.

Wastes increasing and decreasing tendency according to the income level is shown as follows: (the left side is low income level and the right side is high income level in the parentheses.)

(Unit: %)

	THIS SURVEY		SURVEY MADE BY MR. HUSSEIN (1978)	
Increasing tendency	Paper		Paper	
	(14	23%)	(11	20%)
Decreasing tendency	Textile		Rag	
	(4.5	2.8%	2.2	1.8%)
	Grass, wood		Bone	
	(6.0	3.5%)	(2.4	0.9%)
	Vegetables		Vegetables	
	(67	58)	(78	78%)

Paper increases, and vegetable decreases as the income goes up.

The apparent density of waste decreases as the income level rises (254 - 192 kg/cm^3). As described above these results are reasonable because of the increase in paper and plastics and decrease in vegetables.

2.2.3 Compsotion of street wastes

According to the result of the on-the-spot survey, the street wastes composition seem to be different according to the street structure or surrounding environmental conditions, etc. Physical composition analysis was made for street wastes collected both from main streets and narrower streets that have some distance from main street.

Tab. 2-2-4 shows the results, and

Tab. 2-2-5 shows the paste data for reference.

Main streets are important for the connection of districts and regional traffic, and have driveways and sidewalks generally, almost all of them are paved and some are with trees. The wastes surveyed are considered as pure street wastes, since soil, sand and dust account for about 52% of the total weight. The remainder consists mainly of various packing paper, cigarette butts, tree leaves.

On the other hand, most of narrow streets away from main street have no sidewalks, and are in the residential areas. In addition to pure street wastes, domestic wastes is also found, and the wastes composition is somewhat different from that found in main streets.

The same tendency is observed by the survey made by Mr. Hussein in 1978. These results show that efforts of residents are very important for improving the efficiency of cleansing service of street sweepers as well as beautification of the streets.

2.2.4 Composition of waste carried into the Airport Dump Site

Most of wastes collected from different districts in Alexandria were carried into the Airport Dump Site located in East district. Physical and chemical composition analysis was made for wastes collected from total 16 places in 4 districts (East, Middle, Gomrok and West districts) where a relatively a large quantity of wastes are collected. (3 residential places: high, middle and low income area, and one commercial area were selected from each district.)

Tab. 2-2-6 shows the names of wastes collection places and names of samples, and

Tab. 2-2-7 shows the method of physical composition analysis.

Tab. 2-2-8 shows method of chemical composition analysis on three components (moisture, ash and combustibles) and ultimate analysis (refer to Note 4).

Tab. 2-2-9 describes the equation for calculating calorific value.

Tab. 2-2-10 shows the results of physical composition analysis of wastes.

Combustibles account for 93.68% (considered to be actually about 87%) of the total weight, and composition in the decreasing order for each kind of wastes is as follows: Others (29.4%, Note 1, Note 2), Paper (19.4%), vegetables (17.7%), green, etc. (15.7%). Noncombustibles consist mainly of soils (7%), sand, metal, glass, etc.

The weight of unit wastes volume is 237 kg/m^3 on the average, and may be an ordinary value (Note 3). In detail, Samples A-3 and D-2 show low values. This is because of sugar cane dregs accounted for most of the former, and a large amount of paper is contained in the latter.

Tab. 2-2-11 shows the results of totalization by districts, different income areas and kinds of wastes.

As for reusable wastes, the following amounts are found: about 63% for compost raw materials on the wet basis, about 25% of fiber, about 6% of raw materials for synthetic chemicals and about 3% of metals. For reference, the results of wastes composition analysis in the dry basis are shown in Tab. 2-2-12. Compost raw materials are estimated at about 54% of the total weight.

Note 1) Other miscellaneous wastes having a size of about 3cm or less include paper, tree leaves, surgar cane dregs, bread crumbs, kitchen wastes, cigarette butts, soils and sand, etc. This is because undersize of 5-mm screen opening was initially planned but the plan was suddenly changed due to the conditions in Alexandria. (Sufficient work place equipment, work place, facilities, working materials, etc. were not available.)

Note 2) As a result of calculation, others contain average 7.0% noncombustibles on the basis of wet wastes, and most of them are considered as soil and sand.

Note 3) For reference, values in Japan are shown in the following table:

APPARENT SPECIFIC GRAVITY OF WASTES (Tokyo)

YEAR	1963	1964	1965	1966	1967	1968	1971	1972	1973*	1974*
Measurement frequency	27	41	46	20	36	10	22	24	15	30
Average	0.255	0.239	0.227	0.209	0.241	0.227	0.262	0.236	0.254	0.253
Standard deviation	0.057	0.033	0.033	0.014	0.028	0.030	0.042	0.C39	0.059	0.061

* Fiscal 1973 and 1974 (segregated collection was started in April, 1973).

Note 4) The results of the chemical composition analysis were obtained by the staff of Alexandria University and Cairo University upon our request.

Tab. 2-2-13 shows the results of moisture on the wet basis. Weighted average values of moisture are those of wet waste total weight standard in consideration of the respective wastes compositin ratios.

Tab. 2-2-14 shows the results of ashes on the dry basis. Weighted averages of the ashes are values of dry combustibles in consideration of the respective wastes composition ratios.

Tab. 2-2-15 shows the results of combustibles and ultimate analysis of combustibles on the dry basis (Note 5). Weighted averages of combustibles are values obtained by subtracting weighted averages of moisture and ashes from 100%.

As can be seen in the three tables, the results are summarized as follows:

(1) Moisture of garbage is about 23 to 47%, and its averages is about 32% throughout Alexandria City.

(2) Ashes on the basis of dry combustibles is about 10 to 37%, and its averages is about 18% all over Alexandria City. Therefore, the average of combustibles on the basis of dry combustibles is about 82% throughout Alexandria City.

(3) Ultimate analysis shows carbon (40%), oxygen (31%), hydrogen (6%), total halegen (2%), phosphorus (1.3%) and nitrogen and sulfur (0.7% each).

Note 5) For reference, an example of data in Japan is shown in Tab. 2-2-17.

Tab. 2-2-16 summarizes three components of wastes, C/N ratio, calorific value, individual data and averages of each districts and the whole city by income blackets (Note 6).

a. Three components (moisture, ashes and combustibles) are on the wet basis.

b. Plastic percentage (wt.%) in combustibles is on the dry basis, and used for calculating the calorific value.

c. C, N and C/N value are on the dry basis.

d. Higher calorific value was obtained by using the Gumz equation on the basis of ultimate analysis values since no actual measurement could not be done in Alexandria.

e. Lower calorific value was calculated in two cases as follows:

   i. From higher calorific value
   ii. From moisture and combustibles.

For calculation of calorific values, refer to Tab. 2-2-9.

The abovementioned tables are summarized as follows:

ITEM	UNITS	RANGE	AVERAGE
Three components			
Moisture	wet %	23 - 47	32.3
Ash	wet %	9.6 - 31	17.3
Combustibles	wet %	39 - 56	50.4
Ultimate analysis			
C	dry %	33 - 48	40
N	dry %	0 - 2.3	0.7
C/N	-	19 - 820	58
Higher calorific value	kcal/kg dry	3,410 - 5,740	4,360
Lower calorific value (1)	kcal/kg wet	1,400 - 3,500	2,540
(2)	kcal/kg wet	1,660 - 3,190	2,230
(3)	kcal/kg wet	1,580 - 3,280	2,230

a. The nitrogen value (%) in the ultimate analysis is considerably lower than the conventional level, and therefore, C/N is rather high. This is probably because animal garbages are scarcely found in wastes.

b. In individual data of lower calorific value, there are great differences, between the values i obtained from the higher calorific value and ii obtained from the moisture and combustibles in three Samples A-1, A-4 and C-2. In the averages, the values obtained from the higher calorific values is about 15% higher, but this is not a problem. The influence of plastics seems to be within a permissible error of measurement, and no large difference was observed in this survey.

c. There seems to be no characteristic difference by each districts and income areas in the wastes compositions, three components of wastes, ultimate analysis and calorific value except for C/N value affected by nitrogen.

Note 6) For reference, wastes composition in Japan is shown in Tab. 2-2-18.

Tab. 2-2-1 METHOD FOR SURVEY OF GENERAL HOUSEHOLD WASTES COMPOSITION

The survey was executed in following manners:

(1) Plastic bags were distributed to sampling households every day.

(2) Plastic bags filled with waste were collected by survey staff next day.

(3) Each plastic bag collected was weighted.

(4) Generation rate was calculated by using following formula.

$$\text{Generation rate} = \frac{\sum_{i=1}^{n} \cdot \sum_{n=1}^{n} (\text{weight of each plastic bag}) \times 1/7}{\text{Total number of persons}}$$

i: Number of days surveyed

n: Number of sampling households

(5) Survey was implemented for 8 days from 15th 22nd in September. Data of Sept. 15th was not counted, since the day was considered as preparatory.

Note: Weighted Arithemetic Mean ... Population ratios for low, middle and high income levels are assumed to be 50%, 40% and 10% respectively. This assumption was based on Mr. Hussein's 1978 report.

Sampling areas of low, middle and high income household were selected by counterpart.

Tab. 2-2-2 COMPOSITION OF GENERAL HOUSEHOLD WASTE

(Wet %)

ITEMS	HIGH-INCOME	MIDDLE-INCOME	LOW-INCOME	ARITHMATIC AVERAGE
Combustible				
Vegetable	57.7	54.7	67.3	59.9
Paper	23.2	21.5	13.8	19.5
Glass/Wood	3.5	5.2	6.6	5.1
Sub-total	(92.6)	(88.4)	(96.1)	(92.4)
Non-combustible				
Metals	2.8	4.6	1.6	3.0
Glass	2.5	2.5	2.1	2.4
Bones	0	1.1	0.3	0.5
Miscellaneous (inerts)	2.0	3.3	0	1.8
Sub-total	(7.3)	(11.5)	(4.0)	(7.6)
Total	99.9	99.9	100.1	100.0
Density (kg/m^3)	192	224	254	223

Tab. 2-2-3 CHARACTERISTIC OF DOMESTIC SOLID WASTES OF DIFFERENT STANDARDS OF LIVING IN ALEXANDRIA CITY, 1978

(%)

	1978 Mr. HUSSEIN REPORT				
	HIGH-INCOME	MIDDLE INCOME	LOW INCOME	ARITHMATIC MEAN	FOLLOW-UP DEP.
Combustible					
Garbage	69.6	79.0	78.1	75.6	69.6
Paper	19.5	14.8	10.5	14.9	23.0
Rag	1.5	2.0	2.2	1.9	-
Plastics	0.5	0.3	0.5	0.4	0.2
Sub-total	(91.1)	(96.1)	(91.3)	(92.8)	(92.8)
Non-combustible					
Dust	3.7	2.1	4.8	3.5	-
Bones	0.9	1.0	2.4	1.4	0.5
Glass	2.0	0.4	0.8	1.1	2.0
Metals	2.3	0.4	0.7	1.1	1.7
Material	-	-	-	-	3.0
Sub-total	(8.9)	(3.9)	(8.7)	(7.2)	(7.2)
Total	100.0	100.0	100.0	100.0	100.0
Density (kg/m^3)	205	193	210	203	-

Tab. 2-2-4 COMPOSITION OF STREET WASTES

(Wet %)

CLASSIFICATION / KINDS OF WASTES	MAIN STREET: HORAYA ROAD	MAIN STREET: COMMERCIAL	MAIN STREET: COAST ROAD	MAIN STREET: AVERAGE	SUB-STREET OF INSIDE AREA: MOHARAM BEY (1)	SUB-STREET OF INSIDE AREA: MOHARAM BEY (2)	SUB-STREET OF INSIDE AREA: AVERAGE
Combustibles							
I Paper	19.6	18.8	26.7	21.7	15.8	13.8	14.8
Textiles, Rag	-	-	-	-	1.9	2.7	2.3
II Plastics	-	13.7	9.1	7.6	5.1	4.1	4.6
Leathers, Rubber	-	-	-	-	-	-	-
III Greens, Grass Wood, Bamboo	26.0	-	3.6	9.9	4.1	6.9	5.5
IV Vegetable Putrescible	2.1	4.3	7.3	4.6	38.4	44.1	41.3
VI Cigarett Butt	2.5	5.1	6.7	4.8	-	-	-
Sub-total	(50.2)	(41.9)	(53.4)	(48.5)	(65.3)	(71.6)	(68.5)
Non-combustible							
V Metal	-	1.4	1.8	1.1	1.4	0.9	1.2
Glass, Ceramics	-	-	-	-	6.6	0.5	3.6
Bones	-	-	-	-	0	0.2	0.1
Stones	-	-	-	-	4.2	2.7	3.5
VI Sand	49.8	56.8	44.8	50.5	22.6	24.2	23.4
Sub-total	(49.8)	(58.2)	(46.6)	(51.5)	(34.8)	(28.5)	(31.7)
Total	100.0	100.1	100.0	100.0	100.1	100.1	100.1

Tab. 2-2-5 COMPOSITION OF DIFFERENT TYPES OF STREET SOLID WASTES IN ALEXANDRIA, 1978

(%)

TYPE / ITEM	1978 Mr. HUSSEIN REPORT		REMARKS
	PURE STREET WASTES	COMBINED STREET WASTES	
Combustible			
Garbage	-	41.8	
Weeds	33.1	8.8	
Wood	-	4.8	
Paper	3.6	3.5	
Rags	0.1	1.5	
Plastics	0.2	1.3	
Sub-total	(37.0)	(61.7)	
Non-combustible			
Dust	63.0	30.2	
Stones	-	6.4	
Bones	-	0.8	
Metal	-	0.5	
Glass	-	0.4	
Sub-total	(63.0)	(38.3)	
Total	100.0	100.0	

Tab. 2-2-6 ABBREVIATION OF SAMPLE NAME FOR WASTE ANALYSIS

NAME OF DISTRICT	CLASSIFICATION OF AREA	NAME OF SAMPLE	NAME OF PLACE IN DISTRICT
Middle District	High-income	A-1	Latiency Square
	Middle-income	A-2	Attarln Railway Station
	Low-income	A-3	Toson Public Building
	Commercial area	A-4	Raml Station
Gomrok District	High-income	B-1	27 July Street
	Middle-income	B-2	Ismail Sabri Street
	Low-income	B-3	El Sayala
	Commercial area	B-4	Manchia
West District	High-income	C-1	Karmos
	Middle-income	C-2	Ragheb BAshu
	Low-income	C-3	El Ishan El Sinaie
	Commercial area	C-4	Ghielt El Enab (Nachiel Street)
East District	High-income	D-1	Zezenia
	Middle-income	D-2	Side Gaber
	Low-income	D-3	Ghiebrial
	Commercial area	D-4	Rushcli

Tab. 2-2-7 ANALYTICAL METHOD OF PHYSICAL COMPOSITION OF WASTES

(1) Confirm whether or not the vehicle collected wastes from the predetermined places.

(2) Confirm the whole wastes unloaded from the collection vehicle.

(3) Select 4 or 5 parts likely to be the representative of the wastes, and collect samples to give the total quantity of about 50kg.

(4) Spread the collected wastes samples on a sheet, and mix thoroughly the samples by hand.

(5) Reject half of the resulting sample by the method of quatering.

(6) Mix thoroughly the remaining sample by hand.

(7) Reject half of the sample by the method of quatering again. Take the rejected sample as a sample for measuring the weight of unit volume by the step 11.

(8) Classify about 10kg of the sample by the methoid of quatering into 11 kinds of waste shown in the attached table (Note 1).

(9) Weigh the respective classified wet samples (Note 2).

(10) Take the weighed samples as samples for chemical composition analysis (Note 3).

(11) Put the wastes sample into a rigid polyethylene container of volume about 18 l (27cm in diameter and 31cm in height) full, an drop the container from a height of about 30cm three times to determine the weight per unit volume from the volume and weight.

Note 1) Attached Table

LARGE DIVISION (1)	SMALL DIVISION (2)	KIND OF WASTE
I	1	Paper
	2	Textiles, Rag
II	1	Plastics
	2	Leathers, Rubbers
III	1	Greens, Grass Wood, Bamboo, Straw
IV	1	Kitchen garbage (Vegetables, Putrescibles)
V	1	Metal
	2	Glass, Ceramics
	3	Bones
	4	Miscellaneous, Inerts
VI	1	Others (Note 4)

Note 2) Spring balances of weighing capacities (2kg, 4kg and 10kg) were used.

Note 3) Chemical composition analysis was carried out for each large division (1), and the waste samples were taken according to the ratios of the small division (2), mixed, put into polyethylene bags and sealed up.

Note 4) Miscellaneous mixtures of size about 3cm or below and contain paper, tree leaves, sugar cane dregs, bread crumbs, kitchen wastes, cigarette butts, soil, sand, etc.

Tab. 2-2-8 ANALYTICAL METHOD OF CHEMICAL COMPOSITION OF WASTES (Three components and ultimate analysis of wastes)

(1) Take an optional amount of sample from the wastes, and dry the sample in an electric oven at about 105±5°C to about a constant weight. Determine the moisture from the weight loss on the wet basis.

(2) Pulverize the sample to a particle size of about 2 m/m in a pulverizer, and dry the sample in an electric oven at 105°C. Ash the dried sample at 800±25°C for 2 hours to determine the ash from the weight loss on the dry basis.

(3) Convert the ash to the wet basis, and subtract the moisture and ash from 100% to determine the combustibles on the wet basis.

(4) Carry out the ultimate analysis by using the pulverized and dried samples in the same manner as in the determination of ash in a micro-ultimate analyzer to determine the results on the dry basis.

Note: The analysis of three components of the refuse was carried out by the staff of Alexandria University, and ultimate analysis was made by the staff of Cairo University at our request.

Tab. 2-2-9 ANALYTICAL METHOD OF CHEMICAL COMPOSITION OF WASTES (2) (Estimation of calorific value)

(1) Estimation of higher calorific value

Since the university had no measuring instrument for higher calorific value, the actual measurement was stopped. Higher calorific value was estimated from the ultimate analysis values by using the following equation (Gumz equation) giving values relatively close to the experimental value:

$$H_0 = 81.3\ C + 297\ H + 15\ N + 45.6\ S - 23.5\ O \quad \text{---} \qquad (X)$$

where

H_0: Higher calorific value of dried wastes (kcal/kg DS)

C, H, N, S, O: Percentage by weight of carbon, hydrogen, sulfur and oxygen in the sample

(2) Estimation of lower calorific value (1)

The value is estimated from higher calorific value by using the following equations:

$$H_{1d} = H_0 - 600 \times 9\ hd$$

$$H_1 = H_{1d}(1-w) - 600\ w \quad \text{---------------} \qquad (Y)$$

where

H_{1d}: Lower calorific value of dried wastes (kcal/kg dry)

H_1 : Lower calorific value of wet wastes (kcal/kg wet)

hd : Hydrogen in 1 kg of dried wastes (kg)

w : Moisture in 1 kg of wet wastes (kg)

(3) Estimation of lower calorific value (2)

As in the case of municipal wastes sample, the value was estimated from easily measurable moisture, ash and combustibles by using the following two equations:

$$H_1 = 4{,}800V - 600W \quad \text{-----------------} \qquad (A)$$

In case the weight ratio of plastics is known, the abovementioned equation is given by

$$H_1 = [4{,}400(1 - \quad) + 800 \quad]V - 600W \quad \text{---} \qquad (B)$$

where

V : Combustibles in wet wastes (%) × $\frac{1}{100}$

W : Moisture (%) in wet wastes $\frac{1}{100}$

: Ratio of plastics in combustibles

Tab. 2-2-10 PHYSICAL ANALYSIS OF SOLID WASTE COMPOSITION

(wet %) October, 1984

CLASSIFICATION	MIDDLE DISTRICT				COMROK DISTRICT				WEST DISTRICT				EAST DISTRICT				AVERAGE	STANDARD DEVIATION
	HIGH	MIDDLE	LOW	COMMERCIAL	HIGH	MIDDLE	LOW	COMMERCIAL	HIGH	MIDDLE	LOW	COMMERCIAL	HIGH	MIDDLE	LOW	COMMERCIAL		
SAMPLE NAME KIND OF WASTES	A-1	A-2	A-3	A-4	B-1	B-2	B-3	B-4	C-1	C-2	C-3	C-4	D-1	D-2	D-3	D-4		
Combustibles																		
Paper	12.5	12.0	8.5	27.9	27.5	20.8	22.7	11.5	19.1	15.3	14.4	15.5	23.2	41.2	13.2	25.7	19.44	8.14
Textiles, Rag	3.4	4.7	0.8	1.8	3.3	7.1	12.9	14.8	12.1	3.2	1.6	13.1	0.8	8.8	0.7	-	5.57	5.15
Plastics	6.2	1.3	2.6	9.9	0.2	4.1	3.9	4.3	1.2	7.8	5.3	11.4	7.2	3.4	13.5	6.2	5.53	3.74
Leather, Rubber	-	-	-	-	-	--	-	7.7	-	-	-	-	-	-	-	-	0.48	1.93
Greens, *2, Grass, wood, Bamboo	9.2	20.7	*3 64.0	11.3	8.2	2.3	15.8	7.4	20.3	12.9	36.0	12.0	12.6	3.1	8.4	6.7	15.68	15.24
Vegetable/ Putrescibles	34.5	22.9	0.3	8.8	27.0	19.5	8.9	19.4	1.9	12.3	12.0	14.3	32.9	15.1	36.4	15.9	17.63	10.88
Others *1	23.0	34.1	23.0	30.3	32.8	42.0	33.8	30.8	32.1	26.1	28.6	24.8	17.9	23.0	25.8	41.5	29.35	6.69
Sub-total	(88.8)	(95.7)	(99.2)	(90.0)	(99.0)	(95.8)	(98.0)	(95.9)	(86.7)	(77.6)	(97.9)	(91.1)	(94.6)	(94.6)	(98.0)	(96.0)	(93.68)	(5.69)
Non-combustible																		
Metal	4.3	0.8	-	8.0	0.1	0.9	1.5	2.0	5.5	7.8	1.0	9.0	3.4	2.0	0.6	1.8	3.04	2.99
Glass, Ceramics	6.2	-	0.8	1.9	0.6	2.6	0.4	0.9	7.8	8.3	0.8	-	1.4	2.7	0.9	1.3	2.28	2.70
Bones	0.7	3.6	-	-	0.3	0.6	-	1.2	-	-	0.4	-	0.5	0.7	0.4	0.9	0.58	0.89
Miscellaneous, Inerts	-	-	-	-	-	-	-	-	-	6.3	-	-	-	-	-	-	0.39	1.58
Sub-total	(11.2)	(4.4)	(0.8)	(9.9)	(1.0)	(4.1)	(1.9)	(4.1)	(13.3)	(22.4)	(2.2)	(9.0)	(5.3)	(5.4)	(1.9)	(4.0)	(6.87)	(5.58)
Density (kg/m^3)	247	280	121	237	290	237	194	317	237	210	226	317	237	156	237	247	237	52

*1: Matter less than about 3cm, include papers, leaves, dregs of sugar cane, garbage, cigarett butt, sand, etc.
*2: Greens refer to large lower leaves and stems of vegetables, etc. rejected mainly in the market, etc.
*3: The extraordinary value is due to the dregs of sugar cane.

Tab. 2-2-11 PHYSICAL ANALYSIS OF SOLID WASTE COMPOSITION

(wet %) October, 1984

CLASSIFICATION	CLASSIFIED BY DISTRICT				CLASSIFIED BY DIFFERENT INCOME AREAS				AVERAGE & S.D			PAST DATA IN ALEXANDRIA	
DIVISION (1) DIVISION (2) KIND OF WASTES	MIDDLE	GOMROK	WEST	EAST	HIGH INCOME AREAS	MIDDLE INCOME AREAS	LOW INCOME AREAS	COMMERCIAL AREAS	AVERAGE	STANDARD DEVIATION	FROM GOVERNORATE 1966	COMPOST ENGINEERS REPORT 1964	DOMESTIC SOLID WASTES IN ALEX. CITY, 1978
Combustibles													
I 1 Paper	15.2	20.7	16.1	25.8	20.6	22.3	14.7	20.2	19.4	8.1	16	6	12.6
2 Textiles, Rag	2.7	9.5	7.5	2.6	4.9	6.0	4.0	7.4	5.6	5.2	7	1	2.0
Sub-total	(17.9)	(30.2)	(23.5)	(28.4)	(25.5)	(28.3)	(18.7)	(27.6)	(25.0)	-	(23)	(7)	(14.6)
II 3 Plastics	5.0	3.1	6.4	7.6	3.7	4.2	6.3	8.0	5.5	3.7	0	0.2	0.4
4 Leather, Rubber	0	1.9	0	0	0	0	0	1.9	0.5	1.9	-	-	-
Sub-total	(5.0)	(5.0)	(6.4)	(7.6)	(3.7)	(4.2)	(6.3)	(9.9)	(6.0)	-	(0)	(0.2)	(0.4)
III 5 Greens, Grass wood, Bamboo	26.3	8.4	20.3	7.7	12.6	9.8	31.1	9.4	15.7	15.2			
6 Vegetable/Putrescibles	16.6	18.7	10.1	25.1	24.1	17.5	14.4	14.6	17.6	10.9	64.5	83	78.1
7 Others*	27.6	34.9	27.9	27.1	26.5	31.3	27.8	31.9	29.4	6.7			
Sub-total	(70.5)	(62.0)	(58.3)	(59.9)	(63.2)	(56.7)	(73.3)	(55.9)	(62.7)	-	(64.5)	(83)	(78.1)
Sub-total	(93.4)	(97.2)	(88.2)	(95.9)	(92.4)	(91.1)	(98.3)	(93.4)	(93.7)	(5.7)	(87.5)	(90.2)	(93.1)
Non-combustible													
IV 8 Metal	3.3	1.1	5.8	2.0	3.3	2.9	9.8	5.2	3.0	3.0	4	0.4	0.7
9 Glass, Ceramics	2.2	1.1	4.2	1.6	4.0	3.4	0.8	1.0	2.3	2.7	5	1	0.7
10 Bones	1.1	0.5	0.1	0.6	0.4	1.2	0.2	0.5	0.6	0.9	3.5	1	1.8
V 11 Miscellaneous/Inerts	0	0	1.6	0	0	1.6	0	0	0.4	1.6	0	7.4	3.7
Sub-total	(6.6)	(2.7)	(11.7)	(4.2)	(7.7)	(9.1)	(1.8)	(6.7)	(6.9)	(5.6)	(12.5)	(9.8)	(6.9)
Density (kg/m^3)	221	260	248	219	253	221	195	280	237	52			

*1 Matter less than about 3cm, include papers, leaves, dreg of sugar cane, garbage, cigarett butt, sand, etc.

Tab. 2-2-12 PHYSICAL ANALYSIS OF SOLID WASTE COMPOSITION

(dry %) October, 1984

CLASSIFICATION	MIDDLE DISTRICT				COMROK DISTRICT				WEST DISTRICT				EAST DISTRICT				AVERAGE	STANDARD DEVIATION
SAMPLE NAME	HIGH	MIDDLE	LOW	COMMERCIAL	HIGH	MIDDLE	LOW	COMMERCIAL	HIGH	MIDDLE	LOW	COMMERCIAL	HIGH	MIDDLE	LOW	COMMERCIAL		
KIND OF WASTES	A-1	A-2	A-3	A-4	B-1	B-2	B-3	B-4	C-1	C-2	C-3	C-4	D-1	D-2	D-3	D-4		
Combustibles																		
Paper, Textiles, Rag	16.3	23.5	10.2	32.3	37.0	32.3	45.1	22.8	41.6	20.1	17.7	28.7	24.9	51.4	12.3	30.1	27.9	11.8
Plastics, Leather, Rubber	10.6	2.4	3.5	13.8	0.4	6.1	6.0	18.6	1.6	11.1	8.1	15.9	10.2	4.7	17.5	8.5	8.7	5.7
Greens, Grass, wood, Bamboo	11.2	25.3	79.0	11.2	9.1	2.6	10.0	9.4	17.9	12.7	33.1	10.0	10.4	2.8	7.9	4.4	16.18	18.5
Vegetable/ Putrescibles	24.7	11.6	0.1	6.0	16.5	18.5	4.1	16.2	1.5	9.3	10.5	11.4	29.4	16.4	35.0	9.1	13.8	9.7
Other	18.1	28.8	5.5	22.8	35.2	24.3	31.8	26.7	19.2	14.9	27.2	21.4	17.5	17.4	24.8	42.4	24.3	9.1
Non-combustible	19.1	8.3	1.1	13.8	1.8	6.1	2.9	6.3	18.1	31.9	3.4	12.5	7.5	7.4	2.5	5.5	9.3	8.2
Total	100.0	99.9	100.0	99.9	100.0	99.9	99.9	100.0	99.9	100.0	100.0	99.9	99.9	100.1	100.0	100.0	-	-

PHYSICAL ANALYSIS OF SOLID WASTE COMPOSITION

(dry %) October, 1984

CLASSIFICATION	CLASSIFIED BY DISTRICT				CLASSIFIEDY DIFFERENT INCOME AREAS				
DIVISION (1) / DIVISION (2) / KIND OF WASTES	MIDDLE	GOMROK	WEST	EAST	HIGH INCOME AREAS	MIDDLE INCOME AREAS	LOW INCOME AREAS	COMMERCIAL AREAS	AVERAGE
Combustibles									
Paper, Textiles, Rag	20.6	34.3	27.0	29.7	30.0	31.8	21.3	28.5	27.9
Plastics, Leather, Rubber	7.6	7.8	9.2	10.2	5.7	6.1	8.8	14.2	8.7
Greens, Grass, Wood, Bamboo	31.7	7.8	18.4	6.4	12.2	10.9	32.5	8.8	16.1
Vegetable/putrescible	10.6	13.8	8.2	22.5	18.0	14.0	12.4	10.7	13.8
Others	18.8	32.0	20.7	25.5	22.5	23.9	22.3	28.3	24.3
Non combustible	10.6	4.3	16.5	5.7	11.6	13.4	2.5	9.5	9.3
Total	9.9	100.0	100.0	100.0	100.0	100.1	99.8	100.0	-

Tab. 2-2-13 RESULTS OF MOISTURE % OF THE COMBUSTIBLE COMPOSITION RATIO

(wet %) October, 1984

CLASSIFICATION	MIDDLE DISTRICT				COMROK DISTRICT				WEST DISTRICT				EAST DISTRICT				AVERAGE (S.D)
	HIGH	MIDDLE	LOW	COMMERCIAL	HIGH	MIDDLE	LOW	COMMERCIAL	HIGH	MIDDLE	LOW	COMMERCIAL	HIGH	MIDDLE	LOW	COMMERCIAL	
SAMPLE NAME KIND OF WASTES	A-1	A-2	A-3	A-4	B-1	B-2	B-3	B-4	C-1	C-2	C-3	C-4	D-1	D-2	D-3	D-4	
Combustibles																	
1. Paper, Textile, Rag	40	25	18	22	35	22	18	44	20	24	33	28	27	25	32	14	26.7 (8.3)
2. Plastic, Leather, Rubber	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Greens, Grass, Wood, Bamboo	29	35	7.0	29	40	24	59	18	35	31	28	40	42	35	28	52	33.3 (12.4)
4. Vegetable/ Putrescible	58	73	66	51	67	36	70	46	41	47	54	43	37	21	26	58	49.6 (15.4)
6 Others	54	55	82	46	42	45	39	44	56	60	73	38	31	45	36	25	48.2 (14.8)
Weighted average *1	41.46	46.92	25.21	28.24	45.93	32.61	35.14	35.37	26.49	29.88	34.91	28.38	29.49	27.11	22.97	26.68	32.30 (7.22)

*1 Weighted average based on the total weight of wet wastes.

Tab. 2-2-14 RESULTS OF ASH % OF COMBUSTIBLE COMPOSITION RATIO

(dry %) October, 1984

CLASSIFICATION	MIDDLE DISTRICT				COMROK DISTRICT				WEST DISTRICT				EAST DISTRICT				AVERAGE (S.D)
	HIGH	MIDDLE	LOW	COMMER-CIAL	HIGH	MIDDLE	LOW	COMMER-CIAL	HIGH	MIDDLE	LOW	COMMER-CIAL	HIGH	MIDDLE	LOW	COMMER-CIAL	
NO. OF SAMPLE / KIND OF WASTES	A-1	A-2	A-3	A-4	B-1	B-2	B-3	B-4	C-1	C-2	C-3	C-4	D-1	D-2	D-3	D-4	
Combustibles																	
1. Paper, Textile, Rag	1.9	9.3	2.8	6.1	8.1	5.5	16.2	4.2	7.6	10.2	9.1	14.6	16.6	6.0	7.2	6.4	8.24 (4.38)
2. Plastic, Leather, Rubber	0.2	0.9	4.1	0.5	3.5	1.0	3.3	4.8	3.3	7.6	3.6	16.0	2.5	4.5	5.6	1.3	3.92 (3.80)
3. Greens, Grass, Wood, Bamboo	15.4	15.4	4.8	12.7	14.1	3.1	16.1	7.0	19.8	9.4	8.2	11.3	3.3	15.2	15.9	4.2	10.96 (5.36)
4. Vegetable/ Putrescible	19.7	4.0	27.9	10.3	6.7	6.8	33.0	9.0	20.4	14.6	19.7	9.5	5.6	5.2	5.5	36.5	14.65 (10.47)
6 Others	33.6	26.2	29.2	51.7	36.4	40.8	44.8	37.0	55.0	45.2	47.9	56.4	34.5	63.5	23.4	69.6	43.45 (13.31)
Weighted average *	16.07	15.41	5.96	18.43	18.54	18.29	25.49	15.65	20.84	17.88	12.97	24.06	13.44	16.83	10.31	37.12	17.96 (7.00)

* Weighted average based on the dry basis of combustibles.

Tab. 2-2-15 MEAN RESULTS OF THE ULTIMATE ANALYSIS OF SOLID WASTE SAMPLES

(dry %) October, 1984

CLASSIFICATION	MIDDLE DISTRICT				COMROK DISTRICT				WEST DISTRICT				EAST DISTRICT				
	HIGH	MIDDLE	LOW	COMMERCIAL	HIGH	MIDDLE	LOW	COMMERCIAL	HIGH	MIDDLE	LOW	COMMERCIAL	HIGH	MIDDLE	LOW	COMMERCIAL	AVERAGE (S.D)
NO. OF SAMPLE / ULTIMATE	A-1	A-2	A-3	A-4	B-1	B-2	B-3	B-4	C-1	C-2	C-3	C-4	D-1	D-2	D-3	D-4	
Dry base C (%)	43.6	33.1	44.7	42.6	46.2	37.8	35.0	48.3	33.4	42.2	38.6	32.8	40.0	41.7	46.5	32.7	40.0 (5.3)
H (%)	9.3	5.7	6.5	5.3	6.7	4.4	5.5	6.0	5.6	5.8	5.2	4.9	6.7	6.3	6.9	5.2	6.0 (1.1)
O (%)	27.2	42.4	40.6	27.2	23.0	33.7	30.8	23.7	35.5	30.4	39.9	35.3	35.7	27.6	30.0	19.4	31.4 (6.6)
N (%)	1.05	1.48	1.18	2.30	1.32	0.47	0.95	0.89	ND	ND	ND	0.20	ND	0.13	1.00	0.04	0.69 (0.69)
S (%)	1.23	ND	ND	1.07	1.03	1.26	0.77	1.43	1.24	0.27	0.75	ND	0.75	0.63	ND	0.39	0.68 (0.51)
P (%)	1.21	1.28	0.53	1.38	1.54	1.68	1.06	2.17	0.31	0.64	0.18	1.94	1.21	2.53	1.94	1.35	1.32 (0.65)
Total-Halogen (%)	0.30	0.62	0.53	1.83	1.68	2.41	0.42	1.88	3.10	2.81	2.34	0.79	2.19	4.22	3.20	3.77	2.01
Combustibles (%)	83.93	84.59	94.04	81.57	81.46	81.71	74.51	84.35	79.16	82.12	87.03	75.94	86.56	83.17	89.69	62.88	82.04 (7.00)
Ashes (%)	16.07	15.41	5.96	18.43	18.54	18.29	25.49	15.65	20.84	17.88	12.97	24.06	13.44	16.83	10.31	37.12	17.96 (7.00)

Tab. 2-2-16 THREE COMPONENTS, C/N RATIO AND CALORIFIC VALUE OF REFUSES
(Individual Data, Averages by Districts and Averages by Income Areas and Total Average)

			THREE COMPONENTS (WT %)			PLASTICS IN COMBUS-TIBLES (WT %)	C/N RATIO			HIGHER CALORIFIC VALUE EQUATION (X)	LOWER CALORIFIC VALUE		
			MOISTURE	ASHES	COMBUS-TIBLES		C(%)	N(%)	C/N		EQUATION (Y)	EQUATION (A)	EQUATION (B)
Middle District	High	A-1	41.46	18.86	39.74	15.58	43.6	1.05	41.5	5740	2817	1659	1722
	Middle	A-2	46.91	11.92	41.29	3.12	33.1	1.48	22.4	3410	1866	1701	1582
	Low	A-3	25.21	5.21	69.57	3.58	44.7	1.18	45.9	4629	3049	3188	2999
	Commercial	A-4	28.24	21.28	59.37	19.56	42.6	2.30	18.5	4481	2841	2249	2402
Gomrok District	High	B-1	45.93	10.84	43.23	0.44	46.2	1.32	35.0	5272	2379	1799	1633
	Middle	B-2	32.61	15.66	51.63	7.86	37.8	0.47	80.4	3653	2105	2282	2222
	Low	B-3	35.14	17.92	46.83	8.05	35.0	0.95	36.8	3805	2065	2037	1986
	Commercial	B-4	35.37	13.57	51.05	22.37	48.3	0.89	54.3	5241	2966	2238	2445
West District	High	C-1	26.49	25.85	47.67	2.43	33.4	ND	-	3601	2266	2129	1980
	Middle	C-2	29.88	30.93	39.19	18.40	42.2	ND	-	4452	2723	1702	1805
	Low	C-3	34.91	19.28	54.91	9.31	38.6	ND	-	3778	2067	2427	2391
	Commercial	C-4	28.38	24.09	47.64	20.11	32.8	0.20	164	3295	2000	2117	2271
East District	High	D-1	29.49	14.05	56.36	12.46	40.0	ND	-	4437	2696	2528	2556
	Middle	D-2	27.11	16.76	56.14	5.79	41.7	0.13	321	4643	3001	2532	2425
	Low	D-3	22.97	9.64	67.28	18.94	46.5	1.00	46.5	5139	3584	3091	3281
	Commercial	D-4	26.68	29.73	43.59	14.04	32.7	0.04	818	3765	2394	1932	1978
Average by Districts	Middle		35.47	14.31	50.24	9.86	41.0	1.50	27.3	4675	2570	2199	2176
	Gomrok		37.26	14.50	48.19	10.09	41.8	0.91	45.9	4493	2406	2089	2067
	West		29.92	22.79	47.35	12.17	36.8	0.05	736	3782	2266	2093	2111
	East		26.56	17.55	55.84	13.04	40.2	0.29	139	4496	2893	2521	2560
Average by Income Areas	High-income areas		35.84	17.39	46.75	7.79	40.8	0.59	69.2	4763	2595	2029	1973
	Middle-income areas		34.13	18.82	47.06	8.40	38.7	0.52	74.4	4040	2257	2054	2008
	Low-income areas		29.56	10.76	59.65	10.11	41.2	0.78	52.8	4338	2650	2686	2664
	Commercial areas		29.67	22.17	48.16	19.19	39.1	0.96	40.7	4306	2645	2134	2274
Total average			32.30	17.29	50.41	11.34	40.0	0.69	58.0	4362	2539	2226	2230

Tab. 2-2-17 PROPERTIES OF MUNICIPAL WASTES
ULTIMATE ANALYSIS VALUES OF MUNICIPAL WASTES BY RESPECTIVE COMPOSITIONS
(from values measured by Tokyo Metropolitan Cleansing Laboratory)

(Unit: %)

COMPOSITION	ASHES	COMBUS-TIBLES	C	H	O	N	N	CL
o Paper	11.5	88.5 (100.0)	43.2 (48.8)	6.6 (7.4)	37.7 (42.5)	0.7 (0.8)	0.4 (0.5)	
o Fiber	6.9	93.1 (100.0)	46.8 (50.3)	6.3 (6.8)	35.1 (37.7)	4.4 (4.7)	0.5 (0.5)	
o Wood, Bamboo	1.8	98.2 (100.0)	49.6 (50.5)	6.8 (6.9)	40.9 (41.6)	0.6 (0.6)	0.3 (0.3)	
o Straw	12.8	87.2 (100.0)	41.5 (47.6)	5.9 (6.8)	38.4 (44.0)	1.0 (1.1)	0.4 (0.5)	
o Grass leaves	27.1	72.9 (100.0)	38.8 (53.2)	4.3 (5.8)	26.9 (36.9)	2.5 (3.4)	0.4 (0.5)	
o Vegerable garbage	26.4	73.6 (100.0)	37.2 (50.5)	5.3 (7.2)	28.2 (38.3)	2.3 (3.1)	0.6 (0.8)	
o Animal garbage	16.9	83.1 (100.0)	45.1 (54.2)	6.6 (7.9)	23.6 (28.4)	7.3 (8.8)	0.5 (0.6)	
o Bread, Left-over food	5.2	94.8 (100.0)	42.4 (44.7)	6.7 (7.1)	43.6 (46.0)	1.7 (1.8)	0.3 (0.3)	
o Plastics	14.7	85.3 (100.0)	56.1 (65.8)	9.4 (11.0)	19.9 (23.3)	0 (0)	0 (0)	
Average of 3 garbages		(100.0)	(45.53)	(6.81)	(45.62)	(2.03)		
Average of 6 plastics	8.02	91.98 (100.0)	(70.98)	(12.22)	(12.83)	(0.98)	(0.27)	(2.72)
Average of 6 compositions except plastics	19.46	80.54 (100.0)	(47.28)	(7.69)	(42.82)	(1.45)	(0.19)	(0.53)

Tab. 2-2-18 WASTE COMPOSITION OF RESPECTIVE CITIES (1977)

(Unit: %)

NAME OF CITY	TOKYO	OSAKA	YOKOHAMA	NAGOYA	KYOTO	SAPPORO	KAWASAKI
Moisture	-	49.2	50.0	62.8	46.7	54.2	52.9
Ashes	-	17.1	14.0	6.9	15.8	14.8	13.1
Combustibles	-	33.8	36.0	30.3	37.5	31.0	34.0
Lower calorific value (kcal/kg)	1,280	1,522	1,542	1,135	1,460	1,284	-

2.3 Street Characteristics

2.3.1 Purpose and Methodology

The Governorate of Alexandria extends some 50km in the east-west axis and some 100km in the north-south axis, totalling an area of 2,568km^2. Since a vast amount of time and labour would be required to carry out a study on the physical conditions of the entire city area, an intensive survey was carried out on the selected sampling areas. The results of this survey will be used as basic data for the evaluation of the street characteristics over the entire city area.

The main purpose of the study was to understand the conditions for solid waste collection and haulage. The study was, therefore, carried out mainly to determine street inventory and interviews were also conducted according to need in regard to the situation of waste accumulation and collection. Furthermore, the assessment of other infrastructures, such as water supply and sewage, etc., were also roughly evaluated.

The method of study was to select the following four types of roads in sample areas of some 1km^2 each for the investigation and measurement work.

a.	Truck road	an arterial road in the City
b.	Main road	an arterial road in a sample area
c.	Secondary road	a feeder road in a sample area
d.	Tertiary road	an alley in a sample area

The study items for the street inventory were as follows:

a. Cross-section of the road
b. Road width
c. Carriage-way width
d. Pavement width
e. Type of paving
f. Road maintenance
g. Type of building utilization along street
h. Parking conditions

2.3.2 Selection of Sampling Areas

The waste dealt with here is so-called municipal waste, mainly consisting of domestic, commercial and street wastes. In the light of the regional characteristics, eight sampling areas were selected, as shown in Figure 2-3-1, and are classified into the following five caterogies;

a. Commercial Centre Area
   Middle District I

b. Orderly Old Residential Area
   Middle District II, Middle District III

c. Disorderly Old Residential Area
   Comrok District

d. Orderly Newly-Developed Residential Area
   West District, East District

e. Disorderly Newly-Developed Residential Area
   Ameriyah District, Montazah District

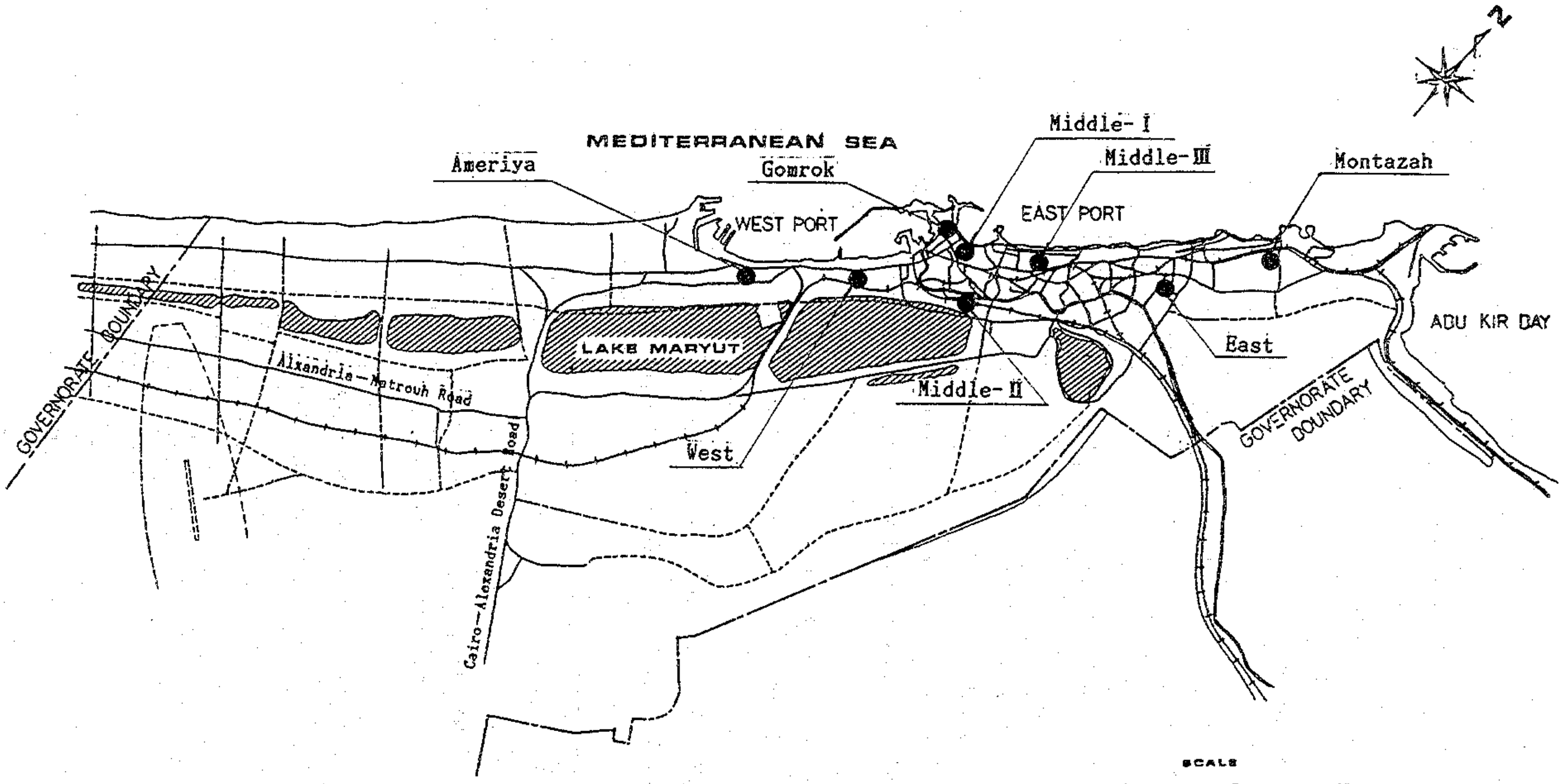


Fig. 2.6.1 Sampling Study Area for the Street Characteristics in Alexandria

2.3.3 Results

The study results are shown in Table 2-6-1 to Table 2-6-3, "Street Inventory of Sampling Area (1)-(3)".

The following is a summary of the results of the study;

a. The Commercial Area and the Orderly Old Residential Area are clean as solid waste collection and sweeping are adequately carried out.

b. Excepting the Ameriya and Montazah Districts, the streets in the sample areas have adequate space for solid waste collection.

c. Collection and sweeping are disturbed by the many illegally parked cars on the streets.

d. The population density is considered to be high as there are many high buildings in the areas. As a result, the volume of solid waste to be generated per unit space is also anticipated to be high.

e. The overload of solid waste is dispersed by wind and animals around many waste containers before collection.

f. As most of the streets have separate pedestrian ways, adequate space for pedestrians is already available.

g. Most of pedestrian ways are intruded by illegal parking, street shops, store extensions and eating/drinking places, etc.

h. The accumulation of solid waste and the burning of solid waste are often seen in the Disorderly Newly-Developed Residential Area.

i. Sanitary conditions in these areas much depend on the availability of the collection service which affects the volume of accumulated and burnt solid waste.

j. The unavailability of solid waste collection and solid waste accumulation in areas correlates with the provisions of other infrastructures, sanitary facilities, street paving and the sewage system in particular.

k. In the unpaved streets, the overflow of waste water from septic tanks is often observed, due to the insufficient capacity on the sewage system. Consequently, it seems to be difficult for collection vehicle to access for the collection of solid waste.

Tab. 2-3-1 STREET INVENTORY OF SAMPLING AREA (1)

Sample Study Area (Terms)	Type of Road	Road Width m	Carriage-way Width m	Pedestrian Width m	Type of Pavement: Carriage-way	Type of Pavement: Pedestrian	Maintenance: Carriage-way	Maintenance: Pedestrian	Type of Building Utilization along the Street: Ground Floor	Type of Building Utilization along the Street: Story	Parking Condition	Remarks
Ameriyah District	Trunk	20.5	14.5	6.0	Asphalt	None Partly Tile-paved	Good	Poor	Shop and	1-6	Good	Guard Rail
	Main	7.0	7.0	-	None	-	Bad	-	Residence	1-6	Poor	
	Secondary	6.0	6.0	-	None	-	Poor	-	Residence	1-5	Good	
	Tertiary	3.0	3.0	-	None	-	Poor	-	Residence	1-4	-	
West District	Trunk	30.0	15.0	7.0	Asphalt	Tile	Good	Poor	Shop, Store and Residence	3-5	Good	TRAM
	Main	20.0	12.0	8.0	Stone and Asphalt	Tile	Good	Poor	Shop and Residence	2-7	Good	
	Secondary	100	7.0	3.0	Asphalt	None	Good	Poor	Residence	2-5	Good	
	Tertiary	8.0	6.0	2.0	Asphalt	None	Poor	Poor	Residence	2-4	Good	
Gomrok District	Trunk	29.0	20.0	7.1	Asphalt	Tile	Excellent	Good	Shop	2-10	Poor but Partly Excellent	Median
	Main	17.5	12.5	5.0	Stone	Partly Tile-paved Factory	Good	Poor	Shop, Office and	1-4	Good	TRAM
	Secondary	8.0	6.5	1.5	Asphalt	Partly Tile-paved	Poor	Poor	Shop and Small Factory	1-4	Poor	
	Tertiary	5.5	4.0	1.5	Asphalt and Stone	Partly Tile-paved	Good	Good	Shop and Residence	1-4	Good	

Tab. 2-3-2 STREET INVENTORY OF SAMPLING AREA (2)

Terms Sample Study Area	Type of Road	Road Width m	Carriage-way Width m	Pedestrian Width m	Type of Pavement Carriage-way	Type of Pavement Pedestrian	Maintenance Carriage-way	Maintenance Pedestrian	Type of Building Utilization along the Street Ground Floor	Type of Building Utilization along the Street Story	Parking Condition	Remarks
Middle District I	Trunk	24.0	16.0	7.0	Asphalt	Tile	Good	Good	Shop and Office	4-6	Good	Median TRAM
	Main	15.5	8.5	7.0	Asphalt	Tile	Excellent	Excellent	Shop	2-5	Excellent	One Way
	Secondary	11.0	7.0	4.0	Asphalt	Tile	Excellent	Excellent	Shop	4-6	Good	One Way
	Tertiary	9.0	6.0	3.0	Asphalt	Tile	Good	Good	Shop and Store	1-5	Bad	
Middle District II	Trunk	19.0	12.0	7.0	Asphalt	Tile	Good	Good	Shop	2-10	Good	TRAM One Way Tree
	Main	12.0	7.0	5.0	Asphalt	Tile	Good	Good	Shop	2-8	Good	One Way
	Secondary	9.5	6.5	3.0	Asphalt	Tile-paved Partly Non-paved	Good	Poor	Residence	2-5	Good	
	Tertiary	8.0	6.0	2.0	Asphalt	Tile-paved Partly Non-paved	Good	Poor	Residence	2-5	Good	
Middle District III	Trunk	20.5 (37.0)	14.5	6.0	Asphalt	Tile	Good	Good	Shop	2-12	Good	TRAM
	Main	14.0	7.0	7.0	Asphalt	Tile	Good	Good	Residence and University	2-9	Good	
	Secondary	9.5	6.5	3.0	Asphalt	Tile-paved Partly Non-paved	Good	Good	Residence	2-8	Good	
	Tertiary	4.5	3.5	1.0	Asphalt	Partly Tile-paved	Poor	Poor	Residence	2-8	-	

Tab. 2-3-3 STREET INVENTORY OF SAMPLING AREA (3)

Terms Sample Study Area	Type of Road	Road Width m	Carriage-way Width m	Pedestrian Width m	Type of Pavement		Maintenance		Type of Building Utilization along the Street		Parking Condition	Remarks
					Carriage-way	Pedestrian	Carriage-way	Pedestrian	Ground Floor	Story		
East District	Trunk	23.5	17.5	4.0	Asphalt	Tile	Good	Poor	Shop and Residence	2-6	Good	Median
	Main	24.0	18.0	4.0	Asphalt	None-paved Partly Tile-paved	Good	Poor	Residence	2-5	Good	Median
	Secondary	24.9	19.0	5.0	None	None	Bad	Bad	Residence	2-6	Good	
	Tertiary	9.5	6.5	3.0	None	None	Bad	Bad	Residence	2-6	Good	
Montazah District	Trunk	22.5	9.0	13.5	Asphalt	None	Good	Bad	Shop	1-8	Good	
	Main	19.5	9.0	-	Asphalt	-	Poor	-	Residence and Shop	1-4	Good	Tree
	Secondary	11.0	8.0	-	Asphalt	-	Poor	-	Residence Partly Shop	1-6	Good	
	Tertiary	2.0 to 8.0	2.0 to 8.0	-	None	-	Bad	-	Residence	2-4	-	

2.4 Residential Recognition Concerning Solid Waste

2.4.1 Purpose

Interviews with 600 households were carried out for the following purposes:

(1) To know the existing conditions regarding storage and discharge manner of residents; i.e. by whom, where, how often, by what type of container household garbages are stored and discharged.

(2) To know residents' opinion about storage and discharge of household garbages.

2.4.2 Period and Dates

Interviews were made with 600 households during 5 days from 1st October to 6th October 1984 except for 5th October (Friday).

The interviews were mainly made during the hours from 9 a.m. to 2 p.m. of the days.

2.4.3 Method of Selection of Interview Area
(Refer to the table below.)

We have selected 25 areas according to the following principles:

(1) To select interview areas from all of the 6 districts.

(2) To select 3 different income classes (low, middle & high) in each of the 6 districts.

(3) To select both residential and commercial areas of 3 different income classes in each of the 6 districts.

According to the above-mentioned principles, there are, theoritically, 36 areas (combinations); 6 districts x 3 different income classes x 2 types (residential & commercial).

However, in reality, some combinations do not exist, and actually 25 areas were selected.

Note:
Refer to the attached list and maps which show names and location of the areas, respectively.

2.4.4 Selection of Apartments (interviewees)

In each area, we selected 24 apartments, paying attention to the following points:

(1) whether apartments (to be selected) are near or far to the nearest communal container.

(2) whether apartments (to be selected) are on the 1st, 2nd, 3rd or other floors.

We selected a few apartments (interviewees) from each of the combinations that are possibly made from the above-mentioned choices.

2.4.5 Execution of Interviews

We have employed 13 men (most of them are university students) as interviewers. 2 interview areas were assigned to each interviewer except for the last interviewer who made interviews in only one area.

Out of 13 male interviewers, 3 of them were accompanied with female interviewers. This was to make interviews smooth; some interviewees, to enter the house alone.

2.4.6 Result of the Interviews

All the information (except for the comments) obtained through the interviews have been transferred to the coding sheets, then, put into a computor, in Japan, for analysis.

INTERVIEW AREA

(Number shown on the table are the area code numbers.)

		R.HIGH	R.MIDDLE	R.LOW	C.HIGH	C.MIDDLE	C.LOW	TOTAL
(1)	MONTAZA	1	2	3		4		(4)
(2)	EAST	5	6	7	8		9	(5)
(3)	MIDDLE	10	11	12	13			(4)
(4)	GOMROK	14	15	16		17		(4)
(5)	WEST	18	19	20			21	(4)
(6)	AMERIYAH	22	23	24			25	(4)
	TOTAL	(6)	(6)	(6)	(2)	(2)	(3)	(25)

(1) MONTAZA:						
1.	Tourtistic Mamora	H			R	
2.	Khalid Ebn el Walid St.		M		R	
3.	Southern Sidi Ishr			L	R	
4.	Khalid Ebn El Walid St.		M			C
(2) EAST:						
5.	Zizinya	H			R	
6.	Sidi Bager El Chikh		M		R	
7.	Gobrial			L	R	
8.	Horria St./Rushdy	H				C
9.	Moustafa Kamel St.			L		C
(3) MIDDLE:						
10.	Latin District	H			R	
11.	Ebrahimia South of Tram Lime		M		R	
12.	Southern Hadara			L	R	
13.	Ebn Zoher fSt./Ebrahimia	H				C
(4) GOMROK:						
14.	26 July St.	H			R	
15.	Ras El Tin St.		M		R	
16.	El Banna Leans besides Abu El Abas			L	R	
17.	Esmail Sabry St.		M			C
(5) WEST:						
18.	EL Max	H			R	
19.	Git El Anab		M		R	
20.	Industrial houses			L	R	
21.	Ragib St.			L		C
(6) AMERIYAH						
22.	El Bitash Agami	H			R	
23.	El Hanovil Agami		M		R	
24.	El Dkhila			L	R	
25.	Masged Nagil El Dkhila			L		C

Notes: H: High income — R: Residential area
M: Middle income — C: Commercial area
L: Law income

2.5 Collection Experiment in 1985

2.5.1 Program for Collection Experiment

1) Organization and Staff

(1) Advisory members

Mr. Galal Hassan Hamdy, Middle District Chief
Mr. Saad Rapheal, General Manager of General Follow-Up Dept.
Mr. Hassan Roushdy, Deputy Director of Housing Directorate
Dr. Olfat El Sebaie, High Institute of Public Health

(2) General Supervision and Advice (The General Follow-Up Dept.)

Mr. Ahmed Hamed, Manager of the Cleansing Follow-Up Sec.
Mr. Kamel Ahmed, Deputy Chief of the Follow-Up Site Sec.
Mr. El Sayed Higazy, Follow-Up Cleansing Section

(3) Collection Planning

Mr. Masato Ohno, Chief of Collection Study
Mr. Abd El Hamid EL Dawy, Assistant Supervisor of the Middle District Cleansing Dept.
Mr. Salah Mohamed El Sayed Aly, Assistant Supervisor of the Middle District Cleansing Dept.

(4) Execution and Control of Workers

Mr. DAwy for Ebrahimiyah and Moharam Bey
Mr. Salah for Mohatat el Raml

(5) Public Instruction and Campaign

Mr. Hisashi Ogawa & Mr. Mahmoud-Saleh Riad

(6) Monitoring & Evaluation during the Experiment

Mr. Dawy, Mr. Salah, Mr. Ohno, Mr. Toru Naito & Mr. Suzuki

(7) Inspection & Patrol

Mr. Dawy, Mr. Salah, Mr. Suzuki, Mr. Naito & Mr. Ogawa

(8) Interview

a- Planning: Mr. Sakaguchi & Mr. Ogawa

b- Execution before experiment: Mr. Sakaguchi

c- Execution during the experiment: Mr. Suzuki

d- Analysis of interview results: Mr. Ogawa, Mr. Sakaguchi, Mr. Ohno & Mr. Suzuki

(9) Photo taking

Mr. Salah, Mr. Dawy & Mr. Suzuki

(10) Post Experiment Evaluation

Mr. Ohno, Mr. Dawy & Mr. Salah

(11) Coordinators

Mr. Hiroshi Abe, Mr. Mahmoud-Saleh Riad & Mr. Sakaguchi

2) Objectives

(1) To study the feasibility of refuse collection with plastic bags.

(2) To compare plastic bag collection system with communal container system in view of cleanliness of streets and collection efficiency.

(3) To assess the availability of public cooperation in discharge and street cleansing.

3) Sub Objectives

(1) To abolish open garbage stations (places where garbages are placed without being packed in plastic bags or containers) from the view-points of public health and collection workers working conditions.

(2) To provide regular and reliable collection services.

(3) To lead residents and shopowners to discharge their garbages at designated locations and hours.

(4) To guide people to change their habits of throwing garbages through windows of houses and cars.

(5) To decrease street sweeping activity through the cooperation of residents.

4) Period

Preparation: July 1, 1985 to August 14, 1985.
Execution : August 15, 1985 to Setember 30, 1985.

5) Area Selection

The following areas were selected;

(1) Ebrahimiyah

Residential area. In the experiment area there are about 7,500 residents, 1,500 households, 180 buildings and 170 shops and offices. The experiment area is about 90,000 square meters. Most residents use plastic bags.

(2) Moharam Bey

Residential area. In the experiment area there are about 5,000 residents, 1,050 households, 160 buildings are 160 shops and offices. The experiment area is about 70,000 square meters. Communal container system is applied.

(3) Mohatat El Raml

Commercial area. In the experiment area there are about 500 shops and offices, 200 households, and 1,000 residents. The experiment area is about 20,000 square metres. Few residents and shopowners use plastic bags.

6) Collection System

(1) General conditions for all experiment areas.

a- Frequency: Once daily 7 days a week.

b- Time : 7:30 - 12:00 in the morning.

c- Workers and vehicles: 3 or 4 collection workers and one vehicle with a driver were mobilized for each experiment area.

(2) Particular conditions for each experiment area.

a- Ebrahimiyah

- Garbages were collected from each garbage station by three collection workers and one truck (Nissan, Open-type with 4 ton capacity) with driver.
- The collection route during the experiment was changed to cover 23 garbage stations in the experiment area.
- The distance between a garbage station and the entrance of a building was 25m on the average and 100m at maximum.
- Residents were requested to use plastic bags and discharge bagged garbages to the nearest garbage stations.
- Residents were requested to discharge before 7 AM.

b- Moharam Bey

- Garbage collection was done by 4 collection workers and one truck (Truxmore, capacity 10 tons) with driver.
- The collection route during the experiment stayed the same to cover 9 communal containers in the experiment area.
- The distance between a communal container and a building was 50m on the average, and maximum 70m.
- Residents were instructed to discharge their garbages to the nearest communal container. (Residents were not requested to use plastic bags.)
- Residents could discharge their garbage at any time.

c- Mohatat El Raml

- Garbage collection was done 3 collection workers and a truck (Leach, 7 ton capacity) with driver.
- The collection route during the experiment was changed to cover 7 garbage stations in the experiment area.
- The distance between a garbage station and a building was 25m on the average and maximum 50m.
- Residents were requested to use plastic bags, shops were requested to use plastic bags or their own containers, and both were requested to carry their garbages to the nearest garbage station.
- Residents were requested to discharge before 7:30 AM, however shops, office or factory could discharge garbages after closing time in evening.

7) Street Sweeping

In the Ebrahimiya and Moharam Bey experiment areas, street sweeping was done once a week on Saturday except for the main streets which were swept daily during the experiment period. This sweeping schedule was subject to change according to the situation.

8) Public Instruction and Campaign

Discharge instructions to the residents and shops, and campaigning for the experiment were carried out to obtain public cooperation.

(1) Public instruction

a- Instruction sheets

Instruction sheets were delivered and explained to all households, shops and offices of the experiment areas for 3 days from 11th to 13th August using 27 persons, of which 17 were sent by the Alexandria Health Directorate.

b- Station panels

Station panels were put on all containers and the walls near the garbage stations in order to inform the residents of the location of the stations and the designated garbage discharge manner and time.

(2) Campaign

a- Radio broadcasting by the Alexandria Radio broadcasting station:
The experiment was announced by the radio twice a day from the 7th to 14th August, 1985.

b- Posters and badges:
Posters calling for residents cooperation weere put on some of the building walls of the three experiment areas. Badges were worn by all the personnel involved in the experiment.

c- Regional meeting with Loyal Nubian Society:
A regional meeting was held at Loyal Nubian Society on 9th August. The meeting started at 7 PM with talks presented by a JICA member and a district cleansing service personnel, followed by open discussion. In the meeting opinions of both citizens and district officials were exchanged.

d- Microphone and vehicle:
The discharge instruction was delivered by a microphone-loud speaker equipped on a vehicle in the 3 experiment areas for a week before, and first wek of the experiment.

e- Mosques and churches:
A message concerning our experiment was delivered to the people during mosque Friday prayers (August 9th), and churches Sunday morning meeting (August 11th).

9) Inspection and Patrol

(1) Throughout the experiment period, inspection and patrol were done in order to guide the residents and enforce the required discharge and collection systems. Inspectors visited residents' houses when necessary.

(2) For this purpose 10 men were mobilized in addition to the following personnel in each area:

a- 1 inspector
b- 1 first workmaster
c- 1 workmaster

(3) A committee for fines was mobilized from September 1st to 15th to impose fines on violators.

10) Evaluation of Experiment

The success or failure of the experiment was judged by comparing the situations before and after the experiment by the followng methods;

(1) Photographs
The change in the degree of cleanliness was measured by taking photographs at fixed places and times once every week before and during the experiment.

(2) Interview survey
Interview survey was conducted to assess the changes in residents opinions on sanitary conditions and cleanliness of streets, satisfaction for cleansing service, willingness to pay collection fee and other. Interviews were made with 350 residents in the 3 experiment areas; 150 in Ebrahimiyah, 150 in Moharam Bey and 50 in Mohatat el Raml, before and during the experiment. In the first interview, an additional 150 interviews were made in the non-experiment area of the Middle District.

(3) Collection efficiency
The degree of collection efficiency was measured once every week before and after the experiment by applying the following calculation:

$$\frac{A \times B}{C}$$

Where;

A: Respective number of workers, drivers and swepers mobilized for collection service for an area.

B: Time (hours) spent for the collection service by respective workers.

C: Weight of garbages collected during the service.

2.5.2 Results of the Experiment

Results of the experiment are summarized for each area as follows:

(1) Ebrahimiyah

a- Use of plastic bags

Most residents in this area used plastic bags before the experiment. The use of plastic bags further increased during the experiment, indicating only a little resistance of the residents to use plastic bags. A few shops in this area use plastic bags.

b- Discharge of garbage

Household garbages were placed at the designated collection station as a result of instructions and station panels. The discharge manner of shop garbages was not so good, creating open garbage conditions at some stations.

c- Open garbage station

Except for scavengers' opening plastic bags and discharge from shops, the situation of open garbage stations was greatly improved.

d- Aesthetics and public health

Although the daily street sweeping was reduced to sweeping once a week during the experiment, no great change was observed. However, a sweeping frequency of twice a week or more was considered to be appropriate. Furthermore, the improvements in street conditions, parking regulations and the people's manners are necessary in addition to street sweeping.

Due to the reduction in open garbage stations the public health of the area was greatly improved. This may result in raising the awareness of the residents and cleansing workers.

e- Collection efficiency

The travel distance for collection increased because the route was changed to include inner streets. However, the garbage collection by sweepers was eliminated and the loading became easy due to the increase in use of plastic bags. Consequently the collection efficiency was clearly increased.

f- Summary

The plastic bag collection system is considered to be highly feasible. Especially the residents accept the use of plastic bags without complaint. The public cooperation was obtained from 80 to 90% of the residents. For the remaining population, stringent regulation, especially punishment, is necessary.

Other problems are as follows:

- Some stations panels were taken off by the residents. JICA Study Team had to change the location where no complaint was raised by any resident.

- Car parking on both sides of the streets was found to be an obstacle to the collection vehicle operation.

- Car parking was also found in front of the collection station.

- To imprve the cleanliness of the area, pavement of side walks, removal of accumulated sand and gravel, removal of garbages under parked cars and strengthening of public education are necessary.

(2) Moharam Bey:

a- Discharge of garbage

Fewer residents were found to leave garbages on the streets, the corners or entrances of buildings, during the experiment. Most people were bringing down their garbages to the communal containers.

b- Open garbage station

The open garbage stations which existed before the experiment, disappeared during the experiment.

c- Garbage around the containers

Most people (80 to 90% of the residents) put their garbages into the containers, and few people continued to throw garbages around the containers. However, the situation greatly improved.

d- Aesthetics and public health

No great change was observed before and during the experiment.

e- Collection efficiency

Since the garbage collection by sweepers was stopped, the efficiency was improved. However, no great change was found in loading time.

f- Summary

Where the plastic bag collection system is not used, the communal container system is much better than the open garbage station collection. Although enough capacity was provided for the area, certain containers were found always full. However the people were against the idea of locating container near their living spaces and of dischargng to a longer distance, and therefore it was difficult to redistribute the containers. The Truxmore operation requires the street width of at least 7m under an assumption of parking on both sides. The residential areas satisfying this condition are very small.

(3) Mohatat el Raml

a- Use of plastic bags

Despite repeated instructions to the shops in the area, a satisfactory result was not obtained.

b- Discharge of garbage

Newly designated collection stations were not used by the shops and workshops. Sweepers, zabbaleen and doormen collected garbage from the shops and discharged without any container. A very stringent regulation was necessary for this area.

c- Open garbage station

The situation was somewhat improved by the inspection and patrol during the experiment. However, shops were not controlled well and hence garbage station could not be completely eliminated.

d- Aesthetics and public health

No great change occurred before and during the experiment.

e- Collection efficiency

No great change occurred before and during the experiment.

f- Summary

No great improvement was obtained by the experiment. However, it was learned from this experiment that in commercial areas it is not appropriate to have the people bring down their garbages for a long distance to the stations and a stringent regulation is necessary.

2.6 Operation and Maintenance of the Abis Compost Plant

2.6.1 Purpose of investigation

The Abis Compost Plant initiated its operation in Nov. 1984, and was handed over to the Alexandria Governorate in March 1985.

Purpose of this investigation is to understand the present situation of this plant's operation and to analyze the quality of compost produced there. Consequently the problems concerning the operation were understood and referred to in making the plan of the New Abis Compost Plant, these many problems hindered the obtaining of satisfactory results in the existing plant.

To eliminate the problems with the existing Abis Compost Plant it will be essential to examine them and draw up an improvement plan for this plant. At the same time, it will be of paramount importance to ensure that when the new Abis Compost Plant is built the same problems will not repeat themselves.

In this sense, a detailed study of the problems with the existing plant will provide some good lessons to be learnt from previous mistakes. In any event, a repeat of the same problems and mistakes as have arisen on the existing plant will not be allowed for the new Abis Compost Plant.

In drawing up the plans for a composting plant, it is very important to pay due attention to the following two considerations.

The first important consideration is the preservation and maintaining of the urban environment and of public health through the sanitary treatment and disposal of the enormous amounts of urban waste generated daily in the life of the city and through effective reduction of waste amount.

To achieve this goal, the plant must be capable of reliable operation, ensure that the design or target rate throughout is constantly met, and that the plant has a troublefree, consistent availability allowing it to be utilized for waste treatment on a daily basis and without fail.

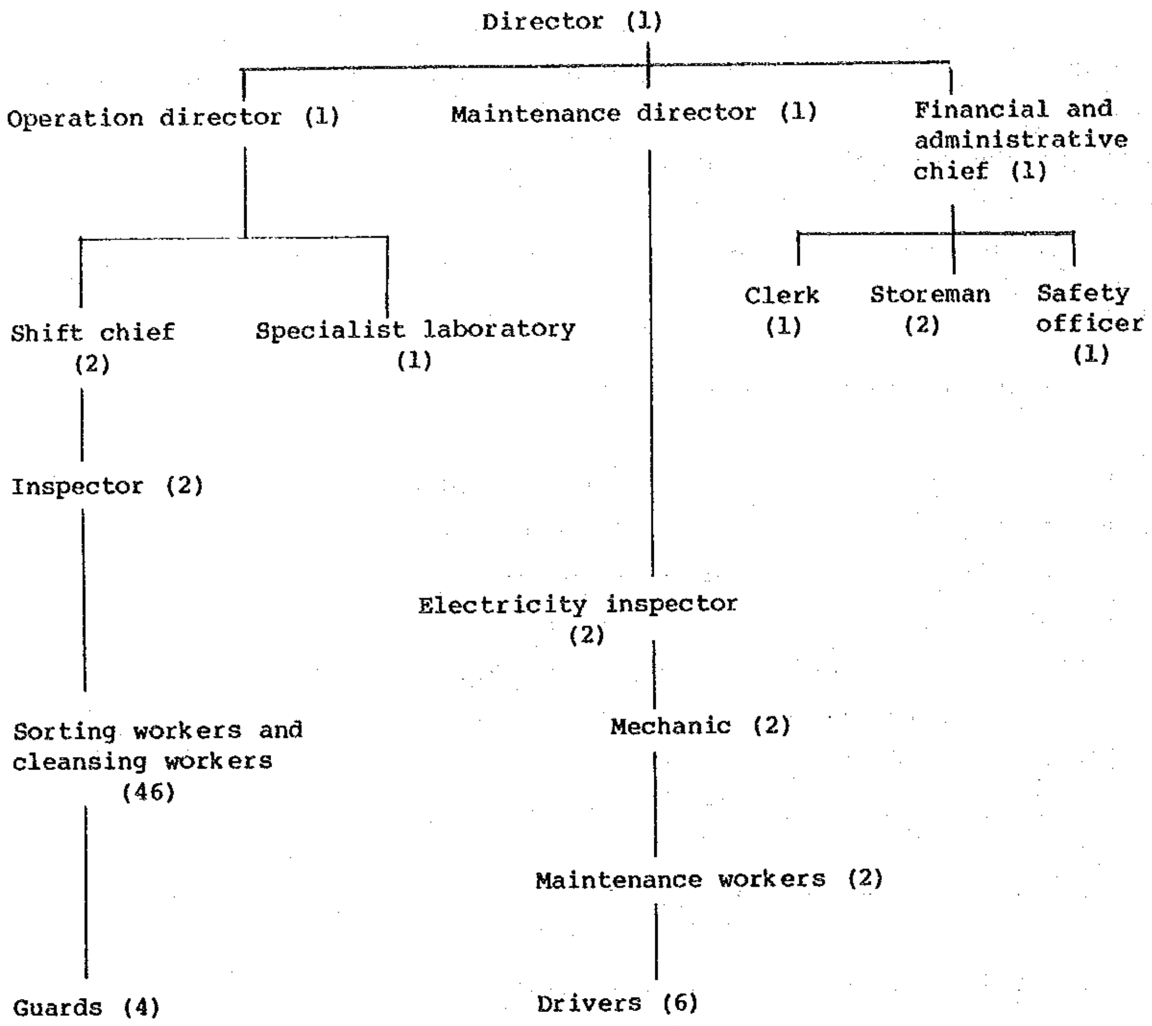
The second important consideration is that the plant should lead to the recovery of compost as a valuable product obtained from the urban waste input. It is essential to deal with the following two questions concerning the compost recovered from the waste feed: First, how can the presence of foreign matter (that is, non-compostable materials) be minimized, and second, by what means is it possbile to achieve a properly matured compost?

2.6.2 Outline of the Abis Compost Plant

(1)	Name	: Abis Compost Plant
(2)	Plant Capacity	: 10 ton/hour (160 ton/day)
(3)	Process flow	: Windrow Type
(4)	Planned operation hour	: 16 hours/day
	Work time 1st shift	7:30 - 21:30
	2nd shift	14:30 - 22:00
(5)	Personnel and Organization	: Fig. 2-6-1
	Number of personnel	: 74 persons
(6)	Budget	:

Showing a deficit of 200,000 LE in the proposed budget of 1985.

Other detailed specifications are shown on the Tab. 2-6-1.



Plant director	1	Mechanic	2
Operation director	1	Inspector	2
Maintenance director	1	Driver	6
Administrative, financial	4	Maintenance worker	2
Laboratory	1	Sorting, cleansing worker	46
Shift chief	2	Guards	4
Electricity inspector	2		
		Total	74

Fig. 2-6-1 PERSONAL AND ORGANIZATION

Tab. 2-6-1 DETAILED SPECIFICATION

No.	Items	Specification	Note
1	Weigh Bridge	Load cell/Pitless Type	25 tons/stage approx. 8 mL x 3 mW
2	Tipping Hall	Approx. 300 m^2	
3	Refuse Plate Feeder	Belt width 1 m/0.05-0.3 m/s	Apron Conveyor
4	Feeding Conveyor	Belt width 1 m	Rubber Belt Conveyor
5	Hand Picking Belt	Belt width 1 m/0.22-0.75 m/s	Flat Rubber Belt Conveyor/Net width 700 mm
6	Magnetic Separator	Head Pully type	
7	Baler for Ferrous Metal	Bale size 400 x 400 x 260 m	Manual operation
8	Roller Conveyor	Approx. roller width 450	
9	Baler for Paper & Textile	Bale size 1,200 x 700 x 600	Manual operation
10	Conveyor to Durm	Belt width 1 m	Rubber Belt
11	Homogenising Drum	Cap. 10 t/h/10 rpm/dia. 3.12 m	With Screen (Hole size 50-65ø), 11-1 Watertank
12	Conveyor for Residue	Belt width approx. 500	Rubber belt
13	Container for Residue	With wheel	
14	Distributing Conveyor	Belt width 500, length 180 m, speed approx. 20 m/min.	Rubber belt
15	Turning Machine	Turning equipment 3,600 W x 1,800 H	
16	Fermentating Yard	Approx. 180 mL x 17mW x 2 sides = 6,120 m^2	Fermentating Period 5 weeks
17	Maturing Yard	Approx. 60 mL x 45 mW = 2,700 m^2	Maturing Period 4 weeks
18	Compost Refiner Feeder	With Belt conveyor	
19	Conveyor to Refiner	Belt width approx. 500	Rubber belt
20	Vibrating Screen	Screen 4 mL x 1.2 mW = 4.8 m^2, size of holes 23 mmø	
21	Conveyor for Residue	Belt width approx. 500	Rubber belt
22	Container for Residue	With wheel	
23	Generator	700 KVA, 380 V, 50 Hz	Available since October 1985

.specification of Homogenizing Drum

The Alexandria and Cairo plants have roughly the same construction.

Drive:

Alexandria	Gear
Cairo	Rubber tire

Residence time - 1 hour

a Feed hole
With water injection hole mounted on the lateral side.

b Drum unit
Cutter fitted inside. Configuration not known. Breakdown, moisture adjustment and mixing capability inside.

c Sorting screen
Diameter: 50 - 60 mmø

d Partition
There is one aperture for discharge in little amounts.
When leaving the drum, carton/paper etc. do not keep their original shape.

e Baffle plates
Mounted on internal circumference of drum, eight rows equidistantly pitched over inner surface. In view of its overhang shape, there is no coiling up of fabric/cloth, etc.

f Discharge chute

Note: Inferior breaking-down and separating efficiency compared with the selective pulverlizing classifirer.

.Design Specification for fermentation yard

- Planned space : Approx. 189 m(L) x 17 m(W) x 2 sides $= 6,120\ m^2$
- Compostable material: 166 t/d (Planned value)

  Planned pile volume

  $$A = 3.4\ m \times 2.1\ m \times \frac{1}{2} = 3.57\ m^2$$

  $3.57\ m^2(A) \times 180\ m(L) \times 5$ piles x 2 sides $= 6,426\ m^3$
- Truning Cycle : 1 time/5 days
- Fermenting period : 5 weeks = 35 days
- Specific gravity of compostable material as measured on September 3, 1985 $= 0.532\ t/m^3$
- Volume of compostable material : $166\ t/d \div 0.532\ t/m^3 = 312\ m^3/d$

Therefore, allowable fermenting period is obtained as follow:

$$\frac{\text{Planned pile volume}}{\text{daily production of compostable materials}} \times \frac{\text{365 days}}{\text{Plant operation day per year}}$$

$$= \frac{6,420\ m^3}{312\ m^3/d} \times \frac{365\ d/year}{300\ d/year} = 25\ days$$

Furthermore, since the height of fermenting pile is limited to only 1.5 m due to low capacity of the turning machine, acutal volume and period for fermenting is only 4,590 m^3 and 18 days respectivey.

In other words, it can be said that 80 t/d capacity for waste treatment.

Solution: to expand fermenting yard up to 12,000 m^2

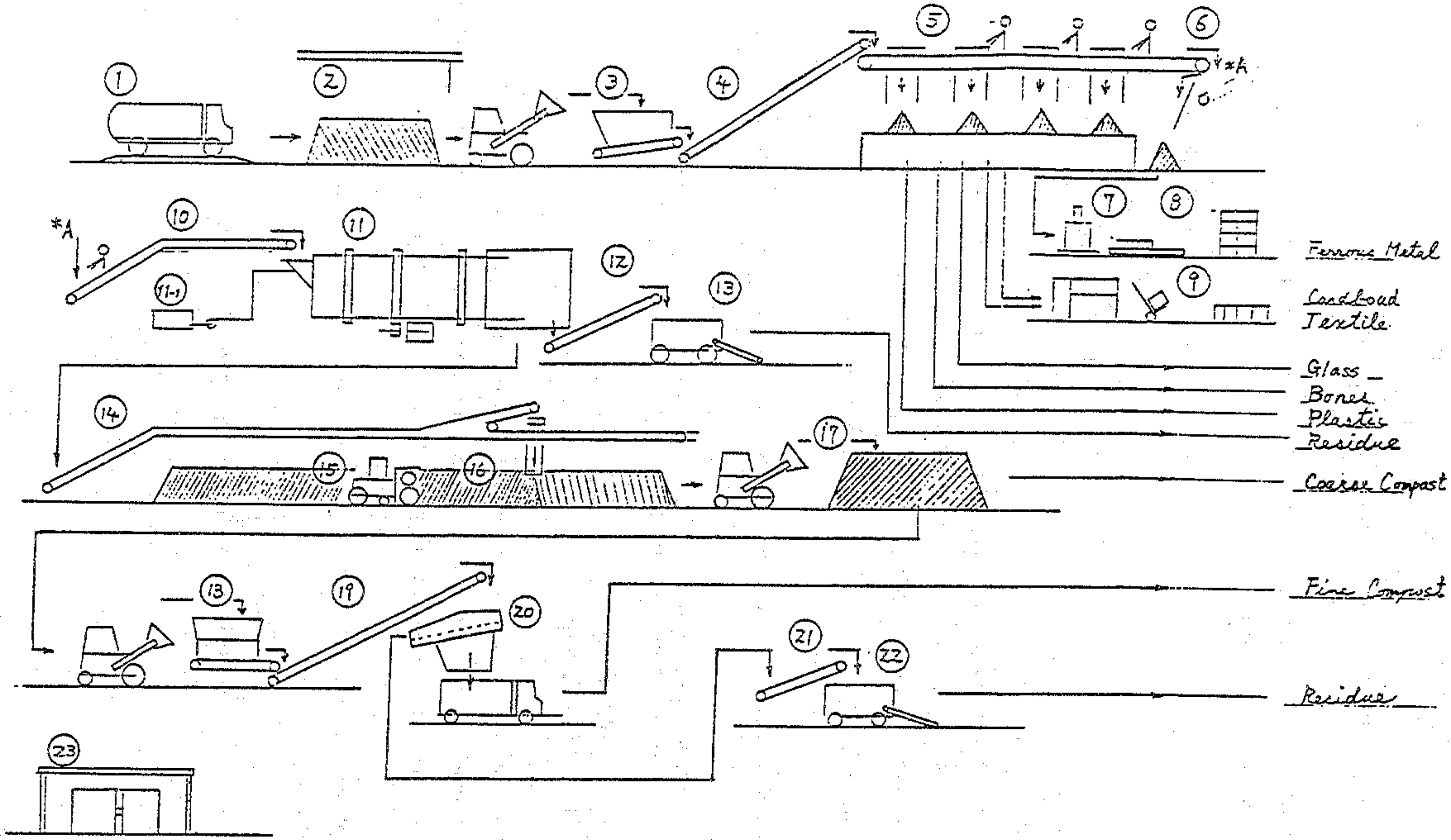


Fig. 2-6-1 PROCESS FLOW OF ABIS COMPOST PLANT

2.6.3 Operation Record of Abis Compost Plant

The existing plant went into trial operation effective as of November 1984. The number of operating days during the period from November 1984 through June 1985 was 96 days. The plant was commissioned in January 1985 and during the six month period (150 days = 25 x 6 months) from July to December 1985 it was in operation for a total of 85 days. This is equivalent to a plant availability factor of 57%.

The amount of waste treated during the twelve (12) month period of operation was 18,746 tons, a treatment capacity corresponding to approximately 39% of the planned treating capacity under normal plant operating conditions (160 t/d x 300 days = 48,000 tons).

Treatment ratio of first six months of 1985 and last six months is calculated as follows:

- From Jan. to Jun.

$$\text{Treatment ratio (1)} = \frac{6,885}{24,000 \text{ (planned capa.)}} \times 100 = 28.7\%$$

- From Jul. to Dec.

$$\text{Treatment ratio (2)} = \frac{11,862}{24,000} \times 100 = 49.4\ \%$$

Although the treatment ratio improved from 28.7% to 49.4% and actually reached 58% during the last three months of October, November and December in 1985; the plant has evidently not accomplished the planned treatment capacity.

On the other hand, the hourly treatment capacity reached 11.72 tons in average, which exceeded 1.72 t/hr in comparison with design capacity as shown in Tab. 2-6-2.

According to the above data, the plant operation was not stable and not achieving the planned operation.

Table 2-6-2 OPERATION RECORD

	Waste (t)	Actual op. hours	Actual cap. (t/h)	Reusable Material (t)							Compost (t)		Reject (t)	% of reject
				Paper	Iron	Textile	Glass	Bread	Bone	Other	Fine	Coarse		
'84 10/20-12/31	671.89	51.17	13.13	10.03	2.77	3.23							100.78	14.99
'84 Jan.	970.765	86.3	11.24	19.65		1.16							101.9	10.49
Feb.	1,156.06	117.1	9.88	13.44	4.95	1.32							61.01	5.27
Mar.	1,466.32	142.4	10.29	21.07	3.88	4.1					12.48	14.76	301.65	20.57
Apr.	749.72	82.1	9.13	18.32	3.41		8.47				373.925	16.42	181.24	21.17
May	636.45	53.3	11.94	11.83	3.32		1				274.35	171.19	109	17.12
Jun.	1,232.46	131.5	9.37	10.29	2.7						265.04	710.28	270.18	21.92
Sub total	6,884.665	663.87	10.37	104.63	21.03	9.81	9.47	0	0	0	925.795	912.65	1,125.76	16.35
Jul.	2,271.67	193.35	11.74	33.75							51	1,088.29	492.36	21.67
Aug.	423.25	45.5	9.30	5.23	6.3	10.41					20	767.33	94.86	22.41
Sep.	2,168.84	211.1	10.27	45.61		2.73	7.3					226.9	507.45	23.39
Sub total	4,863.76	449.95	10.80	84.59	6.3	13.14	7.3	0	0	0	71	2,082.52	1,094.67	22.50
Oct.	1,266	106.25	11.91	29.55	7.39	1.77					17.8	114.96	239.1	18.88
Nov.	2,831.93	206.5	13.71	42.12	6.5	6.31	1.25	1.8		1.564	74.33	564.66	572.58	20.21
Dec.	2,900	172	16.86	48.91	6.76	8.91	17.125	1.83	0.39	0.02	184.81	1,033.61	610.76	21.06
Sub total	6,997.93	484.75	14.43	120.58	20.65	16.99	18.375	3.63	0.39	1.584	276.94	1,713.23	1,422.44	20.32
Grand total	18,746.355	1,598.57	11.72	309.80	47.98	39.94	35.145	3.63	0.39	1.584	1,273.735	4,708.4	3,642.87	19.43
5 of Grand total				1.65	0.25	0.21	0.18	0.01	0.00	0.00	6.79	25.12	19.43	
Total (Jul-Dec)	11,861.69	934.7	12.69	205.17	26.95	30.13	25.675	3.63	0.39	1.584	347.94	3,795.75	2,517.11	21.22
% of total				1.72	0.22	0.25	0.21	0.03	0.00	0.01	2.93	32.00	21.22	

REUSABLE MATERIALS AND COMPOST PRODUCED BY EXISTING ABIS COMPOST PLANT

2.6.4 Principal Reasons for Plant Shutdown

The principal reasons that led to plant shutdowns during the last six months period in 1985 are enumerated below. The main cause in this itemized account is given as blockage and damage of equipments, accounting for roughly 40% of all stoppages. There is no chance of improving the treating capacity rate until and unless this intrinsic problem is successfully eliminated. Therefore, to achieve continuous and steady plant operation, it will be necessary to modifty the plant.

Principal reasons for plant break down (except trial run period of '85 Jan.-'85 Jun.) are shown in Tab. 2-6-3 and summarized as follows:

a.	Power failure	49%
b.	Fixing equipment or conveyor	39%
c.	No waste	18%
d.	Cleaning	20%
e.	Other	4%
		100%

(1) Power failure (Power Off)

Nature of the Problem:

Constant power supply not assured

Solution:

Installation of a generator

Note:

A 700 KVA output generator is available since October 1985.

Tab. 2-6-3 PLANT SHUTDOWN BY CAUSE

	Shift		Expected	Actual	BREAK DOWN (hr)					
	Single	Double	hours	hours	Total	Power failure	Fix equip. or con'yor	No waste	Cleaning or others	Other
Jan.	27	-	213	90	123	59	20	27	12	5
Feb.	6	18	239	107	132	59	45	5	22	1
Mar.	17	8	296	141	155	61	25	31	36	2
Apr.	24	-	374	109	265	2	216 (*2)	20	27	-
May	9	5x10(*1)	305	66	239	62	145 (*2)	13	19	-
Jun.	1	7x14(*1)	267	129	138	32	56	21	29	-
Sub-total			1,694	642	1,052	275	507	117	145	8
% of break down					100.00	26.14	48.19	11.12	13.78	7.60
Jul.	-	26	395	201	194	23	56	30	36	49 (*5)
Aug.	-	25	393	229	164	20	41	44	59	-
Sep.	-	25	310	53	257	198	18	27	14	-
Oct.	6	20	409	110	299	-	234 (*3)	6	59	-
Nov.	-	24	328	205	123	1	51	28	43	-
Dec.	-	27	408.2	195	213.2	0.2	83	85 (*4)	45	-
Sub-total			2,243.2	993	1,250.2	242.2	483	220	256	49
% of break down					100.00	19.37	38.63	17.60	20.48	3.92
Grand total			3,937.2	1,635	2,302.2	517.2	990	337	401	57
% of grand total					100	22.47	43.00	14.64	17.42	2.48

Note: *1 Ramadan
*2 Breakdown of drum motor
*3 Fixing belt conveyor
*4 Heavy rainfall
*5 Repaving fermentation yard

(2) Mobile equipment failure

Nature of the Problem:

- Turning machine tends to overheat by reason of its low capacity.
- Troubles with type puncture

Solution:

- Turning machine should be changed to one of greater power or reducing the speed of stirring by the existing turning machine or the stacking height of the compost pile
- Use of cut-resistant tyres and chains

(3) Blockage

Blockage occcurs in three (3) locations as explained below.

Blockage

Blockage occurs in the handling section from the feeding conveyor to the handpicking belt. Due to the non-constant feed rate of the waste-plate feeder, the waste fed from the tipping yard by the front-end loader is conveyed in lumps without being leveled.

Solution (1):

Improve the non-constant feed rate of the waste plate feeder and need to replace the waste-plate feeder and feeding conveyor completely.

Blockage (2):

Blockage occurs in the handling section from the handpicking belt to the conveyor to drum section. In addition to problem (1), there is the problem that foreign material and coarse waste is not adequately recovered/eliminated at the handpicking line.

Section (2):

Same as Solution (1) and to upgrade operating efficiency at the handpicking line, by means of reducing the belt conveyor speed and to widen the belt.

Blockage (3):

Blockage occurs in the charging section of the homogenizing drum and in the homogenizing drum

Section (3):

Same as Solution (2)

Note: Refer to attached sheet showing the construction of the homogenizing drum.

The breakdown power of the homogenizing drum is too weak and its outlet dimensions are too small, thus giving rise to blockage in the partition of the drum outlet. This is an intrinsic problem in the equipment/plant construction.

2.6.5 Equipment and Facilities

For numbering No. refer to the Process Flow Chart shown on the Fig.

(1) Tipping Hall 2

Present tipping hall has 300 m^2 floor for waste storage.
However, the plan could not operated over 337 hours due to waste in the tipping hall during last one year, and it counts almost 15% of total shutdown of the plant.
The waste storage capacity of the exising tipping hall is estimated as follow:

floor area x height of waste pile x x

: space factor for moving line of front-end loader = 0.6

: unit weight of waste = 0.33 t/m^3

300 m^2 x 2.5 m x 0.6 x 0.33 t/m^3 = 149 t

Therefore tipping hall has only 90% of storage capacity against daily treatment capacity of the plant.

Solution:

The tipping hall will have to be extended at least by 1.5 times of the existing hall area.

(2) Waste Plant Feeder 3

Poor fixed feed-rate capability. The waste fed from the front-end loader is piled up on the conveyor and conveyed in this condition to the subsequent process stages so that trouble with blockage tends to occur.

Solution:

Replacement with a feeder having a high capability for fixed-rate feeding. Example: Changing the conveyor 4 with a sharp angle and mounting a leveller in the path.

(3) Handling Belt 5

Poor recovery of reusable materials and coarse or lumpy wste.

Solution:

. Upgrading the performance of the waste feeding plate to operate at a fixed-rate.
. The current conveyor speed of 20 m/min. should be reduced to 10 m/min.

(4) Homogenizing Drum 11

Waste is apt to concentrate in lumps inside the drum causing blockage. The reasons for this problem are the weak breakdown force of the drum, entrance of coarse and lumpy waste into the drum due to inadequate handpicking, and thirdly the formation of lumps by lengthy materials as rope, cord, etc., which are present in the waste and enter the drum.

Solution:

It is essential to fully remove materials that are difficult to breakdown, lengthy materials and coarse and lumpy waste in the handpicking line prior to being fed into the drum. A partial solution to avoid entrance of lumpy waste into the drum would be to apply a pulverizer to breakdown the coarse and lumpy waste before it is feed into the drum.

It is also recommendable to remove coarse and lengthy waste in the storage area before feeding to the apron conveyor.

(5) Fermentating Yard 16

At present, the space of the fermenting yard cannot accommodate a 35 days fermentation for raw compost to be produced at rate of 166 t/d.

(6) Maturing Yard 17

The maturing yard space does not hava a capacity corresponding to 160 t/d of waste input taking into consideration of moving line for the truck and/or loading shovel.

Solution:

Additional 50% of existing space is required for maintaining the treatment ratio of 160 t/d.

(7) Feeder for compost refiner 18

Blockage occurs in the compost refiner feeder so that two operators are required to be there throughout the operating period in order to prevent blockage in the hopper and at the feeder outlet.

Solution:

Modify or change the feeder to maintain a feeding rate in order to avoid blockage.

Example: conveyor 19
changed to a steep slope apron
conveyor with leveller

(8) Hourly Treatment Capacity of 10 t/hr

The existing plant is planned to operate 16 hours per day by a two-shift system with the aim of achieving a waste treatment capacity of 160 t/d.

It is however, impossible for the plan to treat the waste continuously during 16 hours, since a certain amount of time is consumed for daily cleaning and maintenance of the plant equipments.

2.6.6 Material Balance

Fig. 2-6-2 gives the estimated material balance. Fig. 2-6-4 gives the average material balance for the period from July, 1985 till December, 1985. The figures show that the actual amount of reusable material recovered in the handpicking process was significantly lower (2.5%) than the planned values (7.8%).

The reason lies in the poor fixed-rate feed capability to the handpicking line and in the high speed of approximately 20 m/min. of the handpicking conveyor.

For the other values including the compost recovery rate and the reject rate, however, there is not no dramatic discrepancy between the design and actual values.

2.6.7 Sales of Compost

As of October 1985, 22 customers contracted for this plant as shown in Table 2-6-4, 6 customers among them contract more than 200 ton each, 4,200 ton of coarse compost and 1,400 ton of fine compost in all. This amount can be converted to the fine compost of 4,130 tons, and it is 1.5 times of the total production of this plant during last one year. At present, the contracted amount of compost exceeds the producted amount taking into account other customers of small contracts and the fact that the plant is not operating as planned. Furthermore, there are many other customers who want to make a contract.

Price of the compost differs according to the kind and contract amount. From the 27th of July 1985, coarse compost contracted for more than 1,000 ton is 5.5 LE/t and 7.25 LE/t for fine compost as shown in Table 2-6-5.

These prices was decided at the meeting of the Plant with the Ministry of Agriculture. Compost produced in this plant was sold well to the customer and is delivered in bulk at this plant.

Regarding reusable materials, the Plant contracts with some dealers. Price and sales amount of compost and reusable material are shown in Table 2-6-6.

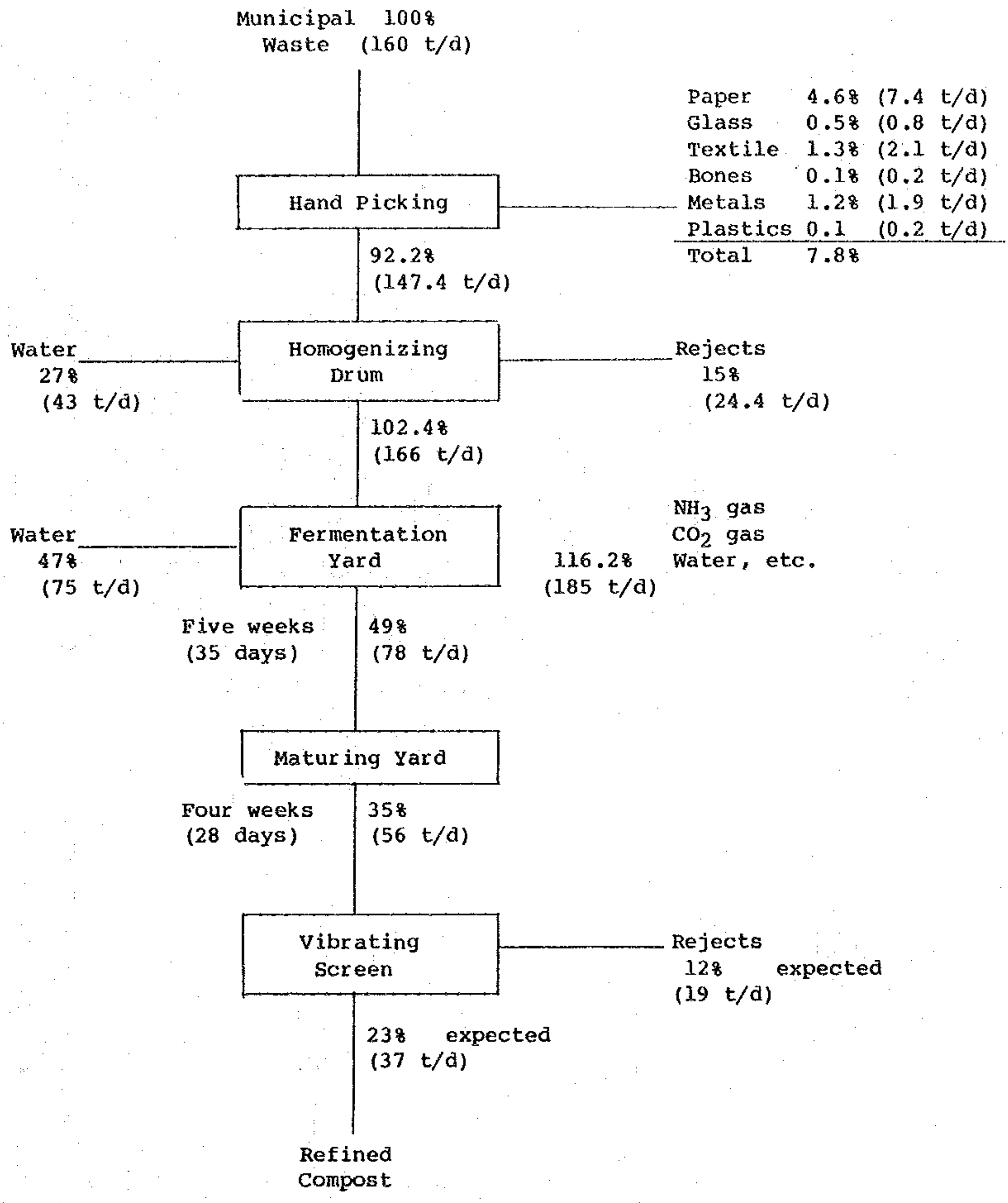


Fig. 2-6-2 EXPECTED MATERIAL BALANCE OF THE EXISTING ABIS COMPOST PLANT

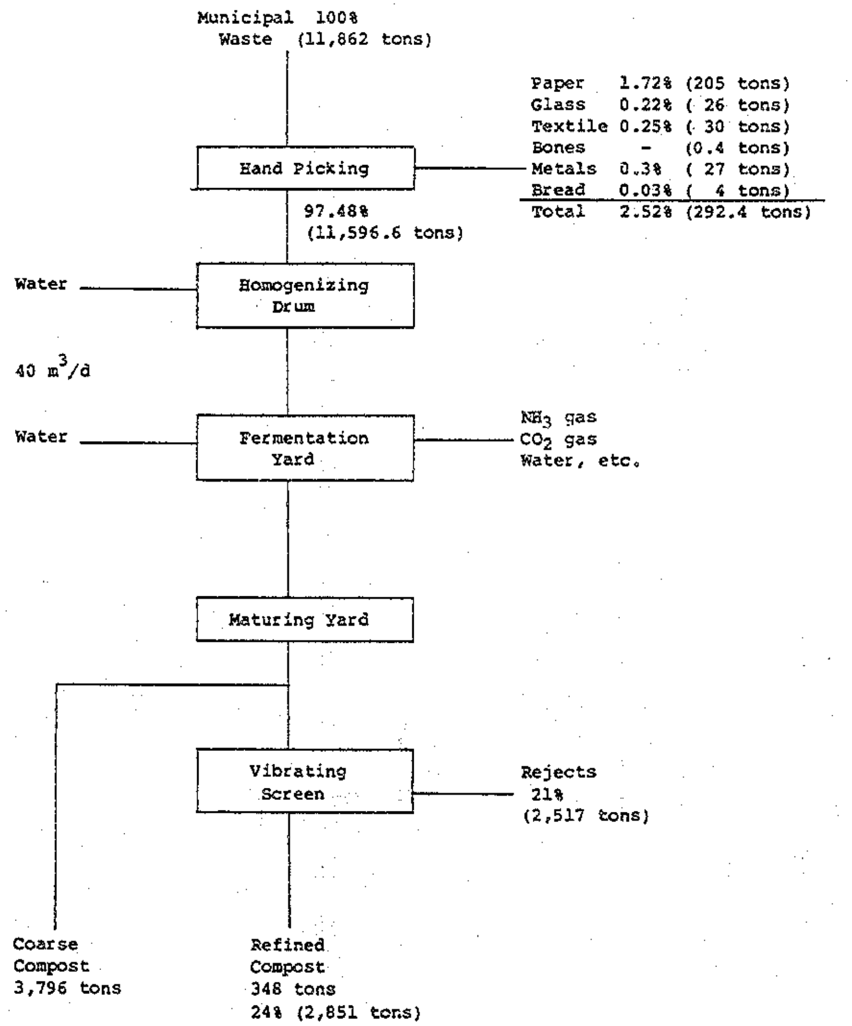


Fig. 2-6-3 MATERIAL BALANCE OF EXISTING ABIS COMPOST PLANT (July 1985 - Dec. 1985) (except Trial run period)

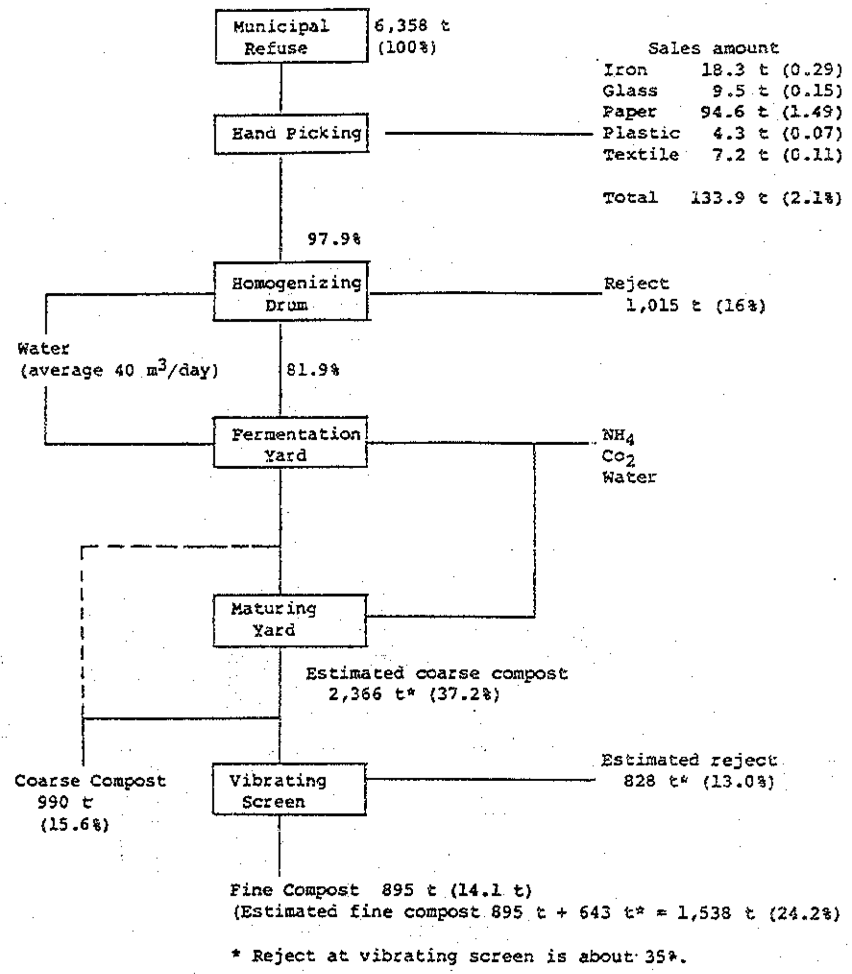


Fig. 2-6-4 ACTUAL MATERIAL BALANCE OF ABIS COMPOST PLANT

From Jan. to June 1985

Tab. 2-6-4 LIST OF PLANT CUSTOMERS

Customers more than 200 t/year

Name	Amount	Type	Address
Moustafa Ali Rezk	1,200 ton	Coarse	Eletarh
Ahmed Fouad Ali	1,200 ton	Coarse	Eletarh
Nour Eldeen elsherief	1,500 ton	Coarse	Khorshed-Eatai Elbaro d
Saeed Elvantawy	300 ton	Coarse	----
Mahmoud Abd Elghani	1,200 ton	Fine	Abis - 6th village
Abd Ellateef Elsaid	200 ton	Fine	Elgara-er village

Customers less than 200 ton

Name	Address
Elsaid Ali Elsaid	Elgaze-er village
Eohamed Elsaeh	Elgaze-er village
Dabrouri Ebraheem	Abis 8th village
Mohamed Ahmed Ali	Abis 10th village
Mohamed Ahmed Badr	Kafer El dawaar
Arafa Mohmoud Badr	
Shabaan Ali Awad	
Magdi Mohamed Yousef	
Lohamed Elsheech	
Mahmoud El maghrabi	
Saleh Saleh	
Eemad lotfi	
Shawki Badrousi	
Geber Taha Hossain	
Salah Mohamed	
Abd El Aati Abd Elfattaah	

Tab. 2-6-5 SELLING PRICE OF COMPOST

LE/ton

Amount	Until 27th July, 1985		From 27th July, 1985	
	Coarse	Fine	Coarse	Fine
Less than 50 ton	7	9	7	9
50 - 200 ton	6	8	7	9
200 - 500 ton	5	7	7	9
500 - 1,000 ton	5	7	6.25	8
More than 1,000 ton	4	6	5.5	7.25

Tab. 2-6-6 SELLING INCOME OF COMPOST AND REUSABLE MATERIAL (From 25 Oct. '84 to 31 Dec. '85)

Items	Amount (T)	Unit Price (LE/T)	Income (LE)
Compost			
Fine	1,284	7.19 *	9,232
Coarse	4,708	5.5 *	25,894
Sub total	5,992		35,126
Reusable material			
Iron	48.0	9.0	432
Glass	35.1	20	702
Paper	309.8	40 **	12,392
Plastic	1.6	120	192
Rags	40.5	20	810
Sub total	435.0		14,582
Total			49,654

* Average Price of 200 t - 1,000 t and more than 1,000 t.

** Including transportation cost

2.6.8 Operation and Maintenance Cost

Operation and maintenance cost except basic wage of this plant during last year is 71,291 LE as shown in Tab. 2-6-7. Some 73% is for personnel expenses for incentive and overtime. Although this plant did not operate constantly, the treatment cost of one ton waste is estimated about 7.8 LE as the following calculation.

$$\frac{\text{Cost - Sales revenue}}{\text{Treated amount of waste}} = \frac{142{,}331 \text{ LE} - 49{,}654 \text{ LE}}{11{,}861 \text{ t}}$$

$$= 7.8 \text{ LE/t}$$

The production cost of fine compost is about 45 LE/t as the following calculation.

$$\frac{\text{Cost - Sales revenue of reusable material}}{\text{Produced amount of fine compost + (Produced amount of coarse compost x 0.65)}}$$

$$= \frac{142{,}331 \text{ LE} - 14{,}582 \text{ LE}}{348 + (3{,}796 \times 0.65) \text{ t}} = \frac{127{,}749 \text{ LE}}{2{,}815 \text{ t}} = 45.4 \text{ LE/t}$$

Actual record and estimated budget ('85/86) of the income and expenses for the plant operation are shown in the Tab. 2-6-8.

Tab. 2-6-7 ACTUAL EXPENSES FOR PLANT OPERATION FROM 25 OCT. FROM 25 OCT. 1984 TO 31 DEC. 1985

(LE)

Items	Amount
Incentive and overtime	52,046
Fuel, oil and lub.	4,000
Wire for baling	1,000
Puncture fixing	800
Oxygen and acetylene	500
Belt conveyor fixing	150
Miscellaneous expenses	940
Electricity	10,787
Water	1,000
Analysis	68
Sub total	71,291
Estimated basic wages (74 persons x 960 LE/year)	71,040
Total	142,331

Tab. 2-6-8 INCOME AND EXPENSES OF ABIS COMPOST PLANT

(LE/year)

Item	Actual Record from 25 Oct. '84 to 31 Dec. '85	'85/'86 Budget
Income		
Selling of compost	25,126	67,200
Selling of reusable material	14,582	32,102
Sub total	49,654	99,302
Expense		
Wages including overtime and incentive	123,086 *	222,521
Maintenance and spare parts	2,390	24,000
Fuel and oil	4,000	10,800
Water and electricity	11,787	15,080
Operation cost	1,068	14,000
Stationaries	-	16,300
Sub total	142,331	302,701
Balance	-92,677	-203,399

Note: Basic wage + incentive and overtime

= (74 persons x 960 LE/year) + 52,046 LE

= 71,040 + 52,046

= 123,086 LE

2.6.9 Waste Composition

Composition of the waste hauled to the Abis Compost Plant was analyzed and its results were summarized on Table 2-6-9.

As can be seen, miscellaneous inerts is very hight at percentage of 20 against low percentage of compostable materials comparing with estimated value.

Therefore it is recommended that the collection vehicles to be hauled the Abis Compost Plant will be defined to which collect such areas as house-hold, restaurant, hotel and so on.

Table 2-6-9 PHYSICAL COMPOSITION OF WASTE

(%)

	Samples Collected at Abis Plant				Estimation	
	8 Sep.	11 Sep.	18 Sep.	Average	1984	2000
Combustible						
- Paper	19.44	36.71	27.95	28	20	23
- Textile	5.98	1.64	2.82	3	5	6
- Plastics, Leather and and Rubber	3.98	8.23	5.84	6	6	9
- Green Grass, Straw Wood, Bamboo	7.24	5.11	6.28	37	72	51
- Others (Vegetable putrescible)	41.71	25.63	25.27			
Sub total	78.35	77.32	68.16	74	93	89
Non Combustible						
- Metal	3.59	3.92	3.18	4	3	6
- Glass, Ceramics	1.64	2.34	2.08	2	2	4
- Bones	0.49	0.45	0.78	20	2	1
- Miscellaneous Inerts	16.60	15.93	25.75			
Sub total	22.32	22.64	31.79	26	7	11
Total	100.67	99.96	99.95	100	100	100

2.6.10 Quality of Compost

According to the analysis result of compost as shown in Table 2-6-10 and 2-6-11, quality of compost produced in this plant satisfied the standard by the law No. 100, 1967 except compost humidity.

Table 2-6-10 RESULTS OF ANALYSIS OF PRODUCED ORGANIC FERTILIZER SAMPLES FROM ABIS COMPOST PLANT IN ALEXANDRIA

Type of Analysis	Sample (1) Fine	Sample (2) Coarse	Specification ACC to Law 100/1967
Nitrogen	1.25%	1.1%	0.5 + 0.04% min.
Organic Matter	19.3%	21.1%	18 + 1% min.
Humidity	20.5%	22%	30 + 2% min.
Density	691 Kg/m^3	615 Kg/m^3	750 + 40 max.
Carbon: Nitrogen	1 : 16	1 : 19	1 : 1 - 1 : 25
Volume of Particles	A suitable volume in order to apply on soil		
Bachteria	Not present	Not present	
Bacteria Plate Count	$1.8X10^{12}$/gm	$1.8x10^{12}$/gm	
Putrefication	$550X10^6$/gm	$550X10^6$/gm	
	Same number & types as found in atmosphere.		
Algae (Heatodate)	Not present	Not present	

14th March, 1985

Table 2-6-11 RESULT OF THE COMPOST QUALITY

Sample No. / Parameter		Coarse Compost S-1	S-1	S-3	Fine Compost S-4	S-5	S-6
I- Fertilizer Content							
P_2O_5	% 1.65	1.67	1.70	1.73	1.75	1.83	
K_2O	% 2.16	2.16	2.17	2.16	2.16	2.17	
CaO	g/Kg	78.4	67.2	84.0	72.8	112.0	72.8
MgO	g/Kg	100	85.6	85.6	95.2	28.75	76.1
II- Organic Composition							
Pratein	%	20.8	25.6	19.2	24.0	24.0	24.0
Fatty matter	%	2.85	3.09	2.51	3.26	3.92	4.09
Cellulose	%	13.38	17.23	5.7	11.13	14.34	14.92
III- Heavy Metals							
T-Hg	g/Kg x 10^{-6}	1.9	3.2	3.0	3.3	3.3	3.7
Cd	g/Kg x 10^{-5}	30	80	16	25	25	25
Zn	g/Kg	0.45	0.400	0.440	0.39	0.430	0.420
Cu	g/Kg	0.015	0.021	0.061	0.025	0.029	0.020
Pb	g/Kg	0.012	0.010	0.010	0.013	0.010	0.007
IV- Elution Test							
T-Hg	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Cd	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Pb	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Cr^{+6}	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
CN	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Moisture % at 110°C		11.4	11.8	17.45	14.0	11.2	9.9
Ash % at 800°C							
Volatile residue % at 550°C		45	47	49	49	47	51
T-C %		23.6	27.6	28.0	24.5	24.4	28.5
T-N %		1.3	1.6	1.2	1.5	1.5	1.5
C/N		18.2	17.25	23.3	16.3	16.2	19.0
Nitrogen Content							
NH_3-N	g/Kg	1.40	5.6	1.4	1.00	1.0	1.0
NO_2-N	g/Kg	0.002	0.0	0.006	0.001	0.003	0.0006
NO_3-N	g/Kg	0.036	0.024	0.012	0.008	0.016	0.008

S-1, S-4: 8 Sep. 1985

S-2, S-5: 11 Sep. 1985

S-3, S-6: 18 Sep. 1985

Tab. 2-6-12 RESULTS OF THE COMPOST QUALITY (1)

Parameter / Collection Date	8 Sep. '85			11 Sep. '85			18 Sep. '85		
	Fermentation Yard	Coarse Compost	Fine Compost	Fermentation Yard	Coarse Compost	Fine Compost	Fermentation Yard	Coarse Compost	Fine Compost
Temperature (°C)	56-52	68	50	56-52	64	49	56-49	36	26
pH	7.6	7.5	7.5	7.4	7.5	7.5	7.2	7.7	7.6
E.C. mhoS	4000	6500	7000	5000	5000	8500	5500	5000	8000
Grain Size (%)									
1 cm	60.0	50.0	6.7	39.5	27.7	5.2	29.0	16.9	6.3
0.25 cm	26.8	41.8	60.6	45.3	43.1	56.9	53.1	60.7	56.2
0.25 cm	13.2	8.3	32.6	15.1	29.1	37.9	17.8	22.4	37.5
Weight/unit volume (Kg/m^3)	557	452	459	534	455	463	515	444	487

ambient temp. 29°C.

2.7 Topographic Survey and Geotechnical Investigation

2.7.1 Topographic Survey

In order to design the New Abis Compost Plant and the MBSDS (Moharam Bey Square Disposal Site), topographic surveys were carried out at both sites. The following maps and drawings are prepared.

1) New Abis Compost Plant

Route and Off-set Map	;	Scale	1: 1,000	
Topographic Map	;	Scale	1: 500	
Cross-sections	;	Scale	Vertical	1: 20
			Horizontal	1:200

2) MBSDS

Route and Off-set Map	;	Scale	1: 1,000	
Topographic Map	;	Scale	1: 500	
Cross-sections	;	Scale	Vertical	1: 20
			Horizontal	1:200

2.7.1 Geotechnical Investigation

For the design of the New Abis Compost Plant, a geotechnical investigation was done in it's site and borrow pit for landfilling material. The geotechnical investigation consists of,

- exploration of subsurface conditions and preparation of a geological profile of the New Abis Compost Plant Site.

- laboratory test of soil samples at both compost plant site and borrow pit

To know the permeability of the existing bank of the Drinking Water Canal, the variable head permeability tests were carried out additionally.