

MUNICIPALITY OF POZNAN
MINISTRY OF PHYSICAL PLANNING AND CONSTRUCTION
THE REPUBLIC OF POLAND

**THE STUDY
ON
THE SOLID WASTE MANAGEMENT
FOR
POZNAN CITY
FINAL REPORT
VOLUME III: ANNEXES**

MAY 1993

**KOKUSAI KOGYO Co.Ltd.,
PACIFIC CONSULTANTS INTERNATIONAL**

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MUNICIPALITY OF POZNAN

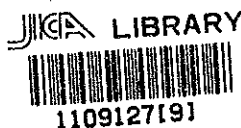
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In this report, project cost is estimated at January 1993 price and at an exchange rate of 1 US\$ = ¥ 125 = 15,700 Zl.

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PROFILE OF THE STUDY AREA

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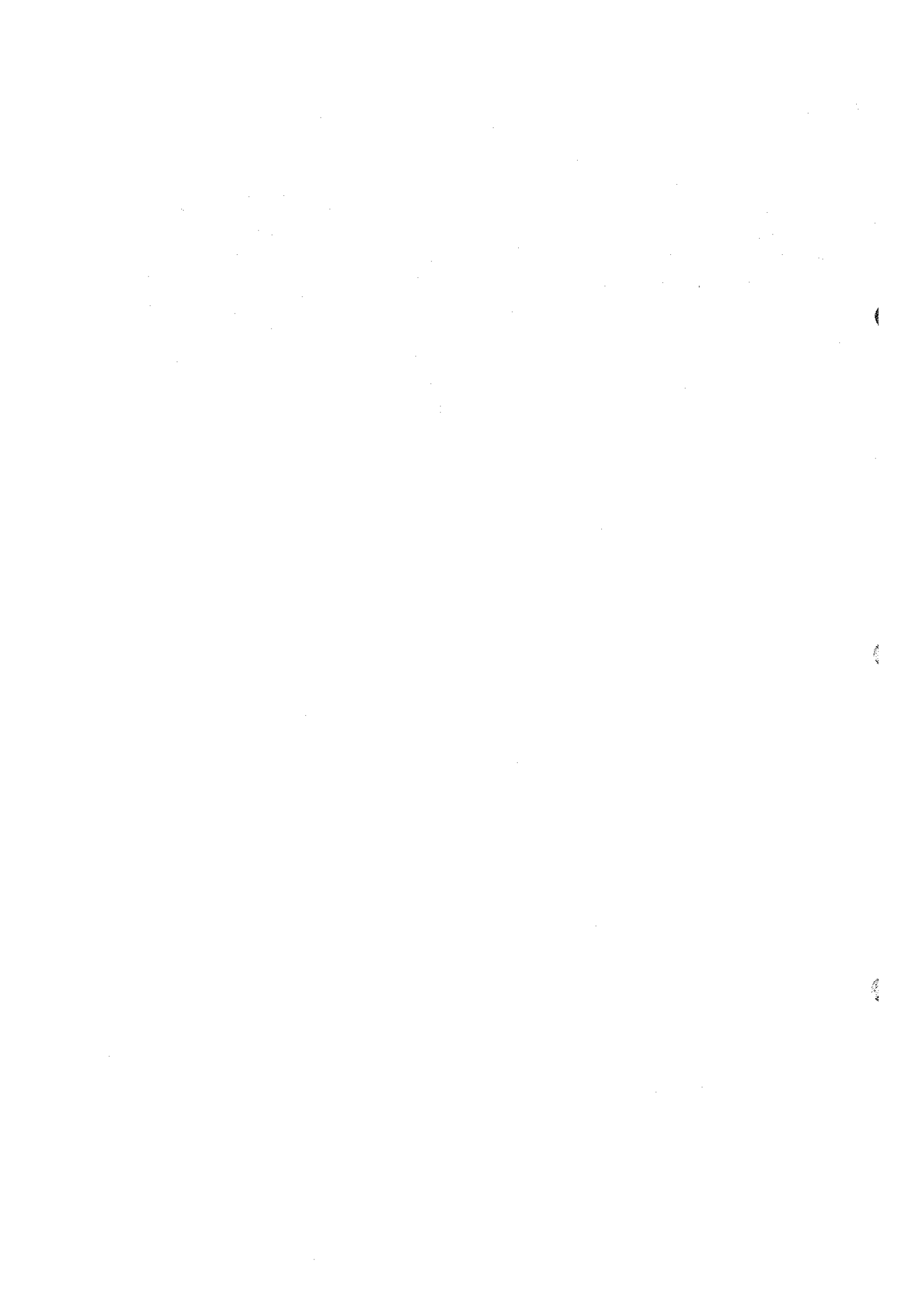
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ANNEX A PROFILE OF THE STUDY AREA

This chapter describes the present background conditions, such as natural conditions, urban structure, social conditions, population and economic conditions, related to the Study.

A.1 Natural Conditions

A.1.1 Location and Area

The Republic of Poland is located north of Central Europe, and is situated between 49° and 55° latitude and between 14° and 24° longitude. Poland is mainly a lowland country with an average altitude of 174 m above sea level and has an area of 325,500sq.km.

According to the census conducted in 1988, the population of Poland was about 38 million. 23.4 million people (61.6% of the population) live in towns and cities. The largest cities (more than 500 thousand inhabitants) are Warsaw, Poznan, Lodz, Wroclaw and Cracow.

The longest Polish rivers are Vistula (1,047 km), the Oder (854 km including 742 km in Poland), the Warta (808 km) and the Bug (772 km including 587 km in Poland).

Poznan city is located in central-western Poland. The topography of the city is generally flat and its altitude is between 54 m and 154 m above sea level.

The Warta river runs through the centre of the city. Road and railway transportation routes going to the east and west link the city to Warsaw and Berlin (distance between Poznan and Warsaw is 306 km, Poznan-Berlin-332 km). Poznan has its own air and river ports, too.

The city is the fifth largest in Poland. At the end of 1991, Poznan, with an area of 261 sq. km, was inhabited by 590,100 people, which is 2.6% of all the urban population of Poland.

Poznan can be called a "green city" because more than 20% of its total area is occupied with forests and parks.

A.1.2 Climate

Poland lies in a temperate climatic zone. Its climate borders between marine (due to the effect of the Atlantic) and continental and is characterized by largely varying weather conditions.

Table A.1.2-1 shows the temperatures and rainfall in Poznan city during the last decade.

Temperatures in Poznan city also vary according to its location. The lowest temperature, dropping to nearly -30°C , was recorded in 1987, and the highest temperature exceeded 35°C in 1983 and in 1988.

Annual rainfall in Poznan city ranges from 275 mm to 635 mm and the average annual rainfall during the last decade is around 480 mm. Although it is very cold in winter, there is very little snowfall.

Table A.1.2-2 shows the average temperatures and rainfalls during the last five years.

Average monthly temperatures in Poznan city ranges from about -7°C to 3°C , during the coolest month of January, to 17°C and 18°C , during the hottest months of July and August.

Table A.1.2-1 The annual temperature and rainfall

Year	Temperature (unit: $^{\circ}\text{C}$)			Annual rainfall (unit: mm)
	Average	Highest	lowest	
1980	7.0	29.6	-17.5	538
1981	8.2	30.6	-17.8	632
1982	8.9	32.0	-20.1	275
1983	9.4	35.7	-14.5	356
1984	8.1	34.0	-11.0	402
1985	7.2	31.4	-24.6	498
1986	7.8	32.6	-22.5	508
1987	7.0	30.2	-28.5	613
1988	8.9	35.7	-10.2	635
1989	9.7	34.9	-13.5	335
1990	9.5	34.3	-9.3	524
1991	8.3	-	-	419

(Source: Statistical Year Book of Poland if 1991, Data of Statistical Division in Poznan city)

Table A.1.2-2 The average monthly temperature and rainfall

Month year	Average monthly temperature (unit: °C)			Average monthly rainfall (unit: mm)		
	1985	1989	1990	1985	1989	1990
January	-7.4	2.2	2.6	15	8	16
February	-6.5	4.1	5.4	10	16	31
March	3.0	6.1	7.0	24	13	17
April	7.9	9.0	8.3	29	31	47
May	15.2	14.0	14.2	47	18	25
June	14.2	16.0	16.3	55	26	99
July	17.7	18.7	16.7	31	61	54
August	17.2	17.9	17.9	166	48	60
September	12.5	15.1	11.4	30	21	60
October	8.4	10.4	9.7	9	25	36
November	1.0	2.0	4.6	21	25	40
December	2.7	1.2	0.2	61	61	39

(Source: Statistical Year Book of Poland in 1991)

A.2 Urban Structure

A.2.1 Administration

Poland had been under a socialist regime since the 2nd World War until 1989 when the country embraced a democratic government. Now, it is presently undergoing a thorough transition with emphasis on democracy, privatization, free market economy, and decentralization of authority. In other words, a complete transformation of the former planned economy and centralized administration.

Since 1989, the Polish Government has done remarkable efforts to reconstruct and modernize the political and administrative systems. A transition as extensive as the Polish, however, will take several or more years as it will primarily involve the formulation of necessary legislation and administration, and secondly, the changing of ways of thinking and behaviour.

Organization

Poland is divided into 49 provinces or voivodeships (3 cities, Warsaw, Cracow and Lodz, with provincial status are included) and more than 2,100 municipalities

consisting of Urząd Miejski (bigger municipalities for towns and cities) and Gmina (small municipalities in rural areas).

Political System

As a democratic country, the Polish political system is governed by a President and a two-chamber National Assembly. The Senate is the upper chamber with 100 senators and the "Sejm" is the lower chamber with 460 deputies. The President, Senators and deputies are elected by public voting, and the Government headed by the Prime Minister is the executive organ of the State accounting to the "Sejm".

Two senators represent one Province (Voivodeship), except for Warsaw and Katowice which each have three senators. The Senate does not legislate laws, but has the power to vote or propose changes to bills drafted by the "Sejm". However, the Sejm may overrule a vote from the Senate with a two-third's majority. At a local level the municipalities are headed by publicly elected Councils.

The provincial level does not have a directly elected body. However, a Provincial or Voivodeship Assembly composed of delegates from municipalities is designated advisory and monitoring roles.

Administration

Administrative governments are organized at national, provincial and local levels.

The national Government is headed by the Prime Minister and has 16 ministries.

The Provincial Governments (Voivodeships) are executing bodies from the central government. The Provincial Governments headed by the "Voivode", have the right to suspend decisions taken by the municipalities.

The local governments (here referred to as municipalities) are headed by a mayor called "Vojt" in small municipalities ("Gmina"), "Burmistrz" in medium-sized municipalities (towns) and "Prezydent" in major cities (like Poznan).

The Local Government Law passed in 1990 defines the municipal council as the only directly elected unit of local government and designates more power than before. The municipal councils are free to decide on all matters affecting their locality as long as it is within the law. The council's executive body is the Board comprising the Mayor, his deputy and a maximum of 5 other members elected by the Council.

The Local Government Law allows municipalities on a voluntary basis to join associations in order to perform certain functions jointly.

Poznan Municipality

Poznan Municipality consists of 5 districts. The City Council with 65 seats represents the whole municipality and the 5 districts have administrative and executing roles in some of the municipal activities.

The City Council is the legislative body of Poznan Municipality, and from it twelve commissions are appointed, eg. the Ecological Commission and the Areal Management Commission, to take charge of various aspects.

The executive body, the Board, comprises of the Mayor, the three Vice-Mayors and two Board Members. All are elected by the Council, but are not necessarily elected members of the Council.

In February 1992, the new organization structure of Poznan Municipality was proposed. It includes the determination of tasks and responsibilities related to each administrative body. According to the municipality the proposed organization will be implemented and the proposal is subject to the following presentation.

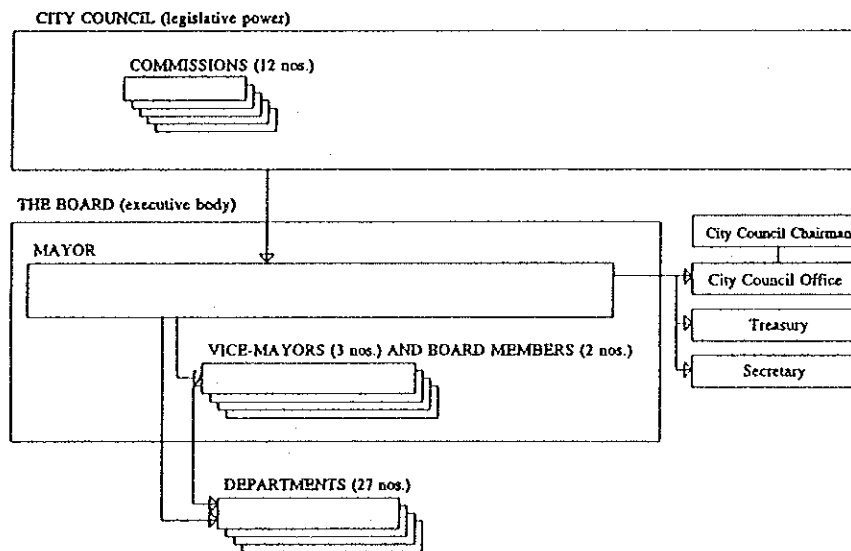


Fig.A.2.1-1 Organization of Poznan Municipality (proposal of February 1992)

The administration includes 27 departments headed by a member of the Board.

At a local level, the City is organized in settlements (Osiedle) represented by a Council of Settlement working on a voluntary basis and designated no powers and duties. The Council of Settlement acts as advisers to the City administration.

A.2.2 Land Use

Total area of Poznan City is 26,100 ha and its total population was 590,100 at the end of 1991, as shown in Table A.2.2-1.

Table A.2.2-1 Land Use Condition of Poznan

Category	Area (ha)	Share (%)
Developed area		
Residential area	5,640	21.6
Commercial area	840	3.2
Industrial area	1,620	6.2
Transportation area	1,150	4.4
Public facilities	70	0.3
Public green area	2,380	9.1
Agricultural Facility Area	520	2.0
Others	380	1.5
Sub-total	12,600	48.3
Non-developed area		
Forest	3,300	12.7
Water area	600	2.3
Meadow	2,100	8.0
Cultivated land	7,500	28.7
Sub-total	13,500	51.7
Total area	26,100	100 %

A.2.3 Infrastructure

1) Transport

The city is located in central-western Poland along the river Warta. Road and rail transportation routes linking Paris and Berlin with Warsaw and Moscow, through the Baltic and Scandinavian countries with the Balkans, are established here. Poznan has its own air and river ports, too, and tramways and buses in towns are provided for public transportation. Generally, the transportation system has been well developed, but due to modernization, traffic conditions are worsening.

Basic information on transport in Poznan is described as follows:

- Length of tramway route : 57.34 km
- Length of bus route : 251.7 km
- Road lengths
 - . State road : 49 km
 - . Provincial road : 221.9 km
 - . Municipal road : 707.1 km
- Length of paved road : 703 km
- Length of unpaved road : 275 km
- Number of bridges : 11 places
- Number of railway flyover : 32 places
- Bridge for pedestrian : 10 places
- Underground, passages and tunnels : 25 places

2) Water Supply and Sewage System

The government-owned Water Supply and Sewage Enterprise in Poznan City covers the following towns: Poznan, Lubon, Mosina, Puszczykowo, Swarzedz, Czerwonak, Murowana Goslina.

6 water treatment plans and water supply network with a total length of 1,073 km cover almost all population.

3 sewage treatment plans and network with a total length of 1,169 km cover approximately 80% of the population and all effluent are discharged into the Warta River without biochemical treatment.

Outline of the water supply and sewage system in Poznan is described as follows.

-- Capacity of water facilities

Table A.2.3-1 List of Water Facilities

No.	Location	Unit	Water intake	Water treatment plant	The whole water supply system
1.	Poznan-Debina ul. Wisniowa	m ³ /24h	85,000	149,600	85,000
2.	Mosina, Radzewice, Krajkowo	m ³ /24h	140,000	150,000	140,000
3.	Gruszczyn	m ³ /24h	9,600	12,000	9,600
4.	Garby-Zalasewo	m ³ /24h	600	600	600
5.	Swarzedz	m ³ /24h	4,800	3,200	3,200
6.	Murowana Goslina	m ³ /24h	2,600	2,400	2,400
	Total:	m ³ /24h	242,600	317,800	240,800

- Intermediate pumping station of clear water : 1 unit
Koronna St. capacity - 43,200 m³/24h
- Water reservoirs
 - . ul. Grobla of capacity : 5,000 m³
 - . Debiec of capacity : 18,000 m³
 - . Gruszczyn of capacity : 5,000 m³
- Emergency deep wells
 - . number : 30/204 pcs
 - . capacity : 118/4,600 m³/24h
- Length of water supply network with connections
 - . Poznan city : 1,073.1 km
- Sewage treatment plants
 - . 3 plants
 - . Total capacity : 159,128 m³/24h
- Intermediate sewage pumping station capacities
 - Poznan : 104,918 m³/24h
 - Swarzedz : 3,057 m³/24h
 - Murowana Goslina : 5,000 m³/24h
- Length of sewage network with connections in
Poznan city : 1,168.7 km
- Length of total sewage network
in Poznan city : 1,224.2 km
- Total amount of sewage collected : 61,018,000 m³
including: Poznan city : 58,769,000 m³
- Total amount of sewage treated : 38,186,000 m³
- Total water supply network length
in Poznan city : 1,073.5 km

A.2.4 Urban Development Master Plan of Poznan City

Although an Urban Development Master Plan has been formulated, it is considered invalid due to the change in government. At present, the formulation of a new Urban Development Master Plan is being carried out by the Poznan Municipality. The phase I study formulating the main scheme of urban development plan, is supposed to be completed at the end of 1992. As for the phase II study, the strategies will be proposed.

According to the Urban Development Master Plan study team, only Franowo-Michalowo area is to be proposed as a solid waste treatment site.

A.3 Social Conditions

A.3.1 Customs and Religion

More than 98% of the Poles are of ethnic origin and the overwhelming majority is Roman Catholic. Religion plays a notable role for all Polish generations. However, the role of religion will not hinder the modernization of society as in Western-European countries and the United States.

The many years under a socialist system have cultivated in the people dislike in the centralized authority and democracy to them generally means decentralization of authority, establishing minimum central authority as possible.

A.3.2 Public Health

The public health system offers free medical care to the citizens. Financial contributions are conducted on a voluntary basis and is widespread due to lack of financial sources. Private hospitals and clinics are operating and the future development of the private health system will be determined by the financial capability of the citizens and the level of service offered by the public system.

Public Health and Environment

It must be assumed that the years without anti-environmental pollution measures have significantly affected the health situation in Poland.

Poland faces a tremendous environmental challenge requiring considerable technical and financial efforts for the years ahead to protect human health. In addition to gaining control over the continuing pollution of the environment, substantial actions must be taken to clean contaminated sites.

The Ministry of Environmental Protection, Natural Resources and Forestry states that the lack of research on the effects of environmental pollution on human health was viewed by the former authorities as convenient enabling one to believe that environmental health hazards did not exist /NK-1/. The threat was not realized and industrial production was developed without considering the impact on human health and the environment.

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The effect of pollution human health in Poland can be illustrated by the following statistics /NK-1/:

- Life expectancy in Poland is 67 and 75 years for men and women respectively. For developed countries the life expectancy is 72 and 77 years. In regions in Poland with heavy pollution, the life expectancy is at least one year shorter.
- In the period 1970-1989 the life expectancy has developed as follows:

For men:

- . In Poland; stable at 67 years with a declining trend.
- . In Europe; rose from 68 to 71.5 years.
- . In Switzerland; rose from 72 to 74 years.

For women:

- . In Poland; between 73 to 74 years with a declining trend.
- . In Europe; rose from 74 to 77 years.
- . In Switzerland; rose from 77 to 79 years.

Children have always been the most sensitive health indicator of the population. Mutagenic and carcinogenic substances are responsible for development of defects like neurological diseases, abnormalities of the eye and dementia. Infant mortality is 16.1 for Poland against 5.8 in Sweden and 7.7 in France. The percentage of premature babies and babies with low initial weight is also significantly higher in Poland and more cases of spontaneous abortions are noted.

Plausibly, the impact caused by pollution will increase in the future when children of today give birth to the next generation. In addition to their inherited burdens, the coming generation will also live in an environment with a high level of pollution.

Generally, the biggest impact on human health is registered in areas with severe air pollution. In Silesia, in the southern part of Poland, the health situation is a subject needing serious consideration due to heavy air pollution.

The main sources of air pollution are the power generation system, heat production and motor vehicles. Transboundary air pollution also affects Poland. The correlation between exports and imports of main pollutants is extremely negative for Poland; the figures are 1:11 compared with Germany and 1:2 with Czechoslovakia for sulphur dioxide.

Contaminated sites including old dumping sites for municipal and industrial wastes also contribute significantly to poor human health conditions.

The Ministry of Environmental Protection, Natural Resources and Forestry has made a national assessment of measurable and accountable losses caused by environmental pollution. The annual environmental losses suffered by the national economy amount to about 10% of the national income. The distribution of the losses is assessed as:

- Losses due to air pollution : 46 %
- Losses due to surface degradation : 39 %
- Losses due to water pollution : 15 %

Losses involving human health covers 7% of all losses. However, this only applies to moneterial losses arising from increased costs of medical treatment, temporary

unfitness for work and resulting production losses /NK1/. The total losses involving human health must be deemed considerably higher, including social and human aspects not assessed.

A.3.3 Living Conditions

The planned economy performed during the socialist period insured uniformed living conditions in Poland.

After 1989, the Government tightened fiscal and monetary policies which should transform the Polish economy into market economy within the shortest time possible. Part of the policies, which was to remove subsidizes, affected the living conditions for the Poles as wages could not keep the speed of the inflation. Wage inflation in 1989 caused a significant increase in nominal average earnings. During 1990 and 1991, however, wages decreased by approx. 30% in real terms due to the inflation.

A growth in the national income, which should relieve the consequences of the policy have not yet appeared and thus the incentive for the tight fiscal and monetary policies is missing, leading to a decline in the living conditions and disappointment.

Monthly salaries in public sector added to some 2 million Zl. in November 1991. Social security charges and payroll taxes totalling 65% of the basic salary are additional labour costs for the employer. In December 1991 the minimum wage was a net 900,000 Zl. per month.

A.3.4 Employment

There are 17 million people employed in Poland, 12 million work for the public sector and in the co-operative sector including 4.8 million employed in industry.

Of the 5 million employed in the private sector, 3.7 million are involved in agriculture and the remainder in manufacturing, handicrafts, services and trade.

For many years Poland suffered from a shortage of labour. However, since the collapse of the socialist regime, the unemployment rate has generally been high.

A.4.2 Population Forecast

The Poznan City Master Plan assumed the range of the population forecast to be 610,000 to 620,000 in 2010 for unforeseen changes. Therefore the population forecast of 620,000 in 2010 is adopted for the SWM master plan.

The annual growth rate of population is, therefore, assumed to be 2.66 %.

The postmigration demographic forecast for Poznan City was prepared taking into account internal and foreign migration, it was formed based on registering-in and out following a change in permanent residential address. Quantities and structures consider the population registered in Poznan for permanent stay.

The basis for this forecast utilize the estimates of quantities and structures according to sex and five year age brackets (on 31 December, 1990) prepared by the Main Agency for Statistics. The basic data included also accommodate birth, death and migration rates calculated according to five year age brackets for 1988 - 1990.

For the postmigration demographic alternative an assumption was made regarding the stability of partial birth, death and migration rates in 1990 - 2010. The forecast was made with the using the Rogers - Willekens' models. The postmigration forecast according to its alternative indicates the study character.

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The annual growth rate of population is, therefore, assumed to be 2.66 %.

The population forecast and the population forecast by age are shown in Table A.4.2-1 and -2.

Table A.4.2-1 Population Forecast

Year	1992	1995	2000	2005	2010
Population	590,100	595,083	603,388	611,693	620,000

Table A.4.2-2 Population Forecast by Age

Age	1992		2010	
	Population	Share(%)	Population	Share(%)
0 - 2	19,800	3.4	18,600	3.0
3 - 6	33,100	5.6	27,280	4.4
7 - 14	72,700	12.3	55,800	9.0
15 - 18	34,700	5.9	33,480	5.4
19 - 24	52,300	8.9	55,180	8.9
25 - 59/64	294,100	49.8	329,840	53.2
over 60/65	83,400	14.1	99,820	16.1
Total	590,100	100.0	620,000	100.0

Note: men/women

A.5 Economic Conditions

A.5.1 National Economy

The restructuring of the Polish economy is presently in full swing. Therefore, it is difficult to predict the figures for the near future. Although the hyper-inflation seems to be under control, the rate of inflation is still high. The annual inflation rate for 1991 was 70.3%, which exceeded the forecasted rate of 36%. The major reason is that the imports from republics of the former USSR began to be denominated in hard currency. The inflation rate for 1992 is estimated at a range of 40%. The income level (GDP per capita) seems to be lower than the standard of living of the Polish people, however, the data from WEIS ARC report states a higher figure.

Regional development in Poland had been implemented by introducing large-scale industrial investment until the end of 1970s. Poznan city is one of largest industrial cities in Poland.

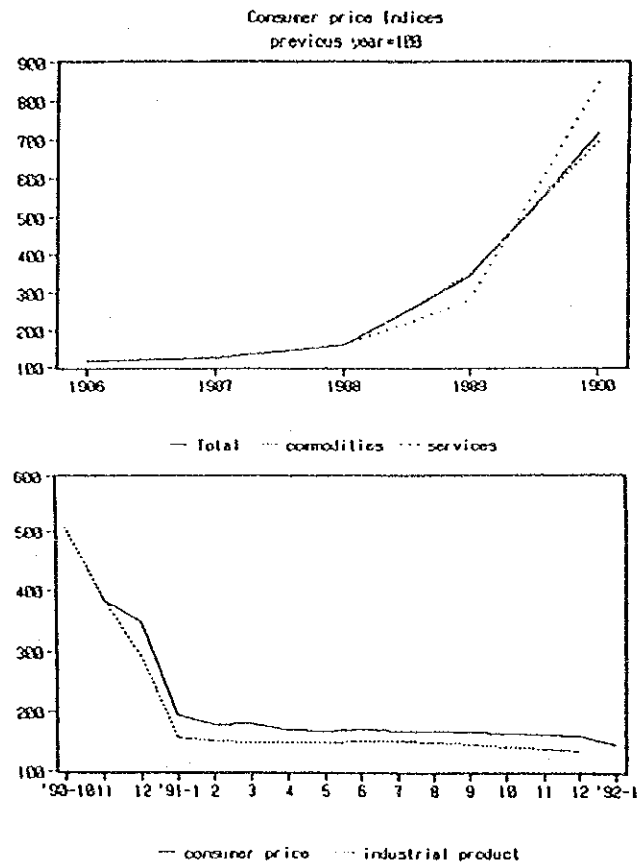


Fig.A.5.1-1 Price Indices

Since World War II Poland has become an industrialised country, though agriculture remains relatively important in employment terms. After rapid expansion of industry during the 1970s, Poland entered the 1980s with declining levels of output. By 1982, domestic output amounted to only three quarters of its 1978 peak level. Although economic decentralization was partially introduced from January 1, 1982 and self-management organs were set up in 1983, the reform failed because of the unexperienced self-management under centralized materials distribution system and the foreign debt burden. These situation needed the "second stage" of economic reform.

A highly comprehensive reform program, the Economic Transformation Program (ETP) was prepared with the support of IMF and the World Bank.

The ETP pursues three broad objectives:

- stabilization
- structure reform
- progressive restoration of credit worthiness

Stabilization was the most urgent policy to overcome the hyper-inflation. The policy consists of three major pillars:

- reducing demand pressure and strengthening financial discipline
- implementing a monetary policy
- using the exchanging rate and wages to break the momentum of inflation

Polish GDP for 1990 was 506,253 billion zł, with 273,900 billion zł(54%) from the industrial sector, 38,246 billion zł(8%) from the agriculture sector and 90,452 billion zł(18%) from the trade sector.

Table A.5.1-1 Trend of GDP (bill.zł, %)

	1970	1980	1985	1989	1990
GDP			8,658	104,752	506,253
current price			7,030	7,869	6,695
constant price in 1984			162.6	181.9	154.8
1970 = 100	100	169.1			
Industry	54.6	52.1	48.6	47.9	42.6
Construction	9.8	10.1	12.0	12.0	12.1
Agriculture	17.3	15.8	14.4	12.8	15.0
Forestry			1.4	1.3	1.2
Transport	6.7	7.2	4.3	4.4	4.2
Communication			0.9	1.1	1.3
Trade	9.9	12.8	16.5	18.4	21.7
Other productivity activities	1.7	2.0	0.8	1.0	1.0
Public enterprises			1.1	1.1	1.1
	100.0	100.0	100.0	100.0	100.0

Note: share is calculated in constant price base.

With its output continuing to increase compared to that of public sector, the private sector is playing more of a promotive role in the Polish economy. And the 1992 privatization's timetable predicts that the better half of Poland's GDP will be produced by the private sector by the end of 1994.

Poland was the first Eastern European country to introduce a flexible currency to facilitate foreign trade. No limits are currently imposed on the acquisition of hard currency to fund imported goods and services. The zloty was devalued in May 1991 by increasing the amount exchanged for the US dollar from 9,500 to 11,300.

The changes in trade are shown in Table of A.5.1-2.

Table A.5.1-2 Changes in Trade

	1985	1986	1987	1988	1989	1990
All countries (billion zl)						
Import	1,595	1,964	2,876	5,272	14,864	90,513
Export	1,691	2,116	3,237	6,012	19,476	136,055
Surplus	96	152	361	739	4,612	45,543
I areas (Ruble mn)						
Import	10,044	10,830	10,950	10,819	10,106	6,640
Export	9,329	10,329	10,950	11,938	12,217	11,014
Surplus	-715	-501	15	1,119	2,111	4,374
II areas (US \$ mn)						
Import	5,077	5,437	5,844	7,302	7,766	8,254
Export	6,135	6,510	7,079	8,311	8,533	12,020
Surplus	1,060	1,073	1,235	1,009	767	3,766

Sources; Rocznik Statystyczny 1991

In 1990 the export increased both for Area I (former USSR and COMECON countries) and Area II (other countries). The balance of trade has increased because the export of industrial goods rose, though its import decreased.

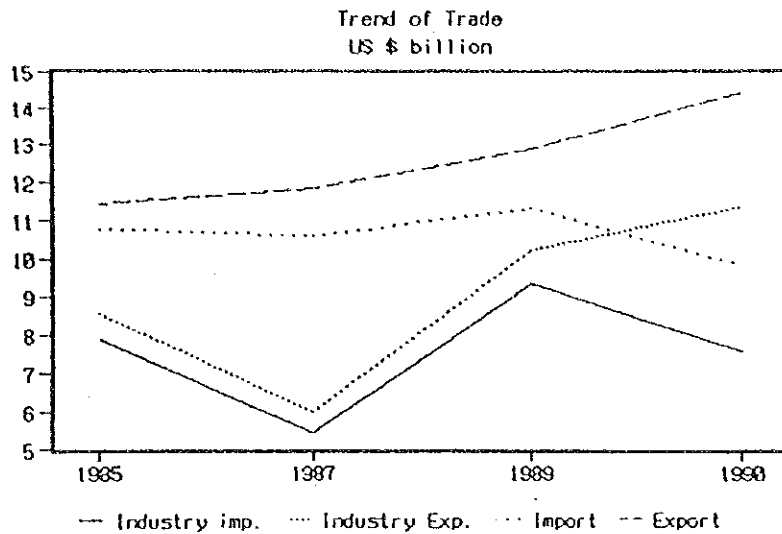


Fig.A.5.1-2 Trend of Trade

Central Planning Office(CUP) identified the following development as "positive tendencies" in the first quarter of 1992:

- industries stirring from recession (which reports claim 17% increase in March from February)
- growing export profits (17% above the 1st quarter 1992 figures) along with 5% reduction in imports, producing 385 million US \$ trade surplus in the 1st quarter 1992.
- reduced inflation (prices increased 11.6% in the first 3 months, approx. 6 % below the anticipated figure)
- smaller budget deficit than anticipated in the Government's draft Budget bill (10,400 billion zl compared with the anticipated 18,600 billion zl)
- Banks' growing foreign exchange reserve (by 3.9%)
- smaller unemployment figures

It is difficult to evaluate the stability policy mentioned above although the hyper-inflation seems to have been controlled and the balance of trade improved, but the financial situation becomes worse than that in 1990.

But the potential of Polish economy with both technical and historical backgrounds will overcome the constraints and it will pave a way of developments Eastern Europe and in that sense Poland should become an affluent society.

A.5.2 Regional Economy

Regional development in Poland had been implemented by introducing large-scale industrial investment until the end of 1970s. Poznan city is one of large industrial cities with leading Polish manufacturing, and there are many obstacles to overcome such as industrial waste in order to create a comfortable city. On the other hand, this city is located in centra-western Poland, where road and rail transportation routes linking Paris and Berlin with Warsaw and Moscow and, the Baltic and Scandinavian countries linking with Balkans. These spatial characteristics shows the potentiality of this area aiming to a border-less economy.

Poznan province, which comprises an area of 38,200 sq km, is an industrial/agricultural region with a well-developed network of transportation services. There are no data on GDRP(gross regional domestic product) in Poland, therefore, the industrial characteristics are pointed out by the figures of investment and production of major industries.

Table A.5.2-1 Regional Economy in 1985, 1990

	Current Price			Constant Price		
	1985 M.ZI	1990		1985 M.ZI	1990	
		M.ZI	%		M.ZI	difference
Investment						
Total	76.6	4461.7	3.9	46.8	71.1	51.9
Industry	17.8	1269.5	3.1	11.4	19.5	71.8
Construction	2.1	73.2	4.2	1.4	1.2	-14.4
Agriculture	13.3	621.8	4.7	8.3	9.1	9.6
Forestry	0.3	14.5	3.3	0.2	0.3	37.6
Transport	6.4	128.1	2.0	4.3	2.2	-49.1
Communication		98.5	5.4		1.9	
Trade	2.2	278.4	6.7	1.5	4.9	229.3
Other productive activity	0.2	48.0		0.1	0.8	455.6
Public enterprises	7.0	312.6	4.8	4.5	5.2	15.0
Community activity	21.6	1161.5	3.9	13.5	17.8	32.3
Science & technic	0.5	31.1	7.9	0.3	0.6	101.3
Education	2.3	199.7	6.1	1.5	3.7	153.3
Culture & art	0.4	16.7	5.7	0.2	0.3	26.6
Sports	1.4	110.6	4.2	0.9	1.9	114.4
Tourist	0.6	31.1	2.8	0.4	0.5	36.6
Others	0.5	66.4	1.7	0.3	1.2	250.9
Production						
Industry	452.9	23742.0	4.1			
Construction	84.7	3081.1	7.4			
Agriculture	57.6	1835.5	4.9			
Trade	200.5	11346.0	4.3			

Notes: Industry includes mining

Sources: "Rocznik Statystyczny Wojewodztwa Poznanskiego"
1991,1986

4% of the economic growth of the country is attributed to Poznan province although it holds only 3.5% of the country's population and 2.6% of the country's area.

The changes of the investment according to industries are shown in Table A.5.2-2 and A.5.2-3. The increment of trade is most impressive, which is about 120 times in Province in 5 years, form 1986 to 1991, and more than 145 times in the city in the same 5 years.

Table A.5.2-2 Investment in Poznan Province

(Bill.zl)

	1985	1986	1987	1988	1989	1990	1991	1991/ 1986
Total	76,560	99,327	139,298	248,018	738,472	4,461,736	6,334,833	63.8
Manufacturing	17,519	24,653	36,112	73,443	229,058	1,269,451	2,057,338	83.5
Construction	2,133	3,259	5,222	9,395	19,538	73,219	90,851	27.9
Agriculture	13,310	16,992	21,698	37,443	108,547	621,848	470,605	27.7
Transport	5,225	6,224	11,181	12,645	24,247	128,136	200,083	32.1
Trade	2,540	3,737	4,961	10,035	39,837	278,356	445,647	119.3
Public enterprises	6,967	8,374	11,721	23,200	70,024	312,563	411,534	49.1
Community activities	21,550	25,684	33,128	54,504	163,914	1,161,452	1,641,894	63.9
Others	7,316	10,004	15,25	27,353	83,307	616,711	1,016,881	101.6

Table A.5.2-3 Investment in Poznan City

(Bill.zl)

	1985	1986	1987	1988	1989	1990	1991	1991/ 1986
Total	29,290	40,808	58,290	103,500	281,797	1,662,823	2,626,073	64.4
Manufacturing	8,649	12,957	20,635	40,209	106,609	617,561	829,199	64.0
Construction	1,801	2,636	4,334	7,944	14,874	41,244	53,430	20.3
Agriculture	731	476	648	1,425	5,032	8,405	3,702	7.8
Transport	1,470	3,512	5,405	6,322	6,411	44,587	92,400	26.3
Communication	967	1,351	1,851	3,205	11,982	65,235	61,295	45.4
Trade	1,311	1,772	2,692	5,720	21,104	165,809	257,923	145.6
Public enterprises	3,289	3,334	4,422	8,581	29,565	111,902	216,200	64.8
Community activities	7,087	9,112	10,181	15,408	42,506	304,447	525,413	57.7
Others	3,985	5,658	8,122	14,686	43,714	303,632	586,511	103.7

The city of Poznan is the centre of the Poznan region. The comparison of major socio-economic factors between Poznan City and Poznan Province is shown in Table A.5.2-4.

Table A.5.2-4 Comparison of Poznan City and Province

	City	%	Province
Area (sq.km)	261	(3.2)	8,151
Population (1.000)	590.1	(44.2)	1,334.1
Investment (bill zl)	1,662.8	(37.3)	4,461.1
- Industry	617.6	(48.6)	1,269.5
- Construction	41.2	(56.3)	73.2
- Agriculture	8.4	(1.4)	128.1
- Forestry	5.7	(39.3)	14.5
- Transport	44.6	(34.8)	128.1
- Communication	65.2	(66.2)	98.5
- Trade	165.8	(59.6)	278.4
- Other productivity activities	16.4	(34.2)	48.0
- Public management	111.9	(35.8)	312.6
- Communities activities	304.4	(26.2)	1,161.5
Production			
- Industry (Zl bn)	2,842	(54.1)	23,742
- Agriculture (ha)	8.9	(1.6)	544.9

According to the data of 24 March in 1992, there are 17,476 enterprises in Poznan city shown in Table A.5.2-5.

Table A.5.2-5 Number of enterprises leistered

	Total	State	Municipal	Foreign	Private
Total	17,476	806	278	170	16,222
Industry	3,429	113	68	79	3,169
Construction	1,403	64	37	4	1,298
Agriculture	116	29	2	0	85
Forestry	12	4	0	0	0
Transport	431	46	4	3	378
Communication	14	10	0	0	4
Trade	8,380	48	56	45	8,231
Public management	713	11	2	0	700
Others	2,978	481	109	39	2,357

Within 17,476 enterprises, private enterprises count to 16,222 (93%) and foreign enterprises are 170. These show the potentiality to develop this region as a worldwide trade center in jointing foreign enterprises and introducing new technology.

A.5.3 Income Level

The changes in income level based on GDP per capita are shown in Table A.5.3-1.

Table A.5.3-1 Changes of Income level

	1985	1986	1987	1988	1989	1990
GDP (trillion zł)	8.7	10.7	14.0	25.0	105.0	506.3
Changing rate (Zł/US \$)	147.2	175.2	265.2	430.6	1446	9500
Population (million)	37.3	37.6	37.8	37.9	38.0	38.2
GDP per capita (US \$)	1,577	1,624	1,398	1,531	1,910	1,395
(reference) GNP per capita* (US \$)	6,470		6,883	7,270	4,560	

Sources: Rocznik Statystyczny 1991

* mark WEIS ARC report(CIA,Economic Statistics 1990)

The income level (GDP per capita) seems to be lower than the standard of living of the Polish people, however, the data from WEIS ARC report states a higher figure.

The standard of living is supposed to be declining due to hyper-inflation. The statistics on income show that the average wage of employees increased 50 times in 5 years, from 1985 to 1990, although the indices of consumer price increased more than 60 times.

Although it is assumed that the effect of inflation altered the life of the people, the statistical data show that it only affected the households of retired persons and pensioners. The revenue of employees' household increased having to cope with the increase in expenditure (refer Fig.A.5.3-2). Shares of fuel, electric and thermal power in expenditure rose, though that of food decreased. The main reason for this change seems that energy subsidies had been cut step by step.

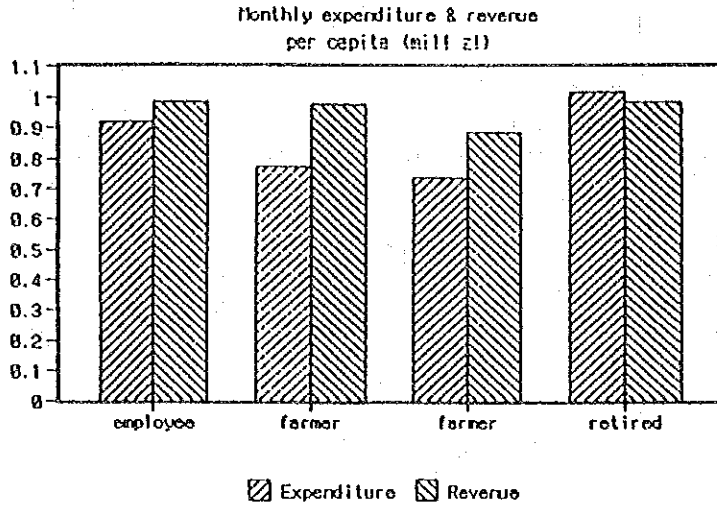


Fig.A.5.3-1 Monthly Expenditure and Revenue

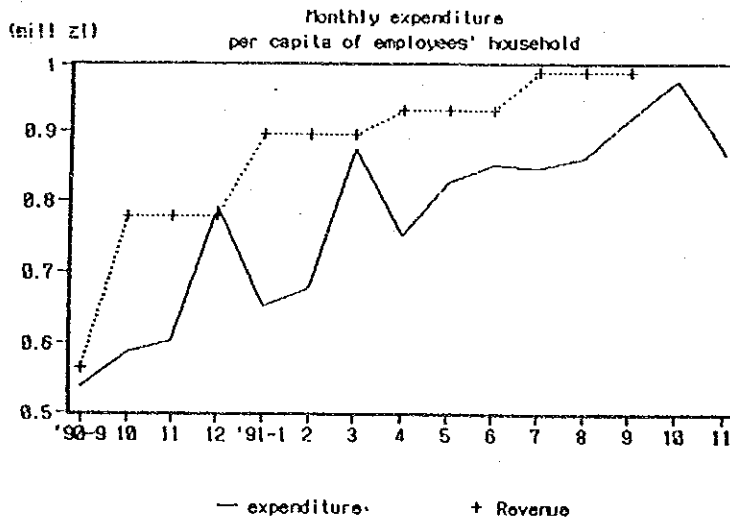


Fig.A.5.3-2 Changes of Monthly Expenditure

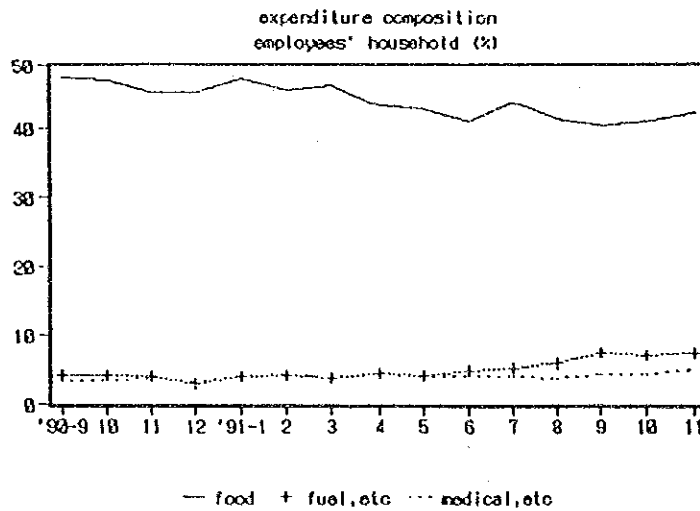


Fig.A.5.3-3 Changes of Expenditure Composition

Compared to the national level, the income level of Poznan city is much higher. The surveys on Poznan were conducted on employees, retirees and pensioners showed higher income levels than the national survey results.

Table A.5.3-2 Comparison of revenue

Household	National			Poznan	
	1985(A)	1990(B)	(B/A)	1990(C)	(C/B)
Employees	11.4 (10.3)	563.0 (488.7)	49.4 (47.4)	632.2 (496.9)	1.12 (1.02)
Employees-farmers	11.4 (9.1)	596.3 (454.6)	52.3 (50.0)		
Farmers	12.0 (10.2)	577.3 (509.3)	48.1 (49.9)		
Retired person and pensioners	9.3 (9.8)	493.8 (486.0)	53.1 (49.6)	570.7 (486.0)	1.16 (1.01)

Note: upper is revenue 1,000 Zl/month per capita
down is expenditure

The composition of expenditure in accordance with income class are shown in Fig.A.5.3-4.

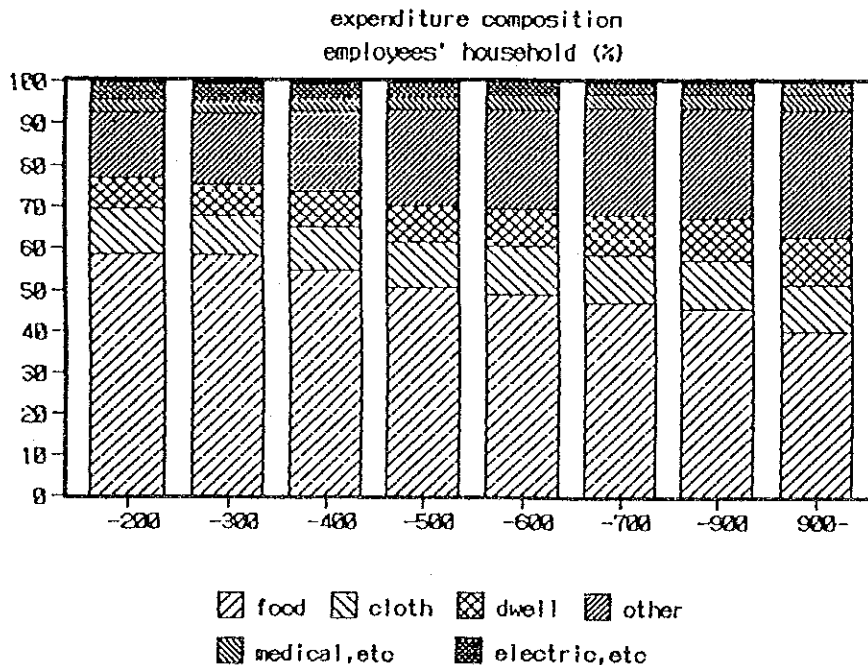


Fig.A.5.3-4 Expenditure Composition and Income Class

Food shares decreased as the income level increased. The other shares, which include the expenditure for culture, education, sports, tourism and recreation, has increased as income level increased. It is typical that the expenditure for fuel, electric and thermal power have high shares in the lower income class.

A.5.4 Industries

1) Manufacturing industries

The manufacturing industry of Poznan employs 158,600 people, 27% of the province working populace. The remaining 52% are government employees. At present the industry is beset with difficult problems, such as lack of funds for the reconstruction of plants or facilities to introduce modern production methods and standard of efficiency, and absence of effective measures against negative environmental impacts.

Although the production of private companies was only 7,185 billion (30%) in 1990, privatization was implemented. This new trend has revealed the willingness of many production companies to join or merge with foreign firms.

Sales production in 1990 in Poznan Province was dominated by the food industry, followed by the electrical appliance and machineries manufacturing industry which holds the largest number of employees.

Table A.5.4-1 Production and employment

Industry	Sales of Production		Employment
	Amount (bill.Zl)	%	%
Fuel and power	1,305.3	7.3	3.9
Metallurgical	182.9	1.0	0.2
Electrical machinery	5,286.8	29.5	43.7
Chemical	1,679.2	9.4	6.9
Mineral	252.8	1.4	2.6
Wood& paper	936.3	5.2	7.8
Consumer goods	625.9	3.5	10.9
Food	7,199.3	40.1	18.6
Other	482.4	2.7	5.4
Total	17,950.7	100.0	100.0

Sources; Rocznik Statystyczny Wojewodztwa Poznanskiego, 1991

New legal regulations, concerning the investment of foreign capital in Poland combined with the positive attitudes of local authorities towards various forms of

cooperation with foreign investors as well as efficient handling of all the necessary formalities, has placed the Poznan Province second in the country with a number of foreign farms with foreign capital. In the network of foreign enterprises, chemical, clothing, food and textile industries predominate. Among joint venture companies, food and crop processing, clothing and building materials industries are numerous. In joint venture companies, German investors have the largest share, that is 54% of the total.

2) Agriculture

The agricultural industry (livestock and crop production) in Poznan Province has a high standard and productivity despite of poor soil quality. This makes the province one of the leading regions in agricultural output.

There area has 544.9 thousand hectares of agricultural land and 44% and 56% are owned by the public and private sector, respectively. 474.3 thousand hectares are cultivated and seeded, and 41% is occupied by the private sector.

The compositions of crops on seeded land is as follows:

	%
- grain	: 47.0
- potatoes	: 8.5
- industrial material	: 12.4
including sugar beets	: 5.5
- others	: 32.1

3) Trade

In 1990, there were 10,126 shops, of which 3,169 were under public ownership including cooperative associations and 6,857 were private shops. The number of shops doubled since 1985. The sales of consumption goods reach 6,048 billion zł, i.e 4.5 million zł per capita per year.

The number of retail shops in Poznan city is 5,410, and total floor space is 335,700 sq. m, i.e 568 sq. m per 1,000 inhabitants and many more shops opened this year.

4) Energy

There are two plants supplying electricity and heat. There is a network for transferring of electricity in Poland. The electric demand decreased because of privatization of state enterprises, that reflects on the figures of imported of electricity(refer Fig.A.5.4-1). It also is said that there is a reduction of 6,000 MW in

the power produced although 25,000 MW is needed in Poland. Therefore the enterprises faces great losses.

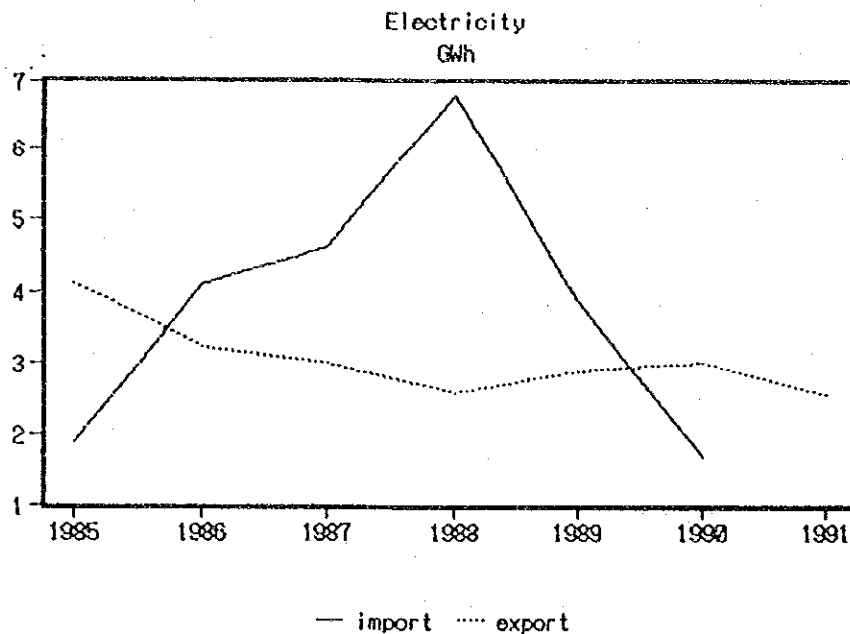


Fig.A.5.4-1 Changes of Import of Electric Power

The demand for heat supply, alters according to the temperature in winter. Consumers are having to pay more as the policy cutting the energy subsidies was enforced by the state. Therefore, there is little choice for the users as heat energy is sold to a local distribution municipal enterprises (PEC).

5) Tourist

There are 19 hotels with 2,373 rooms and 4,195 beds in Poznan city. The number of overnight stays in 1991 reach 490,100.

The Poznan International Fair affects the economy of the city. Every year, about 20 different international trade events take place. The most famous is the Fair in June. In 1991, it attracted 4,151 exhibitors from 38 countries and over 200,000 visitors.

6) Services and others

Poznan has become the second largest centre of banking and businesses in Poland. There are nearly 30 banks and 11 insurance agencies in the city. Poznan also boasts the largest number of joint venture companies.

A.5.5 Local Finance

For administrative purposes, Poland is divided into 49 voivodships and 2,121 communes. The voivodship comprises 46 provinces and 3 cities with provincial statuses (Warsaw, Krakow and Lodz) and they provide basic government services. The provincial authorities (voivodship) plan, supervise, co-ordinate and assist them in carrying out their tasks.

New local councils changed fiscal regulations in 1990, and introduced a new local financial system since January 1st, 1991. The validity of the Act was limited within 1991 only, because further reforms of Polish economic system was planned, especially the introduction personal income tax. According to this "tentative" Act, local revenues consist of:

- local taxes, fees and charges
- government grants (general and specific for delegated powers)
- earnings from Council rents
- budget surpluses from previous year
- income from loans and bonds (short-term loans may not exceed 5% of command annual expenditure)

The most important local taxes are:

- different local taxes (local property tax among them)
- agricultural taxes

Central government determines maximum rate of important taxes and local authorities will be able to reduce (or even abolish) rates in particular cases.

Municipalities and Communes (gumina) also share income tax revenue, which is mainly shared by state government (central tax):

- income tax from enterprises located in particular units : 5% of revenue form this tax (50% of most of small scale private sector enterprises)
- tax on salary : 30% of revenue

Central grants will consist of three different types:

- general grants
- conditional grants
- conditional grants for delegated powers

From the aims mentioned above, the portion the of municipal has to shoulder is larger than that of the voivodeship.

A.5.6 Tax System and Utilities Charging System

In Poland, new tax systems are now being reviewed. A value-added tax(VAT) is expected to be implemented in 1993. On May 4th,1992, a fresh set of sales taxes were published. The tax rates for imported articles, domestically-produced goods and services have been increased, for example;

- profits of casinos from 35% to 40%
- profits of lotteries
and betting office from 5% to 10%
- cars with engines from
2,000 c.c. from 25% to 30%
- cars with diesel engines ditto.

Sales tax is being introduced on manufactured foods,e.g. cured meat, diary goods, flour mill products, prepared fruits, sugar or kitchen oil. A 5% tax is being imposed on children's goods, building materials and construction services. These alterations in tax systems reflect the needs of the state budget and the move toward the introduction of VAT and excise tax. It is said, however, that these tax rates will change retail prices by 6% , thus increasing inflation by 3%.

The present tax systems consist of many kinds of taxes. The three majors taxes are three as follows;

- Corporate Profits Tax Corporate entities are liable to corporate profits tax at 40% rate.

- Sales Tax(Turnover Tax) Turnover tax is imposed on services and trade carried out within Poland and on goods imported. Rates vary depending on the nature of the goods or services involved.

-- Individual Income Tax

A new unified personal income tax was introduced on 1st January 1992, consolidating several categories of personal taxation. Under this system, taxable income of residents is generally taxed at progressive rates of 20%, 30% and 40%.

Other taxes are "Withholding Taxes"(20% for dividends and royalties and 30% on interest) and "Inheritance and Gift Taxes"(progressive tax rates ranging from 5% to 40%).

Poland has three local taxes;

-- Real property tax

Buildings and parts of buildings apartments are required to pay the real property tax. Communal authorities establish the applicable rate. The tax is based on the area in which the building stands, the initial value of buildings or the area of the land.

-- Transport vehicles tax

The Ministry of Finance establishes rates for each type of transportation vehicle, based on technical features rather than its value.

-- Dog ownership tax

Naturally persons are liable for dog ownership tax on each dog in their possession.

Certain fees are also levied in addition to local taxes. Administrative fees are charged if a new law is passed by the communal authorities and official actions are not covered by a stamp indicating duty legislation. Vendors must pay a market-place fee. A local fee is also charged on persons staying temporarily at spas and similar facilities.

The fee for SWM is collected by "SANITECH", which is one of the municipal enterprises. The fee for waste collection depends on the types of containers and frequencies of collection, although the latter diverts from the contract specifications.

Table A.5.6-1 Price List of SANITECH Service

	SANITECH		Other firms	
	municipal wastes	municipal household and after production	municipal wastes	municipal household and after production
1. Vehicle private, combi, pick-up, private with trailer	25,000	35,000	45,000	55,000
2. Vehicle van 0.5 - 1 t capacity	50,000	70,000	90,000	110,000
3. Truck 1 - 2 t capacity	75,000	105,000	135,000	165,000
4. Truck 2 - 4 t	100,000	140,000	180,000	220,000
5. Truck 4 - 6 t	125,000	175,000	225,000	275,000
6. Truck 6 - 8 t	175,000	245,000	315,000	385,000
7. Truck 8 - 10 t	225,000	315,000	405,000	495,000
8. Truck 10 - 12 t	275,000	385,000	485,000	605,000
9. Truck 12 - 16 t	300,000	420,000	540,000	660,000
10. Truck 16 - 20 t	375,000	525,000	675,000	825,000
11. Truck 20 - 24 t	500,000	700,000	900,000	1,100,000
12. more than 24 t	625,000	875,000	1,125,000	1,375,000
13. Truck trailer 1 axle	50,000	70,000	90,000	110,000
14. Truck trailer to 4 t	100,000	140,000	180,000	220,000
15. Truck trailer 4 - 5 t	125,000	175,000	225,000	275,000
16. Truck trailer 5 - 6 t	150,000	210,000	270,000	330,000
17. Truck trailer 5 - 8 t	200,000	280,000	360,000	440,000
18. Truck trailer 8 - 10 t	250,000	350,000	450,000	550,000
19. more than 10 t	350,000	490,000	630,000	770,000
20. Special-non-dust				
a/ 11.5 m ³ capacity	287,000	402,000	517,000	632,500
b/ 12 m ³ capacity	300,000	420,000	540,000	660,000
c/ 14.5 m ³ capacity	362,000	507,000	652,000	797,000
d/ 16 m ³ capacity	400,000	560,000	720,000	880,000
21. Special container type (depending on container capacity)				
a/ SPW-5 (SPW-6)	125,000	175,000	225,000	275,000
b/ SPW-7	175,000	245,000	315,000	390,000
c/ SPW-8	200,000	280,000	360,000	440,000
d/ SPW-10	250,000	350,000	450,000	550,000

^ - for individual residents of Poznan

Poznan, 13 April, 1992

Table A.5.6-2 Price List of Dumping in Suchy Las Landfill

	municipal wastes	municipal homothetic and after-production
I. Fee for collection with non-dust vehicles		
1. Detached house area order/contract	for collection of 1 container	
a/ SM-110 contract	18,000	18,000
b/ SM-1100 contract	92,000	92,000
2. Multi-storey building area		
a/ SM-110 contract	10,500	10,500
b/ SM-1100 contract	73,500	73,500
3. One-time collection		
a/ SM-110 order	20,000	20,000
b/ SM-1100 order	110,000	110,000
II. Fee for collection with container vehicles (division takes container capacity into account)		
1. SPW-5, SPW-6 contract/order	300,000	410,000
2. SPW-7 contract/order	410,000	550,000
3. SPW-8 contract/order	500,000	600,000
4. SPW-10 contract/order	600,000	750,000
III. Fee for landfill dumping	25,000/m ³	35,000/m ³

Poznan, 13 April, 1992.

The tipping fee at the disposal site depends on the volume of waste, therefore compression to reduce the volume of waste is becoming a good business in Poznan.

There are charges to protect environment and water resources. The waste is categorized into four groups according to their impact on the environment. The charge is collected in proportion to the discharged volume of waste:

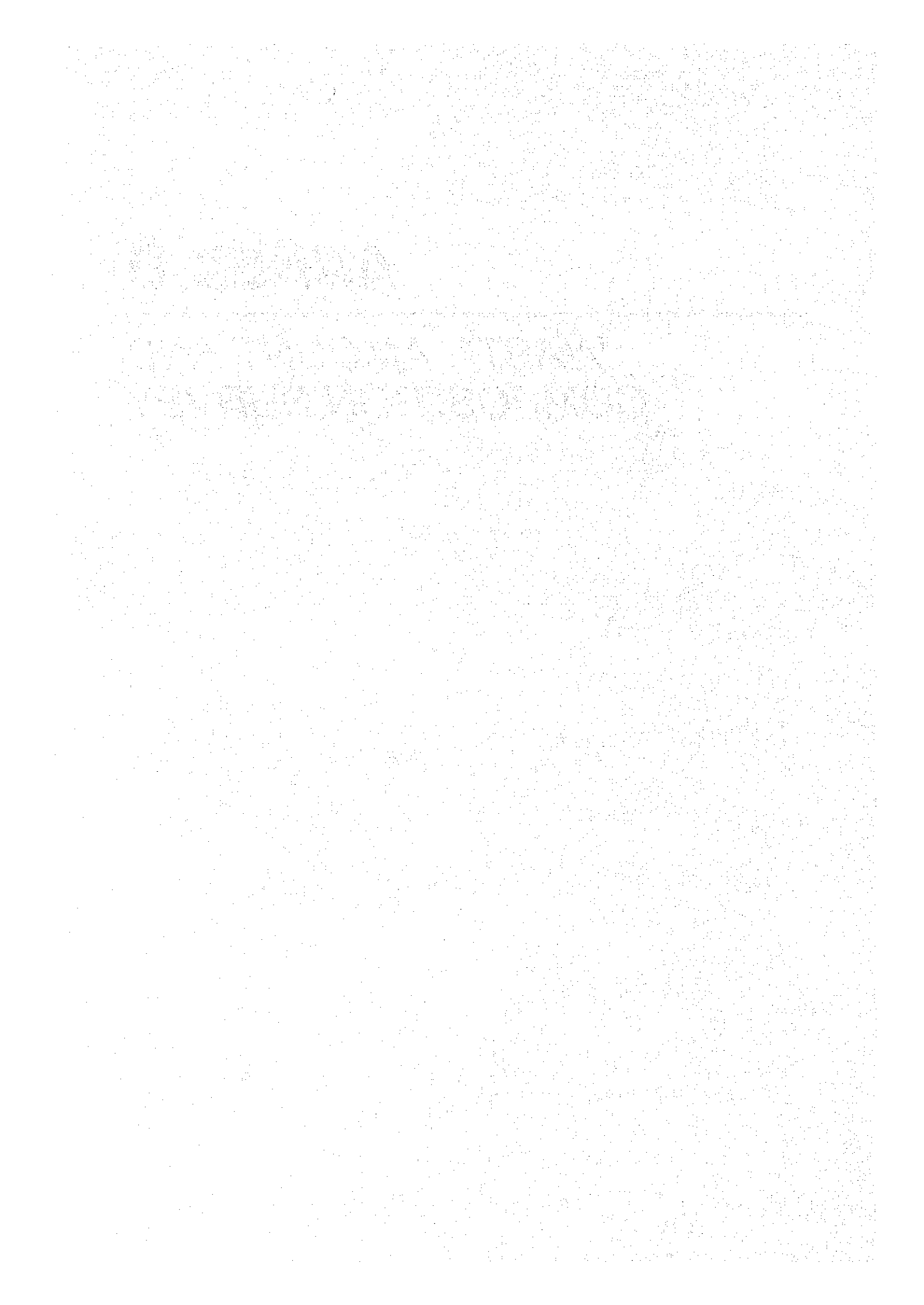
I group	250,000 Zl/ton
II group	100,000 Zl/ton
III group	40,000 Zl/ton
IV group	20,000 Zl/ton

This charge is the resource of the Provincial(voyvodship) Funds for environmental Protection and Water Management.

The tariff on electric, thermal power and water supply is also charged by these supply and distribution companies. In Poland, a contract is usually made between the managing authorities of buildings and these companies. The residents make a contract with the authorities for total management fees including solid waste collection fee, for examples in proportion to their area or the number of family because there is no way the volume of each consumption can be determined. It is easier to collect the fees for waste collection, but difficult to reduce the volume of solid waste.

ANNEX B

WASTE AMOUNT AND COMPOSITION SURVEY



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ANNEX B WASTE AMOUNT AND COMPOSITION SURVEY

B.1 Objectives and Definitions

1) Objective of the Survey

Basic information such as the quantity of solid waste generated in the survey area, the population covered by the collection services, collection area map, etc. is the key for formulation of a successful and workable solid waste management plan.

A WACS (Waste Amount and Composition Survey) was thereby carried out in order to obtain basic information of waste generation ratio, discharge amount, amount of self-disposal and collection, and finally to clarify the waste stream in the Study area.

The WACS was carried out both in summer (June, 1992) and winter (December, 1992) to get the waste data in these season. The average data was then determined from these data.

2) Definitions of Wastes

In order to make the contents of the WACS and the waste stream clearly understood, the words used in the study are defined as follows:

a. Household waste

Waste generated in or discharged from each household. Those generated through commercial activities are excluded.

b. Commercial waste

Only refers to wastes generated and discharged from shops or any commercial activity. Shops include restaurants, hotels, drug stores, grocery shops, printing shops, private offices, etc..

c. Market waste

Waste generated in or discharged by markets both for wholesale and retailing.

d. Institutional waste

As for institutional waste, government office waste is examined in the Study.

e. Road sweeping waste

Road sweeping waste include all wastes generated by the following cleansing services:

- road sweeping waste; and
- public area cleansing waste.

f. Bulky waste

Abandoned bulky items (such as furniture and trucks), which are discharged from the above-mentioned categories of sources, is considered as bulky waste in the Study.

g. Other wastes

Other wastes in the Study are the wastes disposed of at the present Suchy Las disposal site and are not considered as the MSW (item a. to f.).

3) Method of Waste Amount Survey

Waste amount survey was divided into the following three methods:

- discharge ratio survey at generation sources;
- final disposal amount survey at the present Suchy Las landfill; and
- interview survey for generation sources.

In addition, the results of the POS were referred for the final determination of the amount. The method applied to the WACS is tabulated in Table B.1-1.

Table B.1-1 Method of Waste Amount Survey

Category	Discharge Ratio Survey	Disposal Amount Survey	Interview Survey
MSW (Total)		x	
Household Waste	x		
Market Waste	x		
Commercial	x		
Institutional	x		
Road Sweeping	x		
Bulky Waste		x	
Others (Total)	x		
PEC Ash			x
Sewage Sludge			x
Others	x		

Note: The item given "x" was surveyed in the Study.

B.2 Selection of Sampling Point for Discharge Ratio Survey

In order to know the discharge ratio of each waste, the following categories of wastes were sampled at each generation sources. However, the bulky and other wastes were only studied regarding their amount by means of observation at the present landfill. The sampling points are presented in Table B.1.2-1.

Table B.2-1 Sampled Waste Category

in summer	in winter
<ul style="list-style-type: none"> - Household Waste - Commercial Waste - Market Waste - Institutional Waste - Road Sweeping Waste 	<ul style="list-style-type: none"> - Household Waste - Commercial Waste - Market Waste - Institutional Waste

1) Household Waste

The ash discharged from the stove in the residents was deemed to be an important factor for the composition of waste. Therefore, household waste was classified into the six categories as shown below.

- new apartment built after 1945 with heat supply
- new apartment built after 1945 without heat supply
- old apartment built before 1945 with heat supply
- old apartment built before 1945 without heat supply
- detached or semi-detached house with heat supply
- detached or semi-detached house without heat supply

Additionally, only in winter the waste was sampled from waste collection trucks, of which collection area was new apartment with heat supply, only for waste composition analysis in order to compare the difference of data due to the different sampling methods.

2) Commercial Waste

Commercial waste was classified into two categories which consist of food supplier like a restaurant and ordinary shop.

The amount of waste discharged from both categories was measured. The composition analysis, however, was carried out concerning the waste of food supplier due to the reason as shown below;

- The composition of waste discharged from food supplier was quite different from that of ordinary shop.
- Waste discharged from ordinary shop is almost equal to the institutional waste in appearance.
- Therefore the waste composition of ordinary shop can be replaced with that of institutional waste.

3) Market Waste

Poznan City is dotted with some markets of middle and small scale. As the result of the reconnaissance, the two representative markets were selected in consideration of kinds of commodities and scale of selling. As waste composition between two sampling points was not different apparently and discharge amount of each market

was too much (8m³ each), waste amount survey was carried out at the two points and waste composition survey was carried out only for the one point.

4) Institutional Waste

Amount and composition survey of institutional waste was carried out at the municipality office and pension office.

Waste amount was measured at the two offices and waste composition was analyzed at the one office because the waste composition between two sampling points did not differ apparently.

5) Road Sweeping Waste

The amount of road sweeping waste and the distance of road were measured during Time and Motion Study.

All above mentioned is shown in Table B.2-2.

Table B.2-2 Sampling Points of Waste Amount and Composition Survey

Category (1)	Category (2)	Category (3)	Nos.
Household Waste	New Apartment	Heat Supply	25
	New Apartment	Non Heat Supply	5
	Old Apartment	Heat Supply	5
	Old Apartment	Non Heat Supply	10
	Detached or Semi-detached House	Heat Supply	5
	Detached or Semi-detached House	Non Heat Supply	10
	Mixed Waste (only in winter)	Heat Supply	1
	Commercial Waste	Shops Other than Catering	
Catering Shops			3
Market Waste	Wholesale		1
	Retailing		1
Institutional Waste	Municipality Office		1
	Pension Office		1
* Road Sweeping Waste			1

Note: * As for the road sweeping waste, only its amount was surveyed once in summer by Time and Motion Survey.

Table B.2-3 List of Survey Points for Waste Amount and Composition Survey

No	District	Category	Nos. of Sample	Address	Nos. of Residents
1	2	3	4	5	6
1 & 2	Piatkowo	New Apartment building after 1945 PEC	10	1 TOBISZEWSKI os. Bolesława Chrobrego 9F/147 2 BLAZEJCZAK os. Bolesława Chrobrego 9F/140 3 BONIECKI os. Bolesława Chrobrego 9F/139 4 TOBACZYNSKI os. Bolesława Chrobrego 9F/138 5 IWINSKA os. Bolesława Chrobrego 9F/135 6 GASIOR os. Bolesława Chrobrego 9/136 7 KIROLCZUK os. Bolesława Chrobrego 9/161 8 KRZYWDA os. Bolesława Chrobrego 4/9 9 ZAKLAD FRYZJERSKI os. Bolesława Chrobrego 21/c 10 POLCZYNSKA os. Bolesława Chrobrego 17/116	5 4 5 3 3 4 3 4 5 6
3 & 4	Wino-grady	New Apartment building after 1945 PEC	10	1 DROBNIAK os. Zwyciestwa 19A/137 2 MAJEWSKI os. Zwyciestwa 19A/117 3 SPORNA os. Zwyciestwa 19A/118 4 KUNERT os. Zwyciestwa 19A/122 5 BIALY os. Zwyciestwa 19A/125 6 LITWICKA os. Zwyciestwa 19A/112 7 KOZA os. Zwyciestwa 19A/63 8 SZYMANSKI os. Zwyciestwa 19A/64 9 KESZYCKI os. Zwyciestwa 19A/65 10 GOLEBIEWSKA os. Zwyciestwa 19A/8	4 3 5 4 4 5 4 5 3 4
5	Rataje os. Orla Białego 47 : 51	New Apartment building after 1945 PEC	5	1 JANCZAK os. Orla Białego 47/1 2 NOWAK os. Orla Białego 49/2 3 SPLAWSKA os. Orla Białego 51/2 4 KRAWCZYK os. Orla Białego 54/4 5 PETRAS os. Orla Białego 69/2	5 4 5 6 (4)
6	Wilda ul. Rolna	New Apartment building after 1945 NO PEC	5	1 ZIETA ul. Rolna 27/4 2 KJIEWSKI ul. Rolna 42/8 3 WASZKIEWICZ ul. Rolna 29A/13 4 KLUCZYNSKI ul. Rolna 66/6 5 ULINSKI ul. Rolna 58/7	6 4 4 7 3
7	Centrum	Old Apartment building before 1945 PEC	5	1 BINIARZ ul. Ratajczaka 16/17 2 JANICKA ul. Powstan. Wielkop. 8/13 3 HELMAN ul. Garbary 3/12 4 MATUSZEWSKA ul. Mostowa 33/11 5 BUGUSZ Plac Wolnosci 4/12	3 2 3 4 2
8	Rynek Lazarski	Old apartment before 1945 NO PEC	5	1 BRUKARCZYK Rynek Lazarski 10A/4 2 WOZLAK Rynek Lazarski 16/3 3 MAJOREK Rynek Lazarski 16/12 4 PALUSZCZAK Rynek Lazarski 4/9 5 MYTKOWIAK Rynek Lazarski 10A/9	5 3 2 2 5
9	Wilda ul. Madalin	Old apartment before 1945. NO PEC	5	1 SMURA ul. Madalinskiego 7/6 2 KULINSKI ul. Madalinskiego 9/1 3 URBANIAK ul. Madalinskiego 13/23 4 MATUSZEWSKI ul. Madalinskiego 21/3 5 FLANC ul. Madalinskiego 23/4	1 5 4 3 2
10	Wino-grady	Detached or Semi-detached Houses PEC	5	1 SZWABIG ul. Kmieca 27a 2 PORALA ul. Kmieca 21 3 KOSTRZEWSKI ul. Kmieca 19a 4 ROCHOWIAK ul. Soltysia 22 5 STACHOWIAK ul. Kmieca 13	6 10 7 5 2
11	Broni-borska	Detached and Sceme-detached NO PEC	5	1 HOJAN ul. Broniborska 1a 2 MOROZ ul. Broniborska 7 3 GORECKA ul. Broniborska 8 4 SZYMKOWIAK ul. Broniborska 8a 5 KRZYZYNIAK ul. Broniborska 13	2 6 2 3 5
12	Solacz	Detached or semi-detached house NO PEC	5	1 WANDA ul. Goralska 4 2 KRUK ul. Pomorska 6 3 KRUK ul. Mazowiecka 27 4 WALERYCH ul. Mazowiecka 38 5 RACZKOWIAK ul. Malopolska 16	4 8 3 14 4
Total		Detached or semi-detached NO PEC	35 25	RESIDENTIONAL WASTE	

13	Sw. Marcin	sklepy, restauracje	5	1 SKLEP KONFEKCYJNY 2 SKLEP OBUWNICZY 3 BAR-BISTRO 4 RESTAURACJA 5 BAR MALA GASTRO.	ul. Sw. Marcin ul. Sw. Marcin ul. Sw. Marcin ul. Sw. Marcin ul. Sw. Marcin	61 61A 39 25 23	84m ² 136 63.8 110 110
14	Stare Miasto	sklepy, restauracje	5	1 KAWIARNIA 2 SKLEP JVC 3 SKLEP SPOZYWCZY 4 RESTAURACJA 5 RESTAUR. "BISTRO"	Stary Rynek Stary Rynek ul. Kozia ul. Kantaka ul. 27 Grudnia (Kasia)	106 86 5 8/9 13	500m ² 200 20 540 964
Total			10	COMMERCIAL WASTE			
Institutional		office	1 1	1 Municipality 2 Social Welfare Office.	Plac Kolegiacki ul. Dabrowskiego		700 p. 570 p.
Total			2	INSTITUTIONAL WASTE			
market; fruit & vegetable		Market	1 1	1 PLAC WIELKOPOLSKI 2 RYNEK JEZYCKI			225 p. 300 p.
Total			2	MARKET WASTE			

B.3 Survey Period of Discharge Ratio Survey

The survey was conducted in summer from 10th to 17th June 1992, and in winter from December 4th till 11th in 1992.

B.4 Method of the Discharge Ratio Survey

Method of the Survey is tabulated in Table B.4-1. Upon consideration of the daily fluctuation of discharged waste, the survey was conducted continuously for 8 days.

1) Collection of Sample

Before the execution of the WACS, a required numbers of plastic bags distributed to residences, shops and offices selected as sampling points. Then, the samples collected by the Study Team are classified or distinguished with a sticker.

Samples discharged in markets were collected by the container.

2) Waste Amount Survey

Amount of waste was measured at each sampling point. Samples taken from plastic bags were measured by spring balance and samples from containers were measured at the truck scale installed by the Study Team.

3) Waste Composition Survey

a. Method of sampling

The composition of waste measured in the dry base in summer and in wet base in winter in accordance with the following categories.

- residential area (PEC)
- residential area (Non PEC)
- commercial
- market
- institutional
- mixed waste from new apartment area (only in winter)

Each category of waste was gathered and mixed together. Then, waste mixed together was reduced in volume by applying the reducing method described below many times until the volume became 30 to 50 litres as shown in Fig. B.4-1.

i. Mixing

In case that, large size waste e.g. cardboard, textile etc. was contained in the waste, those big size waste was made small and mixed again.

ii. Dividing

Waste mixed well was divided into four blocks which should be almost same volume.

iii. Reducing

The diagonal two blocks of waste divided into four was removed.

Above i-iii method was continued until remaining waste volume became the designated amount for waste composition analysis (30 to 50 litres). Then, the waste was put into a plastic bucket.

The plastic bucket containing waste tapped on the ground several times and measured the waste volume with eye and the weight by the platform balance.

ASG (Apparent Specific Gravity) was calculated by following formula.

$$\text{ASG} = \text{Weight of Waste (kg)} / \text{Volume of Waste (l)}$$

After ASG was measured, waste was applied to the composition survey. Items of waste composition survey were shown in Table B.4-1.

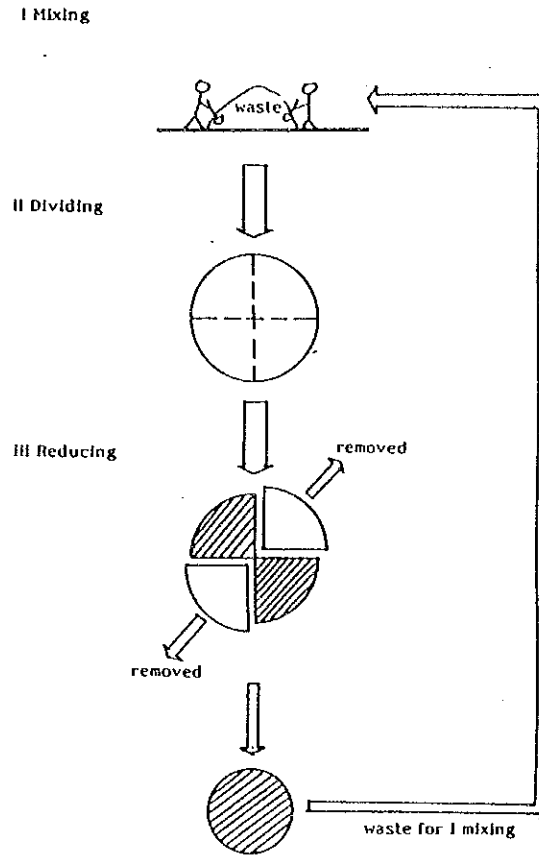


Fig.B.4-1 Waste Reduction Method

Table B.4-1 Method of Survey

Discharge source	Collection of Sample	Waste Amount Survey	Waste Composition Survey
Residential Area (PEC)	by plastic bag	by spring balance	Analysis Items - ASG (Apparent Specific Gravity) - Physical composition ... dry base (garbage, paper, textile, plastic, glass, grass and wood, leather and rubber, metal, ceramic and soil, others) - Chemical analysis + Three contents (moisture, combustibles, ash) + Lower calorific value + Ultimate analysis (carbon, hydrogen, nitrogen, sulphur, chlorine, oxygen)
Residential Area (NO PEC)	by plastic bag	by spring balance	
Commercial Area	by plastic bag	by spring balance	
Market	by container	by weighbridge	
Institutional	by plastic bag	by spring balance	
Residential Area (Mixed Waste)	from communal container	nil	

b. Composition analysis

Physical composition and chemical analysis were conducted on the following items:

i. Physical composition

The Physical composition was measured in dry base in summer. The samples were dried in the dryer (100°C, 3 days). After drying samples were classified into the following 10 items.

Physical composition was measured in wet base in winter. Before drying, sample was divided into the following 10 items, then the weight of each item was measured.

- garbage
- paper
- textile
- plastic
- grass and wood
- leather and rubber
- metal
- glass
- ceramic and soil
- other

Result of the physical composition was described in percentage.

ii. Moisture content

Samples after measured physical composition were dried by nature drying for 3 days, then they were dried in the dryer for 1 day (100°C, 24 hours). After drying, the weight of each-item of sample was measured. Moisture content was calculated by following formula.

$$\text{Moisture content(\%)} = \frac{\text{before drying weight (kg)} - \text{after drying weight (kg)}}{\text{before drying weight (kg)}} \times 100$$

iii. Chemical analysis

After drying, sample was applied to chemical analysis. The sample was took out combustible samples from the after drying sample. The combustible samples were following 6 items.

- garbage
- paper
- textile
- plastic
- grass and wood
- leather and rubber

Each combustible samples were pulverized into the fraction less than 2mm size by the cutting mill. After pulverization samples were mixed together again, then the sample was applied to chemical analysis. Chemical analysis was practised for the following items.

- Ash content

Ash content in this Study includes ash after the combustion of the combustible matters and the following non-combustible items:

- . metal
- . glass
- . ceramic and soil
- . other

- Combustibles content

Combustibles content was got from the subtraction the weight of combustion ash from the weight of the combustible matters.

- Lower calorific value

Lower calorific value was obtained by the combustion in the calorimeter bomb, measuring water temperature increase in a calorimetric vessel which surrounded the bomb.

- Ultimate analysis

Ultimate analysis was done for the following 6 items.

- . carbon
- . hydrogen
- . nitrogen
- . sulphur
- . chlorine
- . oxygen

Result of the ultimate analysis was expressed by percentage.

B.5 Results of the Survey

B.5.1 Results of the Survey in Summer

1) Waste Amount

a. Household waste

The result of waste amount survey is tabulated in Table B.5.1-1. Amount of waste discharged from residence per unit per day was different in PEC and Non PEC. Discharged ratio of waste from residence was 427 g/day/person in PEC and 674 g/day/person in Non PEC. Average discharge ratio of waste was 529 g/day/person.

Table B.5.1-1 Discharge Ratio of Household Waste in Summer

Category	Number of Residence	Total Number of Family Members	Average Discharge Amount (g/d)	Average Discharge Amount (g/d/per)
Household (PEC)	35	151	64,425	427
Household (Non PEC)	25	107	72,375	676*
Average	60	258	136,800	530

Note: * The figure included domestic ash.

b. Commercial, market and institutional waste

The result of waste amount survey is tabulated in Table B.5.1-2.

Table B.5.1-2 Discharge Ratio of Commercial, Market and Institutional Waste

Category	Number of Samples	Total number	Total number of area (m ²)	Average Discharge Amount	Average Discharge Amount	Average Discharge Amount (g/d/m ²)
Commercial (1) ^{*1}	7	-	2,534	62,083	-	24.5
Commercial (2) ^{*2}	3	-	193.8	33,605	-	173.4
Market	2	525 ^{*3}	-	1,682,463	3,204.7 ^{*5}	-
Institutional	2	1,270 ^{*4}	-	80,264	63.2 ^{*6}	-

Note: *1 commercial (1) shops
 *2 commercial (2) catering
 *3 Number of shops
 *4 Number of employee
 *5 g/shop/day
 *6 g/employee/day

2) Waste Composition

a. Apparent specific gravity

The result of Apparent Specific Gravity survey is tabulated in Table B.5.1-3.

Table B.5.1-3 Apparent Specific Gravity in Summer

Category	Apparent Specific Gravity
Household (Heat Supply)	0.216
Household (Non-heat supply)	0.206
Market	0.199
Commercial (Catering)	0.228
Institutional	0.074

b. Waste composition

The results of waste composition survey are tabulated in Tables B.5.1-4 to B.5.1-10. The following items shall be noted for the use of the results:

i. Domestic ash

- Domestic ash was mixed together with other wastes for obtaining the sample (30 l - 50 l) for physical composition analysis at the first day.
- Therefore, the data of the first day was excluded for the preparation of the average of household (non-PEC) and summary.
- Domestic ash was not observed among the other wastes than household (Non PEC).
- Due to the confusion, domestic ash in household waste (Non PEC) was included in the category of ceramic and soil in summer, and in the category of other in winter.

ii. Analysis base

- Physical composition analysis was done in dry base in summer and in wet base in winter.
- For the better comparison, the result of summer (in dry base) was converted into wet base, using average water content of each category of waste in winter.

iii. Estimation of the lower caloric value

The lower calorific value (LCV) of waste can also be estimated by the following formula based on the result of the study in Poznan and data obtained in the Japan.

Due to the limitation of the sample amount for the LCV analysis (about 1/5000 of the sample amount for the physical composition analysis, i.e. 1 to 2 g), the measured LCV highly depends on a chance and may not represent the actual figure. Therefore, the LCV estimated by this formula was applied to the design of the incineration plant in this study, referring to the LCV measured in the laboratory.

$$\text{LCV} = (\text{RGa}^{*1} * 1,400 + \text{RPa}^{*2} * 2,550 + \text{RT}^{*3} * 2,450 + \text{RPI}^{*4} * 6,900 + \text{RGr}^{*5} * 630 + \text{RL}^{*6} * 3,400) / 100$$

RGa^{*1} ;Ratio of garbage in wet weight (%)

RPa^{*2} ;Ratio of paper in wet weight (%)

RT^{*3} ;Ratio of textile in wet Weight (%)

RPI^{*4} ;Ratio of plastic in wet weight (%)

RGr^{*5} ;Ratio of grass and wood in wet weight (%)

RL^{*6} ;Ratio leather and rubber in wet weight (%)

Table B.5.1-4 Summary of Waste Composition Survey in Summer

Classification		Household (PEC)	Household (Non PEC)	Market	Commercial	Institutional	
Physical composition	combustibles	garbage (%)	31.36	29.32	32.64	29.99	9.38
		paper (%)	16.94	16.71	22.40	14.64	62.33
		textile (%)	8.66	7.93	7.89	6.63	7.69
		plastic (%)	8.14	7.30	8.51	8.14	5.19
		grass and wood (%)	11.90	12.29	19.47	7.21	3.15
		lather and rubber (%)	2.54	3.64	0.44	0.15	0.00
	Total (%)	79.54	77.19	91.35	66.76	87.74	
	non-combustibles	metal (%)	4.00	4.03	2.49	7.19	4.55
		glass (%)	11.02	8.76	2.36	23.10	5.18
		ceramic and soil (%)	1.44	6.32	2.08	1.68	1.17
other (%)		4.01	3.69	1.71	1.26	1.37	
Total (%)	20.47	22.81	8.64	33.23	12.27		
Total (%)		100.01	99.99	99.99	99.99	100.01	
Chemical analysis	Three contents	moisture (%)	42.19	40.34	70.11	40.94	20.50
		combustibles (%)	36.04	35.32	21.59	26.07	63.56
		ash (%)	21.77	24.34	8.30	32.99	15.94
		Total (%)	100	100	100	100	100
	Chemical contents of combustible	carbon (%)	18.35	18.92	10.90	13.37	29.08
		hydrogen (%)	3.92	4.05	2.46	2.90	6.68
		nitrogen (%)	0.88	0.80	0.34	0.37	0.32
		sulphur (%)	0.04	0.08	0.04	0.02	0.06
		chlorine (%)	0.31	0.19	0.19	0.14	0.25
		oxygen (%)	12.54	11.28	7.65	9.27	27.16
Total (%)	36.04	35.32	21.59	26.07	63.56		
Measured LCV (kcal/kg)		1,662	1,490	536	1,126	2,987	
Estimated LCV (kcal/kg)		1,806	1,736	1,946	1,568	2,287	

Table B.5.1-5 Result for Household (PEC) in Summer

Classification			10 Jun. 1992	11 Jun. 1992	12 Jun. 1992	13 Jun. 1992	14 Jun. 1992	15 Jun. 1992	16 Jun. 1992	17 Jun. 1992	Average
Physical composition	com- bustibles	garbage (%)	34.76	34.45	31.46	22.79	-	37.50	26.60	31.97	31.36
		paper (%)	15.45	16.62	19.08	15.53	-	18.60	15.81	17.47	16.94
		textile (%)	8.88	9.23	10.37	4.11	-	6.10	12.35	9.55	8.66
		plastic (%)	6.56	8.53	9.22	9.44	-	9.67	7.28	6.28	8.14
		grass and wood (%)	14.07	12.50	10.13	9.47	-	12.34	10.55	14.27	11.90
		leather and rubber (%)	0.69	0.60	0.49	0.42	-	4.21	3.21	8.16	2.54
	total (%)	80.41	81.93	80.75	61.76	-	88.42	75.80	87.70	79.54	
	non- comb- ustibles	metal (%)	2.37	3.03	3.37	4.65	-	3.17	8.04	3.39	4.00
		glass (%)	9.32	11.09	10.46	27.82	-	3.38	9.98	5.08	11.02
		ceramic and soil (%)	0.00	0.00	2.18	3.01	-	1.60	2.87	0.45	1.44
other (%)		7.97	3.97	3.23	2.76	-	3.44	3.31	3.38	4.01	
total (%)	19.66	18.09	19.24	38.24	-	11.59	24.20	12.30	20.47		
Total (%)			100	100	99.99	100	-	100	100	100	100.01
Chemical analysis	Three contents	moisture (%)	54.51	47.55	38.78	33.07	-	41.21	39.67	40.55	42.19
		combustibles (%)	28.41	35.10	39.54	28.34	-	40.19	34.19	46.51	36.04
		ash (%)	17.08	17.35	21.68	38.59	-	18.60	26.14	12.94	21.77
		total (%)	100	100	100	100	-	100	100	100	100
	Chemical contents of com- busti-ble	carbon (%)	14.60	17.03	19.10	15.05	-	19.93	18.45	24.31	18.35
		hydrogen (%)	3.00	3.74	4.23	3.28	-	4.28	4.07	4.83	3.92
		nitrogen (%)	0.63	1.10	0.97	0.42	-	0.62	1.01	1.39	0.88
		sulphur (%)	0.01	0.06	0.02	0.01	-	0.11	0.02	0.07	0.04
		chlorine (%)	0.26	0.18	0.42	0.36	-	0.23	0.56	0.18	0.31
		oxygen (%)	9.91	13.00	14.79	9.23	-	15.02	10.09	15.73	12.54
	total (%)	28.41	35.11	39.53	28.35	-	40.19	34.20	46.51	36.04	
	Measured LCV (kcal/kg)		1,156	1,582	1,986	1,451	-	1,883	1,601	1,975	1,662

Table B.5.1-6 Result for Household (Non PEC) in Summer

Classification		10 Jun. 1992	11 Jun. 1992	12 Jun. 1992	13 Jun. 1992	14 Jun. 1992	15 Jun. 1992	16 Jun. 1992	17 Jun. 1992	A- ver- age	
Physical composition	com- busti- bles	garbage (%)	20.43	26.43	32.71	31.40	-	36.10	23.90	25.39	29.32
		paper (%)	14.11	16.26	20.22	14.42	-	14.45	18.98	15.94	16.71
		textile (%)	2.72	10.84	6.83	8.17	-	6.73	9.41	5.59	7.93
		plastic (%)	4.04	6.47	7.11	7.01	-	7.37	9.73	6.10	7.30
		grass and wood (%)	6.93	12.91	10.31	13.71	-	11.48	10.79	14.56	12.29
		leather and rubber (%)	5.19	4.16	2.73	3.10	-	8.00	2.12	1.71	3.64
	total (%)	53.42	77.07	79.91	77.81	-	84.13	74.93	69.29	77.19	
	non- com- busti- bles	metal (%)	2.54	6.04	3.54	3.86	-	3.99	4.94	1.81	4.03
		glass (%)	9.91	12.59	9.23	7.98	-	3.10	16.45	3.21	8.76
		ceramic and soil (%)	30.64	0.00	3.50	6.21	-	4.25	0.70	23.27	6.32
other (%)		3.49	4.29	3.83	4.13	-	4.53	2.97	2.41	3.69	
total (%)	46.58	22.92	20.10	22.18	-	15.87	25.06	30.70	22.81		
Total (%)		100	99.99	100	99.99	-	100	99.99	99.99	100	
Chemical analysis	Three con- tents	moisture (%)	31.03	46.88	41.84	45.14	-	49.44	32.47	26.27	40.34
		combustibles (%)	22.59	31.40	35.03	30.20	-	32.34	42.93	40.00	35.32
		ash (%)	46.38	21.72	23.13	24.66	-	18.22	24.60	33.73	24.34
	total (%)	100	100	100	100	-	100	100	100	100	
	Chemical con- tents of co- mb- usti- ble	carbon (%)	9.99	16.78	19.54	17.42	-	16.33	22.43	21.01	18.92
		hydrogen (%)	2.50	3.74	4.00	3.45	-	3.92	4.87	4.31	4.05
		nitrogen (%)	0.41	1.02	0.77	0.45	-	0.84	0.46	1.28	0.80
		sulphur (%)	0.04	0.04	0.06	0.00	-	0.12	0.07	0.16	0.08
		chlorine (%)	0.42	0.37	0.10	0.19	-	0.19	0.20	0.09	0.19
		oxygen (%)	9.23	9.46	10.56	8.68	-	10.94	14.89	13.15	11.28
total (%)	22.59	31.41	35.03	30.19	-	32.34	42.92	40.00	35.32		
Measured LCV (kcal/kg)		627	1,376	1,486	1,082	-	1,262	1,977	1,754	1,490	

Table B.5.1-7 Result for Market in Summer

Classification			10 Jun. 1992	11 Jun. 1992	12 Jun. 1992	13 Jun. 1992	14 Jun. 1992	15 Jun. 1992	16 Jun. 1992	17 Jun. 1992	A- ver- age
Physical comp- osi- tion	com- busi- bles	garbage (%)	33.67	34.85	32.76	31.74	-	30.71	31.17	33.58	32.64
		paper (%)	23.76	22.18	19.12	22.57	-	26.50	20.72	21.98	22.40
		textile (%)	7.52	7.75	8.37	8.38	-	8.25	7.15	7.79	7.89
		plastic (%)	8.14	7.71	8.67	8.49	-	9.14	8.81	8.61	8.51
		grass and wood (%)	16.81	18.63	19.66	19.98	-	19.19	23.29	18.74	19.47
		leather and rubber (%)	0.24	0.25	0.27	0.27	-	0.26	1.55	0.25	0.44
	total (%)	90.14	91.37	88.85	91.43	-	94.05	92.69	90.95	91.35	
	non- comb- ustibles	metal (%)	2.46	2.45	2.06	3.10	-	1.82	2.23	3.29	2.49
		glass (%)	4.69	2.12	4.28	1.37	-	0.57	1.14	2.38	2.36
		ceramic and soil (%)	1.11	2.39	2.99	2.27	-	1.77	2.38	1.67	2.08
other (%)		1.60	1.68	1.82	1.82	-	1.79	1.56	1.69	1.71	
total (%)	9.86	8.64	11.15	8.56	-	5.95	7.31	9.03	8.64		
Total (%)		100	100	100	99.99	-	100	100	99.98	99.99	
Chem- ical anal- ysis	Three contents	moisture (%)	65.74	69.04	74.59	74.69	-	73.54	63.77	69.41	70.11
		combustibles (%)	26.51	20.67	16.31	18.15	-	21.99	24.50	22.98	21.59
		ash (%)	7.75	10.29	9.10	7.16	-	4.47	11.73	7.61	8.30
	total (%)	100	100	100	100	-	100	100	100	100	
	Chem- ical contents of comb- usti- ble	carbon (%)	12.75	10.91	7.11	8.59	-	11.82	13.18	11.97	10.90
		hydrogen (%)	2.87	2.74	1.70	1.94	-	2.67	2.89	2.69	2.46
		nitrogen (%)	0.26	0.27	0.36	0.29	-	0.36	0.44	0.43	0.34
		sulphur (%)	0.04	0.04	0.02	0.04	-	0.04	0.07	0.01	0.04
		chlorine (%)	0.07	0.11	0.21	0.24	-	0.20	0.36	0.12	0.19
		oxygen (%)	10.52	6.87	6.92	7.06	-	6.89	7.55	7.76	7.65
	total (%)	26.51	20.67	16.32	18.16	-	21.98	24.49	22.98	21.59	
	Measured LCV (kcal/kg)		820	421	304	311	-	509	676	712	536

Table B.5.1-8 Result for Commercial in Summer

Classification			10 Jun. 1992	11 Jun. 1992	12 Jun. 1992	13 Jun. 1992	14 Jun. 199 2	15 Jun. 1992	16 Jun. 1992	17 Jun. 1992	Ave- rage
Physical composi- tion	combust- ibles	garbage (%)	38.56	33.02	33.43	29.70	-	23.93	28.54	22.73	29.99
		paper (%)	9.96	9.46	17.78	19.25	-	17.92	16.51	11.62	14.64
		textile (%)	5.31	3.29	8.05	7.56	-	10.84	5.59	5.78	6.63
		plastic (%)	5.22	4.93	10.26	10.73	-	8.04	9.23	8.58	8.14
		grass and wood (%)	5.33	3.30	7.35	7.58	-	5.70	5.84	15.37	7.21
		leather and rubber (%)	0.00	0.00	0.00	0.00	-	1.03	0.00	0.00	0.15
	total (%)	64.38	54.00	76.87	74.82	-	67.46	65.71	64.08	66.76	
	non- comb- ustibles	metal (%)	10.24	3.66	6.17	3.95	-	8.72	7.46	10.14	7.19
		glass (%)	24.19	40.68	9.02	16.75	-	22.02	24.41	24.62	23.10
		ceramic and soil (%)	0.00	0.91	6.33	2.81	-	0.57	1.16	0.00	1.68
other (%)		1.19	0.74	1.61	1.66	-	1.24	1.26	1.15	1.26	
total (%)	35.62	45.99	23.13	25.17	-	32.55	34.29	35.91	33.23		
Total (%)			100	99.99	100	99.99	-	100	100	99.99	99.99
Chemical analysis	Three contents	moisture (%)	38.61	23.93	52.19	53.78	-	40.28	40.64	37.18	40.94
		combustibles (%)	27.53	29.36	25.38	22.37	-	27.37	25.34	25.13	26.07
		ash (%)	33.86	46.71	22.43	23.85	-	32.35	34.02	37.69	32.99
	total (%)	100	100	100	100	-	100	100	100	100	
	Chemical contents of comb- usti- ble	carbon (%)	12.70	14.52	13.70	11.82	-	14.54	13.90	12.39	13.37
		hydrogen (%)	2.88	3.31	2.80	2.62	-	3.09	2.91	2.68	2.90
		nitrogen (%)	0.15	0.22	0.44	0.51	-	0.43	0.57	0.27	0.37
		sulphur (%)	0.01	0.03	0.04	0.02	-	0.00	0.01	0.02	0.02
		chlorine (%)	0.12	0.11	0.17	0.09	-	0.21	0.18	0.13	0.14
		oxygen (%)	11.68	11.17	8.25	7.31	-	9.10	7.77	9.64	9.27
total (%)	27.54	29.36	25.44	22.37	-	27.37	25.34	25.13	26.07		
Measured LCV (kcal/kg)			1,109	1,251	1,073	883	-	1,313	1,173	1,081	1,126

Table B.5.1-9 Result for Institutional in Summer

Classification			10 Jun. 1992	11 Jun. 1992	12 Jun. 1992	13 Jun. 1992	14,15 Jun. 1992	16 Jun. 1992	17 Jun. 1992	Ave- rage
Physical composi- tion	combust- ibles	garbage (%)	9.72	6.79	23.47	12.55	-	10.56	7.27	9.38
		paper (%)	61.95	69.69	35.82	51.52	-	64.13	64.35	62.33
		textile (%)	6.17	4.79	9.50	6.52	-	12.34	8.63	7.69
		plastic (%)	4.84	5.96	4.41	5.45	-	4.93	4.77	5.19
		grass and wood (%)	4.06	2.15	4.68	4.77	-	2.84	1.92	3.15
		leather and rubber (%)	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00
	total (%)	86.74	89.38	77.88	80.81	-	94.80	86.94	87.74	
	non- comb- ustibles	metal (%)	3.78	9.08	5.20	4.97	-	2.67	2.24	4.55
		glass (%)	6.34	0.09	9.87	10.11	-	0.13	9.21	5.18
		ceramic and soil (%)	1.56	0.31	4.75	2.45	-	0.78	0.77	1.17
other (%)		1.58	1.14	2.29	1.66	-	1.61	0.84	1.37	
total (%)	13.26	10.62	22.11	19.19	-	5.19	13.06	12.27		
Total (%)		100	100	99.99	100	-	99.99	100	100	
Chemical analysis	Three contents	moisture (%)	23.74	17.13	34.37	24.94	-	24.15	12.57	22.82
		combustibles (%)	60.25	68.05	45.06	52.86	-	67.64	68.98	60.47
		ash (%)	16.01	14.82	20.57	22.20	-	8.21	18.45	16.71
		total (%)	100	100	100	100	-	100	100	100
	Chemical contents of comb- ustible	carbon (%)	25.70	32.28	20.77	24.36	-	29.94	33.11	27.69
		hydrogen (%)	6.29	7.28	4.68	5.34	-	7.32	7.19	6.35
		nitrogen (%)	0.20	0.23	0.15	0.36	-	0.22	0.61	0.30
		sulphur (%)	0.09	0.07	0.06	0.05	-	0.04	0.05	0.06
		chlorine (%)	0.21	0.33	0.17	0.27	-	0.19	0.26	0.24
		oxygen (%)	27.76	27.86	19.23	22.48	-	29.93	27.76	25.84
	total (%)	60.25	68.05	45.06	52.86	-	67.64	68.98	60.47	
	Measured LCV (kcal/kg)		2,569	3,068	2,150	3,281	-	2,797	3,222	2,848

B.5.2 Results of the Survey in Winter

1) Waste Amount

a. Household waste

The result of waste amount survey is tabulated in Table B.5.2-1.

Table B.5.2-1 Discharge Ratio of Household in Winter

Category	Number of Residence	Total Number of Family Members	Average Discharge Amount (g/d)	Average Discharge Amount (g/d/per)
Household (PEC)	35	146	72,839	499
Household (Non PEC)	25	90	99,340	1,082
Average	60	236	170,183	721

Note:

*The figure includes domestic ash.

b. Commercial, market and institutional a waste

The result of waste amount survey is tabulated in Table B.5.2-2.

Table B.5.2-2 Discharge Ratio of Commercial, Market and Institutional Waste

Category	Number of Samples	Total number	Total number of area (m ²)	Average Discharge Amount (g/d)	Average Discharge Amount	Average Discharge Amount (g/d/m ²)
Commercial (1) ^{*1}	6	--	1,858	42,548	--	22.9
Commercial (2) ^{*2}	4	--	315	45,234	--	143.6
Market	2	525 ^{*3}	--	1,502,130	2,861.2 ^{*5}	--
Institutional	2	1,270 ^{*4}	--	66,929	52.7 ^{*6}	--

Note:

- *1 commercial (1) shops
- *2 commercial (2) catering
- *3 Number of shops
- *4 Number of employee
- *5 g/shop/day
- *6 g/employee/day

2) Waste composition

a. Apparent specific gravity

The result of Apparent Specific Gravity survey is tabulated in Table B.5.2-3.

Table B.5.2-3 Apparent Specific Gravity in Winter

Category	Apparent Specific Gravity
Household (Heat Supply)	0.216
Household (Non-heat supply)	0.222
Market	0.248
Commercial (Catering)	0.170
Institutional	0.129
Household (from collection truck)	0.247

b. Waste Composition

The result of waste composition survey is tabulated in Table B.5.2-4 to B.5.2-10.

Table B.5.2-4 Summary of Waste Composition Survey in Winter

Classification		Household (PEC)	Household (Non PEC)	Market	Commercial	Institutional	Vehicle Sample	
Physical composition	combustibles	garbage (%)	43.63	35.28	32.40	29.31	9.01	39.76
		paper (%)	16.31	19.20	21.14	21.54	56.11	18.51
		textile (%)	5.76	9.17	2.03	1.46	2.81	4.16
		plastic (%)	6.90	8.13	7.63	13.64	8.11	6.89
		grass and wood (%)	2.43	1.17	16.39	0.80	0.86	3.33
		lather and rubber (%)	2.06	2.55	0.26	0.00	0.00	1.41
	Total (%)	77.09	75.50	79.85	66.75	76.90	74.06	
	non-combustibles	metal (%)	3.37	2.52	2.54	8.27	3.04	4.71
		glass (%)	18.34	17.42	12.73	24.40	18.94	14.74
		ceramic and soil (%)	0.00	0.00	0.60	0.43	0.76	1.34
		other (%)	1.19	4.50	4.31	0.11	0.34	5.10
	Total (%)	22.90	24.43	20.18	33.21	23.08	25.89	
	Total (%)		100	100	100	100	100	100
Chemical analysis	Three contents	moisture (%)	33.12	32.34	48.26	29.56	16.46	32.82
		combustibles (%)	39.48	39.61	27.83	35.22	54.91	37.24
		ash (%)	27.40	28.06	23.91	35.21	28.63	29.95
	Total (%)	100	100	100	100	100	100	
	Chemical contents of combustible	carbon (%)	19.36	19.72	12.57	16.93	24.51	19.60
		hydrogen (%)	4.28	4.45	3.09	3.87	6.06	3.82
		nitrogen (%)	0.75	0.63	0.60	0.70	0.46	0.76
		sulphur (%)	0.04	0.09	0.01	0.01	0.05	0.03
		chlorine (%)	0.84	0.22	0.53	0.56	0.11	0.33
	oxygen (%)	14.21	14.50	11.03	13.08	23.72	12.71	
	Total (%)	39.48	39.61	27.83	35.23	54.91	37.25	
Measured LCV (kcal/kg)		1,993	2,075	1,110	2,004	2,870	1,788	
Measured LCV (kcal/kg)		1,729	1,863	1,681	1,942	2,191	1,675	

Table B.5.2-5 Result for Household (PEC) in Winter

Classification			04 Dec. 1992	05 Dec. 1992	06 Dec. 1992	07 Dec. 1992	08 Dec. 1992	09 Dec. 1992	10 Dec. 1992	11 Dec. 1992	Average
Physical composition	combustibles	garbage (%)	69.00	22.50	-	43.40	55.60	44.00	35.90	35.00	43.63
		paper (%)	10.60	25.10	-	17.60	10.90	15.10	21.40	13.50	16.31
		textile (%)	9.30	7.50	-	3.10	5.70	2.50	4.80	7.40	5.76
		plastic (%)	3.30	9.80	-	9.60	6.80	7.70	6.30	4.80	6.90
		grass and wood (%)	0.30	3.30	-	0.30	1.40	2.00	8.20	1.50	2.43
		leather and rubber (%)	2.00	2.10	-	0.40	1.60	0.00	2.80	5.50	2.06
	total (%)	94.50	70.30	-	74.40	82.00	71.30	79.40	67.70	77.09	
	non-combustibles	metal (%)	0.70	4.40	-	4.20	3.60	5.00	2.00	3.70	3.37
		glass (%)	3.10	23.40	-	21.00	12.60	23.70	16.00	28.60	18.34
		ceramic and soil (%)	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00
		other (%)	1.70	1.90	-	0.30	1.80	0.00	2.60	0.00	1.19
	total (%)	5.50	29.70	-	25.50	18.00	28.70	20.60	32.30	22.90	
	Total (%)		100	100	-	99.90	100	100	100	100	99.99
Chemical analysis	Three contents	moisture (%)	43.61	20.54	-	37.35	38.24	32.97	33.03	26.12	33.12
		combustibles (%)	43.77	45.00	-	34.31	40.74	34.88	41.46	36.20	39.48
		ash (%)	12.64	34.46	-	28.35	21.00	32.13	25.51	37.69	27.40
		total (%)	100	100	-	100	99.98	99.98	100	100	100
	Chemical contents of combustibles	carbon (%)	23.60	19.16	-	17.08	20.08	16.38	22.11	17.09	19.36
		hydrogen (%)	5.34	4.22	-	3.60	4.54	3.73	4.56	3.94	4.28
		nitrogen (%)	0.56	0.50	-	0.64	0.98	0.88	1.00	0.71	0.75
		sulphur (%)	0.00	0.14	-	0.03	0.11	0.02	0.00	0.01	0.04
		chlorine (%)	1.39	0.80	-	0.54	0.68	0.67	1.33	0.44	0.84
		oxygen (%)	12.87	20.18	-	12.42	14.35	13.20	12.46	14.00	14.21
	total (%)	43.76	45.00	-	34.31	40.74	34.88	41.46	36.19	39.48	
	Lower calorific value (kcal/kg)		2,098	2,413	-	1,797	1,940	1,742	2,119	1,840	1,993

Table B.5.2--6 Result for Household (Non PEC) in Winter

Classification			04 Dec. 1992	05 Dec. 1992	06 Dec. 1992	07 Dec. 1992	08 Dec. 1992	09 Dec. 1992	10 Dec. 1992	11 Dec. 1992	A- ver- age
Physi- cal comp- osi- tion	com- busti- bles	garbage (%)	31.40	30.80	-	41.40	39.50	47.10	20.30	32.60	35.28
		paper (%)	7.50	32.40	-	21.70	23.10	10.10	18.00	9.90	19.20
		textile (%)	2.70	8.40	-	8.90	7.90	6.80	6.00	17.00	9.17
		plastic (%)	2.70	6.90	-	7.60	13.50	10.10	6.20	4.50	8.13
		grass and wood (%)	0.40	1.30	-	1.20	0.50	0.20	0.50	3.30	1.17
		leather and rubber (%)	0.10	0.00	-	4.80	0.00	1.40	2.00	7.10	2.55
	total (%)	44.80	79.80	-	85.60	84.50	75.70	53.00	74.40	75.50	
	non- comb- ustibles	metal (%)	1.50	4.50	-	1.70	2.70	0.80	2.40	3.00	2.52
		glass (%)	3.70	13.70	-	4.60	6.60	21.20	39.70	18.70	17.42
		ceramic and soil (%)	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00
other (%)		50.00	2.00	-	7.90	6.10	2.20	5.00	3.80	4.50	
total (%)	55.20	20.20	-	14.20	15.40	24.20	47.10	25.50	24.43		
Total (%)			100	100	-	99.80	99.90	99.90	100	99.90	99.93
Chem- ical analy- sis	Three con- tents	moisture (%)	30.18	34.58	-	38.83	35.65	37.37	23.05	24.53	32.34
		combustibles (%)	17.60	41.69	-	44.39	46.25	34.90	26.96	43.48	39.61
		ash (%)	52.23	23.72	-	16.79	18.10	27.73	49.98	32.01	28.06
	total (%)	100	99.99	-	100	100	100	99.99	100	100	
	Chem- ical con- tents of comb- ustible	carbon (%)	8.54	21.37	-	22.12	18.88	17.96	13.68	24.33	19.72
		hydrogen (%)	2.14	4.95	-	4.73	4.92	3.71	2.92	5.49	4.45
		nitrogen (%)	0.41	1.10	-	0.69	0.60	0.43	0.49	0.46	0.63
		sulphur (%)	0.01	0.13	-	0.15	0.14	0.04	0.08	0.00	0.09
		chlorine (%)	0.09	0.17	-	0.21	0.32	0.15	0.13	0.31	0.22
		oxygen (%)	6.40	13.96	-	16.48	21.39	12.59	9.67	12.89	14.50
total (%)	17.59	41.68	-	44.38	46.25	34.88	26.97	43.48	39.61		
Measured LCV (kcal/kg)			724	2,356	-	2,322	2,341	1,647	1,428	2,356	2,075

Table B.5.2-7 Result for Market in Winter

Classification			04 Dec. 1992	05 Dec. 1992	06 Dec. 1992	07 Dec. 1992	08 Dec. 1992	09 Dec. 1992	10 Dec. 1992	11 Dec. 1992	A- ver- age
Physi- cal comp- osi- tion	com- busti- bles	garbage (%)	30.00	54.10	-	40.00	27.60	15.40	29.90	29.80	32.40
		paper (%)	30.80	15.30	-	22.90	14.60	23.00	14.70	26.70	21.14
		textile (%)	1.40	1.10	-	1.50	5.50	2.40	0.10	2.20	2.03
		plastic (%)	7.10	3.70	-	9.70	3.30	13.90	7.40	8.30	7.63
		grass and wood (%)	25.10	8.80	-	19.60	16.80	25.50	10.10	8.80	16.39
		leather and rubber (%)	0.00	0.00	-	0.00	0.00	0.00	1.80	0.00	0.26
	total (%)	94.40	83.00	-	93.70	67.80	80.20	64.00	75.80	79.85	
	non- comb- ustibles	metal (%)	0.10	3.30	-	2.50	2.30	2.40	3.30	3.90	2.54
		glass (%)	1.30	11.30	-	3.90	29.90	17.40	5.00	20.30	12.73
		ceramic and soil (%)	4.20	0.00	-	0.00	0.00	0.00	0.00	0.00	0.60
other (%)		0.00	2.40	-	0.00	0.00	0.00	27.80	0.00	4.31	
total (%)	5.60	17.00	-	6.40	32.20	19.80	36.10	24.20	20.18		
Total (%)			100	100	-	100	100	100	100	100	100
Chem- ical analy- sis	Three con- tents	moisture (%)	57.11	40.73	-	55.43	44.45	50.06	40.39	49.65	48.26
		combustibles (%)	31.33	36.59	-	33.28	20.52	27.15	21.68	24.23	27.83
		ash (%)	11.57	22.69	-	11.29	35.03	22.78	37.92	26.12	23.91
	total (%)	100	100	-	100	100	99.99	99.99	100	100	
	Chem- ical con- tents of combu- st- ible	carbon (%)	14.58	16.54	-	16.85	10.09	11.91	8.71	9.30	12.57
		hydrogen (%)	3.57	3.95	-	4.09	2.40	2.86	2.35	2.42	3.09
		nitrogen (%)	0.70	0.74	-	0.81	0.29	0.37	0.58	0.69	0.60
		sulphur (%)	0.00	0.00	-	0.01	0.01	0.01	0.03	0.01	0.01
		chlorine (%)	0.71	0.54	-	0.68	0.45	0.46	0.41	0.46	0.53
		oxygen (%)	11.78	14.82	-	10.84	7.27	11.53	9.61	11.35	11.03
total (%)	31.34	36.59	-	33.28	20.51	27.14	21.69	24.23	27.83		
Measured LCV (kcal/kg)			1,204	1,482	-	1,298	808	1,079	923	978	1,110

Table B.5.2-8 Result for Commercial in Winter

Classification			04 Dec. 1992	05 Dec. 1992	06 Dec. 1992	07 Dec. 1992	08 Dec. 1992	09 Dec. 1992	10 Dec. 1992	11 Dec. 1992	Aver- age
Physi- cal comp- osi- tion	com- busti- bles	garbage (%)	47.40	44.90	-	40.80	22.40	9.70	29.30	10.70	29.31
		paper (%)	23.10	23.00	-	14.50	36.10	25.50	14.40	14.20	21.54
		textile (%)	1.10	0.90	-	0.30	1.10	1.30	0.10	5.40	1.46
		plastic (%)	6.50	17.40	-	11.90	19.70	13.70	13.00	13.30	13.64
		grass and wood (%)	1.80	0.00	-	0.80	0.70	0.10	0.10	2.10	0.80
		leather and rubber (%)	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00
	total (%)	79.90	86.20	-	68.30	80.00	50.30	56.90	45.70	66.75	
	non- comb- ustibles	metal (%)	3.20	10.70	-	3.80	7.40	7.40	11.20	14.20	8.27
		glass (%)	16.60	0.00	-	27.50	12.60	42.20	31.90	40.00	24.40
		ceramic and soil (%)	0.00	3.00	-	0.00	0.00	0.00	0.00	0.00	0.43
other (%)		0.30	0.00	-	0.50	0.00	0.00	0.00	0.00	0.11	
total (%)	20.10	13.70	-	31.80	20.00	49.60	43.10	54.20	33.21		
Total (%)			100	99.90	-	100	100	99.90	100	99.90	99.96
Che- mical analy- sis	Three con- tents	moisture (%)	38.42	30.00	-	47.41	30.72	20.02	27.91	12.46	29.56
		combustibles (%)	38.43	53.40	-	20.27	45.93	28.37	27.61	32.56	35.22
		ash (%)	23.17	16.59	-	32.32	23.33	51.60	44.49	54.98	35.21
		total (%)	100	99.99	-	100	99.98	99.99	100	100	99.99
	Che- mical con- tents of combu- stible	carbon (%)	17.68	26.30	-	8.57	23.39	13.35	13.37	15.88	16.93
		hydrogen (%)	4.22	5.94	-	1.93	5.20	3.23	3.15	3.45	3.87
		nitrogen (%)	0.34	1.33	-	0.26	1.45	0.34	0.85	0.88	0.78
		sulphur (%)	0.00	0.02	-	0.00	0.01	0.01	0.01	0.00	0.01
		chlorine (%)	0.40	0.57	-	0.22	1.09	0.27	0.61	0.75	0.56
		oxygen (%)	15.79	19.25	-	9.30	14.79	11.17	9.63	11.60	13.08
	total (%)	38.43	53.41	-	20.28	45.93	28.37	27.62	32.56	35.23	
Measured LCV (kcal/kg)			2,000	2,948	-	1,040	2,879	1,584	1,476	2,102	2,004

Table B.5.2-9 Result for Institutional in Winter

Classification			04 Dec. 1992	05 Dec. 1992	06 Dec. 1992	07 Dec. 1992	08 Dec. 1992	09 Dec. 1992	10 Dec. 1992	11 Dec. 1992	Aver- age
Physi- cal compo- sition	com- busti- bles	garbage (%)	10.80	6.90	-	15.90	6.30	6.80	11.70	4.70	9.01
		paper (%)	69.90	44.20	-	61.60	52.20	53.00	42.50	69.40	56.11
		textile (%)	8.10	0.20	-	7.90	1.10	1.70	0.30	0.40	2.81
		plastic (%)	3.70	13.40	-	10.10	8.50	3.20	5.10	12.80	8.11
		grass and wood (%)	0.40	0.50	-	1.90	0.00	0.20	2.20	0.80	0.86
		leather and rubber (%)	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00
	total (%)	92.90	65.20	-	97.40	68.10	64.90	61.80	88.10	76.90	
	non- comb- ustibles	metal (%)	0.60	9.20	-	2.50	1.50	0.80	4.90	1.80	3.04
		glass (%)	5.50	19.10	-	0.00	30.30	34.40	33.20	10.10	18.94
		ceramic and soil (%)	0.00	5.30	-	0.00	0.00	0.00	0.00	0.00	0.76
other (%)		1.00	1.20	-	0.00	0.20	0.00	0.00	0.00	0.34	
total (%)	7.10	34.80	-	2.50	32.00	35.20	38.10	11.90	23.08		
Total (%)			100	100	-	99.90	100	100	99.90	100	99.98
Chem- ical analy- sis	Three con- tents	moisture (%)	29.08	12.90	-	22.19	13.47	13.87	10.54	13.16	16.46
		combustibles (%)	56.47	48.95	-	67.98	50.47	46.13	46.63	67.72	54.91
		ash (%)	14.45	38.14	-	9.83	36.06	40.00	42.82	19.12	28.63
	total (%)	100	99.99	-	100	100	100	99.99	100	100	
	Chem- ical con- tents of com- bustible	carbon (%)	27.05	21.39	-	29.49	20.49	21.09	21.73	30.35	24.51
		hydrogen (%)	6.30	5.04	-	7.79	5.43	5.13	5.29	7.47	6.06
		nitrogen (%)	0.51	0.70	-	0.45	0.33	0.26	0.26	0.68	0.46
		sulphur (%)	0.04	0.03	-	0.07	0.05	0.04	0.04	0.05	0.05
		chlorine (%)	0.16	0.08	-	0.14	0.07	0.10	0.11	0.11	0.11
		oxygen (%)	22.41	21.71	-	30.04	24.10	19.51	19.20	29.06	23.72
total (%)	56.47	48.95	-	67.98	50.47	46.13	46.63	67.72	54.91		
Measured LCV (kcal/kg)			2,829	2,635	-	3,245	2,524	2,535	2,326	3,997	2,870

Table B.5.2-10 Result for Household Waste (from Container) in Winter

Classification			04 Dec. 1992	05 Dec. 1992	06 Dec. 1992	07 Dec. 1992	08 Dec. 1992	09 Dec. 1992	10 Dec. 1992	11 Dec. 1992	A- ver- age	
Physi- cal comp- osi- tion	com- busti- bles	garbage (%)	51.60	32.00	-	41.40	41.80	24.70	51.80	35.00	39.76	
		paper (%)	17.10	10.80	-	17.80	21.50	29.50	19.40	13.50	18.51	
		textile (%)	1.70	1.40	-	2.60	3.20	11.30	1.50	7.40	4.16	
		plastic (%)	5.00	6.40	-	8.50	5.70	10.40	7.40	4.80	6.89	
		grass and wood (%)	2.40	5.30	-	6.00	4.60	1.60	1.90	1.50	3.33	
		leather and rubber (%)	0.00	0.30	-	3.10	0.00	0.50	0.50	5.50	1.41	
	total (%)	77.80	56.20	-	79.40	76.80	78.00	82.50	67.70	74.06		
	non- com- busti- bles	metal (%)	2.20	9.10	-	8.00	3.70	2.30	4.00	3.70	4.71	
		glass (%)	6.10	17.80	-	4.50	15.80	17.20	13.20	28.60	14.74	
		ceramic and soil (%)	9.40	0.00	-	0.00	0.00	0.00	0.00	0.00	1.34	
		other (%)	4.60	16.70	-	8.00	3.70	2.50	0.20	0.00	5.10	
	total (%)	22.30	43.60	-	20.50	23.20	22.00	17.40	32.30	25.89		
	Total (%)			100	99.80	-	99.90	100	100	99.90	100	99.95
Chem- ical anal- ysis	Three con- tents	moisture (%)	34.38	22.89	-	37.17	34.50	32.33	42.32	26.12	32.82	
		combustibles (%)	38.79	30.07	-	37.96	36.87	42.91	36.94	37.17	37.24	
		ash (%)	26.83	47.04	-	24.88	28.64	24.78	20.74	36.72	29.95	
	total (%)	100	100	-	100	100	100	100	100	100	100	
	Chem- ical con- tents of comb- ust- ible	carbon (%)	22.75	15.05	-	20.51	17.38	23.29	18.16	20.07	19.60	
		hydrogen (%)	3.99	3.01	-	3.80	3.90	4.57	3.93	3.52	3.82	
		nitrogen (%)	0.98	0.92	-	0.56	0.74	0.89	0.57	0.67	0.76	
		sulphur (%)	0.01	0.10	-	0.00	0.01	0.04	0.02	0.00	0.03	
		chlorine (%)	0.46	0.13	-	0.43	0.29	0.35	0.43	0.21	0.33	
		oxygen (%)	10.60	10.86	-	12.65	14.54	13.77	13.82	12.70	12.71	
	total (%)	38.79	30.07	-	37.95	36.86	42.91	36.93	37.17	37.25		
	Measured LCV (kcal/kg)			1,720	1,401	-	1,792	1,965	2,143	1,790	1,702	1,788

B.6 Findings

B.6.1 Waste Amount

1) Discharge Ratio

a. Household waste

The waste discharge of households receiving heating supply from the district in winter was almost the same as in summer. On the other hand, the waste discharge of households not receiving any heating from the district in winter is much higher than the data in summer. Ashes resulting from the burning of coals used as heating sources were observed to cause the increase in waste discharge. Table B.3-1 presents the comparison of the waste discharge ratio of the population supplied and not supplied with heating.

Table B.6.1-1 Waste Discharge Ratio of Household Waste
unit: g/person/day

Category of population	Population	Summer	Winter	*Weighing Average
Heat supply	354,060	427.0	499.7	469.4
Non-heat supply	236,040	676.4	1,081.6	912.8

Note:

* According to the information from PEC, summer period is May to Sept. (5 months) and winter period is Oct. to Apr. (7 months). The weighing average is deduced based on this period.

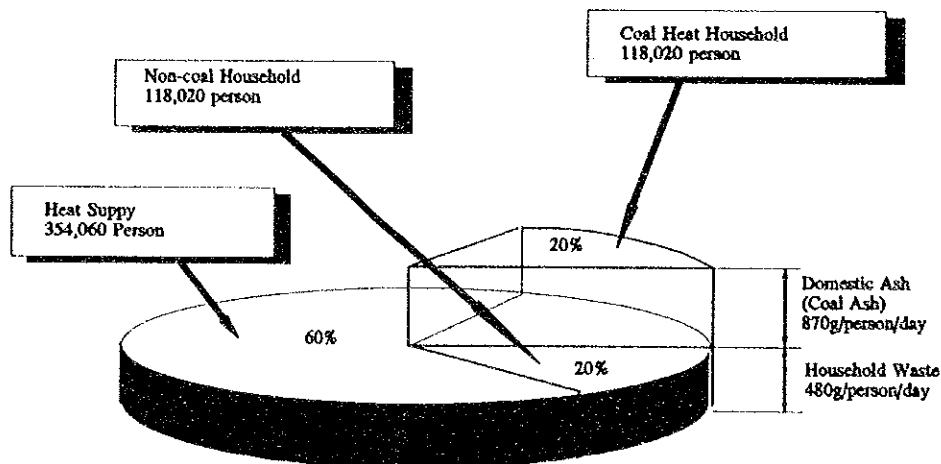


Fig.B.6.1-1 Component of Household Waste

Although the population that discharges ash fluctuates by season, about 50% of the population not receiving heat from the district uses coal for heating according to the POS and WACS done by the Study Team. Table B.3-2 shows the comparison of waste discharge ratio of the population using coal for heating and those not using coal among the household not having district heating.

Table B.6.1-2 Waste Discharge Ratio of Non-heat Supply Population
unit: g/person/day

Category of population	Population	Summer	Winter	Weighing Average
Coal heat	118,020	903.0	1,663.6	1,346.7
Non-Coal heat	118,020	449.8	499.6	479.0

Table B.3-3 presents the comparison of the waste discharge ratio of household waste and domestic ash of the population using coal for heating. Domestic ash here means the ash discharged by households using coal-heating.

For better understanding, the component of household waste is illustrated in Fig.B.3-1.

Table B.6.1-3 Waste Discharge Ratio from Coal Heat Population
unit: g/person/day

Category of Waste	Population	Summer	Winter	Weighing Average
Household waste	118,020	449.8	499.6	479.0
Ash from coal	118,020	453.2	1164.0	867.8

As clearly shown in Fig.B.3-1, household waste is divided into two categories: household waste and domestic ash. Consequently, the discharge ratios in 1992 are concluded as follows:

- household waste : 480 g/person/day for total population
- domestic ash : 870 g/person/day for ash discharge population
- : 174 g/person/day for total population

Hence, the discharge amount of wastes is:

Household Waste	: 283.2 ton/day
Domestic Ash	: 102.8 ton/day
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Total	: 386.0 ton/day

b. Commercial, market and institutional waste

Based on the average of the data in summer and winter, unit discharge ratio was determined as shown in Table B.6.1-4.

Table B.6.1-4 Waste Discharge Ratio

Waste Category	unit	Summer	Winter	Average	Adopted Figure
Commercial Waste					
Shops	g/m ² /day	24.5	22.9	23.7	24
Catering	g/m ² /day	173.4	143.6	158.5	160
Market Waste	g/shop/day	3,204.7	2,861.2	3,037	3,040
Institutional Waste	g/employee/day	63.2	52.7	58.0	58

Accordingly, the discharge amount in 1992 of each category of waste is as follows:

i. Commercial waste

The floor areas of each business category are as follows;

Catering shops	: 202,966 m ²
Other shops than catering	: 172,725 m ²

Hence, the amount of wastes discharged were estimated as follows;

Catering shops	: 27.6 ton/day
Other shops	: 4.9 ton/day

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Total	: 32.5 ton/day

ii. Market waste

The number of shops in markets given were 1,970 shops in 1992.

Amount of waste discharged : 6 ton/day

iii. Institutional waste (Office waste)

The total number of institutional employees were estimated at 161,085 persons by the statistic data, hence;

Amount of waste discharged : 9.3 ton/day

c. Road sweeping waste

Based on the Time & Motion Survey conducted in June 1992, the following discharge ratio was obtained:

Total discharge amount : 410 kg
Total milage : 7.2 km

Hence,

Unit discharge ratio : 57 kg/km
Average sweeping distance per day per truck : 20 km/day
Average number of sweepers working per day : 4 units
Average sweeping length per day : 80 km/day

Hence,

Amount of waste collected : 4.6 ton/day

However, if the number of working days a year is 315, then,

Discharge ratio per day : 4.0 ton/day

d. Bulky waste

The amount of the bulky waste was obtained by the three days observation of incoming vehicles to the SLL(Suchy Las Landfill) in May 1992. The amount of the bulky waste is deduced as follows;

- average number of vehicles per day : 13 units
- average weight : 1.4 ton/day
- disposal amount per day : 18.2 ton/day

The working days of the SLL a year is 315 days. Hence,

Discharge ratio per day : 15.7 ton/day

e. Other wastes

The Suchy Las landfill received wastes other than MSW mentioned above and they are categorized as follows;

- PEC ash
- sewage sludge
- others

The total disposal amount of the other wastes was obtained by the record of truck scale installed in June 1992. Considering the working days (315 days) of the SLL and the results of interview survey to the PEC and two sewage plants, daily disposal amount of the other wastes are as follows:

- PEC ash : 14.9 ton/day
- sewage sludge : 40.9 ton/day
- others : 26.6 ton/day

f. Conclusion

The waste discharge and disposal ratio was concluded as shown in Table B.6.1-5.

Table B.6.1-5 Waste Discharge

Category of Waste	Discharge Ratio	Quantity	Waste Amount per Day (tonne/day)
1. MSW			
Household Waste	-	-	386.0
(Household Waste)	(480)	(590,100 persons)	(283.2)
(Domestic Ash)	(870)	(118,020 persons)	(102.8)
Commercial Waste	-	-	32.5
(Shops)	(24)	(202,966 m ²)	(4.9)
(Catering)	(160)	(172,725 m ²)	(27.6)
Market Waste	3,040	1,940 shops	6.0
Institutional Waste	58	161,085 employee	9.3
Road Sweeping Waste	-	-	4.0
Bulky Waste	-	-	*15.7
Sub-total			453.5
2. Other Wastes			
PEC Ash	-	-	14.9
Sewage Sludge	-	-	40.9
Others	-	-	26.6
Sub-total			*82.4
Total			535.9

Note: * The figure is disposal amount.

Accordingly, the following major figures on waste discharge ratio are deduced:

- MSW discharge amount : 453.5 ton/day
- MSW discharge ratio per capita : 769 g/person/day
- Annual MSW discharge : 165,500 ton/year

2) Waste Disposal Amount at Suchy Las Landfill

The waste disposal amount at Suchy Las landfill obtained by the use of the truck scale is as follows;

- in summer : 573.4 ton/day
- in winter : 600.6 ton/day
- Average : 589.3 ton/day (5 months summer and
7 months winter)

Assuming the working days per year for the disposal site is 315 days/year, the total disposed amount per day is **508.6 ton/day**.

According to the observation shown in Table B.6.1-5, the disposal amount of wastes other than MSW was 82.4 ton/day. Consequently, the actual disposal amount of MSW is calculated at **426.2 ton/day**. The figure is equivalent to **93.9%** of the estimated discharge amount of MSW.

Considering the present collection coverage ratio is 90 % and permissible error of the WACS, these results are observed to be quite reasonable.

B.6.2 Waste Composition

Upon consideration of the ratio of the discharge amount of each category of waste, the composition of MSW except for domestic ash, road sweeping and bulky wastes is estimated and tabulated in Table B.3-9 and B.3-10: i.e. the weighing average waste composition of household waste excluding ash, commercial, market and institutional wastes is calculated.

Table B.6.2-1 Physical Composition of MSW (Wet Base)

Category	Item	Ratio (%)
Combustible	Garbage	33.95
	Paper	19.33
	Textile	7.27
	Plastics	7.89
	Grass & Wood	5.90
	Leather & Rubber	2.26
	Sub-total	76.60
Noncombustible	Metal	3.76
	Glass	15.16
	Ceramic & Soil	1.53
	Others	2.93
	Sub-total	23.38
	Total	100

Note: MSW here excludes domestic ash and road sweeping and bulky waste.

Table B.6.2-2 Chemical Composition of MSW

Category	Item	Ratio (%)
Three contents	Moisture	35.74
	Combustible	38.04
	Ash	26.23
Chemical Contents of Combustible	Carbon	19.03
	Hydrogen	4.21
	Nitrogen	0.71
	Sulphur	0.05
	Chlorine	0.40
	Oxygen	13.63
C/N Ratio		26.8
Lower Calorific Value (All Waste and Measured)		1,854 kcal/kg
		7,762 kj/kg
Lower Calorific Value (Combustible Matter)		5,442 kcal/kg
		22,785 kj/kg

Note: MSW here excludes domestic ash and road sweeping and bulky waste.

In order to clearly understand the lower calorific value (all waste) of MSW excluding road sweeping and bulky wastes, the following figures are calculated by the formula described in the previous section b, iii Estimation of the LCV.

Table B.6.2-3 Lower Calorific Values

Waste Category	Lower Calorific Value (kcal/10g)
MSW ^{*1} without Ash (Measured)	1,854
MSW without Ash (Estimated)	1,805
MSW with Ash (Estimated)	1,437
Household Waste without Ash (Estimated)	1,792
Household Waste with Ash (Estimated)	1,384
Household Waste (Coal-heat household) with Ash (Estimated)	806
Household Waste (1984/85 Waste Study) ^{*2}	855

Note: *1 MSW here excludes domestic ash and road sweeping and bulky waste.

*2 1984/85 Waste Study means "Research on Technological Properties of Poznan Municipal Waste" done by Engineering College of Warsaw.

For more reference, the comparison figures are prepared as shown in Fig. B.6.2-1 to B.6.2-5.

The figures show the relationship between non-combustible, combustible, moisture and calorific value. The figures also indicate the data of household waste in 1984/85 and MSW in 1992. This comparison figure also shows the reference lines which are prepared by supposing the lower calorific value of combustibles were 5,000 kcal/kg and 4,000 kcal/kg.

For the elaboration of Table B.3-11 upon consideration of the 1984/85 Waste Study, the three contents of the coal ash were supposed as follows: i.e., coal ash can still be used as a heating stimulant.

- Moisture : 45 %
- Combustibles : 10 %
- Ash : 45 %

According to Table B.3-11, the estimated LCV of household wastes with ash from houses with a coal based heating system is calculated at 806 Kcal/kg. This is very similar to the figure (855 Kcal/kg) of the 1984/85 Waste Study.

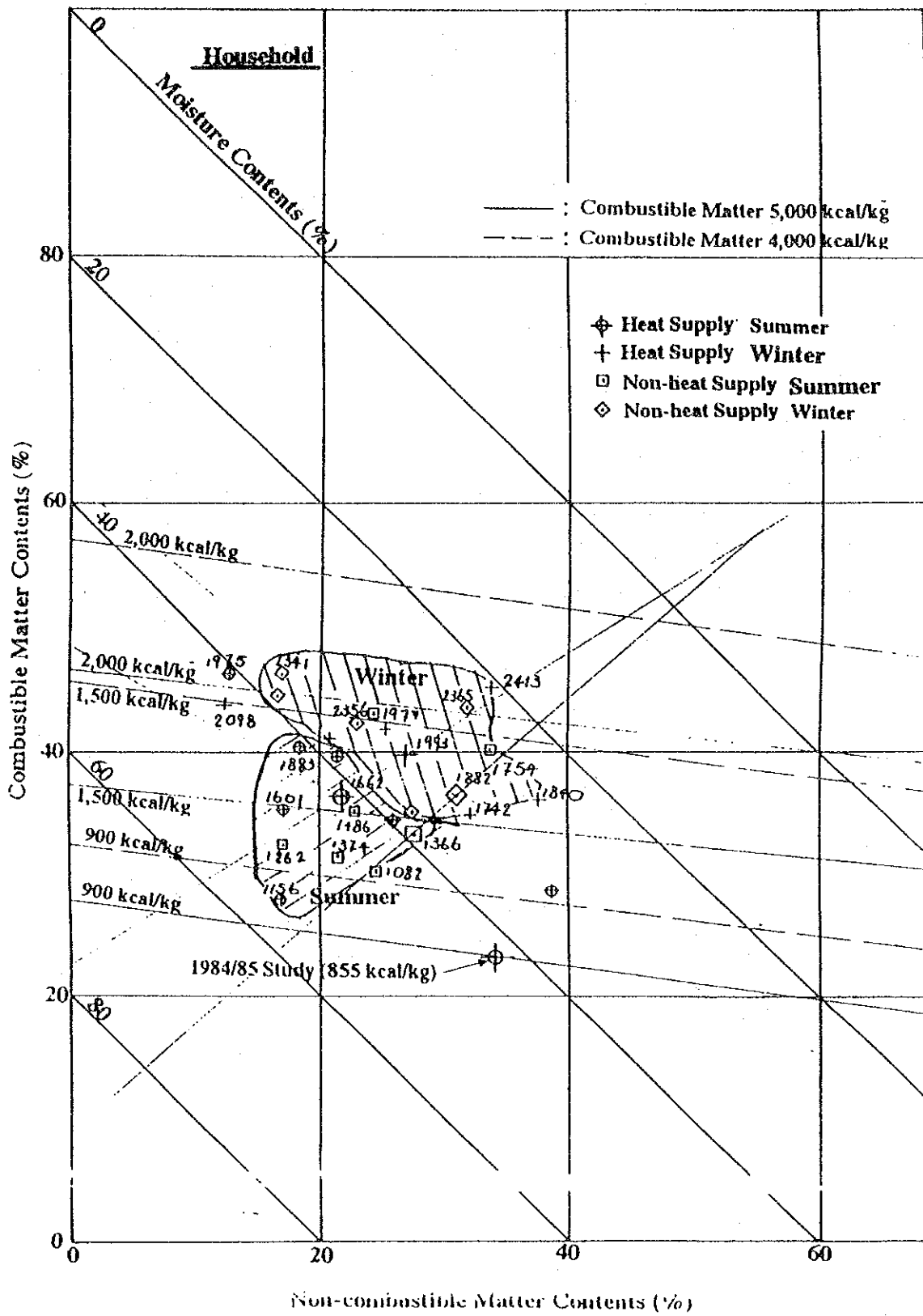


Fig.B.6.2-1 Measured Data of Three Contents of Household Waste

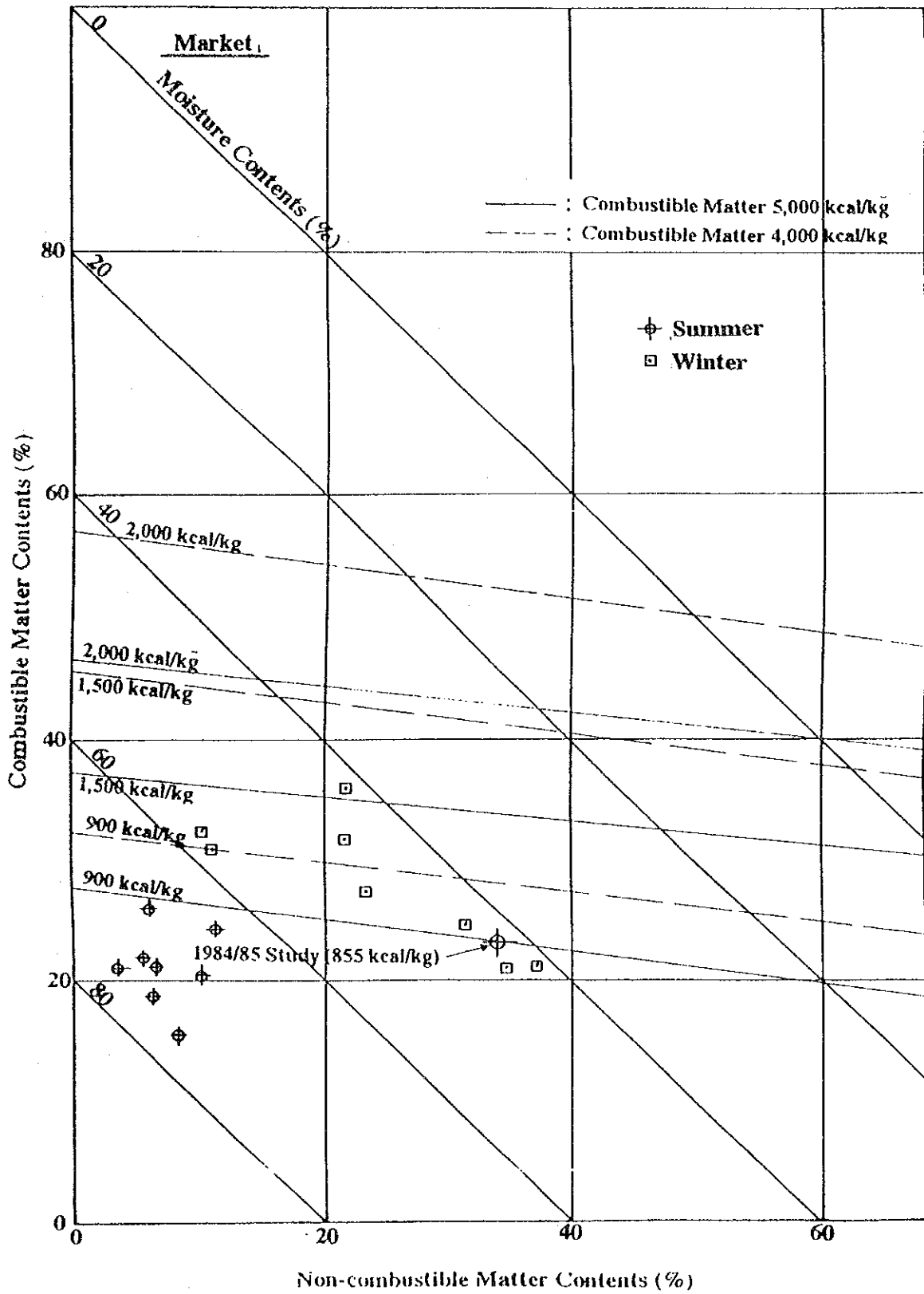


Fig.B.6.2-2 Measured Data of Three Contents of Market Waste

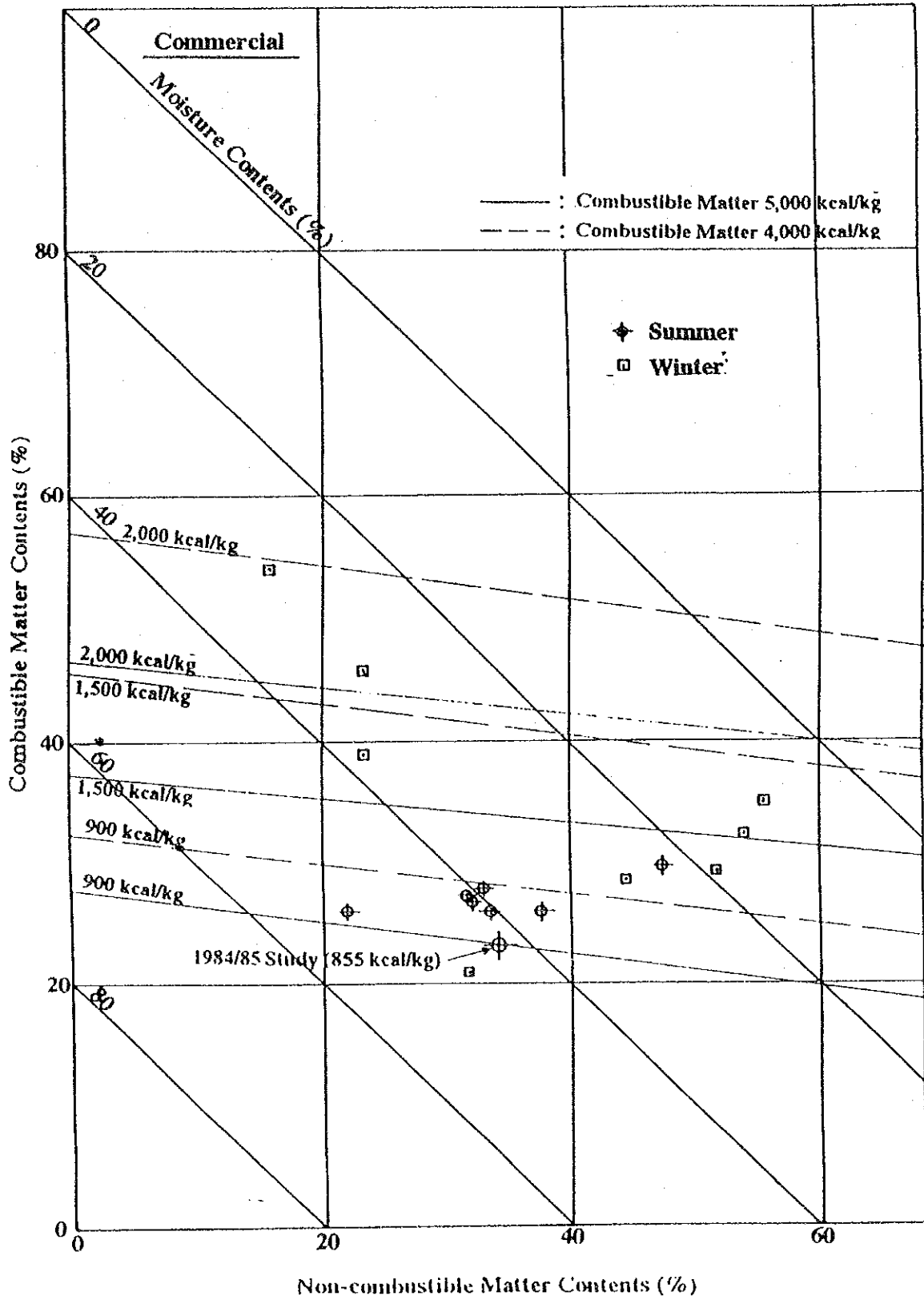


Fig.B.6.2-3 Measured Data of Three Contents of Commercial Waste

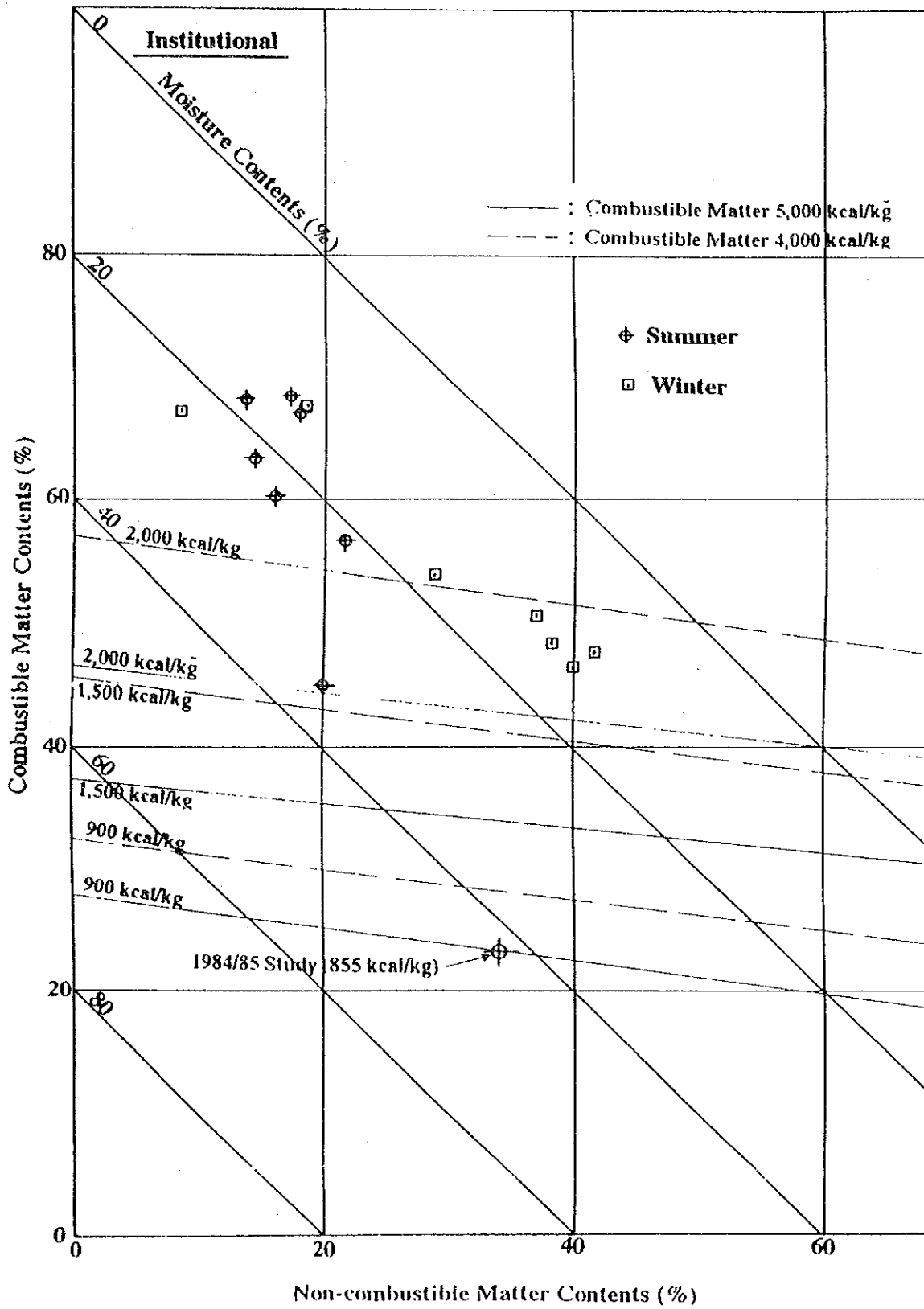


Fig.B.6.2-4 Measured Data of Three Contents of Institutional Waste

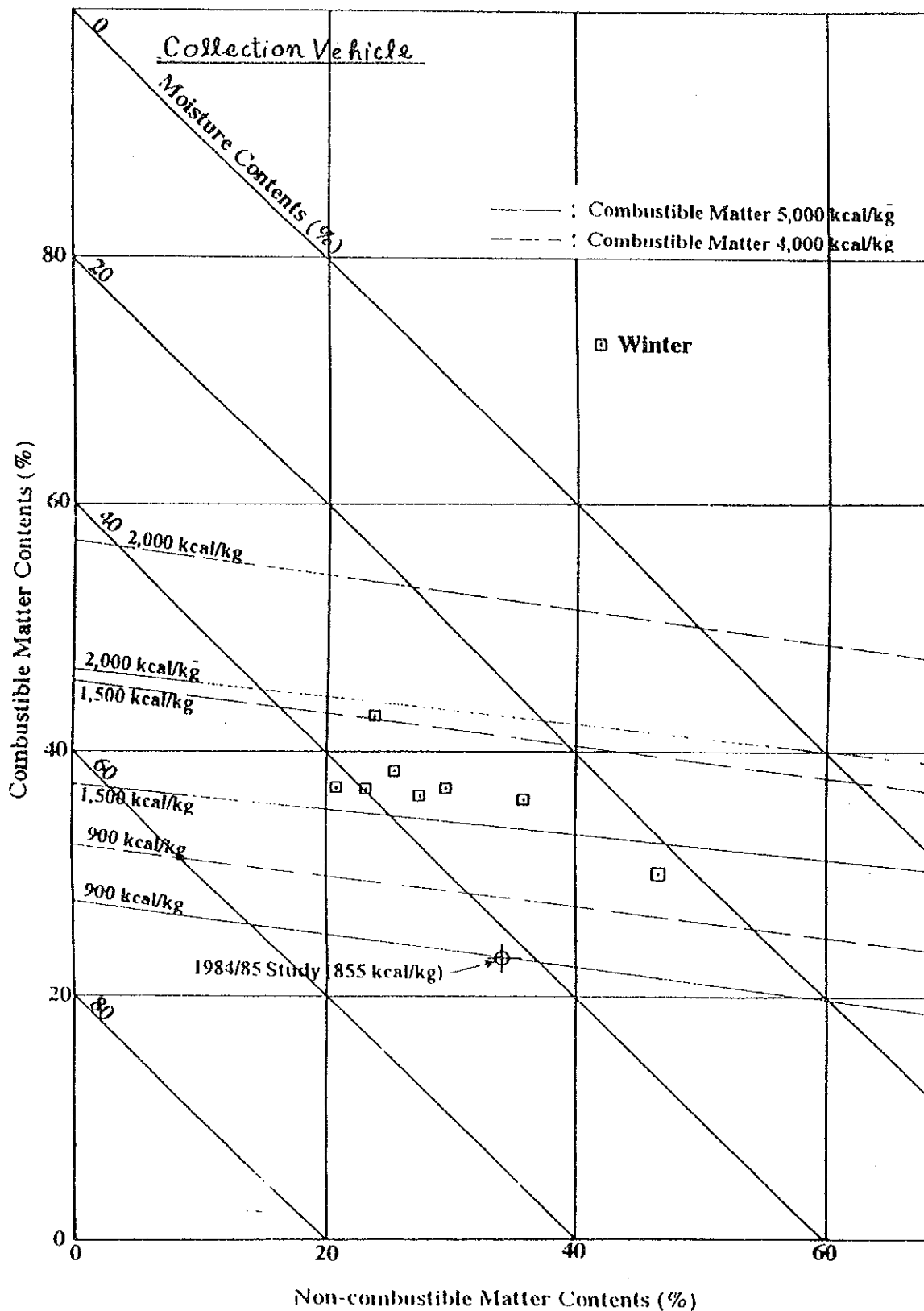


Fig.B.6.2-5 Measured Data of Three Contents of Household Waste from Communal Container

ANNEX C

PUBLIC OPINION SURVEY

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APPENDIX C PUBLIC OPINION SURVEY

This chapter describes the public opinion survey which was carried out during the 1st study period. This survey found citizens' problems, intentions, opinions, etc. concerning MSWM.

C.1 Objectives of the Survey

The public opinion survey was carried out to understand the people's view on SWM, which will be taken into account in the formulation of the SWM master plan. The main objectives are summarized below.

- a. To collect basic information concerning SWM.
- b. To understand the present SWM problems.
- c. To understand the present waste discharge, storage and collection systems.
- d. To obtain the ratio of the families discharging ash.
- e. To comprehend the citizen's understanding level of SWM.
- f. To obtain public cooperation in waste segregation at the generation source.
- g. To understand the given waste collection fee for citizens
- h. To understand the present SWM level considered satisfactory by the citizens.

C.2 Selection of the Survey Area

In order to obtain the public opinion of and the basic information concerning the majority of the citizens in Poznan City, the sample residences and shops were selected in the following manners:

- 1) The residential area was classified into the three categories shown below and interviewees were selected in each categories in the proportion to the actual population of these residential areas.
 - New buildings constructed after 1945 : 60 interviewees
 - Old buildings constructed before 1945 : 30 interviewees
 - Detached or semi-detached house : 30 interviewees

- 2) The disposal of ashes from residential stoves to waste containers is considered to be very important in determining the composition of waste. Forty percent of the interviewees in residential areas were selected from areas not receiving heat supply from the municipal company, PE3.2. Therefore, the population in Poznan City receiving heat supply from PEC was 60% in 1991.
- 3) For sampling in shops and restaurants, areas with various shops were selected so that the average composition of waste represents will be obtained.

Table C.2-1 Sample Points of Public Opinion Survey

No	Category	Heat	Sample No.	Location
1	New Apartment after 1945	PEC*	10	Piatkowo
2			10	Piatkowo
3			10	Winogrady
4			10	Winogrady
5			10	Rataje Osiedle Orla Bialego 47-71
6		Not PEC	10	Wilda ul. Rolna
7	Old Apartment before 1945	PEC	10	Centrum
8		Not PEC	10	Lazarz Rynek Lazarski
9			10	Wilda ul. Madalinskiego
10	Detached or Semi-detached House	PEC	10	Winogrady, os, Kosmonautow/os, Przyjazni
11		Not PEC	10	Junikowo ul. Braniborska
12			10	Solacz
13	Shop, Restaurant, etc.	-----	15	Sw. Marcin
14		-----	15	Stare Miasto
Total			150	

Note: * PEC means central heating distributed area.

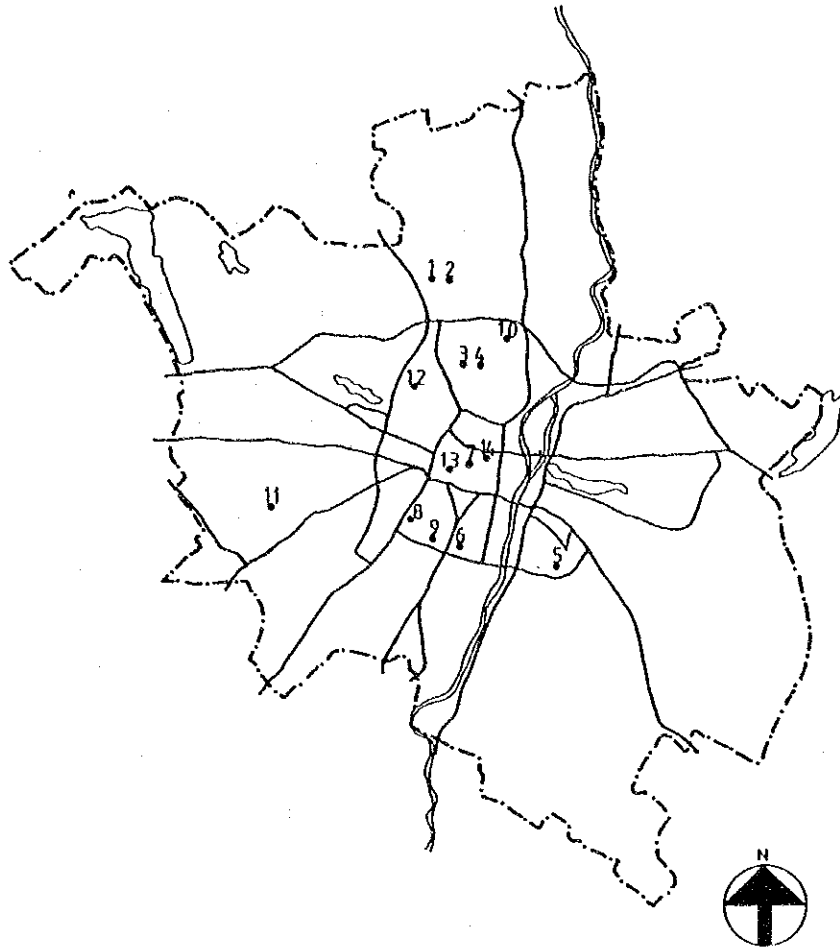


Fig.C.2-1 Sampling Points Map of Public Opinion Survey

C.3 Method of the Survey

Considering the present condition of SWM and the characteristics of Poznan City, a draft questionnaire was written in English by the Study Team. After translation into Polish, the draft questionnaire was reviewed and corrected through discussion with the counterparts in order to meet with the situation Poznan City.

Before the execution of the survey, the Study Team performed a lecture for the interviewers in order to let them understand the objectives and the contents of the survey.

POS was conducted by interviewing each resident, shop and restaurant owners or employees. The interviewer visited each interviewee and collect answers from them at the same time. All the answers were imputed into a computer for analyzing.

C.4 Results of the Survey

Q1-3 Category of House

	Residential Area	Commercial Area
New Apartment Building (after 1945)	46 %	7 %
Old Apartment Building (before 1945)	28 %	90 %
Detached or Semi-Detached House	26 %	3 %

Q1-4 Distance from the house to communal container of discharge point

	Residential Area	Commercial Area
In front of the premises	10 %	19 %
Less than 10 m	30 %	33 %
10 - 29 m	33 %	36 %
30 - 49 m	13 %	0 %
50 m or more	7 %	6 %
There is no communal container or discharge point in this area.	7 %	6 %

II General Questions

Q2-1 Business Category of the House

	Residential Area	Commercial Area
Residence	97 %	0 %
Restaurant	0 %	23 %
Shops except restaurant	0 %	40 %
Private Office	0 %	3 %
Others	3 %	34 %

Q2-2 Type of Interviewee

	Residential Area	Commercial Area
Housewife	18 %	0 %
The master of house or owner of shop	62 %	30 %
Children	4 %	0 %
Other family member	11 %	0 %
Housekeeper or employee	3 %	60 %
Others	2 %	10 %

Q2-4 Number of persons staying in the house/shop/office.

	Residential Area	Commercial Area
Number of persons staying	3.95 persons	22.3 persons

Q2-5 Number of dwelling years at this place

	Residential Area	Commercial Area
Less than 5 years	23 %	57 %
5 - 10 years	16 %	7 %
10 - 19 years	26 %	13 %
20 years or more	35 %	23 %

Q2-6 Area of the house/shop/office

	Residential Area		Commercial Area
	Apartment	Detached	
Area of the house/shop/office	56.9 m ²	125.3 m ²	356.5 m ²

Q2-7 Heat Supply System

	Residential Area	Commercial Area
Municipal Heating Network	65 %	43 %
Stove	22 %	17 %
Gas	11 %	13 %
Others	3 %	27 %

Q2-8 If so, is the ash collected separately from the other waste?

	Residential Area	Commercial Area	Total
Yes	42 %	75 %	49 %
No	58 %	25 %	51 %

Q2-9 How many month per year the ash is discharged?

	Residential Area	Commercial Area	Total Average
Discharge month per year	6.44	8.87	6.9

Q2-10 Employment of The Master

	Residential Area	Commercial Area
Public Servant	35 %	40 %
Employee of Private Company	16 %	30 %
Owner of company, shop, etc.	10 %	30 %
No working people	39 %	0 %

Q2-11 Total expenditure of your family per month

	Residential Area
Less than 2 million zlotych/month	13 %
2 - 4 million zlotych/month	50 %
4 - 6 million zlotych/month	11 %
6 - 8 million zlotych/month	4 %
More than 8 million zlotych/month	0 %
I don't know.	22 %

III Questions on Discharge of Waste from Your House

Q3-1 Do you discharge ash from your heating equipment?

	Residential Area	Commercial Area
Yes	35 %	27 %
No	65 %	73 %

If yes, please answer 3-2 and 3-3.

Q3-2 Do you discharge ash with other mode of wastes?

	Residential Area	Commercial Area
Yes	79 %	17 %
No	21 %	83 %

Q3-3 How many months per year do you discharge ash?

	Residential Area	Commercial Area
month per year	6.44	8.87

Q3-4 Who discharges waste from your house?

	Residential Area
Housewife	28 %
The master	42 %
Children	8 %
Other family member	17 %
Guardian or employee	3 %
Others	3 %

Q3-5 Where do you discharge waste from your house?

	Residential Area	Commercial Area
Individual container	33 %	37 %
Communal container	63 %	50 %
Dust chute	3 %	0 %
Others	1 %	13 %

Q3-6 What type of container do you use for carrying waste to discharge point in question No.3-5?

	Residential Area	Commercial Area
Plastic bag	29 %	27 %
Plastic bucket	64 %	43 %
Metal bucket	8 %	7 %
Others	0 %	23 %

Within the replies of "Others", more than half interviewees replied for "Cardboard".

Q3-7 Why do you use it? (Multiple answers were made by interviewee.)

	Residential Area	Commercial Area
It is clean after collection work.	38 %	28 %
It prevents foul odour.	16 %	21 %
It is easy handling.	73 %	46 %
Keep away pest such as flies.	3 %	0 %
Others	0 %	5 %

Q3-8 Do you discharge waste at fixed time?

	Residential Area	Commercial Area
Yes	38 %	37 %
No	57 %	63 %
I don't know.	6 %	0 %

Q3-9 If "Yes", what time do you usually discharge your waste?

	Residential Area	Commercial Area
6:00 - 8:59	22 %	0 %
9:00 - 11:59	4 %	5 %
12:00 - 14:59	0 %	0 %
15:00 - 17:59	7 %	19 %
18:00 - 20:59	23 %	24 %
21:00 - 23:59	9 %	8 %
24:00 - 2:59	0 %	0 %
3:00 - 5:59	1 %	1 %
I don't know.	34 %	35 %

Q3-10 What type of container do you use for waste collection?

	Residential Area	Commercial Area
Individual container of the SANITECH (110 litre)	34 %	37 %
Individual container other than the one of SANITECH	4 %	0 %
Communal container of the SANITECH	44 %	37 %
Communal container other than the one of SANITECH	9 %	0 %
Others	1 %	19 %
I don't know.	8 %	7 %

Q3-11 Where is your container for waste collection located?

	Residential Area	Commercial Area
In front of my premises	36 %	24 %
Behind the premises	20 %	17 %
Communal container yard of the building	43 %	59 %
Curb side near my building	1 %	0 %