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LNWT IN GUYANA

CASE STUDY ON WASTE MANAGEMENT

By

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INTRODUCTION

This study analyzes the environmental issues arising from solid and liquid waste management in Guyana. It reviews on the basis of earlier work, particularly that of the World Bank, and the data collected in the present study, the existing waste management situation in Guyana with particular references to municipal, rural, industrial, agricultural and special wastes. Socio-cultural aspects are also considered. Liquid waste disposal and solid waste management are analyzed as key elements of a comprehensive waste management plan, as well as such other elements as internal programs and external assistance. Finally, recommendations for undertaking a pre-feasibility study is made and an outline of the TOR of this study is given.

1 ENVIRONMENTAL BACKGROUND

1.1 Policy

Environmental Policy for Guyana is still not clearly defined although a National Environmental Action Plan (NEAP) and National Environmental Policy (NEP) are in the process of development and approval. After the change in government it was decided that these documents required review before they could be published and implemented.

In July 1993 a World Bank team visited Guyana and prepared a draft report on major development sectors to assist in preparation of the NEAP by government. The Office of the President has been using the World Bank reports to revise the NEAP.

1.2 Legislation

There are several legislative acts pending, yet to be put before Parliament, these include the Conservation of Wildlife Bill, 1987; the Pesticides and Toxic Chemicals Control Bill, 1992; and the Environmental Protection Act, 1993; the Guyana Biosphere Reserves Bill, 1983; and, the Environmental Assessment Act, 1993. The Environmental Management Plan for Mining is also under discussion at present.

On the other hand, a number of acts relevant to environmental management exist now in Guyana such as: The Water Authority Act, The Demerara Water Conservancy Act, The Forest Act, Sea Defense Act, The Fisheries Act, The State Lands Act, Transport and Harbours Act, Plant Protection Act, Drainage and Irrigation Areas Act, Town and Country Planning Act. Municipal and District Councils Act.

1.3 GAHEF and EPA

It was expected that GAHEF (Guyana Agency for Health, Environment and Food) would play a coordination role in the development of linkages between organizations with a capability in the environmental sector. An IDB/UNDP Subprogramme was designed to assist the Environmental Division of GAHEF in improving its capability through advisory services of the consultants, training the national team on environmental monitoring, EIA (Environmental Impact Assessment) reviewing, provision of guidelines for undertaking the EIAs, strengthening interagency linkages, and enforcing activities on environmental education. These would assist Guyana in implementing its environmental policy. As a matter of fact, GAHEF has no specific legal mandate, but it has a brief for environmental monitoring and education by an order of 27th June 1988 under the Public Corporation Act. Additionally, the Environment Division reviews EIA's and chairs the Inter-Agency Committee on the Environment and Development (which to the knowledge of the international team has been inactive).

In October 1993 it was proposed GAHEF should be dissolved. The papers are still, however, with the Chamber of the Attorney General and no bill has so far been drafted for the dissolution nor, naturally, has Parliament yet approved dissolution of the agency; this is expected to occur early in 1994. A New Environmental Protection Agency (EPA) in the Office of the President has to take over the environmental functions of GAHEF plus other functions stipulated in the legislation.

1.4 Natural Resources and the Environment

About 80% of the total land area of Guyana is covered by forest of various types, 6% permanent pasture, 2.4% land suitable for cultivation and 11.6% other types of lands. The most abundant tree species are Wallaba, Greenheart and Mora. Greenheart is the most valued tree because of its suitability for marine work and because it occurs nowhere else in the world.

A wide range of wildlife inhabits the high forest of Guyana, but little information is known about the total number of species and their quantities. According to the working paper of the WB on Natural Resources Management, 98 species of birds, 27 mammals and 19 reptiles of the Guyana wildlife are threatened or in danger of extinction.

Water resources are plentiful throughout the country, but there are seasonal problems of drought and flooding in different regions. Water is supplied to farmers without metering and the system is operated through the principle that there will be a nearly constant water level.

One of the most complicated and difficult problems threatening the natural resources of Guyana is illegal deforestation. Whereas legal concessionaires are reported to harvest seven or eight Greenheart trees per hectare leaving the other species in relatively good condition, no information is available on the amount and types of trees being cut and exported by timber smugglers. However, it is generally accepted that the real rate of deforestation is several times higher than the official rate of 0.1% per annum.

The hunting of wild game to serve local demand for meat is of serious concern to some local ecologists. Wildlife is being exploited both for local consumption and for export. In the past there has also been concern over trade in rare plants such as orchids. Lobbies inside and outside Guyana are pressing for a ban on the wildlife trade. The government issued no export quotas for wildlife in 1993 to give breathing space for the passage of the Conservation of Wildlife Bill (1987); unfortunately this is not yet passed. With a ban on legitimate trade it is likely the illegal trade is flourishing.

Some information on species distribution and population levels may be available through ongoing surveys and past research, such as the ongoing collaboration between University of Guyana (UG) and the Smithsonian Institution on the Flora of the Guyana. Under the direction of the National Biodiversity Unit (NBU) chaired by GAHEF, a country study on biological diversity is being prepared as required under the UNCED, but this has only served to highlight the paucity of information. UNEP has been funding the preparation of the country study but the MOU between UNEP and government has expired leading to a hiatus in this activity. There is a pressing need for research initiatives.

Another environmental problem is the subject of agricultural chemicals (fertilizers, pesticides, herbicides, and other toxic chemicals). The sugar industry is a heavy user of herbicides and pesticides, whereas the rice industry depends on pesticides and fertilizers. Limited research is available on the effects of pesticides on aquatic eco-systems in the tropics. Levels reported to cause chronic or acute effects in particular fish species, for example, differ substantially and are generally based on laboratory studies rather than sampling a natural system. A specific limit on pesticide levels in drainage water is difficult to impose as the chemicals concerned are not easily detected in water samples. The most reliable measure is to test a species in the higher levels of the food chain, for instance fish. This approach is also the most relevant to gauge the threat to human health. A proposed Pesticides and Toxic Chemicals Bill (1992) has not yet come into force.

Water pollution by sawmill wastes is a problem which has yet to be solved. A lot of sawmill wastes heaped on the banks of rivers spills over or is pushed into the water increasing its turbidity and BOD. The regulations which call for maintenance of 50 m buffer strips is not respected by gold miners who demolish the river banks by their missile dredgers. Enforcement of the regulations is hampered because they apply only to forestry and not mining activities. This is a combined institutional, legislative, and waste management problem.

1.5 Mining Industry and the Environment

The mining industry in Guyana includes currently bauxite, gold, sand and diamonds. Two petroleum prospecting licenses also exist. Discussion will concentrate in the following on bauxite and gold mining.

1.5.1 Bauxite mining

This is controlled by the governmental owned BIDCO which controls LINMINE and BERMINE. Rehabilitation/ revegetation, acidity, air quality and sedimentation are among the environmental problems associated with the bauxite industry and which were identified in the WB working paper on Minerals and the Environment. At LINMINE and BERMINE there has never been any attempt to rehabilitate the mined-out pits or revegetate them. Measurements have not yet been undertaken to determine whether they are producing acid leachate or increasing dust levels in the air.

In some cases, e.g., in LINMINE it is not known whether it was the acidity of the waste and water or other natural processes which has prevented natural vegetation from regrowing. At the same site of LINMINE the tailings dam which prevented the release of the fines of the bauxite mines to river water is now full, indicating the need to find another storage area. Also at LINMINE, it was reported that fugitive dust blowing with the wind from the stacks has increased lung diseases and asthma in Linden. In the Aroaima mine, high levels of sediment were reported entering the Berbice river through a man-made canal.

1.5.2 Gold mining

Gold mining activities in Guyana are divided into small-scale mining (comprising about 10,000 exploitation licenses) and large-scale mining, such as the Omai Gold Mines (OGM). Declared gold production in 1992 from small-scale gold mines was about 2.5 tonnes, whereas the production of gold from OGM started in Feb. 1993 is estimated at about 8 tonnes per year in the first three years increasing to 8.7 tonnes for a further seven years.

1.5.2.1 Small-scale mining

About 90% of the gold produced in small-scale mines is removed from the dredge in a black sand concentrate which is then treated with mercury. The gold-mercury amalgam is squeezed through a fine cloth to remove excess mercury then heated to evaporate the rest of the mercury. According to miners' estimates 1 kg of mercury is needed to extract 2.5 kg of gold. It was also reported that very few miners attempt to recover mercury or prevent contamination during handling.

Mercury utilization in gold mining raises a number of environmental issues. First, the potential risk of mercury poisoning, either through skin or inhalation, is rather high. Mercury poisoning can cause permanent damage to the human nervous system or even be fatal. Second, a considerable portion of the mercury used in the treatment of gold is released into the environment. Assuming that 50% or 60 % of the mercury used in gold treatment is released to the environment and that the figures given on gold production by small-scale miners are correct, the amount of mercury released into the environment in the course of the last twenty years would be in the order of 10 tonnes of mercury. This is of special concern because mercury is an accumulative pollutant and can be concentrated in the food chain, e.g. in this case, in aquatic life. When humans eat aquatic species they are ingesting poison. According to a report of a sampling programme for mercury in the main mining areas carried out by GAHEF, the levels of mercury were found to be insignificant.

More recently, GEMCO (Guyana Environmental Monitoring and Conservation Organization), an NGO working on environment monitoring, made other analyses, at the request of the GGMC (Guyana Geological Mining Commission). The report of the analyses was the subject of heated debate in the newspapers before it was released, apparently for political reasons more than technical ones. GEMCO's report concentrated on the Konawaruk River and nearby waterways. The samples analysed included soil and river sediment, suspended solids and fish tissues. GEMCO reported mercury traces in all the samples. The report summarised in the newspaper, but yet published nor distributed, indicated the highest concentrations of mercury were detected in sediment samples taken at the washing and burning areas at mining sites but gave no values. In fish and shellfish the reported value was 0.14 ppm about 1/3 the maximum acceptable level in Japan and 1/7 that of USA. In spite of the fact that these values are still on the safe side, concentrated attention and actions are needed on this issue to ensure the problem is controlled and does not grow.

The measurements of sediment carried out by GEMCO showed that sediment level opposite dredge sites (0.344 ppm) were about three times more than their levels opposite the mouth of the Konawaruk River (0.112...0.139). The report also claims that in the course of the past twenty years the sediment level in the river increased by 100 to 200 times.

1.5.2.2 Omai Gold Mines (OGM)

The Omai Gold Mines (OGM) is situated 170 km Southwest of Georgetown and 4 km from the Essequibo River. The project is a joint venture in which GOG holds 5% of the total shares. The

OGM use a conventional cyanide leaching and CIP circuit to recover the gold. The OGM are also exploiting a gravity separation circuit expected to extract 30...40% of the gold. The OGM use a standard waste disposal system, with the construction of a tailings dam and an aeration pond to treat the water-cyanide solution prior to discharge into the river.

The OGM submitted an Environmental Impact Statement (EIS) with the feasibility study. The decay of the residual cyanide in the aeration pond is estimated to take from 1 to 5 years according to a Canadian simulation model. The EIS was approved by GAHEF with assistance from the Commonwealth Secretariat.

There seems to be a need to clarify a number of issues in the case of OGM. For example, it is not clear whether any seepage occurs from the tailings dam, and if it does how much. Also, as the depth of the collecting pond increases stratification will also increase and, accordingly, a vertical cyanide concentration gradient might exist with continuous increasing concentration at the bottom. This would considerably increase the decay time of the cyanide if adequate measures are not taken.

Another problem which needs to be given more attention in the future is the non-existence of a sewage treatment plant. The sewage, after being mechanically minced, has so far been directly discharged into the environment, causing odour nuisance and hygienic problems, after which it flows to the river. Future plans include an aerobic process which will hardly be enough.

One more important issue which should be addressed in the case of OGM is the handling, transportation and operation of hazardous materials. In the course of last year three accidents took place and cyanide was reported to have been leaked to the environment in two occasions. One following an accident during the transportation of the cyanide imported in containers at the river bank, and the other at the plant itself following the malfunction of a reservoir pump. In both cases it was reported that the cyanide/cyanide solution leaked was treated by hydrogen peroxide. It seems that no actions were taken to decrease the probability of similar accidents in the future and to ensure that adequate measures would be taken under the supervision of an expert. The only action taken was the construction a shallow concrete enclosure to hold any toxic solution that may spill over again.

1.6 Energy Situation

In 1988, the capacity of the power system of Guyana was 168 MW, with an annual energy production of 385 GWh. This gives an electricity consumption per capita of about 510 kWh. In the beginning of the 1990s, electricity demand increased sharply without corresponding increase in the supply. This led to continuous blackouts which lasted for several hours and which became a routine of the day. As a result all commercial buildings as hotels, shops, restaurants, etc, and many private houses and governmental offices have their own stand-by units which start manually or automatically in case of a blackout.

In the beginning of 1994, the situation improved a little following the commission of two Diesel Power Plants each 5 MW by Wärtsilä Diesel, Finland.

As was mentioned earlier, water pollution by sawmill wastes is a problem which has yet to be solved. A lot of sawmill wastes heaped on the banks of rivers spills over or is pushed into the water increasing its turbidity and BOD.

This problem was included in the National Forestry Action Projects (projects 34 and 35), but, unfortunately, it was given second priority, hence it did not attract any donors. In the working paper of the WB on Natural Resources Management, among the six projects recommended a Feasibility Study of Densified Wood Manufacture was mentioned. It could be recommended here that a combined study of projects 34 and 35 be undertaken. The new study, could be entitled: "Densification and Utilization of Sawmill Wastes in Power Production". In this case the study would concentrate on the feasibility of using the sawmill waste *in situ* as fuel in its own power plant, through gasifiers-prime mover combination, and any surplus could be densified, transported and sold as a substitute to fuelwood. The environmental advantages of this solution are numerous:

a. Prevention of water pollution by Sawmill Wastes;

b. Decreasing air pollution by using a renewable biofuel in place of the diesel oil usually used;

c. Decreasing the risk of water pollution by oil spills during transportation.

In addition, there are economic advantages in that the costs of purchasing and transporting of diesel fuel used will be saved.

1.7 Waste Management and the Environment

Georgetown has a core population of 80,000 and a greater area population of 200,000. Municipal waste, collection, treatment and management are in bad shape. Solid wastes suffer from years of under-funding and public neglect. Municipal solid wastes consist mainly (87%) of organic wastes. The rest, which consist of metal, glass and dust represent about 13% of the total wastes. Heaps of wastes left in the street to decompose and clog the drain system is a common sight in Georgetown. The City Council responsible for solid waste collection was dissolved at the beginning of the year, and an Interim Committee is taking over the work of the council until a new one is elected.

Municipal liquid wastes are not in much better condition than solid wastes. The main sewerage system covers 80,000 inhabitants only. The rest have septic tanks which are not regularly emptied. The sewage wastes collected from both systems are not treated either because of the absence or malfunction of the treatment plants. They are usually discharged into the Demerara River without treatment. Industrial wastes suffer from the same fate of municipal liquid wastes i.e., they are discharged into water bodies without treatment. Among those plants discharging wastes into natural waters are 47 food processing plants, 5 distillers/breweries and 7 sugar refineries.

As mentioned above, management of municipal wastes seems to be one of the most urgent environmental problems to be addressed. Management of industrial waste has lower priority than municipal wastes indicating Guyana, as is not uncommon in developing countries, encourages industry regardless of any resulting environmental problems.

1.8 Management of Coastal Zones

The problem of sedimentation and land erosion has been one of the major environmental problem of the coastal zones of Guyana for centuries. This problem is outside the scope of the present case study, however some assistance in monitoring conditions could be recommended in connection with the computerized data base system discussed below.

2 EXISTING WASTE MANAGEMENT SITUATION

2.1 Municipal Wastes

Guyana has five duly constituted municipalities:

(1)	Georgetown	-	1837
(2)	New Amsterdam	-	1891
(3)	Linden	-	1970
(4)	Corriverton	-	1970
(5)	Rose Hall	-	1970

Some 32.2 % of the country's total population (800,000) live in these urban areas.

Georgetown, the capital, is a flat sprawling city on the eastern bank of the estuary of the Demerara River. It is two meters below sea level with a protective sea wall and a large assortment of canals and drains, some gravity-flow to the river in the west at low tides and others are pumped to sea in the north. The poor socio-economic conditions in Guyana in the past two decades are reflected in the lack of maintenance in the city and other municipal areas.

2.1.1 Liquid Wastes

Georgetown is the only municipality in Guyana served by communal sewerage systems for liquid waste disposal. These systems are as follows:

(i) Central Georgetown: This main sewerage system covers about 1.160 acres and serves about one-third of the city's population (80,000 people). The system was constructed in 1929 and is believed to be the oldest in CARICOM. There are 24 pumping stations on a ring main or trunk sewer; but power outages, ageing pumps and solid waste dumping interfere with continuous flow and discharge into the lower estuary of Demerara River.

(ii) University of Guyana Campus: This sewerage system was installed some 20 years ago to serve the university. It has a treatment plant which is currently inoperative.

(iii) Tucville area: The sewer system serving this part of Georgetown is also without an operative treatment plant at this time.

The main sewerage system is operated by the Georgetown Sewerage and Water Commissioners. Outside of the Georgetown communal sewerage systems septic tanks and pit latrines are used to serve the remaining 120.000 population of the city. These sewage disposal methods are used in all other communities in Guyana. The problem is that the septic tanks are not cleaned regularly and, like pit latrines, overflow from time to time.

2.1.2 Solid Wastes

In Georgetown, more than elsewhere, solid waste management suffers years of under-funding and public neglect. The city's lack of collector vehicles has led to the use of contractor vehicles. However, in the absence of funds contractor fees are often unpaid, leading to non-collection of solid waste or the dumping of waste in nearby public areas rather than at the distant official site. The resulting waste pollution and decomposition, as well as drain clogging, have been for sometime common sights and experiences in all city districts.

The organization responsible for solid waste management in the city is the Cleansing Section, one of five sections supervised by the city's Medical Officer of Health. The Cleansing Section is sub-divided into three Subsections: Transport, Sanitation and Incineration/Dumps. The Cleansing Section serves the city's 38 districts, which are amalgamated into 13 zones for solid waste collection.

Georgetown generates an average of 60 tonnes of solid waste per day that must be collected and disposed. Quantities of solid waste generated in Georgetown has an average for the city of about 200 g/person/day. The characteristics of the solid waste generated in Georgetown are shown in Table 1.

Table 1. Household Waste Composition [1)]

	Item	Percentage by Weight
1.	Food	21.5
2.	Garden & Yard	29.8
3.	Paper	14
4.	Plastic	9.4
5.	Rubber & Leather	1.4
6.	Textiles	8.6
7.	Wood	2.4
8.	Ferrous Metal	3.7
9.	Copper	0.01
10.	Aluminum	.7
11.	Non-ferrous Other	.0
12.	Glass & Ceramics	2.4
13.	Dirt, Rubble, Ash, Rock	6.1

[1)] Source: Waste Management, Working paper prepared by R. Williams, World Bank, 1993.

There are too few approved waste containers serving residences and shops, and therefore collection is inefficient and costly. There is relatively little separation between garden waste and indoor (e.g., kitchen) waste, which would enhance transportation and disposal. In the past the daily vehicular use consisted of 19 city collectors, 10 contract collectors, and two private collectors. Uncovered loads accounted for 37 % of the loads. Collection frequency is reported as follows:

Town	-	weekly
Market	-	daily
Residential	-	bi-monthly
Hospital	-	daily
Others (e.g., abattoir)		daily

With respect to disposal, the city's old waste incinerator reportedly operates at 10 % capacity, and its yard is strewn with rusty tin cans confirming the overall lack of maintenance in all aspects of solid waste management. Landfill operations have been shifted from the Ruimveldt site to a new site in the northeast part of the city. The site is small and is a holding operation until a large site outside the city can be worked.

Recently, the City Council of Georgetown was dissolved and an Interim Management Committee (IMC) was established. A number of organizations have donated many needed items such as water coolers, grass cutters, wheel barrows, spades, forks, cutlasses, pitchforks, files and gloves to facilitate the work of the IMC. The Cleansing Department has developed a short term solid waste programme to restore some sense of cleanliness and beauty to the capital.

The project, is being conducted in two phases. The first will concentrate on the "Old Georgetown" area, which for convenience, has been divided into fifteen wards. The exercise will collect household refuse and parapet garbage simultaneously.

The initial stage will utilise 21 trucks and three loaders which will cost in excess of $2 million. The Council is at present faced with the task of removing 90 tonnes of refuse, on a daily basis, from an area of 15,325 square miles with 52 men.

Another major problem is that of a land fill site. The incinerator or 'Old Smoky' is almost out of operation, except for a few panels "which could hardly take care of the medical waste", the report said.

The present site, in the Woolford Avenue area, according to Ministry of Health officials the life of the site will come to an end in the next six months.

The IMC is in the process of working out a plan to introduce the use of plastic bags for storage and proper disposal of garbage bags. But the effectiveness of this method will depend heavily on the efficiency of the Council's collection system and the cooperation of the citizenry.

A report of IMC pointed out that a serious constraint is an acute shortage of vehicles and equipment which had plagued the Cleansing Department for a number of years. Because of this the Council has confined cleansing operations to six collection vehicles, two of which are assigned to hospital and abattoir waste on a daily schedule.

The Mechanical Workshop "is of little use" to problem plagued vehicles. There is urgent need for revamping and modernising of the section, the report said.

2.2 Rural Wastes

The rural waste situation in Guyana has not been studied, but it is known to suffer from the inadequacy of pipe-borne water supplies in many areas. In areas of scattered housing, pit latrines are used for excreta disposal. Otherwise, septic tanks are used for domestic sewage disposal.

Such tanks are approved by the regional environmental health officer(s), and a filter box is also employed for dispersing tank effluent into the soil, depending on the depth of the water table. Pit latrines, if they are properly covered and maintained, are adequate for rural areas without a pipe-borne water supply.

The recent cholera epidemic in such areas in the northwest is believed to have migrated from neighbouring Venezuela into an area that suffers from poor water supply and sanitation services, and where river water is used for excreta disposal (e.g., "drop" privies) and for drinking water.

As a result of this situation, enteric diseases (e.g., water-borne) abound in the wet season and sanitarian services need to be upgraded. However, there are socio-economic constraints such as:

Accessibility	-	Many rural areas in the vast interior are not easily accessible, and improvement activities have to be self-sustaining
Public awareness	-	Rural peoples, especially the Amerindians, do not accept external changes of their social systems easily
Resource mobilization	-	Except for the mining and forestry companies, funding for activities and cost recovery possibilities are minimal
Disease occurrence	-	In some rural areas malaria is widespread and enteric diseases (e.g., typhoid) are commonplace.

The solid waste situation in the rural areas is not as intense as in the municipal areas with their higher population and commercial density. Waste generation is lower, and a higher percentage is organic (e.g., food wastes), which is disposed of by composting or burial on an individual basis.

2.3 Industrial Wastes

Other than domestic sewage, the main liquid waste is industrial waste water. There has been limited industrial development in Guyana since independence. In a UNESCO Environmental Profile (1992) the following industries were identified: 66 sawmills, 47 food processing plants, 5 distilleries/breweries, 7 sugar refineries, 9 detergent/soap manufactures, 8 metal-working/foundry operations, 6 chemical/pharmaceutical companies and 4 plastics companies. Their potential pollutants and likely disposal watercourses are listed at Table 2 and they are located at Figure 1.

The majority of industry is related to food/drink processing, and waste water from these plants discharged into canals and rivers without treatment will contribute pollution in the form of biochemical oxygen demand and nutrient enrichment. In the case of sawmills which are plentiful, they are a relatively dry industry and tend to pollute air and land more than water. In view of the high dilution factor offered by Guyana's rivers and coastal waters, and the limited industrial development, it is no surprise that Government and private sector officials give no priority to pollution from industrial waste water (World Bank 1993).

Table 2. A Summary of Manufacturing and Industry in Guyana [2)]

Category	Number					Potential Pollutants
	ESQ	DEM	BRB	CRT	Total	
Sawmills	4	27	19	16	66	BOD, dust
Food Processing	2	31	11	3	47	BOD, phosphates, solids, dust, pathogens
Metalworking/ foundry	3	5			8	heavy metals, solids
Detergents/soap thermal		9			9	BOD, phosphate, caustic
						CaCl2, CFCs
Ice making						
Tannery		1			1	dyes, toxic chemicals,
Textile		1			1	heavy metals
Paper, printing						BOD, dyes, heavy metals
Sugar refineries	1	4	1	1	7	BOD, solids, caustic, phosphate
Chemical		2			2	acid, alkali, phosphate, solids
Building materials		2	1		3	solids, dust
Pharmaceutical		4			4	?
Refrigerators						CFCs solids, heavy metals
acid,						caustic, paint, xylene
Distilleries/ brewery	1	4			5	BOD, phosphate, thermal
Plastics		3	1		4	CFCs, solids
Cosmetics		3			3	acid, alkali? packaging?
Assembly		1	2		3	solids

[2)] Source: Gurudatt Naraine, Julia Liebeseschuetz and P.J.B. Scott, February 1992.

Industries are listed by category, number and nearest river into which pollutants could be drained or dumped.

ESQ = Essequibo River and adjacent coast
DEM = Demerara River and adjacent coast
BRB = Berbice River and adjacent coast
CRT = Corenture River and adjacent coast

2.4 Agricultural Wastes

Faecal wastes from animals (e.g., pigs, cattle) and poultry farms are good for soil conditioning for plant growth, but they are also potential pollutants. In many farms the open deposit and storage of such animal wastes will run off with every rainfall and may drain into adjacent streams and rivers, and place an unnatural demand for their oxygen content. In some soils, the contaminated water may percolate into and pollute groundwater. As these animal farms develop in Guyana provision has to be made for the lagooning of animal waste, and the use of solids for soil conditioning, while the treated liquid effluent is allowed to irrigate the fields.

Agricultural lands are drained into nearby waterbodies, and solid waste matter is burnt or composted. The major concern is disused agrochemical containers and packaging. But such chemicals may be found in artesian wells, fresh water canals and drainage canals in the agricultural fields of Mibicuri and Black Bush Polder in Berbice, which serves to remind us of the need for "cradle-to-grave" control.

2.5 Special Wastes

Ship-generated waste is not the problem in Guyana that it may be in the small Caribbean islands with a strong tourism industry and regular visits from cruise ships. The port handles mostly cargo liners, and solid waste is removed from ships in bags and trucks to the Georgetown disposal site.

The special waste for which there is most concern is hospital waste, which can be categorized as follows: General waste, pathological waste, chemical waste, infectious waste, "sharps" and pharmaceutical waste. Hospital waste is bagged in plastic after separation, and it is collected and trucks to the old incinerator.

Wastes from five Georgetown markets and the municipal abattoir (e.g., vegetables and meat/bone) are collected daily and trucks to the incinerator or landfill site. Solid wastes from industry are generally dumped to the disposal site. However, the situation lacks control, and further work on the quantification and characterization of such waste from industries and institutions has been recommended so that their reaction on the entire solid waste management system and the environment could be better understood.

3. ENVIRONMENTAL IMPACTS OF WASTE

An environmental health impact assessment evaluates the impacts of an action/development on environmental parameters which have a strong significance for environmental health. Waste disposal is an activity that can impact negatively on man.

3.1 Liquid Waste [3]

The potential negative impacts of liquid waste disposal in Guyana are:

	Potential Negative Impacts	Rating in Guyana Low	Med.	High
*	Degradation of neighbourhoods from sewer overflows at pumping stations		x	
*	Degradation of receiving water quality (e.g., Demerara and other rivers) from discharges of raw sewage, industrial waste water and agricultural run-off	x		
*	Public health hazards in vicinity of discharge sites for sewage and industrial waste water	x		
*	Soil, crop or groundwater contamination and disease vector breeding or feeding through improper animal waste disposal	x		
*	Nuisances and public health hazard from sewer overflows and backups			x
*	Nuisances and public health hazard from septic tank effluent overflows into canals (e.g., Georgetown)			x
*	Loss of fisheries productivity in rivers and along coast	x		
*	Soil contamination by overflowing septic tanks and pit latrines during flooding		x	

[3] Source: World Bank, 1993.

3.2 Solid Waste [4]

The potential negative impacts of solid waste management in Guyana are:

	Potential Negative Impacts	Rating in Guyana Low	Med.	High
(a)	**Storage**			
	* Refuse scattered from plastic bags, card-board boxes etc. by stray dogs		x	
	* Decline in civic pride and public morale when solid waste visibly degrades urban environment		x	
(b)	**Collection**			
	* Uncollected refuse clogs open drains and sewers			x
	* Aesthetic degradation and property value loss from litter and clandestine dumping			x
	* Populations of disease vectors (e.g., flies, rats, cockroaches) increase where refuse is either uncollected or open dumped		x	
(c)	**Transport**			
	* Dust and litter along roads used by solid waste collection vehicles	x		
	* Traffic jams when collection vehicles working along city streets	x		
(d)	**Disposal**			
	* Dust from unloading and spreading/grading operations at land disposal sites in urban areas		x	
	* Smoke from open burning of refuse at land disposal sites		x	
	* Odours from land disposal sites			x
	* Restriction to beneficial uses of ground-water and other receiving waters contaminated by disposal site leachate	x		
	* Emission of potentially toxic volatile organics from hazardous waste disposal and landfill sites	x		
	* Contamination of air quality from old incineration operations in Georgetown	x		
	* Land use conflicts when solid waste facilities are not well located		x	
	* Public opposition to location of solid waste disposal facilities near their homes			x
	* Loss in public's faith in Government when solid waste facilities/disposal sites are not operated and maintained properly		x	

[4] Source: World Bank, 1993

4. SOCIO-CULTURAL ASPECTS

In coastal areas, the high water table prohibits the sub-surface discharge of septic tank effluent (e.g., through a filterbox or soakaway), and the discharge of such partially treated sewage is by way of surface canals and drains. In the meantime, because the frequency of solid waste collection is generally poor (once per week at best), the public relieves their situation at home or at the side-walk stall by dumping their waste at the nearest public area.

The vandalizing of water supply mains to facilitate an illegal house connection is not uncommon; and the breakdown of sewerage pumping in Georgetown results from the public's use of the pump wet-wells as a dumping site.

In addition to the low level of concern among the public, there is also the age old stigma attached to solid waste that perpetuates its management with a low level of untrained workers. Attempts by GAHEF and NGOs to educate the public have not helped significantly, although a regular Clean-up Campaign in the city is effective, and a Woman-and-Environment movement has promised.

The private sector in the urban areas contributes to their Clean-up Campaigns, but a more interesting effort in the interior is taking place where mining and other companies are assisting the local governments with providing water and waste management to the public (e.g., Linden).

Another optimistic activity noted is the fact that the brain-drain has slowed down considerably, and there are signs that expatriate Guyanese may be returning to their mother country to help develop her promising potential.

In addition, the IDB Urban Rehabilitation Project is expected to assist in establishing the well-known fact that it is the country's people, not their government, who are ultimately the managers of their environment.

5. KEY ELEMENTS OF A COMPREHENSIVE WASTE MANAGEMENT PLAN

5.1 Liquid Waste Disposal

The "sanitation" situation in the Georgetown area is:

Sewer system (no treatment)	-	49,000 pop.
Septic tank & filter-box	-	103,000 approx.
Pit latrines	-	8,000
Public toilets	-	8

5.1.1 Domestic Sewage

With respect to the communal sewerage systems in Georgetown the main issues are:

(a) Coverage: Extend coverage to all homes and other buildings in the greater Georgetown area, and study other urban areas (e.g., New Amsterdam with its new water treatment plant) with a view to serving areas with a high population/building density.

(b) System Operation and Maintenance: Special attention should be paid to improving the operation and maintenance of the sewerage systems in Georgetown. This includes increased budget and manpower to put in place and guarantee improved operation and maintenance procedures.

(c) Sewage Treatment: As part of the sewerage system extension, the question of treating the sewage before it is discharged into the Demerara River should be examined in the hope of installing preliminary treatment facilities to reduce the polluting potential of the city's sewage

The location, design and operation of septic tanks in Guyana require some study, especially in the urban areas where effluent reportedly pollute canals and drains, and where septic-tank emptier trucks are too few to meet the local demand for emptying their septic tanks every five years.

Also important is the approval mechanism and capability for septic tanks in urban areas and in the regions by local government environmental health officers/assistants, and the fact that 12.5 % of the population still have no access to sanitation (UNDP Human Development Report, 1992).

5.1.2 Industrial Waste water

While it is generally agreed that the disposal of untreated industrial waste water is not causing any marked pollution of the Demerara River and elsewhere at this time due to immense river dilution capability, the lack of institutional responsibility, monitoring action, and environmental quality standards, is cause for concern in the long term. There are currently no data available on the nature or extent of the pollution from industrial waste waters.

Certainly, waste water from such local industries as sugar, food and distillers/breweries would place a higher biochemical oxygen demand (BOD) on rivers than raw domestic sewage (220 ppm BOD), while other waste water may contribute heavy metals and other toxic chemicals.

The options for industrial waste water disposal are clearly:

- Collection in public sewers and treatment in one plant with domestic sewage; and
- Treatment before individual waste water disposal into a waterbody of acceptable size for adequate dilution

5.2 Solid Waste Management

Before specific issues are considered it is necessary to mention that in the 1990-91 period the Pan American Health Organization assisted the City of Georgetown and the national government by providing a number of solid waste management consultants from the Trinidad and Tobago Solid Waste Management Company Ltd. to examine the situation and make recommendations for improvement. Most of the advice given has not been implemented and is still valid. It is an excellent example of the local environmental health scenario - the problems are known and understood, but the solutions are not implementable in the present socio-economic climate.

5.2.1 Generation, Collection and Storage

The following are the issues that require the most urgent attention at this time:

(a) Institutional Strengthening: In the absence of trained manpower, an adequate budget and improved technical operations no satisfactory solid waste management program can be implemented.

(b) Collection Frequency: The present unguaranteed collection frequency (once per week at best) is the cause of much of the dumping in urban areas. Collection must be stepped up to two or three times per week, on a guaranteed basis, using city trucks or contractor collectors for all of the greater Georgetown area.

(c) An integrated municipal solid and liquid wastes solution is highly recommended at this stage of Georgetown development as indicated below.

6. WASTE MANAGEMENT PROGRAMME FOR GEORGETOWN, GUYANA

A large part of the waste produced in all communities is organic food/vegetable waste which is possible to digest, thus producing biogas and fertilizers. AVECON International Ltd has developed an anaerobic digestion process suitable for organic household waste and sewage sludge which allows recovery of biogas (Methane and Carbon dioxide) and thus gives possibilities to recover energy from this type of waste. The treatment also reduces the amount of material (by weight and volume) by 50 - 60 %, which reduces the transportation costs to for example fields or gardens when the end product (humus or compost) is used as a fertilizer. This process is one solution to decrease the amounts on the disposal places, extract energy and usable end products from waste and improve the environmental conditions.

6.1. Why Anaerobic Waste Treatment

The advantages of the anaerobic waste treatment over other available technologies as landfills/incineration can be summarised in the following:

* Environmental soundness on the national, regional and international scales.

* Hygienic for the inhabitants close to the plant and for the plant staff thanks to the closed process of the plant.

* In view of this hygienic environment, the plant could be centrally located, thus cutting collection and transportation costs.

* In view of the plant compactness, land space and land costs are accordingly saved.

* Both organic matter and RDF (refuse derived fuel) are used as domestic fuel to produce energy.

* Products as indigenous good quality fertilizers, metal scraps, glass,..could be produced from the waste.

* The use of bio-fertilizers will decrease import of chemical fertilizers, thus saving foreign currency and at the same time decreasing emissions of nitrous oxide and carbon dioxide; two greenhouse gases produced during the application and manufacturing process of chemical fertilizers.

* The plant is economically competitive.

* The technology is not sophisticated and could be easily transferred.

6.2. The Process

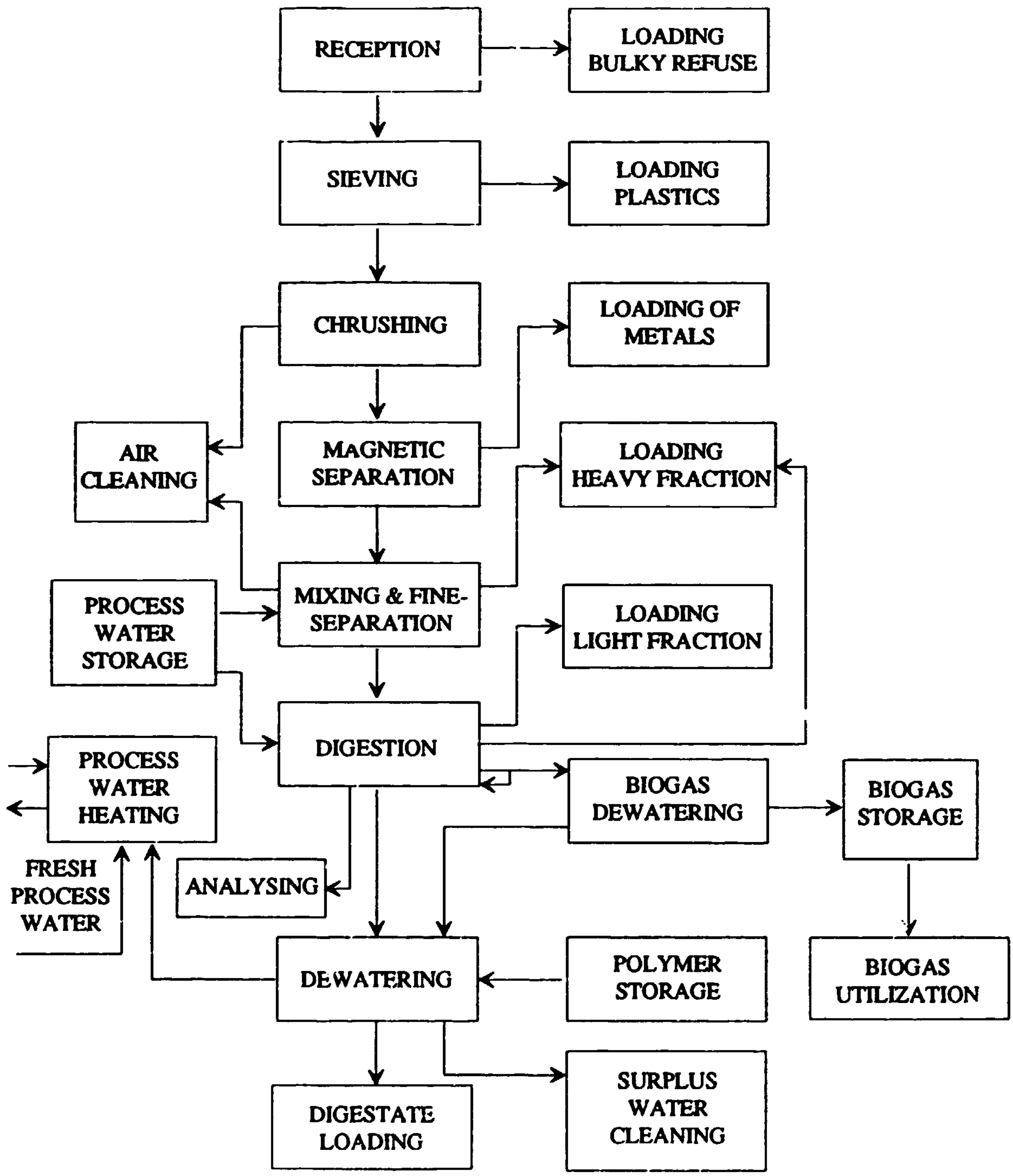
The different stages of the process are schematically shown in Fig. 1

6.3. Start Values

The plant is sized to treat a part of the waste generated in Guyana but can also receive some dewatered sewage sludge or other industrial type organic waste. The start values used are given in Table 3, and in Fig. 2.

Table 3. Municipal Solid Waste Composition in Georgetown

Material	Percentage	Amount t/year
Organic kitchen waste	57 %	5,700
Paper	14 %	1,400
Plastics	9 %	900
Metals	4 %	400
Stones	7 %	700
Glass	3 %	300
Rubber + textiles	5 %	500
Sludge		15,000



Fig, 1, Schematic Diagram of the Anaerobic Waste treatment System in Vaasa

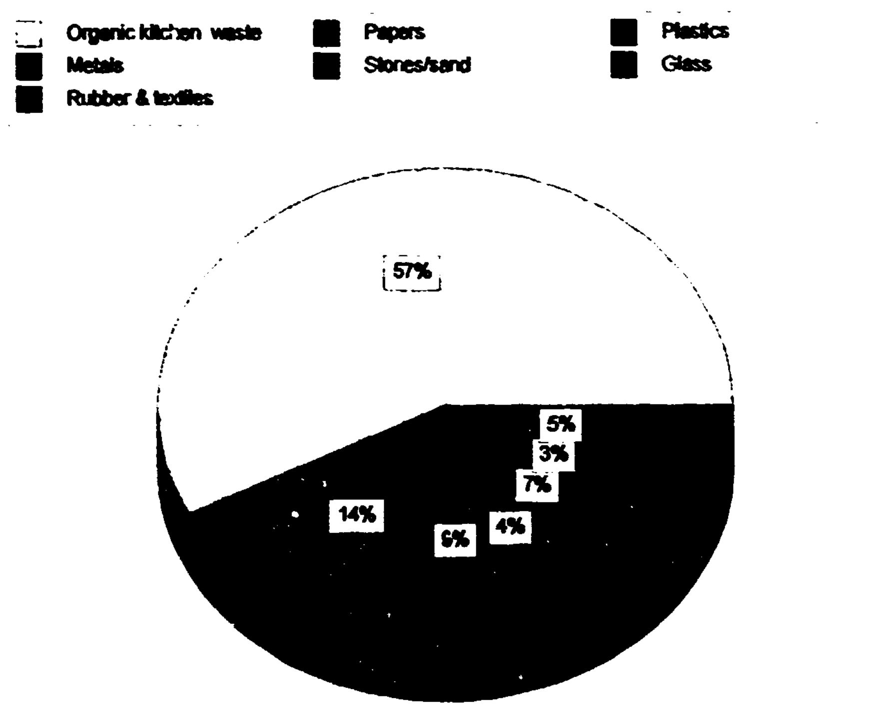


Fig. 2. Composition of Municipal Solid Waste of Georgetown

This composition gives a treatment capacity of 10,000 tonnes "biowaste" per year and 15,000 tonnes dewatered sewage sludge (TS = 15 %) per year.

The amount equals 40 t/day of "biowaste" and 60 t/day of dewatered sewage sludge.

The waste treatment plant will consist of the following main parts:

6.4 Pretreatment Plant (Fig. 3.)

Receiving silo
Screen
Crusher
Magnetic separator
Conveyor belts
Control room

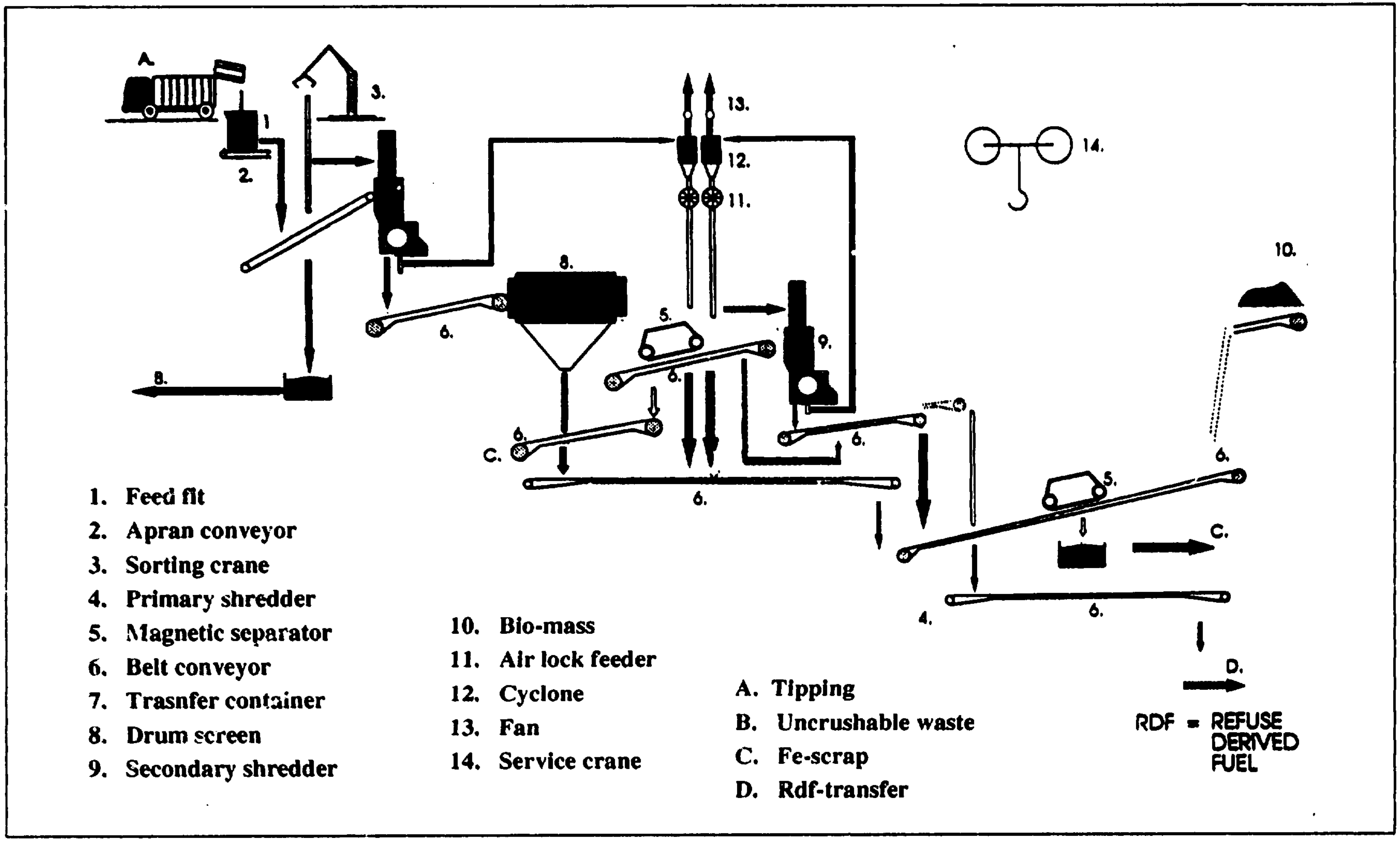


Fig. 3. Components of Pretreatment Plant

6.5 Biological Treatment Plant (Fig. 4)

This plant consists of the following parts:

- Sewage sludge receiving tank
- Mix-separator
- Biomass pump
- Bioreactors/digesters
- Gas cleaning system
- Heat recovery
- Process water system
- Mechanical dewatering equipment
- Biofilter

The Vaasa process includes components as the Mix-separator and the Twin reactor which efficiently removes undesired materials, such as glass, stones, plastics, from the end material. Therefore the dewatered digested sludge is of a higher quality compared to conventional composting end products and may be used in the agriculture. However, the anaerobic process will not remove heavy metals which leaves consumers with a responsibility to separate non-wanted materials.

6.6 End products

With the input mentioned above the plant will produce the following products:

	Amount	Remarks
1. Biogas	1.8×10^6 Nm^3/a	CH_4 61 %
2. Digested sludge	8,400 t/a	TS 35 %
3. Surplus water	12,000 t/a	
4. Disposable products	2,500 t/a	

6.6.1 Biogas

The biogas is used in a power generation plant, producing electricity a total of approx. 4,000 MWh/a and heat 6,000 MWh/a. The internal electricity consumption of the plant is approx. 450 MWh/a and the heat consumption is approx. 750 MWh.

6.6.2 Digested sludge

The digested sludge is a good fertilizer which can replace imported fertilizers in the agriculture. The amount of digested sludge will be 8,500 t/a. The final usage of the digested sludge will however depend on the local restrictions for fields and the heavy metal content in the digested sludge.

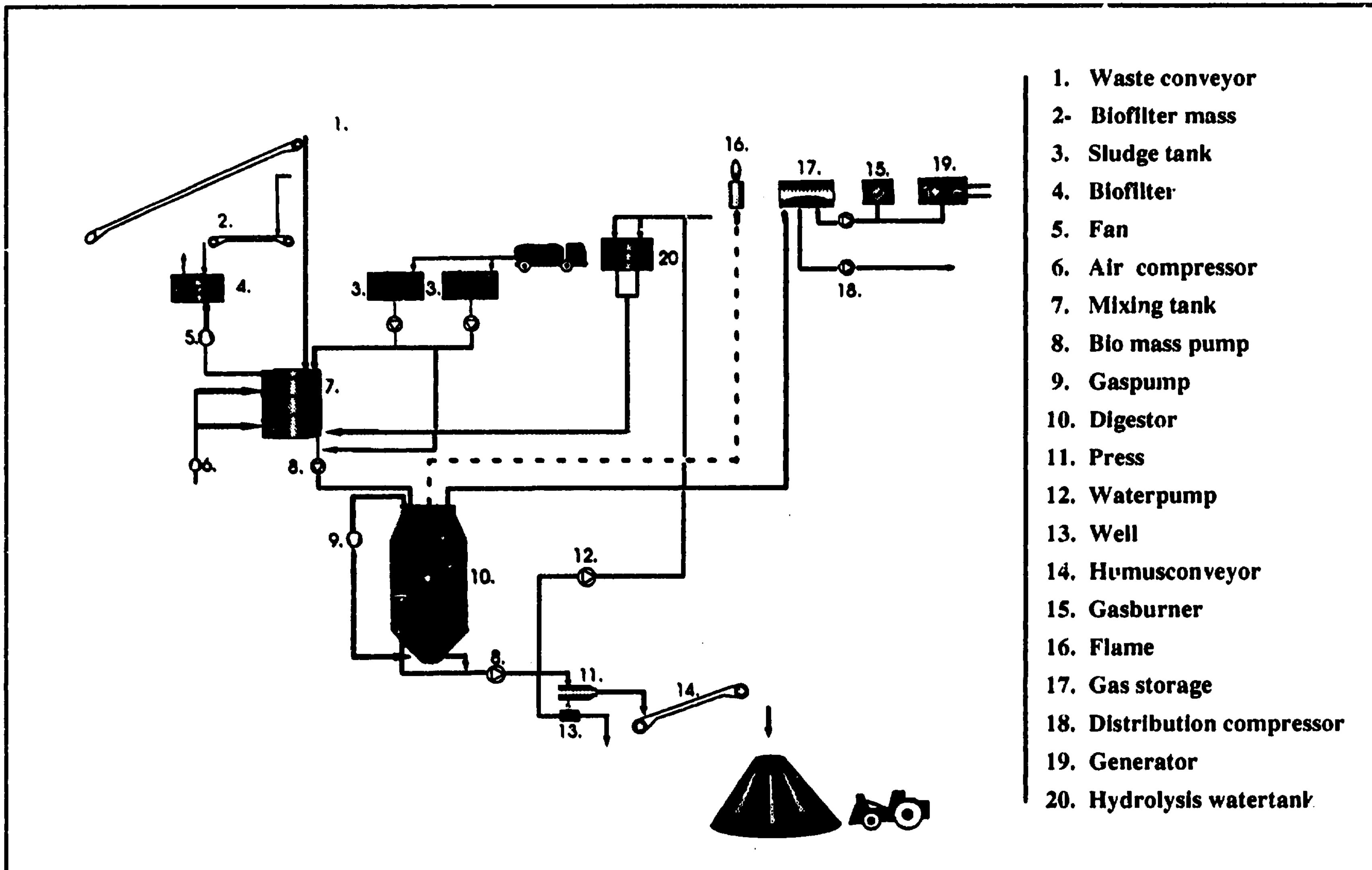


Fig. 4. Main Components of Biological Treatment Plant

6.6.3 Surplus water

The surplus water may also be used in the agriculture as a liquid fertilizer, amount approx. 12,000 t/a. If local restrictions do not allow the spreading of liquid fertilizers on fields the water should be treated in a waste water treatment plant.

6.6.4 Disposable products

Since the waste is assumed to contain some inert material this has to be separated and treated. The appropriate treatment for inert waste is disposal, disposing inert materials is no environmental hazard. The amount of disposable products is approx. 2,500 t/a.

6.6.5 Sewage sludge and other organic waste

The plant is designed to treat dewatered sewage sludge. This treatment will enable the recovery of energy from sludge in form of biogas and similarly give a fertilizer as an end product. Vegetable products, slaughter house waste, and other organic, non-toxic waste can also be treated.

6.7 Needed Operational Personnel

A plant of this size can be operated during 5 days a week, 8 hour per day (one shift) by 4 operators, not including administrative personnel.

6.8 Staff training

The plant in Vasa, Finland which has been in operation since 1990 is involved in training of new operators. On site, practical training will be carried out at the Vasa plant before start-up of new plants.

6.9 Layout

An example of a possible layout is given in Fig. 5. The final layout will naturally depend on the actual site conditions.

6.10. Investment

An exact investment calculation is impossible to carry out at this stage since the starting values are uncertain. However, the range of the overall investments for the above plant is US$ 7 - 9 million . This is not an exact figure since local conditions, possibilities of local manufacturing of certain items, labour costs, transportation costs and so on would change the situation radically.

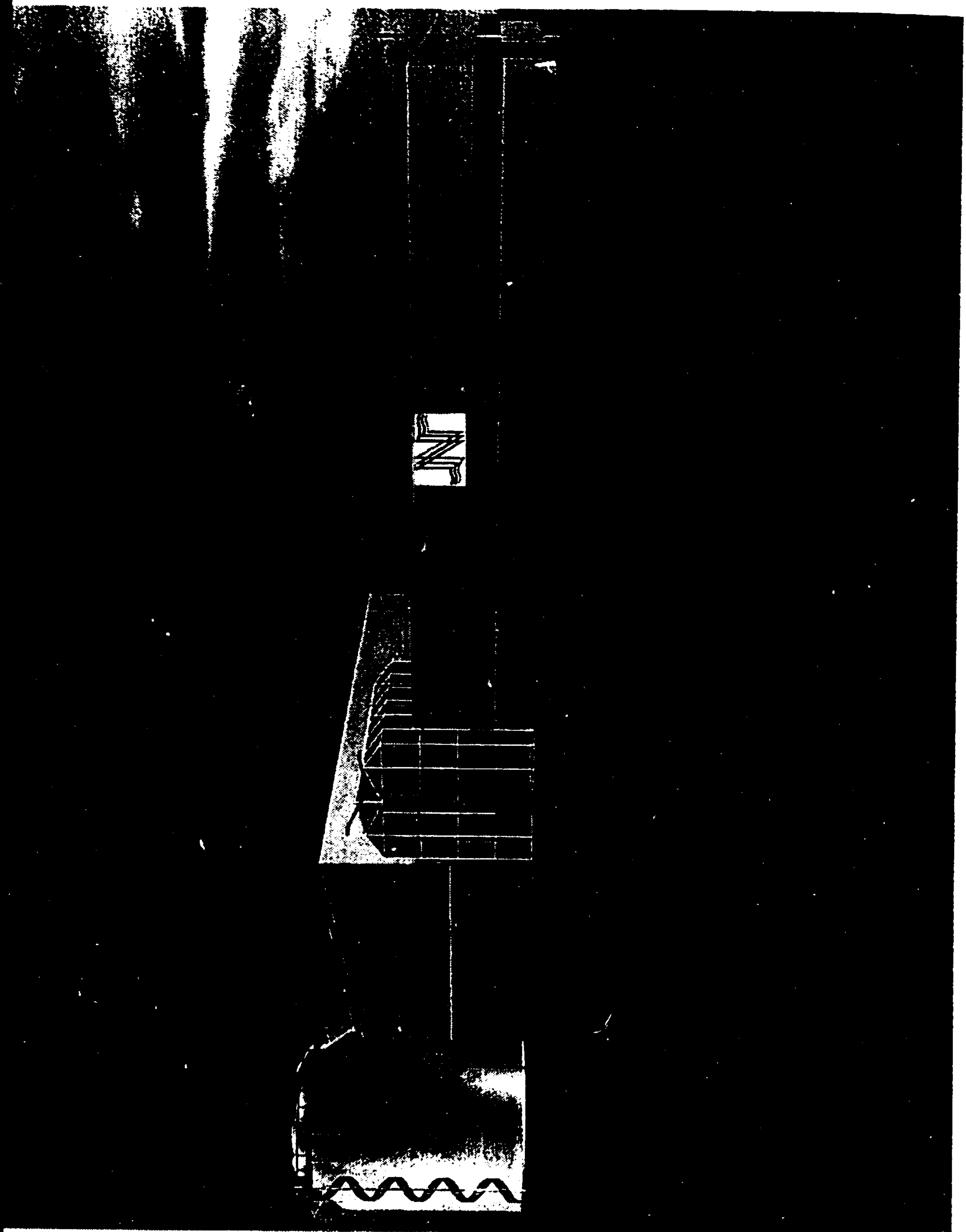


Fig. 5. An Example of a Possible Layout of the Plant

7 SUGGESTED TOR OF PRE-FEASIBILITY STUDY

Use of biogas plant for treatment of Georgetown municipal waste and power production

The study would consist of

1. Investment and subsidies
2. Operational costs
3. Transportation costs
4. Waste amounts
5. Incomes from end products

1 CALCULATION OF INVESTMENT COST FOR THE BIOGAS PLANT

1.1 Waste
1.1.1 Amount of waste
1.1.2 Composition of waste
1.1.3 TS and VS of waste
1.1.4 Temperature of waste

1.2 Biogas
1.2.1 Gas for electricity production
1.2.2 Gas for heat production
1.2.3 Gas as vehicle fuel
1.2.4 Gas for direct sales
1.2.5 Gas for flaring

1.3 Digested Sludge
1.3.1 Usage of digested sludge
1.3.2 TS-demand for the digested sludge
1.3.3 hygienic demand for the digested sludge
1.3.4 Refining of digested sludge

1.4 RDF
1.4.1 Refining of RDF
1.4.2 Using as fuel on site

1.5 Other Products
1.5.1 Allowed amount
1.5.2 Allowed TS
1.5.3 Allowed VS

1.6 Site Location
1.6.1 Available space
1.6.2 Distance from population
1.6.3 Transport distance from source
1.6.4 Distance to final usage of end products
1.6.5 Geo-technics
1.6.6 Architectural demands
1.6.7 Other application needs

1.7 Operation
1.7.1 1- or 2- or 3-shift
1.7.2 Weekend operation
1.7.3 Operational philosophy

1.8 Emission Limits
1.8.1 To air
1.8.2 To soil
1.8.3 To water

1.9 Excess Water
1.9.1 Amount
1.9.2 Treatment

2 CALCULATION OF OPERATIONAL COSTS

2.1 Personnel
- needed manpower
- costs per person

2.2 Amount of Working Shifts per Day
2.3 Weekend Operation
2.4 Electricity Costs
2.5 Heat
2.6 Maintenance
2.7 Control of End Products
2.8 Disposal Costs

3 TRANSPORTATION COSTS

3.1 Transportation Costs for the Waste
3.1.1 Amount
3.1.2 Frequency
3.1.3 Distance
3.1.4 Vehicle type
3.1.5 Way of transportation
3.1.6 Principles of sorting/separation

3.2 Transportation Costs for the End Products

4 WASTE AMOUNTS

4.1 Waste Amounts for the Different Types of Waste

5 INCOMES FROM END PRODUCTS

5.1 Gas

5.1.1 Gas direct
- variations in consumption

5.1.2 Variations in gas production rate

5.1.3 Gas for electricity production
- day price
- night price
- price politics

5.1.4 Gas for heat production
- price politics
- variations in consumption

5.1.5 Gas as fuel for vehicles

5.2 Digested Sludge

5.2.1 Usage as cover material

5.2.2 Usage on green areas

5.2.3 Usage as fertilizer

5.2.4 Usage for energy grass cultivation

5.2.5 Usage of energy grass as fuel

5.3 RDF

5.3.1 RDF as raw material

5.3.2 RDF crushed and separated

5.3.3 RDF as pellets