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UNIDO PROJECT EG/RAF/92/G34

FEASIBILITY STUDY ON WASTE STOCK EXCHANGE MANAGEMENT SYSTEMS (WSEMS)

WATER POLLUTION CONTROL
AND BIODIVERSITY CONSERVATION
IN
THE GULF OF GUINEA LARGE MARINE
ECO-SYSTEM (LME)

BY

MAMSCO MANAGEMENT VENTURES LIMITED
ACCRA-GHANA

FINAL REPORT

AUGUST, 1998

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ACKNOWLEDGEMENT

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Ministry of Environment, Science and Technology,(MEST) Accra
Volta Aluminium Company, Tema
Aluworks (Gh) Ltd., Tema
Tema Steel Co. Ltd., Tema
Aluminium Enterprise Ltd., Tema
Crocodile Matchets (Gh) Ltd., Tema
L' Air Liquide Ltd., Tema
Lever Brothers (Gh) Ltd., Tema
Tema Textiles Ltd., Tema
Tema Lube Oil Co. Ltd., Tema
Metaloplastica (Gh) Ltd., Accra
Poly Group of Companies, Accra
Panbros Salt Industries, Accra
Ghana National Petroleum Corporation, Tema
Super Paper Products Co., Tema
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GOIL, Accra
Ministry of Trade and Industry
Timber Export Development Board
Government Statistical Board

EXECUTIVE SUMMARY

The elaboration of the Waste Stock Exchange Management System (WSEMS) feasibility study is a sub-contract under the Water Pollution Control and Biodiversity Conservation in the Gulf of Guinea Large Marine Ecosystem (GOG LME) project, whose main objective is "to protect and restore the health of the GOG LME and its natural resources".

The WSEMS is one of the options of developing national and regional strategies and policies for the long-term management and protection of the GOG LME. The concept of the WSEMS identifies industries producing certain types of wastes and industries which can use/trade the wastes as primary/secondary raw material.

The objective of this sub-contract is to undertake a feasibility study on the establishment of a self-financing WSEMS for the industrial areas in Tema/Accra Metropolis of Ghana.

To this end specific Terms of Reference were defined. The study was conducted through questionnaires, information from Environmental Management Plans (EMPs) of some industries and personal interviews. Based on the survey of available literature and other sources including Ghana's experience in the WSEMS, the study summarized the lessons learned from similar activities elsewhere.

Examples of successful recycling programmes around Canada covering wastes from household, commerce and industry were cited. Similarly experiences from Australia and Malaysia were indicated. The current state of industrial pollution of some coastal wetlands in Ghana and the EPA approach through the EPA Act 1994 (Act 490) to pollution control in the existing industries are discussed.

It is envisaged that the project concept shall be executed in phases. The first phase of the entire project shall be organised under five departments, namely, Training/MIS department, Production department, Maintenance department, Finance/Administration department, and Sales/Marketing department. All the departments shall belong to the same set up under one Managing Director.

The Management Information Systems (MIS) shall not generate revenue in this first phase but rather shall provide supporting services to the Production department. However, private sector participation shall be encouraged in the area of waste processing.

The first phase shall treat the waste lime, gypsum, spent lubricating oil and saw dust. The second phase will involve the setting up of MIS to serve as databank. Subsequent phases shall include the treatment of other waste for sale to industries and the general public.

Most of the waste characterized have some adverse health effects associated with

them which warrant the institution of preventive measures to reduce risk of diseases and injuries. These have been discussed in the report.

Technical analysis of data collected from 25 industries and organizations, identified 18 tradable wastes available in commercial quantities and have potential for market. These are: -

Calcium hydroxide (slaked lime), spent lubricating oils (waste oil), calcium sulphate di-hydrate (gypsum), plastics and rubber, sawdust and wood waste, slag from steel production, carbon, paper and paper products, broken glass, steel scrap, fish waste, spent malt, aluminium scrap, carbon dioxide, Rolling Oil, Cocoa shell, Dross and Domestic Waste (Organic).

Details of waste types, source of waste and their effect on the environment have been given and quantities of these wastes are provided in chapters 3 and 4. List of type of waste, quantities and corresponding values are presented below. The first six have been analyzed in detail in chapter 4.

Table I List of type of waste, quantities and values

NO	WASTE GENERATED	QUANTITY(Annual Averages) (MT)	VALUE IN DOLLARS (US$)('000)
1	Calcium hydroxide (slaked lime)	780	8
2	Spent lubricating oils (dirty oil)	22,538	676
3	Calcium Sulphate dehydrate (gypsum)	9014.2	270,000
4	Plastics	7,533	257
5	Sawdust	99,776	-
6	Slag	4,954	-
7	Carbon	672.5	49
8	Paper	81,533	2,787
9	Broken Glass/bottles	3,205.25	662
10	Steel Scrap	-	-
11	Fish Waste (Offal)	50,972	-
12	Spent malt	3,000	-
13	Aluminium Scrap	-	-
14	Carbon dioxide	600	-
15	Rolling Oil	393.6	41
16	Cocoa Shell	1,966	5
17	Dross	1726.8	184
18	Domestic Waste	210,912	-

The analyses further revealed the possibilities of converting these wastes to tradable commodities All the identified wastes will only require some slight physical treatment to convert them to

tradable commodity.

Calcium hydroxide, can simply be sun-dried and bagged for sale to the paint industry and the general public. Waste oil can also be filtered and used as fuel.

The study further revealed that 55% of domestic waste is organic which could be composted and sold to gardeners. This would not be financially viable but socio-economically desirable.

Market potential for these wastes is enormous. Most of them have been identified as import substitution products. For example an average of 45,646 MT, of lime is consumed annually in Ghana in the building industry as lime wash for newly plastered walls. There is room for using it as liming material for acidic soils in agriculture.

The nation also consumes an average of 40,978 MT of lubricating oils annually. Mines and industries employ fuel oil for firing their furnaces. The proposed thermal plants for the nation are also expected to consume large quantities of fuel oil.

The total initial project cost for the establishment of WSEMS is estimated at US$1,056,240 to be financed by a mix of debt/equity in the ratio of 50:50., i.e., $528,120 loan and $528,120 equity

Results of financial analyses are impressive. The project will yield a net profit of $52,809 in the first year increasing to $78,136 in the second year and $147,792 in year six.

The Projected Balance Sheet and the Projected Funds Flow Statement indicate clearly that the project can repay the loans and interest within the projected repayment periods and that they would not need additional funding. The project's Internal Rate of Return (IRR) was 36.5% which is far above the 10% borrowing rate used in the interest calculation. Also a Net Present Value (NPV) of $1,006,697 was found. Grant input has only been recommended to facilitate speedy take off and ease on loan burden for the project.

The study revealed that the exchange system could be both Passive and Active.
The establishment of WSEMS in the Accra/Tema metropolis was found to be technically feasible, socially desirable, economically and financially viable.

When the WSEMS is fully developed it would provide an economic incentive frame work for Private Sector participation in the reduction of the land-based pollution of the LME. This is seen as an effective regional approach to address the problem of land-based pollution and degradation of the critical habitats in the Gulf of Guinea LME shared by several West and Central African Countries

The projects are therefore recommended for support by international agencies, environmental NGOs, financial institutions and governments.

The undermentioned team of experts from MAMSCO executed the assignment.

1)	Professor Yaw Ahenkorah	Agro - Environmentalist Team Leader
2)	Mr. Martin Asamoah-Manu	Programme Management Specialist/ Project Co-ordinator
3)	Mr. J. B. Ofosu-Mensah	Chemical Engineer/Project Analyst (Bilingual - French & English) (Asst. Team Leader)
4)	Mr. Franklin Kuma Gavu	Environmental Chemist
5)	Dr. Edith Clark	Occupational Health Specialist
6)	Dr. Michael Yaw Boateng	Socio-Economist/Environmental Economist
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9)	Mr. B. Odei Bempong	Information Technologist(IT Manager)
10)	Miss. J. Mensah	Secretary/Typist

1.0 INTRODUCTION

The Waste Stock Exchange Feasibility Study is a Sub-Contract under the Water Pollution Control and Biodiversity Conservation in the Gulf of Guinea Large Marine Ecosystem project, whose main objective is "to protect and restore the health of the Gulf of Guinea LME (G0G LME) and its natural resources". To achieve this goal five immediate objectives are being pursued through:

1) Strengthening regional Institutional capacities to prevent and remedy pollution of the Gulf of Guinea LME and associated degradation of critical habitats:

2) Developing an integrated information management and decision making support system for environmental management:

3) Establishing a comprehensive programme for monitoring and assessment of the health of the Gulf of Guinea LME,

4) Preventing and controlling land-based sources of industrial and urban pollution-.

5) Developing national and regional strategies and policies for long-term management and protection of the Gulf of Guinea LME,

One of the major activities under the immediate objective (5) above is the eventual establishment of a WASTE STOCK EXCHANGE MANAGEMENT SYSTEMS (WSEMS) within the regions of the G0G LME.

1.1 CONCEPT OF THE WASTE STOCK EXCHANGE MANAGEMENT SYSTEMS (WSEMS)

The concept of WSEMS identifies industries and organizations producing what types of waste (gas, liquid, solid) and industries which can use/trade the waste (domestic, municipal, metropolitan and industrial) as a primary/secondary raw material.

The WSEMS focuses on the 4 Rs: recovery, reuse, recycle and reduction as means of pollution prevention and control which is an important aspect of the GOG LME Project. It also addresses UNIDO's Ecologically Sustainable Industrial Development(ESID) and Cleaner Production Programme.

The concept was accepted by the MEST/UNDP/UNIDO ROUNDTABLE CONFERENCE held in Accra, Ghana, June 10th - 11th, 1997.

The ROUNDTABLE accepted the Concept with recommendations to bring the WSEMS to fruition. The establishment and the consolidation of the WSEMS may be based on the MAMSCO's 5 -in- I principle of project implementation namely:

1) Feasibility study (research) to identify the tradable waste to maximize Reuse and Recycle;

2) Dissemination of Feasibility Report to stakeholders;

3) Feedback/reaction from Stakeholders for finalization of Report;

4) Establishment of electronic-mail based information data bank on tradable waste;

5) Commissioning and consolidation of the WSEMS into a self financing institution.

The aim of the study would promote and evaluate the viability of an innovative mechanism to reduce industrial pollution load.

1.2 OBJECTIVE OF SUBCONTRACT

The purpose of this subcontract is to undertake a feasibility study on the establishment of a self-financing WSEMS for the industrial areas in Accra/Tema Metropolis of Ghana.

1.2.1 Terms Of Reference

The specific responsibilities under the subcontract will include the following-.

1. Review of literature on waste stock exchange systems within the concept of industrial ecology, including technical issues related to re-cycling and re-use of industrial and municipal waste. Based on the literature survey and other sources, to summarize lessons learned from similar activities elsewhere.

2. To prepare a list of potential stakeholders related to the establishment of a Waste Stock Exchange System in Accra/Tema.

3. Undertake a technical survey of the industries in the Accra/Tema industrial areas to evaluate existing Environmental Management Plans and to obtain comprehensive quantitative data on waste generation, including effluent and waste characteristics and quantities.
4. Identify and assess opportunities for re-cycling and re-use and estimate the commercial potential of waste exchange within the industrial and municipal sector, including price levels of identified tradable wastes.

5. Prepare and present a comprehensive proposal towards the development and implementation of the Waste Stock Exchange System, including institutional structure and financial mechanism. In particular, the use of electronic information bulletin on sources, availability and prices should be elaborated.

1.3 METHODOLOGY/INDICATIVE ACTIVITIES

From MAMSCO's (the Contractor's) experience (see paragraph 2.8.6 below) potential stakeholders were identified and appropriate questionnaires (31) were administered to the various industries. Of these 25 responded. In some cases EMPs (10) were obtained. In addition personal interviews with some stakeholders (I8) were also conducted. The type of information covered included production quantities, waste generated, disposal management including potential users and economic potential of the waste and health aspects. Information and data from these sources were analyzed.

2.0 LITERATURE REVIEW (PROBLEM OF WASTE MANAGEMENT)

2.1 Background

Waste Management is one of the major challenges of the 1990s. Many countries are already facing critical shortage of landfill space, and there are growing concerns about the environmental impacts of traditional methods of waste generation and disposal methods. The best approach to waste management is to reduce the quantity of waste generated and/or not to produce waste at all.

The waste management hierarchy of the "4Rs", **(Reduce, Reuse, Recycle, Recover)** has been employed by many institutions which seek to manage waste. Wherever possible, waste reduction is the preferable option - it is best to produce as little waste as possible. If waste is produced, every effort should be made to reuse it. Recycling is the third option in the waste management hierarchy. Although recycling does help to conserve resources and reduce waste, it is important to note that there are economic and environmental costs associated with waste collection and recycling processes. For this reason, recycling should only be considered for waste which can neither be reduced or reused. Finally it may be possible to recover materials or energy from waste which cannot be reduced, reused or recycled.

2.2 Waste Exchange

The concept of "Waste Exchange" hinges on the **4Rs** of waste management. The Waste Stock Exchange provides a "matching service" between the waste generator and potential users of the waste product. The Waste exchange System works on the maxim the ***"one man's waste is another man's raw materials"***

Waste Exchange System, apart from being one of the alternatives to disposal of byproducts from industrial processes and household wastes, is also a pivot in industrial ecology, which is a means of approaching sustainable development by initiating nature's ability to use closed-loop materials and energy.

2.3 Operation and Management

The Waste Exchange System usually serves as a clearing - house and a repository for a variety of industry, business, trade associates, academic etc., to exchange both solid and hazardous materials as a means of pollution prevention, waste minimization and recycling. That is, it usually puts potential users of waste materials into contact with waste producers. A company having material that is unusable at its facility but which has potential value may list that

material with the Exchange.

The Exchange System could either be a Passive or an Active Exchange. A Passive Exchange System helps waste generators and potential users to get in contact with each other, but refrains from charging a commission on the Exchange. Active Systems, on the other hand, provide services similar to a commodity broker, buying and selling wastes and charging a fee, which is usually a percentage of the sale, for acting as a middle man. The Active Exchange System provides information on-.

⇒ market development;
⇒ recycled product;
⇒ current regulations / legislation;
⇒ alternative and emerging waste management technologies;
⇒ trade journals and associations;
⇒ technical reports;
⇒ the availability of and demand for waste materials;
⇒ waste management services and products.

Moreover, Active Exchange System Operators would concentrate on only those wastes most likely to maximize his fees, whereas passive Exchange Operators would list all wastes offered by generators. The passive Exchange is neither liable nor responsible for the character or content of any item listed, or for that matter determination of what may constitute a hazardous substance or create a hazardous condition. Under this circumstance, the Exchange does not make recommendation with respect to or legal requirements for storage, handling, transportation, or disposal of what may be defined as hazardous substance.

2.4 Subscription/Listing of Materials

An individual or company could only be admitted into the Waste Exchange Systems if the individual or company gets registered as a subscriber. This registration allows *access to* materials listed in either the Materials Available Listing or Materials Wanted Listing. *(Here access* to listed materials means that a waste generator has been connected to its prospective / potential user or versa). Fees are normally charged for subscription as the Exchange is to be self-sustaining in the long term.

2.4.1 Listing Policy

Materials and goods listed on the Exchange must be the waste or by-products of internal operations, processing, construction or other related activities, or surplus inventory, overstock and parts resulting from changed processes or business operations, obsolescence, or discontinuation. The Exchange is not a catalogue service and hence does not accept listings for new materials, products, goods and equipment.

In the event where a member violates these criteria, the Exchange has the right to remove the listing from the Exchange, charge the offending member an administrative fee to cover the removal action, and/or cancel the offending company/organization's membership without regard to membership and listing fees.

Subscription fees are valid usually for a period. Individual listings are valid within a certain period from the date of submittal at which time they are automatically deleted from the active inventory. If a member/subscriber wants to continue the listing, it must be resubmitted as new listing.

2.4.2 Listing Option

Listings can be submitted as either ***open or anonymous*** listing. Open Listings forms are added to the listing database without modification, (i.e. if one includes information or data in the descriptive information on the listed materials/goods that reveal or can be linked to one's companies/organizations do anonymous listings for the purpose of keeping their patented rights.

With anonymous listings, interested parties must contact the Exchange to communicate their interest in a listing. This information will be forwarded to the anonymous lister for follow-up action. Under no circumstance will the Exchange reveal the identity of the anonymous lister to the interested party or parties, the anonymous lister remains the exclusive option to make the initial contact. Some companies/organizations.

2.4.3 Materials Wanted/Available

The catalogue for the Exchange usually contains at least two sections, Materials available and Materials Wanted. For Active Exchange, a section on Waste Management Services is included. Normally there is no fee charged for Material Wanted Listing, but fees are charged for Material Available and Waste Management Service Listing. However, fee for

Material Available Listing can be waived depending on the financial stand of the Exchange and whether it is being funded by a local government or a benevolent Organization.

Materials Available/Wanted are grouped according to the following categories:

1. Acids
2. Alkalis

3. Other Inorganic Chemicals
4. Solvents
5. Other Organic Chemicals
6. Oils, Fats and Waxes
7. Plastics and Rubber
8. Textiles and Leather
9. Wood and paper
10. Metals and Metal Sludge
11. Compostable Materials
12. Miscellaneous

Code numbers will be usually assigned to each Material Available and Material Wanted Listings for confidentiality reasons.

2.5 Benefits of Waste Exchange

- **Resource Recovery** - Large amounts of process chemicals and raw materials discarded as waste from numerous industrial and manufacturing processes can be used as input to other processes and products.

- **Natural Resource Conservation** - The recovery and reuse of materials will have a profound impact on the conservation of natural resources. Substituting recovered materials for Virgin resources not only preserves the natural resource, but reduces the energy necessary to process the virgin materials to the same production state as the recovered resources.

- **Waste Minimization** - Resources recovery and reuse naturally reduce the amounts of wastes that have to be processed and managed.

- **Pollution Prevention** - The reduction in generated waste, even with increased industrial and economic activity, will encourage pollution prevention through process modifications and material substitution.

- **Environmental Protection** - Resource recovery, resource conservation, waste

minimization and pollution prevention all accrue benefits to the environment and its protection.

- **Sustainable Economic Development** - Creating long - term economic opportunity while improving the environment and quality of life for existing and future generations.

- **Increased Profitability** - The costs of virgin materials and the transportation, treatment and disposal of excess materials and products can be a substantial portion of operating costs. By finding secondary markets for waste streams, both generators and potential users can reduce operating cost.

2.6 POLLUTION PREVENTION AND RECYCLING

In-plant practices that reduce, avoid, or eliminate the generation of hazardous waste or the release of toxic chemicals at their source, rather than controlling, treating or managing hazardous waste or toxic chemicals after their generation or release, to reduce risks to employees, public health, and the environment are what is being interchangeably referred to as pollution prevention or source reduction. This concept of source reduction or elimination of waste is the pivot of UNIDO/UNEP's concepts of Cleaner Production.

More specifically, pollution prevention means in-plant practices, including, but not limited to'.

◊ Process Modifications;
◊ Feedstock Substitution;
◊ Product Reformulation;
◊ Management Practices or House Keeping Alterations;
◊ Recycling within Industrial Process; or
◊ Equipment Replacement or Modifications.

Methods for achieving waste reduction divide conveniently into two basic types-,

- Pollution Prevention or Source Reduction; and
- Recycling

Recycling: which is the use, reuse, or reclamation of waste either on-site or off-site, after it is generated.

Recycling methods include:

- The effective use or reuse of waste as a substitute for a commercial product
- Removing Contaminants from Waste to allow its reuse- and
- Reclaiming useful constituent fractions with a waste material.

Simply collecting materials is not recycling. In the past, many recycling programmes floundered because the markets for the materials collection were unreliable and unpredictable. This problem still faces the recycling industry. If the supply of recyclable materials is increased without increasing the demand, materials markets will become glutted and the revenues paid to recycling programmes will fall. In order to build a sustainable recycling systems there is the need to "close the loop" by increasing the demand for products containing recycled materials, such as hand towels made from recycled paper, and re-refined motor oils.

The establishment of Waste Exchange is a positive step towards the solution of the problem of closing the loop - which is what industrial ecology stands for. Other approaches to help solve the problem facing the recycling industry is to implement purchasing policies that favour products containing recycled materials.

2.7 LESSONS LEARNED FROM SIMILAR ACTIVITIES ELSEWHERE

The concept of Waste Exchange Systems and for that matter recycling is not new. Many States in the United States of America, Canada and Australia have developed and implemented programmes that have enhanced recycling and Waste Exchange initiatives.

Because of the seriousness of the Waste problem the US Administration issued an Executive Order (October 20th, 1993) on the Federal Acquisition, Recycling and Waste Prevention.

The Federal Provincial and Municipal Governments of Canada and concerned corporate bodies and individuals recognising the urgency of the waste problem in Canada have been working to reduce the amount of waste needing disposal. In April 1989, the Canadian Council of Resource and Environment Ministers - now the Canadian Council of Ministers of the Environment - agreed that targets and schedules for waste minimisation be established including a fifty percent (50%) reduction in waste generation by the year 2000.

2.7.1 North American Example

There are many examples of successful recycling programmes around Canada, covering household wastes, commercial / institutional wastes, and industrial wastes.

2.7.1.1 Household Wastes

One of the best known examples of household recycling is Ontario's "blue box" program.

which serves more than 2.2 million households in the province. Householders in participating municipalities are given a blue plastic box in which to collect newspaper, glass, metal containers and, in some cases, plastic soft drink bottles; some cities also collect waste motor oil. Once per week, special recycling crews collect these recyclable materials from blue boxes set out at the curb.

Participation in Ontario's blue box program has been very good (70 to 80 percent), and the program diverted more than 200,000 tonnes of waste in 1989. These results have inspired cities in other provinces - including British Columbia, Alberta, Quebec, Nova Scotia and New Brunswick - to initiate similar curbside recycling programs.

But the household blue box is only the first step on the road to 50 percent waste reduction. In most cities, blue box collection is restricted to single family homes and lowrise apartments. Even the best existing programs divert only about 10 to 15 percent of residential wastes from disposal. As a result, pioneering municipalities are using a variety of approaches to attack the remaining wastes.

- Municipalities such as Mississauga, Guelph, Toronto and Ottawa, Ontario have set up recycling depots in highrise apartment buildings. This has involved adapting collection methods and equipment to a range of building types.

- Recycling depots have been established in many rural areas, where distances and collection costs make curbside programs impractical. In Wellington County, Ontario, for example, depots at landfill sites and municipal properties have proven to be very popular. In a pilot project, residents in some areas of the county were provided with blue boxes in which to collect and transport recyclable materials to the depots. Participation and yields increased dramatically, and the county is now providing blue boxes to other residents served by the depots.

- Nova Recycling, a non-profit company in Newfoundland, has established recycling buy back centres and mobile units to collect metal and plastic soft drink containers from urban and rural areas in that province,

- Increasing attention is being paid to organic wastes (food and yard wastes), which account for more than one third of the residential waste stream. Some municipalities, such as Metropolitan Toronto, are trying to encourage home owners to compost their organic wastes by providing them with low-cost composters. Other municipalities, including cities in Ontario, Quebec and British Columbia, are experimenting with curbside collection of yard waste and with composting depots.

- The city of Guelph, Ontario is testing variations of the "wet/dry" waste separation system used in many European cities. In a pilot project, householders have been asked to separate their waste into wet and dry streams; some have been given special containers. The "wet" wastes (e.g., organic materials) are composted, and the dry waste stream is being surveyed

to determine its contents.

Approximately one percent of household wastes contain hazardous materials and should be disposed of in licensed hazardous waste management facilities. Many provinces have been encouraging municipalities to collect these materials at special "household hazardous waste (HHW) day" events or by operating HHW collection depots. "Toxic Round ups" have been held in major cities in Alberta, and municipalities in Ontario, Manitoba and Saskatchewan have also organised special HHW days. However, the costs of these special events have prompted municipalities such as Winnipeg in Manitoba, and Toronto, Guelph and the region of Peel in Ontario, to establish permanent depots to which residents can bring their hazardous wastes.

These are only a few examples of the residential recycling activity taking place across Canada. But residential wastes account for only about one third of Canada's solid wastes. Significant efforts are also being made to recycle commercial and industrial wastes.

2.7.1 2 Commercial and Institutional Wastes.

Offices, retail outlets and institutions such as governments, schools and hospitals produce more than 20 percent of Canada's solid wastes. Construction wastes account for another 30 percent. The growing realization that recycling can yield economic benefits in the form of reduced waste disposal costs, as well as revenues from the sale of recyclable materials, has prompted commercial enterprises to recycle a variety of materials.

- The federal government's Papersave program in the National Capital Region recycles more than 10,000 tonnes of office paper annually In 1989, savings in avoided waste disposal charges were in excess of $350,000. This program, which operates in more than 80 buildings, has been operating since 1976. It is now being upgraded with new equipment and collection service- this is expected to significantly increase yields and revenues.

- Canada's largest office building First Canadian Place in Toronto is also a model of recycling initiative. Cardboard, fine paper, beverage cans and glass bottles are recycled, wooden pallets are reused, and food wastes are saved for collection by a local pig farmer. In total, approximately 30 tonnes of waste are diverted daily.

- Many smaller businesses are finding it profitable to source-separate fine paper and old corrugated cardboard for recycling. For example, in Edmonton, Alberta, a non-profit Organization called Paper Chase Recycling hires unemployed young people to pick up and process waste paper from offices for recycling.

- Municipal governments are beginning to require consideration of recycling in the early stages of building planning. For example, the City of Toronto recently enacted a by-law

requiring that waste management plans be included in development plans. Among other considerations, developers are required to ensure that sufficient space is provided in new commercial buildings to effectively carry out a materials recovery program.

- Gypsum wallboard, or drywall, is a significant source of waste, and can produce toxic hydrogen sulphide in landfill sites. One company, New West Gypsum Inc., has been recycling gypsum waste in New Westminster, B.C. since 1987, and is now expanding into Ontario. The company crushes and screens wallboard waste to produce marketable gypsum and paper.

2.7.1.3. Industrial Wastes

There are numerous opportunities to recycle industrial waste, and Canadian industries are capitalising on them. Savings in waste transport and disposal fees can be significant, even if the material recycled is not highly valuable.

- The Canadian Waste Materials Exchange (CWME) and provincial waste exchanges help industries get in touch with potential users or recyclers of their wastes. Since it started in 1978, the (CWME) has assisted in the recycling and reuse of approximately 355,000 tonnes per year of waste from a variety of industries.

- Canadian entrepreneurs have also been finding new business opportunities in recycling. One Calgary company, Industrial By-Product Recycling (IBR), specialises in finding recyclers or users for industrial by-products.

- Boeing Canada's de Havilland Division in Downsview, Ontario recycles approximately 25 percent of its waste stream. Cardboard, computer printouts, office paper, cans and bottles, and scrap metal are all collected for recycling

- The Society of the Plastics Industry of Canada has developed a coding system for plastic containers, in order to help consumers determine which containers are recyclable and to assist recyclers in sorting by plastic type. This system is being implemented on a voluntary basis by plastic container manufacturers and users.

- The foundry industry in Canada is estimated to generate more than 600,000 tonnes per year of waste sand from mould and core-milling processes. Highland Foundry Inc. of Surrey, B.C. is one company that has installed equipment to reclaim its sand. Highland has reportedly reduced its purchases of new sand by 90 percent.

2.7.2 Australian Example

There are some established waste Exchanges in Australia. For example the Illawarra Waste Exchange which is an initiative to facilitate the reduction of waste materials in the Wollongong, Shellhabour, Kiama and Shoalhaven Local Government Areas in new South Wales offers free service. The Illawarra Waste Exchange is administered by Illawarra Waste Management and Planning Board representing communities within the Illawarra Region. Its task is to mobilise the community to minimise waste (household waste, commercial and industrial waste, building and demolition waste) with the target of "60% less waste to landfill in Wollongong, shallharbour, Kiama and Shoallaven, by the year 2000".

The Waste management and Planning Board encourages all to find out if someone else has a use for their waste by searching for materials wanted or registered materials available in the Exchange before putting their waste materials in a bin and sending them to the tip.

The Dean of the Faculty of Science at Sydney University and the Federal Department of the environment have developed a Waste Exchange Web Page, which is currently being supported by the concept "Clean Up Australia". It is a whole new plan aimed at providing a network for exchange of information on waste. The information provided is to be developed into a Waste Recycling Database.

2.7.3 Developing Countries Example

Various web sites of some developing countries were visited. The findings indicated that Waste Stock Exchanges has not caught up well. However, many of such countries have developed and are implementing solid waste management programmes. For example, Malaysia has developed a comprehensive waste management plan covering a 25 - year period (1996 - 2020). In October 1994, the Malaysia Government initiated the privatisation of the country's waste management by issuing a call for proposals. This decision was made part of the Vision 2020 initiative which focuses on having the country evolve into a fully industrialised nation by the year 2020 while protecting public health, environment and sustainable utilisation of natural resources.

2.8 GHANA'S EXPERIENCE

The post-independence industrialisation aspirations of several West and Central African countries which share the Gulf of Guinea LME did not integrate individual national environmental management. This pattern of non-sustainable development effort is depicted visibly by the siting of the industries and urban waste disposal facilities predominantly at water courses. Indeed, the siting of such facilities appears to have been dictated by the then concept

of pollution minimisation through dilution regardless of pollution loads that exceeded the assimilative capacities of such water bodies. The practice has resulted in the environmental impact of marine, coastal wetlands, and inland drainage systems, and constitute land based sources of the pollution of the larger marine ecosystem.

2.8.1 Land - Based Pollution Sources And Impacts On Coastal Wetlands And Large Marine Pollution

Along the whole coastline of the Gulf of Guinea, improper solid waste disposal and consequent runoff and discharges into the environment of effluent which are, to a large extent, untreated and unregulated, increase the risk of pollution of the marine environment especially in the centres of high population densities.

In Ghana the negative effects of inland drainage on coastal lands and waters arise mainly from the impoundment of rivers. Also surface waters may carry into the coastal zone pollutants originating from point sources such as municipal and industrial drains or diffuse sources including land runoff with high sediment loading, and some agro-chemicals (pesticides and fertilisers). Municipal/domestic sources of pollution originate from households, markets, transport terminals, restaurants etc., and contain among others, organic matter, nutrients, micro-organisms, parasitic worms, oil and trace metals.

The coastal zone, especially Accra, Tema and Takoradi has been the major area of industrial development. Almost 60% of all large and medium scale industries in the country are located in the Accra - Tema Metropolis which covers less than 1% of the total area of Ghana. This trend continues to serve as driving force that attracts high human population drift. The main producers of industrial pollutants are the textile, food and beverages, petroleum refining and handling, mineral exploitation and processing industries.

A UNIDO study which investigated the sources of industrial effluents and their probable contributions (UNEP, 1984) reported that for the zone between Cote D'Ivoire and Benin, the main producer of industrial pollutants by weight was the textile industry whose wastes contain about 30% of all polluting substances. The manufacture of food and beverages contributes 25% while petroleum refining and handling accounts for 20%. Mineral exploitation and processing are also responsible for about 10%. These four activities contribute up to 85% of the total pollution load. The situation might be different today but will not negate land-based pollution source from industry.

2.8.2 Current State Of Pollution Of Some Coastal Wetlands

The current state of pollution of some coastal wetlands (Chemu Lagoon) has been studied by the Environmental Protection Agency, EPA (1994), the Council for Scientific and Industrial Research (1995) and similarly the Odaw River and Korle Lagoon by the International Marine and Dredging consultants (1994). These recent studies indicate that the untreated effluent discharged into the wetlands constitute high pollution loads in excess of the assimilative capacities. The effluent are characterised by relatively high values of suspended solids, conductivity, salinity, sulphides, BOD, COD, ammonia and heavy metal concentrations compared with background values for sea and river water. The pollution indicator levels measured are invariably higher than acceptable levels in accordance with World Bank Guidelines.

The very high biochemical and oxygen demand has resulted in oxygen depletion in some parts of the water bodies which recorded zero dissolved oxygen levels. Generally, anaerobic conditions prevailing in these water bodies generate methane, and sulphide gases with characteristic pungent smell and odour nuisance in the environ of the lagoons thus posing threat to public health. The harmful and toxicity levels of the pollutants have led to the destruction of coastal ecosystems particularly the fairly fragile nursery grounds of certain species of fish, habitats and bio-diversity.

High pH values above 8.4 or low pH of 5 and below cause toxicity to aquatic life and soil productivity loss. Fish and common aquatic organisms prefer pH of 6.5 - 8.4. Highly toxic gases are also liberated from cyanides, sulphides and fluorides at low pH levels and heavy metals precipitate at high pH levels. High suspended solids and turbidities result in the impairment of photosynthesis through reduction of light transmitted through the upper layers of receiving streams. Nitrates, ammonium and phosphates serve as nutrients for all types of plant life. All these therefore led to Development of Ghana's Environmental Action Plan. (EAP).

2.8.3 Ghana's Environmental Action Plan (EAP) And Protection Of Marine And Coastal Wetlands

In March 1988, the Government of Ghana put environmental issues on the priority agenda when it estimated the costs imposed on Ghanaians and the economy from environmental degradation sectors such as agriculture, forestry, hunting, industry and mining. The picture is incomplete in a number of respects. Nevertheless, as conservative as these estimates may be, the costs of environmental degradation are significant. The total estimated annual losses in 1988 amounted to 41.7 billion cedis (about 21 million US dollars) equivalent of 4 per cent of

total GDP. The exercise has culminated in the preparation of National Environmental Action Plan (NEAP), a strategy to address the key issues relating to the protection of the environment and better management of renewable resources.

The NEAP defines a set of policy actions, related investments, and institutional strengthening activities to make Ghana's development strategy more environmentally sustainable.

In recognition of the concept of sustainable development, Ghana also adopted the National Environmental Policy (NEP) to operationalise the Action Plan by effecting programmes to clean-up the environmental degradation over the years of non-sustainable development. The policy actions for the protection of the marine and coastal ecosystems include the enactment of legislation and regulations on coastal zone management and the establishment of protected areas in the coastal wetlands. Further, the marine environment will be accorded special attention through-.

- The implementation of the conventions and protocols of relevant international bodies dealing with marine pollution, especially in the West African sub-region; and

- The reduction of land-based pollutants into the seas as a result of the dumping of raw sewage and untreated liquid industrial wastes.

Some environmental protection measures to ensure the attainment of the policy objectives relevant to the protection of coastal wetlands and reduction of land-based pollution sources will include ***inter alia:***

- Control of waste discharges into water bodies and establishment of water shed and coastal wetlands protected areas.

- Institution of appropriate measures of pollution control guided by preventive approach through the use of economic and social incentives in addition to regulatory measures (e.g. application of Polluter pays Principle of preventing, minimizing and abatement of pollution).

2.8.4 Environmental Protection Agency (EPA) Approach To Pollution Control In Existing Industries

Globally, the emergence of environmental laws and regulations in many countries is also driving industry to adopt Environmental Management System (EMS) for continual improvement and voluntary compliance to standards. The development of International Standards Organization (ISO) 14000 as an environmental protection by internal standards buttress the global acceptance and expectation of environmental management in industry.

In Ghana, the development of existing industries awareness of environmental management is being effected by the Environmental Protection Agency (EPA). The EPA was established by the enactment of EPA Act 1994 (Act 490). Section 12 of the Act confers enforcement and control powers on the EPA to administer environmental impact assessment. This is also reflected in the administration of Environmental Management Plan (ENV) preparation by industries initiated by the EPA as a national approach to encouraging cleaner production approaches to environmental management.

2.8.5 EMP Approach

The EMP approach helps industries to develop company's environmental action plan through institution of prevention, reduction of waste generation at source, and to select the combination of primary processes and pollution abatement techniques. The key principles of the EMP as an internal environmental management system for industry satisfy the emerging global approaches to environmental management system, ISO 14000. The system recognises that environmental management is an integral part of an organization's overall management responsibility and seeks to enable a company to integrate quality management systems, organisational structure, practices, procedures, processes, planning and resource conservation for implementing continual improvement in environmental performance.

2.8.6 Initiation of Industrial Waste Stock Exchange Management System (IWSEMS) by MAMSCO

As part of the EMP programme to ensure sustainability of the Chemu Lagoon Restoration Programme, the EPA directed that all operations discharging into the catchment area should prepare EMPs to ensure the establishment of Environmental Management Systems (EMS) with the highest corporate commitment. Industries are subsequently asked to operationalise the EMPs by developing costed programme budgets for all improvement plans that would ensure that effluent and emission quality as well as solid waste disposal management meets EPA guideline where they exist, otherwise World Bank guidelines.

In response to the EPA directive, MAMSCO Management Ventures Limited, undertook consultancy services for some industries for the purpose of preparation of their Environmental Management Plans (EMPs). From the individual industry's END brought into focus the idea of the Stock of Exchange Management possibility of the Tema Industrial Area.

To this end, MAMSCO Management Ventures Limited, a Private Consulting Firm, presented a Concept Paper on Industrial waste Stock Exchange Management System at a MEST/UNDP/UNIDO ROUNDTABLE Conference for Consideration on the basis of its technological feasibility, economic viability, political desirability and roles expected of both private and public sector institutions. The Conference accepted the concept with

recommendations *inter alia* for the realization of the WSEMS in Ghana towards ensuring Sustainable Development of Ghana's Industrial Sector. MAMSCO now possesses a COPY RIGHT of this intellectual property. (Appendix 2. 1).

3.0 THE PROJECT

3.1 PROJECT DESCRIPTION

MAMSCO's concept of Waste Stock Exchange Management System was approved by a Round table Conference organised by The Ministry of Environment, Science and Technology (MEST) and other International organisations including UNIDO.

The Present feasibility Study seeks to develop the concept into an operating machinery charged with the implementation of a Stock Exchange System involving industrial waste in the Accra - Tema Metropolis.

The first phase of the entire project shall be organised under five departments, namely,: Training/MIS department, Production department, Maintenance department, Finance/Administration department, and Sales/Marketing department. All the departments shall belong to the same set up under one Managing Director.

The Management Information Systems (MIS) shall not generate revenue in this first phase but rather shall provide supporting services to the Production department.

The possibility of setting up the MIS as a separate department to generate funds to sustain itself shall be considered during the second phase of the project. From the questionnaires, Potential Stakeholders appear not yet ready to be involved, and only a few were willing to pay reasonable subscription fees.

The set up under this first phase shall treat four(4) industrial wastes and sell the products to industries and the general public. These products are:

i) lime wash from waste lime;
ii) fuel oil from spent lubricating oil,
iii) gypsum from waste calcium sulphate generated on our beaches alongside salt production, and
iv) briquettes from saw dust.

In addition, it shall offer training in industrial waste management to personnel from interested industries and organisations.

The second phase of the project shall look at the possibility of setting up the MIS as a separate department to collect and store up data on industrial wastes to serve as data bank. Stakeholders will have access to this data bank to source information on waste quantities and their qualities. This will enable them sell their wastes or purchase wastes which are suitable as raw materials for their production processes. It is proposed that this phase shall come into operation two years after the commencement of the first phase. It is believed that two years intensive campaign to educate potential stakeholders on the benefits of this project, shall be adequate to make them willing to register as subscribers and pay reasonable subscription fees, which can render the project self-sustaining.

3.2 PROJECT FIXED ASSETS

3.2.1 EQUIPMENT FOR MANAGEMENT INFORMATION SYSTEM (MIS)

3.2.1.1 HARDWARE REQUIREMENT

An Integrated Later Approach MIS setup for processing of Waste Stock Exchange System Information, would comprise a Mini Server and two (2) terminals, of which the server would be a non-dedicated. The following would be the possible Technical specifications of Files Server and terminals to be connected in a **Bus Topology** Network environment for the initial MIS setup of the project.

A File Server

A single processor Server would be an ideal type. Other required parameters are:

ITEM	DESCRIPTION/TYPE
• Processor	Pentium II / 233 Mhz
• Hard Disk	2.5 G bytes
• Memory RAM	32 M bytes Expandable
• CD - ROM	8 x 12 Speed
• Network Card	
• MODEM	US Robotics
• Parallel and serial Ports	
• Expansion slots for Extra Connectivity	
• Key board	102 Enhanced
• Monitor	15" Super VGA
• EISA/PCI	Standard Bus System

B. Intelligent Terminals

The Intelligent terminals are all single processor PCs. Other required parameters are:

ITEM	DESCRIPTION/TYPE
• Processor	Pentium II / 233 Mhz
• Hard Disk	2.5 G bytes
• Memory RAM	32 M bytes Expandable
• CR - ROM	8 x 12 Speed
• Network Card	
• MODEM	US Robotics
• Parallel and serial Ports	
• Expansion slots for Extra Connectivity	
• Key board	102 Enhanced

- Monitor 15" Super VGA
- EISA/PCI Standard Bus System

C. **Peripheral Equipment**

Laser printer (HP) Series

Total Hardware Requirement

3.2.1.2 SOFTWARE REQUIREMENT

The above Hardware requirements show a matching Network Software and related Application packages for the Network accessibility. The following are proposed software requirements:

a) Operating Systems Software

The current and up-to-date Network Operating system is Microsoft Windows NT 4.0 Workstations for Server and terminals. The choice is that, this combines ease of use of Windows 95 with the reliability and security of NT. Terminals can easily be increased without affecting its performance or future upgrades.

b) Other Application Software

- Microsoft Visual Foxpro - Related Database
- Professional Edition
- Corel Draw Version 8
- Microsoft Office 97

3.3.1 TRAINING EQUIPMENT REQUIREMENT

Training in Waste Management is one of the essential requirements for the successful implementation of a waste stock exchange management systems. The main objective, of this Institute *inter-alia*, shall be to offer Training in all aspects of Waste Management to beneficiaries and the general public. It shall be a bilingual (English and French) Institute to offer opportunity to neighbouring countries.

The Training shall be in the form of Workshops and Seminars with duration ranging from 2 weeks to 3 months. The areas to be covered shall include the following:

- Industrial Waste Management:
- Production Technology of Waste Treatment:

Below is the training equipment

TABLE 3.1 - TRAINING EQUIPMENT REQUIREMENT

DESCRIPTION OF ITEM	*QUANTITY REQUIRED*
Computer Projection Units	2
Pentium 133 Multimedia Computers	2
Television Sets	1
Video Deck	1
Overhead Projectors (OHP)	1
Projection Screens	2
Flip Chart Standboard	2

3.4 OFFICE EQUIPMENT

The necessary office equipment for the project are as listed below.

Table 3.2 Office Equipment

DESCRIPTION OF ITEM	QUANTITY
Personal Computer(Pentium)	3
Laser Printer	1
Unit Air Conditioner	8
200L Refrigerator	1
Uninterrupted Power Supply Unit	3
Switch Board	1
Telephone Receivers	10
Binding Machine	1
Photocopier	1
Fax Machine	1

3.5 FURNITURE AND FIXTURES

The lecture halls shall be provided with tables and chairs. The Offices are already furnished with the necessary furniture and fixtures.

3.6 VEHICLES

Four duty vehicles (Pick-up, twin cabin) shall be provided for the operations. Three tipper trucks, two fork lifts of 2.5 tonnes, one wheel loader and two waste oil tankers shall be provided. This will serve to transport finished products to marketing centres in Accra, Kumasi and Takoradi.

3.7 LAND AND BUILDING

The project shall initially make use of the office premises already acquired in the Tesano Business centre whiles the factory will make use of part of the 10 hectares of land acquired in Dodowa for the factory buildings and subsequently the offices. Part of the land will be available for dumping of tradable waste prior to treatment

3.8 PLANT AND MACHINERY

The project shall initially require equipment for treating Waste oil and Waste slaked lime. The Plant and Machinery required are listed in Table 3.3 below.

Table 3.3 List of Plant and Machinery Equipment

DESCRIPTION OF ITEM	*QUANTITY*	*TECHNICAL SPECIFICATION*
Filter Press	1	Capacity to Filter 20m ^{3} Oil a Day
Oil Cuve	2	25Om^3 Capacity
Briquette Press	1	
Waste Oil Depot	1	
Tools & Implements	1Set	-

3.9 PROJECT FINANCING

The socio-economic benefits of waste stock exchange management are enormous but its financial viability is not yet tested, being the first of its kind in Africa. Its successful implementation therefore demands technical and financial support from environmental NGO's International Organisations, United Nations Agencies, Governments and individual Stakeholders.

It has been proposed that the entire project be financed by equity participation and loans with a 50 : 50 debt/equity ratio. Chapter 6 gives a summary of project cost and financing plan.

3.10 SOME POTENTIAL STAKEHOLDERS

List of some potential stakeholders, type of waste generated by them, and their corresponding users are presented in Table 3.4.

Though the potential stakeholders are many (more than 35), they do not all appear on the list but are grouped together according to the waste type they generate.

Profile of Mamsco Management Ventures Ltd. is presented in Appendix 3.1

Table 3.4

List of some stakeholders(generators/users) and type of waste generated with respect to WSEMS

NO	STAKEHOLDER/GENER4TOR	WASTE GENERATED	STAKEHOLDER/ USER
I	Air Liquide, Wahome	Slake Lime	Paint Industry
2	Oil Companies e.g. Mobil, Shell etc., Industries, Garages	Spent Lubricating Oils (Waste oil)	Mining Companies e.g. AGC
3	Salt Industries.e.g. Panbros, etc.	Calcium Sulphate Dihydrate (Gypsum)	Cement Industries e.g Ghacem, Medical use(POP)
4	Plastic Industries e.g Poly Products, Top Industries, etc	Plastics	Plastic Industries
5	Wood Industries e.g. pergamon etc	Sawdust	Building Industry (Chip Board), Fuel (Briquette)
6	Steel Industries e.g. Tema Steel, Wahome, Ferro Fabric	Slag	Road Industry Road Construction
7	Valco	Carbon	Steel Wahome
8	Valco	Dross	Aluminium Enterprise Ltd Baka Yaro Aluminium Ltd

Table 3.4 Cont'd

NO	STAKEHOLDER/GENER4TOR	WASTE GENERATED	STAKEHOLDER/ USER
9	Super Paper Products Co. Ltd, (SPPC) Publishing Companies e.g Ghana Publishing Co. IKAM Publishing etc.	Paper	SPPC
10	Breweries e.g Achimota Brewery Ltd, Coca Cola, Ghana Bottling	Broken Bottles	Abosso Glass Factory, Beads Manufacturing
11	Pioneer Food Company (PFC), Gafco	Offal (Fish Waste)	Poultry Farmers
12	Cocoa Industry, Cocoa Processing Co. Tema	Cocoa Shell/husk	Local Soap Manufacturing, Export to U-K
13	Aluworks	Rolling Oil	Baka Yaro Aluminium Ltd
14	Breweries e.g ABC, ABL	Carbon Dioxide	Soft Drink Manufacturers e.g ABC, ABL, Pepsi etc.
15	Breweries e.g ABC, ABL	Spent Malt	Animal Feed (Poultry, Piggrey).
16	Steel Fabrication e.g., Crocodile Matchets, etc	Steel Scrap	Wahome Steel, Tema Steel, Ferro Fabric
17	Aluminium Fabrication/Extrusion e.g., Ghana Aluminium Co. Ltd, Ghana Pioneer Aluminium Co.	Aluminium Scrap	Aluworks
18	Community (Excluding Industrial Type)	Domestic (Organic Waste)	Agriculture (Manure)

4.0 TECHNICAL SURVEY OF INDUSTRIES IN ACCRA-TEMA

4.1 BRIEF DESCRIPTION

The technical aspects of the project, including the evaluation of Environmental Management Plans(EMPs) and analysis of questionnaires administered on various waste types in the Accra-Tema Metropolis shall be reviewed in this chapter.

Ten EMPs were evaluated and thirty - one questionnaires were sent out to some selected industries and organisations to collect data on the quantities of wastes they generate and their means of disposal, twenty-five responded. These data have been carefully analysed and eighteen of the wastes have been identified as tradable because of the quantities and the immediate economic/commercial values involved.

The Table 4.1 below summarises types of waste, quantities generated and values in dollars with respect to WSEMS.

Table 4.1 List of type of waste, quantities and values

NO	WASTE GENERATED	QUANTITY(Annual Averages) (MT)	VALUE IN DOLLARS (US$)('000)
1	Calcium hydroxide (slaked lime)	780	8
2	Spent lubricating oils (dirty oil)	22,538	676
3	Calcium Sulphate dehydrate (gypsum)	9014.2	270,000
4	Plastics	7,533	257
5	Sawdust	99,776	-
6	Slag	4,954	-
7	Carbon	672.5	49
8	Paper	81,533	2,787
9	Broken Glass/bottles	3,205.25	662
10	Steel Scrap	-	-
11	Fish Waste (Offal)	50,972	-
12	Spent malt	3,000	-
13	Aluminium Scrap	-	-
14	Carbon dioxide	600	-
15	Rolling Oil	393.6	41
16	Cocoa Shell	1,966	5
17	Dross	1726.8	184
18	Domestic Waste	210,912	-

The table below shows effluent characterisations of some typical Industries in Accra-Tema.

Table 4.2 Effluent Characterisation

ITEM	PARAMETER	TPYE OF INDUSTRY					
		NON-FERROUS METAL IND. (Aluminium Fab.)	**FERROUS METAL IND. (Steel fab.)**	**CHEMICAL (Paint &Acetylene)**	**BREWERY**	**FOOD (Tuna Processing)**	**PETROLEUM REFINING & PRODUCTS**
1	PH	9.2	2.5	7.6 - 11.9	5 - 11.04	6.4	7.6
2	TEMP. ^{o}C	30.0	28.5	29 - 31	25.7 - 41.8	34	31
3	BOD/ppm	-	18.0	380 - 510	60 - 5500	13.6	25
4	COD/ppm	64.0	68.0	604 - 6200	38 - 21000	40.0	1560
5	COND/µs/cm	6300	8160	562 - 8790	364 - 1697	36.0	5510
6	TURBIDITY/ NTU	124	3.4	78 - 20600	--	10	45
7	AMMONIA/ ppm	2.2	0.41	10 - 28.5	-	0.05	0.17
8	GREASE & OIL/ppm	0.0	0.0	0.0 - 27.0	-	146	100

Table 4.2 Effluent Characterisation Cont'd

ITEM	PARAMETER	TYPE OF INDUSTRY					
		NON-FERROUS METAL IND. (Aluminium Fab.)	**FERROUS METAL IND. (Steel fab.)**	**CHEMICAL (Paint &Acetylene)**	**BREWERY**	**FOOD (Tuna Processing)**	**PETROLEUM REFINING & PRODUCTS**
9	PHOSPHATES/ ppm	0.O28	0.23	0.3 - 19.8	-	124.6	0.05
10	NITRATES/ ppm	<0.01	2.4	0.0 - 1.12	-	0.2	2.6
11	SALINITY/ppm	0.34	0.46	0.2 - 0.5	-	610	3.2
12	SUSPENDED SOLIDS/ppm	818	5.0	172 - 40700	60 - 618.5	410	248
13	SULPHIDE/ ppm	<0.001	-	7.86 - 14.18	-	240	0.018
14	LEAD/ppm	<0.02	ND	<0.02	-	ND	-
15	ESTIMATED EFFLUENT QUANTITIES/ HL	-	-	-	6000000	324294	-

The first six (6) have been analysed in detail in this chapter.

The analysis covered the followingareas-.

- Description of type of waste:
- Source of waste:
- Its effect on the environment:
- Possibilities of conversion to tradable commodity- and
- Market Potential for the commodity.

4.2 CALCIUM HYDROXIDE WASTE

4.2.1 Description Of Waste

Calcium hydroxide, Ca $(OH)_2$, known as slaked lime in trade, is the hydroxide which results when quicklime (Ca 0) is dissolved in water.

$$CaO+H_20 \longrightarrow Ca(OH)_2$$

The reaction is reversible at red heat. It is a whitish mass which dissolves in water to form milk of lime.

4.2.2 Source Of Calcium Hydroxide Waste

Calcium hydroxide waste is generated in large quantities in the acetylene industry. Acetylene is produced by the action of water on calcium carbide.

$$CaC_2 + 2H_20 \longrightarrow C_2H_2 + Ca(OH)_2.$$

From the above reaction, every 64kg of calcium carbide employed produces 26kg of acetylene and generates 74kg of slaked lime as by - product.

Air Liquide's acetylene plant in Tema is the major source of this waste. The plant's average annual production of 220m^3 of acetylene is accompanied by the generation of about 60OMT of slaked lime. Wahome in Tema also contributes a significant proportion of lime waste. It generates its own acetylene for its operations.

Besides there are numerous other small scale producers of acetylene within the Accra Tema Metropolis especially artisans and welders who generate acetylene for direct burning, who together produce about 20% of Air Liquide's capacity.

4.2.3 Effect Of Calcium Hydroxide Waste On The Environment

Calcium hydroxide waste is a major source of alkaline pollution of the Large Marine Ecosystem (LME). Alkaline pollution modifies the PH of water, turning it from acidic or neutral to basic. Increased alkaline pollution can deny aquatic life of its oxygen for survival. It is among the sources of pollution dangerous to the habitat.

A field survey of this sector revealed that producers of Calcium hydroxide waste do not have any proper disposal methods. They simply dump them on the ground or dig pits and bury them. Although this waste is not discharged directly into the lagoons and waterways, it is gradually washed into drains and streams, and eventually discharge into the LME.

4.2.4 Technical Analysis Of Data

Table 4.3 below presents data on the estimated national generation of calcium hydroxide waste.

Table 4.3 Annual Calcium Hydroxide Waste Generation

YEAR	***AIR LIQUIDE (GH) LTD(MT)***	***OTHERS (MT)***	*TOTAL* **(MT)**
1994	723.4	62.7	786.1
1995	702.9	104.7	807.6
1996	553.3	225.9	779.2
1997	399.2	347.6	746.8
Average	594.7	185.2	780

Table 4.3 above indicates that the Accra-Tema Metropolis alone generates an annual average of 780 MT of calcium hydroxide waste of about 17% moisture content.

4.2.5 Conversion Of Calcium Hydroxide Waste To Tradable Commodity

Calcium hydroxide waste comes out from the factory in the form of milk of lime. When dumped into pits, the Calcium Hydroxide particles settle, leaving water on top. The water is pumped or drained out and the resulting mass contains between 17 - 25% moisture. There are no impurities from operations associated with this waste.

The waste can simply be sun-dried and bagged for sale to the Paint Industry and the general public.

4.2.6 Market Potential For Slaked Lime Waste

In Ghana, Calcium hydroxide is used extensively in the building industry for painting walls, especially newly plastered ones. Newly plastered walls receive lime wash as their first coating before any other paint.

It is sold on the market as quicklime (CaO) which is dissolved in water to form slaked lime for painting purposes. It is also sold directly in the form of slaked lime.

The demand for lime is enormous. Ghana imports large quantities of lime to supplement its domestic production, mainly for the building industry and for the Mines.

Table 4.4. below gives details of data on imports and domestic production of lime, extracted from statistics compiled by the Ghana Statistical Services.

Table 4.4 Import And Domestic Production Of Lime

YEAR	*IMPORTS (M7)*	*DOMESTIC PRODUCTION* (MT)	*TOTAL (M7)*
1993	8012	1850	9862
1994	22,101	4760	26861
1995	84,311	6,509	90820
1996	45,909	9132	55041
Average			45,646

Source - Ghana Statistical Services

Domestic production has been rising steadily over the years, but it still forms a small percentage of national consumption. The market share for the proposed lime production by WSEMS is about 1.4%, which can easily be absorbed by the market.

In conclusion, waste calcium hydroxide can be converted to tradable commodity by simply collecting from source, sun drying and bagging for sale to the general public and the paint industry.

While ridding the environment of this nuisance, the project will create business opportunity for the nation.

4.3 SPENT LUBRICATING OILS(Waste Oils)

4.3.1 Description Of Waste:

Waste oil is the name popularly given to spent lubricating oils in Ghana. Lubricating oils are long chain hydrocarbons of C18 and above, associated with heavy distillates and residue fractions during the fractional distillation of Crude oil. Additives such as antioxidants, detergents, extreme pressure agents, antifoam compounds, viscosity index improvers and antiscuff agents are usually added to make them suitable as lubricants in engines and machines to reduce friction between metallic moving parts and joints, to prevent excessive heating. As they loose their viscosity and quality of additives in the course of action, they become ineffective and must be changed.

They become contaminated with fine metallic particles from tear and wear of the joints they lubricate, as well as with carbon particles from incomplete combustion of fuel. These carbon particles give the oil a black or dirty appearance, hence the name Dirty oil.

4.3.2 Source Of Waste Oil

Lubricating oils are drained periodically from engines as they loose their viscosity in the course of action and become ineffective in preventing excessive heating.

The automobile industry is the major source of Waste oil pollution. Vehicles change their engine oils after every 4000 km on the average. The Waste oil is usually discharged on the ground or into drains and streams. The mines and other industries also discharge large amounts of waste oil into the environment without pre-treatment.

4.3.3 Effect Of Waste Oil Pollution On The Environment

Waste oil is a major source of land based pollution of the Large Marine Ecosystem(LME). It is easily washed away into drains and streams and eventually discharged into the sea and lagoons through rivers and waterways.

Waste oil is toxic to aquatic life. At increased pollution levels, it destroys the ecosystem of lagoons and pollutes drinking water sources. It can also be harmful to vegetation when discharged on land in large quantities.

4.3.4 Data Analysis

Table 4.5 below presents statistics on total national consumption of lubricating oils in Ghana between 1993 and 1997.

Table 4.5 National Consumption Of Lubricating Oils

YEAR	DOMESTIC PRODUCTION(MT)	IMPORTS(MT)	TOTA L ((MT)	WASTE OIL GENERATED(MT) (55% OF TOTAL)
1993	21454	11,807	33,261	18,294
1994	18869	2,410	21,279	11,703
1995	20,150	67,544	87694	48,232
1996	24709	8984	33693	18,531
1997	25583	3,380	28963	15,930
Average	22,153	18,825	40,978	22,538

Source - Ghana Statistical Services.

On the assumption that 55% of lubricating oil consumption can be recovered as Waste oil, the nation disposes of an average of 22,538MT of waste oil annually. It is estimated that 1200OMT of this amount is generated in Accra-Tema alone.

4.3.5 Conversion Of Waste Oil To Tradable Commodity

Waste oil, in its raw state, can be used as fuel for firing furnaces, just like heavy fuel oil, except that it is contaminated with additives and metal particles. When used in engines to lubricate moving parts and joints, lubricating oils loose their viscosity and become lighter. In that state, they can easily be pulverised for burning.

However, because of the higher percentage of impurities, ordinary burners will operate inefficiently and again will need frequent cleaning.

To convert Waste oil into a tradable commodity, a special atomizer has been designed for this purpose. Such a device is currently being used by the Ashanti Goldfields Corporation, (AGC), the leading Mining Company in Ghana. The Waste oil is simply heated and filtered, and then pulverised for firing in the furnace.

Waste oils in the country contain small amounts of sulphur, an average of 0.3% depending on source of oil. Combustion therefore produces sulphur dioxide, like any other fuel oil. It will therefore be necessary to control the level of sulphur in the oil before sale to the public for industrial heating. Sulphur dioxide is nuisible because it forms Sulphurous acid with moisture in the atmosphere, which is corrosive to metallic installations.

The conversion of waste oil to fuel implies diverting one pollution source, e.g. land based pollution of the LME to another pollution source, e.g. atmospheric pollution. The issues are however complicated.

In certain areas, notably sub-Saharan Africa, and in particular Ghana, the main source of domestic fuel is wood and the principal threat to the ecological system comes from desertification. Atmospheric pollution caused by industrial plants and road vehicles is far less serious and as a result, the environmental imperatives are different.

Viable substitutes for wood - which in practice will usually mean petroleum products - are essential to tackle the problems of deforestation with its attendant degradative factors which the country face today. Concerns over air quality are apparently abstract by comparison.

Waste oils can also be refined for re-use as lubricating oils. The next phase of the WSEMS Project shall cover the areas of calorific value analysis and equipment design to refine Waste oils for re-use as lubricating oils. A detailed business plan shall be prepared on this subject to cover investment cost and financing plan.

4.3.6 Market Potential For Waste Oil

The demand for fuel oil for heating is enormous in Ghana. There are lots of medium and heavy industries which employ fuel oil for heating purposes. The mines, in particular AGC, employ large quantities of fuel oil for heating their furnaces.

In view of the current energy crisis in Ghana, due to low water level in the dam of Akosombo hydroelectric power plant, the nation has realised its over-reliance on natural phenomenon. It is therefore turning to thermal plants.

The Thermal Plant in Aboadze, with an installed capacity of 330 MW consumes large quantities of fuel. Presently two gas turbines in operation, generating at the rate of 110MW each consume light crude oil at the rate of 600,000 MT/annum. Other thermal plants earmarked for the country shall equally consume large quantities of fuel.

The Buipe Cement Plant which is at its promotional stage shall employ about 23000 MT of fuel oil per annum to fire its kiln when it becomes operational.

From the ongoing analysis, (Table 4.5) it can be concluded that the total quantity of 22,538 MT of Waste oil generated annually can find market when refined for re-use as fuel.

4.4 GYPSUM WASTE

4.4.1 Description And Sources Of Gypsum Waste

Gypsum is the trade name given to calcium sulphate dihydrate $CaSO_4 2H_2O$.

Gypsum is produced alongside salt production from sea water. Sea water contains 35.8.% solid matter, of which 27% is common salt and 1.3% is gypsum.

Every tonne of common salt produced is thus accompanied by 20kg of gypsum. Solar

evaporation is the method generally employed by salt producers in Ghana. They make ponds by which they concentrate sea water from 3 Baume to 25 Baume, at which concentration common salt starts precipitating.

Gypsum starts precipitating at 16 Baume; and before any common salt could start precipitating, about 90% of the gypsum in the sea water would have precipitated. The bottom layer of the pond is therefore gypsum contaminated with a small quantity of calcium carbonate.

When precipitation is complete, the salt is scraped off, leaving the bottom layer which is gypsum to pile up with time. This bottom layer containing gypsum is scraped off periodically and dumped on the beach.

4.4.2 Data Analysis

The major common salt (NaCl) producer, Panbros produces about 30% of the total national production.

Table 4.6 below presents data on national salt production and associated production of gypsum. In this table, gypsum is estimated as 5% of total salt produced.

Table 4.6 National Salt Production

YEAR	PANBROS(MT)	OTHERS(MT)	TOTAL (MT)	GYPSUM (MT)
1993	54,641.8	126,013.4	180,655.2	9,032.8
1994	51,814.9	126,400.1	178,215.0	8910.8
1995	50,932.7	140282.1	191214.8	9560.7
1996	37,814.7	133138.0	171,052.7	8552.6
Average	48,801.0	131,483.4	180,284.2	9014.2

Source: Panbros Salt Industries/Ghana Export Promotion Council.

From the table, an estimated average amount of 9000 MT of gypsum is dumped on the coast annually, over the years. Up till now gypsum is not being exploited for any economic value, and the pile up of gypsum over the years is estimated to be in the hundreds of thousands of metric tonnes.

4.4.3 Conversion Of Gypsum Waste Into Tradable Commodity

Gypsum waste, as it occurs along the beaches is contaminated by a trace of Ferric oxide and about 7. 1% of calcium carbonate. (Abilio Garcia - Solar Salt Technology). It is therefore suitable as gypsum for cement production, since some cement manufacturers add calcium

carbonate alongside gypsum.

4.4.4 Market Potential For Gypsum Waste

Cement Mills add about 4% gypsum to the clinker before grinding to regularise the cement setting process. Ghana Cement (GHACEM), the only producer of cement in Ghana, imports an average of 70,000 MT of gypsum annually.

Besides the country imports substantial quantities of gypsum for sale to the general public.

Table 4.8 below presents the national import statistics of gypsum/plasters between 1994 and 1997

Table 4.8 National Imports of Gypsum/Plasters.

YEAR	*IMPORTS (M7)*
1994	675
1995	836
1996	1,269
1997	1,348
Average	1,032

Sources: Statistical Services

The projected production of 900OMT/annum of gypsum is therefore a very small percentage of the total Ghacem Imports (70,000 MT) and the National imports (1032 MT). Therefore the pile up of gypsum at the beaches over the years can supply part of the Country's total requirement.

4.5 SLAG FROM STEELWORKS

4.5.1 Description

Slag from iron smelting industries consists of oxides and sometimes sulphides of calcium, silicon, manganese, iron and phosphates.

A basic slag contains approximately 55 percent CaO, 15 percent SiO_2 5 percent MnO, 18 percent FeO and Other oxides plus sulphides and phosphates.

4.5.2 Sources

Slag is a by-product of the smelting industry. There are three (3) major steel smelting industries in Tema. These are Tema Steel, Wahome and Ferro fabrics. All these industries dump their slag waste on land fill sites.

Table 4.9 Estimated Slag Generated

YEAR	*STEEL PRODUCTION*			*CORRESPONDING SLAG GENERATED*
	TEMA STEEL LTD (MT)	*OTHERS (MT)*	*TOTAL (MT)*	
1994	22,303	66,909	89,212	4,461
1995	25,106	75,318	100,424	5,021
1996	26,907	80,721	107,628	5,381
Average	24,772	74,316	99,088	4,954

Source: MAMSCO

Tema Steel Limited produces about 25% of the total steel production in the Country. From reliable statistics slag generation is 5% of steel production.

From the table the 3 Companies in Tema produce an average of 99,088 ton of steel annually. This implies that an average of 4,954.4 tons of Slag is generated annually. Again from the table above it can be observed that Steel Production increases annually and this will correspondingly increase the amount of slag annually.

4.5.3 CONVERSION OF SLAG TO TRADABLE COMMODITY

Furnace slag can simply be milled to reduce its boulder size and make it suitable as fillers in road construction.

4.5.3.1 Market

Slag, because of its basic properties, can be adapted for use in the construction business especially road construction.

Slag can be used as a fertiliser and ameliorant for highly acidic soils. It can also be used in cement production.

4.6 PLASTICS

4.6.1 Description Of Waste

Plastics are organic polymers based on carbon compounds derived from petroleum. These polymers are long chain molecules loosely tangled together to form molecules of high molecular weights. The polyethylene raw material called low density has a density less than 0.94 gm/cm^3 and the high density polymer is equal to or greater than 0.94gm/cm^3 Polyethylene is marketed as high or low density material.

All plastics are classified as either thermoplastic or thermosetting. Thermoplastics soften on heating without undergoing chemical change while thermosetting plastics undergo an irreversible chemical change during moulding.

4.6.2 Sources

There are over 20 manufacturers of Plastic materials in Accra and Tema alone producing plastic bags and films. Notable among them are Top Industries Limited and Poly Products. The plastic materials identified as creating much problems to the environment aesthetically are the carrier bags and those used for selling ice water. Most of the plastic waste is generated from the food industry as wrappers of food items (e.g. ice cream, drinks, water, take-aways etc.). They are also manufactured as carrier bags for domestic items.

4.6.3 Effects on the Environment

Of all domestic and industrial wastes generated in the Accra-Tema Metropolis, plastic wastes pose the worst problem to environmental cleanliness. They are found littered around in the city's streets, yards, gutters etc. Because of their non-biodegradable nature, they pile up and eventually find their way into gutters and drains.

Though plastics can be adapted to any particular function yet they pose a waste management problem leading to land, water and air pollution. They choke drains, create stagnant water which serves as breeding grounds for mosquitoes. During the rainy season the choked gutters lead to urban flooding. Incinerating of plastics at waste dumping site leads to the release of noxious gases.

4.6.4 Quantities

The amount of raw material for the manufacture of Polybags imported into the country has been increasing gradually and so is the corresponding waste generated over the years. A greater part of the products are potential waste. From the table 4.10 below the annual average imports of polyethylene raw material is 8,862 tons and subsequently the annual estimates of polyethylene waste generated is 7,533 MT based on 85 percent disposal rate.

Table 4.10 Estimated Quantities of Polyethylene Waste

YEAR	*IMPORTS OF POL*YETHYLENE *(Tonnes)*	*85%*
1992	6,820	5,797
1993	7,628	6484
1994	9,732	8,272
1995	6,631	5,636
1996	8,874	7,543
1997	13,485	11,462
Average	8,862	7,533

Source: Ghana Statistical Services

4.6.4 Market

Recycling of Plastics may not be financially viable but socio-economically desirable. Recycling may be more desirable if sorting is done at source.

Consumers will be encouraged to return a used polybag to the retailer for a discount on a new product. The retailer will pass on the used bags to the wholesaler for a discount on new products who will also claim a discount from the manufacturer. Recycling by manufacturers may be tax free.

4.7 SAW*D*UST

Sawdust is a waste generated by the wood industry. Wood is made of cellulose. Ghana is blessed with over 60 species of Timber. The Timber Industry generates about 45% of total wood consumption as waste including sawdust and wood shaving.

4.7.1 Source

The main source of sawdust in the Accra - Tema Metropolis is the timber market at Accra and the numerous sawmills and wood industries all over the environs.

4.7.2 Effect on the Environment

Saw dust could be an environmental and health hazard depending on the particle size. When the particle size is too small, it can be entrained in the air we breathe and pollute it.

4.7.3 Quantities of Sawdust Generated

From reliable sources it is estimated that the processing of log generates about 20% of saw dust. The annual average sawdust production is about 99,776 tons.

Table 4.11 Quantities of Sawdust Generated

YEAR	NATIONAL LOG CONSUMPTION ('000 M^3)	SAWDUST 20% OF LOG CONSUMPTION ('000M^3 Wood)	SAWDUST PRODUCTION (Tonnes)
1990	1092	218.4	98,288
1991	1074	202.8	91,260
1992	1141	228.2	102,690
1993	1186	237.2	106,740
1994	1110	222.0	99,900
Averages	1120.6	221.7	99,776

Source: Timber Export Development Board (Timbod)

4.7.4 Market Potential

There is an enormous market for value added wood products locally and internationally.

The government is encouraging this trend since it banned the exportation of round logs in 1995.

Saw dust with an annual production of about 99,776 tons can be processed into briquettes for uses as fuel and chipboards for the building industry.

Sawdust, which is burnt or discarded as waste, can be processed into briquettes and chipboards for export and for the local market to bring added income to the country as well as the needed foreign exchange. The added value to sawdust will contribute enormously to the Gross National Product (GNP).

In 1995 the Country exported 29.25 m^3 volume of briquette which is 13.2 tons and earned 11,627.44 DM. It is expected that when all the saw dust is processed into briquette alone the nation could earn 90 million DM annually.

A project of this kind will provide direct employment to various categories of skilled and unskilled labour.

Briquettes have been found to have higher calorific value than charcoal and also environmentally more desirable.

4.8 MUNICIPAL WASTE

A comprehensive waste generation and stream study and analysis were conducted in conjunction with the respective Waste Management Departments in Accra and Tema. It involved analysis of waste samples from selected residential areas representing identifiable residential classifications in the cities.

A number of houses were selected randomly in each of the residential areas to have statistically representative sample from each residential classification. The selected houses were made to fill questionnaires to provide information on their household size, income levels and other socio-economic data. A special door - to - door waste collection service was then organised for the selected houses for a defined period to generate information on waste generation rates, etc. Where necessary, the selected houses were provided with 60 litre waste bins to facilitate collection and estimation of waste quantities. The amount of waste in each bin was measured before emptying on collection days. Results of the study are summarised below:

Table 4.12 Daily Domestic Waste Generated (Accra- Tema)

WASTE CHARACTERISTICS	*WEIGHT GENERATED (TONNES/DAY)*		
	ACCRA	*TEMA*	*TOTAL*
Organic	451.33	126.51	577.84
Inert	273.41	79.83	353.24
Plastics	22.85	7.64	30.49
Glass	4.90	2.55	7.45
Paper	34.28	6.94	41.44
Metal	8.16	4.33	12.49
Textile	18.0	2.68	20.68
Rest	3.26	0.93	4.19
Daily Waste Generated (Tonnes/day)	816.16	231.4	1,047.56

Source: MAMSCO

From the analysis, it is observed that 55% of the domestic waste is organic which could be made into compost and sold to gardeners. This may not be viable but socio-economically desirable. Besides, the presence of piles of domestic waste heaps scattered in some parts of the metropolis is insighthly aesthetically, offensive, insect and rodent infested contributing to the spread of diseases.

4.9 Demand for treated waste

There is sufficient demand for all the four products, namely fuel oil from spent lubricating oil, lime from waste calcium hydroxide, briquette from sawdust and gypsum from calcium sulphate waste.

AGC is already employing filtered waste oil to fire its furnace. Some thermal plants which are in their feasibility study stage have agreed to employ our treated waste oil, when they become operational, provided suitable atomisers can be designed for the purpose.

Calcium hydroxide waste produced by Wahome and Air Liquide is being partly utilised by some workers to paint their newly plastered walls.

Pergamon Joinery Limited; a wood processing industry based in Accra is already exporting briquettes from sawdust. The local market is also being penetrated gradually, especially to heat brick ovens for bread baking and for fish curing by fishmongers.

Gypsum produced alongside salt production is only contaminated by about 7.1% calcium carbonate, which is a suitable quality gypsum for cement manufacture. It can therefore find market in either Ghacem, the existing local cement manufacturing company and/or the new Buipe Cement, which is under its promotional stage, when it becomes operational.

5.0 ORGANISATION AND MANAGEMENT

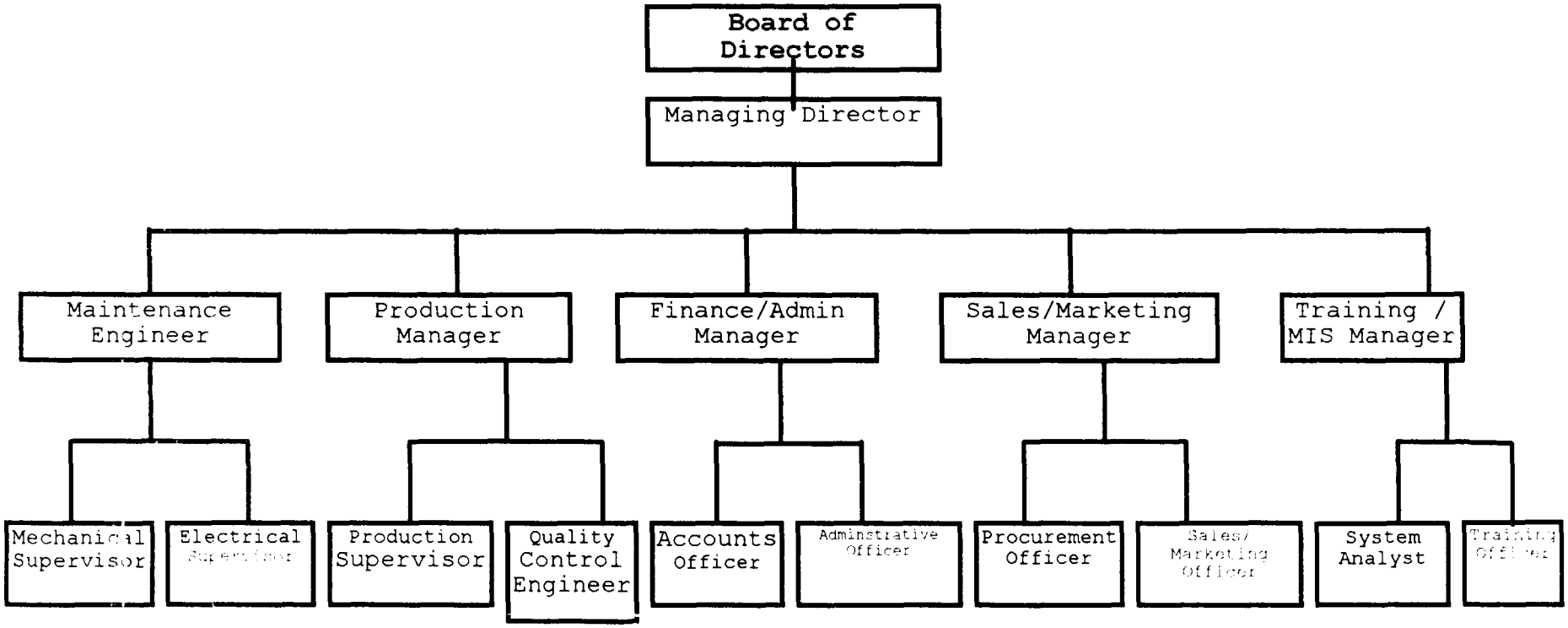
5.1 INTRODUCTION

The entire project has been structured into 5 departments under one Managing Director. The Production Department shall be involved in the Active Exchange System. The other departments, namely Training and MIS department, Finance/Administration department, Maintenance department, and sales/Marketing department shall provide supporting services.

5.2 ORGANISATIONAL STRUCTURE

The proposed organisational structure for the entire project for the top level personnel is presented in Fig 5.1 below:

ORGANISATIONAL STRUCTURE



The proposed organisational structure has been designed for the project, taking into account its work load, to facilitate the efficient and smooth running of the entire plant. The objectives of the structure are to ensure that:

- the activities to be performed in order to achieve the operational objectives are well defined;
- the main functions of the project are grouped, taking cognisance of work load to facilitate effective supervision, co-ordination and control;
- channels of communication are clearly established to facilitate the flow of information and enhance co-ordination.

The above organisational structure shall be modified as the project grows into the next and subsequent phases.

5.3 MANAGEMENT PROFILE

5.3.1 BOARD OF DIRECTORS

A seven member Board of Directors drawn from shareholders and financing institutions is being proposed for the set up. They must be people with enormous experience in Financial Management and Production processes.

The functions of the Board shall include, among other things, the following:

- initiation and formulation of guidelines and policies for the efficient management and administration of the project,
- enforcing sound and proper financial management and practices on the part of management;
- periodic assessment of operational performance of the company;
- approval of conditions of service of employees, major contracts and agreements with other parties; and
- responsibility for the recruitment and dismissal of the company's management staff including the Managing Director.

5.3.2 MANAGING DIRECTOR

The day to day management of the company running the project, shall be entrusted to the Managing Director, who shall be assisted by the 5 departmental heads.

The incumbent shall possess at least a first degree in Administration or Engineering with at least 10 years post qualification experience in a related industry.

5.3.3 PRODUCTION MANAGER

He shall be the head of the Production Department. He shall be in charge of the day to day production operations and quality control.

He shall also develop a coherent method of monitoring and evaluating operational progress of the company.

Production Supervisors shall assist the Production Manager in his duties.

The incumbent shall possess a minimum of first degree in engineering, preferably chemical engineering with at least 8 years post qualification experience in a related industry.

5.3.4 MAINTENANCE ENGINEER.

The Maintenance Engineer shall be in charge of the Maintenance Department. He shall be responsible for day to day maintenance and repair works of the company's manufacturing equipment and machinery. He shall also plan and execute routine maintenance and undertake repairs during major plant breakdown.

The Maintenance Engineer must possess a first degree in Mechanical Engineering, with at least 5 years post qualification experience in a related industry. An individual with a diploma in Mechanical Engineering with at least 8 years post qualification experience could also be considered.

5.3.5 FINANCE/ADMINISTRATIVE MANAGER

He shall be the head of the Finance/Administration Department. He shall be in charge of the company's finances and accounts, as well as administrative and personnel matters. His duties will include, but not limited to the following:

- preparation of quarterly financial statements for consideration by management and Board;
- preparation of budgets and draft accounts; and
- management of the company's cash flow to ensure repayment of loans.

The Finance and Administrative Manager shall possess a B.S.c degree in Administration with accounting option or Chartered Accountant(CA) intermediate with at least 5 years post qualification experience.

5.3.6 SALES/MARKETING MANAGER

The Sales/Marketing manager shall be in charge of the Sales/Marketing Department. He shall be responsible for commercial activities such as sales, marketing and procurement. He shall be responsible for assessing the appropriate demand and supply patterns and relevant prices of products. He shall be assisted in his duties by a Sales/Marketing Officer and a Procurement Officer.

The incumbent shall possess a strong academic qualification in Marketing, with a minimum of five(5) years post qualification experience in a related industry.

5.3.7 TRAINING/MIS MANAGER

He shall be the head of the Training/MIS Department. He shall be responsible for arranging the Training programme and recruiting relevant resource personnel to give lectures on the various subjects involved in the programme. He shall also be in charge of setting up the MIS programme.

The incumbent shall be a holder of a B.S.c degree in Administration or Computer science, with at least a minimum of 5 years post qualification experience in a related industry.

5.4 MANPOWER REQUIREMENTS

The project's manpower schedule is presented in Table 5.1 below. A total of 55 persons, including the Managing Director shall be required for the project.

Resource personnel shall be engaged on part-time basis to give lectures in the Training programme. In this respect, the project shall count very much on expatriate volunteer consultants who will provide technical advice for the initial set up of programmes for the Training/MIS Department.

TABLE 5.1

MANPOWER SCHEDULE

DESIGNATION	NO.
A) DIRECT LABOUR	
Production Manager	1
Maintenance Engineer	1
MIS/Training Manager	1
Production Supervisors	2
Quality control Engineer	1
Training Officer	1
System Analyst	1
Programmers	2
Operators	4
Mechanics	2
Electricians	2
Factory hands	10
Drivers	4
Sub-Total	32
B) INDIRECT LABOUR	
Managing Director	1
Finance/Admini. Manager	1
Sales/Marketing Manager	1
Procurement Officer	1
Marketing Officer	1
Account Officer	1
Administrative Officer	1
Secretaries	4
clerks	4
Drivers	4
Security personnel	4
Sub-Total	23
GRAND TOTAL	55

6.0 FINANCIAL ANALYSIS

6.1 INTRODUCTION

The previous chapters were devoted to analyses to establish the availability of some selected wastes in commercial quantities, the technical feasibility of trading in these wastes and the market potential for the treated wastes. This chapter covers the financial analysis to estimate project cost and financing plan as well as establishing its long term viability for the purpose of obtaining both equity and loan funding for the project.

6.2 ASSUMPTIONS.

The basic assumptions underlying the financial analysis are as follows:

- depreciation is calculated on straight line basis;
- capitalised interest is amortized over 5 years
- an interest rate of 10% is applied to the loan
- repayment period of 6 years including moratorium of one year on both interest and principal is applied to the loan
- it is assumed that the project shall penetrate the market at 60% of its maximum capacity in year 1, increasing to 70% in year 2 and 80% in year 3 and subsequent years
- the entire project cost shall be financed by 50% loan and 50% equity
- the project, due to its socio-economic benefits to the nation, and also by virtue of its classification under the waste management sector, qualifies to enjoy a tax holiday for at least the first 5 years.

FIXED ASSETS

6.2.1 LAND AND BUILDINGS

DESCRIPTION	COST (US $)
Land at Dodowa - 10 ha.	95,500
Shed for drying lime, gypsum & sawdust	38,150
Factory building for waste oil treatment	39,150
Office block (12 offices & 1 lecture hall	43,150
	215,950

6.2.2 PLANT AND MACHINERY

Waste oil cuves	47,000
Waste oil depots	30,000
Filter press / hopper	40,000
Briquette press	35,000
	152,000
Installation Cost 2%	3,040
	155,040

6.2.3 TRAINING / MIS EQUIPMENT

Computer projection units (2)	3,000
Pentium 133 multimedia (2)	5,000
Television sets (1)	500
Video cassette recorders (1)	300
Screens (2)	200
Flip stands (2)	200
Overhead Projector(OHP)	600
Accessories	200
Sub-Total	10,000
MIS equipment / accessories	
File Server	5,000
Intelligent Terminals(2)	5,000
HP Laser Printer	4,000
Uniterrupted power Supply units(3)	2,100
Microsoft Windows NT Workstations	1,200
Microsoft Visual Foxpro prof. Edition	0,900
Corel Draw Version 8	0,950
Microsoft Office '97	0.900
Sub Total	20,050
Total	30,050

6.2.4 VEHICLES

DESCRIPTION	QTY	UNIT PRICE	TOTAL
Waste oil tankers	2	48,000	96,000
Tipper Trucks	3	40,000	120,000
Fork lift (2.5 tonnes)	2	7,500	15,000
Wheel loader	1	85,000	85,000
Pick up (4 W D)	4	20,000	80,000
			396,000

6.2.5 OFFICE EQUIPMENT

ITEM	QTY	UNIT PRICE	TOTAL
Personal Computer(Pentium)	3	2,000	6,000
Laser printer	1	4,000	4,000
Unit air conditioners	8	900	7,200
200L Refrigerator	1	600	600
Uninterrupted Power Supply Unit	3	700	2,100
Switch Board	1	3,000	3,000
Telephone Receiver	10	200	2,000
Binding machine	1	400	400
Photocopier	1	7,500	7,500
Fax Machine	1	750	750
			33,550

6.2.6 FURNITURE AND FIXTURES

DESCRIPTION	QTY	UNIT PRICE	TOTAL
Lecture hall	1	3,500	3,500
Managers offices	5	1,500	7,500
ManagingDirector's office	1	2,000	2,000
Other offices/Secretariat	5	1,000	5,000
Dressing room	1	2,500	2,500
Reception	1	1,200	1,200
			21,700

6.2.7 SUMMARY OF FIXED ASSETS ESTIMATE

ITEM	COST
Land and Building	215,950
Plant and machinery	155,040
Training/MIS equipment	30,050
Vehicles	396,000
Office equipment	33,550
furniture and fixtures	21,700
	852,290

6.3 WORKING CAPITAL

1)	Purchase of 3 months stock of raw mat. (lime)	1,360
2)	Purchase of 3 months stock of raw mat. (waste oil)	42,000
3)	Purchase of 3 months stock of raw mat. (gypsum)	8,775
4)	6 months salaries and wages	107,865
		160,050

6.4 PRE-OPERATING EXPENSES

Market promotion	17,200
Travelling/Admin. expenses	11,700
Consultancy charges	15,000
	43,900

6.5 PROJECT INVESTMENT COST AND FINANCING PLAN

The investment cost for the entire project, covering fixed assets requirement, initial working capital and pre-operating expenses is presented in Table 6.1 below:

TABLE 6.1

ITEM	EXISTNG	ADDITIONAL	TOTAL
Land and buildings	95,500	120,450	215,950
Plant and machinery	0	152,000	155,040
Training/MIS equipment	0	30,050	30,050
Vehicles	0	396,000	396,000
Office equipments	0	33,550	33,550
Furniture & fixtures	5,000	16,850	21,700
Working capital	0	160,050	160,050
Pre-operating expenses	20,000	23,900	43,900
TOTAL	120,500	935,740	1,056,240

FINANCING PLAN

Equity (50%)	120,500	407,620	528,120
Loan (50%)	0	528,120	528,120
	120,500	935,740	1,056,240

6.6 RESULTS OF FINANCIAL ANALYSIS

6.6.1 INVESTMENT COST:

The total investment cost including fixed assets, initial working capital requirement and pre-operating expenses is established at $ 1,056,240. This is made up of $ 852,290 fixed asset, $ 160,050 initial working capital and $ 43,900 pre-operating expenses.

6.6.2 FINANCING PLAN

It is proposed that a mix of equity and loan will be used to finance the project.In order to satisfy the lending criteria for most financial institutions, a debt/equity ratio of 50:50 participation totalling $ 528,120 and loans totalling $ 528,120 would be required.

6.6.3 PROFITABILITY

The project's profitability analysis is presented in Appendix 6.1. It indicates that the project would yield a net profit of $ 52,809 in year 1 increasing to $ 78,136 in year 2 and $ 147,792 in the year 6. A 50% dividend can be declared in the third year and subsequent years. The corresponding net profit margin would increase from 6.5%in year 1 to 8.3 % in year 2 and 21.1% in year 6.

6.6.4 PROJECT BALANCE SHEETS

The project's projected balance sheets are presented in Appendix 6.2. The projections show that the net worth of the project, represented by the shareholders funds will increase appreciably from $ 580,929 in year 1 to $ 659,065 in year 2 and then steadily to $1,010,151 in year 6. The working capital will improve greatly from $ 1,161,861 in year 1 to $ 1,123,811 in year 2 and then decrease gradually from the third year to 1,010,151.

6.6.5 PROJECTED FUNDS FLOW STATEMENTS

The projected funds flow statements are presented in Appendix 6.3. They indicate that the project would generate enough funds to repay the loan and interest within the 6-year repayment period. The annual debt service coverage ratio during the repayment period ranges between 1.5 and 1.8 the average being 1.6. Cumulative cash balance is positive during the 6-year repayment period, indicating that the project would not need additional funding during this period.

6.6.6 Discounted Cash Flow Analysis

The project was discounted for a project life of 10 years. The project's Internal Rate of Return (IRR) was 36.5%, which is far above the 10% borrowing rate used in the interest calculation. Also a Net Present Value (NPV) of $1,006,697 was found.

6.6.7 Sensitivity Analysis

The Sensitivity analysis of the project under two scenarios is presented in Appendix 6.5 and 6.6, to test the projects viability on the effect of:

a) a 10% shortfall in revenue: and

b) a 10% increase in operating cost without corresponding increase in revenue.

At a 10% shortfall in revenue, operating costs remaining the same, the projects viability is not undermined. The Net Positive Value (NPV) of the project is still positive at $598,151 and the Internal Rate of Return (IRR) is 25%.

When the total operating costs are increased by 10% with revenue remaining the same, the project

still remains viable. The net present value still stands positive at $443,416 and the IRR is 22%.

7.0 ENVIRONMENTAL HEALTH IMPLICATIONS

7.1 HEALTH EFFECTS OF WASTES IDENTIFIED

Over 80% of the industries Interviewed said their waste products could be recycled, and some had been trying to find ways of profitably recycling their waste. Those who did not know how to recycle their products said there have not been vigorous research into the chemical composition of their waste products and thus think about recycling them.

A few have identified users of their waste products and are now selling them very cheaply at $5.00 or ¢10,000/ton to the public users. Most of them give the wastes to users free of charge. Asked how they would arrange for the tradable waste to be exchanged, the respondents prepared users to collect the wastes from sources.

Most of the wastes characterized have some adverse health effects associated with them which warrant the institution of preventive measures to reduce risk of diseases and injuries form accidents. These include:

7.1.1 Waste Oil

Oils used in industry contain aromatic hydrocarbons or synthetic lubricants used either neatly or in a water-mix. They are used as metalworking fluids lubricants etc. Contamination occurs during usage resulting in Waste oils containing in addition to the original compound metallic compounds, sand, etc.

Effects

Exposure by skin contact, inhalation, ingestion are hazardous to health. It may cause skin cancer, oil acne and other skin affections may occur from skin contact. The important compounds responsible for cancer causation are polycyclic aromatic hydrocarbons (PAHs), important ones including Dibenz (a, h) anthrancene and Benzo (a) pyrene.
Eye injury (chemical conjunctivitis bums) from splashes into the eye.

Safety Measures

PPE Goggles, overalls, gloves, aprons, boots etc. Good personal hygiene.

Medical Exam - Regular programme of skin inspections

7.1.2 *Slag*

Slag is a complex mixture of side products and consists of wastes resulting from the smelting of metals and alloys.

Health Effects
Effects depend on its state

(i) *Molten* State - Source of intense heat, infrared radiation and gases (SO_2 & CO). It can therefore result in bums. Infra - red radiation can cause thermal bums to the skin and eyes as well as induce cataract formation. Carbon monoxide may result in headaches, impaired judgement, heart attacks and death. For severe cases of asphyxiation $S0_2$ causes irritant and toxic effects on airways and aggravates pre-existing respiratory and cardiac problems.

(ii) *Solid* State - Produces considerable amount of dust. This is an irritant to the respiratory tract and many lead to severe pneumonia, upper respiratory infections and eye irritation and occasionally an eczematous skin reaction.

Safety and Health Measures.

- Dust formation is prevented by using wet methods for grinding slag
- All operations involving the crushing, grinding and moving of slag must be carried out in fully enclosed installations equipped with local exhaust ventilation.
- Routine cleaning of premises should preferably be done with vacuwn cleaners
- Crushed slag should be transported from storage heaps by a pneumatic conveying system
- Regular medical examinations particularly of the respiratory tract is needed for workers with slag

- Personal Protective Equipment - special overalls, headwear and nasal masks made of dust-proof material.

- Necessity for washing and showering facilities at workplace

- Prohibition of consumption of food on the shopfloor.

7.1.3 Gypsum

This is a hydrated calcium sulphate in microcrystaline form which can be used in the building industry, particularly in plaster board. Careful heating (hives off, part of the water to produce 'Plaster of Paris' which sets when mixed with sufficient water to return it to the fully hydrated sate.

Some deposits contain quartz while others contain elongated crystals likely to damage the lung. Such crystals also form when gypsum is processed to make plaster board. It is often marketed in powdered form.

During the processing of gypsum the major health effects arise from inhalation of the crystals in dusts generated by the processes. It is generally classified as a nuisance dust because many workers survive many years of exposure without serious respiratory difficulty.

However, studies in the U.K. have demonstrated an association with pneumoconiosis (dust damage to lungs) more frequent in dust from areas with high quartz content

Health and safety measures

- Dust masks, goggles, overalls

- Periodic Lung function Tests & X-Rays.

7.1.4 Waste Paper

Possible hazards that may arise in the course of handling waste paper may arise from incompletely converted wood producing wood dust or chemicals used in processing. These include alum, glues and adhesives.

Wood dust may be a fire and explosion hazard while alum can cause nose and throat irritation. Glues and adhesives may cause dermatitis as well as nose and throat irritation.

Paints, lacquers and varnishes all contain volatile and potentially toxic solvents which may cause respiratory or cardiac illness.

Health and Safety Measures

- Ensuring of adequate ventilation inwork area and area for storage of waste paper.
- Personal protective equipment - Gloves, nasal masks, overalls, boots.
- Regular medical supervision of workers concentrating particularly on Respiratory, and cardiovascular system as well as the skin.

7.1.5 Saw Dust

Wood dusts have irritant as well as allergic effects. Associated with cancer especially of the Nasal sinuses and of the lungs (from the respirable fraction).

It is also associated with Occupational Asthma de novo or worsens pre-existing Asthma in workers. Types of wood with which this has been associated include Mahogany, obeche, iroko and Western Red Cedar. Immediate effects of

inhalation are Acute Respiratory infections e.g. running nose from irritant effects.

Wood dust also causes dermatitis through a hypersensitivity reaction.

Health & Safety Measures

- Exhaust ventilation at the point of production
- PPE to be employed in handling - i.e. overalls, nasal masks with specifications limiting respirable dusts from being inhaled
- Regular screening for lung function

7.1.6 Broken Glass

These arise from damage to bottles otherwise used in bottling of drinks. The major risk posed by broken glass from these bottles is from lacerations caused by manually handling bottles, walking on floor with broken pieces and explosions of the bottles resulting in splintering 'tering'

Health and safety measures

These should include:

- The use of PPE Gloves, overalls, boots, goggles.
- The institution of an Anti-tetanus immunization programme.
- Availability of facilities for first aid close to work site.

7.1.7 Lime

Lime is a general term used for the products of calcined limestone e.g. calcium oxide and calcium hydroxide. Calcium oxide is used as flux in steel making or as raw material for chlorinated lime bleaching powder and for soil ameliorant in agriculture. Also calcium hydroxide is used as mortar and cement in civil engineering works, as lubricants, for proofmg material in pulp and paper manufacture.

Hazards

Dust is a hazard both in the manual crushing, screening, drying and loading of lime. This may be inhaled and cause lacerations of the upper respiratory tract and may occasionally cause Bronchitis and pneumonia. Contact with eyes may also cause eye lesions, the conjunctivae being usually involved.

- Considerable quantities of carbon monoxide and carbon dioxide are given off during the kilning of lime which may lead to poisoning and asphyxia.
- Skin contact produces lesions resulting in various forms of dermatitis. It may also cause serious bums and ulcerations of the skin.

These effects are mostly due to the action of calcium oxide which has a

pronounced irritant and caustic action. The action of calcium hydroxide is less pronounced.

Safety and Health Measures

Dust control measures in Plant should be located in open air, enclosure of dust sources and fitted with exhaust ventilators

- Personal protective Equipment - work clothes of resistant material, canvas hand protection, Eye and face protection and respiratory protective equipment.
- Exposed skin - coated with vaseline or oil.
- Adequate sanitary facilities - workers should not shower till all traces of lime adhering to the body have been removed with oil or vaseline.

Prohibition of consumption of food and beverages in Workshops.

First Aid

Eye wash fountain and provision for early referral to physician for application of appropriate chemical bum treatment.

For skin bums, removal of all traces of lime with mineral or vegetable oil and affected parts bathed with 5% solution of citric, tartaric, acetic and hydrochloric acid.

7.1.8 Plastics

Raw plastics are rarely used on their own. Potential health hazards tend to be associated with additives used invarious formulations.

There is a potential danger of inhaling toxic fumes during thermal degradation from gases like hydrochloric acid gas resulting in"polymer fume fever". Fumes may also be inhaled from resins containing isocyanates or formaldehyde. This may lead to severe respiratory distress including asthmatic attacks.

Dermatitis may arise from skin contact with 'reactive chemicals' contained in resins.

Solvents for cleaning and bonding may be inhaled and without adequate exhaust ventilation may result 'in narcosis of operators. Fire and explosive hazards exist since plastics are combustible.

Health and Safety Measures

- Work must be done in conditions of good general ventilation 'in the workroom.
- Processing plants need to be fitted with exhaust ventilators.
- Use of personal protective equipment by plant operatives and handlers of waste should be mandatory.
- Immediate relocation of Asthmatics if there is indication of a worsening of **condition.**
- Periodic medical examination**with** emphasis on lung function resting and **skin** examination.

8.0 SUSTAINABILITY OF PROGRAMME

In order to ensure the sustainability of the programme, MAMSCO will establish a bilingual (English & French) International Institute for Management, Environment and Tourism to offer the theoretical under pinning of the WSEMS and its relevance. Approval has been given for the establishment of the school and a site for its facilities has been acquired.

8.1 POTENTIAL SOCI-ECONOMIC BENEFITS

The project will provide technical, financial and economic information necessary for investment decision on industrial waste stock exchange programme and subsequent groupings and promotion among potential beneficiary industries.

Further there will be:

- Maximisation of waste recycle, re-use, and recovery
- Reduction, minimisation, of waste volume to solid waste disposal sites (SWDSs.)
- Prevention, minimisation and/or mitigation of potential sources of land-based pollution of the coastal wetlands and the marine environment being addressed in a Global Environment Facility (GEF) Sub-regional project, namely Gulf of Guinea Large Marine Eco-system under Montreal Guidelines on land-based pollution of Coastal areas and Marine Environment.
- Employment generation and Poverty Reduction/Alleviation Projects.
- Secondary Raw Materials supply as important sources of resource conservation, cost-effective production and consumption, as well asfreign exchange savings strategy.

There will be a reduction in land-based sources of industrial pollution of surface water resources particularly coastal lagoons, waters and mangrove and ultimately the large marine ecosystem.

Waste Stock Exchange Management would provide an economic incentive frame-work for private sector participation in the reduction of the land-based pollution of the LME.

8.2 RISKS AND ASSUMPTIONS

The effectiveness of the project will obviously depend on the availability of funds for

implementation of the WSEMS. It is therefore anticipated that loan funding would be obtained from sources such as the Venture Fund Management Company, National Investment Bank and other traditional financial houses.

Sustainability of the project will also depend on the co-operation of industrial operators (particularly, those outside Ghana) in the preparation of their EMPs and EIAs by the Consultants and the establishment of the Bilingual International Institute for Management, Environment and Tourism mentioned above to offer the theoretical under pinning of the WSEMS and its relevance.

9.0 CONCLUSIONS AND RECOMMENDATIONS

The feasibility study outlined the lessons learnt from elsewhere on the Waste Exchange Management and underscored Ghana's experience in the WSEMS, The study revealed enormous potential for WSEMS in Accra - Tema Metropolis. The study identified 18 wastes which can be recycled or re-used by other industries within the Accra-Tema Metropolis. The market potential for these wastes is great.

Most of these wastes, which are import substitution have been found to be tradable if treated before recycling, The socio-economic implications of the project is desirable. While creating business and market opportunities for these wastes, their effect as land based pollution sources of the LME is reduced drastically.

Results of the financial analysis are impressive. The total investment cost is $1,056,240 made up of $852,290 fixed asset, $160,050 initial working capital and $43,900 pre-operating expenses. A mix of equity and loan with debt / equity ratio of 50:50 participation will be used to finance the project.

The project's profitability analysis indicates a net profit yield of $52,809 in year 1, $78 136 in year 2 and $147,792 in year 6. The projected balance sheets and projected funds flow statements indicate clearly that the project can repay the loans and interest within the projected period. The Internal Rate Return(IRR) is 36.5% which is far higher than the 10% borrowing rate used in the calculation. Grant input is recommended only to facilitate early/immediate take off of the project.

Phase I will establish the treatment of four industrial wastes and Phase II will set up the MIS/Training Department. Subsequent phases will include the treatment of other wastes for sale

to industries and the general public.

If funding, being the major risk, is provided the project can be viable and can sustain itself. The exchange system could be both positive and active. As outlined above, the project is technically feasible, financially viable and socio-economically desirable. It is therefore recommended for support by the government, stakeholders, environmental NGOs UN agencies and other international agencies.

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APPENDICES

Certificate Of Registration

LW/000 - 0087/97

REPUBLIC OF GHANA

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TITLE OF WORK MAMSCO'S WASTE STOCK EXCHANGE MANAGEMENT SYSTEM

NAME OF AUTHOR MAMSCO MANAGEMENT VENTURES LTD

PUBLISHER AND YEAR OF PUBLICATION PUBLISHED
GOLDEN TULIP HOTEL, ACCRA 1997.

Given under my hand at Accra this 14TH

day of OCTOBER, 1997

Copyright Administrator

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OUR REF: Mamsco/M-C/CA/008 YOUR REF: ..... DATE: 14/OCT./1997

MAMSCO'S WASTE STOCK EXCHANGE MANAGEMENT SYSTEM is an INTEGRATED 5-In-1 S-M-A-R-T Eco-Tourism Package comprising the following five PHASES:

PHASE 1 * THE RESEARCH COMPONENT

- A base line study to establish the socio-economic impacts of the local community's socio-economic activities on the NATURAL ENVIRONMENT

- IDENTIFICATION OF
  - (i) AGRICULTURAL
  - (ii) ECO-TOURISM POTENTIALS
  - (iii) Agricultural and Tourists infrastures & facilities and
  - (iv) Classification of WASTE TYPES which can serve as In-puts (Secondary Raw materials) to some other industries

PHASE 2 *AWARENESS DEVELOPMENT PHASE

PHASE 1 Serves as the data for a 2-day seminar/workshop for the development of the awareness of STAKE-HOLDERS, who will determine " THE WAY FORWARD" STAKE-HOLDERS include

- Officials of the District Assembly
- De-centralized Departments
- Traditional Leaders
- Youth Leaders
- Other Significant Opinion Leaders

PHASE 3 DESIGN OF DRAFT ECO-TOURISM PLAN

- (a) Development of Draft Eco- Plan for appraisal by STAKE-HOLDERS
- (b) Development of strategies for the Integration of the Eco-Tourism Plan into National & International Eco-Tourism Plan
- (c) Design of marketing strategy for the Eco-Tourism plan for the selected area

PHASE 4: THE MARKETING AND IMPLEMENTATION OF THE ECO-TOURISM PLAN

This Phase includes the following activities
Development of

- (a) Initial structures/capacity building activities for local team members (Re The role of the International Institute for Management, Environment & Tourism - *IIMET*)
- (b) Marketing of the plan
- (c) Implementation of the plan (ACTION PLAN)
- (d) Integration of Eco-Tourism plan of the selected area into National and International Eco-Tourism plan
- (e) MAMSCO's role in ensuring sustainable development

PHASE 5 UTILIZATION OF THE NUTRIENT-RICH EFFLUENT FOR IRRIGATION & LAND-SCAPING PURPOSES.

MAMSCO's 5-In-1 S-M-A-R-T Package is a community-based Internationally-focused (Export-oriented) Eco-Tourism Strategy, made available in a mechanism (- Industrial Domestic , Municipal and Metropolitan), organized as a WASTE STOCK EXCHANGE MANAGEMENT SYSTEM to serve as a Clearing House, processing centre or Trade-In-Centre, ultimately utilizing the nutrient-rich WASTE WATER for irrigation and land-scaping purposes (ECO-TOURISM Promotion and development)

KEY

- **4 - R s:**
  - **Re - cover**
  - **Re - cycle**
  - **Re - duce**
  - **Re - use**
- **S-M-A-R-T**
  - **S pecific purpose**
  - **M - easurable objectives**
  - **A - ttainable goals**
  - **R - ealistic aims**
  - **T - ime-bond schedules**

THE COMPANY:

MAMSCO MANAGEMENT VENTURES LTD.

WHO ARE WE?

MAMSCO Management Ventures Ltd is a Multi-disciplinary Engineering-based, Environmental Management and Tourism Development Consulting Firm, with focus in the following areas:

01: ENVIRONMENTAL MANAGEMENT

02: ENGINEERING SYSTEMS

03: GENERAL MANAGEMENT & TOURISM DEVELOPMENT

04: INTERNATIONAL PROGRAMMES ON ENVIRONMENTAL MANAGEMENT AND TOURISM

05: THE ESTABLISHMENT OF A WASTE STOCK-EXCHANGE MANAGEMENT SYSTEM

06: THE 4-IN-1 S-M-A-R-T PACKAGE

07: THE DEVELOPMENT OF THE INTERNATIONAL INSTITUTE FOR MANAGEMENT, ENVIRONMENT & TOURISM

Established in 1985, originally called MAMSCO Management and Agro-allied Services Ltd, the company was re-structured in 1991 to become MAMSCO MANAGEMENT VENTURES LTD, when ENVIRONMENTAL MANAGEMENT became central to its operations, adopting the Motto:

"MANAGING THE ENVIRONMENT FOR SUSTAINABLE DEVELOPMENT IS OUR BUSINESS"

MAMSCO's commitment is to integrate Environmental concerns into the imperatives of economic planning and development for sustainability.

In this brochure, MAMSCO's areas of specialization are spelt out in 02 and 03, while 04 provides the list of MAMSCO's Resource Personnel. MAMSCO's office and laboratory is located in the Tesano Business Centre, Tesano, via the Tesano Police Station, opposite San[illegible] Marke[illegible] the [illegible]y Sta

THE COMPANY derives its strength from the variety of supportive and integrated services (offered by its subsidiaries) as well as the full range of professionals that perform and offer special packages in the following areas -

- Business Management Consulting Services. (including feasibility studies and project management)
- Environmental Management Services: (including, design of Environmental Management Plans, Environmental Testing Laboratory services in pollution monitoring, industrial effluent testing, mining pollution analysis, environmental auditing, contaminated and degraded land reclamation, etc.
- Renewable Energy: MAMSCO's renewable energy position is that of sustainability i.e. only by respecting functioning ecosystems is it possible to promote sustainable economic development. MAMSCO therefore promotes solar, biomas etc.
- Private Sector Health Care Management services: (Nursing Agency) - Management and Service
- Management Training and Development: (including MAMSCO's special 3-AP package on Performance Appraisal (Modular) System which incorporates oth the Development and Evaluative components. MAMSCO's 3-AP Approach can transform your conflict-laden performance appraisal system into one of the most effective motivational management tools for your organisation.

(02) MAMSCO ENVIRONMENTAL MANAGEMENT CONSULTANCY SERVICE: (MEMCONSULT)

In addition to general Business Consultancy Services, one of the major areas where MAMSCO has stepped up its consultancy services is in the area of ENVIRONMENTAL MANAGEMENT (see MEMCONSULT for details)

MEMCONSULT
This is MAMSCO MANAGEMENT VENTURES CONSULTANCY DIVISION with specialization in the following fields:

MANAGEMENT:

- Feasibility studies
- Organi[illegible]al Re-[illegible]uring
- Capacity-Building

ENVIRONMENTAL MANAGEMENT:

- The establishment of a WASTE STOCK-EXCHANGE MANAGEMENT SYSTEM
- Environmental Impact Assessment (EIA) for projects
- Environmental Management Plans (EMPs) for established organisations
- Environmental Audit (EA) for existing (on-going projects

ENGINEERING:

- Engineering Systems
- Renewable Energy (Solar, Biogas & Biomass)
- Street Lighting
- Rural Electrification

ECO-TOURISM DEVELOPMENT:

- A Consortium on TOURISM DEVELOPMENT
  The application of the 4-in-1 package.

INTERNATIONAL PROGRAMMES:
This takes two forms:-

A) In collaboration with Mr. Mike Okereke's Business Education Council of Nigeria, a number of AWARENESS DEVELOPMENT and CAPACITY-BUILDING PROGRAMMES IN ENVIRONMENT

B) The establishment and development of the INTERNATIONAL INSTITUTE FOR MANAGEMENT, ENVIRONMENT AND TOURISM.

(03) MAMSCO'S ENVIRONMENTAL ANALYTICAL AND LABORATORY SERVICES

In collaboration with like-minded International Laboratory Testing Services, MAMSCO plans to provide an extensive testing service for pollution monitoring, hazardous waste analysis, contaminated degraded land reclamation and water testing services using the principle of RECOVERY, RECYCLE, REDUCE AND REUSE. MAMSCO's comprehensive environmental, analytical and laboratory testing programmes offer services in

(i) Environmental Testing and Pollution Monitoring
(ii) Mining Pollution Analysis
(iii) Industrial Effluent [illegible]s
(iv) Waste Management Studies and

Under the Environmental Testing and Pollution Monitoring, MAMSCO, in joint Venture with NST of USA, and others, will possess the latest instrumentation, computerized data and Laboratory Management Systems (LMS) using Gas Chromatography (GC), Gas Chromatography/Mass Spectometry (GC/MS) and High Performance Liquid Chromatography (HPLC) techniques will be the mainstay in the analysis of tracing organic contaminants in ground water, industrial effluents sewage and hazardous waste.

Inorganic/organic environmental laboratory analysis will be our concern. Under Industrial Analysis Services, (with the international collaborators) and others, industrial workers and workplace environment would be monitored for ventilation efficiency, up-take of noxious and toxic materials. Industrial effluent testing and monitoring services would be offered. MAMSCO plans to undertake services in ISO 9000 & 14000.

(04) MAMSCO'S RESOURCE PERSONNEL:

MAMSCO's permanent staff is strengthened by a full range of highly-qualified professionals drawn from Associated Consulting Firms (National and International) who are in a special collaborative relationship with MAMSCO. Another sourcing group of individual professionals are in a special category called *ASSOCIATE CONSULTANTS*. They range from Environmental Analysts through Project Management Consultants to Chemical Engineering and Medical Services fields.

Internationally, MAMSCO is in joint-venture relationship with a number of international organizations including NORTH-SOUTH TECHNOLOGIES (NST) of (USA). These professionals offer services as:

- Environmental Management Plans Specialists
- Management Specialists
- Chemical Engineers
- Ecological and Baseline Studies Experts
- Geological Scientists
- Hydrologists
- Inorganic/Organic Environmental Laboratory Analysts
- Environmental Management Education Specialists
- Agricultural and Food Scientists
- Renewable Energy (Solar, Biogas, Biomass) Experts
- Project Management Consultants
- Performance Appraisal Modular System Development specialists
- Private Sector Health Care (Nursing Agency) Management Specialists etc.

PARTIAL LIST OF SATISFIED CLIENTS:

The partial list of MAMSCO's satisfied clients includes:

LOCAL

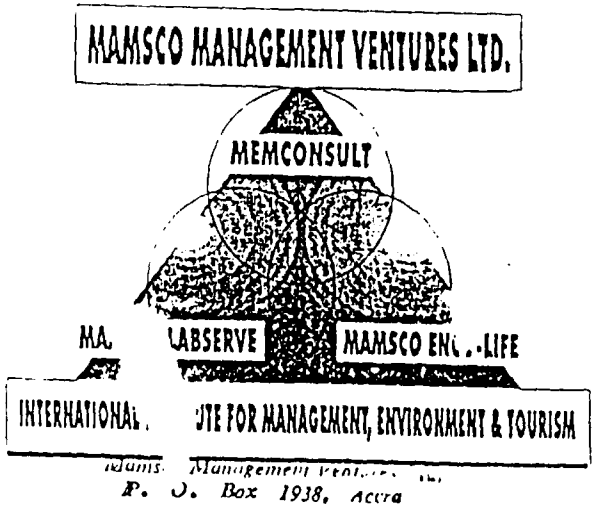
- Darko Farms & Co. Ltd
- GHACEM
- The Methodist Church of GHANA
- L'Air Liquide (GH) Ltd
- Advance Computers Ltd.
- GHANAL
- Environmental Restoration Organisation
- Crocodile Matchet
- LAMBDA (GH) Ltd
- Private Enterprise Foundation (PEF)
- The Assemblies of God Literature Centre Ltd. (AGLC)
- Tema Oil Refinery (TOR)
- GAFCO

INTERNATIONAL:

- HONDA ETS, Lome, Togo
- ABA Brothers, Lome, Togo
- The Full Gospel Business Men's Fellowship International (Africa Office)
- DANIDA

MULTI-NATIONAL:

- World Bank
- UNDP/UNIDO/GEF



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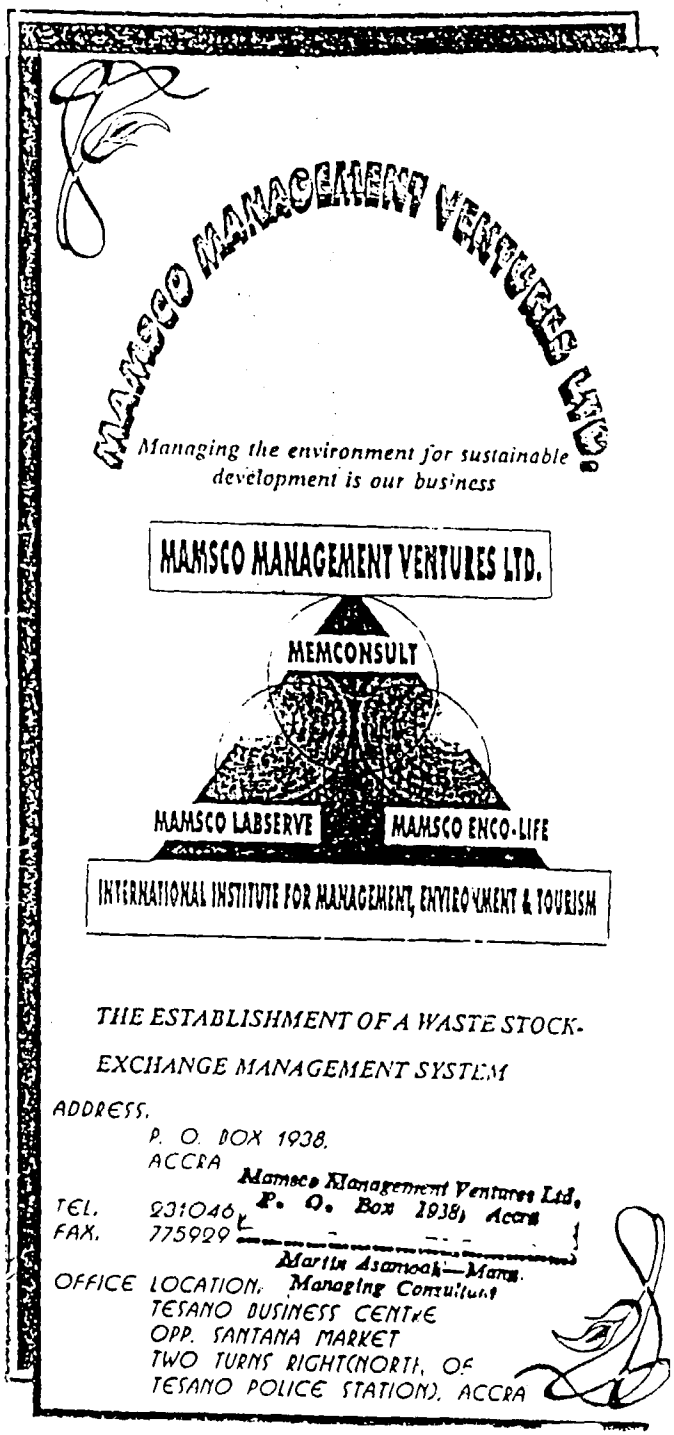

APPENDIX 6 1

PROJECTED OPERATING STATMENTS
(US$)

ITEM/YEAR	1	2	3	4	5	6
CAPACITY UTILIZATION	60%	70%	80%	80%	80%	80%
a) Sales revenue	808800	943600	1078400	1078400	1078400	1078400
Cost Production						
Raw materials	237000	276500	316000	316000	316000	316000
Packaging materials	1560	1820	2080	2080	2080	2080
Vehicle running cost	13104	15288	17472	17472	17472	17472
Consumable spares(2% sales)	16176	18872	21568	21568	21568	21568
Repairs and maintenance	33732 6	33732 6	33732 6	33732 6	33732 6	33732 6
Salaries Wages	153648	153648	153648	153648	153648	153648
Depreciation	107553	107553	107553	107553	107553	107553
Utilities(1% sales)	8088	9436	10784	10784	10784	10784
Other factory expenses (2% sales)	16176	18872	21568	21568	21568	21568
b) Total Direct Cost	587037 6	635721 6	684405 6	684405 6	684405 6	684405 6
c) Gross profit	221762 4	307878 4	393994 4	393994 4	393994 4	393994 4
Indirect Cost						
Directors emoluments	10,000	10,000	10,000	10,000	10,000	10,000
Salaries and Wages	114912	114912	114912	114912	114912	114912
Gen & Administrative Exp (2% sales)	16176	18872	21568	21568	21568	21568
Insurance	8522.9	8522.9	8522.9	8522.9	8522.9	8522.9
Amortization	19342 4	19342 4	19342 4	19342 4	19342 4	0
d) Total indirect cost	168,953	171,649	174,345	174,345	174,345	155,003
e) Profit before int & tax	52,809	136,229	219,649	219.649	219,649	238,992
f) Interest payment	0	58,093.20	46,474.54	34,855.92	23,237.28	11,618.64
g) Profit before tax	52,809	78,136	173,175	184,793	196,412	227,373
h) Taxation (35%)	0	0	0	0	0	79580.5
I) Net profit	52,809	78,136	173,175	184,793	196,412	147,792
j) Dividend payment (50%)	0	0	86587	92397	98206	73896
k) Transferred to income surplus	52,809	78,136	86,587	92,397	98,206	73,896
Net profit margin(%)	6 5	8 3	16 1	17 1	18 2	21 1
Gross margin(%)	27 4	32 6	36 5	36 5	36 5	36 5

APPENDIX 6 1

SUPPORTING SCHEDULES FOR POS

REVENUE ESTIMATES (US$)

1 ***Waste oil (treated) at 100% capacity***

Estimated recoverable amount	=	8000 MT
Selling price per MT	=	$105
Revenue	=	$840,000

2 **Lime Wash at 100% capacity**

Estimated recoverable amount	=	650 MT
Selling price per MT	=	$150
Revenue	=	$97500

3 **Gypsum at 100% capacity**

Estimated recoverable amount	=	8000MT
Selling price per MT	=	$25
Revenue	=	$200,000

4 **Briquette**

Capacity of 2 presses at 750m^3 /annum each	=	1500m^3
Yield of briquettes	=	900MT
Price of briquette per MT	=	$145
Revenue	=	$130,500

5 **Training**

Estimated average no. of participants per year	=	200
Average charge per participant	=	$ 400
Revenue	=	$80,000

Summary of revenue estimates (US$)

	Production/service	Revenue
1	Fuel oil	840,000
2	Lime wash	97,500
3	Gypsum	200,000
4	Briquette	130,500
5	Training	80,000
		1,348,000

Projected Revenue Estimate

Year	-	1	2	3
Capacity	100%	60%	70%	80%
Revenue	1,348,000	808,800	943,600	1,078,400

APPENDIX 6 1

SUPPORTING SCHEDULES FOR POS

Operating Cost Estimate

1 Raw Materials Cost

Raw Materials	**Qty (MT)**	**Unit Cost (MT)**	Total Cost ($)
Waste oil	10,000	30	300,000
Waste lime	780	15	11,700
Gypsum	10,000	8	80,000
Sawdust (m)	1500	2 2	3,300
Total			395,000

2 Packaging Material for Lime Wash

Item	**Average Content per sack**	**No. of Sacks required**	**Unit Cost**	**Total Cost**
Polypropylene sacks	50 kg	1300	0.2	2,600

Projected Material Cost

Year	-	1	2	3
Capacity Utilization	100%	60%	70%	80%
Raw material	395000	237000	276500	316000
Packaging material	2600	1560	1820	2080
Total	397600	238560	278320	318080

3 Vehicle Running Cost (Fuel, Luricating % Tyres)

Types of Vehicle	**No. of Vehicles**	**Average km per Vehicle/annum**	**Running Cost/km**	**Total Running Cost**
Heavy duty vehicles	5	12000	0 2	12000
Wheel loader	1	6000	0.24	1440
Pickups	4	15000	0 14	8400
				21840

APPENDIX 6 1

Miscellaneous Schedules

1 Depreciation

Item	Value	Rate	Allowance
Land and Buildings	215,950	2.0%	4319
Plant and Machinery	155,040	10.0%	15504
Training/MIS Equipment	30,050	10.0%	3005
Vehicles	396,000	20.0%	79200
Office Equipment	33,550	10.0%	3355
Furniture and Fixtures	21,700	10.0%	2170
			107553

2 Insurance

Land and Buildings	215,950	1.0%	2159.5
Plant and Machinery	155,040	1.0%	1550.4
Training/MIS Equipment	30,050	1.0%	300.5
Vehicles	396,000	1.0%	3960
Office Equipment	33,550	1.0%	335.5
Furniture and Fixtures	21,700	1.0%	217
			8522.9

3 Repairs and Maintenance

Land and Buildings	215,950	2.0%	4319
Plant and Machinery	155,040	4.0%	6201.6
Training/MIS Equipment	30,050	4.0%	1202
Vehicles	396,000	5.0%	19800
Office Equipment	33,550	4.0%	1342
Furniture and Fixtures	21,700	4.0%	868
			33732.6

4 Amortization

Pre-Operating Expenses	43,900	20%	8780
Capitalized Interest	52812	20%	10562.4
			19342.4

APPENDIX 6.1

Supporting Schedules of POS
Loan Repayment Schedule
(US$)

Principal Loan Amount	528,120
Interest Rate per annum	10%
Moratorium on principal & interest	1yr
Repayment Period	6yrs
Installments	yearly
Capitalised interest	52812

Year	Beginning Balance	Principal Repayment	Interest Payment	Capitalized Interest	Total Payment	End Balance
1	528,120	0	0	52812	0	580,932
2	580,932	116186.4	58093.2	0	174279.6	464,746
3	464,746	116186.4	46474.56	0	162661	348,559
4	348,559	116186.4	34855.92	0	151042.3	232,373
5	232,373	116186.4	23237.28	0	139423.7	116,186
6	116,186	116186.4	11618.64	0	127805	0

APPENDIX 6.1

Supporting Schedules for POS

Manpower Schedules

Designation	No of Employees	Basic Salary	Total Annual Salary
A) Direct Labour			
Production Manager	1	15,000	15,000
Maintenance Engineer	1	14,400	14,400
MIS / Training Manager	1	14,400	14,400
Production Supervisors	2	7,200	14,400
Quality Control Engineer	1	7,200	7,200
Training Officer	1	6,000	6,000
System Analyst	1	4,800	4,800
Programme / Application Software User	1	4,200	4,200
Operators	4	2,400	9,600
Secretary (MIS)	1	4,200	4,200
Mechanics	2	2,160	4,320
Electricians	2	2,160	4,320
Factory Hands	10	1,800	18,000
Drivers	4	1,800	7,200
	32		128,040
Add 20% for SSF Contribution			25608
			153,648
b) Indirect labour			
Managing Director	1	18,000	18 000
Finance / Admin Manager	1	14,400	14,400
Sales/Marketing Manager	1	14,400	14,400
Procurement Officer	1	6,000	6,000
Marketing Officer	1	6,000	6,000
Accounts Officer	1	6,000	6,000
Administrative Officer	1	6,000	6,000
Secretaries	4	2,400	9,600
Clerks	4	1,440	5,760
Drivers	4	1,200	4,800
Security Personnel	4	1,200	4,800
	23		95,760
Add 20% for SSF Contribution and other staff cost			19152
Subtotal			114,912
Grand Total	55		268,560

APPENDIX 6 2

Projected Balance Sheets
(US$)

Year	1	2	3	4	5	6
Fixed Assets						
Land and Buildings	215,950	215,950	215,950	215,950	215,950	215,950
Plant and Machinery	155,040	155,040	155,040	155,040	155,040	155,040
Training MIS Equipment	30,050	30,050	30,050	30,050	30,050	30,050
Vehicles	396,000	396,000	396,000	396,000	396,000	396,000
Office Equipment	33,550	33,550	33,550	33,550	33,550	33,550
Furniture and Fixtures	21,700	21,700	21,700	21,700	21,700	21,700
Gross fixed Assets	852,290	852,290	852,290	852,290	852,290	852,290
Less AccumulatedDepreciation	107553	215106	322659	430212	537765	645318
a) Net Fixed Assets	744,737	637,184	529,631	422,078	314,525	206,972
Intangible Assets						
Pre-operating expenses	43,900	43,900	43,900	43,900	43,900	0
capitalized Interest	52812	52812	52812	52812	52812	0
	96,712	96,712	96,712	96,712	96,712	0
Less accumulated Amortization	19342.4	38684.8	58027.2	77369.6	96712	0
b) Net Intangible	77,370	58,027	38,685	19,342	0	0
Current assets						
Stocks	59640	69580	79520	79520	79520	79520
Trade receivables	67400	78633	89867	89867	89867	89867
Bank and Cash balances	235,095	302,766	465,476	574,391	689,115	809,649
c) Total Current assets	362134.5	450979	634863	743778	858502	979036
d) Total assets (a+b+c)	1,184,241	1,146,191	1,203,179	1,185,198	1,173,027	1,186,008
Current Liabilities						
Trade payables	22380	22380	22380	22380	22380	22380
Dividend payment	0	0	86587	92397	98206	73896
Taxation	0	0	0	0	0	79580.5
e) Total current liabilities	22380	22380	108967	114777	120585.9	175857
f) net current assets	339754.5	428599	525896	629001.3	737916	803179
g) Net assets	1,161,861	1,123,811	1,094,211	1,070,422	1,052,441	1,010,151
Financed as follows						
Equity	528,120	528,120	528,120	528,120	528,120	528,120
income surplus	52,809	130,945	217,532	309,929	408,135	482,031
h) Total shareholders fund	580,929	659,065	745,652	838,049	936,255	1,010,151
Long Term Liabilities						
Term Loan	580,932	464,746	348,559	232,373	116,186	0
I) Total L/T Liabilities	580,932	464,746	348,559	232,373	116,186	0
j) Total capital employed	1,161,861	1,123,811	1,094,211	1,070,422	1,052,441	1,010,151

APPENDIX 6.3

Projected Funds Flow Statements

Year	1	2	3	4	5	6
Sources						
Internally generated funds						
Net Profit	52,809	78,136	173,175	184,793	196,412	135,220
Depreciation	107553	107553	107553	107553	107553	107553
Amortization	19342.4	19342.4	19342.4	19342.4	19342.4	19342.4
Interest	0	58093	46475	34856	23237	11619
a) Net internally generated funds	179,705	263,125	346,545	346,545	346,545	273,734
Increase in Shareholders funds						
Equity	528120	0	0	0	0	0
b) Total increase in shareholders funds	528120	0	0	0	0	0
Increase in Long Term Liability						
Term Loan	528120	0	0	0	0	0
Capitalized interest	52812	0	0	0	0	0
c) Total increase in long term liability	580932	0	0	0	0	0
Increase in Current Liability						
Trade payables	22380	0	0	0	0	0
Dividend payment	0	0	108766	154964	204067	237872
Taxation	0	0	0	0	0	72810.65
d) Total increase in current liability	22380	0	108766.1	154964.4	204067.4	310683
e) Total sources (a+b+c+d)	1,311,137	263,125	455,311	501,509	550,612	584,417

APPENDIX 6.3

Projected Funds Flow Statements

Applications	1	2	3	4	5	6
Increase in Fixed Assets						
Land and Buildings	215950	0	0	0	0	0
Plant and Machinery	155040	0	0	0	0	0
Training / MIS equipment	30050	0	0	0	0	0
Vehicles	390000	0	0	0	0	0
Office equipment	35550	0	0	0	0	0
Furniture and Fixtures	21700	0	0	0	0	0
f) Total increase in Fixed Assets	854290	0	0	0	0	0
Increase in Intangible Assets						
Pre-Operating expenses	43900	0	0	0	0	0
Capitalized interest	52812	0	0	0	0	0
g) Total increase in Intangible assets	96712	0	0	0	0	0
Increase in current assets						
Stocks	59640	9940	9940	0	0	0
Trade receivables	67400	11233	11233	0	0	0
h) Total increasing current assets	127040	21173.333	21173.33	0	0	0
Debt Servicing						
Interest payment	0	58093	46475	34856	23237	11619
Principal repayment	0	116186	116186	116186	116186	116186
i) Total debt servicing	0	174279.6	162661	151042.3	139423.7	127805
j) Total application	1078042	195452.93	183834.3	151042.3	139423.7	127805
Net Funds Flow						
Current Surplus / Deficit (e-j)	233,095	67,672	271,475	350,467	411,188	456,612
Cumulative Cash Balance	233,095	300,766	572,242	922,709	1,333,897	1,790,509

Trade receivables = 1 month sales revenue
Stock = 3 months raw/packaging materials
Trade payables = 1 month salary

APPENDIX 6.4

Discounted Cash Flow Analysis

Year	1	2	3	4	5	6	7	8	9	10
Cash Out Flow/Investment Cost										
Fixed Assets	852290	0	0	0		0	0	0	0	0
Working Capital	160050	0	0	0	0	0	0	0	0	0
Cash Inflow										
Net Profit	52809	78136	173175	184793	196412	147792	147792	147792	147792	147792
Depreciation	107553	107553	107553	107553	107553	107553	107553	107553	107553	107553
Amortization	19342	19342	19342	19342	19342	0	0	0	0	0
Interest	0	58093	46475	34856	23237	11619	0	0	0	0
Taxation	0	0	0	0	0	79580.5	79580.5	79580.5	79580.5	79580.5
Residual Value	0	0	0	0	0	0	0	0	0	85229
Working Capital recovery	0	0	0	0	0	0	0	0	0	160050
Net Cash Flow	(832635.5)	263125	346545	346544	346545	346544.5	334926	334926	334926	580205

IRR = 36.5%
NPV at 10% interest rate = 1,006,697

A project life of 10% is assumed in this analysis
Residual value = 10% Fixed Assets in year 10
100% Working Capital recovery in year 10

Appendix 6.5

Sensitive Analysis - 10% shortfall in revenue (US$)

Income Statement

	1	2	3	4	5	6
Adjusted Sales Revenue	727920	849240	970560	970560	970560	970560
Total Operating Cost	755991	797371	858751	858751	858751	858751
Profit before tax	(28071)	51869	111809	111809	111809	111809
Taxation (35%)	0	0	0			
Net Profit/Loss	(28071)	51869	111809	111809	111809	72676

Year	1	2	3	4	5	6	7	8	9	10
Cash Out Flow										
Investment cost										
Fixed Assets	(852290)	0	0	0	0	0	0	0	0	0
Working Capital	(160050)	0	0	0	0	0	0	0	0	0
Cash Inflow										
Net Profit/Loss	(28071)	51869	111809	111809	111809	72676	72676	72676	72676	72676
Depreciation	107553	107553	107553	107553	107553	107553	107553	107553	107553	107553
Amortization	19342	19342	19342	19342	19342	0	0	0	0	0
Interest	0	58093	46475	34856	23237	11619	0	0	0	0
Taxation	0	0	0	0	0	39133	39133	39133	39133	39133
Residual Value	0	0	0	0	0	0	0	0	0	85229
Working Capital recovery	0	0	0	0	0	0	0	0	0	160050
Net Cash Flow	(913516)	236857	285179	273560	261941	230981	219362	219362	219362	464641

IRR = 25%
NPV at 10% = 598151

APPENDIX 6.6

Sensitivity Analysis - 10% increase in total operating cost
Income Statement

Year	1	2	3	4	5	6
Sales revenue	808800	943600	1078400	1078400	1078400	1078400
Adjusted Operating Cost	831590	877108	1002409	1002409	1002409	1002409
Profit before tax	22790	66492	75991	75991	75991	75991
Taxation (35%)	0	0	0	0	0	26597
Net Profit	22790	66492	75991	75991	75991	49394

Year	1	2	3	4	5	6	7	8	9	10
Cash Outflow										
Investment Cost										
Fixed Assets	(852290)	0	0	0	0	0	0	0	0	0
Working Capital	(160050)	0	0	0	0	0	0	0	0	0
Cash Inflow										
Net Profit / Loss	(22790)	66492	75991	75991	75991	49394	49394	49394	49394	49394
Depreciation	107553	107553	107553	107553	107553	107553	107553	107553	107553	107553
Amortization	19342	19342	19342	19342	19342	0	0	0	0	0
Interest	0	58093	46475	34856	23237	11619	0	0	0	0
Taxation	0	0	0	0	0	26597	26597	26597	26597	26597
Residual Value	0	0	0	0	0	0	0	0	0	85229
Working Capital recovery	0	0	0	0	0	0	0	0	0	160050
Net Cash Flow	(908235)	251480	249361	237742	226123	195163	183544	183544	183544	428823

IRR = 22%
NPV at 10% = 443416