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A STUDY ON
RECYCLING OF INDUSTRIAL WASTES IN BAHRAIN

NC/BAH/95/01D

BAHRAIN

Report

Prepared for the Government of Bahrain under UNDP-financed TSS-1 facility

V.96-82086

The study was co-ordinated by V. Ishchenko of the Environment and Energy Branch Industrial Sectors and Environment Division, and Ms. J.Jensen, of Arab Countries Programme, Country Programmes and Funds Mobilization Division based on the work of Mr. V. Ishchenko (UNIDO), Mr. Glynn Hughes (UNIDO Consultant) and the National Experts, Mr. Mohsin Al-Mahmood of EPC, Bahrain, and Mr. Fadhel Abbas of Central Municipal Council, Bahrain.

Our special thanks to Mr. Khalid M. Fakhro, Vice Chairman of the Environmental Protection Committee (EPC) for his time, courtesy and wisdom , and to Ms. Mary Cherian for her assistance in processing this report

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Introduction

The Government of Bahrain requested assistance from UNIDO to formulate a national programme and specific projects in respect of industrial waste recycling. UNIDO appointed an expert for a period of 1.2 months to undertake the following assignments:

1. Undertake a fact-finding mission to Bahrain to conduct an assessment of the present situation and to recommend technical solutions for the problem of industrial waste recycling.

2. Review the industrial policy of the Government, the institutional environment and the legal framework and the regulations in respect of industrial waste management & disposal.

3. Identify and analyze the possibilities for industrial waste recycling and to identify the major constraints industries are facing if they want to improve and/or set up for business.

4. Develop a study which will include an analysis of wastes and technologies currently used for waste processing, existing environmental legislation, assessments of the future volumes of wastes, a waste recycling programme and project proposals for improving waste recycling.

This report has been produced in accordance with those requirements. This report will provide the information that will be used for the production of a UNIDO Project Document, in the prescribed form. This project document will, after full discussion and approval of the Government of Bahrain, be used to arrange the funding and implementation of the recommendations. To achieve this, the project document will provide in fine detail, the needs including personnel and costs.

RECOMMENDATIONS

The following actions are recommended:

The establishment of the new Environmental Law will be the basis of the organisation and the powers required to enforce it.

Establish the change of the Environmental Protection Committee (EPC) to the Environmental Protection Agency (EPA), as it is in many other countries, including the UK, USA, Germany, Switzerland, etc., with executive powers of regulation, inspection and enforcement.

Arrange a budget to enable the EPA to fulfil its duties of enforcing the Environmental Law and to assist the Covernment of Bahrain to fulfil its obligations, accepted upon becoming signatory to international agreements such as the Basel Convention.

Decide on the definition of the term "Hazardous Wastes". The United Nations (UNEP) definition is offered as a suitable definition within the text.

Arrange a classification of Hazardous Wastes. This should be done in conjunction with UNIDO experts when the Project Document is implemented.

Recruit new staff and arrange for the existing and the new staff to be trained. The new staff numbers and skill levels will be specified in the project document together with all the required training and how that can be arranged.

Establish Waste Exchange to actively establish the industrial wastes generated in Bahrain and to actively establish which of these wastes can be used as feed stocks for other industries within Bahrain.

Establish a library of relevant information about industrial waste production, generation, re-use and recycling technologies and disposal techniques. A minimal bibliography is in Annex 4.

When the new EPA has gained the expertise needed they should arrange training courses to relevant employees in industry to be trained in waste handling and management techniques.

The long term needs for industrial waste management will be addressed in the project document and will include:-

- Establishment of a Hazardous Wastes Landfill Site;
- The need for a Hazardous Wastes Chemical Treatment Plant;
- The establishment of an Industrial and Hazardous Wastes Incinerator;
- The establishment of a Central Medical Waste Incinerator.

Immediate action should be undertaken by the EPC, prior to the Project Document, as a matter of urgency as follows:-

Obtain a copy of the book "Design, Operation and Closure of Municipal Solid Waste Landfills. This is obtainable, normally free of charge by writing and requesting a copy from the Centre for Environmental Research Information, US Environmental Protection Agency, Cincinnati, OH 45268, USA. A copy of their list of other publications should also be requested. The methods of operation within this publication should be applied to the operation of the Askar landfill site by the Municipality.

The computer system within EPC should be joined to the Internet and have e-mail facilities. Sites of interest on the Internet are given in Annex 4.

Contact foreign embassies in Bahrain and request names and addresses of foreign trade associations and international companies. The ones for the types of industries present in Bahrain should be approached and asked how their members deal with the wastes produced and what those wastes are.

A working relationship should be established with Universities and relevant laboratories (Jaffair) particularly regarding waste recycling or utilisation.

Get an agreement from the relevant Ministry to ensure that waste grits and lime can be included in concrete and ashaltic mixes. Draft regulations to ensure maximum inclusion of these materials. Advise on the maximum recommended amounts can be obtained from the Arabian Gulf University.

Write a questionnaire asking for the amount and type of waste produced and the disposal method and send to every SME in Bahrain. Analyze and evaluate answers, visit those who do not respond. A time limit for responses should be stated.

Waste management plans must be obtained from GIIC, ALBA and ASRY and weekly visits should be made to their premises to ensure compliance with their own plans.

Draft regulations should be prepared for industrial and hazardous waste management. At a minimum these should include the responsibilities for the producer, transporter and disposer. These should make the producer responsible for the wastes from the cradle to grave. The transporter should be responsible for the safe transportation of the wastes in accordance with the guidelines issued by the Civil Defence and Fire Service Directorate. The disposal should be in accordance with the regulations applicable to the Addur hazardous waste disposal site and at Askar, according to the operational procedures detailed in the US EPA publication Design, Operation and Closure of MSW landfills. The existence of contracts between producer, contractor or disposer must not be allowed to release the producer from his obligations. This is in accordance with most Western Countries regulations including the UK. USA, Germany and Switzerland, etc.

The procedure and penalties for breaches of these regulations should be a system of increasing severity. In the case of recurring offenses the procedure for enforcement should be:

- Friendly discussion and advice
- Written warning
- Prosecution
- Fine
- Gaol
- Closure

As UNIDO has undertaken to research oil residue treatment processes and disposal methods, the EPC should instigate discussions with the involved firms, when the information is received, to discuss the possibility of their implementation.

When the EPC receives the information promised by the international consultant the companies given should be approached for details of their products that can alleviate specific problems in Bahrain.

A letter should be written to the Commercial Secretary at the British Embassy requesting a copy of Her Majesty's Inspectorate of Pollution Standards for emission from smelting furnaces, MSW incinerators, hazardous waste and medical incinerators. These are in common use throughout Europe.

A discussion should be started between the EPC and the Municipality as to the possibility of installing waste oil storage tanks in suitable locations near to workshops and garages and instigating a collection system to transfer the oil to BAPCO for reclaiming and recycling.

The Industrial Policy of the Government of Bahrain:

The industrial policy of the Government of Bahrain is to encourage industry to expand and to diversify in order to increase and vary the sources of income and to provide future non-reliance on oil and oil related industries in order to increase and secure the standard of living of its' citizens.

The availability of cheap energy has been a major factor in the successful establishment of major industries. Energy is approximately one fifteenth of the European price with the result that energy intensive processes such as aluminium production, rolling and treatment are expanding in Bahrain and contracting in Europe.

Conversely, the success of the Government of Bahrain has resulted in an increase in the production of industrial and hazardous waste. The production of industrial and hazardous wastes can be loosely tied to the Gross Domestic Product. Whilst it is extremely difficult to place an accurate figure of MT of industrial waste per US$ 1 billion of GDP it can be stated more firmly that a percentage increase in GDP will be reflected in a similar percentage increase in the industrial waste generated.

Similarly process improvements can result in the decrease and even the disappearance of industrial waste. Just such a situation has appeared during the period of this study. The 110 MT per year of rock wool and ceramic fibre waste produced by ALBA is expected to drop by half by 1998 and to zero by the year 2,000.

Similarly, the 180 MT per year of bath dust produced by ALBA and previously regarded as a waste is now recycled back into the process.

The Present Situation in Bahrain Regarding Industrial and Hazardous wastes:

- There is no national hazardous waste definition.
- There is no national waste classification.
- Bahrain has no legislation regulating the management of hazardous waste. Environmental Protection Act is currently in preparation by EPC, Ministry of Housing Municipal Affairs & Environment and Legal Affairs. The Public Health Act 1975, amended in 1989, entrusts the Ministry of Health with several functions related to environmental protection such as management of sewage, water resources sanitation and waste including construction, garden, industrial, toxic and hazardous waste. This duty and the EPC has now been transferred to the Ministry of Housing, Municipalities and Environment.
- There are no national regulations pertaining to industrial waste collection, storage, recycling, treatment and disposal.
- The EPC has no powers of inspection and enforcement.
- Problems with private carriers company for industrial waste disposal.
- Stockpiling of industrial wastes, (e.g. Aluminum Smelter - Oil refining - dry dock).
- Uncontrolled disposal of oils and chemical wastes in the desert and to sea out falls (e.g. Oil and gas sector, SMEs). The EPC has no power to stop this.
- Industrial municipal waste disposal near water desalination plant intakes.
- The National hazardous waste landfill site closed at the end of 1990.
- The temporary site is inadequate as it is not lined and there is no leachate control
- Absence of legislation and regulations concerning hazardous wastes.
- Absence of adequate facilities for industrial waste, chemical waste, collection, storage, recycling, treatment and disposal

- There is lack of information about the quantity and type of waste generation from small and medium scale enterprises (SMEs). The EPC has no Waste Exchange system.

- There is no waste classification (Categories) for waste generation from SMEs.

- An increase in new industries & the generation of more hazardous wastes.

- Major industries are increasing their production and the generation of hazardous wastes.

- SMEs lack resources and incentives for proper waste management.

- Insufficient financing and manpower to conduct monitoring programs.

- Absence of specific standards related to hazardous wastes.

- There are many industries disposing their wastes illegally into the municipal landfill and elsewhere.

- There is no legislation in place regarding industrial wastes other than for discharge of effluents to waterways and sewers.

- There are proposed effluent guidelines which are not enforceable due to the lack of legislation.

- The EPC is inadequately staffed and has no regional offices.

- The Civil Defence and Fire Service Directorate has guidelines for the transport and storage of hazardous wastes.

- The EPC has an inadequate library and database regarding industrial and hazardous wastes.

- The EPC has an inadequate number of trained personnel.

The lack of enforcement leads to small companies recycling printed aluminum cans, that the large aluminum companies are not interested in, in ways that produce pollutants such as dioxin and fluorides etc. Ways that can be used to combat this pollution include:

- Shut the violating companies down.

- Insist that the violating companies use non-polluting furnaces with afterburners installed to increase the exhaust gas temperature at the exit point of the furnace to 1200°C to destroy the pollutants.

- Change the method of treating the cans from melting and making into ingots to high density baling and leave it to the large processors who are the current recipients of the ingots to produce the ingots from the bales.

- Introduce an "exempt" system for small scale producers of ingots.

Improvements to the Present Situation

Changes to improve the current situation should be made as follows:-

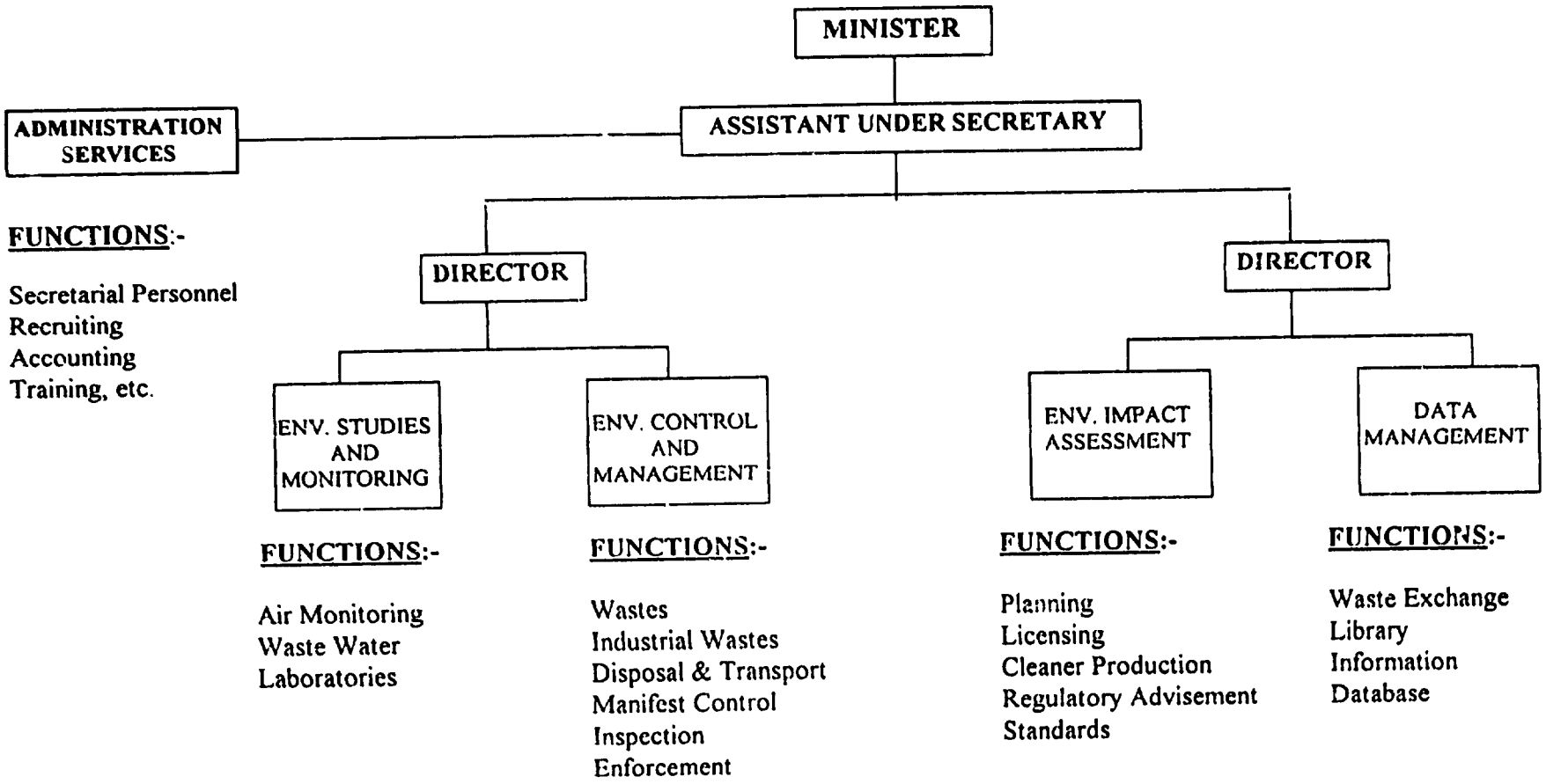
The proposed Environmental Protection Act, currently being reviewed should include the responsibilities for the wastes from production. through transport to treatment or disposal. If the producer hires a contractor to transport or treat the waste the producer should be held legally responsible that the contractor fulfils his responsibilities within the terms of the law. If a breach of the law occurs, the managers and directors of the companies concerned should face heavy fines and gaol sentences, as well as the actual perpetrator of the breach. This is in accordance with US and European practice.

The term "Hazardous Waste" should be defined. A good definition that could be adopted was produced by the UNEP Ad Hoc Working Group of Experts on the Environmentally Sound Management of Hazardous Wastes in December, 1985:

"Hazardous Wastes means wastes other than radioactive wastes which by reason of their chemical reactivity or toxic, explosive, corrosive or other characteristics causing danger or likely to cause danger to health or the environment, whether alone or coming into contact with other wastes, are legally defined as hazardous in the state in which they are generated or in which they are disposed of or through which they are transported".

Due to the Government's increasing involvement in international agreements regarding hazardous wastes a budget must be approved to establish an Environmental Protection Agency with executive powers to enforce the legislation. The obvious way to do this is by expanding the existing EPC into the Suggested Administration Organization shown on the chart. The provision of the budget could be looked on as the Government's liability or it could be recovered from industry directly if the philosophy of "the polluter pays" is adopted.

The establishment of the Environmental Protection Agency will be in accordance with the practices in other countries such as the USA, UK, Germany, Switzerland, Japan, etc.



SUGGESTED ADMINISTRATIVE ORGANISATION

If the sggested Administrative Organization is adopted, the following points should be noted:

Inspection:
The inspectors must have the legal authority to enter any industrial property and to inspect it and all records at any time and without the need to notify the manager or owner of the establishment. As in other countries, e.g. the U.K, if access is prevented or made difficult the managers and owners must be liable for a substantial fine. The inspectors must have the authority to close the premises down if the circumstances warrant it. Such powers are essential to deal with the vast problems posed by GIIC and their iron palletising plant. The complete plant is totally covered in dust which is spilling from the inlet and discharge ends of all the conveyors and wind-blown from the conveyor belts and the stockpiles of material held on the site, uncovered.

Waste Exchange:
An office and officer should be established to catalogue all the industrial wastes generated and to see if any of the wastes can be used in other industries. For example, during the visit the experts were asked for advice on getting rid of waste solvents by one company and later in the visits made, it was found the paint manufacturing company recycled solvents and added the reclined solvents to its equipment cleaning solvents. The two companies were put in touch with each other with the result that the producing company has solved its problem of disposal and the paint company does not have to buy as much solvents.

Library and Information Database:
Later in the report are suggestions for databases and additions to the library. The CIRUS database, in particular, is useful as it details over 27,000 different chemicals and over 1,000 chemical companies that produce them and who will give recommended procedures and methods for dealing with the materials.

The expert met with the First and Second Commercial Secretaries at the British Embassy who said the British Government will be prepared to pay for the required databases.

The USEPA is another good source of, usually, free information.

Standards:
Standards from Europe and the USA for land application and disposal should not be adopted as the environment and climate of these countries are so different to Bahrain. However, effluent and air emission standards from these countries can be adopted as Bahrain will want good air and water quality. It would be useful to obtain copies of standards used in Saudi Arabia and Kuwait (and any other Gulf States), to examine the standards and to decide if they are suitable for adaptation in Bahrain. International industrial trade organisations should also be contacted for their advice on treating wastes and the international requirements they have to meet. Assistance in reaching this decision should be sought from UNIDO.

Training Courses for existing and newly recruited staff will be required. This should include on-site training in established pollution control organisation as well as formal educational courses. Long term, the goal should be for the EPC to be technically competent to organise its own educational and training courses for industrial participants.

The long term improvements required ar. for the establishment of hazardous waste treatment and disposal facilities. The funding for these can be selected or mixed from the following options:-

- Government funded via a waste tax on industry.
- Government funded facilities leased to commercial operating company.
- Privately owned and operated.
- Joint venture between Government and industry.
- Funding from international agencies.

The facilities required are:

- Hazardous waste landfill site.
- Hazardous waste chemical treatment plant.
- Industrial and Hazardous waste incinerator.[1]
- Central medical waste incinerator and collection services.

All of these facilities will require feasibility studies to establish the best technology, the size, location and environmental impact.

The Bahrain Centre for Studies and Research (BCSR) has the necessary expertise and high-tech equipment to locate suitable sites once they are supplied with the site requirements.

The Transport and Disposal Manifest System used by the Municipality for hazardous wastes should finish up at the EPC so they can ensure that the correct procedures are carried out and build up a database of what hazardous materials are being moved around Bahrain. In the future it would be advisable to include a grid reference in Section C for locating the position of the waste in the landfill and a line for the method of destruction if it is treated in any other suggested facilities.

However, it should be noted that if regulations are introduced and rigorously enforced by the inspectors, a number of the existing recycling companies will shut down because their smelting furnaces for drink containers will not meet the standards.

It may be necessary to introduce an annual throughput limit, below which the company is exempted.

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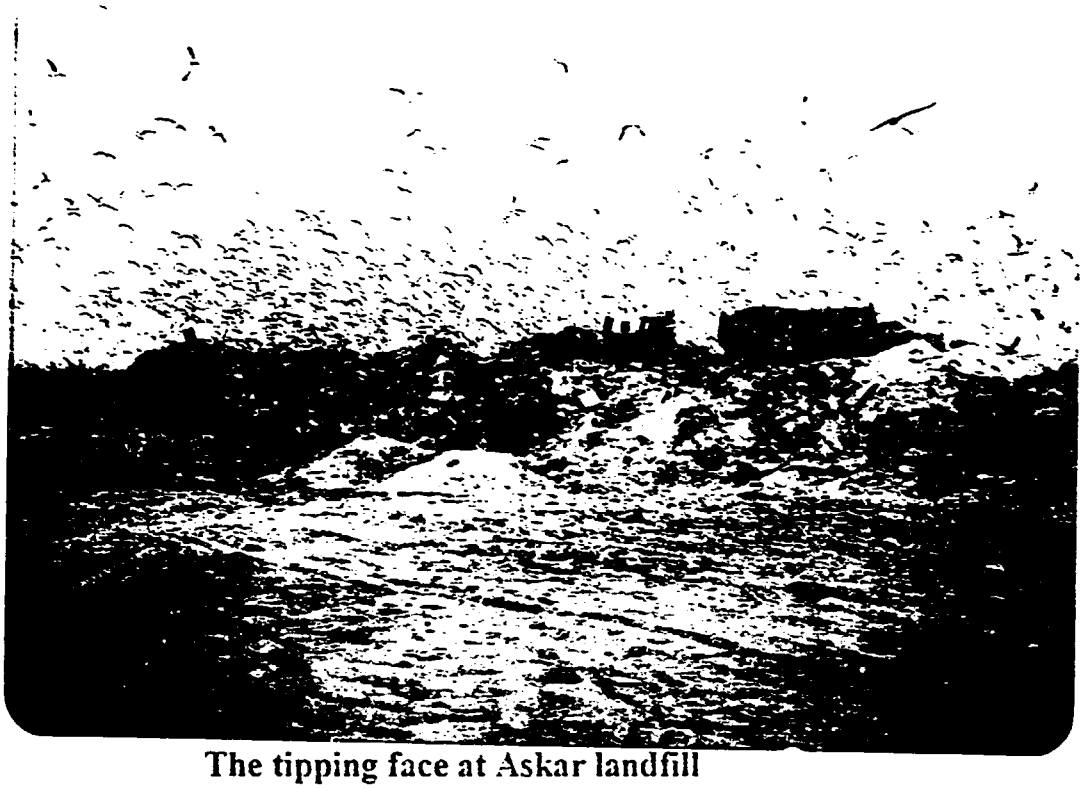
[1] Metalco is currently in discussion with a US incinerator manufacturer regarding the possible installation of a hazardous waste incinerator in Bahrain.

Photographs of Wastes

and

Some of the Problems



The tipping face at Askar landfill

Industrial waste is also deposited at Askar

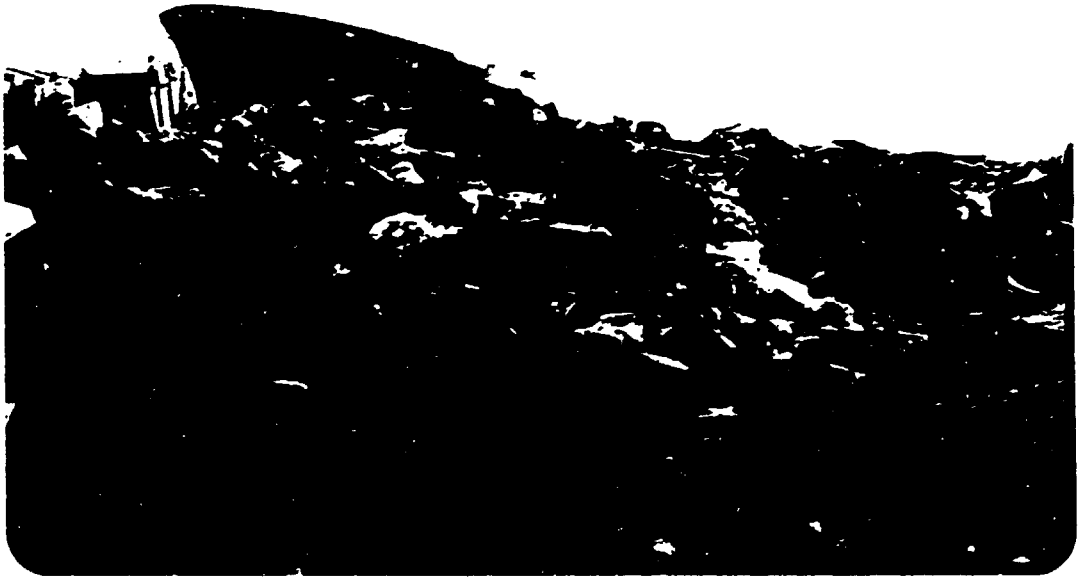
Industrial waste at Askar landfill

Pot lining waste from ALBA

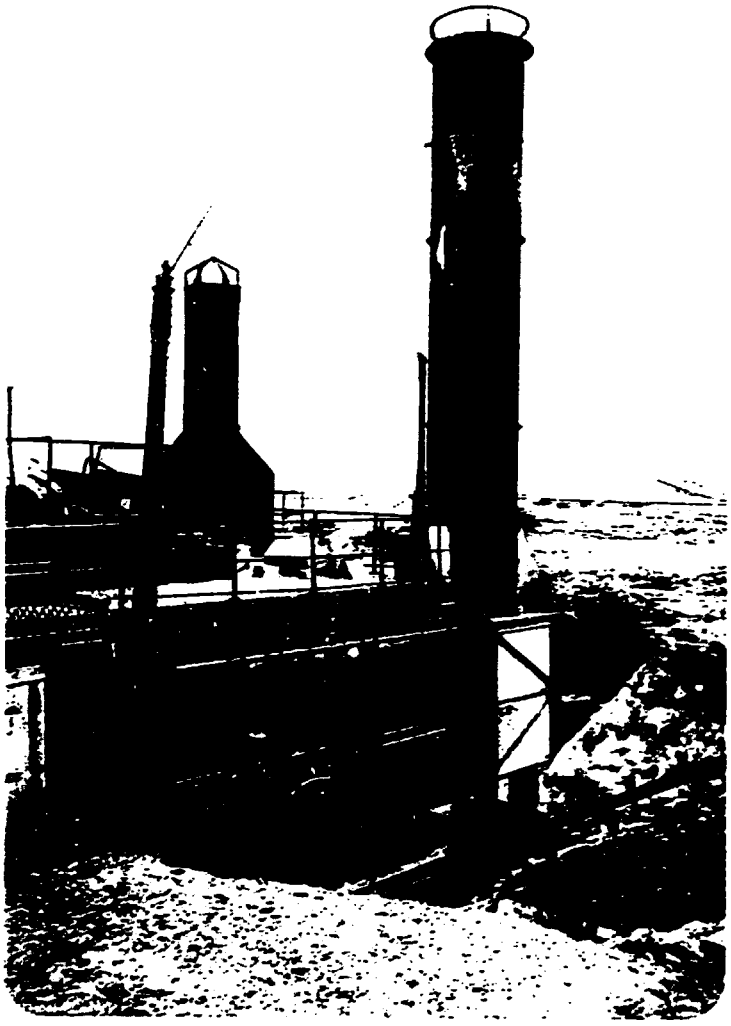
Carbon waste from ALBA

One and a half million tons of pitch, accumulated over thirty years at the BAPCO Site. The pitch is owned and the responsibility of CALTEX who operated the refinery during this period

Oil sludge storage pit at Ship Repair Yard (ASRY)



Blasting grit at ASRY



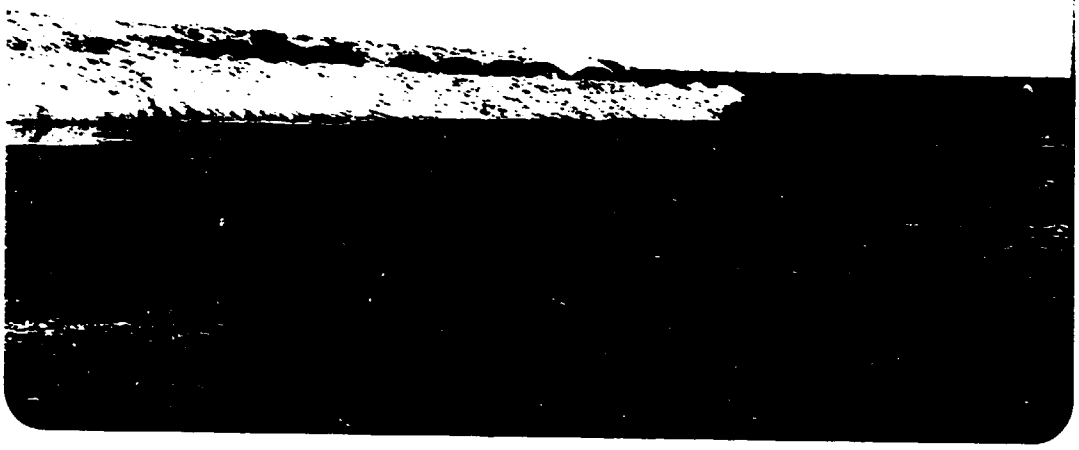
Medical waste incinerator at Awali

Spent refractory material stored at the back of ALBA

Spent pot lining stored at the back of ALBA

Unauthorized dumping of waste in a disused quarry

Unauthorized dumping of unknown slurries at Hamala



The hazardous waste landfill at Ad Dur

Indiscriminate dumping of old tyres

The Constraints on Industry

The main constraints on industry who want to enlarge, improve or set up in business are four fold:

- The first constraint is caused by the fragmentation of the decision making policy.
- The second is the long delay in obtaining decisions which is often caused by the third constraint.
- The third constraint is the lack of experience in the decision makers regarding complex industrial processes. This can be avoided in future by making the EPA responsible.
- The fourth constraint is the lack of communication between the concerned governmental agencies.

To give one example:

Gulf Aluminium Rolling Mill Company (GARMCO) are extending their facility with a US$ 70 million extension. They are a highly reputable company who believe in working to the rules. The extension is an identical process to the existing process. The equipment is the same. The only difference is that the thickness of the finished metal is less, which is the whole point of the extension, to extend the range of products. The thickness measuring devices include low level isotopes as used in the existing plant. The isotopes were purchased and sent to Bahrain. The airport authorities require an official letter of authorization to release the isotopes. GARMCO requested this letter in June 1995 and to date, January 1996, they have still been unable to get the letter. They have supplied endless information including the original Environmental Impact Statement for the original planning permission. The other isotopes they ordered are being stored in the USA involving demurrage charges. If the plant commissioning is held up due to this delay GARMCO estimate losses of US$ 500,000 for each month delay. EPC were unaware of this situation which illustrates all four constraints acting in one situation. The letter was obtained at the end of January.

If the suggested administrative organisation had been in place this situation could not have arisen. As the EPC would have dealt with the application and the lack of communication to the EPC would have been irrelevant.

Possibilities for Industrial Waste Recycling

The Possibilities for Industrial Waste Recycling in Bahrain are rather limited by the material involved, the current efforts of private recycling companies and the rigid adherence to standards by governmental agencies and by the lack of encouragement and incentives to follow through on initiatives.

However, some possibilities exist. These include:

Using the 35,000 tonnes per year of used shot blasting grit from the Arab Shipbuilding Repair Yard (ASRY) for road foundations, using it in the asphalt mix in the sub-base and for the partial replacement of marine sand (the removal of which has caused immense environmental damage to Bahrain's coastal sea bed) in precast concrete blocks. Cost-minimal plus savings on the buying of the raw material replaced.

The 1440 MT per year of hydrated lime wastes generated from the acetylene production industry can be incorporated into the asphalt top layer of road construction. The lime wastes can also be incorporated in concrete. It is also possible that the wastes could be used by GIIC in their iron palletising plant. Probable costs-minimal with a saving on the buying of the replaced raw material.

The unknown but considerable, amounts of wood waste can be chipped and used as a fuel. The bark waste can be used as a mulch to reduce evaporative water loss in parks and gardens. This wood can also be turned into charcoal for barbecues. Costs-probably under BD 20,000.

Scrap tyres, approximately 280,000 per year, can now be burnt in specially designed furnaces and the heat produced can be used to generate electricity or used as process heat for industry. Costs probably in the order of BD 250,000.

Rubber obtained from the tyre remoulding industry and rubber from tyre chipping can be incorporated in the asphalt used for playgrounds and athletic tracks resulting in fewer injuries due to the increased flexibility of the surface caused by the inclusion of the rubber. Costs probably in the order of BD 20,000.

It may be possible to find a use and therefore a market for the aluminium hydroxide dried sludge produced by BALEXCO at 150 MT per year.

The fine powder ($CaCO_3$) produced as a waste from asphalt producers can probably be used in the GIIC palletising process. Discuss with GIIC.

Waste solvents can be reclaimed and used as cleaning solvents by Hempel Paints.

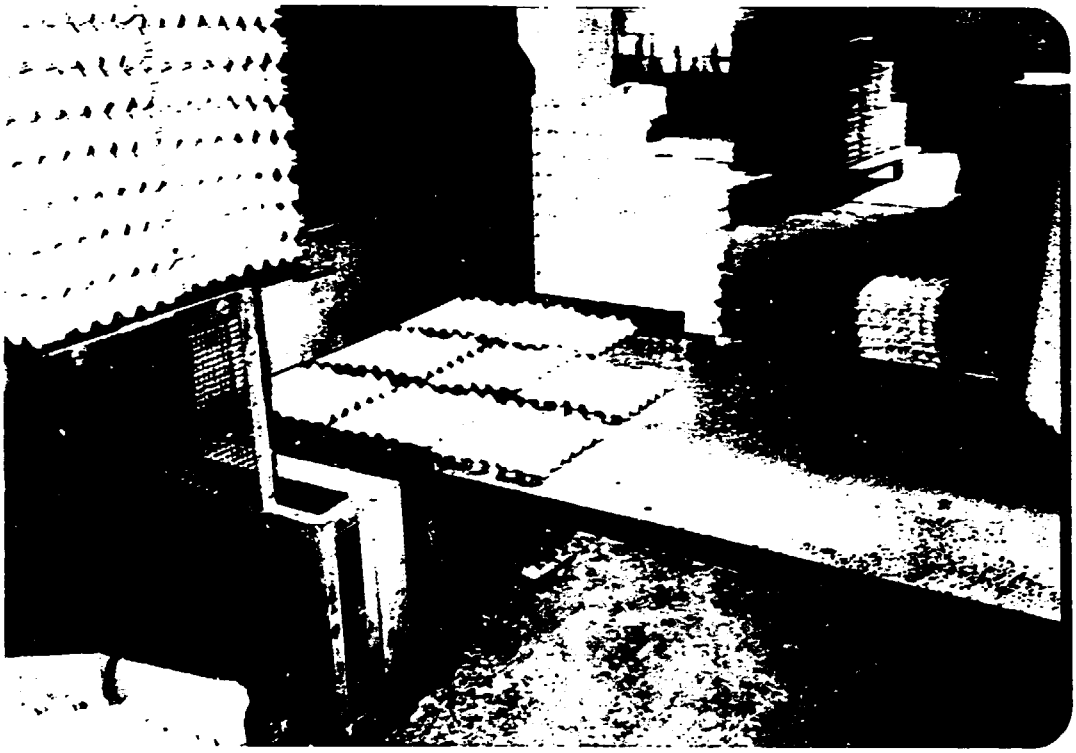
A small proportion of the 3-4 MT per year of the sulphur slurry produced by the process at Gulf Acids is removed by individuals and used as an insecticide in their gardens. It is possible that it would be of interest to an insecticide manufacturer.

A small industry could be established drying blood from the abattoir and boiling, drying and grinding animal bones and packaging the end products for sale as fertilizers, dried blood and bonemeal. Costs probably in the order of BD 10,000.

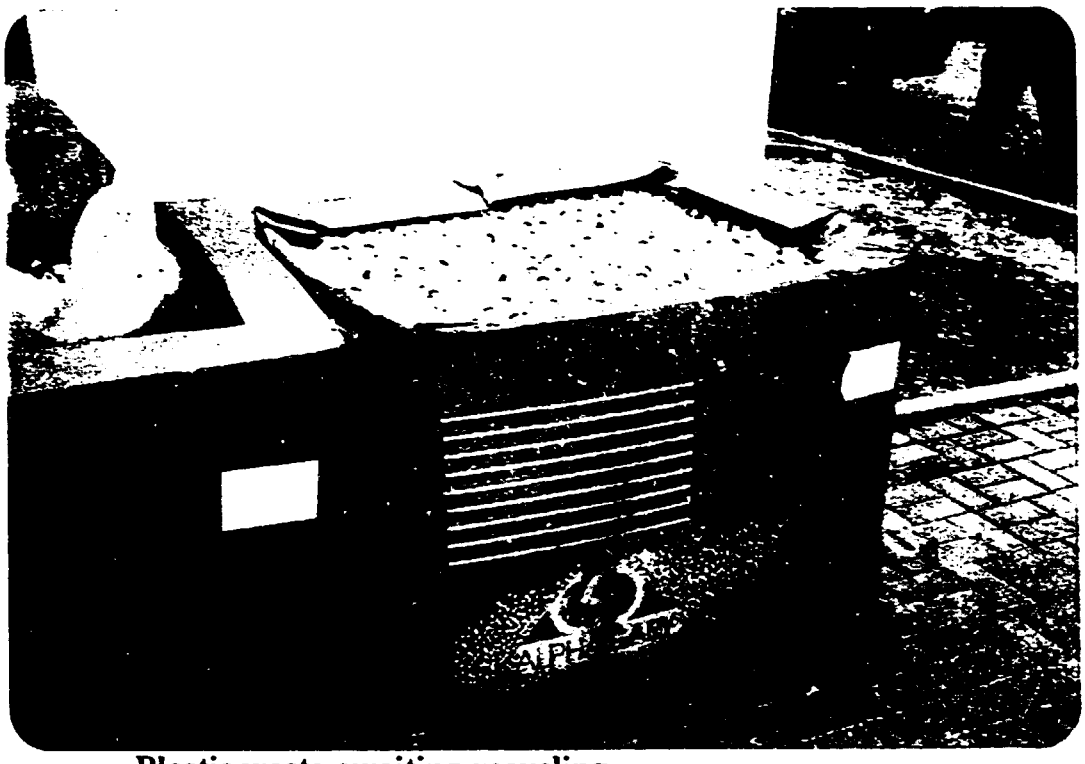
There is a market for glass cullet in Dubai. Bottle banks can be provided for different coloured glass. The glass can be transported to a central point and mechanically shattered into cullet for transportation.

Obviously the financial viability of all these possibilities will have to be considered as discussed in the Section "A Waste Recycling Programme and Incentives". Accurate costings can only be obtained after the EPC has been supplied with equipment manufacturers names and addresses and they have been contacted for their latest prices.

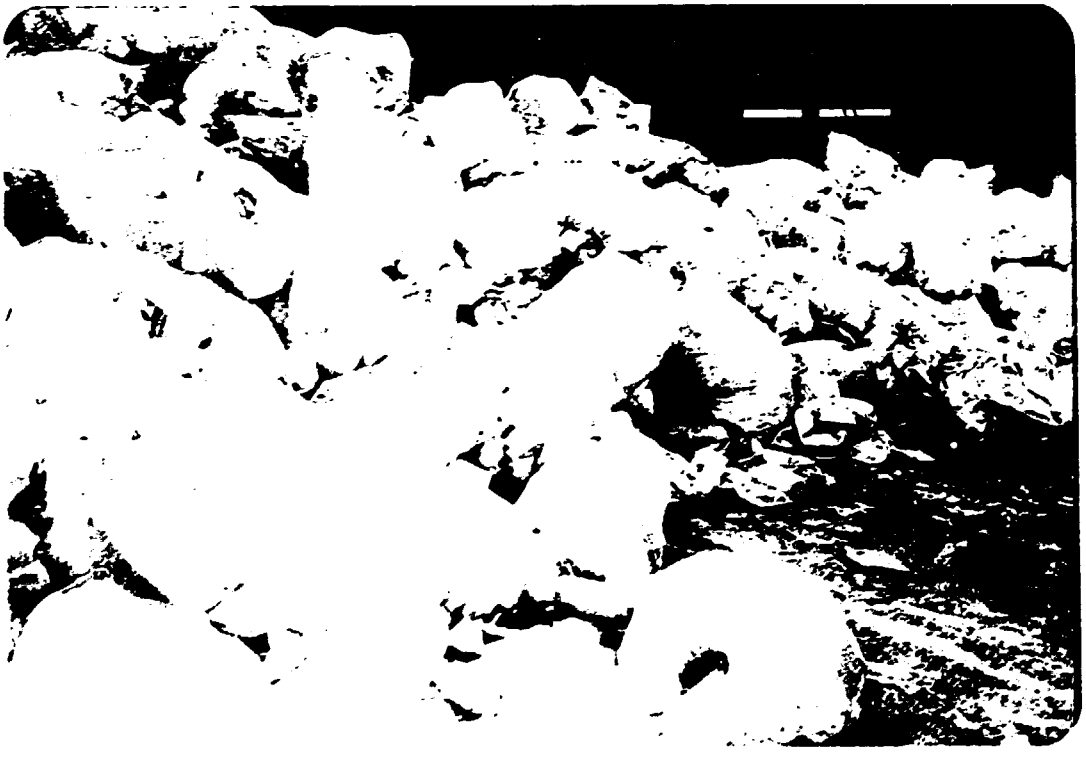
Photographs of Some Commercial Recycling Activities in Bahrain



Egg packing trays, made from recycled paper
are exported throughout the Gulf,
from Bahrain



Plastic waste awaiting recycling

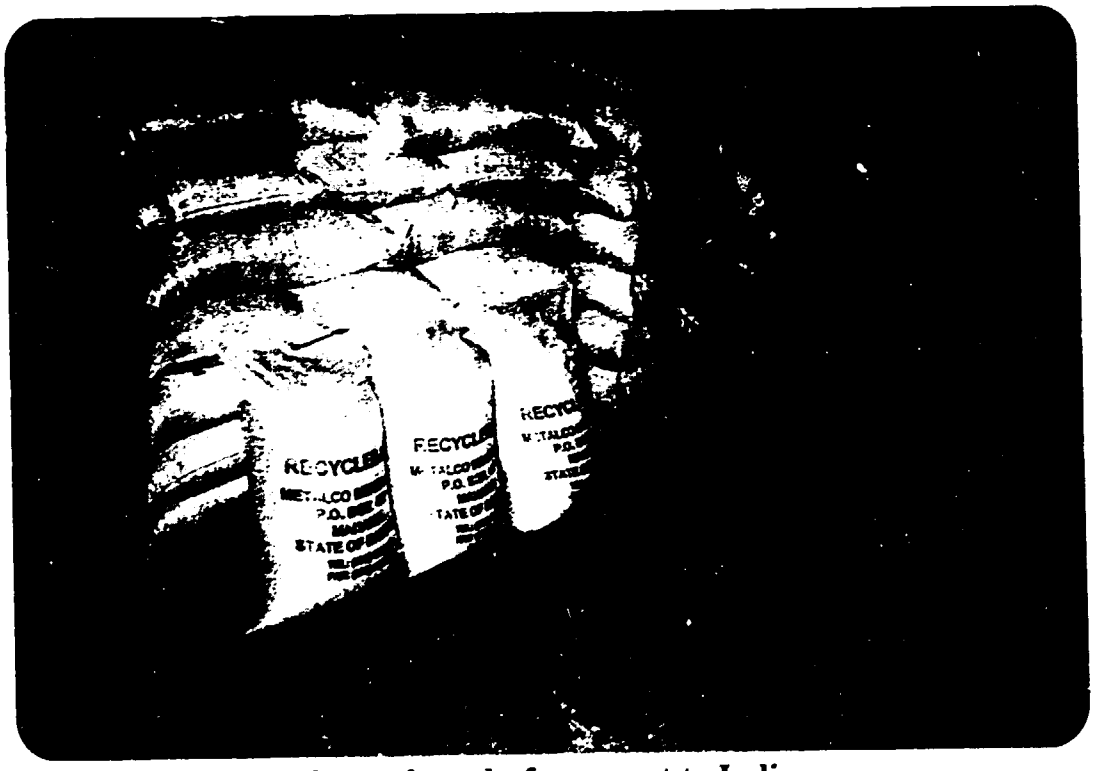


Scrap metal cables prior to insulation stripping and melting and moulding into ingots

The primitive melting pot used. When aluminium drink cans are melted, dioxins and other hazardous gases will be exhausted

Finished pallets of recycled aluminium

The finished product after chipping, washing and drying



The finished product, bagged ready for export to India

A Waste Recycling Programme & Incentives

Before a waste recycling programme is decided upon a number of actions need to be undertaken. It will be best to take these actions after the Waste Exchange Office is established and Waste Exchange Officer is appointed as the officer should be made responsible for most of these actions. The actions to be taken are as follows:-

Identify all the industrial wastes, constituents and amounts, generated in Bahrain and classify into the following categories:

- Hazardous
- Non-hazardous
- Recyclable
- Re-useable
- Non-recyclable - requiring treatment or disposal.
- Non-reusable - requiring treatment or disposal.

Select the recyclable element and identify markets. Simultaneously, meet with the waste producers and discuss the reduction and or elimination of the wastes.

Discuss prices and minimum quantities with the markets.

Assess financial viability of each project.

If it is feasible - proceed.

If it is not feasible - abandon.

Incentives to encourage the minimisation of wastes and the encouragement of waste recycling could include:-

- The adoption of the "polluter pays" principle to discourage the production of wastes;
- A continuing publicity campaign in schools and in the media to draw attention to the environmental and economic benefits of waste minimisation and recycling;.
- An escalating scale of charges for disposal to landfill related to the volume generated;
- Tax credits for a reduction in wastes generated below agreed levels;
- A system of high prestige awards for companies which achieve measurable progress in recycling;
- The imposition of a tax on companies, both manufacturing and distributors, whose products and containers become a public nuisance, eg. Drink containers, to force them to take a positive role in collection for recycling.
- The provision of facilities to encourage members of the public and small companies to bring recyclable materials to convenient collection points;
- Companies in or wanting to be in, the recycling business should be eligible for tax relief and low interest rate Government loans.

Further Stages that should include UNIDO Involvement

- Assist EPA in producing standards and categories for industrial wastes.

- Training EPA staff in Hazardous Waste control by arranging training courses and arranging on-site training with organisations such as the UK Department of the Environment (H.M. Inspectorate of Pollution), USEPA, Environment Canada or any successful environmental protection agencies within the Gulf States. Probably the best mix for on-site training would be a period with a stringent western agency followed by a period with a Gulf Agency to study and decide how the western approach can best be applied to Bahrain.

- Assist the EPA in hazardous waste landfill requirements, site selection, design, construction and operation including the training of Bahraini nationals.

- Assist the EPA in hazardous waste chemical treatment plant requirements and if a treatment plant is needed, assist the EPA in site selection, design, processes, construction and operation including training the personnel.

- Assist the EPA in industrial and hazardous waste incineration plant requirements, site selection, design requirements, construction and operation including training the personnel.

- Assist the EPA in the medical waste incineration and collection service requirements, site selection, construction and operation including training the personnel.

- In the event that a hazardous waste landfill site, chemical treatment plant, incinerator or medical waste incinerator is decided on UNIDO can also assist the EPA with the following:-

- Pre-tender qualification
- Tender documentation
- Tender selection
- Contract documentation
- Contractual negotiation

ANNEX -1

A Summary of Wastes Generated, Current Disposal Methods, Current Landfill Life Amount of Materials Recycled and the 1995 Analysis of Household Waste

SUMMARY OF WASTE GENEPATED IN BAHRAIN

(i) : INDUSTRIAL SOLID WASTE - 1996

Type of Waste	Source	Quantity MT per Year	Properties	Current Disposal Methods
Spent pot Lining	Aluminium Smelter (ALBA)	12,700	Containing CN & F	>50% Recycled & Hazardous landfill
Carbon Dust		4,500	Containing 99% Carbon	Recycling & Mun. Landfill
Dross		8,000	Containing Alum. Oxide	Recycled
Sewage sludge		100	Containing Human refuse	Municipal Landfill
Slurry from desulf. plt.		135	Containing Sodium Nitrate	Municipal landfill
Bath Dust		180	Flourides 60 % Alum. Oxide 30%	Recycling on-site
Chromium Sludge	Aluminium Coating (ALZAMIL)	180	Contaminated by Cr.	Hazardous Waste L.fill
Dried Sludge	Aluminum Extrusion (BALEXCO)	150	Containing AL(OH)3	Municipal Landfill
Chromium Sludge		7.5	containing 30% chrom. hydroxide	Stored on-site
Spent Catalysts	Petro Chemical (GPIC)	153	Mainly Metal Oxides	Export or store on-site
Metalic Scale	Oil Refinery (BAPCO)	10	Contaminated by T.E.Lead	Stored on proper site
Spent Catalysts		1518	Mainly Metal Oxides	Export or store on site
Salt Cake	Dross Recycling (ALUSERV)	18,500	AL Oxide 45%,Salt 50% & Metals 5%	Stored on-site (To be exported)
Dross	Aluminum Rolling (GARMCO)	500	Containing Alum. Metal	Recycling (900 MT/Y by 2000)
Slurry	Acetylene Products (YATEEM OXYGEN AND AHMED M. AL-A'ALI PLT.)	1,440	Lime Generated From Decomposition of calcium carbide	Municipal Landfill or Discharge to Sewage
Fine Powder	Asphalt Plants	7,000	Containing CaCO3	Municipal Landfill
Sand Plasting Grit	Shipyard (ASRY)	35,000	Sand plasting Containing Metals	Recycling or Land Reclamation
Slurry	Acid Production (Gulf Acids)	1.2 - 2.0	Containing 40% Sulphur	Used in agriculture as pesticide
Silt	Sea sand washing plants	35,000	Fine Materials < 35 micron	Reused and Store on-site
Ash	Medical Waste Incinerators	217.5	May Contain Heavy Metals and Sharps	Municipal Landfill
Sewage Sludge	Sewage Treatment Plants	7,665	Contaminated By Virus	Recycling in Agriculture
Intestines	Slaughterhouse	350	Organic	Recycled
Leathers		1,750	Organic	Recycled
Plastics	Gulf Plastics Al Noor Factory United Zeera Factory Wholesales	380	Mainly PVC and PE	Most Recycled
Medicines	Govern. & private Pharmacies	not known	Several kinds	Incineration or Mun. Landfill

SUMMARY OF WASTE GENERATED IN BAHRAIN

(ii) : OILY WASTE AND SLUDGE - 1996

Type of Waste	Source	Quantity MT per Year	Properties	Current Disposal Methods
Oil Sludge	Oil Refinery (BAPCO)	40	Contain water, Sand, debris, contaminated by hydrocarbon	Land farming, Municipal L.fill, storage
Oil Sludge		873	Contaminated by lead	Store on-site
Oil Sludge	Ship repair yard (ASRY)	3,000-10,600	Contain metals & Heavy hydrocarbon	Store on-site
Oily Waste		4000	Waste polluted by oil	Municipal Landfill
Oil Slop		7000	Waste oil from Slop oil process	Recycled by BAPCO Refinery
Waste oil	Ship Maintenance (BASREC)	50	Waste Oil From Bilges	Recycling or Mun. Landfill
Oil Sludge	Oil Wells (BANOCO)	3000-4000*	Dried Crude Oil/ Water Mixed	Put on pits in the desert
Tarry Pitch	Aluminium Smelter (ALBA)	225	Tar from dust collection tower	Store on pits (BAPCO)
Esp Tar		75	Tar from fumes cooling tower Contain Sulphur	Municipal Landfill
Motors Waste Oil	Garages & Filling Stations	3,000 *	Exhausted motors Lubrication oil	Most Recycled
Tarry Pitch	Oil Refinery (CALTEX)	1,500,000	Very high viscosity and hydrocarbon content	Production storage over last 30 years
Waste Oil	Midal Cables	12	Wire Drawing Lubricant	Municipal Landfill

* Quantities are Estimates only.

SUMMARY OF WASTE GENERATED IN BAHRAIN

(iii) : LIQUID WASTE DISPOSED OF AT MUNICIPAL LANDFILL(1996)

Type of Waste	Source	Quantity CM per Year	Properties	Current Disposal Methods
Surfactant & Corrosion Liquid	Steel Galvanized (Bah.Workshop)	32	Contaminated by metals	Neutral with DA ash & Evaporation Mun. landfill
Slurry/ Water mixed	De-Sulphurizing Plant (ALBA)	270	Containing Sodium Nitrate 50% Water	Evaporation in Municipal Landfill
Sterilizing Water	Medical Equip. Sterilize (Jalil Factory)	1,000*	Mix of 3 KG Ethylene Oxide & 27 Kg CO2 27KG CO2 in in 7200 litres Water	Evaporation in Mun. landfill or Discharge to Sewage Plant.
Cutting Emulsion	Aluminium Rolling Mill (GARMCO)	960	Oil dissolved in Water	Sprayed on Municipal Landfill
Cooling Emulsion	Aluminium Products (MIDAL CABLE)	85	10% Oil dissolved in Water	Sprayed on Municipal Landfill
Cleaning Water	Chicken & Sheep's Slaughter House	4,500	Containing 20-30% Blood	Discharged in Municipal Landfill
Chemical Water	Aluminium Coating (AL ZAMIL)	9,125	Containing Metals	Neighbouring Land or Municipal Landfill
Paint Water Mixed	Hempel Marine Paints	90	Washing Water of Emulsion Paint Products	Municipal Landfill
Caustic Water Sludge	Aluminium Extrusion (BALEXCO)	85	Aluminium Hydroxide from Metal Analyzing	Municipal Landfill
Oil/Water Mixed	SAVOLA	120*	Food Oil Refining Process Waste	Municipal Landfill
Oil/Water mixed	Garages & Factories	1000 *	Containing Human Waste	Municipal Landfill

* Quantities are Estimates Only

SUMMARY OF WASTE GENERATED IN BAHRAIN

(iv) : MISCELLANEOUS WASTE -1996(GENERAL CATEGORIES):

Type of Waste	Source	Properties	Current Disposal Methods
Redundant Chemicals	Chemical Stores Wholesales or Laboratories	Solid, Liquid or Gaseous, Possibly Toxic, Flammable, or Corrosive	M.. icipal Landfill, hazardous Landfill or Discharge to Sewage
Redundant Chemical Products	Wholesalers and Retail Stores	Solid, Liquid or Gaseous, Possibly Tox.,Flam. or Corros.	Municipal landfill, or hazardous waste landfill
Pesticides	Agricultural Wholesalers, Importers, Retail or Pest Control	Solid or Liquid Organic or Inorganic May Containing Heavy Metals	Hazardous Landfill, Municipal Landfill or Storage
Asbestos	Industrial, Commercial or Domestic Construction	Solid Sheets, Pipes or Insulation Fibre, White, Blue AND Brown	Municipal Landfill
Paints and Solvents	Factories, Workshops & Dry cleaners	Semi-solid or Liquid, Flammable	Municipal landfill, or Discharge to Sewerage
Transformer Waste Oil	Electrical Transformers	Contaminated by Poly Chlorinated Bi Phenyles	Export or Store on-site
Radioactive Waste	Research Centres, medical & Engineering	Solid or Liquid	Export or Storage to Decay
Contaminat Clothes & Tools	Substation Ministry of Power & Water	Contaminated by Sulphur Hexa Flouride(SF6)	Hazardous waste Landfill Store on site
Electronic Products	Commercial, Workshops, Houses, Industry		Municipal Landfill
Plastic Ru er	Plastic Manufacturers & Construction	PVC, Poly Ethylene Poly Propylene and Others	Most Recycled and Municipal Landfill
Photograph Wastes	Photo Films Developing Laboratories	Containing Silver Nitrate	Recycling or Discharge to Sewage

#	Source	Type	No. of Beds	Wastes (t/y)	Current disposal method
1	**Public Hospitals:**				
	1. Sulmaniya Hospital	Medical Waste	611	864	Incineration
	2. Psychiatric Hospital	Medical Waste	201	3	Incineration
	3. Maternity Hospital	Medical Waste	340	145	Incineration
	4. Geriatric Hospital	Medical Waste	68	2	Incineration
2	Military Hospital Bahrain Defence Force	Medical Waste	196	173	Incineration
3	**Private Hospitals:**				
	1. International Hospital	Medical Waste	100	10	Incineration
	2. American Mission Hospital	Medical Waste	34	22	Incineration
	3. Awali Hospital	Medical Waste		75	Incineration
4	Private Clinic	Medical Waste		13	Incineration
5	Health Centres	Medical Waste		147	Incineration
6	Public Health Laboratories	Medical Waste		7	Incineration
	Total Waste Generated			1461 t/y	

SUMMARY OF WASTE GENERATED IN BAHRAIN

(Vi) : MUNICIPAL WASTE :

The anticipated life of the present landfill area, quarries # 3 and 4 , is est another three years, whereas extentions are taking place in the other qua provides huge volume estimated to be enough for another thirty years.
askar landfill site is the only municipal solid waste disposal site available which consists of disused lime stone quarries.
the density of the household waste that are being deposited at askar land estimated to be 91 kg/m3. the Total quantity of wastes received is about which includes wastes from household, markets, commercial, agricultur industrial.

HOUSEHOLD WASTES ANALYSES MADE IN 1995

CONSTITUENT	% Wt	HOUSEHOLD WASTE TONNES/YEAR
1- Vegetable & Putrescible	59.0681	112,090
2- Paper and Cardboard	12.7932	24,277
3- Plastic (film + hard)	7.4387	14,116
4- Metal (ferrous + non-ferrous)	2.0535	3,897
5- Glass & Bottles	3.3877	6,429
6- Textiles	2.9336	5,567
7- Babies napkins	3.9974	7,586
8- household hazardous(medicine , flourecent tubes, batteries etc..)	0.1913	363
9- Garden Waste	6.7295	12,770
10- Miscellaneous	1.4056	2,667
TOTAL =	100	189,765

NOTE : Building Rubble, Commercial & Industrial Wastes Not Included.

SUMMARY OF WASTE GENERATED IN BAHRAIN

(Vii) RECYCLABLE MATERIAL FROM THE MUNICIPAL LANDFILL :

TYPE OF MATERIAL	QTY. MT/Y
1- PAPER & CARDBOARD	9,868
2- IRON STEEL	35,240
3- ALUMINIUM	5,350
4- COPPER	450
5- LEAD	75
6- PLASTIC & RUBBER	380
7- GLASS	NIL
8- OLD TYRE	24,000
9- INTESTINES	350
10- LEATHER	5,000
11- WASTE OIL	3,000
12- WOOD	NOT KNOWN
13- BUILDING RUBBLE	NOT KNOWN

WASTE TREATMENT AND DISPOSAL FACILITIES -1996

TYPE OF WASTE	AVAILABLE FACILITIES
Domestic Wastes :	Askar Landfill Site
Hazardous Wastes :	Ad Dur Hazardous Waste Site
Waste Water :	Tubli Sewage Treatment Plant
Domestic/Industrial Waste Water :	Sitra Sewage Treatment Plant
Clinical Waste :	Salmaniya Hospital Incinerator BDF Hospital Incinerator Awali Hospital Incinerator International Hospital Incinerator
Waste Oil :	BAPCO Refinery, Bahrain Oil Co., Toranco and Karimi
Dross :	ALUSERV Middle East Bahrain Recycling Sa'ar Aluminium Turk Mechanics
Metals :	Scrap Mold Metalco
Plastics :	Metalco
Cardboard & Papers :	Bahrain Cleansing Est. Bahrain Insulation Plt. AL Waha Est.
Old Tyres :	BahrainTyres Renewing Factory

ANNEX-2

LIST OF PERSONS/INSTITUTIONS VISITED

#	Name	Position	Organization	P.O.B.	Fax #.	Tel.#
1	Mohamed Saleh Shaikh Ali	Undersecretary	Ministry of Oil & Industry	1435	293093	290300 525550
2	Hmood Khalifa Al-Khalifa	Head of Promotion & Finance	Industrial Development Directorate	1435	290302	525559 291511
3	Khalid M. Fakhro	Vice Chairman	Environmental Protection Committee	26909	293694	293693
4	Abdul Mohsin AlMahmood	Chemist	Environmental Protection Committee	26909	293694	293693
5	Yusuf Ahmed Al-Sayigh	Director - Env. Health	The Central Municipal Council	53	780646	687575
6	Fadhel Abbas Yosuf	Environmental Chemist	Central Municipal Council	53	780646	687575 M 9606564
7	Mahmood H. Al-Kooheji	Director Government Shareholdings Directorate	Ministry of Finance & National Economy	333	532895	526759
8	Abdulla M. Bu-Qahoos	Environmental &Safety Engineer	Ministry of Oil & Industry	1435	730939	734023 731011
9	Mirza Salman Khalaf Dr. Afaf Al-Sholla	Occupational Hygiene Occupational Hygienist	Ministry of Health	42		279227 9 498389
10	Jonathan Mark Prebble	Manager-Metallurgy & Laboratory	Aluminium Bahrain B.S.C. (c)	570	830083	833475 833423
11	Jaffar G. Ameeri	General Manager Carbon & Metal Services	Aluminium Bahrain B.S.C. (c)	570	833833	833344
12	Ahmed E.K. Al-Quraan	Acting Advisor-Environmental Affairs	The Bahrain Petroleum Co. (Bapco)	Awali	755552	755660
13	Anthony Antoniou	Technical & Q.A. Manager	Arab Shipbuilding & Repair Yard Co.	50110	670236	674024
14	Paul D. Webster	General Manager	Al-Zamil Coating	285	700336	700555 700335 /7

15	Reyadh Alshaibani	Superintendent Quality Assurance	BALEXCO	1053	735630	734457 730221 x
16	Yousif Fahad AL-Hashil	Technical Services Manager	BALEXCO	1053	735630	734437
17	Jaffar A.N. Shehabi	Technical Services Manager	Gulf Industrial Investment Co.	50177	675258 9 485791	673824 673311x206
18	G. Thiyaga Rajan	Executive Secretary	Metalco Industries	417	830379	830038
19	Mike Earp	Manager, Fire, Safety & Security	Gulf Aluminium Rolling Mill Co.	20725	730542	734634 731000x334
20	S.M. Tahir	Production Manager	Gulf Acids Industries W.L.L.	2770	731991	730686
21	Iyer Girichandran	Factory Manager	Hempel Paints (Bahrain) W.L.L	997	729951	728668
22	Monam M.K. Alsharif	Managing Director	Bahrain Workshop Co.	404	701535	700798
23	Frank McGarry	General Manager	Yateem Oxygen	60	400446	400443 400675
24	Abdul Nabi Al-Saffar	General Manager, Oil Recycling	Manaber Commercial Centre	3233	223115	223118 458737
25	Phil Smith	General Manager	AluServ Middle East	519	272761	274224
26	Stein Wennberg	Manager, Al Services	Heckett MultiServ East	UK - 044-	171-3141420	+ 314 1427
27	Derek J.S. Brown	Regional Environmental Coordinator	Caltex Services Corporation	25125 Awali	753122	753131 M 470746
28	Brian Charlesworth	Div. Manager Treatment Operations	Sewerage & Drainage Dir. PWA, Min. of Works & Agri.	5	785829	784040 B 9489601
29	Waleed A. Kooheji		Bahrain Tyre Retreading Plant (BATREP)	1021	785495	784640 M 461369
30	Eduard C. Le Roux Horn	Plant Manager	Gulf Petrochemical Industries	26730	731047	731777

31	Khalil I. Al-Obaidat	General Manager- Tech.Div.	GPIC	26730	731047	731777
32	Nihal P. Weerasinghe	Manager - Asphalt Div.	Eastern Asphalt & Mixed Concrete Co. (EAMCO)	474	702309	701090 458812
33	P.U. Devassy	Quality Control Manager Asphalt Div.	Eastern Asphalt & Mixed Concrete Co. (EAMCO)	474	702309 253262	701386
34	Dr. Ahmed Moh'd Khater	Scientific Research Dept.	BCSR	496	756225	754757
35	Dr. Abdul Jalil M. Zainal	Director, GIS & Computing	Bahrain Centre for Studies & Research (BCSR)	496	754678	754757
36	Dr. Fouad I. Kanbour	Sr. Env. Affairs Officer	UNEP / ROWA	10880	276075	276072 / 3
37	Dr. Hashim Suliman Hussein	Industrial Programme Coordinator	UNIDO	26814	729922	725552
38	Abdul Ali Al-A'Ali	Chairman	United Enterprises	11763	701515	700606 9 642112
39	Ebrahim A. Aziz Al-A'Ali	Director	United Enterprises	11763	701515	700606/076
40	Barry Seddon	Dpty Head of Mission & 1st Secr.	British Embassy	114	533307	534404
41	Ian Lewis	Second Secretary (Commercial)	British Embassy	114	531273	534404

ANNEX - 3

Literature and Legislation Reviewed

Literature Reviewed

The following is a list of the literature reviewed during the study:-

- Cleaner Technology in Bahrain: An Assessment Study. Ahmed Hamza. 1992 .
- Visit To Bahrain. Report on Wastes. JMD. 1992 (French report).
- National Waste Management for Bahrain. IMO 1993.
- Development of a Solid Waste Policy for Bahrain. Environmental Health Directorate. 1994.
- Current Status and Categories of Hazardous Wastes in Bahrain - Case Study - 1994.
- Clinical Waste Generation in Bahrain. Dr. Raveendran 1995.
- Landfill Operation. RMI.
- Review of Landfill Disposal Operations at Askar Landfill Site. RMI. 1988.
- Domestic Waste Analysis. 1993.
- Law No 3 for 1975 with respect to Public Health. Ministry of Health.
- Bahrain Proposed Effluent Guidelines. State of Bahrain.
- The transportation of hazardous materials by road. Civil Defence and Fire Service Directorate.
- Hazard Warning Panels and Labels. Civil Defence and Fire Service Directorate.
- Guidelines for Hazardous Waste Management. Ministry of Housing, Municipal and Environment.
- Third Legal/Technical Expert Meeting on the Draft Protocol on the Control of Marine Transboundary Movements of Hazardous Wastes and other Wastes. Report of Meeting. 1994.
- Transportation and Emergency Contingency Plan. National Environmental Preservation Co.

- Development of a National Toxic Waste Disposal Facility. E R L 1987.
- Environmental Protection Regulation in Bahrain. A Report on the Way Forward. Professor Feates, 1991.
- Report on Recycling Wastes. Environmental Health Directorate, 1991.
- Clinical Waste Disposal Review 1995. Environmental Health Directorate. 1995.
- Environmental Management in Bahrain. An Action Plan. O.A. El-Kholy. UNEP 1993.
- Guidance Notes for Clinical Waste Incineration Processes up to One tonne per hour. Ministry of Housing, Municipal Affairs and Environment. 1995.
- Amiri Decree No. 7, 1980.
- Data Form EA-2.
- Legislative Decree No. 11 of 1991 (Sewerage and Surface water).
- Various research projects from the University of Bahrain and AGU.

MEETINGS ATTENDED AND SITES VISITED

Meetings Attended

Meetings have been held with officials from the following organizations:

Inaugural meeting with Environmental Protection Committee
Ministry of Health - Department of Occupational Health
Ministry of Housing Physical Planning Department
Ministry of Finance - Government Holdsharing Dept.
British Embassy
Bahrain National Oil Co.
Bahrain Centre for Studies & Research
UNEP
UNIDO
UNDP
Ministry of Development and Industry

Site Visits

The following list is of site visits made, accompanied by the National experts. The information received is presented in the relevant table rather than in the form of text.

Waste Disposal Sites Visited Accompanied by National Experts:

- Askar municipal waste landfill site.
- Ad Dur hazardous waste landfill site
- Salmaniya Hospital incinerator
- Awali medical waste incinerator
- Buhair old Landfill Site
- BDF Hospital Incinerator
- Unauthorised dump by lake
- Unauthorised dump with unknown sludge deposited
- Abandoned waste pulverizing plant
- Illegal dumping of Hazardous waste in Quarry area
- Improper storage of contaminated recyclable materials at Bramco Yard in Quarry area.

Industrial Sites Visited Accompanied by National Experts:

At the following sites discussions were held with site staff regarding the processes involved, the wastes produced (if any), the storage methods and facilities, recycling and re-use possibilities. The sites were toured, the wastes viewed and the storage methods and facilities examined.

- Ship Repair yard - A S R Y
- Oil Refinery - B A P C O
- Caltex - including visit to pitch storage pond.
- Bahrain Insulation Company.
- Iron palletizing plant - GIIC
- Steel galvanizing - BWS
- Nass Sand Washing Company
- Scrap Plastic Recycling - Metalco
- Bahrain Aluminium Extrusion Company - B A L E X C O
- Aluminium Smelter - A L B A
- Aluminium Coating (Al Zamil)
- Aluminum Rolling Mill Co. (GARMCO)
- Paint Manufacturing (HEMPEL)
- Sulphuric Acid Prod. (Gulf Acids)
- Acetylene Prod. (Yateem Oxygen)
- Aluminum dross recycling (ALSERV)
- Gulf Petrochemical Industries Co. (GPIC)
- Bahrain Recycling Company
- Sewerage Treatment Plant (Tubli)
- Bahrain Tyres Renewing Factory
- Silver Electro-plating Co.
- National Foundry Co.
- Mina Sulman Industrial Area
- Eastern Asphalt and Mixed Concrete Company.

LIBRARY AND DATABASE

The Establishment of a Database

It is recommended that a database be established by the EPC to establish information on industrial non-hazardous and hazardous wastes. As a start the following should be obtained or used:-

CHEMDATA - obtainable for approximately UK 2,000 from National Chemical Emergency, Harwell, UK.

Cirus, a chemical information retrieval and updating system, detailing over 27,000 chemical companies and over 1,000 chemical manufacturing companies who can be contacted for advice on handling their products.

There are several useful sites on WWW on the Internet:-

http://www.yahoo.com/government/countries
http://www.eia.doe.gov.
http://cct.seas.ucla.edu.
http://cygnusgroup.com/packgaging/study.html.
http://wastenol.inel.gov/envirosense
gopher://gopher.epa.gov (select-prevention pesticides & toxic substances)
http://www.law/intervlaw.html
http://mmw.ac.uk/enc/

The International Trade Association of any industry, national or international, that is operating in Bahrain should be approached and requested to supply a copy of their guidelines that are available to their members. Specifically the request should refer to the treatment or disposal of the wastes generated by the industry and what regulations the industry is subject to internationally.

References and Information Sources on Hazardous Wastes

References published by UN Agencies:

1. Safe Disposal of Hazardous Wastes: The Special Needs and Problems of Developing Countries. Three Volumes. World Bank/WHO/UNEP (1989).

2. Treatment and Disposal Methods for Waste Chemicals. IRPTC (1985).

3. Wastes and their Treatment: Information Sources and Bibliography. INFOTERRA (1986).

4. Management of Hazardous Waste: WHO Regional Publication. European Series, No.14 (1983).

5. Rapid Assessment of Sources of Air, Water and Land Pollution. WHO Offset Publication No. 62, WHO (1982).

6. The Basel Convention on Control of Transboundary Movements of hazardous Wastes and their Disposal. UNEP (1989).

7. The Cairo Guidelines and Principles for the Environmentally Sound Management of Hazardous Wastes. UNEP (1987).

8. Encyclopaedia of Occupational Health and Safety. (3rd edn.) Two volumes, ILO.

9. Legal File. IRPTC.

10. Guidelines for Establishing Policies and Strategies for Hazardous Waste Management. UNEP/CDG (1986).

11. "Industry and Environment" Special editions on -
    * Hazardous Waste Management (March 1988).
    * Waste Minimisation (March 1989).

12. Audit and Reduction Manual for Industrial Emission and Wastes. UNEP/IEO, UNIDO (1991).

13. Storage of Hazardous Materials: A Technical Guide for the Safe Warehousing of Hazardous Materials. UNEP/IEO (1990).

14. Many UNEP IE/PAC technical guides including recommendations on waste minimisation and management.

References from Other Sources:

15. W.S. Forrester and John H. Skinner (eds.) International Perspectives on Hazardous Waste Management. Academic Press (1987).

16. Adapting Hazardous Waste Management to the Needs of Developing Countries, a special edition of Waste Management and Research Vol. 8 No. 2 (March 1990).

17. John R. Cahman Management of Hazardous Waste: Treatment/Storage/Disposal Facilities. Technomic (1986).

18. G.W. Danson and B.W. Mercer Hazardous Waste Management. Wiley Interscience (1986).

19. Waste Audit Manual. Ontario Waste Management Corporation (1989).

20. Waste Minimisation Opportunities Manual. USEPA (1988).

21. Assessment of Sources of Air, Water, and Land Pollution, 2 vols, WHO, Geneva, 1993.

22. Hazardous Waste Management Handbook, Ed. A. Porteous, Butterworths, 1985.

23. Handling and Management of Hazardous Materials and Waste, T.H. Allegri, New York, Chapman and Hall, 1986.

24. Toxic and Hazardous Waste: Proceeding of the Eighteenth Mid-Atlantic Industrial Waste Conference, G.D. Boardman, Lancaster, Technomic, 1986.

25. Technical Guidelines for Environmentally Sound Management of Wastes Subject to the Basel Convention, Secretariat of the Basel Convention, Geneva, 1993.

26. Landfill Disposal of Hazardous Wastes and Sludges, Pollution Technology Review No. 62, Marshall Sittig, Noyes Data Corporation, New Jersey, USA, 1979.

27. Parameters Characterising Toxic and Hazardous Waste Disposal Sites: Management and Monitoring, B. Mickan, Luxembourg, CEC, 1987.

28. Requirements for Hazardous Waste Landfill Design, Construction and Closure, Seminar Publication, EPA/625-89/022, USEPA, 1989.

29. Unit Operations for Treatment of Hazardous Industrial Wastes, D.J. Dc Renzo, Park Ridge, NDC, 1978.

30. The Solid Waste Handbook - A Practical Guide, William D. Robinson, John Wiley & Sons, 1986.

31. Waste Management Paper No.4 - The Licensing of Waste Facilities, Her Majesty's Inspectorate of Pollution, London, 1976. (Revised 1988).

32. Solid Wastes - Engineering Principles and Management Issues, G. Tchobanoglous et al., McGraw Hill, 1977.

33. Closing Open Dumps, DR Brunner, Washington D.C., Government Printing Office, 1971.

34. 'Clay Soil Permeability and Hazardous Waste Storage' in Journal of WPCF, Vol. 53, No.8, pp. 1347-1354, 1981.

35. Management of Uncontrolled Hazardous Waste Sites. National Conference, Nov. 29 - Dec. 1, Washington D.C. 1982.

36. Programme of Research on the Behaviour of Hazardous Waste in Landfill Sites. Dept. Of Environment, WLR, Technical Note Series, London, 1976.

37. National Guidelines for the Landfilling of Hazardous Waste, Canadian Council of Ministers of the Environment, April, 1992.

38. Industry and Environment Review (Quarterly), ISSN 0378-9993. Hazardous Waste Management and related topics.

39. Guidelines for Assessing Industrial Environmental Impact and Environmental Criteria for the Siting of Industry. UNEP IEO, ISBN 92-1015-X, 122pp. 1980.

40. The Impact of Water-Based Drilling Mud Discharges on the Environment: An Overview. UNEP IEO, ISBN 92-807-1080, 50pp. 1985.

41. Environmental Aspects of Alumina Production: An overview. UNEP IEO, ISBN 92-807-1088-5. 42pp. 1985.

42. Environmental Management Practices in Oil Refineries and Terminals: An overview. UNEP IEO, ISBN 92-807-1108-3. 103pp. 1988.

43. Environmental Aspects of the Metal Finishing Industry: A Technical Guide (Technical Report Series No.1). UNEP IEO, ISBN 92-807-12160. 91pp. 1989.

44. Environmental Auditing (Technical Report Series No.2) UNEP IEO, ISBN 92-807-12535. 125pp. 1990.

45. UNEP International Register of Potentially Toxic Chemicals-Report of the Expert Meeting to review the IRPTC Waste Management File (9-13 March 1992), Geneva UNEP/IRPTC-PAC, Geneva.

46. CCME (April 1991) National Guidelines for the Landfilling of Hazardous Wastes. The Canadian Council of Ministers of the Environment.

47. UK Department of the Environment (1984) The Selection of Landfill Sites. Department of the Environment Landfill Practices Review Group- WLR Technical Note Series No-64.

48. UNEP Final report on the Regional Workshop on Landfill of Hazardous Industrial Wastes-Amman, Jordan (22-25 June 1992)-UNEP Industry and Environment Programme Activity Centre, Regional Office for West Asia, and Environmental Education and Training Unit.

49. International Environment Bureau (IEB) [1990] Special Wastes-prevention, reduction, disposal. State of the art in technology and management proceedings of an international symposium sponsored and organised by Ciba-Geigy Limited EIB.

50. ISWA Series 1991 No. 1 Safe Hazardous Waste Management Systems : a state-of-the-art guide for decision makers. ISWA Working Group on Hazardous Wastes. Published by the USA/Canadian International Solid Waste management Federation in cooperation with the International Solid Wastes and Public Cleansing Association (ISWA).

51. AEA Environment and Energy 1992. New Development in Landfill. Harwell Waste Management Symposium.

52. IE/PAC information folder, Introduction to Cleaner Production.

53. Management to Landfill of Hazardous Industrial Wastes, IE/PAC (1990).

54. Introduction to Landfill of Hazardous Industrial Wastes, IE/PAC (1990).

55. Environmentally Sound management of Hazardous Wastes, UNEP (1987).

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STATE OF BAHRAIN
ENVIRONMENTAL PROTECTION COMMITTEE

دولة البحرين
لجنة حماية البيئة

EA - 2

إستمارة بيانات لتقييم الأثر البيني للمشاريع الصناعية

Data Form
Environmental Screening of Industrial Projects

رقم الطلب	

1 - Project Name _____ ١ - اسم المشروع

2 - Project Location ٢ - موقع المشروع
Industrial Area _____ المنطقة الصناعية
Plot no. _____ رقم القطعة
Coordinates _____ الإحداثيات
Lat. _____ العرض
Long. _____ الطول

(Please attach a map) (يرجى ارفاق خارطة تبين موقع المشروع)

3 - Proposed Starting Date ٣ - التاريخ المقترح للبدء
(i) Construction _____ أ - الإنشاء
(ii) Operation & Production _____ ب- التشغيل والإنتاج

4 - Total Allocated Area (m^2) ٤ - مساحة الارض المخصصة للمشروع ($م^2$)
Plant area (m^2) مساحة الارض التى سيقام عليها المصنع ($م^2$)

الطلب غير مكتمل البيانات يعتبر مرفوضا
Incomplete form/data will be rejected

Tel. : 293693, P. O. Box 26909, Telex : 8511 HEALTH BN, Telefax : 0973-293694 (٩٧٣) ٢٩٣٦٩٤ تلكس: ٨٥١١ صحة بن - تلكس: ٢٦٩٠٩ ص.ب ٢٩٣٦٩٣ تليفون

5 - No. of Employees

non Bahraini غير بحريني

_____

٥ - عدد العاملين

Bahraini بحريني

_____

6-Project description

٦ - وصف المشروع

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(يرجى إرفاق) :

i - وصف تفصيلي للعمليات الصناعية بما في ذلك التكنولوجيا المستخدمة وأسباب اختيارها.

ii - رسم بياني يبين العمليات الصناعية ، أجهزة التحكم في التلوث ، مكان إدخال المواد الخام، الإنبعاث إلى الهواء والماء والتربة ، ومكان إنتاج وتخزين المنتجات .

(Please attach) :

i. A detailed description of industrial processes including the technology used and justification for selection.

ii. A flow diagram identifying process, control equipment, where raw materials enter the process, where emission to air, water and land exit and where finished products are handled.

الطلب غير مكتمل البيانات يعتبر مرفوضا

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7 - Production Capacity (T/Y) ٧ - الطاقة الانتاجية (طن/سنة)

8 - Products ٨ - المنتجات

Quantity الكمية T/y	Type النوع (s,l,g)*	Product المنتج	رقم No

* s = solid ; l = liquid, g = gas.

9 - Resource use ٩ - إستخدام الموارد

(i) Water (١) المياه

Source المصدر

Sea ☐ ☐ مياه البحر

Municipal network ☐ ☐ شبكة المياه

Boreholes ☐ ☐ آبار جوفية

Volume (m^3 /y) _____ الحجم (متر ^{3}/سنة)

(ii) Electricity _____ (٢) الكهرباء

Source _____ المصدر

Power (KW-h) _____ القدرة (كيلووات ساعة)

(iii) Gases _____ (٣) الغاز

Source _____ المصدر

Volume (m^3 /y) _____ الحجم (متر ^{3}/سنة)

(iv) Others _____ (٤) أخرى

(Pls Specify) _____

الطلب غير مكتمل البيانات يعتبر مرفوضا

Incomplete form/data will be rejected

10- Chemicals (Including CFCs) ١٠ – المواد الكيمائية (بما فيها مواد الكلوروفلوروكاربون)

الكمية المستوردة أو المبتاعة محليا Quantity imported or locally bought (T/y)	الاستخدام Usage *	الاستهلاك Consumption (T/y)	أهم المكونات Major constituents	النوع Type (s,l,g)	الاسم Name	رقم No

* Cleaning , Anti-scalant, in the Process , Corrosion Protection , Others

11- Raw materials used in the manufacturing processes : ١١ – المواد الخام الداخلة في عمليات التصنيع :

المصدر Source	الكمية المستهلكة Consumption (T/y)	المادة Material	رقم No

(يرجى ذكر كل المواد الخام والمواد الكيميائية الداخلة وغير الداخلة في عمليات التصنيع والكيميائيات الوسيطة والسامة . يجب أن تستخدم الأسماء العلمية للمواد الكيميائية ، وفي حالة معرفة الاسم التجاري فقط ، يرجى بيان المصنع كما يرجى إرفاق معلومات عن سمية هذه الكيميائيات وطرق التخلص منها)

(Please list all raw materials, process and non-process chemicals, intermediates and toxic chemicals. IUPAC names or commonly known names are needed. If only trade names are known, indicate manufactures. Submit a data sheet on toxicity and method of disposal).

الطلب غير مكتمل البيانات يعتبر مرفوضا
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2 - Emission to Environment

(a) To Air

(i) Point Source Emision

١٢ – الانبعاث الى البيئة

(أ) الى الهواء

(i) من مصادر محددة

Substance	Average release rate mg/sec	Average release conc. mg/m^3	Maximum release conc. mg/m^3	Stack height m	Stack diameter m	Gas exit temperature °C	Gas exit velocity m/s	Water Vapour Content %
Particulates								
CO								
SO_2								
NO_2								
H_2S								
HCl								
Cl_2								
Heavey metals								
Dioxines/Furans								
Hydrocarbons								
Smoke								
Others *								

* Please specify

الطلب غير مكتمل البيانات يعتبر مرفوضا

Incomplete form/data will be rejected

(ii) إنبعاث غير محدد الموضع

يرجى إرفاق وصف لأي إنبعاث إلى الهواء من نقاط غير محددة في العمليات الصناعية ، خزانات تخزين المواد أو المنتجات ... الخ .

(ii) Fugitive emission:

Attach a description of fugitive (non stack) emission from processes, material handling, storage...etc.

(b) To Water (ب) إلى الماء

(i) حدد كل نقاط التصريف ، سواء الى البيئة البحرية أو تسهيلات على الارض حسب الجدول التالي:

(i) Identify each point source, by coordinate, of discharge to marine environment or land-based facility, as described in table below .

Point Coordinate إحداثيات نقطة التصريف Long and Lat.	Source of Effluent مصدر الانبعاث	Quantity m^3/d الكمية متر^3 / اليوم	Discharged to مصرفة إلى

(يرجى إرفاق رسم جغرافي يبين موقع نقاط التصريف والطرق والمنشآت المجاورة)

(Attach a plot plan that shows location of points of discharge, roadways, residenees and other structures).

(ii) تحليل مياه الصرف الصناعي

أرفق جدولا للتراكيز المتوقعة للعناصر ذات العلاقة لمياه الصرف الصناعي .

(ii) Effluent Analysis:

Attach an anticipated analysis of effluent quality for relevant parameters as in the following table :

الطلب غير مكتمل البيانات يعتبر مرفوضا

Incomplete form/data will be rejected

PARAMETERS	UNITS	
Flow Rate	m^3/day	
Floating Particles	m/m^2	
pH	pH	
Temperature	^0C	
Total suspended solids	mg/L	
Turbidity (NTU)	N.T.U.	
Ammonical Nitrogen as N	mg/L	
Dissolved Oxygen	mg/L	
Sulfide as H_2S	mg/L	
Chlorine residual	mg/L	
Cyanide as CN^-	mg/L	
Chloride (Cl^-)	mg/L	
Nitrate (NO_3^-)-N-	mg/L	
Nitrite (NO_2^-)-N-	mg/L	
Phosphorous - Total	mg/L	
M.B.A.S	mg/l	
Fluoride (F^-)	mg/L	
Biological Oxygen Demand	mg/L	
Chemical Oxygen Demand	mg/L	
Total Kjeldahl Nitrogen	mg/L	
Hydrocarbons(FLUOR or IR)	mg/L	
Oil & Grease (Hexane ex.)	mg/L	
Phenols	mg/L	
Aluminium	mg/L	
Arsenic	mg/L	
Cadmium	mg/L	
Chromium Total	mg/L	
Copper	mg/L	
Iron	mg/L	
Lead	mg/L	
Mercury	mg/L	
Nickel	mg/L	
Selenium	mg/L	
Silver	mg/L	
Zinc	mg/L	
Total Coliforms	No/100	
Others *	mg/L	

* Please specify

الطلب غير مكتمل البيانات يعتبر مرفوضا

Incomplete form/data will be rejected

(c) Solid Wastes

(ج) المخلفات الصلبة

Description نوع المخلفات	Source of Wastes مصدر المخلفات	Composition المحتوى	Annual Quantity (T/y) الكمية (طن/ سنة)	Disposal method طريقة التخلص

١٣ - يرجى إرفاق الخطوات المتخذة لبرنامج رصد تلوث الهواء والماء والتربة .

13- Please describe the monitoring programme of air, water and land pollution.

١٤ - يرجى وصف طرق منع أو التحكم في تلوث الهواء والمياه والتربة بالتفصيل ، بما في ذلك التكنولوجيا المستخدمة .

14- Please describe the prevention or control methods for air, water and land pollution, including the technology used.

Attach a physical description, dimensions and drawings of each pollution control equipment used, including maintenance schedules, breakdown and by-pass procedures.

الطلب غير مكتمل البيانات يعتبر مرفوضا
Incomplete form/data will be rejected

١٥ - يرجى الإفادة حول الترتيبات الادارية لشئون البيئة .

15 - Please describe the management and administration of environmental affairs, at your premises.

١٦ - تكاليف حماية البيئة بالنسبة لرأس المال / الكلفة السنوية للتحكم في التلوث .

16- Cost of environmental protection relative to capital investment /annual cost of pollution control.

أتعهد بإرسال معلومات وبيانات فصلية عن نتائج رصد الملوثات وأي تطور في عمليات التصنيع

I affirm that I will provide EPC with quarterly monitoring and progress data/information ☐ ***(Please tick)***

أقر بأن المعلومات الواردة كاملة وصحيحة ومعتمدة من قبل _____

توقيعه _____

I affirm that the information is submitted to the best of my knowledge and is complete, correct, reviewed and endorsed by _____

Singature _____

مالك / مالكي المشروع :
:Project Owner(s)

الاسم : : Name	
العنوان : : Address	
المسئول الذي يمكن الاتصال به : : Contact Person	
الوظيفة : : Position	
التوقيع : : Signature	
رقم الهاتف : : Telephone	الفاكس : Fascimile

الطلب غير مكتمل البيانات يعتبر مرفوضا
Incomplete form/data will be rejected

مقدم الطلب (في حالة اختلاف المعلومات عما ذكر أعلاه)

Applicant (If differenet than above)

الاسم : : Name	
العنوان : : Address	
المسئول الذي يمكن الاتصال به : : Contact Person	
الوظيفة : : Position	
التوقيع : : Signature	
رقم الهاتف : : Telephone	الفاكس : Fascimile

ختم الجهة مقدمة الطلب

Stamp of Applicant

يجب أن ترسل هذه الاستمارة نسخة أصلية إلى لجنة حماية البيئة مرفقا بها تصريح وزارة النفط والصناعة على العنوان المدون .

This form should be sent in original to EPC attached with the permit of the Ministry of Oil & Industry on the written address

ان صاحب المشروع مسؤول عن الآثار البيئية التي تم التأكد أن المشروع قد سببها أثناء الإنشاء أو التشغيل أو الترك . كما أنه مسؤول عن تحمل كافة النفقات المطلوبة لمعالجة تلك الآثار . إن المخاطرة بإهمال إجراءات المعالجة المحددة يعني أن إجراءات التحكم المضافة والمترتبة وغالية الثمن سوف يجب القيام بها .

The developer is liable and will bear the cost of mitigation measures needed to control any unforeseen environmental impacts proofed to be resulting from the proposed project during construction, commissioning, operation and/or abandonment. The risk of ignoring a prescribed mitigation measure means that the subsequent expensive add-on control easures will need to be implemented.

الطلب غير مكتمل البيانات يعتبر مرفوضا

Incomplete form/data will be rejected

For official use only :

Received by :

Date :

Forwarded for action to:

Assessed by :

Signature :

Date :

STATE OF BAHRAIN

THE CENTRAL MUNICIPAL COUNCIL

دولة البحرين

الهيئة البلدية المركزية

HAZARDOUS WASTE SITE
TEL NO. 9606564 - 451314
FAX NO. 780646

MAINIFEST FOR TRANSPORTATION AND DISPOSAL OF HAZARDOUS WASTE

(A) PRODUCER RECORD	SOURCE: ALZAMIL ALUMINUM COATING FACT.
	CODE NO:
	TYPE: CHROMIUM SLUDGE
	CONT. PERSON: MOHAMMAD SALEH
	TELEPHONE NO: 223009 - 223084 - 223071
	TELEFAX NO: 223112
(B) TRANSPORTER RECORD	TRANSPORTER NAME: SPHINEX SERVICES
	TRANS. SUPERVISOR: MR. HABEEB DHAHI
	TELEPHONE NO: 700032 - 700222 -456224
	VEHICLE NO. :
	QUANTITY : ----------DRUMS(240L)
	SIGNATURE :
(C) DISPOSAL SITE NOTIFICATION	I AM HEREBY CERTIFY THAT THE WASTE DESCRIBED IN (A) HAS BEEN RECIEVED AT HAZARDOUS WASTE SITE
	DATE: / /
	TIME:
	SUPERVISOR:
	SIGNATURE:

AMIRI DECREE NO. 7 For The Year 1980

Establishment of the Environmental Protection Committee

Isa Bin Salman - Amir of State of Bahrain

After reviewing section 8 & 39 (B) of the Legislation and based on a request by the Minister of Health and after the approval of the Ministers' Council, we decided as follows:

Sec. (1)

A Committee for the environmental protection (Environmental Protection Committee) will be established and attached to the Ministers' Council.

Sec. (2)

The Committee will be chaired by the Minister of Health and will include membership from the following Ministries: Health, Development & Industry, Works Power & Water, Housing, Commerce & Agriculture, Transportation, Education, Interior, Legal Affairs, Finance, Information and Municipality.

Sec. (3)

The Committee could call upon anyone it feels required in any of its meetings.

Sec. (4)

Functions of the Committee:

1. To study the state of environment and sources of pollution and evaluate these studies and present the recommendations in this effect.

2. To coordinate between the different Government Agencies regarding development activities and to ensure environmental consideration during the implementation stages.

3. To ensure that monitoring mechanisms are instituted wherever necessary on a permanent basis.

4. To prepare adequate legislation which will allow adequate environmental management. The corresponding Government sectors will enforce it.

5. To integrate environmental considerations in global planning and implementation of development in the country and carry out environmental studies and evaluations prior to the initiation of any project.

6. To study and propose means for funding environmental protection programs.

7. To ensure that the professionals and technicians are trained in the environmental field and that special training programs are prepared for them.

8. To ensure that environmental education is included in the academic educational plans and in the mass media.

9. To make any other decision on matters that relate to the state of the environment of the country that may be entrusted to it by a higher authority.

Sec. (5)

The Committee meets not less than once a month by a request from its Chairman who chairs all the meetings and when not present a Vice-Chairman acts on his behalf.

- The meetings are officially convened by a majority attendance rule.

- Decisions are made based on majority rules and in case of a tie the Chairman's decision is final.

- The members are to convey the suggestions of their Ministries to the Committee (on matters discussed).

- The committee could form a sub-committee from the members or others in order to carry out special assignments or studies.

Sec. (6)

A Technical Secretariat is attached to this Committee. This Secretariat will undertake the responsibilities of serving the Committee and preparing its agenda, follow-up the implementation of its decisions, study the formulation of the Sub-Committee and coordinate between them, presenting the outstanding matters to the Chairman for discussion, collecting all the information and data that the Committee may need in its discussions, following up on

the scientific research that is carried out in the country, informing the Ministry of Foreign Affairs on the issues related to the environment so as to participate and make decisions regarding international treaties and agreements.

The Ministry of Health will take the responsibility for creating this Secretariat which should consist of professionals and administrators. Work is carried out based on decisions of the Chairman of the Committee.

Sec. (7)

The necessary budget for the Committee should be placed under the ceiling of the Ministry of Health.

Sec. (8)

A yearly report should be submitted to the Ministers' Council by the Chairman of the Committee. This will describe the activities of the Committee, its achievements, the difficulties faced and the proposed solutions to them.

Sec. (9)

This decree will be published in the official paper and will be acted upon accordingly.

****