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HAZARDOUS WASTE MANAGEMENT IN SRI LANKA: A PRELIMINARY ASSESSMENT

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PREFACE

This staff report on hazardous waste in Sri Lanka was prepared in cooperation with CEA as an NAREPP/IRG staff project by Shenuka Chanmugam in order to provide GSL officials, USAID, NGOs, and technical assistance personnel of NAREPP and other donors, with basic background information and an identification of needs. It relies on the best available information and comments on earlier drafts from experts here and abroad, and it presents recommendations designed to advance understanding and action in this important aspect of overall pollution management in Sri Lanka.

We invite further comments on this report and look forward to continued development of expertise and management responses to hazardous waste issues in Sri Lanka. Our hope and expectation is that Sri Lanka can continue to avoid the severe hazardous waste problems that now confront so many other developed and developing countries.

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July, 1993

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HAZARDOUS WASTE IN SRI LANKA - SUMMARY OF FACTS

- Sri Lanka lacks basic data and information on the quantity and characteristics of its hazardous waste. There is no generally accepted or legal definition of hazardous waste.

- CEA is the key institution responsible for the management of hazardous waste. There are no disposal or discharge standards available for the disposal of hazardous waste. No legal regulations to control or prevent importation of hazardous waste into the country are in place. Waste can be exported only to licensed facilities in other countries.

- Since the volume of hazardous waste generated in the greater Colombo area is estimated to be very small, people are unaware of the health and environmental hazards. Currently there is no disposal site for hazardous waste.

- Two legislative Acts on the importation and use of hazardous chemicals are being drafted. The Hazardous Chemical Act and Toxic Chemical Act. The use of DDT and malathion is restricted. In 1989 crocidolite (blue) asbestos and crocidolite containing materials were banned under the Import/Export Act of 1969.

- Many small and medium-scale industries are unaware of the environmental and health problems related to their handling of chemicals and disposal of hazardous waste. Most large-scale industries follow the technical advice given by the parent or associated companies abroad.

- Hospital waste is a critical problem in the Colombo area. The hazardous waste generated from hospitals in the Colombo area is estimated to be about 3 tons per day. Hospital workers lack awareness of safe handling or disposal methods for hospital waste. Unlike industrialized countries that collect waste according to its toxic nature and dispose of it accordingly, local hospitals do not segregate waste when disposing. There is no special disposal facility available for hospital waste.

- Pesticides are widely used in Sri Lanka. There are 8 main pesticide formulating and repacking industries in Sri Lanka. The Registrar of Pesticides is responsible for the importation and use of pesticides in Sri Lanka. The Pesticide Control Act lays down the rules for the importation, use, storage and transportation of pesticides. The disposal of pesticide storage drums and outdated stocks is an issue of concern. Most formulating industries recycle the drums with the Steel Corporation or, with the approval of the Registrar of Pesticides and CEA, they sell the drums to private parties. Approximately 7000 (200 liter) steel drums are disposed of per annum, and 8000 kg of packing material waste is generated per annum. Outdated pesticide stocks constitute about 600 - 800 liters of liquid and 1000 kg of solid. Only Hayleys, the holding company for Haychem pesticide-formulating industry, has an incinerator for waste disposal.

- Disposal of tannery waste is a problem. However, the CEA with assistance from the Dutch government, is planning to locate all tannery industries in one central area with a common waste treatment plant.

- The generation of PCB contaminated waste is negligible. Only one or two industries/hotels still use PCB containing transformers. However, the old transformers containing PCBs are in storage and a means of disposal needs to be identified.

OVERVIEW

Sri Lanka is a largely agricultural-based economy but is gradually looking towards a bigger contribution from industry. The economic liberalization reforms which began in 1977 created a pathway for export led industrialization. The pace of the reforms, however, has been hindered by a number of factors - large budget deficits, the North-East conflict and insurgency in the South. To further the process of economic reforms, and help overcome the unemployment problem of the country, the Government of Sri Lanka outlined an industrialization strategy in 1988. The strategy places great emphasis on industrial development by promoting export-oriented industrialization and increasing the role of the manufacturing sector through adoption of prudent macroeconomic policies. Growth in the manufacturing sector accounts for 17.5 % of GDP, with the private sector being the engine of growth. The rate of industrialization has increased from 6.9% in 1991 to 10% in 1992.

Sri Lanka is a densely populated country with a population of 17.2 million. The Colombo and Gampaha districts have an area of 796 square kilo meters and a population of almost 2 million. It is in these two districts that many industries find the infrastructure and skills compatible for growth. Approximately 80 percent of all small and medium-scale industries are located in this area. In 1992, the functions of the Greater Colombo Economic Commission (GCEC), in charge of all investment in the three free trade zone areas -- Katunayake, Biyagama and Koggala -- and the investment outside the zones, handled by the Foreign Investment Advisory Commission (FIAC), were merged under the Board of Investment (BOI). Adequate safeguards are supposed to be taken from the planning stages of an industry within the BOI. The Central Environmental Authority (CEA) is responsible for the management of hazardous waste. The CEA and BOI must jointly approve a permit for a hazardous waste industry.

Standards for industries on industrial pollution are set by the CEA and BOI. However these standards apply basically to conventional air and water pollution. No standards have been established for the control or disposal of hazardous waste.

Why are we concerned with hazardous waste?

Industrial development is inevitably associated with production of waste, some of which is classified as hazardous waste. In Sri Lanka, no differentiation has been made between hazardous waste and general solid waste, except for very few cases like pesticides, asbestos and hospital waste. Generally, both hazardous waste and general solid waste are disposed of together. Under the US definition of hazardous waste, a mixture of hazardous waste and general solid waste is identified as hazardous waste. Hazardous waste are a special category of wastes and have one or more of the following characteristics: toxicity, flammability, corrosivity, reactivity, mobility etc. However, a number of waste products can be hazardous to human health and the environment due to their nature, composition or quantities. For example, waste containing lead, cadmium, hexavalent chromium, organo

phosphorus, organo chlorine, PCB, cyanide, arsenic and mercury are identified as hazardous in most industrialized countries. On contact or mixed with other waste these can give rise to hazardous situations through heat generation, fires, explosion or release of toxic substance. Many of these wastes when disposed of on land degrade very slowly or degrade into substances that are also hazardous. Some of the waste products are moved to other locations by wind, storm water or floods, or permeate through to the ground water. Such waste can also create substantial risks for humans and the environment long after disposal. Some of the waste can cause birth defects, cancer, genetic damage, neurological effects, or liver damage. These wastes are detrimental even in small amounts and, therefore, need to be treated and/or disposed of with special care. The sad lesson has been learned by most industrialized, and even newly industrializing countries, which have now developed, or are in the process of developing strategies to manage hazardous waste.

Although the magnitude of hazardous waste generated does not seem to be significant in Sri Lanka, it is vital that we learn from the problems and experiences that industrialized countries such as the US and Japan have had. As Sri Lanka plans to achieve NIC status by the year 2000, it is unavoidable that, as our economy grows in terms of GDP, our waste -- especially hazardous waste -- will be growing too. The root cause of the environmental hazard problems in the US is due to the lack of proper accounting for the waste and the costs associated with improper disposal. It has been stated that: "The roots of our hazardous waste problem date back to a time when this country's population was small, and therefore, natural resource and human opportunities seemed limitless. These conditions encouraged the early waste disposal practices and attitudes which we find unacceptable today. In retrospect, it was easy to miss the potential connection between this early waste disposal practice and future environmental problems" (1). Thailand, a newly industrializing country, has realized that, by not having effective selection criteria for certain industries to attract foreign investment, not only the production of, but also the pollution from hazardous waste have increased rapidly.(2)

Although only a small fraction of the waste generated from industries and hospitals in Sri Lanka is considered to be hazardous, the risk factor is very high. Early signs of environmental damage are often subtle. Even visible incidents such as chlorine leaks, poisoning of water bodies, and indiscriminate landfills are often not taken seriously by the public and industrialists due to lack of knowledge on related consequences. The main reason is that many industries, particularly the small and medium-scale industries, are unaware of hazardous waste and lack training in the disposal of it. Some are not in a position to identify between hazardous and solid waste. Nor are they fully aware of the risks involved in careless management of hazardous waste. However, larger industries are able to follow the disposal technology which they receive from their parent or associated companies abroad.

Many laboratories, hospitals, and pharmaceutical outlets do not know how to dispose of chemical and other hazardous products. They are usually randomly disposed of in dumps or in unsupervised (insanitary), poorly designed landfills. For example, a battery

manufacturing industry in Kotehena disposed of about 200 expired batteries containing sulfuric acid in a dump pile near a temple in Kotehena. Fumes were released from the batteries causing inconvenience to residents. A chlorine leak in a paper manufacturing company, and the bursting of an acid tank, killed one person and injured many in each incident.

Hazardous waste exported from industrialized countries to third world countries is becoming more common. In 1991, US companies exported more than 200 million pounds of toxic plastic waste to third world countries, mainly in Asia - Indonesia, Philippines, Hongkong, Thailand, India, Pakistan, South Korea and Malaysia. More than 35 million pounds were exported to Indonesia and 75 million pounds to Hongkong, most of which was sent to China. Most of the waste exported to third world countries is not recycled and, for example, in Indonesia, it is estimated that up to 40% of the imported waste is directly landfilled at a local dump (3). Although Sri Lanka was not on this list, it is possible that, if importation of waste is not banned, Sri Lanka can become a hazardous-waste dump yard. Already signs of interest from industries in industrialized countries to export their waste to Sri Lanka is visible. In 1991 an Australian company wanted to export its hazardous waste to Sri Lanka and set up a company where certain minerals such as cadmium, selenium, gold and mercury would be extracted from the waste. However, after many discussions the Australian company was denied permission to set up such a company in Sri Lanka.

An effective management strategy for hazardous waste not only means careful disposal, but also requires consideration of characteristics, quantity with active component, and location of the waste and dump site. Hazardous waste can be made less hazardous or non-hazardous through treatment by means of a physical or biological process. The US Environmental Protection Agency's recommended measures for managing hazardous waste (2) can be employed in Sri Lanka. The modified recommendations (in order of priority) are as follows:

- Minimize the amounts generated by upgrading and modifying the industrial process
- Recycle or transfer the waste to another industry that can use or recuperate them
- Reprocess the waste to recover energy, materials etc.
- Separate hazardous from nonhazardous wastes at the source, thus reducing the costs of handling, transportation, and disposal
- Wherever possible dispose of the wastes in a secure landfill (one that is located, designed, operated, and monitored, even after it is closed, in a manner that protects life and the environment).
- Incinerate the waste or subject them to treatment that makes them nonhazardous.

Sri Lanka is still in the early stages of dealing with hazardous waste and lacks public awareness of hazardous waste, risks, basic data on the type and volume of hazardous waste generated by industries and hospitals, and a working definition of hazardous waste.

formulate a sound hazardous waste management strategy the above information will be crucial, especially accurate data. The purpose of this paper is to give a sketch of all relevant background data available on hazardous waste in the greater Colombo area, which will facilitate the work of a consultant to develop a management strategy for hazardous waste. Since we do not have accurate data on the characteristics and quantity of hazardous waste generated by industrial and non-industrial sources, surveys or studies need to be done. This will also help identify priority sectors that require regulatory controls while evaluating the existing guidelines available for some sectors.

Section 1 of this paper identifies the various facilities available for hazardous waste transportation, storage and disposal and the current legislation in place. Section 2 of this paper gives a brief outline of selected industrial and non-industrial sources that are likely to generate a significant proportion of the hazardous waste in Sri Lanka. The annex gives additional supplementary data.

1.1 DEFINITION OF HAZARDOUS WASTE AND SOLID WASTE

There is no statutory definition of hazardous waste in Sri Lankan legislation. However, the only definition of hazardous waste is under the Environmental Impact Assessment (EIA) regulations under Section 23CC of the National Environmental Act. The definition is as follows:

> "Hazardous waste means any waste which has toxic, corrosive, flammable, reactive, radioactive or infectious characteristics"

The definition of hazardous waste in other countries is much more specific and detailed. Since we do not have concrete data on the characteristics or quantity of hazardous waste generated in Sri Lanka, for the purpose of this report we have used the broad definition developed by the US Environmental Protection Agency under the Resource Conservation Recovery Act (RCRA). Most countries have come up with a definition based on an inclusive listing of the following factors:

- particular types of hazardous waste
- industrial processes from which the waste are defined as hazardous; and
- substances, either specific or classes, the presence of which is indicative of a potential human health and/or environmental hazard. (4)

At a workshop conducted by NAREPP\IRG on hazardous waste management for regulatory agencies in April 1993, a list of hazardous waste generated by industries in Sri Lanka were identified. The processes involved in the production of the following items result in some hazardous waste being generated. Surface water was identified as the primary pathway of hazardous wastes.

- Heavy metals
- PCBs
- Carcinogenic compounds
- Aromatic compounds
- Chlorinated solvents
- Asbestos
- Cyanides
- Lead compounds
- Industrial solvents
- Pigments and dyes (toxic)
- Paints/coatings
- Biocides

1.1a. Definition of hazardous waste

The RCRA definition of hazardous waste is as follows:

> "A hazardous waste is any solid, or combination of solid wastes which, because of its quantity or concentration; or physical, chemical, or infectious characteristics, may:
>
> - cause, or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or
> - pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed."

For a material to be defined as a hazardous waste, it must be a "solid waste." The RCRA definition of solid waste distinguishes between waste and all other materials.

1.1b. Definition of solid waste

The RCRA defines a solid waste as:

- a solid, liquid, semi-solid, or contained gas
- any garbage, refuse, sludge, or other waste material
- any other waste material resulting from industrial, commercial, mining, or agricultural operations or community activities, which:
  - is discarded or accumulated, stored, or physically, chemically, or biologically treated prior to being discarded; or
  - has served its originally intended use and sometimes is discarded; or
  - is a manufacturing or mining by-product and sometimes is discarded

"Specifically, a solid waste is determined to be a hazardous waste if: it is not exempted from the regulations; it has certain specific characteristics; it is listed in the regulations as hazardous; or it is broadly classified as a statutory waste because it can cause harm to humans or the environment, regardless of whether it is presently regulated."(1)

1.1c. Characteristics of Hazardous Waste

A waste is classified as hazardous if it displays one or more of the following characteristics: ignitability, corrosivity, reactivity, or extraction potential toxicity.

♦ *Ignitable:* A solid waste is ignitable if it has a flashpoint of less than 140°F (60°C), and when ignited burns vigorously and persistently causing a hazard.

♦ *Corrosive:* A solid waste is corrosive if it has a pH of less than or equal to 2.0 (acidic), or equal to or greater than 12.5 (basic), or it corrodes standard steel containers at a rate greater than 6.35 mm (0.250 inch) per year.

♦ *Reactive:* A solid waste is reactive if it has the potential for explosion; or readily undergoes violent change without detonating; or reacts violently with water; or forms fumes, toxic gases or vapors in sufficient concentrations to endanger human health or the environment.

♦ *Toxic:* A solid waste is toxic if its chemical composition is known or strongly suspected to exhibit, even in low doses, acute or chronic toxic effects, including serious illness, injuries to health and death to humans.

♦ *Leachability:* The characteristic of leachability refers to a waste under a given condition that contains toxic substances that can dissolve in water and migrate away from a waste disposal site.

1.2 HAZARDOUS CHEMICALS

Specific chemicals used in the manufacturing industry are a major source of hazardous waste. Therefore, it is useful to know what chemicals are used in Sri Lanka so that restrictive measures can be placed on the hazardous chemicals being imported.

1.2a List of Hazardous chemicals

In 1988 the CEA compiled a list of all chemicals imported into the country. About 850 chemicals were identified as toxic and, out of this draft list, 25 chemicals were identified as highly hazardous/toxic. The chemicals identified as toxic are restricted in some of the European countries. The CEA is planning on restricting these chemicals or initiating a permit or licence scheme for the import and use of these chemicals.

The CEA published an advertisement in the local newspapers asking all importers to identify the chemicals they import and the quantity imported. From the replies of the importers the draft list was established. The CEA does not have any specific criteria in classifying a toxic chemical or restricting a chemical. The basis of identification of a chemical as toxic was used according to its restriction in certain other countries and its effects on health. The list of restricted chemicals and highly toxic chemicals is given in annex 1.

1.2b Management of hazardous goods and chemicals by the Ports Authority

Most of the chemicals, used for various purposes, are imported into the country. All chemicals imported into the country are handled by the Sri Lanka Ports Authority. The Sri Lanka Ports Authority follows the international classification system for all goods brought into the port, including chemicals. The International Maritime Consultative Organization, an UN affiliation, has developed a set of international guidelines for dangerous goods, called the International Maritime Dangerous Goods Code. Almost all countries follow this international system, including Sri Lanka. The chemicals are grouped into various classes, and are labeled as dangerous goods. The guidelines of the International Maritime Dangerous Goods Code spell out the general packing requirements, how it should be handled, its compatibility with other goods and if it should be separated from other goods. The Sri Lanka Ports Authority seems to be quite aware of the hazardous nature of chemicals and other dangerous goods. When Sri Lanka adopted the International Maritime system, workers handling dangerous cargo were given training on awareness and handling methods by the respective UN agency.

The handling and management of dangerous chemicals and goods in the Port follows an efficient system and no major problems have occurred due to mishandling or bad storage of these items.

packing: The dangerous goods/chemicals are packed in various containers -- plastic containers, drums etc, and have sign labels indicating the danger associated with the chemical -- whether it is explosive, inflammable gas, inflammable liquid, inflammable solid, dangerous when wet, etc.

Storage: The dangerous goods/chemicals are stored in a separate ware-house away from other goods. Incompatible goods and chemicals are separated from one another. Chemicals which are identified as very dangerous are kept in mid-sea until the time of clearance from the port. Chemicals which are not cleared from the Port, this occurs very rarely, are usually disposed of by dumping them in mid-sea.

Monitoring of water quality: The Ports Authority has an environmental laboratory which monitors the water quality in the port area. About 7 years ago there was a chemical leak from an industry located near the port. The chemical had been washed into the harbour water through storm water drainage and had contaminated the water. As a result of the contamination, some Port employees suffered blisters on their feet and legs.

1.3 QUANTITIES OF HAZARDOUS WASTE

There is no substantial data available on the volume of hazardous waste generated (per day or per annum) islandwide or in the Colombo Municipal area. However, an assessment was done in 1990 by a team of consultants from CISIR, CEA and CMC to estimate the quantities of hazardous waste produced by certain industries for off-site disposal (m^3 per annum). The results are given on the next page in Table 1. The margin of error is around 10% to 20%. The estimations given in the table were calculated by multiplying operational data in a particular industrial sector.

Also, an attempt was made by the Colombo Municipal Council to gather information on the types of hazardous wastes disposed and the quantities disposed of on site by industries. A questionnaire was sent out to industries asking them for the relevant information. Only about 25 percent of the questionnaires were returned and, maybe due to the environmental protection licencing scheme, the information disclosed on hazardous waste was minimal. International comparisons, even with Thailand and other developing countries, will not be applicable because of the differences in the types of waste generated and in the classification and definition of hazardous waste from country to country.

Solid waste generation: The Colombo Municipal Council collects about 550 tons per day of solid waste from the Colombo municipal area. 90 percent of this solid waste consists of domestic waste, and the remaining 10 percent are debris, timber, plastics etc, from industries. Hospitals in the Colombo area generate around 3 tons of clinical waste per day However, this data is only an estimate. It does not account for the waste lost during various stages en route to the disposal site, on site disposal, burning, unauthorized dumping, etc.

(Units m^3 per annum)

Industry Data	Textile Footwear Leather	Paper Printing	Chemicals Petroleum	Basic Metals Product	Metal Fabrication Products Machinery	Non-metallic Manufa cturing	Total
Employees * 1000	100	40	40	25	20	10	235000
Acids/alkalis washwaters * 10^3	2000	1.0	36	46	5	10	2098
Corrosive, Oxidizing, Reduction wastes	1000	50	20	20	-	-	1040
Solvents Resins	100	5	5	4	1	2	117
Oils (non-PCB)	10	5	20	20	20	10	85
Organic Chemicals Pesticides, Phenols, Paints	10	2	10	-	5	5	37
PCB	-	-	1	-	-	-	4 (with service utilities)
Metallic residues, sludges, salts	100	20	50	10	15	50	245
Cyanides	-	-	-	-	10	-	10
Inorganic Chemicals Salts, Residues	120	-	20	10	5	30	185
Contaminated soil equipment	100	5	25	5	20	15	170

Source: (5)

1.4 WASTE MANAGEMENT FACILITIES

There is no specific facility available for disposal of hazardous waste. Almost all the hazardous waste generating industries and hospitals dispose of their hazardous waste together with general solid waste. No separation procedure is adopted. This is unsatisfactory as the disposal facilities are not suitably designed to receive hazardous waste. Some large-scale industries have their own treatment facilities and/or dispose of waste as advised by their parent company. Most of the other industries located in the Colombo district, mainly small and medium-scale industries, dispose of their waste in the municipal landfill site. Industries such as tanneries have been requested not to dispose of their waste in the municipal landfill site. Industries, households and commercial activities also adopt common practices such as burning and dumping for waste disposal. Many industries are located near residential areas and their waste is dumped outside the industry. In some garment factories, the residents of the area ask the factory to dispose of their waste nearer to their homes so they could collect the scraps.

The Colombo urban area has one municipal landfill site for solid waste which is located at Wellampitiya, about 20 km east of Colombo city. All domestic and commercial off-site refuse is dumped here. 90 percent of the waste dumped here is household waste. This site is operated by the Colombo Municipal Council, which is responsible for the collection and dumping of the city's waste. This is the only landfill site, under the Municipal council, for solid waste disposal, in Sri Lanka. The local authorities are responsible for the disposal of waste in their respective areas. Since the solid waste generated in areas out of Colombo is not very much, the waste is collected and dumped at a randomly selected site, or it is burned. Only a small fraction of the waste disposed of in the Colombo Municipal landfill site is hazardous.

There are certain criteria which are used in the selection of a solid waste disposal site. For example, the number of welling units near the site, topography, soil media, and proximity to Colombo city. There is no lining or leachate or gaseous treatment available for the Wellampitiya site. The area is marshy and is supposed to have an aquifer under a thick layer of clay. In the past, an incinerator was used for solid waste disposal by the Colombo Municipal Council. Once the landfill is filled the Urban Development Authority will have control over the management of the site area. Some old landfill sites, for example the Peliyagoda site, are privately owned, and the management of the site is returned to the owners once the landfill is closed. Most landfill sites are being utilized for construction of houses, schools etc.

Table 2 gives a list of disposal facilities available to treat waste offsite - away from the place of generation (5). These facilities are identified according to international requirements for the disposal of hazardous waste. This information can be used to identify the need for specific disposal plants and the required capacity, with possible future expansion.

Table 2

Facility Type	Capacity/throughput (m^3)
1. Special industrial waste landfill	- More than 10 sites
2. Municipal landfills accepting industrial waste	- (25,000 m^3/a capacity)
3. Solvent recovery plants	- Not available
4. Oil recovery plants accepting lubricating & industrial oils for reclamation and resale	- Not available
5. Incinerators for industrial waste	- Not available
6. Treatment of cyanide waste	- Not available
7. Storage site for waste requiring incineration or treatment	- Not available

Source:(5)

5 ADMINISTRATIVE AND OPERATIONAL RESPONSIBILITIES

The Central Environmental Authority is the principal institution responsible for the control of hazardous waste. Various responsibilities have been assigned to the relevant agencies (see below). However, no fixed administrative responsibilities are yet in place for the management of hazardous waste.

On the technical side, CISIR assists industries in solving problems associated with waste treatment and waste disposal. Following are the administrative responsibilities of the agencies involved in hazardous waste management.

ACTIVITY	AGENCY IN CHARGE
• Setting and enforcement of environmental standards (air, water, land)	CEA, Sri Lanka Standards Institution, BOI (formerly GCEC)
• Approval of permits for hazardous waste facilities	CEA and BOI
• Environmental monitoring for hazardous waste	CEA and CISIR
• Control over toxic chemicals and pesticides	Registrar of Pesticides
• Import of chemicals, waste products	Min. of Industries, Customs Dept., Import Export Dept. Registrar of Pesticides
• Treatment, disposal of hazardous waste	CEA, CISIR
• Clean-up of dumpsites and chemical spills	Not applicable
• Transport of hazardous waste	No special system exists except for pesticides and asbestos
• Disposal of urban waste	Local Authorities
• Standards for discharge to sewers	Water Supply and Drainage Board, and CMC

1.5a. Agencies Involved in Hazardous Waste Management

REGULATORY AGENCIES

CEA: At CEA the subject of hazardous waste falls under the pollution control program. CEA is in its early stages of developing its hazardous waste program. As a starting point, the CEA is developing a computer data base on toxic chemicals and hazardous waste generating industries in Sri Lanka. This information will help CEA to draft the Toxic Chemical' and 'Hazardous Chemical' Acts and also to identify characteristics and quantity of hazardous waste generated in Sri Lanka. Furthermore, the data will be useful when developing guidelines and criteria for hazardous waste management.

- *Survey on toxic chemicals imported to the country:* CEA has installed a computer database on toxic chemicals. Information includes toxicity of the chemical, health effects, precautions in storage and transportation, quantity, disposal methods, name of company, and whether there are any restrictions on use imposed in other countries.

- *Inventory of hazardous waste generating industries:* CEA has identified a draft list of 244 industries as hazardous waste generating industries. This information has been extracted from the industries that have applied for the environmental protection license. Therefore there may be other hazardous waste generating industries that have not applied for a license. The industries identified as generating hazardous waste are textile, tanneries, pesticides, galvanizing and electroplating, rubber, chemical manufacturers, steel and iron manufacturing industries. The CEA will update and verify this draft list of hazardous waste generating industries by carrying out a study. The study will include the industries in this draft list and also other industries likely to generate hazardous waste. The computer database will carry information on the industry, chemicals used, storage facilities, quantity of waste, type of waste - solid, liquid or gaseous, and waste treatment methods.

BOI: BOI regulates all industries within the 3 industrial estates (Katunayake, Biyagama and Koggala FTZs) as well as industries outside which receive BOI status. Industries identified by BOI as generating hazardous waste materials are mainly the fluorescent bulb manufacturing industries, electroplating industries, foam mattress and textile dyeing and manufacturing industries. BOI recognizes that it is not fully equipped to deal with the hazardous waste problem. Staff need further training and policy guidance on hazardous waste. BOI finds it difficult without proper information to take decisions regarding disposal of hazardous waste and also to approve/reject an industry. The BOI consults the CEA whenever a difficulty arises in disposing waste of hazardous nature. The BOI does not have any special treatment technologies for hazardous waste.

SERVICE ORGANIZATIONS

CISIR: The CISIR provides technical assistance to industries which encounter hazardous waste disposal problems. The CISIR adopts several types of treatment technologies mainly using physico chemical methods. Analytical support and process design for textile, agro and chemical industries are the main areas of concern to CISIR. Treatment designs have been provided for industries such as pesticide, dry cell battery and paint manufacturers. Several industrial effluent studies have been conducted by CISIR including the Kelani river effluent toxicity study, Moratuwa industrial estate effluent study, textile industry effluent study, and an impact study of agrochemicals.

Studies such as effluent sampling and analysis, and water quality monitoring can be undertaken by the CISIR, but specific problems like contamination of ground water and its seriousness cannot be now properly handled; CISIR is not equipped with the appropriate equipment and training in these areas. Pilot plant treatment systems for disposal of hazardous waste of specific industries cannot be set up or fabricated unless a proper program is initiated. In order to strengthen this area adequate financial assistance will be necessary.

NBRO: The Environmental Division of NBRO advises industries on safety disposal of toxic wastes. At the request of industries the NBRO has carried out monitoring studies of inland waters and effluents of industries such as textiles and battery manufacturing industries. NBRO also carried out a study on the identification of landfill sites in the Greater Colombo area.

1.6 STANDARDS AND LEGISLATION

There are no discharge or disposal standards for control of hazardous waste in Sri Lanka. The CEA is in the process of proposing a set of standards that are based on the Japanese standard system. Until then industries act on advice given by their parent company and the CEA. Accordingly, industries dispose of their waste on land (on or off-site) under administrative guidelines and not under standards set by legislation.

In 1991, the government, through the CEA, initiated action in drafting two legislative Acts to regulate the importation and use of hazardous and toxic chemicals. These proposed Acts are:

- Hazardous Chemical Act to control the importation of hazardous chemicals, and
- Toxic Chemical Act to govern the handling of toxic chemicals and their waste.

The following legislation deals with the control of pesticides and asbestos.

- The Control of Pesticides Act No:33 of 1980 regulates the use and import of pesticides. The law requires all pesticides to be licensed and the imports will be permitted on the recommendations of the Registrar of Pesticides. The Department of Agriculture has authority over the implementation of the Act and the Registrar of Pesticides will be the licensing authority of the Act. (see Annex 3 for a synopsis of the Act).

- The Malathion Control Bill was enacted in 1981 to prohibit the possession, transport, sale and use of malathion in Sri Lanka by unauthorized individuals.

- Import/Export Control Act, No:1 of 1969, amended in 1987, bans the importation of crocidolite (blue) asbestos.

- Guidelines for disposal of asbestos waste.

1.6a. Inadequacies in drafting of the Hazardous and Toxic Chemical Acts

The major constraints faced in preparing the Hazardous Chemical Act and the Toxic Chemical Act are inadequate data. Before legislation can be drawn up, further information is required on

- the importation and use of toxic and hazardous chemicals
- toxicity data with respect to the environment and the biological system in Sri Lanka.

In addition, in order to control the importation of a chemical, a possible alternative chemical(s) with lesser environmental damage need to be studied.

Some work has been done on drafting a list of chemicals imported to Sri Lanka and identification of which chemicals are hazardous (see Annex 1). However, information on the quantities imported has still to be compiled.

1.6b. Guidelines for Transportation:

Except for the transportation of pesticides and asbestos, there are no guidelines for the transportation of hazardous chemicals. Control of the transportation of pesticides comes under the Registrar of Pesticides and asbestos, under the CEA.

1.7 CONSTRAINTS IN DEVELOPING TECHNICAL SOLUTIONS

Adequate final treatment and disposal of hazardous waste is essential when developing a hazardous waste management plan. Although various types of treatment technologies are currently being used to treat wastes of hazardous nature in Sri Lanka, we lack the infrastructure to effectively deal with these waste streams. Resources such as analytical/ laboratories, design capability, construction and maintenance of waste treatment plants need to be improved in order to manage hazardous waste efficiently.

Biological, physical and chemical methods including precipitation, flocculation, neutralization, fixation and solidification treatment processes are being adopted by CISIR and other institutions to treat various waste streams. For example, the CISIR has treated battery waste from a battery manufacturing industry using fixation and solidification treatment methods. Many textile industries use the biological treatment process. Yet these are inadequate. The barriers faced by the industries and regulatory agencies in implementing proper hazardous waste management facilities are:

- Setting up of pollution control systems
- Data base and network systems on the use and generation of hazardous chemical substances and its disposal
- Provision of adequate land area at industries for construction of treatment plants
- Lack of awareness on risks associated with improper waste management
- Inadequate laboratory capabilities to monitor performance and progress
- Technical experience base for design capability

1.7a. Waste Treatment and Waste Minimization Programs

Given below is a list of waste minimization programs including waste treatment plants for certain industrial sectors that are/will be in place in the next few years.

Industrial Sector	Implementing Agency/Funding Agency
•Textile	•Waste minimization (CEA/Dutch); pilot scale and on site effluent treatment model (CISIR/NORAD); demonstration WWT plant (CEA/UNIDO); WWT for Ratmalana industrial estate
•Pesticides	•Waste minimization (CEA/Dutch)
•Heavy Metals	•Relocation of heavy metal industries (CEA/Japanese)
•Tanneries	•Common treatment plant for all tanneries (CEA/UNIDO)
•Rubber	•Pilot waste treatment project (CEA/DUTCH)
•Battery	•Solid waste disposal (CISIR)
•PCBs	•CISIR/CEA are looking into possible disposal solutions for old PCB transformers
•Desiccated Coconut	•Pilot scale effluent treatment process (CISIR/NORAD)

1.8 DONOR PROGRAMS ON HAZARDOUS WASTE

NORAD: Provided technical assistance to the CEA to prepare a draft list of toxic chemicals.

WHO: A study was carried out in 1991 on hazardous and solid waste management in the Colombo area. The study indicated that Sri Lanka did not have a problem with hazardous waste, the quantity generated being negligible. The consultant's recommendations are given in Annex 2.

MEIP/WORLD BANK: MEIP will look into hazardous waste management under their industrial pollution management strategy.

Solid Waste Management Programs

MEIP/World Bank and USAID/USAEP are working on a solid waste management plan.

1.9 RECOMMENDATIONS FOR NEXT STEPS

The following recommendations seek to address the most critical needs identified from this status report. It will be important to integrate each of these actions on hazardous waste into the overall pollution control and management framework being developed for Sri Lanka.

DATA IDENTIFICATION

- Develop database on quantities and characteristics of hazardous waste.
  - Inventory of hazardous waste production
  - Inventory of toxic chemicals
  - Identification of the significant hazardous waste issues and the effects on health and environment

  Agency in charge: CEA

  Status: CEA has completed an inventory of toxic chemicals and is currently carrying out an inventory on hazardous waste generating industries in Sri Lanka. A computer database is being developed for both surveys. This will be an initial step in gathering information on characteristics, quantities, and industrial process from which hazardous waste are defined.

- Develop clear definition for hazardous waste in Sri Lanka

  Agency in charge: CEA

  Status: CEA has defined hazardous waste under the EIA regulations. This definition is inadequate. It does not specify the levels of toxicity, corrosivity etc. A qualitative description of the characteristics and properties of hazardous waste is necessary to identify what exactly is or is not a hazardous waste.

IMPLEMENTATION OF PROGRAMS

- Establish guidelines for use and disposal of known hazardous waste substances including sludge. For example: PCBs, pesticide, tannery, battery waste etc.

  Agency in charge: CEA/CISIR

  Status: CEA has developed guidelines for factory storage of chemicals and pollution control guidelines for 8 industries - pesticides, tanneries, textiles, coir, rubber, latex, soft drinks and electroplating.

  Next Steps: Need to further develop guidelines for hazardous waste. This will assist agencies such as BOI when making decisions to approve or reject an industry.

- Establish discharge standards for hazardous waste

  Agency in charge: CEA

  Status: Under the Environmental Protection Licensing Scheme, there are discharge standards which industries must comply with. Water and air discharge standards are being drafted for selected industries.

  Next Steps: Standards need to be updated for hazardous waste.

- Monitoring and inspection to ensure compliance with standards and guidelines.

  Agency in charge: CEA/BOI

  Status: Under the Environmental Protection Licensing Scheme, the CEA conducts annual monitoring of industries. The BOI monitors all industries which have BOI status.

  Next Steps: Set priorities for monitoring of most critical hazardous waste discharge.

- Develop criteria for siting hazardous waste facilities and industries.

  Agency in charge: CEA/CISIR/CMC

  Next Steps: Identify appropriate disposal method for hazardous waste in the Greater Colombo area (i.e landfill, incinerator etc.). CEA considers this as an urgent need.

- Establish criteria for review of new industry and/or processes

  Agency in charge: CEA/BOI

  Next Steps: Develop definition of hazardous waste which will facilitate the process of reviewing new industries.

- Recommendations for hospital waste management - See Annex 6.

- Disseminate technical advice and information on hazardous waste management to industries, chambers and association, local authorities, and general public

  Agency in charge: CEA/CISIR/University of Moratuwa

  Next Steps:
  - *Conduct public awareness program about hazardous waste issues.*
  - *Conduct industrial and governmental awareness/training programs concerning worker health and safety impacts of hazardous wastes, impacts on the environment, and disposal techniques.*
  - *Conduct specific hazardous waste training programs. For example on pesticides, hospital waste, etc*

SECTION II

This section gives a brief description of selected industrial and non industrial sources of hazardous waste. This should provide an indication of the present management operations of the various industries. As mentioned earlier, the quantities of hazardous waste generated by these industries are not available.

The following table gives the characteristics of waste from selected industries.

CHARACTERISTICS OF WASTE FROM SELECTED INDUSTRIAL ACTIVITIES
Table 3

Industry	Origin of major waste	Major Characteristics	Major treatment and disposal methods
Leather processing	Unhairing, soaking, deliming, bating of hides, tanning, retanning and syntanning	High total solids, hardness, salt, sulfides, chromium, pH, precipitated lime, and BOD	Equalization, sedimentation, and biological treatment
Metal Plated products	Stripping of oxides, cleaning and plating of metals	Acid, metals, toxic low volume, mainly mineral matter	Alkaline chlorination of cyanide; reduction and precipitation of chromium; lime precipitation of other metals
Rubber processing	Washing of latex, coagulated rubber, exuded impurities from crude rubber	Acids, high BOD and odor, high suspended solids, variable pH, high chlorides	Aeration, chlorination, biological treatment, sorption and incineration
Pesticides formulation & repacking	Washing and purification products such as 2,4-D and DDT	High organic matter, benzene ring structure, toxic to bacteria and fish, acid	Dilution, storage, activated carbon adsorption, alkaline chlorination
Textiles processing	Cooking of fibres, desizing of fabrics, causticizing or mercerizing, scouring, bleaching, dyeing or printing	Highly alkaline, colored, high BOD and temperature, high suspended solids	Neutralization, physico-chemical precipitation, aerobic biological like treatment, aeration, activated sludge, and RBC
Refineries	Acid sludges and miscellaneous oils from refining	High BOD, odor, phenol, and sulfur compounds from refinery	Acidification and burning of alkaline sludges

2.1 ELECTRIC POWER GENERATION AND TRANSMISSION

The main hazardous waste concern in the electric utility industry is polychlorinated biphenyl (PCB) contaminated equipment. In the past, the Ceylon Electricity Board (CEB), the Sri Lanka Broadcasting Corporation (SLBC) and certain hotels (Intercontinental, Oberoi) used PCB transformers. It is estimated that one or two places still use PCB transformers. The problem now is with the method of disposal of these old transformers. Some used PCB transformers are stored at the CISIR and at the institution or hotel which used them. The CISIR is looking into cost effective ways of disposing these transformers and the likely method of disposal would be cement kilns. Since the generation of PCB contaminated waste in Sri Lanka is negligible, this will not be considered in the management strategy for hazardous waste in Sri Lanka. However, attention needs to be focused on the disposal of old PCB contaminated transformers.

2.2 TANNERY

Sri Lanka has about 15 tanneries. The main waste from the tannery industry are chromium compounds and sulphides. A problem with tannery waste is that a central location is not available for the industries to dump their waste. Most tanneries do not have treatment facilities available on site. Tannery industries used to dump their hide waste in the municipal landfill site. The municipal council has now requested the tanneries not to dump the hide waste in the municipal disposal site. However, the government is planning to locate all tanneries in one central area, north of Colombo, so that the waste could be treated together by establishing a common treatment plant. A location for sludge disposal has not yet been selected.

2.3 PESTICIDES

The main uses of pesticides in Sri Lanka are (i) in public health programs, to kill vectors of malaria and filaria, (ii) for domestic use, to kill insects such as cockroaches (iii) for industrial use like fumigation of houses and buildings, and (iv) in agricultural production. (6)

Sri Lanka plans to achieve food self-sufficiency in the near future. Therefore, in order to increase the volume of Sri Lanka's agricultural crop production, the use of pesticides has increased tremendously in the past few decades. Although pesticides are being used by tomato, chilie, potato, and some other cash crop growers, the paddy farmers are the largest users of pesticides. An estimation in 1985 indicated that about 110 pesticides in about 200 formulations were being used.

The main companies that import pesticides and/or formulate them are:

- A. Baur & Co
- Chemical Industries Colombo
- Harrison & Crossfield
- Lankem Ltd
- Haychem Ltd
- Mackwoods
- Anglo Asian
- Ceylon Petroleum Corporation

2.3a. Importation of Pesticides

Sri Lanka does not manufacture any pesticides. Pesticides are imported as ready-to-use products or as technical material for local formulation. For customs purposes all pesticides are not classified under one BTN number. The pesticide technical material is imported as chemicals, depending on their chemical structure, and are under the control of the Ministry of Industries and Scientific Affairs but on the approval of the Registrar of Pesticides, whereas the formulations of pesticides are grouped separately under another BTN number and are completely under the control of the Registrar of Pesticides.

2.3b. Formulation and Sale of Pesticides

Sri Lanka has adopted the FAO "guidelines for the registration and control of pesticides". Pesticides which are identified as less hazardous under the WHO classification and which are not identified by International Register for Potentially Toxic Chemicals (IRPTC) as having carcinogenic risks, are allowed to be marketed without any restrictions but should have an approval label in all three languages. Pesticides classified under WHO as highly hazardous and potentially carcinogenic compounds, are classified as restricted.

The following restrictions are applied to the corresponding pesticide formulations:

Table 4

Restriction	*Pesticide*
• Sale restriction only to and through authorized persons	-Fumigants and other WHO class I A formulations
• Label restriction on use	-Methamidophos, Pyrethroids, Chlordane, BHC, Aldrin
• Sale restriction on quantity	-Aldrin, Chlordane, BHC, Pyrethroids
• Sale restriction for limited marketing	-Prior to full commercialization on a regional basis

Source: Registrar of Pesticides

2.3c. Restricted Pesticides

Table 3.1 in Annex 3 gives the pesticides banned or restricted for agricultural uses in Sri Lanka. Table 3.2 gives a list of restricted agro-pesticides and indicates whether they are sold by registered dealers or sold to certified users.

2.3d. Handling and Disposal of Pesticides

Most persons using pesticides are unaware of the safety measures needed to be taken when handling pesticides, and in the disposal of remnant pesticides. Often the leftover pesticides are dumped in garbage cans, drains and any dump pile. The spray tanks are washed in streams or water spouts and in many cases the same stream or water spout is used for bathing, washing of vegetables or collection of water for cooking or drinking.

Disposal of drums: Auctioning is a common practice adopted for the disposal of pesticide containers, mainly poly-cans. In the past, used steel or plastic pesticide drums were sold to the people for storage purposes. The CEA has now restricted this and has requested that all drums be cut or perforated so that they will not be used for storage purposes. The perforated drums are now being used for mixing concrete, etc. The Steel Corporation currently recycles the steel drums. The CEA hopes to get the private sector too involved in the recycling of used drums.

Disposal of outdated stocks: Some companies have expired stocks of pesticides in storage. The CEA is looking into various possibilities of disposing of these old stocks of pesticides. A method of disposal would be to use the cement kilns at the Cement Corporation. However, if CISIR develops a suitable and cost effective method of disposal for PCBs, then this method can be used to dispose of old pesticide stocks and other hazardous types of liquid waste.

Table 5 gives the approximate quantity of outdated pesticides and steel drums used per annum.

Table 5

Type	Quantity
Steel Drums (200 litre)	6000 - 7000 per annum
Outdated Pesticides - Liquid - Solid	 600 - 800 litre 1000 Kg
Packing Materials (Includes cardboard, polytene, cans etc.)	8000 Kg per annum

Source: CEA

2.3e. Results of Survey on Pesticide Use

In 1986, a survey was conducted on pesticide use in Mahagastota, in the N'Eliya District. The sample size was 40 farmers involved in vegetable cultivation. The study showed that although the number of pest attacks and diseases were negligible, 40% of the farmers continued to spray pesticides in their fields. The frequency of application and the dosage were generally much higher than the required amount. The farmers were generally under the impression that by spraying a higher concentration, the pests will be destroyed immediately. The most commonly used method of application was found to be in the form of solution. The solution was often mixed with two or more chemicals with a view to saving labour. The study also indicated a high degree of non-adherence to safety measures. Most of the farmers used no special protective clothing or adopted other safety measures when applying chemicals. Even after the spraying of chemicals or washing of the sprayers, they did not clean their hands, body and clothes immediately. Some farmers washed their sprayers at nearby streams which were used for bathing and drinking purposes. In general, farmers were not seriously concerned with the health hazard involved in eating vegetables with high residual concentrations of pesticides. They were more interested in quicker harvesting of their crops, with yields within one to two weeks after application of pesticides. The most commonly used pesticides in the Mahagastota area is given below.(6)

Trade Name	% of Farmers
Insecticides	
Tamaron	48
Monitor	28
Ambush	20
Cidial	10
Others	6
Fungicides	
Polyram	38
Dacanil	13
Antracol	7
Dithane	8
Redomyl	5
Sulfur	5
Vandozeb	3

Source: Farm Survey, 1986/87 Maha Season

2.3f. Health Statistics from Exposure to Pesticides

The following table gives an indication of the magnitude of the problem related to exposure to pesticides in Sri Lanka. Pesticide poisoning accounted for a very much higher percentage of deaths than by occupational hazards or accidents.

Table 5

Pesticides	Discharges from Poisoning	Deaths
Chlorinated hydrocarbons	2955 (12%)	319 (14%)
Organophosphates and Carbamates	9967 (39%)	931 (42%)
Other Pesticides	3163 (13%)	209 (09%)
Medical Agents	2125 (08%)	94 (04%)
Other Poisoning and Toxic effects	7073 (28%)	697 (31%)

It was also noted that, in 1984, the number of deaths, mostly suicides, from pesticide poisoning was higher than the combined total number of deaths from rabies, snakebites, polio, diphtheria, tetanus, whooping cough, malaria and murders that took place that year.

2.4 ASBESTOS INDUSTRIES

The main use of asbestos in Sri Lanka is in the asbestos cement industry. Asbestos cement is widely used in Sri Lanka in the construction industry due to the exceptional technical characteristics asbestos gives to the cement, as well as its cost-performance ratio. The most common applications are on surface materials on ceilings, walls, roofing, floor tiles, pipe, electrical conduits, boiler insulation and lagging materials in some buildings. There are two asbestos cement industries, one located in Ekala and the other in Ratmalana. The asbestos cement factories mainly manufacture asbestos roofing and ceiling sheets. The raw materials used are chrysotile (white) asbestos fibre and cement. There are many small scale industries involved in the manufacturing of brake linings, which also use prefabricated asbestos products, but in much smaller quantities than the asbestos cement industries.

It is estimated that during a normal life-time, a person could inhale about 23 billion fibres of asbestos from the general environment. In Sri Lanka, the general public, including asbestos workers, are unaware of the hazardous nature of asbestos. Broken down buildings which consist of blue asbestos are dumped indiscriminately in vacant land in residential areas.

2.4a. Importation and Use of Asbestos

Sri Lanka imports almost 90% of raw asbestos fibre from Canada. Under the revised Import/Exporters Control Act of 1969, the importation of crocidolite (blue asbestos) and crocidolite-containing materials have been banned since 1989. However crocidolite is still imported for specific purposes.

2.4b. Guidelines for the Disposal of Asbestos Waste

The CEA has drafted a set of guidelines for the disposal of asbestos containing waste. The guidelines lay down the recommended methods for safe disposal, selection of asbestos waste disposal sites and collection and transportation of asbestos waste. Since the importation of blue asbestos is banned, these guidelines are only applicable for white asbestos. Currently, there is no separate disposal site for asbestos waste. Annex 4 gives the guidelines drafted by the CEA.

2.4c. Health Hazards

Asbestos is one of the few substances for which there is undisputable evidence that it causes cancer in humans. The three main diseases associated with asbestos fibre are pneumoconiosis, lung cancer and mesothelioma. When inhaled, asbestos fibres adhere to the lungs and damage them. At high exposure levels, this inhalation can cause asbestosis, a chronic lung disease. After 20 to 40 years, a form of cancer called mesothelioma may develop. This affects the lining of the chest or abdomen. Mesothelioma usually occurs in people exposed to airborne asbestos. The length of the dormant period varies and is determined by the frequency of exposure and amounts inhaled. However, asbestos-induced mesothelioma can occur after even relatively short, low dose exposure. Asbestos workers who are heavy smokers have a much higher mortality ratio from lung cancer, of four times that of nonsmokers. (7).

It is evident that most residents of urban areas inhale and retain some asbestos fibres in their lungs during their life-time. Studies have shown not only persons working in the asbestos cement industry or brakelining industry, but also persons never exposed to asbestos in their workplace, or who did not reside in the proximity of any asbestos operation, having a relatively high presence of asbestos fibres. One such study revealed the presence of about one hundred asbestos fibres per gram of tissue (7).

A Sri Lankan study was done in 1976 on 74 asbestos cement workers and 23 brakelining workers. The results of the study indicated that these workers showed early signs of asbestosis.

2.5 REFINERIES

There is only one petroleum refinery operating in Sri Lanka. It is the Ceylon Petroleum Corporation, located in Sapugaskanda. There is no petroleum production in Sri Lanka. The crude oil is imported from the Middles East and is refined at the Sapugaskanda refinery. The main products and byproducts of oil refining are gasoline, kerosene, lubricants, gas oil and fuel oil, wax, asphalt, petroleum coke, and miscellaneous materials such as petrolatum and insecticides. The main products from the Sapugaskanda refinery are fuel

oil, diesel, kerosene and petrol. Tetraethyl lead is added to petrol at the refinery to increase the octane level of the fuel. Annex 5, Table 5.2 gives a breakdown of the products processed in the refinery. The total output in the refinery for 1990 was 1.67 million tons. The CPC imported a quantity of 1.8 million MT of crude oil in 1990. (8)

Table 6

Capacity Utilization, output and value of Production of CPC Manufacturing						
Refinery	1985	1986	1987	1988	1989	1990
Installed capacity	2.35 Mn	2.35 Mn	2.35 Mn	2.35 Mn	2.35 Mn	2.35 Mn
Output MT	1.54 Mn	1.60 Mn	1.62 Mn	1.67 Mn	1.13 Mn	1.67 Mn
Value of Production	10.60 Mn	7.85 Mn	10.41 Mn	9.74 Mn	7.46 Mn	15.5 Mn
Utilization %	65.7	68.15	68.96	71.22	47.97	71.20

Source: CPC

Agro chemicals imported by the Ceylon Petroleum Corporation:

Table 7

Year	1985	1986	1987	1988	1989	1990
Quantity MT	437	351	265	442	160	707

Source: CPC

2.6 HOSPITALS

The management of hospital waste poses a problem in Sri Lanka. Hospitals dispose of their waste by dumping at a landfill site or with other municipal waste. This is a highly unacceptable practice. The liquid waste is disposed of through the Colombo sewerage system and eventually expelled to the sea at Mattakuliya and/or Wellawatte. Only the Sri Jayawardenapura hospital has an incinerator for waste disposal. No separation process for the collection of the different types of waste is adopted at any of the hospitals. Infectious waste, radioactive waste and general solid waste are disposed together. An estimation of the quantity of hazardous waste released from all the hospitals in Colombo is about 3 tons per day [1]. A much larger proportion of the waste from hospitals is food waste which constitutes about 85% of the total solid waste generated. Sri Jayawardenapura Hospital incinerates approximately 500 - 800 kilograms per day of waste. The waste incinerated includes plastic syringes, specimen bottles, used linen and cotton, and about 200 coconut shells. The coconut shells are used as fuel. Food waste is not incinerated.

[1] 3 ton/day was the proposed capacity of the incinerator to be installed for hospital waste. Estimate given by CMC and General Hospital Colombo.

There are 7 government hospitals and 8 private hospitals in the greater Colombo area. This includes a cancer hospital which is located in Maharagama. The Colombo Municipal Council (CMC) discussed with the Colombo General Hospital the issue of installing an incinerator for hospital solid waste. In addition, they discussed the need for hazardous waste to be segregated from general solid waste before incineration. The incinerator was intended to serve both private and public hospitals. Tender procedures were followed and the bids were evaluated. However, the discussions have come to a standstill and the idea of installing an incinerator has been sidetracked. The General Hospital Colombo (GHC) is the largest hospital in Sri Lanka with a capacity of 2,300 beds. It is a government hospital and is located in the heart of Colombo.

Types of Waste from the General Hospital Colombo

The main types of waste from the General Hospital Colombo (GHC) are classified as (i) waste from wards and intensive care units, (ii) laboratory waste, (iii) radioactive and nuclear waste and (iv) general sewerage.

Waste from Wards: Clinical and non clinical waste is collected together. No separation process is adopted. The waste is collected by the hospital in galvanizing containers and is disposed of in the solid waste landfill site by the Colombo Municipal Council. After the AIDs scare, needles and syringes are collected separately and put into infusion bottles and burned in open dumps in the hospital premises by hospital workers.

Waste from Labs: The liquid waste from labs are washed down the sink. Some buildings in the hospital discharge its sewerage into the canal by the side of the hospital, than the main sewerage system. This waste is then discharged to the Beira Lake situated a mile or two from the hospital. The Norris Canal and the Beira lake are highly polluted water bodies. According to hospital staff, most of the chemicals sent through the sewerage are heavily diluted. They find mercury to be a major problem in the water bodies.

General Sewerage: The general sewerage system leaks into the Norris Canal which is highly polluted. A study is currently being carried out on the Norris Canal by the GHC's Rehabilitation Project Unit. The Rehabilitation Project will make recommendations on the problem once all inadequate discharge points are identified.

Radioactive and Nuclear waste: The radioactive waste from the Pathology Department of the GHC is generally taken care of at the General Hospital. The hospital has a deep well where the liquid waste is collected. The nuclear waste is collected and disposed by the Atomic Energy Authority. Training on disposal of radioactive and nuclear waste has been given to hospital staff workers by the Atomic Energy Authority.

Recommendations for management of hospital waste are given in Annex 6.

The total number of beds available in the hospitals located in the Colombo and Gampaha District for 1989 are 9,447 and 4,537, respectively. Table 8 indicates the demand for inpatient care services and the provision of hospital beds.

Table 8

	1985	1989
1.a. No of beds	44,861	46,620
b. Beds per population	2.8	2.8
2.a. No. of inpatients	2.49 Mn	2.53 Mn
b. No. of inpatients per 1000 population	157.4	150.2

Source: (9)

Annex 1

LIST OF HAZARDOUS CHEMICALS

1. 4 - Amino diphenyl
2. Benzidine and salts
3. 2 - Naphthylamine (B - Naphthylamine)
4. 1 - Naphthylamine
5. Benzene
6. 4 - Dimethylaminoazo henzene
7. 2 - Acetylaminofluorine
8. Arsenic compounds
9. Asbestos fibre
10. Bis chloromethylether
11. 4 - Nitrol diphenyl
12. 3 - 3 Dichloro benzidine and salts
13. Hydrazine
14. 1 - 3 Dinitro benzene
15. 1 - Chloro 2 - 4 Dinitro benzene
16. Vinyl chloride
17. Zinc chromate
18. Lead compounds
19. Mercury compounds
20. O - tolidine
21. B Propiolactone
22. Dichlorotoluene (Benzal chloride)
23. Ethylene Imine
24. O - toluidine
25. Thioacetamide

List of Hazardous Chemicals and Health Impacts

Chemical	Incompatibilities and reactivities	Health hazards	Target organs
2-Acetylaminofluorene $C_{15}H_{13}NO$	None reported	Reduced function of liver, kidneys, bladder, pancreas, carcinogen	Liver, bladder, kidneys, pancreas, skin, lungs
4-Aminodiphenyl $C_6H_5C_6H_4NH_2$	None reported	Head, giddy; lethargy, dyspnea; ataxia, weak; methemoglobinemia; urinary burning; acute hemorrhagic cystitis; carcinogen	Bladder, skin
Arsenic (inorganic compounds)	Strong oxidizers, bromine azide [Note: Hydrogen gas can react with inorganic arsenic to form the highly toxic gas arsine]	Ulceration of nasal septum, dermatitis, Gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, carcinogen	Liver, kidneys, skin, lungs, lymphatic system
Asbestos Hydrated mineral silicates	None reported	Dyspnea, interstitial fibrosis, restricted pulmonary function, finger clubbing, carcinogen	Lungs
Benzene C_6H_6	Strong oxidizers, many fluorides and perchlorates, nitric acid	Irritation eyes, nose, respiratory system; giddy; head, nausea, staggered gait; fatigue, anorexia, lassitude; dermatitis; bone marrow depression; carcinogen	Blood, Central nervous system, skin, bone marrow, eyes. respiratory system
Benzidine $NH_2C_6H_4C_6H_4NH_2$	None reported	Hema; secondary anemia from hemolysis; acute cystitis; acute liver disorders; dermatitis; painful and irregular urination; carcinogen	Bladder, kidneys, liver, skin, blood
bis-Chloromethyl ether $(CH_2Cl)_2O$	Acids, water [Note: Reacts with water to form hydrochloric acid and formaldehyde.]	Irritation eyes, skin, mucous membrane of respiratory system; pulmonary congestion, edema; corneal damage, necrosis; reduced pulmonary function, cough, dyspnea, wheeze; blood-stained sputum, bronchial secretions; carcinogen	Lungs, eyes, skin
3,3'-Dichlorobenzidine $C_6H_3ClNH_2C_6H_3ClNH_2$	None reported	Allergic skin reaction, sensitization, dermatitis; head, dizziness; caustic burns; frequent urination, dysuria; hema; Gastrointestinal upsets; upper respiratory infection; carcinogen	Bladder, liver, lung, skin, Gastrointestinal tract
4-Dimethylaminoazo-benzene $C_6H_5NNC_6H_4N(CH_3)_2$	None reported	Enlarged liver; hepatic and renal dysfunction; contact dermatitis; cough, wheeze, difficulty breath; bloody sputum; bronchial secretions; frequent urination, hema, dysuria; carcinogen	Liver, skin, bladder
Dinitrobenzene $C_6H_4(NO_2)_2$	Strong oxidizers, caustics, metals such as tin & zinc	Anoxia, cyanosis; visual disturbance central scotomas; bad taste, burning mouth, dry throat, thirst; yellowing hair; eyes, skin; anemia; liver damage	Eyes, respiratory system, liver, kidneys, Central nervous system, skin
Ethyleneimine C_2H_5N	Polymerizes explosively in presence of acids	Nausea, vomit; head, dizziness; pulmonary edema; liver, kidney damage; eye burns; skin sensitization; irritation nose, throat; carcinogen	Eyes, lungs, skin, liver, kidneys

	Oxidizers, hydrogen peroxide, nitric acid, metallic oxides, acids	Irritation eyes, nose, throat; temporary blindness; dizziness, nausea; dermatitis; burns skin, eyes; carcinogen;	Central nervous system, respiratory system, skin, eyes
	Strong oxidizers, hydrogen peroxide, acids	Weak, lassitude, insomnia; facial pallor; pale eye, anorexia, low-wgt, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; nephropathy; irritation eyes; hypotension	Gastrointestinal tract, Central nervous system, kidneys, blood, gingival tissue
Mercury Compounds Hg	Strong oxidizers such as chlorine	Paresthesia; ataxia, dysarthria; vision, hearing disturbance; spastic, jerky; dizziness; salivation; lacrimation; nausea, vomit, diarrhea, constipation; skin burns; emotional disturbance	Central nervous system, kidneys, eyes, skin
alpha-Naphthylamine $C_{10}H_7NH_2$	Oxidizes in air	Dermatitis; hemorrhagic cystisis; dyspnea, ataxia, methemoglobinemia; hema; dysuria; carcinogen	Bladder, skin
beta-Naphthylamine $C_{10}H_7NH_2$	None reported	Dermatitis; hemorrhagic cystitis; dyspnea; ataxia; methemoglobinemia, hema; dysuria; carcinogen	Bladder, skin
4-Nitrobiphenyl $C_6H_5C_6H_4NO_2$	Strong reducers	Head, lethargy, dizziness; dyspnea; ataxia, weak; methemoglobinemia; urinary burning; acute hemorrhagic cystitis; carcinogen	Bladder, blood
beta-Propiolactone $C_3H_4O_2$	Acetates, halogens, thiocyanates, thiosulfates	Skin irritation, blistering, burns; corneal opacity; frequent urination; dysuria; hema; carcinogen	Kidney, skin, lungs, eyes.
o-Toluidine $CH_3C_6H_4NH_2$	Strong oxidizers, nitric acid	Anoxia, head, cyanosis; weak, dizziness, drowsiness; micro hematuria, eye burns; dermatitis; carcinogen	Blood, kidneys, liver, Central nervous system, skin, eyes
Vinyl chloride $CH_2=CHCl$	Copper oxidizers, aluminum, peroxides, iron, steel. [Note: Polymerizes in air, sunlight, or heat unless stabilized by inhibitors such as phenol. Attacks iron & steel in presence of moisture.]	Weak; abdominal pain, Gastrointestinal bleeding; hepatomegaly; pallor or cyanosis of extremities; carcinogen	Liver, Central nervous system, blood, respiratory system, lymphatic system

Dangerous Cargo Entering Colombo Ports
(Excluding security items)

Table 1.2

Year	No: of Ships	Group I	Group I A	Group II	Group III	Group IV
1991	909	2,885	3,941	48,687	5,135	7,465
1992 (First 6 months)	513		2,082	24,596	7,096	3,048

Annex 2

CONCLUSIONS AND RECOMMENDATIONS FROM WHO STUDY

♦ Hazardous Waste Identification and Management

CEA should implement existing environmental regulations/standards through permits and enforcement as outlined below:

1. Conduct national waste storage treatment and disposal survey.

2. All facilities participating would receive a part "A" permit; others not complying would be subject to court enforcement act.

3. After time, part "B' permits are issued to those facilities incorporating updated pollution control technologies as required.

4. Industry and citizen participation is a must. Demonstration and training and public awareness programs should be established.

5. The law must be enforced and violators prosecuted.

♦ Hazardous Waste Minimization

CEA should pursue the following implementing waste minimization in Sri Lankan industries.

1. Use the referenced worksheets and work with industry on reducing waste. Discuss with them the cost savings to be achieved by using case studies associated with the textile, paint, metal finishing, and pesticide formulating industries.

2. Select an industry to participate in a full-scale demonstration program to validate the cost savings of implementing a waste minimization program.

3. Follow up on the worldwide network being established for tanneries and their associated wastes. Possibly a demonstration of the benefits of using the "Oxidation Ditch".

4. Use NBRO reports as a basis form implementing a waste minimization program in the textile and tannery industries.

♦ Hazardous Waste Land Disposal

- Separate landfills should be utilized - one for industrial hazardous waste and one for municipal solid waste.

- Detailed design, construction, operation, and maintenance procedures have been given to the authorities at CEA.

- A mathematical computerized model call HELP (Hydrologic Evaluation Landfill Planning) and guidance document have been given to the authorities at CEA.

- As a minimum control scheme for land disposal facilities, a clay liner of at least twelve inches with hydraulic conductivity of 1.0 cm/sec should be installed. It should be sloped towards one end and leachate collected in a sump pump and treated at the surface before discharge. Daily cover should be utilized.

- The above ground landfill concept should be considered as a last disposal option. Information has been given to CEA especially in areas of high water tables.

♦ Pesticide Containers

- Steel drums need to be pressure rinsed at least three times in an appropriate rinsed facility if they are recycled.

- All pesticide containers should be crushed or punctured to prevent reuse.

- Combustible pesticide containers should be increased or buried in special disposal sites or burned in the open in small numbers.

- Metal and glass containers should be recycled or landfilled.

♦ The report also includes recommended waste treatment for pesticides, metal finishing, textiles, paint, tanneries, rubber and petroleum industries.

Annex 3

CONTROL OF PESTICIDES ACT, NO 33 OF 1980

Art. 3&4 Licensing Authority for Pesticides	1) Pesticides have to be licensed by the Registrar of Pesticides, who is advised by a Pesticide Formulary Committee and is responsible to the Director of Agriculture.
Art. 6 Application for licence	2) In making application for registration of a pesticide, the trade name, the proposed label, sample of the container, uses, potency, shelf-life and effect, chemical identity, stability in storage, date of expiry for usage, toxicological data including information on antidotes of pesticide are, *inter alia* required to be stated.
Art. 7 Consideration of application	3) Licences issued after consideration are not permanent but renewable, which is conditional upon review by the Registration of the data on the pesticide.
Art. 8 Issue of Licence	4) (a) For issue of licence, the proposed labels of the pesticide submitted with the application must contain in Sinhala, Tamil and English *inter alia* the following particulars: trade name, common names of the active ingredients in letters not less that half the size of the trade name and placed immediately below, name and address of the licence holder, directions concerning use, period of application of the pesticide and harvest of the crop to which it is applied, adequate warning and precautionary symbols and statements including first aid and antidote information, the statement "Registered under the control of Pesticides Act, 1980" which shall be an official symbol that the prescribe has been licenced under this Act and the licence number assigned by the Registrar. (b) No change of these particulars can be made without prior approval of the Registrar.
Art. 11 Approved container package	5) Approval of the Registrar of a pesticide relates also to its container/package in respect of such container/package. being satisfactory in relation to the conditions required for safe and effective storage and handling of the pesticide.
Art. 12 Alteration in package of composition of pesticide	6) No alteration in the package, label or composition of a pesticide shall be made by the holder of licence without further approval by the Registrar upon application.
Art. 14 - 17 Prohibition	7) (a) No person shall manufacture, formulate, pack or distribute, sell or deliver any pesticide unless its container/package is licensed and if it is adulterated, decomposed or deteriorated.

(b) No person shall store, transport, sell andy pesticides in close juxtaposition with the feedstuff or in such a manner as to contamination of feedstuffs.

Art. 18 Advertisement of Pesticide

8) (a) Advertisements of pesticides have to conform to the particulate relating to it as approved by the Registrar when issuing the licence - *vide* para 4 above (Art.8)

(b) It is unlawful to advertise any pesticide in a manner that is false, misleading or deceptive and not justified by the conditions of its registration.

Art. 19 Storage of Pesticides

9) No person shall store pesticides in bulk other than in a special store kept for that purpose. The store shall be kept locked when loading/unloading is not in progress and a notice must be displayed in a conspicuous position outside the store indicating the hazardous nature of its contents.

Art. 20 Harvesting of crops

10) No person shall harvest/offer for sale any food crops in which pesticides have been used unless the time limit prescribed by regulations has elapsed between such use and harvest of if the food crops contain pesticide residue in excess of levels as prescribed.

Authorized Officers and their powers and functions

The Director shall nominate such numbers of officers of his department as may be necessary to carry out the proposes of this Act, who shall be known as "Authorized Officers".

3.1 PESTICIDES BANNED OR RESTRICTED FOR AGRICULTURAL USES IN SRI LANKA

Table 3.1

Pesticides		Status in Sri Lanka (1987)
Aldicarb	-	Highly Restricted
*Aldrin	-	Highly Restricted
Dieldrin	-	Highly Restricted
*Chlordane	-	Phased out
Heptachlor	-	
Arsenates (Ca/Pb)	-	Not Registered
Arsenites (Cu/Sodium)	-	Not Registered
Azinphos methyl/ethyl	-	Not Registered
Binapacryl	-	Not Registered
*BHC & Isomer	-	Highly Restricted
*Capmphechlor	-	Not Registered
Carbophenothion	-	Registration Canceled
*Chlordimeform	-	Not Registered
*DBCP	-	Not Registered
*DDT	-	Banned
Dicrotophos	-	Not Registered
Disulfoton	-	Phased Out
Endosulfan	-	Restricted
*Endrin	-	Banned
EPN	-	Not Registered
Ethoprop	-	Not Registered
*Ethylparathion	-	Banned
*Ethylene Dibromide	-	Not Registered
Leptophos	-	Banned
Lindane	-	Restricted
Methamiddophos	-	Restricted
Methomyl	-	Restricted
Methyl Bromide	-	Restricted
Methylite Parathion	-	Banned
Monocrotophos	-	Restricted
Mephosfolan	-	Not Registered
Nitrofen	-	Not Registered
Phenamiphos	-	Restricted
Phorate	-	Not Registered
Toxaphene	-	Not Registered
*2,4D	-	Restricted
2,4 5-T	-	Banned
*Paraquat	-	Restricted
Mercuric Fungicides	-	Phased Out

'The Dirty Dozen' - Indicated as the most hazardous for Third World countries

3.2 LIST OF RESTRICTED AGRO-PESTICIDES

Table 3.2

HIGHLY TOXIC AGROCHEMICALS	Sold by Registered Dealers	Sold to Certified Applicators
A. Insecticides	-	
Aldicarb	+	+
Aldrin	-	-
Aluminum phosphide	+	+
BHC	-	-
Chlordane	+	-
1,2-Dichloropropane (plus)		-
1,3-Dichloropane	-	
Hydrocyanic Acid	-	+
Magnesium Phosphide	+	+
Methamidophos	+	-
Methomyl	+	-
Methyl Bromide	+	+
Monocrotophos	+	-
Omethoate	+	-
Oxydemeton-Methyl		
B. Herbicides	+	
Paraquat		-
POTENTIALLY CARCINOGENIC COMPOUNDS		
A. Insecticides	+	-
Dimethoate		
B. Fungicides	+	-
Benomyl	+	-
Captafol	+	-
Captan	+	-
Mancozeb	+	-
Metalaxyl + Mancozeb	+	-
Thiram		
C. Herbicides	+	
2,4-D + Piperophos	+	-
2,4 D		-
FOR OTHER TECHNICAL REASONS		
A. Insecticides	+	
Carbosulfan	+	-
Cyfluthrin	+	-
Deltamethrin	+	-
Endosulfan	+	-
Fenamiphos	+	-
Fenavalarate	+	-
Permethrin		-
B. Fungicides	+	
PCNB (Quintozene)	+	-
TCTMB - MTC		
C. Herbicides	+	
Butralin		-

Annex 4

GUIDELINES FOR DISPOSAL OF ASBESTOS CONTAINING WASTE

1.0 Scope

This guideline gives the recommended practices for the safe disposal of chrysotile containing asbestos waste, and is applicable to waste or discarded material originating form;

1.1 Manufacturing industries producing asbestos containing materials, eg. roofing sheets, ceiling sheets, clutch facings, brake linings etc.

1.2 Buildings or installations where asbestos containing material is being replaced.

1.3 The import and use of crocidolite (blue asbestos) fibres is prohibited in Sri Lanka. This guideline is not applicable to crocidolite containing asbestos waste.

2.0 Type of Asbestos Waste

The type of asbestos waste will generally fall into any one of the following categories;

2.1 Fine dust from dust control equipment, filter units, vacuum cleaners, etc.

2.2 Loose fibre, swarf, floor sweepings, etc.

2.3 Wet waste in the form of sludge, slurry, lumps, etc.

2.4 Offcuts, broken pieces and rejects.

2.5 Empty sacks or bags which contain loose asbestos fibres or mixtures containing asbestos fibres.

2.6 Waste or discarded material from the removal of thermal insulation from factories or sprayed insulation containing asbestos.

3.0 Mode of Disposal

3.1 Land disposal is best suited for asbestos containing waste. The area reserved or identified as disposal site shall have the approval of:

a) Urban Development Authority (UDA) and Central Environmental Authority (CEA) in the case of sites identified by an industry, or

b) CEA for sites identified by UDA and the Local Authority (LA).

3.2 The UDA, CEA or LA shall reserve the right of entry, inspection and investigation to ensure adherence to this guideline in the case of (a).

3.3 Care should be taken not to mix normal sanitary landfills with sites for asbestos waste disposal.

Collection and Transportation of Waste to Disposal Site

4.1 Loose swarf, dust, floor sweepings, empty bags, offcuts and rejects shall be collected and rejects shall be collected and placed in impermeable containers. Plastic and polypropylene bags which are impervious to asbestos fibres are recommended as containers. Once filled, these bags shall be properly sealed. The above operation shall be done daily.

4.2 The solid waste collected in sealed, impermeable bags shall be transported daily to the site. The vehicle used for this purpose should be a tipper capable of directly unloading the waste.

4.3 A cheaper alternative in the case of wet waste would be to use a covering, impervious to asbestos fibres, to cover the waste load completely during it's transportation to the burial site. This covering need be replaced only once its serviceability has diminished.

4.4 Care should be taken not to mix asbestos waste with other waste material for there are no special disposal requirements (eg. Common factory refuse).

4.5 The vehicle must display that it is carrying hazardous waste with a warning sign.

4.6 The vehicle shall be washed and cleaned daily, the wash water being directed to the treatment plant or disposal site.

5.0 Preparation of Site for Waste Disposal

5.1 The site in which asbestos waste is to be buried shall be such that no possible washout of fibres is likely to take place.

5.2 A wall shall be built round the perimeter of the site with permanent warning signs at the entrance and at intervals of 20 meters along the wall.

6.0 Disposal of Site

6.1 The waste generated should be disposed with proper environmental safeguards to eliminate the possibility of fibres becoming airborne.

6.2 The asbestos containing waste shall be covered with at least 15 cm of compacted soil at the end of each day. The final burial height shall be at least 25 cm below the ground level. After filling a site to prevent any exposure, a cover of vegetation should be grown and maintained on the site.

7.0 Subsequent Use of a Filled Site

7.1 Once completely filled, the land shall not be used for any purpose that will eventually expose or disturb the waste.

7.2 Approval for subsequent use must be obtained from the CEA and/or UDA prior to development. In the case of Local Authorities decision be made in consultation with CEA or UDA.

8.0 Safety of the Workers

8.1 Since exposure to asbestos dust occurs during asbestos waste disposal, workers involved must be issued with personal protection devices such as respirators and protective clothing.

Annex 5

REFINERY DATA

Table 5 Changing Pattern of the Product Storage Capacities of the Corporation

Product	1985		1988/89	
	Installed Capacity	Operational Capacity	Installed Capacity	Operational Capacity
Raw Material				
Crude oil	241,188	204,535	413,756	353,783
Base oil	2,306	2,264	2,306	2,264
Slops	7,292	6,581	7,421	6,701
Subtotal	250,786	213,380	423,483	362,748
Intermediate Products				
S.R. naphtha	4,412	4,305	4,412	4,305
Light naphtha	1,460	1,082	1,460	1,082
Platformate	1,460	1,082	1,460	1,082
Vaccume	785	752	785	752
Subtotal	8,117	7,221	8,117	7,221

Table 5.2 Products Processed in the Refinery (Tonnes)

Refinery Crude nput	1985	1986	1987	1988	1989	1990
Crude input	1,620,134	1,696,052	1,706,725	1,771,774	1,200,787	1,758,272
Super	116,181	123,089	131,259	158,861	118,466	179,281
Auto Diesel	364,150	406,594	332,020	417,425	249,678	463,012
Heavy Diesel	56,010	60,995	163,006	79,882	39,337	53,015
Furnace 500	4,378	4,926	4,229	7,093	6,279	6,427
Furnace 800	24,609	17,563	21,048	26,597	23,964	28,389
Furnace 1000	280,273	194,877	79,363	121,121	93,175	102,340
Furnace 1500	269,851	341,253	448,263	442,921	312,502	445,581
Furnace 3500	24,029	878	42,695	24,079	9,891	-
Furnace Oil Total	603,140	559,497	595,598	621,811	445,581	582,737
Fuel Gas	6	169	-	-	-	-
Kerosene	156,948	153,629	152,747	162,851	124,067	171,097
Chemical Naphtha	124,423	133,756	119,894	96,094	57,673	73,291
Heavy Naphtha	-	-	-	-	-	-
SR Naphtha	2,354	-	-	-	-	-
Naphtha (Total)	126,777	133,756	119,894	96,094	57,673	73,291
Bitumen	32,013	47,111	33,160	27,480	26,139	26,139
LPG	11,815	16,480	18,133	20,013	15,195	18,692
Avtur	73,933	96,510	71,149	85,716	48,555	100,589
SBP	755	1,549	1,050	1,222	1,326	2,818
MAWS	1,436	2,034	2,544	2,463	968	1,501
Solvents (Total)	2,191	3,583	3,685	3,685	2,294	4,319
Total Output	1,543,164	1,601,413	1,673,818	1,673,818	1,127,245	1,672,244

Anex 6

RECOMMENDATIONS FOR HOSPITAL WASTE MANAGEMENT IN SRI LANKA

The following are recommendations given by Malcolm Pirnie, Inc., consultants (for NAREPP/IRG) on hospital waste management. The consultants visited the Colombo General Hospital and Sri Jayawardenapura Hospital.

Medical or hospital waste is broadly defined to include all wastes produced by hospitals, medical offices, and medical research facilities. Infectious waste is defined to include those wastes which are capable of producing an infectious disease. When defining a waste as infectious a number of factors must be taken into account: presence of a pathogen of sufficient virulence, dose, portal of entry, and resistance of the host to the pathogen[2].

Key to the cost effective management of hospital wastes is the source separation of the various waste streams based on the physical, chemical, and infectious characteristics of the wastes. Well established (and for the most part cost effective) treatment technologies exist for the management of most solid, liquid, chemical and radioactive wastes generated by hospitals. The designation of what is infectious waste and the associated risks is less well defined. The USEPA defined seven categories of waste that should be defined has hazardous for the Medical Waste Tracking Act. These waste streams are:

- Microbiological wastes - cultures and stocks of infectious waste and associated biologicals that can cause disease in humans.
- Human blood and blood products
- Pathological wastes of human origin
- Contaminated animal wastes
- Isolation wastes - wastes form humans or animals known to be infected with a highly communicable disease.
- Contaminated sharps
- Uncontaminated sharps

The greatest risk of infection in the management of the hospital wastes is to the workers responsible for managing the waste as they are exposed to the waste shortly after its generation. They also have extensive interaction with the waste and if not properly protected, present an exposure route for the pathogen (e.g. puncture, open wound, inhalation).

While it is conceivable that some pathogens could survive and migrate from incineration or landfilling operations the greatest risk of transmission pathogens from medical waste occurs during its handling/storage. Based on our findings the following recommendations are made:

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[2] U.S. Environmental Protection agency, *Guide for Infectious Waste Management*, EPA/530-SW-86_014 (Washington, DC: May 1986)

Most of the waste management issue discussions revolved around the need for incineration to manage the infectious waste streams. While incineration is attractive for its ability to handle all wastes produced in a hospital, and for the reduction in waste volumes their are other technologies that might make better sense for resolving the hospital waste issues in Sri Lanka. Due to the relatively low volume of wastes generated, lower cost capital waste treatment systems should be considered, including:

- Autoclaves (steam sterilization)
- Microwave (thermal treatment)
- Chemical disinfection
- Landfilling

Use of these systems requires that the chemical waste streams (all options) and pathological wastes(with the exception of the landfilling option) be segregated.

- A large percentage (upwards of 90%) of the hospital waste is food waste. This waste stream should be considered for composting.

- Hospital workers handling the wastes should be trained in the use of protective equipment. At a minimum, this equipment should include protective footwear, heavy gloves and safety glasses. Additionally, training should be provided for the proper handling of these wastes. Where possible, source segregation should be practiced to remove potentially recyclable/re-useable items from the waste stream to minimize the sorting of the waste by the workers.

- The CMC should require that sharps disposed of in the solid waste stream be packed in a labeled, secure and closed container that can be handled separately from the remaining waste to assure that it is securely buried.

- Until other waste management issues are resolved the CMC should give serious consideration to the segregation of infectious waste from other solid waste and the prompt burial of this waste to prevent the improper scavaging/recycling of this material. Both hospital representatives mentioned that they have plans in place to be able to start to provide for source separation of infectious materials.

REFERENCES

1. Salcedo, R. N, F. L. Cross, R. L. Chrismon. Environmental Impacts of Hazardous Waste: Treatment Storage and Disposal Facilities. USA: Technomic Publishing Company, Inc., 1989.

2. Panayotou, T, D. Phantumvanit. "Industrialization and Environmental Quality: Paying the Price." Industrializing Thailand and its Impact on the Environment: 1990 TDRI Year-End Conference, December 8 - 9. Synthesis Paper No. 3. Thailand: 1991.

3. Leonard, A. Plastic Wastes Exported to Third World. Daily News Paper, Sri Lanka, October 23, 1992.

4. Batstone, R, J. E. Smith, Jr., D. Wilson. The Safe Disposal of Hazardous Wastes: The Special Needs and Problems of Developing Countries. Volume 1. World Bank Technical Papers No. 93. USA: 1989.

5. Mathes, M. P. J. A. P, R. R. Ellapola and A. R. A. Andradi. Hazardous Waste Situation in Sri Lanka. 1990.

6. Use of Pesticides and Health Hazards in the Plantation Sector. Colombo: Friedrich-Ebert-Stiftung, 1988.

7. Asbestos. Canada: 1986.

8. Ceylon Petroleum Corporation. Oil and Sri Lanka: Statistical Review. Sri Lanka: CPC, 1986 and 1991 (unpublished).

9. Ministry of Health. Annual Health Bulletin. Sri Lanka: 1989.

10. Main Report: National Hazardous Waste Management Plan. Volume 2, Thailand: 1991

11. The Gazette of the Democratic Socialist Republic of Sri Lanka. Sri Lanka: May 1987.

12. Ponnambalam, M. Status Report on Pesticides, Sri Lanka: CEA.

13. Nemerow, N. L. Liquid Waste of Industry: Theories, Practices and Treatment. USA: Addison-Wesley Publishing Company, 1971.

14. Harrison, R. M. Pollution: Causes, Effects and Control. UK: The Royal Society of Chemistry, 1990.

15. Central Environmental Authority. Chemicals in Use in Sri Lanka, Draft List. Sri Lanka: CEA, July 1991.

16. US Department of Health and Human Services. NIOSH Pocket Guide to Chemical Hazards. USA: NIOSH, 1990.

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