Chapter 10

Other Studies

10 Other Studies

10.1 General Recommendation on Industrial Solid Waste Management

The objective of this study is to make general recommendations for improving the present ISWM based on a rapid diagnosis through analysis of existing data. The waste studied here is solid waste generated through industrial activities. It should be reminded that the results of the study have certain limitation in accuracy due a small number of existing literature and reports on industrial solid waste for the city of Dar es Salaam.

10.1.1 Present Conditions of ISWM

a. Overview

Compared to developed countries, Tanzania's industrial sector is small. Industries have been affected by the harsh economic conditions during the last 15-20 years, a problem which is common in other developing countries. In Tanzania about 80%[1] of industries are concentrated in Dar es Salaam city. The major industrial areas in the city include: Ubungo Industrial area, Pugu road, Bagamoyo road and Chang'ombe.

Table 10-1 shows industries that have the potential of producing waste in Dar es Salaam.

[1] Division of Environment (1995) in the Proposed Environmental Policy

Table 10-1: List of Solid Waste Producing Industries in Dar es Salaam

Category		Campany	
i.	Paint Production Industries	1. Berger Paints	Migeyo Road (Chang'ombe)
		2. Organic Chemicals	Saza Road (Chang'ombe)
		3. Kilimanjaro Paints	Lugoda Street (Ilala)
		4. Rainbow paints (T) Ltd.	Pugu Road
		5. Banco Products	Pugu Road
		6. Galaxy Paints	Pugu Road
		7. Gold Star paints	Dakawa Street (Chang'ombe)
ii.	Plastic Industories	1. Tanganyika Tegry Plastic -	Pugu Road
		2. Simba Platic	(Migeyo Road) Chang'ombe
		3. Tanzania Plastic	Pugu Road (Ilala)
		4. Polysacks Company Ltd.	Ubungo
		5. Sozaplast	Mikocheni
		6. Plastimac	Pugu Road
		7. Tac Plastic	Pugu Road
		8. Kanti & Company Ltd.	Saza Road (Chang'ombe)
		9. Melpast	Keko
		10. Polyplex Tanzania Ltd	Pugu Road
		11. N.C.G. Chemical (Plastic) Industries	"
		12. Metalplast	"
		13. Tanzania Extrusion	Pugu Road
		14. Anchmedu Ltd	Mikocheni
		15. Rehmanji Ltd	Keko
		16. Pharm Plast	"
iii.	Papaer Production Industries	1. Kibo Paper Mill	Pugu Road
		2. Mifuko Limited	Pugu Road
		3. Kiuta	Pugu Road
		4. Government Press	Pugu Road
iv.	Agriculture and Livestock Industries	1. Interchick Company Ltd	Bagamoyo Road, Mbezi
		2. NAPOCO (National Poultry Farm	Vingunguti Street
		3. NAFCO (National Agricultural and Food Coop)	
		4. Sukita Farm	Mandela Road
v.	Abattoirs	1. Vinguaguti Slaughter Slab	
		2. Kimara Slaughter Slabs	Slab No. 2
			Slab No. 3
			Slab No. 4
		3. Tanganyika Packers	Old Bagamoyo Road (Kawe)
vi.	Heavy Industries	1. Steelco	Pugu Road (Temeke)
		2. Steelcast	Pugu Road (Temeke)
		3. Aluco	Pugu Road (Temeke)
		4. Pipeco	Pugu Road (Temeke)
		5. Galco	Pugu Road (Temeke)
		6. Yuasa Batteries	Vingunguti Area
		7. Tralco	Wazo Hill
		8. Perma sharp	Pugu Road
		9. Afro-cooling system	Pugu Road
		10. Dar Cottage Industries	Pugu Road
		11. Wire Industries Ltd.	"
		12. Haji Sufeiman Haji	Mbozi Road (Chang'ombe)
		13. Matsushita electric	Pugu Road
		14. National Bicycle	Bagamoyo Road (Mwenge)
		15. Asbesco	Bagamoyo Road
		16. Trailico	Bagamoyo Road
		17. Tanzania Portland Cement-	Bagamoyo Road (Wazo Hill)
		18. Kioo Ltd	Saza Road (Chang'ombe)
		19. UFI Ltd	Morogoro Road (Ubungo)
		20. Metal Products Ltd.	Morogoro Road (Ubungo)
		21. R.K. AUTO Electric Ltd.	
		22. Singh Metal works	
		23. Tanzania Auto Parks	Pugu Road
		24. National Engineering Company	Pugu Road
		25. Tanzania Wire Products	
vii.	Pharmaceutical and Chemical Industries	1. Keko Pharmaceutical Industries	Mapinduzi Road (Keko)
		2. Shellys Limited	Pugu Road
		3. Mansoor Daya Pharmaceutical Industry	Pugu Road
		4. Welcome Pharmaceutical	
		5. National Pharmaceutical	
		6. Hoechst (T) Ltd.	Mbozi Street (Chang'ombe)
		7. Henkel Chemicals	Pugu Road

Category	Company	
	8. Sapa Chemicals	Pugu Road (Chang'ombe)
	9. Twiga Chemicals	Saza Road (Chang'ombe)
	10. Rentokil	Gerezani
	11. Chemi Products	Pugu Road
	12. Medicare Ltd.	Mikocheni Area
	13. NCG Chemicals	Keko
	14. Tanzania Chemical Industries -Ilala	
	15. Industrial Chemical Ltd	Pugu Road
	16. Boby Soap Factory	Temeke
	17. Soap and allied industries-	Temeke
viii. Paper processing Industries	1. Twiga Paper Products	Chuma Road (Chang'ombe)
	2. Kibo Paper Products	Chuma Road (Chang'ombe)
ix. Petroleum Industries	1. PB (British Petroleum)	Kilwa Road
	2. Esso Ltd.	Kilwa Road
	3. Caltex Ltd.	Kilwa Road
	4. Tiper Kigamboni	
x. Cannong Industries	1. Fahari Fruit Products Ltd- Pugu Road	
	2. Vitamin Foods Ltd	
	3. DSM Foof products	
	4. C.B. Spices Ltd	
	5. R.K. Industries	
	6. National Milling Cooperation	
	8. Tropical Food Pugu Road (Vinganguti)	
xi. Vegetable Oil Mills	1. Surat Oil mill Ltd	
	2. Popular Oil Mill Ltd	
	3. Mafia Coconut	Kisarawe Street
	4. Fazal Mohamed Champsi	
	5. Dar es Salaam Oil Mill	Chuma Street (Chang'ombe)
	6. Rajani Industries Pugu Road	
xii. Rubber Industries	1. Bora Shoes	Pugu Road
	2. Mount Carmel Rubber Industries	Mbozi Road (Chang'ombe)
	3. Rubber Industries Ltd	Mwakalinga Street (Chang'ombe)
	4. Jeje Industry	Mwakalinga Street (Chang'ombe)
	5. Jessa Industry DAKAWA Street	(Chang'ombe)
xiii. Tobaco Industry	1. Tanzania Cirgarette Company	Pugu Road
xiv. Milling and Food Processing Industries	1. N.M.C. (Kurasini)	Port Area
	2. N.M.C. (Mzizima)	Pugu Road
	3. N.M.C. (Pugu Road Branch)	
	4. Fidahussein and Company ltd-	Morogoro Road
	5. N.M.C. Bakery Plant (Bread)-	Pugu Road
	6. Said Salim Bakhresa and Company	Pugu Road
	7. Tanzania Biscuits	Mbozi Road Chang'ombe
	8. Tanita Comapny Ltd	Pugu Road
xv. Textiles	1. Kilimanjaro Textile Mill	Kiltex (Gongo la Mboto)
	2. Tanganyika Dyeing and Weaving Mill	Sunguratex (Gongo la Mboto)
	3. Friendship Textile Mill Urafiki (Ubungo)	
	4. Ubungo Spinning Mill USM (Ubungo)	
	5. Tanzania Serving Thread Manufacturers (Ubungo)	
	6. Ubungo Garments Limited (Ubungo)	
	7. Tanganyika Textile Limited (1959) (Chang'ombe)	
	8. Garment Manufacturers (Chang'ombe)	
	9. JV Textile and Garments (Chang'ombe)	
	10. Blanket Manufacturers Limited - BNK (Chang'ombe)	
	11. CALCO Textiles (Pugu Road)	
	12. COTTEX (Pugu Road)	
	13. Tanzania Uniform and Clothing Corporation - TUCCO (Pugu Road)	
	14. Pattex Knitwear Manufacturing	

Industrial solid waste is a collective name for all wastes generated from processing and non-processing industries as well as from utilities (World Bank Technical paper No.5). The nature of industrial solid waste depends on the type of Industry and the production process. Besides this, usually industries also generate wastes similar to domestic solid wastes and packaging materials. The most important industrial solid wastes arises from petrochemicals, pesticides, pharmaceutical and other chemical industries like cement, battery, plastic, metal, glass and paint industries. Table 10-2 below presents the group classification of various types of industries and the type of waste normally generated from them.

Table 10-2: List of wastes to be expected from various industrial groups

Group Classification	Waste generating processes	Expected wastes
Food Processing	Processing, packaging and shipping	Meats, bones, shells, levels, nuts
Textile mill products	Weaving, processing, dyeing and shipping	Cloth and fibre residues
Paper and allied products	Paper manufacture, conversion of paper and paper board manufacture for boxes and containers	Paper and fibre residues, chemicals paper coatings and fillers, inks, glues
Rubber and Plastic Products	Manufacture of prefabricated rubber and plastic products	Scrap rubber and plastics, dyes and curing compounds
Transportation equipment	Manufacture of motor vehicles, truck and bus bodies, motor vehicle parts bicycle parts etc.	Metal scrap, glass fibre, wood, rubber, paints, cloth, petroleum products.
Fabricated metal products	Manufacture of metal cans, hand tools, plumbing fixture, farm machinery and equipment etc.	Metals, sand, coatings
Stone, clay and glass product	Manufacture, fabrication and forming glass, manufacture of stone products	Glass, asbestos abrasives, gypsum

Source: Encyclopaedia of Environmental Science and Engineering, Vol.1 A-M

Table 10-3: Classification of Factories in accordance with the Potential of Generating Hazardous Wastes

Potential	ISIC[2]		Industrial Category	Type of Industry				
				1	2	3	4	5
High Potential Industries	351	3511	Organic and inorganic industrial chemicals		x			
		3512	Fertilizers, insecticides etc.			x		
		3513	Resins, plastics, and synthetic fibres		x			
		3514	Manufactured chemical products		x			x
	352	3521	Paints, varnishes, lacquers, enamels, etc.			x		
		3522	Medicines (pharmaceutical products)		x			x
		3523	Soaps, detergents, shampoos, cosmetics, etc.		x			
		3529	Other non-classified chemical products		x	x		x
	354	3540	Oil and coal products			x		
	356	3560	Other non-classified chemical products		x			x
	371	3710	Iron and steel industries	x				
	372	3721	Basic copper industry	x				
		3722	Copper products and alloys	x				
		3729	Basic non-ferrous metal industries (exc. copper)	x				
	381	3811	Metal cutlery, hand tools and other general hardware				x	
		3812	Metal furniture and fixture				x	
		3813	Metal structures, tanks, corrugated iron, doors and windows				x	
		3814	Metal packages, tools, and household utensils				x	
		3815	Wires, non-isolated cables and by-products				x	
		3819	Other metal products				x	
			Highly Potential Total					
Potential Industries	3211	3211	Textile processing and materials manufacturing					
	3231	3231	Leather tanning and finishing					
	3232	3232	Fur dressing, dyeing and other fur and skin articles					
	3319	3319	Non-classified wooden products					
	341	3411	Paper and pulp					
		3412	Paper containers and boxes					
		3419	Other paper and pulp products					
	3420	3420	Printing, photoengraving, publishing etc.					
	355	3551	Tires, tubes, rims etc.					
		3559	Other non-classified rubber products					
	362	3620	Glass and glass products					
	3699	3699	Other non-metallic mineral products					
	382	3822	Agricultural machinery					
		3823	Wood and metal working machinery					
		3824	Other industrial machinery					
		3825	Office machinery and equipment (inc. computers)					
		3829	Other non-classified machinery					
	383	3831	Motors, generators, transformers etc.					
		3832	Radio, TV, X-ray related machinery and equipment					
		3833	Electric heaters and equipment					
		3839	Other electric machinery					
	384	3841	Ships and boatyards, marine engines and their parts					
		3842	Railroad machinery and equipment					
		3843	Vehicle parts and engines					
		3844	Motorcycles and bicycles					

[2] International Standard Industrial Classification

Potential	ISIC[2]		Industrial Category	Type of Industry				
				1	2	3	4	5
		3845	Airplanes and their components					
		3849	Other transport equipment					
Potential Industries	385	3851	Measurement, controlling and medical machinery					
		3852	Optical and photochemical machinery (inc.lens)					
	390	3901	Jewelry and silverware					
		3902	Musical instruments					
		3903	Sporting, athletic and camping goods					
		3909	Other non-classified manufacturing industries					
	625	6253	Petrol station					
	952	9520	Laundries and dry cleaners					
			Potential Hazardous Total					
			Hazardous Total					
Less Potential Industries	311	3111	Livestock slaughtering and meat production					
		3112	Dairy products					
		3113	Fruits, vegetables, and their products					
		3114	Fish and other sea food					
		3115	Animal and vegetable oils					
		3116	Cereals					
		3117	Bakery, biscuits, cakes, pastas etc.					
		3119	Cocoa and Chocolate powder and sugar confectioneries					
	312	3121	Other non-classified food manufacturing					
		3122	Animal feeds					
	313	3131	Alcohol distilling					
		3132	Wine, ciders and other fermented beverages					
		3133	Malt, beer and malt liquors					
		3134	Non-alcoholic beverages					
	314	3140	Cigarettes, cigars and tobacco					
	3212-3219	3212	Cloth manufacturing and related processing					
		3213	Socks, stocking and knitted products					
		3214	Carpets and rugs					
		3215	Ropes, cables, cordage, nets etc.					
		3219	Other non-classified textile industries					
	322	3220	Garment industries					
	3233	3233	Leather products(exc.footwears)					
	324	3240	Leather footwear					
	3311-3315	3311	Wood processing and wooden products manufacturing					
		3312	Wooden and cane containers manufacturing					
	332	3320	Furniture, fixture etc.					
	361	3610	Potteries and ceramic products					
	3691-3696	3691	Bricks, lettices, walls and refractory materials					
		3692	Cements, lime, and plaster					
		3693	Cement building materials					
		3695	Fibre cement products					
		3696	Plaster building materials					
	410	4101	Generation, transmission and distribution of electricity					
			Less Potential Total					
			Total					

Note: * Type of Industry
1. primary metal industry
2. organic chemical industry
3. pesticides and explosives industry
4. electroplating and surface finishing industry
5. inorganic chemical industry

b. Inventory

In Dar es Salaam recent data are scarce on industrial solid waste management, probably due to lack of resources for the study. The only major study on industrial solid waste management in the city of Dar es Salaam was carried out by Haskoning and M.Konsult in 1988, during which a survey amongst selected industries covering various categories was conducted. Another study (Kiunsi, R) on industries producing hazardous solid waste in Dar es Salaam was compiled in 1993; its major findings were reviewed in this report. Other data on industrial solid waste management for some specific industries in Dar es Salaam have also been compiled and are available at the Department of Environmental Engineering - UCLAS (Solid wasted Management for Tangold Industry, 1992; Industrial Solid Wastes disposal - case study TANITA industry, 1987; Solid waste management for poultry farming industry - case of Intechick, 1994; and Solid Waste management in industrial areas a case of Dar es Salaam, 1984).

Data on waste generating industries for the city of Dar es Salaam have been established by Haskoning and M-Konsult (1988) through a survey on a selected group of industries. A total of 33 enterprises were questioned including those in the following sectors:-

- Food and beverage
- Paper and Wood Industry
- Cotton Industry
- Leather Industry
- Metal Industry
- Pesticide Industry
- Pharmaceutical Industry

The full list of industries studied is as show in Table 10-4.

Table 10-4: List of surveyed industries in Dar es Salaam

Industry Sector	Company
A. Food and Beverage	1. Tanzania Breweries 2. KIOO Ltd. 3. Tangold Products
B. Cotton Industry	4. Friendship textile units 5. Tanganyika Dying and Weaving Mills 6. Sunguratex
C. Metal Industry	7. Alaf Steelcast 8. Asbesco (ALAF) 9. Matsushita Electric Co.
D. Paper and Wood Ind.	10. Metal Products (ALAF) 11. KIBO Paper 12. Arusha timber plant
E. Shoe & Leather Ind.	13. Bora Shoes Company
F. Plastic Industry	14. Tanganyika Tegry Plastics Ltd. 15. Tangayika Plastics Ind. Ltd. 16. Simba Plastics 17. Polysacks
G. Pesticide Industry	18. Moechst Ltd. 19. Twiga 20. Henkel Chemicals
H. Pharmaceutical Industry.	21. Keko Pharmaceuticals 22. Mansoor Daya Chemicals 23. Shelys Chemicals
I. Other Chemical Industry.	24. Banco Products 25. Mount Carmel Rubber Factory 26. Berger Paints 27. Robbialac

Source: Haskoning and M-Konsults, 1988

c. Generation amounts of ISW

The result of an inventory of industrial solid waste generation in Dar es Salaam came to a total of 76,326 tonnes of waste per year. During the study the Dutch figures for waste generation rates per employee according to industrial category were adopted. By multiplying the number of employees in an industrial sector with the waste generation rates per sector and the percentage of production waste generation was calculated. The details of this inventory are summarised in Table 10-5.

Table 10-5: Inventory of Industrial Solid Waste Generation in Dar es Salaam

Industrial	Employees	Waste gen. per employ per year (tonnes)	Actual output (%)	Waste Gen. per year (tonnes)	Waste generation per day (tonnes)
Food & Beverage	14,000	4	40	23,000	63.0
Text & Cott. Industry	27,900	1.5	35	14,650	40.1
Shoe & Leat. Industry	4,700	0.75	20	700	1.9
Paper Industry	6,800	4	60	16,320	44.7
Glass Manufacturing	3,100	10	50	15,500	42.5
Metal Industry	7,400	1.5	30	3,330	9.2
Plastic Industry	1,000	2	10	200	0.5
Chemical Industry					
-Pharmaceutical		1	40		
-Pesticides	2,100	1	20		
-Other Chemical		1	35	670	1.8
Other Industries	7,800	0.5	50	1,950	
Totals	74,800	-	-	76,320	203.6

Source: Haskoning and M-Konsult, 1988

Kaseva and Gupta, in 1996, estimated that the amount of industrial waste generation was 300 tonnes per day in Dar es Salaam.

A total of 57 industries in the city have been identified as producing hazardous solid wastes (Kiunsi, R; 1993). The main categories of industries producing hazardous solid waste are paint, plastic, drugs, chemical, metal processing and finishing and petroleum. Table 10-6 shows the names of the industries in each category, the amount of solid waste generated, hazardous compounds, the disposal methods and the nature of the solid wastes.

Table 10-6: Industries Producing Hazardous Solid Waste In Dar Es Salaam

S/N.	Name of the Industry	tons/year		Hazardous Material	Disposal Method (for solid waste)	Nature of Solid Waste
		Solid Waste	Sludge			
	I. PAINT INDUSTRIES					
1.	Burger Paints (Robbialac Ltd)	7.0	20	. Compounds of chromium, cobalt, copper, zinc, tin, mercury . Brocides . Halogenated solvents . Organic solvents . Aromatic compound	Vingunguti	Packages, damaged and leaky tins, containers and drums, dry paints and pigments waste cotton and dirty
2.	Organic chemicals	0.5	2.5		OS, Re use by workers	
3.	Kilimanjaro Paints	1.5	11		Re use by workers Vinguntuti	
4.	Rainbow Paints (T) Ltd,	15.0	13		OS, Re use by workers Vingunguti	
	(Sadollins Ltd.)				Vingunguti	
5.	Banco Products	21.0	9		Re use by workers Vingunguti	
6.	Galaxy Paints	10.0	5		Vingunguti, Recycled	
7.	Gold Star paints	13.0	*			
	Sub-Total	68.0	60.5			
	II: PLASTIC INDUSTRIES					
1.	Tanganyika Tegry Plastics	390.0		Compound of chromium, cadmium and lead Compounds of chromium, cadmium and lead	Vingunguti, recycled	Packaging bags, rejected materialsand products, dust Packaging bags, rejected materialsand products, dust.
2.	Tanzania Plastic	40.0			Vingunguti, recycled	
3.	Polysacks Company Limited	*			Recycled, Mbagala	
4.	Sozaplast	3.0			Recycled, Mbagala	
5.	Plastic	9.0			Recycled, Mbagala	
6.	TAC Plastic	0.1			Recycled, Mbagala	
7.	Kanti and Company (T) Limited	7.0			Vingunguti, Recycled	
8.	Simba Plastic	0.5			Vingunguti, Recycled	
9.	Melplast	1.5			Recycled	
10.	Polyplex Tanzania Limited	15.0			Recycled	
11.	N.C.G. Chemicals (Plastic)				Vingunguti	
12.	Rehmanji Ltd.	21.0			Recycled	
13.	Tanzania Extrusion	10.0			Recycled	
14.	Anchmwedu Ltd	13.0			Recycled	
15.	Pharmplat	68.0			Recycled	
	Sub-Total	525.6				
	III: DRUGS AND MEDICINES					
1.	Keko Pharmaceutical	2.0	76.5		On Site	Packaging materials, containers and dust.
2.	Shellys Limited	1.0	37.6		Unused septic tank	
3.	Mansoor Daya Pharmaceutical	2.2			Vingunguti (taken by city)	
	Sub-Total	5.2	114.1			

S/N.	Name of the Industry	tons/year		Hazardous Material	Disposal Method (for solid waste)	Nature of Solid Waste
		Solid Waste	Sludge			
	IV: CHEMICAL INDUSTRIES					
1.	Henkel Chemicals	1.5		Compounds of chromium, cadmium and lead	Raused by workers	Packaging materials, containers
2.	SAPA Chemicals	35			Vingunguti	
3.	Twiga Chemicals	58			Vingunguti	
4.	Rentokil	*			Vingunguti	
5.	Chemic Product	52			Vingunguti	
6.	Tanzania Chemical Industries	6.0	3.0		Vingunguti	
7.	Industrial Chemical Ltd.	4.0	*		Recycled, on site sewerage system (sludge)	
8.	Soap and allied industries	6.0	*		Recycled, Vingunguti	
9.	Boby Soap Factory	36	*		Sewerage System	
	Sub-Total	193.5	3.0			
	V: METAL PROCESSING AND FINISHING INDUSTRIES					
1.	Aluco Limited		225	Compounds of chromium and zinc- H_2SO_4 (from Pipeco and Galuco) Asbestos fibre and dust	Recycled	Metal scraps
2.	Pipeco Limited		97		Recycled	
3.	Galuco Limited		378		Recycled	
4.	Steelcast Limited	30	1.2		Recycled	
5.	Asbesco	30	1.6		On site	
	Sub-Total		703			
	VI: OTHER INDUSTRIES					
1.	Yuasa Batteries			Lead compound dust, synthetic rubber Leads & tin compounds	Recycled	Metal Scraps
2.	Afro - Cooling systems Limited				Recycled	Metal Scraps
	Sub-Total					
	VII: PETROLEUM INDUSTRIES					
1.	BP (British Petroleum		1.4	Lead compounds	On site	
2.	ESSO Limited		0.4		On site	
3.	CALTEX Limited		0.4		On site	
4.	Tiper		2952		Direct discharge in to the sea	
	Sub-Total		2956.2			

* - Data not obtained

OS = On site

d. Control of ISW by governmental sectors and generation factories

The DCC being the local government agency, is responsible for the provision of solid waste management services. With this broad task, the DCC has the role and responsibility to set regulations and by-laws regarding public health and environmental protection, thus directly influencing ISWM. However, the existing laws for controling ISWM are generally outdated and characterised by low penalties for offenders. There is also lack of enforcement leaving the DCC with a superficial role of supervision /inspection of ISWM. All industries at present are responsible for collection, transport and /or disposal of their wastes.

e. Processing and disposal of ISW within and outside their premises

e.1 Overview

The fundamental objective of waste processing is to reduce the amount of wastes through recycling and dispose of it in a way so to encourage environmental conservation. Waste generated are subjected to final disposal directly or after intermediate treatment. Intermediate treatment is a very effective and important process designed to reduce the volume of waste, stabilise it to make it harmless.

Very limited data on industrial waste processing are currently available. A study conducted in Dar es salaam between 1993 and 1995, on the scavenging activities and recycling trends of some selected items shows that paper waste is shredded, repulped and reprocessed in the Kibo paper mill for the production of boxes, egg crates and cheap card boards. Metals are melted and refined to other forms at Aluminium Africa Ltd. Glass culliet are melted and are reshaped at KIOO industry. Sheet metals, tins and cans are reshaped into charcoal stoves, dust bins and other items. Clean paper waste is used as wrapping materials. Textile wastes and spongy materials are sold to local pillow makers. Plastic bottles are used for storage purposes and plastic sheets as rough covering materials (Kaseva and Gupta ,1996).

e.2 Solid waste recycling

Between 1988 and 1989, studies on solid waste recycling in Dar es Salaam were conducted both by the Department of Environmental Engineering (UCLAS) and Haskoning and M-Consult Ltd. These studies were conducted when the Tabata dump site was still operating. Findings from these reports indicated that, large scale waste recycling was very limited. For example, the report stated that five percent of raw materials for Simba Plastics were from recycled plastics. In another study, it was stated that the potential for recovering useful materials from industrial solid waste was currently not fully exploited. Recycling in the city were observed to be not only a critical source of raw materials for small scale industries, the absence of which would result in their termination, but also a widely accepted environmentally friendly technology for solid waste management. Out of 294 tonnes of studied waste materials (paper, metal, plastic, glass and textiles) only 4 tonnes are recovered and recycled. The remaining 290 tonnes/day of recyclable material are left to pollute the environment or are collected and transported for final disposal.

e.3 Scavenging

Most of the recycling is done through scavenging and through small scale industries. High income areas, commercial areas and industries are the major sources of wastes

with a large fraction of recyclables. Even though scavenging occurs during waste collection, most scavenging activities are concentrated at the dumpsite.

e.4 Recycled materials

The range of items scavenged from the city's solid wastes, their source and end reuse are summarised in Table 10-7.

Table 10-7: Range of items scavenged from city's solid waste

Recycled Item	Generating Points	End Reuse
1. Vehicle tyres	garage, industries, commercial areas, high income residences	Shoe repair
2. Styrofoam	Commercial areas	Reprocessed into furniture polish by Chande & Brothers Factor
3. Tins & Cans	Commercial areas	Reprocessed into Kerosene lamps charcoal stoves, pots and pans, lids etc.
4. Glass Bottles	Breweries, Bottles, Commercial areas	To hold oils & medicines
5. Leather Products	Commercial and industrial areas, residences	Shoe repair
6. Metallic items	Industrial and construction sites	Reprocessed into buckets, charcoal stoves, washing basin, dust bins, poultry feeding troughs
7. Gunny sacks	Commercial and residential areas	Carrying charcoal
8. Metallic binders	Commercial and residential areas	Binders, secure construction Trusses
9. Cotton rugs & spongy materials	Commercial and residential areas	To make pillows
10. Paper	Residences, Institutions and commercial areas	To wrap products esp. by food vendors and shops
11. Wire mesh, reinforcements and wooden plants	Industries, construction sites, commercial and residential areas	Rousing fish & meat, construction work and carpentry

10.1.2 Evaluation on the Present ISWM

Various studies on industrial solid waste management in Dar es Salaam have revealed that, the city's waste collection facilities do not extend their services to industries and therefore all industries in Dar es Salaam dispose of their own solid waste by burning, dumping at the dumpsite and storing on-site. Industries are allowed to use the dump site at a disposable fee of 800 Tsh., but the majority of industries dispose of their wastes on-site (within their premises) because of lack of transport vehicles.

Most industries have no storage facilities and resort to open ground dumping. This causes useable materials to become dirty, others corrode and the rest decay cause by the rain. In the case of light materials, they get scattered in the wind. This may be a fire hazard Due to improper storage the reclaimed material may be of low-quality and in order to improve its quality, material for cleaning them have to be used. This increases the cost of materials recovery. Industrial solid wastes is collected once a week or sometime once a month by individual industries. This causes nuisances as well as producing a breeding site for disease vectors such as rats.

10.1.3 General Recommendation

a. Necessity of Further Survey

The survey on ISW conducted in this study was not substantial due to the absence of an inventory of industries and lack of available resources for the study. A more detailed survey on ISWM, therefore, should be conducted after an inventory of existing factories has been compiled.

b. Laws and Regulations

A classification system for industrial solid wastes which will distinguish hazardous wastes from non-hazardous wastes should be formulated.

The national government and the DCC should co-ordinate in formulating laws, regulations and guidelines regarding ISW, bearing in mind the hierarchy of the laws, ordinances and guidelines, so to avoid conflicts in environmental legislation.

A control and enforcement system to eliminate illegal dumping of ISW must be established urgently in co-operation with the various agencies concerned.

Legislation which ensures economic incentives to dischargers in return for improved practice should be introduced. This is in order to assist them in taking measures to minimise the discharge of ISW and to use pollution control technologies.

c. Administration and Organisation

An administrative structure which ensures proper ISWM should be established by clearly defining the roles of each organisation concerned.

The different levels of government and the governmental agencies should co-ordinate in law enforcement activities related to ISWM.

The DCC should co-operate with national government authorities on matters related to nuisances and hazards to people caused by mismanagement of industrial wastes.

d. Plans and Technologies

Guidelines and plans should be made with regard to ISWM to serve as a standard which enterprises have to comply with.

The number of staff responsible for ISWM should be increased and given the necessary training.

Furthermore, the administrative officers should have technical knowledge (in discharge, treatment, recycling, and disposal methods, etc.), correct information and work towards the development of appropriate technologies.

The administration should transfer technical information to dischargers and provide them with technical aid through various schemes.

e. Reduction of Generation of ISW at Generation Sources

Dischargers should take action to minimise the amount of ISW through controlling the generation, discharge and recycling amount, although the present generation amount of ISW is not large.

Dischargers should introduce processes which will enable the treatment of ISW at the generation source. Dischargers should examine production methods and take proper countermeasures to mitigate environmental pollution caused by their wastes.

In addition, all enterprises should endeavour to increase the recycling rate through utilisation plans for recyclable materials.

f. Inventory System of Dischargers

Each discharger should submit to the DCC information on the characteristics, amount, treatment and discharge methods of industrial waste they generate. The inventory system is effective for supervising ISWM as long as precise registration and continuous updating of inventories are implemented.

g. Manifest System of ISW

As the first step for a manifest system which should be implemented in future, the administrative agencies should issue permits to transportation companies which allow them to transport industrial wastes from premises. The permits which include necessary information such as characteristics of waste, type of equipment to be used, person responsible , emergency manual, etc., should be submitted in advance of seeking approval.

h. Segregation of Hazardous Wastes

Dischargers should segregate hazardous and non-hazardous wastes at source in order to control the amounts of ISW to be treated and to be disposed of and so that the reuse and recycling of wastes are activated.

i. Treatment and Disposal

The first priority for ISWM should be to establish proper measures for treatment and final disposal of hazardous wastes.

Basic treatment and final disposal methods needed for ISW are chemical treatment such as neutralisation, oxidation and reduction, thermal treatment such as incineration, and sanitary landfill. There are various characteristics of ISW so it is necessary to find the best treatment and final disposal options from a technical and economic point of view.

In many cases the most convenient treatment and final disposal method is secured landfill, as it has the lowest cost. The central government should encourage the private sector to construct such facilities for the sake of environmental protection.

Until the commissioning of such landfills for ISW, hazardous wastes should be stored within generators' premises.

j. Supervision and Advice

Appropriate supervision and sound advice from the central government are most important for the steady introduction of ISWM. Accordingly, the administrative capacity should be improved and consolidated so that it can conduct inspections and give advice to dischargers on the operation of storage, transportation and final disposal of ISW.

10.2 General Recommendation on Medical Solid Waste Management

The objective of this study is to make general recommendations for improving the present medical SWM based on a rapid diagnosis through analysis of existing data. The methodology used in the assessment of medical solid waste in Dar es Salaam has been largely research of previous studies or government reports/statistics. Information was gathered mainly from the Ministry of Health, National Environment Management Council (NEMC), Dar es Salaam City Council (DCC), division of environment, training and research institutions like the University College of Lands and Architectural Studies.

10.2.1 Definition of Medical Solid Waste

The definition of medical solid waste officially specified by the Ministry of Health in Tanzania is as follows.

Medical solid waste includes both non-hazardous and hazardous wastes. Non-hazardous waste includes cotton wool, kitchen wastes, etc. which do not pose any special handling problems, hazards to health or the environment. Non hazardous waste is generated from patients' wards, out-patient-departments (OPD), kitchens, offices, etc.

Medical hazardous waste combines pathological, infectious and chemical waste as well as sharps. Hazardous waste is produced in labour wards, operating theatres, laboratories, etc. The various components of hazardous waste is as described below.

- **Pathological wastes** consists mainly of tissues, organs, placentas, blood, etc. (However the traditional practice is that patients remove/dispose of placentas themselves).
- **Infectious wastes** contains pathogens in sufficient quantity or composition that, when exposed, can result in transmission of diseases - for example, waste from surgical procedures of infectious nature, syringes, contaminated plastic vessels, etc.
- **Sharps** include needles, broken glass, blades and any other items that could cause lacerations or piercing.
- **Chemical wastes** comprise of discarded chemicals - usually from cleaning and disinfecting activities.

10.2.2 Present Situation of Medical SWM in Dar es Salaam.

a. Inventory of Health Care Facilities (HCF)

According to the DCC Annual Health Reports and the Ministry of Heath Statistics, Dar es Salaam city has 363 health care facilities with a total of 1780 beds. Health care facilities include hospitals, health centers and dispensaries which are either owned by the government, parastatal institutions, voluntary/charity/religious organisations or private proprietors. The distribution of hospitals in the three districts of Dar es Salaam are given in Table 10-8.

Table 10-8: Health Care Facilities in Dar es Salaam City

District	Hospitals	Health Centres	Beds	Governmental Dispensaries	Non-Governmental Dispensaries
Ilala	7	1	1135	16	86
Kinondoni	4	3	406	21	90
Temeke	2	1	239	56	77
Total	13	5	1780	93	253

Source: DCC, Health Department

As shown above, 27% of the available dispensaries is owned by the government while the remaining 73% is own by non- governmental sectors.

b. Generation Amounts of Hazardous and Non - Hazardous Soid Wastes

A study of medical waste management in 49 dispensaries and small hospitals in Dar es Salaam conducted by NEMC in 1995 revealed that the medical SW generation rate ranged from 0.03 kg per patient per day to 1.8 kg per patient per day with an average of 0.66 kg per patient per day. The medical SW generation in hospitals alone was estimated at 200 kg per day. Furthermore, the study revealed that hospitals with better medical facilities and good services were found to have a higher waste generation rate. In this study, the Aga Khan Hospital recorded the highest medical SW generation rate of 1.3kg/patient/day which is 9 times that of Temeke hospital (0.15kg/patient/day).

Table 10-9 and Table 10-10 show the waste generation rates of some of the hospitals and dispensaries in Dar es Salaam.

An earlier study on the management of medical wastes in referral hospitals in Tanzania, conducted by NEMC (1994) showed that the Muhimbili Medical Centre (MMC) located in Dar es Salaam, generated about 420 kg waste/day.

Table 10-9: Medical waste generation rates in some hospitals in Dar es Salaam

S/N	Hospital	Number of beds	Waste generation rates	
			kg/patient.day	kg/bed.day
1.	Shree Hindu Mandal	70	0.37	1.83
2.	Ilala	130	0.26	1.37
3.	University Health Centre	24	0.41	3.5
4.	Temeke	140	0.15	1.21
5.	Mission Mikocheni	150	0.79	0.84
6.	Aga Khan	88	1.3	5.8

Table 10-10: Waste generation rates in some hospitals and dispensaries in Dar es Salaam.

Hospital	Refuse Generation rates		
	kg/day	kg/patient.day	kg/bed.day
Aga Khan Hospital	509.0	1.30	5.80
Ali-Jumaa Mosque Charitable Dispensary	22.7	0.20	-
Augusta Huruma Dispensary	1.8	0.88	-
Banana Dispensary	9.6	0.96	-
Burhani Charitable Dispensary	10.1	0.16	-
C.O.G. Dispensary	6.3	0.50	-
C.R.C.T Dispensary	2.0	0.10	-
Elite Dispensary	13.1	0.52	-
Evangelistic Assemblies of God Disp.	7.1	0.35	-
Eye, Nose & Throat Clinic	1.0	0.07	-
Godavern Dispensary	4.5	0.27	-
Gongo la Mboto Dispensary	8.0	0.95	-
Good Samaritan Dispensary	18.1	0.91	-
Hi-care Dispensary	7.1	0.26	-
Hope hospital	26.7	1.50	-
Huruma Health Care Centre	30.2	1.70	-
Ilala Hospital	178.4	0.26	1.37
Kawe Dispensary	23.7	0.38	-
Kilimani Hospital	16.1	1.10	-
Majuda Dispensary	25.0	0.83	-
Marie Stopes - Mwenge	36.3	0.66	-
Mart Buguruni Hospital	6.1	0.61	-
Mission Mikocheni Hospital	125	0.79	0.84
Mkombozi Dispensary	18.1	1.80	-
Moravian Charitable	6.6	0.33	-
Mtongani Health Centre	10.1	2.00	-
Mtoni Dispensary	12.6	1.60	-
Muyas Dental Services	2.5	0.59	-
Mzambarauni Dispensary	12.6	0.53	-
Nyamongo dispensary	3.0	0.30	-
Pangani Dispensary	10.1	0.81	-
Rev. Mangesho Memorial Hospital	24.2	0.97	1.10
Shree Hindu Mandal Hospital	128.0	0.37	1.83
St. Bernard Hospital	32.3	0.65	-
St. Thomas Anglican Dispensary	26.7	0.59	-
T. & Martenity Home & Hospital	17.6	1.00	-
Temeke Hospital	168.8	0.15	1.21
Umoja Hospital	5.5	0.29	-
University Health Centre	84.7	0.41	3.5
Vingunguti dispensary	32.8	0.12	-
Whyte Charitable Dispensary	7.6	0.25	-

Source: NEMC, 1995

Another investigation on "quantitative and qualitative investigation" of medical SW management in the Dar es Salaam city health facilities conducted by Dar es Salaam Urban Health Project (DVHP) in 1996 showed that the average medical SW generation rate in dispensaries is 0.008 kg/patient/day for non-hazardous wastes and 0.0096 kg/patient/day for hazardous wastes. For health centres, the average medical SW generation rate is 0.003 kg/patient/day for non-hazardous wastes and 0.007 kg/patient/day for hazardous wastes. For hospitals, the average generation rate is 0.058 kg/patient/day for non-hazardous wastes and 0.076 kg/patient/day for hazardous wastes. Table 10-11 shows the summary of generation rates for hazardous and non - hazardous wastes in dispensaries in Dar es Salaam.

Table 10-11: Average generation rates for hazardous and non - hazardous wastes in some dispensaries in Dar es Salaam.

Health Facility	Non Hazardous (kg/patient.day)	Hazardous (kg/patient.day)	Total
Dispensaries	0.0082	0.0096	0.0178
Health centres	0.003	0.007	0.01
Hospitals	0.058	0.076	0.0134

The NEMC (1995) study suggested that a waste generation rate of 0.66kg/patient/day can be taken as a design figure for medical waste facilities in Dar es Salaam.

c. Control of hazardous medical wastes by governmental sectors generation sources

The DCC being the local government agency, is responsible for the provision of solid waste management services. With this broad task, the DCC has the role and responsibility to set regulations and by-laws regarding public health and environmental protection; thus directly influencing medical SWM. Due to many operational problems, it is unable to provide adequate trucks to collect medical wastes from the variuos generation points. The services are concentrated on government hospitals and dispensaries, even though they are not adequate. Some private hospitals and dispensaries have entered a contract with Multinet Africa, a private company operating in Dar es Salaam. However, both DCC and Multinet Africa still are unable to collect all of the medical waste generated per day.

From point of view of the health workers, medical waste collection is observed to be a controversial part of solid waste management. For the urban health facilities, if collection is not prompt and efficient, the health workers and users or the public at large will be outraged at the DCC administration.

The principle aim of MSW is to protect public health and the environment of the urban set-up. This encapsulates the broad policy framework of the government's "Primary Health Care" guidelines. As such, concerning general solid waste management, the government's roles and responsibilities include among others, establishing institutional and legal framework for solid waste management.

Assuming that the medical SWM works efficiently, both private and parastatal health care facilities would be expected to comply with the regulations, by-laws and guidelines governing a safe medical SWM system.

d. Processing and Disposal of Medical Wastes within Health Care Facilities' Premises

d.1 Rural Dispensaries

Existing practices show that medical SW is generated in small quantities, contained in small and often improvised receptacles. Medical SW generated is not segregated into any categories.

Waste is thrown into open pits or ground on site and then burned at the end of the day, either daily or at few days intervals. Pit latrines for public use of some dispensaries have been used for dumping/disposal of the generated wastes. Goba Dispensary is known for violations.

d.2 Urban Dispensaries

Experience shows medical SW is generated in greater quantities when compared to rural dispensaries. The wastes are stored in metal receptacles and other improvised vessels, for example, paper boxes, etc. Also waste is not segregated. Medical waste is centrally stored on site in open pits, a hole in the ground or in larger waste containers collection by DCC refuse trucks. If the refuse truck is, for some reason, not available the wastes are burnt on site. Otherwise, the collected medical SW is transported to the current dump-site at Vingunguti.

d.3 Health Centres

Being in located in urban areas, the situation of medical SW is similar to that of urban dispensaries.

Medical SW is collected in 20 litre metal receptacles, baskets and other improvised receptacles. The difference between health centres ard the urban dispensaries is that DCC refuse trucks collect the medical SW more frequently.

d.4 Hospitals

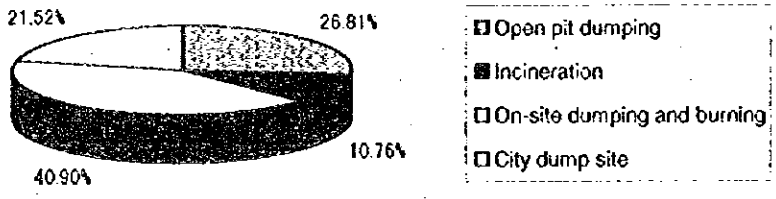
At the various generation points: offices, consulting rooms, minor treatment rooms, etc. refuse bins/receptacles are provided. It is the duty of the hospital staff to empty these receptacles during the course of the day into an intermediate larger receptacle placed within the vicinity of the respective work places. However, segregation of the medical SW is not significant especially in the smaller hospitals such as Temeke, Amana and Mwananyamala. Practices show that only sharps and placentas from labour wards and biological waste from the operating theatre are significantly separated from other wastes. It appears that the main reason for segregating the waste is to prevent the waste handlers from injury by sharp instruments and contamination from pathological wastes during waste handling within the hospital premises, rather than environmental concerns. In many hospitals, the segregated wastes are then put back in the main waste stream. This practise defeats the main purpose of refuse segregation which is to safe guard the waste handlers against the risks of contamination and injury and to protect the environment.

About 43%[3] of hospitals in Dar es Salaam do not segregate their waste. The main reason for this is considered to be ignorance.

In most cases, the medical staff handling the MSW usually have no protective gears, thus exposing themselves to hazards.

About 22%[4] of health facilities in Dar es Salaam receive refuse collection services from Multinet Africa Limited or DCC, the rest have to devise their own means of refuse disposal. The common methods of refuse disposal employed are on site dumping, open pit dumping (burning and burying) and incineration. Figure 10-1 shows the percentage of hospitals using the above mentioned methods of medical waste disposal. It shows that 70 percent of health facilities use the on-site methods and the rest, i.e.30 percent, use off-site methods.

[3] NEMC, 1995
[4] NEMC, 1995



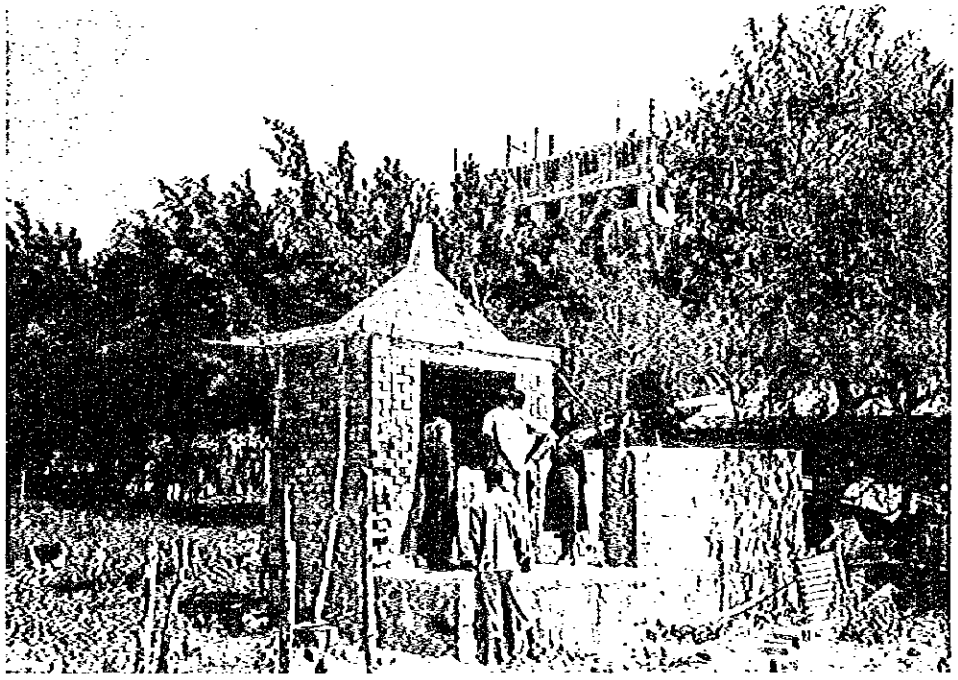
Source : NEMC, 1995

Figure 10-1: The existing medical waste disposal methods in Dar es Salaam

In hospitals normally at the end of working day/shift the cleansing staff (where available) or nursing assistants collect the refuse receptacles from the immediate locations to either on site disposal point(s) or to a bay where the DCC or Multinet Africa refuse vehicle will eventually transfer the refuse to the DCC dump site. The cleansing staff or nursing assistants often man-handle the receptacle containing the medical SW. Only in few big hospitals like MMC where wheel barrow and cars are provided for the purpose of waste collection. However, refuse collection services offered by Multinet Africa Limited are not very reliable. The frequency of refuse collection in most of hospitals served by the company ranges between two to three times a week.

Part of the daily generated hazardous biological wastes, especially from the theatre and maternity ward remain untreated due to lack of incinerators. Citing MMC, in particular the generation of all the wastes that should be incinerated is 0.722 cubic metres per day. But the current incinerator capacity is 0.6m³ per day. This implies that about 17% of the hazardous wastes remain untreated. In Dar es salaam, only Muhimbili Medical Centre (MMC) has a mechanical incinerator and most other hospitals have primitive incinerators which are constituting health risks due to insufficient combustion. Most of the incinerators are constructed from concrete blocks. Since concrete blocks have low temperature tolerance some of the incinerators have cracked as the material passes through hot and cold cycles.

The following picture shows one of the incinerators for medical SW.



Picture : The Incinerator in Mission Mikocheni Hospital under construction in August 1996

The hospitals also face the problem of disposing the ashes from incinerators. Whereas some hospitals bury the ashes within their premises, others transport and bury them off-site. Smoke from incinerators usually causes a nuisance to neighbours (especially in squatter areas) and may bronchitis and aggravate the existing respiratory ailments such as asthma.

If there are any mechanical failures of the incinerators, there is usually no alternative waste treatment other than crude or haphazard dumping either in a pit within the hospital's premises or carried away to a bush and burnt and/or buried.

Whilst on transit and at the dump site scavenging occurs. Waste collectors and other scavengers from the neighbourhood were seen to indiscriminately try and salvage whatever valuables they could find.

e. Processing and Disposal of Medical Wastes outside Health Care Facilities' Premises

The collected waste is transported and disposed of at the Vingunguti dump site. This is Dar es Salaam City's sole official dump site for solid wastes. The dump site is surrounded by squatters on low income.

Crude dumping is practiced at the site as opposed to sanitary landfilling and scavenging is rampant.

Unfortunately, the hospital wastes are not given due regard and are disposed of together with domestic and commercial solid wastes. The non-separation endangers the large number of scavengers earning a living from the wastes. In addition, there are birds, flies and rodents which can spread germs from infectious medical wastes. The Vingunguti dump also boarders the Msimbazi River, which can easily be polluted from the run-off and leachate which might contain pathogenic micro - organisms eminating from the medical waste.

Also, drugs past their expiry dates end up in the dump site without much thought. The drugs can easily be recycled back into the market by ignorant scavengers.

It is obvious, therefore, that medical SW is not properly disposed of and DCC needs to closely follow this up in order to attain safe and acceptable final waste disposal.

10.2.3 Evaluation on the Present MSWM and Suggested Corrective Measures

a. Deficiencies

(i) The personnel deployed for the tasks of medical SWM lack the necessary incentive packages and skills, tools, equipment and protective gears for efficient execution of their duties. Knowledge, attitude and practices as well as environmental awareness are relatively low among those involved in medical SWM.

(ii) Collection services are not reliable. Health facilities in the central business district of DCC are served by a contracted private profit making company - the Multinet Africa Limited which does provide intermittent services as opposed to service contract. Outside the city centre there is no collection service by Multinet Africa Limited but a limited collection service by DCC refuse trucks.

(iii) From the health facilities, the task of medical SWM gradually moves towards the local authority such as DCC. The disposal stage in the waste flow route, requires intervention at higher local and central government levels. However, there is no provision of a refuse vehicle assigned to collect and transport hazardous medical SW to a place where it can be treated. Often, treatment facilities are of low operative capacities or non-existent.

(iv) Proper technical incineration is not carried out. Provision of improvised incinerators usually in most small hospitals, has resulted in incomplete burning of the medical SW with eventual generation of large amounts of ashes, needing secondary handling and treatment.

(v) Crude dumping is practised at the Vinguguti dump site as opposed to sanitary landfilling. Unfortunately, the hospital waste is not considered seriously and is disposed of together with domestic and commercial wastes. The non-separation practice endangers the large number of scavengers earning a living from the wastes.

(vi) The DCC lacks a policy for medical SWM as well as planning resources and technical knowledge in medical wastes management. Management of collection and transportation in the over-all medical SWM system is difficult if inputs of personnel, equipment, vehicles and expenditure cannot be evaluated against demand, priorities and annual budgets.

(vii) The current move of introducing cost-sharing in the health care delivery system does not make the necessary provisions towards allocating financial resources specifically for medical SWM.

b. Remedial measures

(i) For a better, safe and hygienic waste handling practice, appropriate containers should be provided. These containers need to have well fitting lids/covers which are user-friendly and affordable. Pedal bins could be provided at generation points

so as to minimise physical contact with waste. Waste handlers could be provided with and use appropriate protective gears. The segregation of various categories of wastes at generation points should be mandatory to all health facilities.

The promotion of environmental awareness is necessary for hospital staff, patients and the general public with regard to medical waste. Some of the solid waste management problems are partly due to ignorance on the part of hospital staff and the public. The hospital staff entrusted with waste management need to be well motivated and trained through workshops and seminars. The public could likewise, be made aware of medical SWM through use of mass media, information notices in strategic public areas and educational posters.

Each health facility (hospitals) needs to clearly and strategically identify waste storage points with the necessary tools and receptacles to facilitate waste segregation and easy collection by refuse/waste vehicles.

(ii) Each health facility need to be equipped with proper and adequate waste receptacles with clear indications or signs for the different medical solid waste categories, so as to facilitate easy segregation right from the source of generation.

Receptacles should be made of metal or plastic and with appropriate capacities depending on the location or storage point this is for achieving security from vandalism, animals, etc. Litter bins for general public use could be designed and fixed at strategic locations within the premises of the hospital/health facility. Urban health facilities need a collection service for the hazardous medical solid wastes. This service shall include centrally organised equipment, vehicles and handlers (staff).

(iii) Treatment plants such as incinerators which are believed to be the best long term facility for treating medical wastes need to be provided to big hospitals like MMC. Likewise, equipment for sorting, maceration and pulverisation is worth investing, if the economic capacities permit it. Experience shows that incinerators are costly-both to buy and to install. They also have a relatively high operating cost and require skilled operators. However, it remains unbeatable due to their multiple merits.

In view of this, guidance on the selection of the size and type is necessary and they should be strategically located so as to cater for several urban health facilities and operate under commercial basins.

(iv) Ashes and residues from incinerators as well as the general ultimate non-hazardous medical waste should be disposed of at the sanitary landfill site. In line with this, there is a need to develop an appropriate sanitary landfill site with considerations/provisions for the disposal of hazardous wastes, including medical hazardous solid wastes.

(v) The local authorities, would need to allocate adequate funds for medical solid waste management. Given the huge financial burden, privatisation of medical SWM is one option for generating income.

(vi) The DCC may view the establishment of a fully fledged medical SWM system as a very costly and un-sutainable undertaking. This, in the current environment of private sector involvement, may not be as cost-intensive as one may imagine. The

only cost involved will be the service charge (paid to private contractors) and this will have the obvious advantage of doing away with the recurrent costs. Privatization thus appears to be a worth while option demanding reasonable considerations.

10.2.4 General Recommendation

a. Guidelines

In order to enable the government to implement a medical SWM plan, the guideline on medical SWM which are in line with the Sanitary Code containing a section on medical SWM should be put into effect as soon as possible.

b. Education on Source Segregation of Infectious and Non-infectious Wastes

When the medical SW guidelines are enforced, education of staff in medical institutions should be conducted in order to promote source segregation and storage of the infectious and non-infectious wastes.

c. Hierarchy of Legislation

Co-ordination between the national government and the DCC should be sought, when producing laws, regulations and guidelines on medical SW, bearing in mind the hierarchy of the laws, ordinances and guidelines, so as to avoid legislative inconsistency.

d. Coordination

The different levels of government should co-ordinate in law enforcement activities related to medical SWM.

e. Role of the DCC

The role of the DCC should be to co-operate with national government authorities mainly on matters related to nuisances and hazards to people, in general, produced by the mismanagement of medical SW.

f. Enforcement

Medical institutions which violate source segregation regulations for infectious wastes should be strictly punished.

g. Relevant Studies and Projects

The Dar es Salaam Urban Health Project is currently conducting a comprehensive study, called Health Care Waste Management in District Health Facilities, on medical SWM for DSM with the assistance of the Swiss Centre for Development Cooperation in Technology and Management (SKAT). The Tanzanian authorities are requested to respect the findings and recommendations of this study concerning medical SW.