ASSESSMENTS OF GENERATION AND MANAGEMENT OF WASTES IN SELECTED HOSPITALS IN KOGI STATE, NIGERIA.

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BY

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MATRIC. No. 2005/21657EA

DEPARTMENT OF AGRICULTURAL AND BIORESOURCES ENGINEERING

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE.

DECEMBER, 2010

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BEING A FINAL YEAR PROJECT REPORT SUBMITTED IN PARTIAL FUFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG.) DEGREE IN AGRICULTURAL AND BIORESOURCES ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE.

DECEMBER, 2010

DECLARATION

I hereby declare that this project work is a record of a research work that was undertaken and written by me. It has not been presented before for any degree or diploma or certificate at any university or institution. Information derived from personal communications, published and unpublished work were duly referenced in the text.

Olorunsaiye, Josiah Tunde

13/12/2010

Date

CERTIFICATION

s is to certify that the project entitled "Assessments of Generation and Management of stes in selected Hospitals in Kogi State" by Olorunsaiye, Josiah Tunde meets the regulation verning the award of the degree of Bachelor of Engineering (B.ENG.) of Federal University of chnology, Minna, and it is approved for its contribution to scientific knowledge and literary sentation.

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DEDICATION

This project work is dedicated to my lovely father Hon. Olorunsaiye, L.B., my mother and to my wonderful sisters and also to my lovely fiancé.

ACKNOWLEDGEMENTS

My profound gratitude goes to the Almighty God of the universe whom by His grace, mercies and faithfulness has kept me through this programme. May His name alone be praised and glorified forever and ever.

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ABSTRACT

Generation and Management of Waste in selected Hospitals in Kogi State were assessed, the average waste per bed generation in a day was determined to be 0.7124kg/bed/day for the surveyed hospitals of the municipal. Predicting the amount of generated waste is difficult a task because of the various parameters affecting it and its fluctuation is high. In this research, the probable medical waste generation rate from selected hospitals was assessed; the result shows that there were no treatments for the waste generated within the respective facilities, it is strongly recommended that wastes are to be treated before the discharge, also dumpsites should be fenced to prevent scavengers.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 General Background

Medical wastes (solid and liquid), due to its content of hazardous substances, poses a serious threat to environmental health. The hazardous substance include; pathological and infectious materials, sharps and chemical wastes. In hospitals, different kinds of therapeutic procedure (i.e. cobalt therapy, chemotherapy, dialysis surgery, delivery resection of dangerous organs, autopsy, biopsy, paraclinical test, injections etc) are carried out and result in the production of infectious wastes, sharp objects, radioactive wastes and chemical materials.

Medical waste may carry germs of diseases such as hepatitis B and AIDs. In developing countries, medical wastes have not received much attention and it is disposed of together with domestic waste. Improper medical waste prevents a high risk to doctors, Nurses, Technicians, sweepers, hospital visitors and patients due to arbitrary management. Poor scavengers, men, women and children collect some of the hospital wastes (e.g. syringe-needles, saline bags, blood bags etc) desperately for reselling despite the deadly health risk as a result of trying to make a living for themselves and family, (Slack et al., 2004).

It has long ago been known that the re-use of syringes can cause the spread of infections such as AIDs and hepatitis. The disposable items and collection (particularly syringes), its re-sale and potential re-use without sterilization could cause a serious disease burden. The safe disposal and subsequent destruction of illness or injury through contact with this potentially hazardous material and in the prevention of environment contamination, Salvato, (1992).

Unlike ordinary household waste, medical wastes are generally dumped into bins. The liquid and solid wastes containing hazardous materials are simply dumped into the nearest drain or garbage heap or dumpsite respectively basically, proper management both solid and liquid hospital waste is Crucial to minimize health risk. Medical waste requires specialized treatment and management from its source to final disposal because simply disposing of it into dustbins, drains and canals or finally dumping to the outskirts of the city poses a serious public health hazards.

Thus, there is a need to initiate a concentrated effort to improve the medical waste management to reduce the negative impact of waste on; (a) environment; (b) public health; and (c) safety at health-care facilities. Medical wastes (both solid and liquid) account for a very small fraction of about 2% of the total solid waste generated in some town, however, when this tiny amount of waste is not handled properly, it get mixed-up with the domestic waste, and the whole waste stream becomes potentially hazardous.

1.2 Classification of Wastes

1.2.1 General Waste

There are wastes that largely composed of domestic or house hold type waste. It is non-hazardous to human beings, e.g. kitchen waste, packaging material, paper wrappers, plastics etc.

1.2.2 Pathological Waste:

This is a waste that consists of tissue, organ, body parts, human fetuses, blood and body fluid. It is an hazardous waste, it is generated as a result of surgeries, biopsies, autopsies etc.

1.2.3 Infectious Waste:

Blood and blood products and other body fluids contaminated with blood, serum or plasma; cultures and stocks of infectious agents from diagnostic and research laboratories and items contaminated with such agents; isolation wastes from highly infectious patient (including food residues); discarded live and attenuated vaccines, waste, bedding, bandages, surgical dressings, and other contaminated material infected with human pathogen.

1.2.4 Sharps Waste:

Waste materials which could cause the person handling it, a cut or puncture of skin e.g. needles, broken glass, saws, nail, blades, scalpels, specimen tubes, suture needles and others similar materials.

1.2.5 Pharmaceutical Waste:

Includes outdated medications of all kinds, as well as residuals of drugs used in chemotherapy that may be cytotoxic, mutagenic, tetratogenic, or carcinogenic. Items contaminated with or containing pharmaceutical bottles, boxes.

1.2.6 Chemical Waste:

This comprises discarded solid, liquid and gaseous chemicals such as solvents, reagents, film development or developer, ethylene oxide, and other chemicals that may be toxic, corrosive, flammable, explosive or carcinogenic.

1.2.7 Radioactive Waste:

It includes solid, liquid and gaseous waste that is contaminated with radionuclide generated from in-vitro analysis of body tissues and fluid, in-vino body organ imaging and tumour localization and therapeutic procedures.

1.3 Hospital Solid Waste:

Biomedical solid wastes are wastes which are generated from and within hospitals, materials, households, pharmacies, chemists, and laboratories and even from commercial enterprises. The biomedical solid wastes involves syringes, needles, broken glass (contaminated), bandages, surgical dressings, contaminated cotton-wool, razor blades, surgical or latere gloves, suction tubes etc. which are basically categories as infectious waste, anatomical wastes, sharp wastes (used or unused), chemical waste, pharmaceutical wastes, radioactive wastes, Genotoxic wastes, pressurized containers, waste with high contents of heavy metals and finally communal wastes (i.e. low risk wastes).

1.4 Hospital Liquid Waste

Liquid waste – hospital generates liquid waste (infectious or chemical) to avoid the exposure to the general public it is necessary that the waste be properly treated. The liquid pathological wastes should be treated with chemical disinfectant. The solution should be treated with a reagent to neutralize it. This can be flushed into the sewer system for blood, serum sample and body fluids of laboratories should be collected in red bags from penicillin bulbs and send it to incinerator. Put empty penicillin bulbs in the sodium hypochlorite solution. Non-biodegradable wastes can be disposed off in municipal bins non-infectious waste materials like waste and contaminated fluids should be flushed thoroughly.

1.5. Objectives

General objective and specific objectives for the Hospital Waste Management Plan at selected facilities are:

1. To assess the quantity and strength of wastes generated in selected hospitals in kogi state.
2. To assess the way these wastes are managed with a view to knowing the threat they pose to the environment.

1.6 Justification of the Study

Large scale production and improper disposal of waste has become a source of pollution and further accumulation of garbage has resulted in serious deterioration in quality of life and ecological balance. Hospital waste issue has perhaps attracted more lively discussion than scientific topics these resent years. Subsequently, men suddenly realize that his dirty act in practice is wreaking a terrible havoc on his immediate environment. Men are basically the reasons behind every development Endeavour.

When a model is used to determine the futuristic quantity of biomedical waste that can be generated in the hospitals, it would go a very long way to help plant ahead. Many diseases like blood-borne pathogen, aids, hepatitis etc have been reported over and over the years and generally cutting across the developing states and towns due to lack of proper collection and disposal of medical or biomedical wastes, insanitary condition and unsafe utilization of water usage such as drinking, bathing etc an emphasis need to be given on the need of systematic waste management, cost effective method, environmental and procedurally safe and acceptable at low maintenance level. Moreover, equipment (facilities for recycling as well as management of hospital waste are not usually made available by the agencies).

1.7 Statement of the Problem

In previous years, the amount of biomedical wastes generated were relatively low compared to what are been experienced now a days. The public health cost associated with the improper disposal of solid waste can be traced to the proliferation of diseases carrying flies, as well as airborne and water borne diseases through leaching from careless disposal of wastes or dumpsites. Similarly, the burning of waste in an open fire can have significant bronchial effect on human within the environment.

Residents in the vicinity or around the hospital environment where improper management of waste are done are all susceptible to different kinds of health and environmental problems. In some developing states, and town (e.g. areas in Kogi State), selected general hospital has limited means of managing and disposal of hospital waste generation both solid and liquid wastes, wastes in usually burnt within the premises or dumped carelessly at the extreme end of the town which could cause prevalence of various water and air borne diseases and even pollution to the environment which have an hazardous impact on human.

1.8 Scope

The scope of this research is to describe a systematic procedure through which solid and liquid biomedical or hospital waste generation is collected, transported, segregated, sorted, stored and possessed in a proper site to be treated, recycled, re-used and properly disposed adequately in order to reduce environmental and health problems. To evaluate the medical waste generated, and also to assess the various method of hospital/biomedical waste management and suggest a preferred method for hospital waste management and use a mathematical model to predict the quantity of the hospital or biomedical solid and liquid wastes that may be generated in the future, with a condition that, the generated biomedical solid and liquid wastes that may be generated in the future, with a condition that, the generated biomedical or hospital wastes are not recycled or reused.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Management and Method of Disposal of Hospital Waste

One of the consequences of the global urbanization is increasing volume of solid wastes. According to the estimate about 1.3 billion metric tones of waste generated globally in 1990 (Beede & Bloom, 1995). At present, yearly generation of hospital solid wastes equals 0.7 billion tones approximately (united state environmental protection agency, USEPA, 2004).

A considerable amount of money goes into managing such huge volume of solid wastes. These suggest that hospital waste management has become a large, complex and costly service. Hospital waste management is discipline associated with the control of generation, storage, collection transport, treatments and disposal of the medical solid waste.

Hospital waste, in a way is governed by the best principles of public health, economics, engineering, aesthetics and environmental consideration (Daskalopoulos et al.,1999). Hospital or health care facilities in developing countries typically lack the adequate financial resources and skills needed to cope with the problems of waste management. Also, several developing countries have realized that the way they manage their hospital wastes does not satisfy the objectives of sustainable development (Abu Qdais, 2006).

2.2 Socio-Economic aspects of Sustainable Waste Management.

Socio-economic sustainability of municipal waste management system depends on many factors: the degree of privatization of waste management services, the extent of public participation, decentralization of responsibilities and tasks related to waste management. The main actor coordinating within the sector of waste management is local authority, as:

1) Central government decisions are realized in towns;

2) Towns are relatively closed socio-economic systems, negative effects of economic activities as well as consumption results are noticed and felt sooner than global changes;

3) Response to occurring problems on local level is faster: time for identifying them, decision-taking and realizing is shorter; 4) primary information about waste sources, composition, rate and dynamics of formation is

concentrated in towns; 5) local authority can best match waste management system to public needs, there are favorable conditions for making the residents aware of environmental issues and educating them; 6) it is easier to observe and control the operation of waste management system on municipal level, interaction with waste holders is obtained without great effort; 7) local authority can use economic instruments in waste management. Increasing responsibility of waste generators for the produced waste and delegation waste collection and management processes to them; local institutions lose their influence in waste management. At the same time, controlling function becomes more significant; municipalities invest in upgrading control systems, while generators invest in the infrastructure of waste management. Simultaneously there is hardly any other area of environmental protection where every member of society can contribute. Everybody can learn to sort recyclable goods, compost biodegradable waste in households, and make the most of deposit /refund system. (Daskalopoulos et al.,1999)

Socio-economic sustainability of waste management system indicates its financial viability for households, private enterprises, organizations, and local authorities. The sustainability goal is achieved when the financial costs are balanced with the revenues for all waste managers and consumers paying for the service. The system is not financially viable if one of the partners does not benefit from the existing financial arrangements. From the consumer's point of view "economic affordability" and "willingness to pay" must be taken into account. "Economic affordability" requires that the costs of waste management systems are acceptable to all sectors of the community served. "Willingness to pay" is the Degree of actual service payment and indicates whether the users are willing to pay for the provision of the service and how this is demonstrated in practice through their actual service payment. Waste management services are sometimes treated not as a kind of business but as a way to save resources and to reduce external costs (Abu Qdais, 2006). Herewith, waste management system must operate in such a way that expenses are compensated with income, the development of the system is assured and the principle "the polluter pays" is realised. Local waste management costs usually increase when recycling programs are launched or developed. New costs include new collection trucks, containers and labour, processing equipment and labour, educational and publicity materials. Sometimes the overall municipal waste management costs go down after a recycling program is thoroughly integrated into the local system. However, it is not unusual for the overall cost to remain higher with recycling programs

2.3 Environmental Impacts of Hospital Wastes.

Hospital wastes became a global priority in 1990, as a result of world concern for hazardous wastes with the WHO requesting all member nations to develop safe and sound policies on hazardous waste management, with a special concern for hospital wastes because of the epidermic sources of acquired immune disease syndrome (aids). Quiet unlike the developed nations which took the threat of insidious effects of hospital waste seriously and went ahead to evolve policies and strategies to address the menace, Nigeria did not heed to the WHO call, yet the number of public and private hospitals, maternities, dispensaries, clinics, and other healthcare institutions (whether legal or illegal), is at enormous and continue to soar particularly from mid-nineties to date, (sangodoyin and coker, 2002).

The rate of waste generation in these institutions is equally phenomenal and the peculiarly hazardous nature of the waste is more worrisome. in a study on hospital waste management, by (coker, 2002). Reported that out of the fifty-two sampled healthcare facilities, yet in almost all these facilities except the University College Hospital (UCH), the waste storage, collections, transportation, and disposal practices adopted are hazardous. Generally, solid hospital wastes are stored in any available container ranging from plastic buckets to drums, other containers include bowls, wastes baskets, dust pans, and wheel barrow even when taken to the waste disposal sites (which are suppose to be sanitary filled but already turned into mere dumpsite), heedless scavengers gained unhindered access to those wastes. These scavengers are not only susceptible to risks of infection but can also spread the risk to the populace. This careless and casual handling of this pathogenic type of waste is certainly a great concern in this age of highly dreaded and life-threatening HIV/AIDS infections. For the liquid hospital wastes, disposal by sink and then channeled into public open drains to finally end up in stream is the usual practice in most of the surveyed hospitals in kogi state. Many of the reported incidences of communicable diseases such as ascaris, dysentery, diarrhea, cholera, and hookworm, as well as mosquito-borne diseases have been attributed to the use of open drains as a liquid waste conveyance medium (Sangodoyin, 1991).

2.2 Current Status of Waste Management Practice

Currently, hospital waste management in most the developing towns and cities in Nigeria have not been carried out in a sufficient and proper manner in the aspect of collection, transportation and final disposal considering the size and the limited land resources available in those towns and cities. Therefore, the environmental and sanitation (sanitary) conditions have become more serious year by year, and people are likely to be suffering from living such conditions. The scope of problems regarding hospital waste management is very wide and involves the consideration of all the aspect relating to hospital waste and its management, either directly or indirectly, Slack, Gronow, and Voulvoulis, (2004).

2.2.1 Waste Generation and Collection Estimate

The average rate of waste generation from all kinds of healthcare facilities control vanes from 1.896kg/bed/day to 429kg/bed/day in a few major cities. It shows that a trend of waste generation where in increase has been recorded in accordance with city's population besides its social and economic development. Collection rate of hospital or medical waste by respective hospitals or healthcares ranges from 51% to 69% of the total waste generated within their jurisdiction (Pak – EPA, 2005). The uncollected wastes which are 31% to 49% remained on the streets, road corners and open spaces, dumping sites or vacant plots thereby polluting the environmental welfare on continuous basis.

2.2.2 Physical Composition of Hospital Waste

The compositions of medical wastes are in variation from one hospital to another with no distinction between private and public hospitals. It was revealed that the regulated waste made up of "domestic waste' constitutes the larger percentage of the waste stream in all the hospitals. The percentage position ranged between 50% and 66% infectious waste (FEPA, 1991), constitutes between 19% and 37% of the entire medical waste stream sharps constitutes between 7% and 10% of the total waste stream, the chemical waste on average constitutes only 3% of the waste stream while others are insignificant except in one hospital.

2.3 Steps in Management of Hospital Wastes

2.3.1 Collection

Cleaners and nursing assistants are responsible for the collection of medical waste from wards to storage centres in all the hospitals, survey revealed that, poor handling by this set of workers who are therefore exposed to high occupational and health hazards. Resources recovery exist in an informal level and affects mostly office papers, cardboards, plastics, metal cans and glass bottles. The hospital personnel mostly involves are cleaners regulated domestic waste is collected and stored in 50 litres capacity plastic bins or metallic bins with capacities ranging from 2-6 tonnes (FEPA, 2006). Wooden or aluminum boxes are used for the storage of sharps waste type while infectious wastes are stored in black or red plastic bags depending on the hospital.

2.3.2 Segregation

Medical waste segregation is an important step in reducing the volume of hazardous waste as it offers the ability to make more accurate assessment about its composition with the issue of labeled bags to separate infectious waste from domestic waste effectively, segregation of hazardous/infectious waste types is a key to achieving sound medical waste management, therefore a right step health risk reduction.

Results from investigations revealed that, three out of the four hospitals give high priority to segregation from sources of infections and sharps waste by use of colour coding system (FEPA, 1991). It was also revealed that in developing countries, private owned hospitals have the most efficient colour coding system. Coloured buckets, or bags are used; Red for sharps and broken glasses. Green for syringes and needles and Blue for all blood stained cottons, gauze, and bandages. In some hospital infectious wastes is sourced into black plastic bags. Few of the public hospitals practice waste segregation. The entire healthcares collect and store their regulated wastes in black plastic bags for eventual disposal (Lagos state environmental and sanitation law). Despite the commendable level of segregation of medical waste currently achieved in the hospitals. Survey revealed that segregated wastes are at times mixed together by the collector, which portends a serious risk to the general public (WHO, 2005).

2.3.3 Transportation

Internal medical waste transportation is essentially done by adequately designed manual fraction trolleys which ensure stability and impermeability to prevent accident caused by spills, collisions or damages. It is usually labeled and identified according to the type of waste contained in it.

The external medical waste transportation is done by use of vehicle; the hospital waste producer is responsible for safe packaging and adequate labeling of waste to be transported off-site (Pakistan – EPA, 1997). A consignment note should accompany the waste from its place of production to the site it final disposal in separate compartment. It was discovered that due to heavy traffic and odour in the daytime, transportation are usually carried out during the evening and mostly by Night.

2.3.4 Storage

All visited healthcare facilities requires the construction of a central storage place, where the collected hospital solid wastes will be centralized before being) transferred to the treatment or final disposal site. (CEPIS/PAHO-WHO, 1996). It serves as a temporary storage of hospital wastes. The storage of hospital wastes must be for away from hospital rooms and close to the site's door in order to facilitate the transportation operation. Access to transportation vehicles and for loading and evacuation operation should be provided.

2.3.5 Treatment

Implementation of treatment systems for hospital wastes depend on the characteristics of wastes. There are no treatment systems without disadvantages and the final choice of the best available technology depends on the local conditions, (Longe et al., 2005). Therefore, it is very important to adequately segregate hospital waste according to the adopted classification, in order to avoid increasing costs of expensive treatment systems.

Infectious wastes should be treated to reduce or to eliminate health risks. They cannot be disposed of without treatment. The most common treatments are incineration, chemical disinfection, and sterilization with autoclave or microwaves. Treatment operations should be continually monitored to avoid possible environmental pollution and health risks and should be carried out by trained personnel or specialized companies.

According to the characteristics of the selected facilities, and due to environmental and health considerations, sterilization with autoclave is recommended as the best treatment system. However, taking into account the situation of small facilities, a low-cost, low-maintenance treatment system for infectious waste (sharps and non-sharps), such as De Monfort incinerator is suggested, providing that they will be gradually replaced for more environmental friendly options like autoclave.

De monfort incinerator is recommended bearing in mind that the costs of not having a waste treatment are much higher than having one, even it is still inadequate. These incinerators are of high thermal capacity design, and thus needed to be heated up before infectious waste is added. It follows that they should be operated long periods (minimum 2 hours) to avoid using unnecessary amounts of fuel. *De Montfort* incineration is recommended for small facilities, as a transition technology.

2.3.6 Final Disposal

Uncontrolled land disposal in open dumps is not acceptable open dumps are characterized by the uncontrolled and scattered deposit of waste at a site, this leads, to acute pollution problems, fire, high risk of diseases. Transmission and open access to scavengers and animals.

A variety of controlled land disposal options are available to hospital wastes, non-risk hospital wastes can be dispose of in a sanitary and fill. If there is no sanitary land fill, treated waste can be disposed of in a burial pit, lined with an impermeable materials (clay) which is usually constructed within the hospital premises in case of an outbreak of an especially violent infection (such as Ebola virus) both line and soil cover may be added (WHO, 1999).

Non-treated risk-waste should be disposed of in secure landfills. A secure landfill is an installation that permits the confinement of certain types of hazardous waste in the soil, isolated from the environment. However, its utilization should be the last option as waste management technology.

Land filling is considered as a "bottom of the list" option for disposal of untreated hospital waste, and is only recommended when the economic situation of the particular facility does not permit access to environmentally safer technologies, such as the ones previously described.

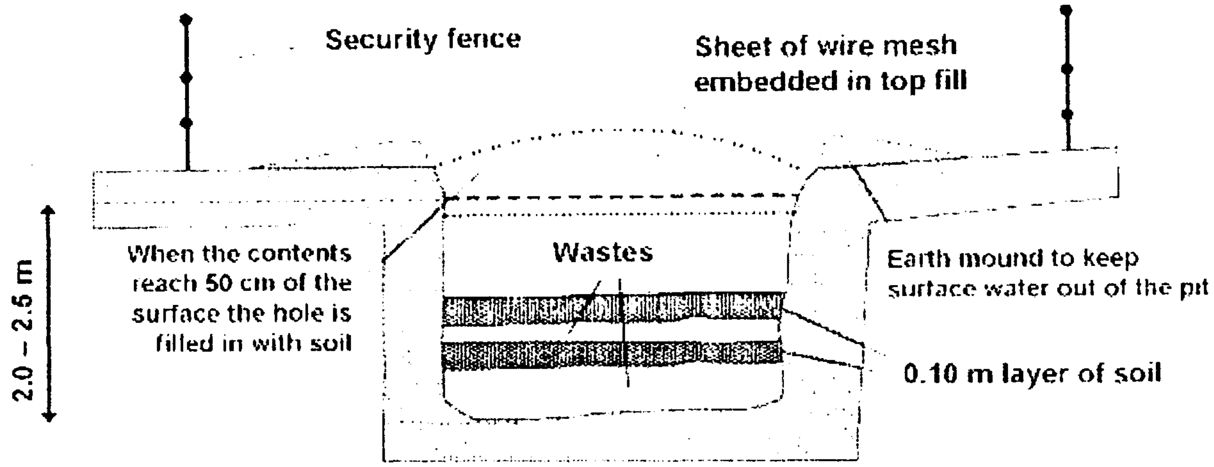


Figure 2.1. Example of a small burial pit for health-care waste

2.4 Wastewater Management

Hospital wastewater contains pathogenic microorganisms, pharmaceutical hazardous chemicals etc which may have an impact on the environmental and public health hospital effluents in some visited facilities are generally discharged towards the urban sewer network, towards septic tanks coupled wastewater disposal well or into open drains, Longe, and Kehinde,(2005).The healthcare establishment should ideally be connected to a sewage system, and where there is no sewage system, technologically or technically sound on-site sanitation should be provided. (WHO, 1999). Discharging of hospital wastewater to municipal sewers without pre-treatment is not recommended an on-site treatment or pre-treatment of hospital wastewater comprises primary treatment (screening, grit chamber, compresses primary treatment (screening, grit chamber, sedimentation tank) secondary treatment (biological treatment process, such as activated sludge, tricking filter, lagoons). Tertiary treatment (physical, biological or chemical process to remove nutrients such as nitrogen and phosphorus, and carbon adsorption to remove chemicals) some small facilities in selected municipals that can not afford to implement the above mentioned treatment system should consider the installation of a proper septic tank and soakaway system as the minimum requirement, however, special care should be taken to ensure a good design, construction, functioning and monitoring of septic tank and soakaway system otherwise odour insurance, flooding and pollution problems could be generated.

2.4.1 Septic Tank

The purpose of a septic tank is to reduce the bacterial and nutrient load (e.g. phosphates and nitrates) of the effluent discharged into it and to avoid the effluent from polluting watercourses or drinking water sources in the vicinity. After leaving the septic tank, wastewater has two options: pass into the subsoil to a soakaway system (which is the usual method in selected facilities) or be conveyed by a system of pipes to a communal treatment point, which may be off-site treatment works reached either via existing sewerage or by tanker. Septic tank is a type of biological sewage treatment system. Waste material is allowed to settle in the tank and is digested by natural bacteria which must be allowed to breed within the tank. The liquid flows out and is discharged via a drainage system under the ground called a "soakaway". Over time partially-decomposed solids build up on the bottom of the tank. This sludge has to be removed regularly to make sure the tank continues to work properly and to prevent the soakaway becoming choked.

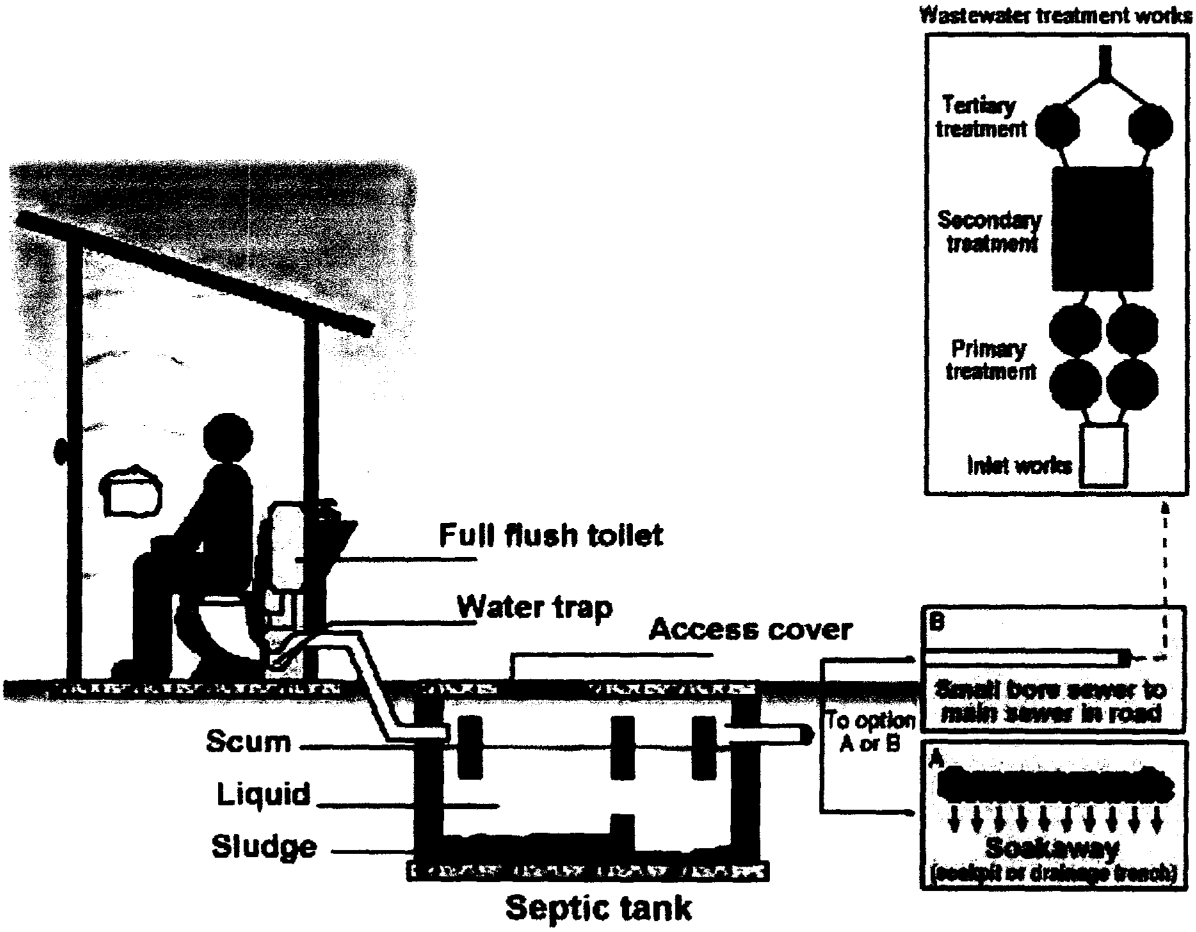


Figure 2.2: Septic Tank and Soakaway or Small Bore Solid-Free Sewer

Source: WHO, 1999.

A septic tank is usually either a large rectangular box made of brick, stone or concrete, although modern types are pre-formed in reinforced fiberglass. Modern septic tanks (often onion-shaped plastic tanks) comprise a watertight primary compartment in which solids are deposited and further watertight secondary settling/treatment compartments in which bacteria break down the waste. Together the primary solids and outcomes from the bacterial activity create sludge (as it has been mentioned), that accumulates in each compartment. The effluent from the secondary compartments discharge into a network of underground pipes or a stone filled soakaway that allows the effluent to percolate into the soil.

When installing and operating a septic tank, it is important to ensure that:

- The septic tank is properly maintained and emptied regularly;
- The septic tank access lids are secure and in good working order; and
- The drains to and from the septic tank, including the soakaway, are free-flowing and free from blockages

2.4.2 Soakaway

A soakaway pit has a perforated lining through which effluent from the septic tank can soak into the surrounding soil (figure 2.3). This effluent contains dissolved polluting materials and also many pathogens that can cause illness. Soakaway trenches or drains performs the same function as the soakaway pit, but are usually more efficient.

The soil type and pit configuration will control the rate at which the effluents will soakaway. As the effluent seeps through the surrounding soil a process of natural purification occurs. This process includes the breakdown of the polluting material by bacteria occurring naturally in the soil, and the eventual "die off" of the pathogens. Adequate purification can only be achieved after the effluent has traveled a fairly long distance through the ground.

A soakaway drain typically comprises a length (around 20+ meters) of perforated pipe laid at a 'flattish gradient' (probably along the contour), in a trench backfilled with poorly graded (i.e., of a similar size) stone chippings (single-sized aggregate). The idea is that the liquid from the tank will percolate through the stone chippings and into the soil. It is not uncommon for the chippings to be laid inside a wrap of geotextile material, which impedes the silting up of the soakaway with fine particles (silt) from the surrounding trench.

The size of the soakaway drain must be sufficient to absorb the tank effluent. If the drain is too short or the soil is too impermeable the drain will become clogged. Typical evaluation of the permeability of the soil will include a 'percolation test' to see how quickly liquid will disappear into the soil. Clay soils will be less absorbent than coarser sandier soils.

When constructing a soakaway, it is necessary to beware of the risk of poisoning local aquifers and water courses:

• Beware of a high water table. A soakaway should not be constructed where the ground water table is close to surface.

• In fine soil, the penetration distance of bacteria may be around 3m from the soakaway. Coarser soils will enable greater penetration. Coliforms (gut bacteria) reportedly can survive for as much as a month if they reach a source of groundwater.

• A limestone or dolomitic geology will most probably be fissured, enabling septic tank effluent to flow away freely. As such, soakaway are unsuitable in areas where this geology occurs.

Overflow from septic tank or soakaway pit or direct discharge without passing through a soakaway system, is polluting and should not be permitted

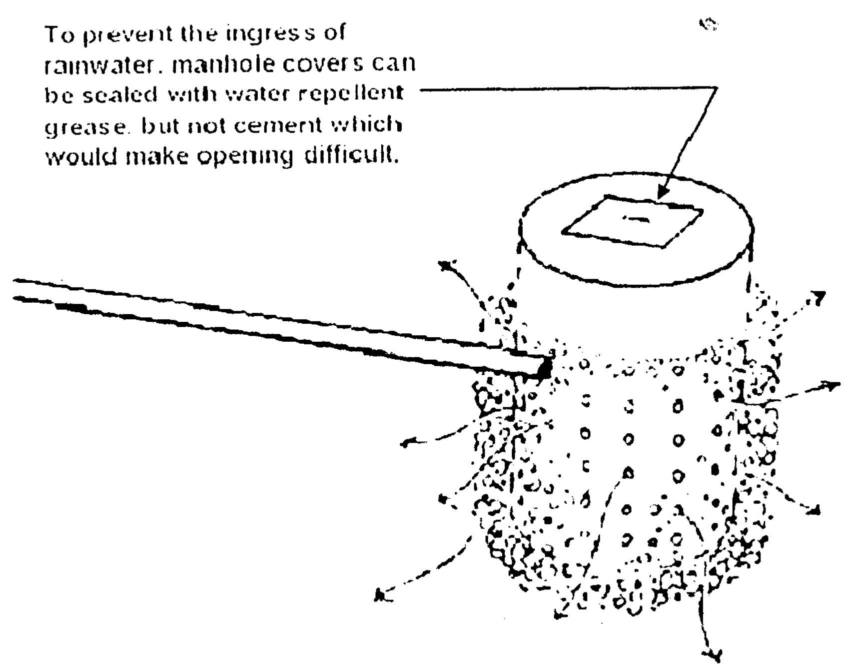


Figure 2.3: Soakaway pit

Source: WHO, 1999.

2.4.3 Negative Effect of Wastewater on Water Supply

Result from various investigations and surveys indicate that water pollution has increased especially in Pakistan (Pak -EPA). The pollution levels are higher particularly in and around the big cities of the developing countries (e.g. Nigeria). The water quality deterioration problems are caused by the discharge of toxics synthetic organic chemicals, pesticide substances, and untreated sewage water to natural water bodies. These substances mixed with water then causes wide-spread water-borne and water – washed diseases (PCRWR).

Disease caused by poor water quality is very high in Pakistan (Pakistan – EPA 2000) taking into consideration the strong sewage smell in some water samples in selected districts, it is also possible to assume that harmful bacteria or other pathogens have found their ways into drinking water from a municipal water sources or well. If these organisms are in the water, illness can occur. Situation of drinking water supply in selected facilities is critical and improving, this situation is imperative and essential.

2.5 Autoclave

Autoclaving is an efficient wet thermal disinfection process. Typically, autoclaves are used in hospitals for the sterilization of reusable medical equipment. The autoclaving process is usually a batch system.

Waste is placed in a sealed chamber and exposed to steam at the required temperature and pressure for a specified time. Minimum contact times and temperatures will depend on several factors such as the moisture content of the waste and ease of penetration of the steam. Autoclaved waste can be disposed of in a sanitary landfill, together with common wastes.

Research has shown that effective inactivation of all vegetative microorganisms and most bacterial spores in a small amount of waste (about 5–8kg) requires a 60-minute cycle at 121°C (minimum) and 1 bar (100kPa); this allows for full steam penetration of the waste material (WHO, 1999).

A major advantage of autoclaving is the capacity a single unit can provide without the spatial requirements associated with incineration systems. The capacity of an autoclave is a function of its size and throughput. For example, an autoclave capable of disinfecting 4,000 pounds per hour of medical waste measures 8 feet in diameter by 24 feet in length, which means it occupies about as much space as a 500-pound-per.hour incinerator.

Autoclaving may be limited in some applications because wastes that are only autoclaved are still recognizable, unless they are shredded or compacted. But this consideration is due principally for aesthetic reasons. In any case, approximately 90 % of regulated medical wastes generated are suitable for autoclaving.

However, Autoclaves are not suitable for cytotoxic and other toxic chemical wastes because of the hazardous nature of these wastes. Autoclaving hazardous materials such as antineoplastic agents, radioisotopes, solvents, or other toxic wastes could lead to chemicals being volatilized by the steam and could result in possible worker exposure between process cycles.

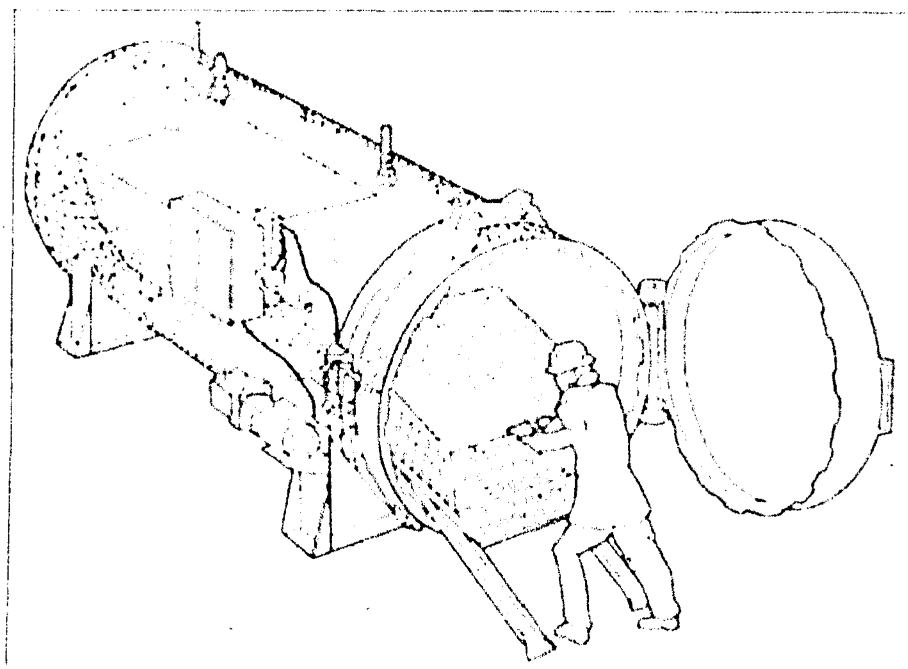


Figure 2.4. Autoclave

Source: U.S. Congress, Office of Technology Assessment. Washington, D.C. 1990

2.6 Incineration

Incineration involves the combustion of waste at high temperatures, which converts waste into heat, sends gaseous emissions to the atmosphere and makes residual ash. Acceptable operating conditions for small-scale incinerators include the continuous supply of combustible required for the selected design, and availability of protective equipment for the operators, such as gloves, boots and aprons (which should be available for all workers collecting or handling such wastes, and not only for the operation of incinerators).

Some locally-built incinerators can function without the need of combustibles, or just by adding other waste such as paper or cardboard. The available space on premises, a minimum distance to the community and the patients, the allocation of resources as well as staff training and most importantly respect of good practices are also prerequisites for incineration (WHO, 2005).Figure 14 illustrates schematically the process flow on an incinerator.

Wastes that should not be incinerated are:

♦ Pressurized gas containers

♦ Large amounts of reactive chemical waste.

♦ Silver salts and photographic or radiographic wastes.

♦ Halogenated plastics such as polyvinyl chloride (PVC).

♦ Waste with high mercury or cadmium content, such as broken thermometers, used batteries, and lead-lined wooden panels.

♦ Sealed ampoule or ampoules containing heavy metals.

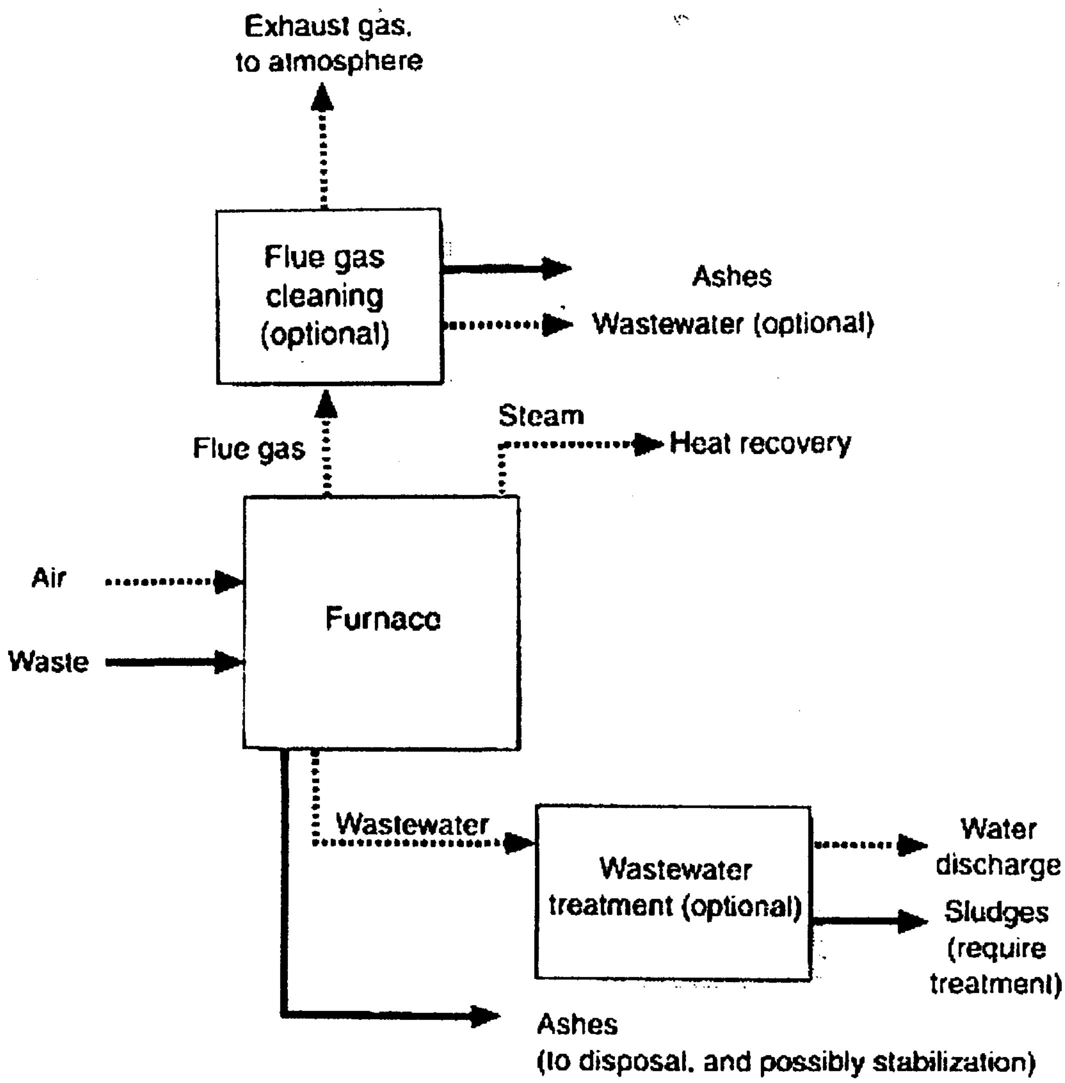


Figure 2.5. Simplified flow scheme of incinerator

Source: WHO, 1999.

The incinerator comprises primary and secondary combustion chambers. The burning zone of the primary chamber is accessible through a door at the front, which lets in air, allows the operator to light the fire, and also allows her/him to remove the ash. The risk waste is dropped in through a loading door above the primary chamber.

The secondary chamber, which is inaccessible to the operator, is separated from the primary chamber by a brick column with an opening at the bottom to induce a cross draught during operation. Additional air is drawn into the secondary chamber through a small opening in the lower section of the rear wall of the secondary chamber. This air mixes with the partially burnt flue gas from the primary chamber and causes secondary combustion.

A self-adjusting draught control for regulating heat output and burn time is mounted at the base of the chimney and controls the flue gases in the chimney. A stove pipe thermometer mounted at the neck of the chimney indicates when the medical waste should be loaded. A 4 meter-high chimney mounted above the secondary combustion chamber releases the flue gases into the atmosphere.

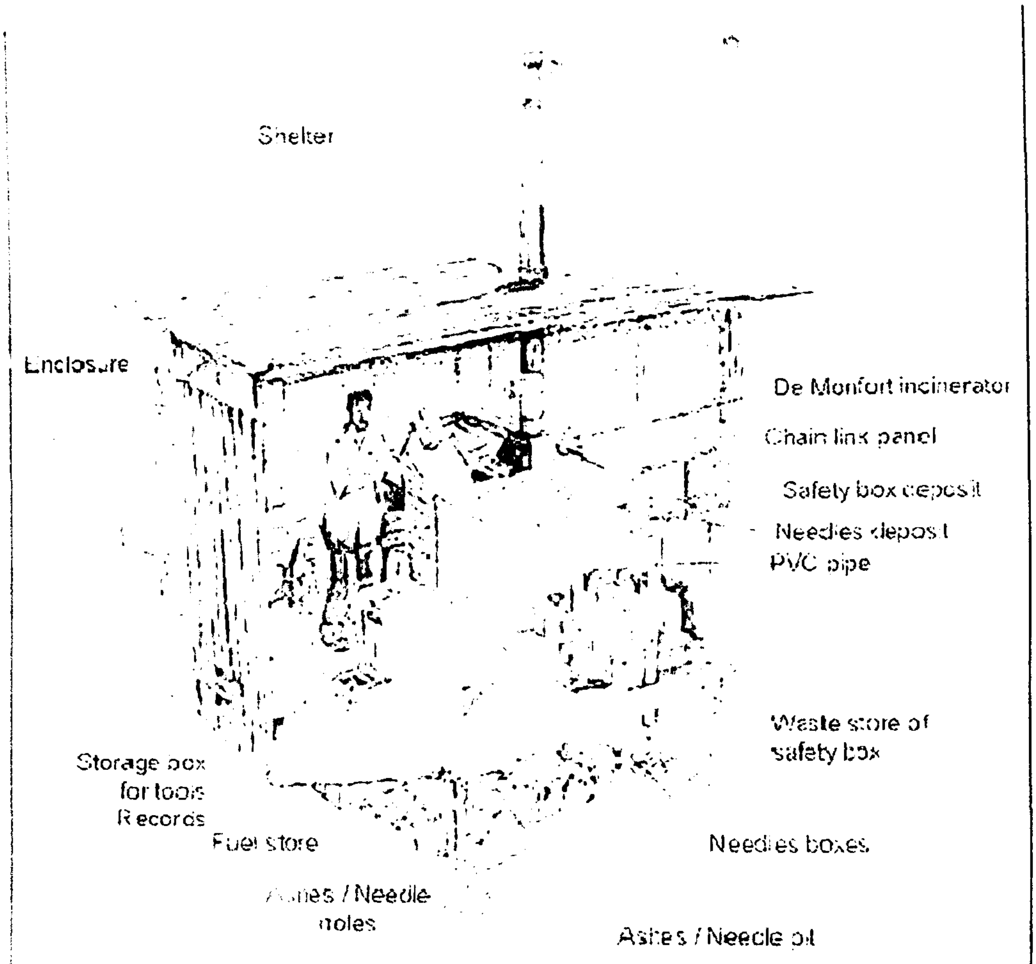


Figure 2.6: Components of the Waste Disposal Unit

Sources: WHO, 1999.

2.7 Pyrolysis

This means heating solid waste at a high temperature in a complete absence or limited supply of air or oxygen. In this technologies, the combustible constituent of the solid waste are heated in a special retort-like chamber referred to as pyrolysis reaction. The operating temperature is usually 600°c to 1000°c or more (Okonkwo and Ebaotu, 1999). This is an endothermic reaction which places economic burden on the process. Nevertheless, it has some alternative appeal to its. The chemical constituents and the chemical energy of some solid waste can be recovered by destructive distillation. Also volume reduction can be as high as 90%. (Okonkwo and Eboatu, 1999).

2.8 Recycling

This is yet another solid waste management procedure that is receiving special attention in many areas recycling means the process of transforming segregated solid waste into raw materials for producing new product which may or may not be similar to the original products involves processing used materials into new product in order to prevent waste of potentially useful materials, reduce the consumption of fresh new materials, reduce energy usage, reduce air pollution from incineration and water pollution from land filling by reducing the need for "conventional" waste disposal, and lower green house gas emissions as compared to virgin production.

Recycling is a key to minimizing solid waste and developing of new products from the assumed waste ones. In the united state, recycling facilities earn estimated revenues of $2.981 billion a year. Growth has exceeded 7% per year for the past five years (2003 to 2008), in part due to rising waste volumes and increasing commodity prices as well as support from the government and business communities, and increased consumer awareness. (United Nation's EPA, 2005).

CHAPTER THREE

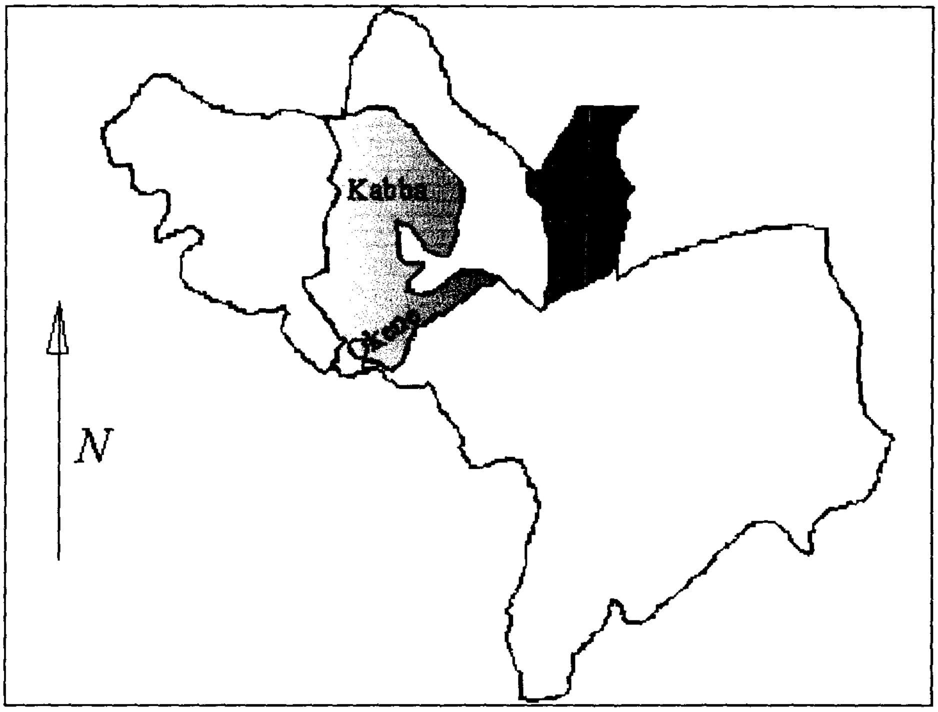
3.0 MATERIALS AND METHODS

3.1 Description of the Study Area

Kogi State is located in North Central Nigeria on the west coast of Africa and it occupies an area of 3,577 square kilometer, which is just about 0.4% of the total land area of Nigeria. It is one of the smallest and also one of the densely populated state in the country with an estimated population of over Two Million inhabitants, based on 1991 population resides in metropolitan Lokoja which is the capital of the state, it is situated in the guinea savanna belt witnessing the AW type of climate. The state has an average maximum temperature of 33.2°c and average minimum temperature of 22.8°c. It is generally hot throughout the year with two district weather which are dry season, (which last from November to February) and raining season (last from March to October), making the average annual rain fall ranges from 1016mm to 1524mm.

The state capital lies between 7°45'27.56 "-7°51'04.34" N and 6°41'55.64" – 6°45'36.58" E within the lower Niger trough. The town is sandwiched to the west and east by the Patti ridge and River Niger Respectively.

FIG. 31 Map of the Study Area



3.2 Materials

Healthcare facilities such as hospital, health centres, medical institutes and clinic are scattered all over the metropolis, and waste generated from them are in most cases mixed with domestic and municipal waste. Six general hospitals (two private and four public) located in different parts (town) of the Kogi state were selected for this research work. The waste management programme of each hospital was carefully studied, and information on the management, segregation, generation, storage and disposal of medical waste was obtained.

Table 3.1. A Summarized Description of the Selected Hospitals.

Hospital	Description	Type of hospital		No. of wards	No. of beds
		public	private		
Hospital A	Lokoja		-	6	50
Hospital B	Okene		-	5	40
Hospital C	Okene	-		10	170
Hospital D	Kabba	-		10	150
Hospital E	Lokoja	-		11	210
Hospital F	Kabba	-		10	120

3.3 Methods

The research design employed involved the use of surveys and also interviews with the officers in charge, Municipal Waste Management (MWM) in each hospital. A single and objective questionnaire based on the guidelines of the safe management of waste from healthcare facilities (WHO, 1999) was administered in each of the hospitals. Healthcare managers, nurses, nursing assistants and waste handles within and outside the hospitals were among those interviewed. The questionnaire contained information on waste generation and main aspects of segregation, collection, storage, transportation, treatment and final disposal of medical waste. Information gathered was used to analyze profile of the management programme adopted by the hospitals for their medical waste. Site visited were conducted for a period of three months between April and June 2010 to supplement and support information gathered from the survey. Site visits were particularly helpful to obtain primary information data on common practices of MWM. Generation rate of hospital wastes in kg/bed/day in each hospital was evaluated.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Results

An accurate forecast of waste generation is an indispensable step in waste management planning. To improve such forecasts for the planning process, one must understand the socio-economic factors that influence the amounts and composition of municipal hospital solid wastes. The amount of municipal hospital wastes vary significantly between different regions overtime. However, accurate forecasting of solid waste quantities is a highly uncertain but indispensable element of waste management planning. The waste generation rates were surveyed as follows; Table 4.1 presents the management consideration used to assess the medical waste management practices. Table 4.2, presents the result of medical waste characterization, while Table 4.3, presents medical waste generation in surveyed hospitals in kg/bed/day and the total waste generated in kg/day. The actual medical waste generation in surveyed hospitals was based on the number of 50litre waste bins used for internal collection and storage of wastes that were filled daily.

TABLE 4.1: Medical Waste Management Consideration

Designation	Hospital Type	Tracking Program	Monitoring Testing	Abatement Facility	MWMP
A	Private	Absent	Absent	None	Absent
B	Private	Absent	Absent	None	Absent
C	Private	Absent	Absent	None	Absent
D	Private	Absent	Absent	None	Absent
E	Private	Absent	Absent	None	Absent
F	Private	Absent	Absent	None	Absent

MWMP: Medical Waste Management Plan.

TABLE 4.2: Composition of Medical Waste from Hospitals (%)

Waste category	Hospital A (private1)	Hospital B (private2)	Hospital C (Public)	Hospital D (Public)	Hospital E (Public)	Hospital F (Private)	Average
Regulated waste	51	50	62	66	70	50	58.2
Infectious Waste	34	36	28	19	20	37	29
Sharps/Pathologica	11	9	8	10	8	10	48
Chemical	2	3	2	4	2	3	2.7
Others	2	2	-	1	-	-	0.8
Total	100	100	100	100	100	100	100

TABLE 4.3: Medical Waste Generation in Surveyed Hospitals

Designation	Hospital Type	Number of beds	Total waste generated (kg/day)	Generation rate (kg/bed/day)
A	Private	50	28.1	0.5620
B	Private	40	22.5	0.5630
C	Public	170	120.2	0.7071
D	Public	150	100.5	0.6700
E	Public	210	199.6	0.9505
F	Public	120	98.6	0.8217

Average = 0.7124 kg/bed day

4.2 Discussion

4.2.1 Waste Management Practices

The adequacy or otherwise of the waste management practices of the surveyed hospitals are were measured against three principal criteria as stipulated in the National Guidelines for the management of medical waste. These include the presence or absence of a tracking programme, monitoring and testing and the existence or otherwise of any medical waste management plan (MWMP) in place. Results of investigation revealed a complete absence of medical waste tracking, monitoring and testing programme in all the hospitals whether public or private. Equally, noted was the absence of an institutionalized medical waste management plan in any of the hospital. Abatement facility in form of incineration was also not available in all the hospital. Results from survey thus revealed non compliance of any of the healthcare facility investigated with the existing national regulatory requirements. Though, the requirements are necessary management consideration, there has not been any known serious compliance by the hospitals in general or enforcement by the relevant regulatory bodies in particular, (FEPA, 1991).

4.2.2 Waste Characterization

From Table 3, Survey results show variations in the composition of medical waste from one hospital to another with no distinction between private and public hospitals. It could be observed that the regulated waste made up of "domestic waste" constitutes the larger percentage of the waste stream in all the hospitals. The percentage composition ranged between 50% and 70%. Infectious waste (FEPA, 1991), constitutes between 19% and 37% of the entire medical waste stream. The chemical waste on average constitutes only 3% of the waste stream while others are insignificant except in two hospitals.

4.2.3 Waste Segregation

Medical waste segregation is an important step in reducing the volume of hazardous waste as it offers the ability to make more accurate assessment about its composition with the use of labeled bags to separate infectious waste from domestic waste effectively. Segregation of hazardous/infectious waste is a key to achieving sound medical waste management therefore, a right step to health risk reduction. Results from investigation revealed that three out of the six hospitals gave high priority to segregation from source of infectious and sharp waste by use of color coding system. The efficient color coding system used; colored buckets are used, red for sharp and broken bottles/glasses, then green for syringes and needles, bleu for all blood stained cottons, gauze and bandages, (Longe, et al., 2005).

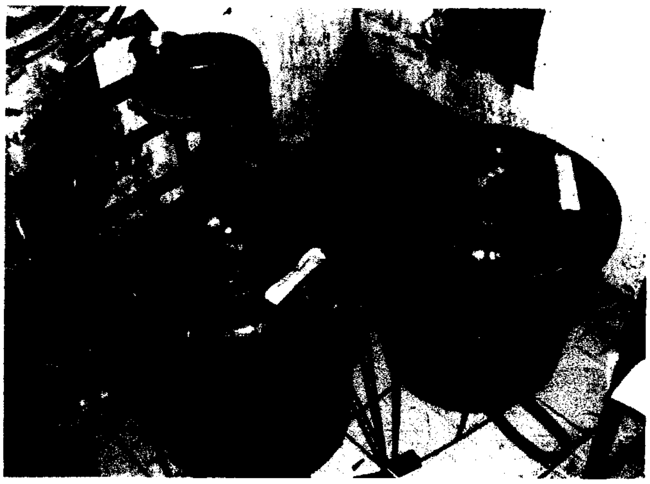


Plate 4.1: Wastes in Different Segregated Waste Bins.

Regulated waste is collected in dustbins. One of the four public hospitals practice waste segregation while there is a complete absence in the other which invariably is the largest of all the surveyed hospitals. It was further observed that there is no uniformity in color coding of medical waste in all the hospitals. The existing National Guideline is also silent about this important aspect of the MWM. However, all the healthcare facilities collect and store their regular waste in black plastic bags for eventual disposal. Surveys revealed that segregated medical wastes are sometimes mixed together by collectors either at the point of collection or at the dumpsites. The whole mixed volume therefore could be considered as being infectious which portends a serious risk to the general public (WHO, 2005a). by the WHO report, it estimated that, in 2000, worldwide, injections undertaken with contaminated syringes caused about 23 million infections of hepatitis B and Hepatitis C and HIV (WHO, 2005a).

4.2.4 Waste Generation

From Table 4, presents medical waste generation in surveyed hospitals in kg/bed/day and the total waste generated in kg/day. It was discovered that most hospitals had no record of the volume of waste being generated by them. The amount of waste generated is easily expressed in volume as most storage facilities are in litres aside those at depot centres. However, all data were evaluated and presented on a weight basis. Medical waste generation rate ranged between 0.562 and 0.950 kg/bed/day, while on average, a generation rate of 0.712 kg/bed/day was obtained. This could not be taken as an absolute value for the entire metropolis due to existence of multiplicity of healthcare facilities within the state. The result, however, serves as a reference point in our initial understanding of medical waste management situation in the state.

The current results are comparable and consistent with the result obtained by Phengray et al., (2005). The total volume of medical waste generated in all the hospitals was 569.5kg/day. This translates to 21.36 kg/bed. Month and a calculated total waste volume of 17,085 kg/month by all hospitals out of this, infectious waste is 4,954.7kg/month, sharps, 8,200.8kg/month and chemical waste 461.3kg/month. Regulated domestic waste constitutes 58.2% of the total medical waste stream. Another noticeable inference is that the proportion of medical waste from the four public hospitals was more than 91% of the total volume of waste stream. The percentages by weight of infectious waste generated by these hospitals are also of higher magnitudes compared with others. The only explanation for this has to do with the number of available medical services and facilities in the four public hospitals.

Plate 4.2: Hospital Waste

Plate 4.3: General Hospital Wastes

4.2.5 Internal Medical Waste Collection and Storage

Cleaners and nursing assistants are responsible for the collection of medical waste from wards storage centre in all the hospitals. The survey revealed poor handling by this set of workers who are therefore exposed to high occupational and health hazard. Resource recovery exists in and informal level and affects mostly office papers, cardboards, plastics, metal cans, and glass bottles. The hospitals have internal storage facilities regulated domestic waste is collected and stored in 50litres capacity plastic bins some of the hospital uses a wooden or aluminum boxes for storage of sharps waste type including the infectious wastes depending on the hospital. Collection of medical waste from the wards to the depot centres is effected about two to three times daily. The frequency of collection from the internal storage facilities by external waste collectors in irregular; Collection could be once in a week or twice in three weeks.

Plate 4.4: Domestic Wastes gathered within the Hospital Environment.

Plate 4.5: Bins for internal collection of wastes

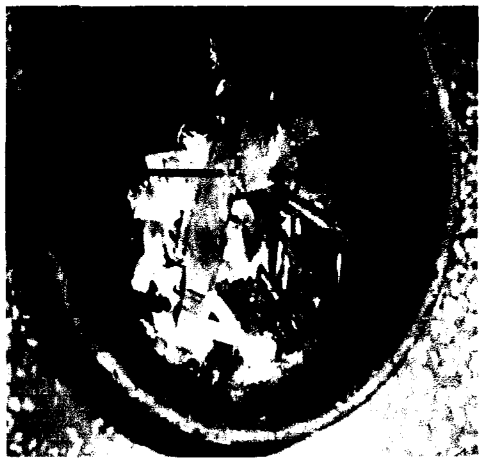


Plate 4.6: Plastic waste bins in surgical room

Plate 4.7: Waste bin in children ward

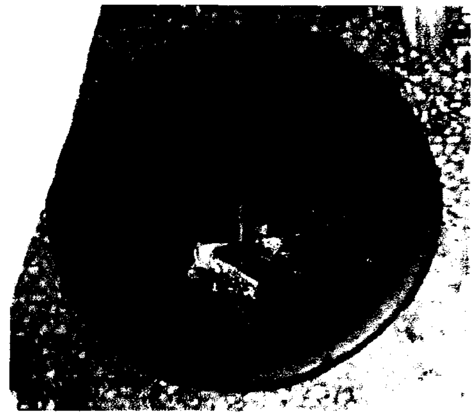


plate 4.8: Waste bin in female ward

Plate 4.9: Waste bin in the labor room

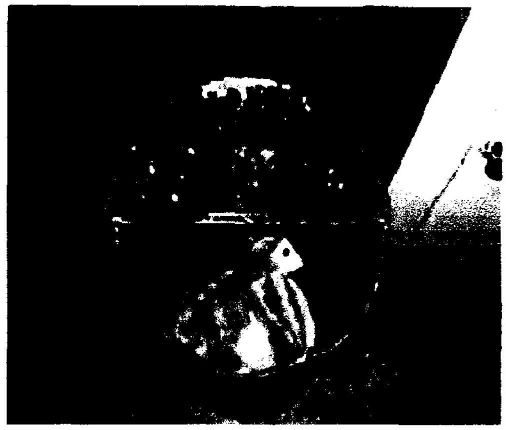


plate 4.10: Waste bin in the laboratory

4.2.6 Treatment and Disposal

Burning and burial of medical waste are practiced; sadly enough medical infectious waste is not excluded from this practice. A common practice is the disposal of infectious and regulated waste type either on fallow land within hospital premises or in canal. This observed poor medical waste management practices is a risk to public health especially when most hospitals are surrounded by densely populated communities. As earlier on indicated that all the hospitals are not equipped with incinerators which invariably means that infectious medical waste and sharps are burn and burry along side with the regulated waste. All the hospitals employ the service of private waste collectors for MW collection and final disposal at government authority that specialize in the collection of industrial wastes from most industrial set ups within the state. Two major observed challenges to the environment are open dumping either within the hospital premises or at government recognized dumpsite; and non treatment of infectious waste before final disposal. Open dumpsites are known to have no control over access of unauthorized persons or scavengers which pose environmental pollution.

Plate 4.11: Wastes scattered

plate 4.12: Scavenger on dumpsite

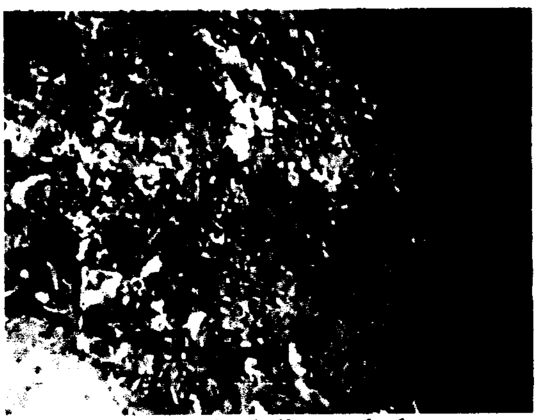


Plate 4.13: Final disposal place

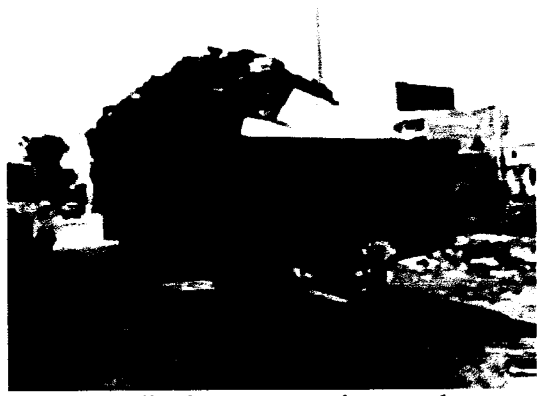


Plate 4.14: Medical transportation truck

Plate 4.16: Disposal of Liquid waste generated within the facility

Hence, the potential health risks (WHO, 1999). The national policy on environment stipulates specific roles for appropriate government agencies to be among others; the determination and the use of environmentally safe and technologically sound techniques for disposal of toxic, hazardous and radio-active wastes. The various dumpsites within the vicinity of the metropolis do not meet necessary design criteria to operate as land fills for hazardous waste. The current medical waste management practice observed within and outside healthcare facilities calls for a specific waste management policy for medical waste in the country, Kogi State in particular. Treatment of infectious waste and sharps waste needs adequate legal backing and sanction, in-case of non-compliance by erring hospitals, health institutions and clinics.

4.2.7 Other Observations

Environmental issues no doubt have found their way to global political agenda in the renewed consciousness of preventing the planet from destroying herself via myriads of unwholesome and unhygienic practices of man. In the Nigerian context, it is high time rhetoric gave way to concerted efforts targeted at stopping a further degradation of the environment via wastes want only generated and carelessly disposed with reckless abandon. It is vital to accept that we have to start all over from the beginning that is come up with reliable baseline data on waste generation rate and waste characterisation, develop cost effective and feasible waste management procedures and system for Nigeria, consider options for minimizing, recycling and safe re-use of wastes and then fashion-out germane national policy on each specific waste. Apart from raising the environmental awareness level of Nigerians FME and other monitoring bodies should go ahead to enforce the existing environmental and environmental health related laws and ethics (edicts) not minding whose ox is gored.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In conclusion, the results of the investigation on the six selected hospitals gave a global view of MWM practice in private and public hospitals in Kogi State medical waste even though, attracted a high level of segregation in most hospitals; it is generally co-disposed with the municipal solid waste stream by waste handlers. The disposal of medical waste in municipal landfills therefore poses serious health and environmental hazards erstwhile land fills are mostly open dumps without adequate design consideration to guaranty protection of the environment from the disposal of such hazardous wastes. Leaches from beneath the landfill base may contain heavy metals and other organic pollutant that could lead to cross contamination of surface and ground water resources, Longe et al., (2005). Hazardous medical wastes require proper monitoring for an effective tracking at all times. Contal of medical can only be fully achieved when adequate monitoring facilities are available. Control means that competent authorities can act rapidly to ensure the possibilities of minimizing inappropriate handling and dumping of medical waste. It also translates to mean that regulatory authorities should have the powers both legally and financially, to act quickly in order to reduce dangers posed to human health and the environment. In order to ensure adequate monitoring and control of medical wastes in Nigeria, governments at national and state levels need comprehensive guidelines on hazardous medical waste management other than what is currently in existence. For effective management therefore, there is need for cooperation among medical waste generators and environmental agencies with coordination among the various persons and corporate bodies involved in the control of medical waste within healthcare facilities should be trained on methods and new techniques of medical waste management and in hazardous effects of medical waste using WHO manual (WHO, 2005b).

5.2 Factors Responsible for Poor and Inadequate Medical Waste Management

In Nigeria these are the factors that militate against effective management of the medical waste, those factors include;

* Attitude of the personnel or workers concerned in the management of the medical waste generated at various healthcare facilities.
* Inadequate infrastructure, including outdated and inadequate collection and processing tools and equipment
* Governmental nonchalant attitude both in legally and financially.
* Corruption; which is a canker worm that has eaten deep into every fabric of the Nigerian society. This we may not deny except to our collective demised and peril.

5.3 Recommendations for Improvements

Based on the generation rates and composition of the medical wastes in Kogi State, integrated medical waste management system which combines a range of solid waste treatment options like source reduction or prevention, composting and waste to energy transformation is recommended. When the hospitals containers and trucks for medical solid waste collection and transportation are insufficient for the medical waste management in the state, responsible body should look after the problem otherwise the municipal solid waste management division should look for other solid waste disposal option.

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APPENDIX

Determining the Mean per Bed Generation rate for the selected hospital:

$$\sum (kg\ /\ bed\ /\ day\ \div number\ of\ hospitals)$$

4.2743÷ 6=0.7124kg/bed/day.

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

DEPARTMENT OF AGRICULTURAL AND BIORESOURCES ENGINEERING

QUESTIONNAIRE FOR PROJECT IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF ENGINEERING (B. ENG.) IN AGRICULTURAL AND BIORESOURCE ENGINEERING.

ON

GENERATION AND MANAGEMENT OF BOTH SOLID AND LIQUID HOSPITAL WASTE IN A SELECTED GENERAL HOSPITAL IN KOGI STATE.

DESIGNED BY:

OLORUNSAIYE JOSIAH TUNDE

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

Questionnaire

HOSPITAL GENERAL INFORMATION

1. General data

Date: ____________________

1.1 Hospital ownership: Ministry of Health (**M**) or ______________________________

1.2 Name of the Hospital: ....

1.3 Address: ....

District: .... Province: ....

1.4 Total area: .... (m²) Open area: ....(m²)

1.5 Type of attention: (✓ the corresponding number below)

General	**1**		Maternity	**7**		Psychiatry	**13**	
Surgery	**2**		Dentistry	**8**		Traumatology	**14**	
Emergencies	**3**		Neurology	**9**		Cardiology	**15**	
Neoplasic diseases	**4**		Ophthalmology	**10**		Gastroenterology	**16**	
Medicine	**5**		Ear, nose & throat	**11**		Urology	**17**	
Paediatric	**6**		Physical rehab.	**12**		Endocrinology	**18**	

1.7 Year of establishment of hospital: [ ]

2. Types ofs ervices offered
(Write in the boxes the letter "**Y**" for those that are offered and "**N**" for those that are not)

2.1 Blood bank		2.10 Chemotherapy ward	
2.2 Out patient department		2.11 Surgery ward	
2.3E mergencies		2.12 Delivery ward	
2.4 General laboratories		2.13 Pharmacy	
2.5 Bacteriology laboratories		2.14 Kitchen	
2.6 Mortuary		2.15 Lunchroom	
2.7 Hemodialysis ward		2.16 Printing	
2.8 Isolation ward		2.17 Cafeteria	
2.9 Medical ward		2.18 Laundry	

3. Statistics Data

3.1 Total number ofp ersons working in the Hospital					
3.2 Number of medical personnel (lab technicians, doctors, nurses, etc)					
3.3 Total number ofb eds (Including nursery)					
3.4 Total number ofo utp atients (day average)					
3.5 Total number ofi n-patients (day average)					
3.6 Total number of deliveries (annual average)					

HOSPITAL SOLID WASTES

1. Is there a department responsible for the solid waste management in the institution? Y/N [ ]

2. Who is responsible for the solid wastes management? [ ]

S Shared with Hospital personnel and a private company
H Hospital employees
P Private Company

3. Working hours of the persons that manage the solid waste (total persons _____)

Shifts	# of persons
1st:	
2nd:	
3rd:	

4. Generation of solid wastes:

Indicate the quantity of wastes generated — Time

Kilograms [K] — Day [D] — Week [W]

	Quantity	Units
4.1 General waste (offices, library, dining room, gardens, etc.)	[ ][ ][ ][ ][ ]	[ ][ ]
4.2H ospitalization wastes (eg. Wards)	[ ][ ][ ][ ][ ]	[ ][ ]
4.3 Wastes from out-patient rooms and emergency	[ ][ ][ ][ ][ ]	[ ][ ]
4.4 Wastes from dressing rooms	[ ][ ][ ][ ][ ]	[ ][ ]
4.5 Laboratory wastes	[ ][ ][ ][ ][ ]	[ ][ ]
4.6 Kitchen and food wastes	[ ][ ][ ][ ][ ]	[ ][ ]
4.7 Ware houses	[ ][ ][ ][ ][ ]	[ ][ ]
4.8 Total wastes generated	[ ][ ][ ][ ][ ]	[ ][ ]

5. Segregation of solid waste

(**Y** for yes and **N** for no) [ ]

6. Primary storage (Write in the boxes the letter **Y** for those that are used and **N** for those that are not)

6.1C ontainer with plastic bags (eg. plastic bin, box, etc.) [ ]
6.2C ontainer without plastic bags (eg.p lastic bin,b ox, etc.) [ ]

7. Internal collection of the solid wastes
(Write in the boxes the letter **Y** for those that are used and **N** for those that are not)

7.1 Container without wheels [ ] — Collection time: ____________________
7.2 Open cart [ ] — ____________________
7.3 Closed cart [ ] — ____________________
7.4 Garbage bags [ ]

8. Interim storage of the solid wastes within the facility is done in:

		Central Storage	
6.1 Cylinders	☐	The storage of the solid wastes:	
6.2 Dischargeable	☐	**C** In a closed environment	☐
6.3 The ground	☐	**A** Open to the air	☐
6.4 No interim storage	☐	**AO** Open to the air with **brick outskirts**	☐

Comments: ______________________________

9. Recovery and recycling of the solid wastes:

	Yes	No
Can you make use of the wastes	☐	☐
Have you thought of recycling the wastes	☐	☐
Have you thought of using it as an energy source	☐	☐
Have you thought of selling the wastes	☐	☐

10. Recovery is done by:

	Yes	No
The hospital employees	☐	☐
Third parties	☐	☐
Informal recovery - hospital employees	☐	☐
- scavengers	☐	☐

The selling is done by:

	Yes	No
The hospital employees	☐	☐
Third parties	☐	☐
Informal recovery - hospital employees	☐	☐
- scavengers	☐	☐

11. Transportation of solid wastes for final disposition:

Municipality	☐
Contractors	☐
Hospital employees	☐

Frequency:

☐	1. Daily
☐	2. Every other day
☐	3. Twice per week
☐	4. Once a week
☐	5. Fortnightly

Collection time [:]

Type of vehicle ....

1. Open back truck or similar
2. Enclosed back truck
3. Dump
4. Compactors
6. Other

12. Treatment:

a. Incinerator

	Yes	No
Ith as an incinerator	☐	☐
Is it working properly?	☐	☐
Renders service to third parties	☐	☐

b. Others ______________________________

13. Final disposal:

Sanitary landfill	☐
Open dumps	☐
Open fire	☐
Buried near or within the Hospital center	☐
Does not know	☐

In the final disposal place:

	Yes	No
Are there people recovering recyclables?	☐	☐

If yes, how many? Men: _______ Women: ______ Children: ______

14. Radioactive wastes generation:

	Yes	No
1. Are there radioactive wastes	☐	☐
2. Do they have previous treatment	☐	☐

3. Actual state of wastes ☐ { L Liquid / S Solid / A Both

4. Final disposition of radioactive wastes

Domestic wastewater	☐
Incinerator from other Hospital center	☐
Sanitary landfill	☐
Dumps	☐
Open fire	☐
Buried near or within the Hospital center	☐
Does not know	☐

WATER SUPPLY AND WASTEWATER MANAGEMENT

15. Liquid wastes management

	Yes	No
Grinders use	☐	☐
Septic tank	☐	☐

16. Final disposal of waste water

	Yes	No
Municipal sewer	☐	☐
Soakage pit	☐	☐
Open drain	☐	☐

17. Type of water supply source

	Yes	No
Direct pumping from ground	☐	☐
If yes, the approximate depth of the well is: ________ ft / m		
Municipality water	☐	☐

18. Water testing

	Yes	No
Tested	☐	☐
If yes, frequency of testing:		
- Quarterly	☐	
- Half yearly	☐	
- Yearly (or more)	☐	

19. Is there a policy of monitoring for water quality testing? _______ What is that policy?

____

20. Who is the person in charge of it? ____

21. Have you ever requested for water testing? If yes, what happened? ____________________

____

22. Why did you request it?
- Change of color ☐
- Bad odor ☐
- Visible suspended solids ☐
- Other: ☐

____

23. Frequency of cleaning of Over Head Reservoir
- Monthly ☐
- Quarterly ☐
- Half yearly ☐
- Yearly ☐
- More than year ☐
- Never ☐

24. Is PAIMAN providing repair / maintenance of water supply / sewerage lines?

Yes	No	Not applicable
☐	☐	☐

25. Do you think the civil works carried out by PAIMAN contributes to negative environmental impacts?

Yes _____ No _____ If yes, how? ____

____

26. Do you think the civil works carried out by PAIMAN are beneficial? Yes _____ No _____

Ify es, how? ____

____

____

____

Persons contacted at the Hospital center:

Names / Contact number	Duty

Recorder:

Name of recorder: ______________________ Signature: ______________________