

**TOTAL HOSPITAL WASTE MANAGEMENT
COLLECTION TREATMENT & DISPOSAL**

A Rational Approach

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A OBJECTIVE

To Identify the types of wastes generated in a Modern Hospital Complex and to recommend safe collection . treatment & disposal system

B SOURCES OF WASTES

Wastes - both solid and liquid are generated from various areas of a typical Hospital . The areas from where the wastes are generated would vary depending upon the type of facilities in the hospital - generally the wastes generated can be classified into two major categories:

- Wastes which are solid in nature and those which can be separated at source .
- Wastes which are liquid , semi solid in nature and such wastes whose separation at source is difficult. However wastes water segregation is possible .

From a typical hospital the wastes generated in the above two categories would be as follows:

S No	Area	Specific Areas Like	Solid Separable at Source Waste	Liquid / Semi Solid Waste
1	General Hospital Area	Non Patient Area - Residence ,Administration etc.	Normal Communal Garbage / Refuse	Normal Liquid Waste Water
2	Hospital Patient Area	Patient Areas - OPD , Wards etc.	Solid wastes will contain bandages ,and other disposal consumable refuse which could be infected	From the Toilet Areas of the Wards / OPD - the liquid waste in all likely hood could carry pathogenic infectious contaminants
3	Hospital Critical Areas	Comprising of OT , ICCU , Labor Room Emergency Areas	Solid wastes will contain bandages ,and other disposal consumable in addition to waste organic tissues , placenta refuse which would be infected	From the Toilet and Wash Area of the OT ICCU etc. - the liquid waste in all likely hood could carry pathogenic infectious contaminants in addition to blood , some organic tissues etc.

S No	Area	Specific Areas Like	Solid Separable at Source Waste	Liquid / Semi Solid Waste
4	Service Areas	Areas like Linen supply for the wards , OT Sterile Supply , catheter Lab etc.	Normally not much solid waste would be generated from these areas - except of discarded linen - which can not be reused and must be disposed	Substantial waste water would be generated from this area in the washing and reprocessing of linen and other reusable consumable in a hospital . The waste water generated will be contaminated - with the contamination coming from the contaminated linen in addition to the detergents , dirt from the linen reprocessing
5.1	Laboratory Services	Normal Pathological Laboratory	Solid wastes would comprise tissue culture and experimental dead animals carcasses etc. and disposable laboratory consumable	Washings of reusable glassware comprising of disposable pathological samples comprising of organic in addition to spent chemicals. This waste water will be contaminated
5.2	Services - Nuclear Laboratory / noninvasive Investigation Techniques	Nuclear Laboratory and Non Invasive Investigation Area employing Nuclear Isotopes	Nuclear Solid Wastes comprising of spent Isotopes and Isotope containers	Spent liquid Isotopes - normally not much liquid wastes
5.3	Services- Non Invasive Techniques Dept.	X Ray and other Non Invasive Techniques like CAT / NMR / Ultrasound , Endoscopy and other non invasive techniques	Spent film wrapping , exposed film etc.	Film developing waste baths containing spent developer containing metals like silver etc. and other chemicals
6	Catering Services	Central Kitchen / Pantry for food preparation & serving	Solid waste comprising of <ul style="list-style-type: none"> • Food pre & preparation wastes • Waste food after serving - this could be contaminated with pathogens 	Liquid wastes generated in catering comprising of <ul style="list-style-type: none"> • Food pre & preparation wastes , Spent cooking medium etc. • Washings of served food utensils etc. - likely to be contaminated with pathogens

C WASTE COLLECTION TREATMENT & DISPOSAL

The above table lists the likely wastes both solid & liquid generated from a typical hospital complex.

The purpose of this note as mentioned is to identify the sources of wastes and to suggest the method of collection and disposal of the wastes.

1. Solid Wastes:

The Solid wastes should be segregated at the source and collected in separate containers .

- a) The non contaminated solid wastes can be disposed along with the communal garbage refuse on sanitary land fill
- b) The contaminated wastes collected separately will have to be incinerated on the on site incinerator
- c) Plastic Wastes to be collected separately and disposed for recycle or incinerated if contaminated.
- d) Glass wastes to be collected separately and sent for recycle .

2. Liquid Waste Waters

GENERAL

Liquid wastes need to be collected in a liquid waste collection system and then treated in a waste water treatment plant. The wastes will be / should be segregated depending on the pollutant.- i.e. weather it is or Organic in nature , , chemical with heavy metals or nuclear with isotopes. There is no need to segregate the organic liquid wastes contaminated with pathogens or not as the down stream waste water treatment system functions and is designed on the basis of pollutant and not weather the waste water has pathogens. The treatment system in case of pathogenic contaminants has to have further additional steps to “Hygenise “ the treated waste water after removal of the primary pollutant - i.e. organic , chemical etc. Based on the waste water sources listed above the following streams need to be segregated

a) X - Ray Waste Waters

X Ray waste water containing heavy metals like silver and spent chemicals. This waste need to be treated separately for removal and recovery of Heavy metals . The treatment steps being - Collection

- i) Equalization
- ii) Reaction to precipitate Heavy metals as sludge
- iii) Phase Separation of precipitate and dewatering of sludge for recovery of metals . The liquid waste can be then mixed with the other organic waste waters.

b) Radio Active Containing Waste Waters

Radio Active waste waters - these need to be separated - contained and disposed is a designated radio active waste disposal area after containment

. The ultimate disposal method will depend upon the nuclear / radio active contaminant

c) Organic Pollutant Containing Waste Water

The balance waste water will be basically containing organic wastes of human origin and as this waste is coming from a hospital it will have a high possibility of pathogenic contamination . There fore this waste needs to be handled with care and has to have special treatment prior to disposal. The recommended treatment would basically comprise of the following

- i) Waste Collection in closed sewer system in the complex.
- ii) Collected waste Sump / Pit
- iii) Screening of waste in an enclosed fine (opening size less than or equal to 5 mm) Plastic or Stainless Steel mechanical bar screen The screenings need to be dewatered , compacted and then collected in compacted form in plastic bags and disposed by incineration. The screenings should not be disposed as land fill and in drained condition as the screenings will be very likely to contain pathogenic materials.
- iv) After screening the waste water will go to an aerated fat / sand trap with a facility of removal of scum (floating oil)
- v) Aerobic Bio Reactor - Suspended Growth with diffused aeration system and aerated in a covered tank and the outlet air being vented out first through filters and then through especially designed aerobic Bio filters to remove pathogens and any odor . All units will be covered and the air vented through the fabric filters followed by bio filters.
- vi) The organic pollutants both dissolved and fine suspended / colloidal will be converted by the aerobic microorganisms which are generally non pathogenic to more microorganisms - using the organic matter as a source of food and oxygen from the air being bubbled through fine bubble membrane diffusers .
- vii) The Bio Reactor will be followed by a settling tank where the bio-mass / micro organisms will settle . A portion of this settled bio mass will be recycled to the aerated aerobic bio reactor for proper F/ M . Some excess bio mass (Sludge) will have to be wasted . There is a strong possibility of this sludge being contaminated , therefore it must be dewatered and Stabilized as well as hygenised for safe disposal . The possible alternatives for safe disposal of the excess sludge are
 - a) Mechanical contained dewatering and then disposal by incineration in the Hospital Solid waste Incinerator.
 - b) Stabilization & Hygenisation after dewatering by mixing with powdered lime - which on mixing with dewatered produces “heat” which will ensure a positive kill of pathogenic organisms , and then disposal in land fill.
 - c) Aerobic Thermophilic Auto-thermal Digestion (ATAD) process by which the sludge will be hygenised &

stabilized (System will operate at 60 deg. C plus ensuring positive kill of pathogens (EPA - of USA has published data on these type of reactors)

d) Pasteurizing - Flash heating of the excess sludge prior to dewatering to 75 - 80 deg. C to ensure a positive pathogen kill.

viii) The overflow treated waste water from the settling tank could also have pathogens so it must be Hygenised prior to disposal. The routes of hygenisation are

a) Ultra-Violet (UV) radiation

b) Ozonation

c) Chlorination - Recommended is chlorinating as it will be fool proof and have a lower cost.

ix) The “Hygenised “liquid waste can after this step can be disposed in to the receiving water body safely of if desired be used after tertiary treatment as horticulture water. The tertiary treatment would essentially comprise of Sand Filtration followed by activated carbon filtration.

The above concept of ***Total Hospital Waste Management System*** has also been depicted in the enclosed Block Schematic for easy understanding of the Concept .

The ***Waste Management System*** including ***Waste Water Treatment System*** described above ensure that all wastes from the complex will be discharged / disposed in a form that will not cause any ***Environmental Damage*** or ***Risk to Human Life*** .