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# Medical Waste and its treatment in Ho Chi Minh city- Vietnam

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<p>Ho Chi Minh city is the largest city in Vietnam. Therefore, the waste discharge into treatment plant is increasing rapidly. Notably, medical waste is the problematic issue that needs a solution immediately. Although the authorities have provided the Regulation on Medical Waste Management in 2007, there are a great number of private healthcare that does not participate in the medical waste treatment. According to the research, two main reasons for this issue are loose management and poor technology. In order to deal with medical waste in the near future, the government should provide clearer policy on medical waste management and socialize in medical waste treatment sector. Furthermore, the treatment technology should be upgraded. Especially, new incinerators with capacity 20 tons per day are highly recommended due to the fact that the current system is overloaded.</p>	

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Keywords

Medical waste treatment, medical waste, waste treatment

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## 1 Introduction

In recent years, as the statistics from Ministry of Health show, the proportion of hazardous waste discharged by hospitals covers 3% of the total amount of medical waste [1]. The amount of hazardous medical waste has risen from 4.7 tons/day in 2000 to 17.16 tons/ day in 2013. At present, the city has 476 medical examination and treatment establishments (public), including central hospitals, city hospitals, district hospitals, medical stations and more than 13,141 medical facilities (private) of diverse type and size. However, only 192 hospitals have their own incinerators for medical waste treatment and have carried out the monitoring of the medical waste treatment. According to annual reports of these hospitals, 99% of the hazardous medical wastes are treated as required. Nonetheless, this number is meaningless due to the fact that all incinerators have degraded without regular maintenance. Therefore, waste treatment with incinerators may cause environmental pollution. Furthermore, under the loose management of the authorities, there are private clinics that discharge their waste directly into general domestic waste.

## 2 Definition and Classification of Medical Waste

### 2.1 Definition

Medical waste is a waste generated from medical examination, treatment, testing and research activities at health care establishments, such as hospitals, healthcare clinics, blood banks, veterinary clinics, medical research facilities and laboratories. Normally, medical waste content blood, body fluids, organs, pumps, needles, sharp objects, pharmaceuticals, chemicals, radioactive substances. Medical wastes are classified as hazardous wastes, requiring special storage, treatment and disposal methods.

### 2.2 Classify of Medical Waste

Medical waste can be divided into infectious waste, hazardous chemical waste and solid radioactive waste. Each medical waste type is described in more detail in the following subsections.

#### 2.2.1 Infectious Waste

There are four groups in infectious waste:

- *Contaminated wastes*: Wastes that are contaminated by bacteria, viruses, parasites, and fungi. This infectious waste category includes blood infusion materi-

als, mucosal secretions of patients, gauzes, cotton swabs, gloves and blood transfusion pipe...

- *Sharp objects*: Needles, scalpels, broken glass and any material that can cause cuts are considered as sharp objects.
- *Hazardous laboratory waste* includes gloves, glasses, test tubes, laboratory samples and blood bags.
- *Anatomical waste*. Organs of patients and animals, body tissue, limbs, and placenta are examples of anatomical waste.

### 2.2.2 Hazardous chemical waste

Hazardous chemical waste can be divided into four main groups:

- *Pharmaceutical products* which are expired or infested and no longer usable.
- *Hazardous chemicals* used in medicine.
- *Cellular toxins*, including the capsules, vials, cytotoxic drugs and secretions from patients treated with chemotherapy.
- *Heavy metal waste* such as mercury (from thermometers, dental waste), cadmium (from batteries) and lead from lead-coated materials used in radiation imaging, radiation therapy).

### 2.2.3 Solid radioactive waste

*Solid radioactive waste* includes materials used in experiments, diagnostics, treatment containing radioactive substances.

## 3 Impact of Medical waste

### 3.1 Impact on human beings

Contact with medical waste could cause injury and disease. HIV, Hepatitis B, staphylococcus could infect the human body through wounds, through scratches cause by sharp objects; through mucosa or mucus membrane, through the respiratory tract; through gastrointestinal tract by swallowing.

Furthermore, cytotoxic waste is extremely dangerous due to the fact that it could be inhaled.

Last but not least, exposure to highly radioactive sources such as X-ray machines, CT scans can cause some damage such as tissue destruction and acute burns. Health care workers or garbage collectors who carry this type of waste are at high risk.

## 3.2 Impact on the environment

### 3.2.1 Impact on soil

Landfilling the medical waste in the wrong way can make microorganisms and toxins infiltrate into the soil, hence increasing the risk of soil pollution.

### 3.2.2 Impact on air

Medical waste cause negative impact on air from the beginning of the disposal process. When sorting and transporting, the dust and spores release diseases-causing particles and organisms as well as toxins into the air. At the stage of treatment, toxic substances such as HX, NO<sub>x</sub>, dioxin, furan, CH<sub>4</sub>, NH<sub>2</sub>, and H<sub>2</sub>S are generated from landfill and steam into the air. Therefore, health of the surrounding communities can be affected.

### 3.2.3 Impact on water

Landfilling medical waste together with domestic waste will cause the risk of groundwater pollution.

## 4 Government Regulation on Medical Waste Management

### 4.1 Regulations on classification

The waste have to be sorted immediately at the sources . There are bags and boxes with color code and symbol for each type of waste (detailed in Appendix 1)

### 4.2 Regulations on storage and management medical waste in hospital

The wastes have to be collected into boxes and bags with color code due to its type and have to be labeled. Hazardous medical waste cannot be put in general waste bags; otherwise the whole bag should be treated as hazardous waste. The maximum amount of waste in each bag is ¾ bags. The waste have to be collected at least 1 per day. Highly hazardous wastes have to be initially treated at the place where it was generated before collecting to the waste treatment place of the medical establishment.

### 4.3 Regulations on transportation of medical waste

Health facilities have to make the contract with the legal status company of transport and dispose of waste. In cases the localities have no legal capacity to transport and destroy medical wastes, medical facilities must report to local authorities for settlement. Hazardous medical wastes have to be transported by specialized means to ensure hygiene, meeting the requirements of the Ministry of Natural Resources and Environ-



ment's Circular No. 12/2006 / TT-BTNMT of December 26, 2006. Providing conditions for professional practice, registration, practice licensing and hazardous waste management codes. Hazardous medical waste must be packed in containers to avoid the breakage of the transportation before shipment to the place of destruction. Surgical wastes have to be kept in two yellow bags or individually packed in boxes, sealed and labeled "SURGICAL WASTE" before being transported for destruction.

#### 4.4 Regulations on model, technology for treatment of medical solid waste

Hazardous medical waste treatment and disposal models have 3 scales:

- *Model 1 (Large scale):* Center for treatment and destruction of medical waste.
- *Model 2 (Medium scale):* Hazardous medical waste treatment and facility for health facilities cluster.
- *Model 3 (Small scale):* Treatment and disposal medical waste at source.

The Regulation on Technology for treatment and disposal of hazardous medical waste said that the method of medical waste treatment technologies have to meet the environmental qualities and meet the conditions of the international conventions to which Vietnam is a signed party. Furthermore, technologies for treatment of hazardous medical wastes include incineration, sterilization by moist heat; microwave technology and other processing technologies. Encourage the utilization of environmental-friendly technologies.

There are also recommendations for initial treatment for high infectious waste. High infectious wastes have to be treated near its generated place. The initial method of treating such high-risk waste may be by one of the following methods:

- *Chemical disinfection:* The wastes are dipped in 1-2% Cloramin B solution or 1-2% Sodium hypochlorite for a minimum of half an hour or other disinfectants according to the directions of use from the manufacturer and in accordance with the regulations of the Ministry of Health.
- *Heat sterilization:* Put high-risk waste into a steam sterilizer and operate in accordance with the manufacturer's instructions.
- *Boiling:* Boil the waste for a minimum of 15 minutes.

Highly hazardous waste after initial treatment can be put into yellow plastic bags to mix with contaminated waste. If this waste is initially treated by heat, microwave or other modern technologies, it could be treated as general waste and could be recycled.

## 5 Medical Waste Situation in Ho Chi Minh City

### 5.1 Incubation of medical waste in HCMC

According to the national environmental report in 2017, the South East is the region with the largest annual medical waste in the country. For example, Ho Chi Minh City with a large concentration of modern medical facilities and high professional qualifications is attracting large numbers of patients from neighboring provinces. Therefore, medical waste is currently a problem for the city.

The city now has 476 medical facilities (public sector), including central hospitals (managed by the Ministry of Health), city hospitals (Department of Health Management), district hospitals, medical centers (ward level), hospitals under the management of, for examples, the Police, Military, Post and the Transportation department. and over 13,141 medical facilities (non-public) of various types and different scale such as: hospitals (general, specialized), clinics (specialty, general, office), maternity homes, medical services (medicine, injection, home health care and dental care. The number of public institutions is still lower than the private one, but in terms of organization size and expertise, the public sector still attracts the majority of visitors; therefore, the volume of medical waste generated accounted for a larger proportion.

According to data released by One-Member Limited Company Urban Environment and Ho Chi Minh City Department of Natural Resources and Environment, the amount of (contaminated) medical waste collected and treated has increased from 4.6 tons / day (2000) to 22 tons / day (2017) from the health facilities.

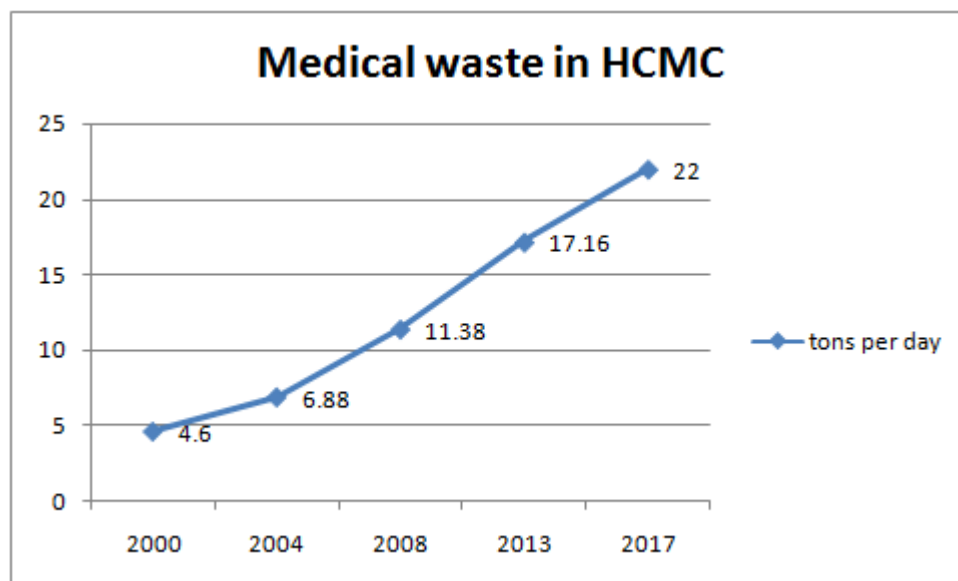


Figure 1. Medical waste in Ho Chi Minh City from 2000-2017 (source: CITENCO)

These figures mostly apply to the public sector that has contracted transport and treatment.

Medical waste in Ho Chi Minh City is forecast to increase by 10% per year (2020 is 30 tons per day and 2025 tons is 50.5 tons per day) [3].

Therefore, there is an estimate that around 8500 private healthcare facilities do not have a contract with the waste treatment company, which means that the medical waste from such facilities has been collected as general domestic waste. Most of those facilities that failed to have the waste treatment contract are small scale facilities.

## 5.2 Collection and treatment of medical waste in HCMC

### 5.2.1 Classification at source

Unlike industrial waste and domestic waste, medical waste is classified only at source, not in transportation, transfer station or treatment plant.

Most healthcare facilities in Ho Chi Minh city classify medical waste in five types:

1. Infectious waste is placed in a *yellow* bag or container
2. Hazardous chemical waste is sorted in a *black* bag or container
3. Radioactive waste is discarded in a *black* bag or container
4. Pressure vessel waste (small one) is place in a *green* bag or container
5. General domestic waste is thrown in a *blue* bag or container and recyclable waste is in a *white* bag or container.

Classification at source is performed very well by the public healthcare units, but it is a problematic issue with the private ones. Approximately 30-50% private healthcare facilities disposed of their medical waste as general domestic waste.

The only solid medical waste collection system currently being organized by the State consists of two parts.

First, Urban Environmental One Member Limited Company (CITENCO) collects medical waste at the source of large scale health facilities such as public and private hospitals and is responsible for transferring the medical waste to the treatment plant.

Second, District Service Providers of Districts are responsible for collecting in districts, mainly from small health clinics such as commune health stations, clinics, nursing homes, midwives, some hospitals and private clinics.

The frequency of collection for large-scale medical establishments is maximum of once per 2 days; for small and medium-sized medical establishments, it shall not exceed one week for clinics without specimens and once a day for clinics with specimens.

### 5.2.2 Reused and recycling

Two main types of solid waste can be recycled (1) plastics, and (2) glass, which are very high value because they are usually very good material. Healthcare facilities, like other business units, have the right to sell their scrap. This is a completely free market, but the city has not quantified the quantity solid waste that can be recycled.

### 5.2.3 Waste treatment

The solid medical waste treatment in Ho Chi Minh City is handled by the State despite the socialization policy (not attractive to investors), and CITENCO is the implementing agency. Currently, the treatment technology after collecting at source is destruction by burning.

There are two medical waste treatment plants in Ho Chi Minh City: Binh Hung Hoa and Dong Thanh. The Cremation Center of Binh Hung Hoa Cemetery has two incinerators as follows:

#### (1) Medical waste incinerator with capacity of 07 tons / day

This is a semi-automatic solid waste incinerator. The firing temperature of the furnace is from 8000C - 11000C, and the execution time of 1 batch is 20 minutes, using gas. This furnace was manufactured by Hoval - Switzerland in 2000 with the full features of a modern medical waste incinerator, designed with a capacity of 7-8 tons per day. However, the operating capacity of the furnace may increase (under allowable conditions and not exceed the designed capacity of the manufacturer) up to 13.95 tons per day. At present, this incinerator is operating at a maximum capacity (12-13 tons / day), almost double the capacity of the furnace. Due to insufficient maintenance, the furnace frequently encounters incidents, and waste at the plant could stagnate with the volume sometimes up to 20-30 tons [2].

#### (2) Industrial waste incinerator with capacity of 04 tons / day

This is a CITENCO investment. The furnace is designed as a standard module with a capacity of 300 kg / h. equivalent to 4,800 kg / day for 16 hours of continuous burning. This means that the system can add up to 20% of capacity in the event of a sudden increase in waste volume. The temperature of the furnace is from 8500C - 10000C.

Furthermore, there are five private hazardous waste incinerators in 15 districts in Ho Chi Minh city, which can participate in medical waste disposal in case of an urgent situation [2].

## **6 The Limitations of the Current Medical Waste Treatment System and Solution**

### 6.1 The Limitations

There are seven limitations, which are described in more detail below:

1. The treatment system tends to be overloaded: the waste stagnation always occurs when there is a problem with the furnace.
2. The private sectors have not participated actively in classification and treatment.
3. Lack of equipment for collecting at source in district scale.
4. Cities do not have a health care waste management plan or strategy up to 2025 (2030).
5. The data for management work is mainly based on administrative data (data reported by reporting units), not based on scientific data (research data) and these figures are very discrete. Particularly, the volume of medical waste arising has seldom been evaluated and forecasted.
6. There is no socialization in collection and treatment of solid medical waste. Therefore, it is not a competitive market in terms of quality and service due to the lack of attractive investors in this area (not profitable).
7. There are no specialists in the environmental field at healthcare facilities or there is staff in charge but not specialist.

### 6.2 Solution suggested

#### 6.2.1 Technology solution

As reported above, the current main furnace is old and overloaded. It cannot handle the work in foreseeable future when the amount of waste approaches over 50 tons per day. Currently, burning waste by incinerator is still the best method that Vietnam could afford. Therefore, a new incinerator is needed. There are two types of incinerators that are widely applied in medical solid waste treatment: controlled-air and rotary kiln.

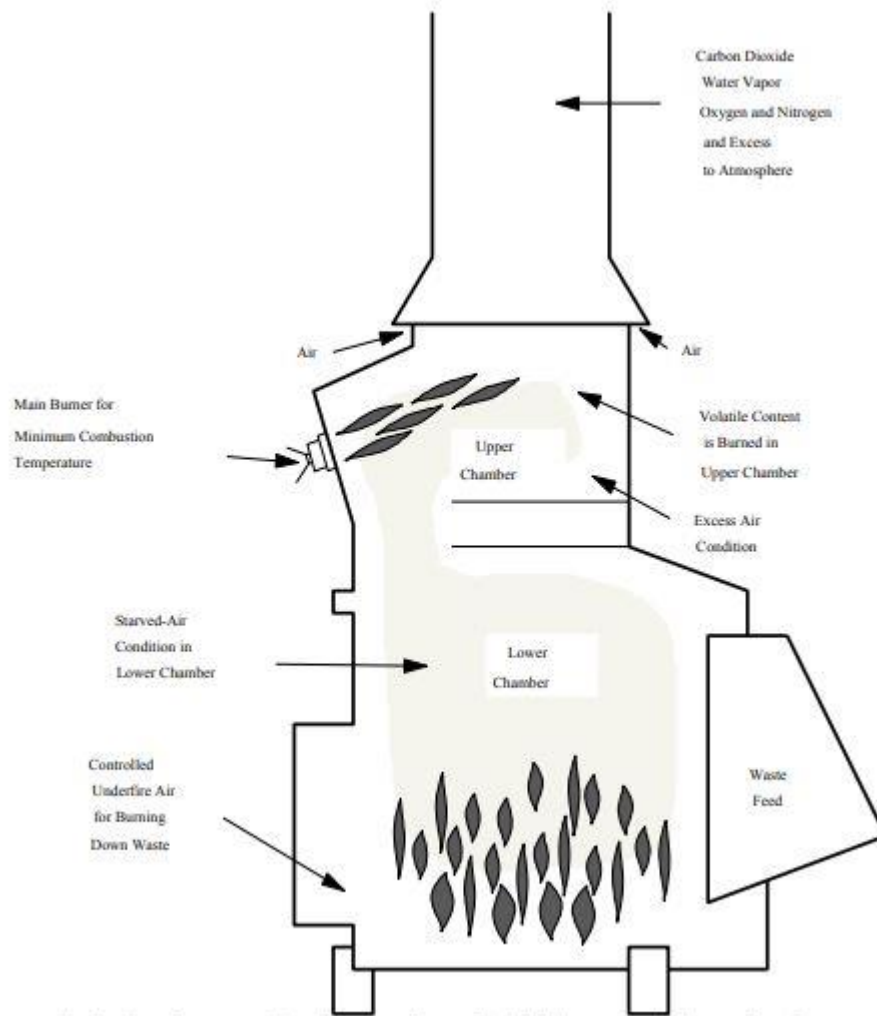


Figure 2. Controlled-air incinerator [4].

Controlled-air incinerator combusts the wastes in two stages. In the first stage, the primary chamber is fed with waste and burn the waste with less than the theoretical amount of air needed for burning. In this stage, the wastes are volatilized and dried by the low air-fuel ratio. At the second stage (upper chamber), adding excess air is needed to complete the combustion.

The advantages and disadvantages of the controlled-air incinerator are listed below.

#### Advantages

- Low investment and operating costs
- Low concentration of dust in the exhaust gas
- Good combustion performance
- Low fuel requirements

- Significant reduction in waste volume

#### Disadvantages

- Needs for pre-treatment of solid waste
- Longer burning time than the rotary kiln
- Poor mixing of waste during incineration

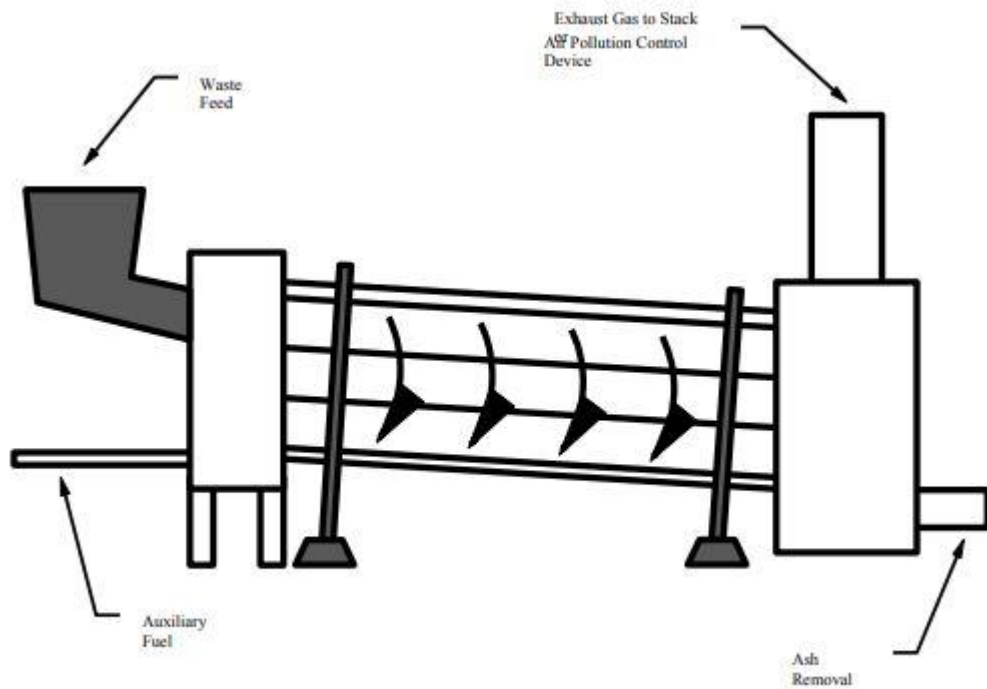


Figure 2.3-3. Rotary Kiln Incinerator

Figure 3. Rotary kiln incinerator [4].

The rotary kiln incinerator is also designed with two chambers: a primary chamber that heats and volatilizes the waste and another chamber that combusts the volatile section. The primary chamber is a slightly tilted rotating kiln where the waste moves from the waste feed to the ash removal end. The amount of input waste is managed by adjusting the rate of kiln rotation and the tilt angle.

The advantages and disadvantages of the controlled-air incinerator are listed below.

#### Advantages

- Very high processing power
- Ability to handle multiple types of waste simultaneously
- High operating temperature
- Increase in the combustion efficiency due to good mixing

### Disadvantage

- High investment and operation expenses
- High maintenance requirements for the furnace refractory and the tightness of the furnace.
- Problems caused by mixing waste
- Exhaust gas with high dust content
- Difficult control of fire conditions along the length of the oven
- Heat losses due to ash

On the basis of the above-mentioned advantages and disadvantages of these two types of incinerators, the air-controlled incinerator is the most suited with current condition in Ho Chi Minh city due to its expenditure and efficiency. It is predicted that medical waste could increase up to 50 tons per day in 2025; thus the highest hourly destruction capacity might be needed to dispose of all that medical waste. The highest capacity incinerator now is around 1000 kg/h (20 tons/day); therefore, the city might need at least two of them included the current one to meet the need in the near future.

#### 6.2.2 Management solution

Firstly, the government should consider a specific and flexible in organizing medical solid waste collection network. For example, public service companies are permitted to collect and transport medical waste according to regulations. Secondly, a mechanism to measure and statistics the criteria surrounding "medical waste" should be established. For example, the amounts of medical waste generated in hospitals, the level of harm, the treatment cost and the consequences to the environment. Next, the government should organize public awareness programs and release materials of technical management, classification, treatment of medical waste for hospital staff. Finally, the authorities should clearly define the roles and responsibilities of the agencies and departments involved in the management of municipal medical waste and ensure the coordination to bring the highest efficiency.

## 7 Conclusions

With the rapid rise of the population of Ho Chi Minh City, it is necessary to increase the number of hospitals and health facilities to meet the needs of people. This means that the collection, sorting and treatment of the medical waste in the city would become more difficult and complex and cause high pressure. In addition, solid medical waste is classified as hazardous waste, thus it is essential to ensure human safety and to avoid environmental pollution. Therefore, the Ministry of Health and the specialized departments have enforced specific solutions to the management of solid waste such as Cir-



cular 12/2006 / BTNMT, the Medical Waste Management Regulation, the Law on Environmental Protection 2005. Besides, the medical waste treatment system in Binh Hung Hoa and Dong Thanh will be completed and improved to adapt to the future situation. With the combination of the solutions mentioned above, the medical waste that polluted in Ho Chi Minh City is hopefully reduced.

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Appendix 1. **Regulation on management of medical wastes 2007**

THE MINISTER OF HEALTH

SOCIALIST REPUBLIC OF VIET NAM

Independence – Freedom – Happiness

No. 43/2007/QĐ-BYT

Hanoi, November 30, 2007

**DECISION**

PROMULGATING THE REGULATION ON MANAGEMENT OF MEDICAL WASTES

**THE MINISTER OF HEALTH**

*Pursuant to the Government's Decree No. 49/2003/ND-CP of May 15, 2003, defining the functions, tasks and organizational structure of the Health Ministry;*  
*Pursuant to the November 29, 2005 Law on Environmental Protection;*  
*At the proposal of the Director of the Therapy Department, the Director of Vietnam Preventive Medicine Department and the Director of the Legal Department of the Health Ministry,*

**DECIDES:**

**Article 1.** To promulgate together with this Decision the Regulation on Management of Medical Wastes.

**Article 2.** This Decision takes effect 15 days after its publication in "CONG BAO."

To annul Decision No. 2575/1999/QĐ-BYT of August 27, 1999, of the Minister of Health, promulgating the Regulation on Management of Medical Wastes.

**Article 3.** The directors of the Office, Departments and Inspectorate of the Health Ministry; directors of provincial/municipal Health Services; directors of hospitals and institutes of the Health Ministry, principals of medical workers-training schools; heads of health sections of branches, managers of private establishments, and heads of concerned units shall implement this Decision.

**THE MINISTER OF HEALTH**

Nguyen Quoc Trieu

# REGULATION

## ON MANAGEMENT OF MEDICAL WASTES

*(Promulgated together with Decision No. 43/2007/QĐ-BYT of November 30, 2007, of the Minister of Health)*

### Chapter I

## GENERAL PROVISIONS

#### **Article 1.** Governing scope

1. This Regulation provides for the management of medical wastes, the rights and responsibilities of organizations and individuals in the management of medical wastes.
2. Medical establishments and organizations as well as individuals participating in the treatment and destruction of medical wastes shall, apart from implementing this Regulation, implement current state regulations on management of wastes.

#### **Article 2.** Subjects of application

This Regulation applies to medical examination and treatment establishments, maternity homes, health stations, establishments engaged in medical and pharmaceutical research, preventive medicine, training of health workers, production of and trading in pharmaceutical products, vaccines, medical biologicals (collectively referred to as medical establishments) and organizations as well as individuals involved in the transportation, treatment or destruction of medical wastes.

#### **Article 3.** Interpretation of terms

In this Regulation, the terms below are construed as follows:

1. Medical wastes means materials in solid, liquid or gaseous form, discharged from medical establishments, including hazardous medical wastes and ordinary medical wastes.

2. Hazardous medical wastes means medical wastes containing elements hazardous to human health and environment such as contagiousness, intoxication, radiation, flammability, explosive-ness, corrosiveness or other hazardous characters if these wastes are not safely destroyed.
3. Management of medical wastes means activities of managing the classification, preliminary treatment, collection, transportation, storage, minimization, re-use, recycle, treatment and de-struction of medical wastes, and inspecting as well as overseeing the implementation.
4. Minimization of medical wastes means activities of restricting to the utmost the discharge of medical wastes, including reduction of medical waste volumes at their sources, use of recycla-ble or re-usable products, good management and strict control of the process of accurate classi-fication of wastes.
5. Re-use means the use of a product for many times until the end of its lifetime or the use of products for a new function or a new purpose.
6. Recycle means the re-production of discarded materials into new products.
7. Collection of wastes at their sources means the process of classifying, gathering, packing and temporarily storing wastes at places where wastes are generated in medical establish-ments.
8. Transportation of wastes means the process of transporting wastes from their sources to places of preliminary treatment, storage or destruction.
9. Preliminary treatment means the process of disinfecting or sterilizing highly contagious wastes at their sources before the transportation thereof to places of storage or destruction.
10. Waste treatment and destruction means the process of using technologies to deprive the wastes of their hazard to human health and environment.

**Article 4.** Prohibited acts

1. Discharging hazardous medical wastes, which are not yet treated or destroyed up to pre-scribed standards, into the environment.
2. Treating and destroying hazardous medical wastes not according to the prescribed technical process and not at the prescribed place.

3. Delivering medical wastes to organizations or individuals having no legal person status for operation in the domain of waste management.

4. Trading in hazardous wastes.

5. Recycling hazardous medical wastes.

## **Chapter II**

# **IDENTIFICATION OF MEDICAL WASTES**

### **Article 5.** Groups of medical wastes

Based on their physical, chemical and biological properties and hazards, wastes in medical establishments are classified into the following 5 groups:

1. Contagious wastes

2. Hazardous chemical wastes

3. Radioactive wastes

4. Pressure containers

5. General wastes.

### **Article 6.** Types of medical wastes

1. Contagious wastes:

a/ Sharp and pointed wastes (Type A) are those which can cause cuts or punctures and may be infected, including injection needles, sharp and pointed ends of transfusion tubes, scalpels, nails and saws, injection ampoules, broken glass pieces and other sharp and pointed instruments used in medical activities.

b/ Non sharp and non-pointed contagious wastes (Type B) are those stained with blood or body biological fluids and wastes from isolation wards.

c/ Highly contagious wastes (Type C) are those generated at laboratories such as swabs and containers stained with swabs.

d/ Surgery wastes (Type D), which include human tissues, organs, body parts; placentas, fetuses and tested animal carcasses.

## 2. Hazardous chemical wastes:

a/ Expired or poor-quality pharmaceuticals which are no longer usable.

b/ Hazardous chemicals used in medical activities (Appendix 1 to this Regulation).

c/ Tissue intoxicants, including drug bottles and pots, instruments stained with tissue intoxicants or substances secreted from patients treated with chemicals (Appendix 2 to this Regulation).

d/ Wastes containing heavy metals: mercury (from broken thermometers, blood pressure meters, wastes from dental treatment), cadimi (Cd (from batteries, accumulated batteries), lead (from lead-coated boards or materials used to prevent X-rays from image diagnosis or X-ray treatment rooms).

## 3. Radioactive wastes:

Radioactive wastes include solid, liquid and gaseous ones, which are generated from diagnostic, therapeutic, research and production activities.

The list of radioactive drugs and marked compounds used in diagnosis and therapy was promulgated together with Decision No. [33/2006/QD-BYT](#) of October 24, 2006, of the Minister of Health.

4. Pressure containers, which include oxygen, CO<sub>2</sub> or gas cylinders, prone to cause fires and explosion when put on the fire.

5. General wastes are those which do not contain contagious elements, hazardous chemicals, radioactive substances, inflammable or explosive elements, including:

a/ Garbage from patients' rooms (excluding isolation wards).

b/ Wastes generated from medical activities such as glass bottles and pots, serum bottles, plastic materials, assorted plasters for broken bone cast, which are not stained with blood, biological fluids and hazardous chemicals.

c/ Wastes generated from administrative activities: papers, newspapers, documents, packing materials, cardboard boxes, plastic bags and film bags.

d/ External wastes: leaves and garbage from external areas.

**Chapter III****STANDARDS OF INSTRUMENTS AND BAGS FOR CONTAINING AND TRANSPORTING SOLID WASTES IN MEDICAL ESTABLISHMENTS****Article 7.** Color coding

1. Yellow for contagious wastes.
2. Black for hazardous chemical and radioactive wastes.
3. Green for ordinary wastes and small pressure cylinders.
4. White for recycled wastes.

**Article 8.** Waste bags

1. Yellow and black bags must be made of PE or PP, not PVC plastic.
2. Medical waste bags must be at least 0.1 mm thick and have sizes suitable to waste volume and the maximum volume of 0.1 m<sup>3</sup>
3. The bag outside must be printed with a line at the 3/4 height of the bag and the phrase “KHONG DUOC DUNG QUA VACH NAY” (NOT CONTAINED ABOVE THIS LINE).
4. Waste bags must comply with the color system specified in Article 7 of this Regulation and be used for proper purposes.

**Article 9.** Sharp and pointed waste containers

1. Sharp and pointed waste containers must suit the final destruction methods.
2. Sharp and pointed waste containers must satisfy the following standards:
  - a/ Their walls and bottoms are hard enough so as not to be punctured.
  - b/ They can resist infiltration.
  - c/ They have proper sizes.
  - d/ They have lids which are easy to open and close.
  - dd/ Their mouths are big enough for putting sharp and pointed objects without push.

e/ They are printed with the phrase “CHI DUNG CHAT THAI SAC NHON” (FOR SHARP AND POINTED WASTES ONLY) and a line at the 3/4 height and the phrase “KHONG DUOC DUNG QUA VACH NAY” (NOT CONTAINED ABOVE THIS LINE).

g/ They are in yellow.

h/ They have handles or are attached with a fixed system.

i/ The contained sharp and pointed objects do not fall outside upon transportation.

3. For medical establishments using injection needle-destroying machines or injection syringe- and needle-cutters, sharp and pointed waste containers must be made of metal or hard plastic, which can be usable and must constitute a part of the injection needle- and syringe-destroying machines or cutters.

4. For re-usable sharp and pointed waste plastic containers, before their re-use, they must be cleansed and disinfected under the medical instrument-disinfecting process. The disinfected plastic containers for re-use must retain all their original properties.

**Article 10. Waste bins**

a/ To be made of high-density plastic with thick and hard bottoms or made of metal with pedal lids. Collection bins of 50 liters or larger should be wheeled.

b/ Yellow bins are used for gathering yellow waste bags and boxes.

c/ Black bins are used for gathering black waste bags. For radioactive wastes, bins must be made of metal.

d/ Green bins are used for gathering green waste bags.

dd/ White bins are used for gathering white waste bags.

e/ Bin capacity depends on generated waste volumes, ranging from 10 liters to 250 liters.

g/ The bin's outside must be printed with a signal line at the 3/4 height and with the phrase “KHONG DUOC DUNG QUA VACH NAY” (NOT CONTAINED ABOVE THIS LINE).

**Article 11. Waste type symbols**



The outside of bags and bins storing assorted hazardous wastes and to-be-recycled wastes must bear symbols indicating proper waste types (Appendix 3 to this Regulation, not printed herein):

a/ Yellow bags and bins storing contagious wastes display the symbol of biological hazard.

b/ Black bags and bins storing tissue-intoxicating wastes display the symbol of tissue intoxicants and the phrase "CHAT GAY DOC TE BAO" (TISSUE INTOXIOANTS).

c/ Black bags and bins storing radioactive wastes display and the phrase "CHAT THAI PHONG XA" (RADIOACTIVE WASTES).

d/ White bags and bins storing to-be-recycled wastes display the symbol of recyclable wastes.

**Article 12.** Waste-carrying vehicles

Vehicles carrying wastes must meet the standards of having walls, lids and tight bottoms, being convenient for loading and unloading wastes, for cleaning, cleansing and drying.

**Chapter IV**

## **CLASSIFICATION, COLLECTION, TRANSPORTATION AND STORAGE OF SOLID WASTES AT MEDICAL ESTABLISHMENTS**

**Article 13.** Classification of solid wastes

1. Waste generators must classify wastes right at their sources.
2. Wastes must be stored in bags and bins with prescribed color codes and symbols.

**Article 14.** Collection of solid wastes in medical establishments

1. Waste bin locations

a/ Departments and sections must clearly identify places for bins to store each type of medical waste; waste sources must have corresponding collection bins.

b/ Waste bin locations must have classification and collection instructions.

c/ Waste bins must be up to prescribed standards and cleaned daily.

d/ Clean bags for waste collection must be always available at places where wastes are generated for replacement of bags of the same kinds, already transported to temporary waste storage places of medical establishments.

2. Each type of waste must be gathered into collection tools according to the prescribed color code and affixed with labels or inscriptions on the outside of waste bags.

3. Hazardous medical wastes must not be stored together with general wastes. If hazardous medical wastes are accidentally stored together with general wastes, such waste mixtures must be treated and destroyed like hazardous medical wastes.

4. The waste volume in each bag is only 3/4 full, then the bags must be tied up.

5. Collection frequency: Nurses or assigned employees shall collect hazardous medical wastes and general wastes from their sources to the concentrated waste places of departments at least once a day and when necessary.

6. Highly contagious wastes, before being collected to the concentrated waste places of medical establishments, must be preliminarily treated at their sources.

**Article 15.** Transportation of solid wastes in medical establishments

1. Hazardous wastes and general wastes generated at departments/sections must be separately transported to the waste storage places of medical establishments at least once a day and when necessary.

2. Medical establishments must prescribe the waste transport routes and time. The transportation of wastes through patients' areas and other clean zones must be avoided.

3. Waste bags must be closely tied up and transported by special vehicles; wastes and waste liquid must not be dropped en route and their strong smells must not be dispersed in the course of transportation.

**Article 16.** Solid waste storage in medical establishments

1. Hazardous medical wastes and general wastes must be stored in separate chambers.

2. Re-usable and recyclable wastes must be stored separately.

3. Waste storage places in medical establishments must satisfy the following conditions:

a/ Being at least 10 meters away from dining halls, patients' rooms, public passages, crowded places.

b/ Being accessible to waste-carrying vehicles from the outside.

c/ Waste storage houses must have roofs, protection fences, doors and locks and must not be intruded freely by animals, rodents or unconcerned persons.

d/ Their areas suit the volume of wastes generated at medical establishments.

dd/ Having hand-washing facilities and protection devices for personnel, having cleansing tools and chemicals.

e/ Having culvert systems, walls and anti-seepage floors, being well ventilated.

g/ Medical establishments are encouraged to store wastes in cold houses.

4. Duration for hazardous medical waste storage in medical establishments

a/ The duration for storage of hazardous wastes in medical establishments must not exceed 48 hours.

b/ The duration for waste storage in cold houses or boxes may reach 72 hours.

c/ Surgery wastes must be transported for daily burial or destruction.

d/ For medical establishments with a volume of less than 5 kg of medical waste a day, the collection frequency must be at least twice a week.

#### **Chapter V**

## **TRANSPORTATION OF SOLID MEDICAL WASTES FROM MEDICAL ESTABLISHMENTS**

### **Article 17. Transportation**

1. Medical establishments shall sign contracts with establishments having the legal person status for transportation and destruction of wastes. Where there are no establishments with the legal person status for transportation and destruction of medical wastes in localities, medical establishments shall report such to local administrations for solution.

2. Hazardous medical wastes must be transported by special vehicles meeting the requirements stated in Circular No. [12/2006/TT-BTNMT](#) of December 26, 2006, of the Ministry of Natural Resources and Environment, guiding conditions for professional practice and procedures for making dossiers, registration, grant of practice licenses and hazardous waste management codes.

3. Hazardous medical wastes, before being transported to destruction places, must be packed in bins to avoid cracks or breaks en route.

4. Surgery wastes must be stored in two yellow hags, packed separately in bins or boxes closely tied up and displaying the phrase “CHAT THAI GIAI PHAU (SURGERY WASTES) before being transported for destruction.

**Article 18.** Dossiers on waste monitoring and transportation

Each medical establishment must establish a system of books to monitor the daily waste volume; keep records of hazardous medical wastes and general wastes carried for destruction, made according to a set form in Circular No. [12/2006/TT-BTNMT](#) of December 26, 2006, of the Ministry of Natural Resources and Environment, guiding conditions for professional practice and procedures for making dossiers, registration, grant of practice licenses, hazardous waste management codes.

**Chapter VI**

## **SOLID MEDICAL WASTE TREATMENT AND DESTRUCTION MODELS AND TECHNOLOGIES**

**Article 19.** Hazardous solid medical waste treatment and destruction models and the application thereof

1. Hazardous solid medical waste treatment and destruction models include:

a/ Model 1: Concentrated hazardous medical waste treatment and destruction centers.

b/ Model 2: Hazardous medical waste treatment and destruction facilities for clusters of medical establishments.

c/ Model 3: On-spot treatment and destruction of hazardous solid medical wastes.

2. Medical establishments shall base themselves on plannings, geological elements, economic and

environmental conditions to apply one of the medical waste treatment and destruction models specified in Clause I of this Article.

**Article 20.** Hazardous medical waste treatment and destruction technologies

1. The selection of hazardous medical waste treatment technologies must ensure environmental standards and satisfy the requirements of treaties to which Vietnam is a contracting party.
2. Hazardous medical waste treatment technologies include incineration in furnaces reaching environmental standards; hot-steam disinfection; microwave and other treatment technologies. The application of environment-friendly technologies is encouraged.

**Article 21.** Methods of preliminary treatment of highly contagious wastes

1. Highly contagious wastes must be safely treated near their sources.
2. Highly contagious wastes can be preliminarily treated by one of the following methods:
  - a/ Chemical disinfection: Highly contagious wastes are soaked in 1-2% cloramin B or 1-2% javel water for at least 30 minutes or other disinfectant chemicals under the use instructions of producers and regulations of the Health Ministry.
  - b/ Hot-steam disinfection: Highly contagious wastes are put into disinfection steamers which are operated under producers' instructions.
  - c/ Non-stop boiling for at least 15 minutes.
3. Highly contagious wastes, after being preliminarily treated, can be buried or wrapped in yellow plastic bags for mixture with contagious wastes. If these wastes are preliminarily treated by autoclave or microwave methods or other modern technologies up to prescribed standards, they can be later treated like general wastes and be recycled.

**Article 22.** Contagious waste treatment and destruction methods

1. Contagious wastes can be treated and destroyed by one of the following methods:
  - a/ Autoclave disinfection
  - b/ Microwave disinfection
  - c/ Incineration

d/ Hygienic burial: Being only temporarily applied to medical establishments in mountain and midland areas where local standard hazardous medical waste treatment facilities are not yet available. The burial sites are designated by local administrations and approved by local environment management bodies. Burial pits must meet the requirements: being surrounded by fences, at least 100m away from water wells and residential houses; their bottoms are at least 1.5m below the surface water level, their mouths are above the ground and temporarily roofs against rain water, each waste layer must be covered by an earth layer of 10-25 cm thick and the final earth layer must be 0.5 m thick. Contagious wastes must not be buried together with general wastes. Contagious wastes must be disinfected before being buried.

dd/ Where contagious wastes are treated by autoclave, microwave method or other modern technologies up to the prescribed standards, they can be later treated, recycled or destroyed like general wastes.

## 2. Sharp and pointed wastes:

One of the following destruction methods can be applied:

a/ Incineration in special furnaces together with other contagious wastes.

b/ Direct burial in cement holes exclusively used for burial of sharp and pointed objects: The holes are built with concrete bottoms, walls and lids.

## 3. Surgery wastes:

One of the following methods can apply:

a/ The contagious waste treatment and destruction methods mentioned in Clause 1 of Article 22.

b/ They are wrapped in two yellow bags, packed in cases and buried in cemeteries.

c/ Burial in concrete pits with tight bottoms and lids.

## **Article 23.** Chemical waste treatment and destruction methods

### 1. General methods for treatment and destruction of hazardous chemical wastes:

a/ Returning them to suppliers under contracts.

b/ Incinerating them in high blast furnaces

c/ Destroying them by method of alkali neutralization or hydrolysis.

d/ Pre-burial inertization: Mixing wastes with cement and a number of other materials in order to fasten hazardous substances in wastes. The mixture ratios will be as follows: 65% pharmaceutical, chemical wastes, 15% lime, 15% cement, 5% water. After an unique block is created, it is transported for burial.

2. One of the following methods can be applied to the treatment and destruction of pharmaceutical wastes:

a/ Incinerating them in furnaces, if any, together with contagious wastes.

b/ Burying them at hazardous waste burial sites.

c/ Inertization.

d/ Liquid pharmaceutical wastes are diluted and discharged into waste water treatment systems of medical establishments.

3. One of the following methods can apply to the treatment and destruction of tissue-intoxicating wastes:

a/ Returning them to suppliers under contracts.

b/ Incinerating them in high-temperature furnaces (Appendix 2: A number of tissue-intoxicating drugs frequently used in medical activities and the minimum temperature for destruction of tissue intoxicants).

c/ Using a number of oxides such as  $\text{KMnO}_2$ ,  $\text{H}_2\text{SO}_4$ , etc., degrading tissue intoxicants into non-hazardous compounds.

d/ Inertization then burial at concentrated waste burial sites.

4. Treatment and destruction of wastes containing heavy metals:

a/ Returning them to producers for recovery of heavy metals.

b/ Destroying them at places for safe destruction of industrial wastes.

c/ If these two methods cannot be applied, the method of packing wastes tight in metal or high-density polyethylene cans or boxes, then adding fastening-substances (cement, lime, sand), letting them dry and packing them tight, then discharging them to waste dumping sites.

**Article 24.** Radioactive waste treatment and destruction

Medical establishments using radioactive substances and radioactive substance- related instruments or equipment must comply with current legal provisions on radiation safety.

**Article 25.** Pressure cylinder treatment and destruction

One of the following methods can apply:

a/ Returning them to producers,

b/ Re using them.

c/ Burying them like pressure cylinders of small capacity.

**Article 26.** General solid waste treatment and destruction

1. Recycling, re-use

a/ The list of general wastes to be recycled or re-used complies with Appendix 4 to this Regulation.

b/ To be- recycled general wastes must not contain contagious elements and hazardous chemicals affecting human health.

c/ Wastes allowed for recycling and reuse are only supplied to organizations or individuals licensed for such operation and having the function of recycling wastes.

d/ Medical establishments assign one unit to organize, inspect and strictly supervise the treatment of general wastes according to regulations for recycling and re-use.

2. Treatment and destruction: Burial at local waste burial sites.

**Chapter IX**

## **TREATMENT OF WASTE WATER AND GASEOUS WASTE**

**Article 27.** General provisions on treatment of waste water



1. Each hospital must have a synchronous waste water collection and treatment system.
2. Those hospitals, which do not have waste water treatment systems, must build complete waste water treatment systems.
3. Those hospitals already having waste water treatment systems which are, however, out of order or have operated inefficiently, must repair and upgrade them for operation up to environmental standards.
4. Newly built hospitals must include waste water treatment systems into construction items approved by competent agencies.
5. Hospital waste water treatment technologies must satisfy environmental standards and conform to topographical conditions, investment, transportation and maintenance costs.
6. Waste water treatment must be qualitatively examined periodically and waste water treatment dossiers must be kept.

**Article 28.** Waste water collection

1. Hospitals must have separate systems for collecting surface water and waste water from various departments, rooms. Waste water culvert systems must run underground or be covered with lids.
2. Waste water treatment systems must have mud-gathering tanks.

**Article 29.** Requirements on hospital waste water treatment systems

1. They are structured with an appropriate technological process for treatment of waste water up to environmental standards;
2. Their capacities suit the volume of hospitals' waste water;
3. Waste water discharge gates must be convenient for inspection and supervision;
4. Mud discharged from waste water treatment systems must be managed like solid medical wastes.
5. Waste water treatment must be qualitatively inspected periodically. There must be books on management of operation and results of relevant quality inspection.

**Article 30.** Treatment of gaseous wastes

1. Laboratories, chemicals or pharmaceuticals storehouses must be constructed with air ventilation systems and toxic gas-gathering cabinets up to the prescribed standards.
2. Equipment using toxic chemical gas must have systems for treating gas up to prescribed standards before it is discharged into environment.
3. Gas discharged from solid medical waste incinerators must be treated up to Vietnam's environmental standards.

**Chapter X****ORGANIZATION OF IMPLEMENTATION****Article 31.** Responsibilities for management of medical wastes

## 1. Heads of medical establishments:

a/ To manage medical wastes from the time they are generated to the time they are finally destroyed.

b/ To possibly contract the transportation, treatment and destruction of medical wastes to organizations or individuals having the legal person status.

c/ To formulate plans on management of medical wastes and work out schemes for investment in and upgrading of infrastructure for management of their units' medical wastes and submit them to competent authorities for approval. Investment projects on construction of infrastructure for medical waste treatment and destruction must comply with current regulations on management of capital construction investment.

d/ To purchase and supply adequate special means up to standards for the classification, collection, transportation and treatment of wastes; to coordinate with local environment bodies and waste treatment establishments in treating and destroying medical wastes according to regulations.

e/ To apply measures to reduce the volume of to be- destroyed medical wastes through minimization, collection, recycling and re-use activities after they are treated according to regulations.

2. Directors of provincial/municipal Health Services shall manage and formulate plans on treatment of medical wastes in their respective localities and submit them to provincial/municipal People's Committee presidents for consideration, approval and implementation organization.

3. Heads of medical establishments under the Health Ministry and heads of branches' health sections shall manage, draw up plans on disposal of medical wastes of their establishments and attached units, and submit them to the minister of the managing ministry for consideration, approval and implementation organization.

4. Bureaus, departments and the Inspectorate of the Health Ministry shall manage medical wastes according to their respective functions and tasks prescribed by the Minister of Health.

**Article 32.** Training and research

1. The Health Ministry shall formulate programs and documents for training on medical waste management for uniform application to medical establishments; incorporate medical waste management into training programs in medical and pharmaceutical schools; research into and apply modern technologies suitable to the treatment and destruction of medical wastes.

2. Medical establishments shall guide the implementation of the Regulation on management of medical wastes to their staff members and concerned subjects, guide patients and their families in classification of medical wastes according to regulations.

**Article 33.** Registration of owners of waste sources and waste treatment

Medical establishments shall register to be owners of waste sources and waste treatment under the guidance in Circular No. [12/2006/TT-BTNMT](#) of December 26, 2006, of the Ministry of Natural Resources and Environment, guiding conditions for professional practice and procedures for making dossiers, registration, grant of practice licenses and hazardous waste management codes.

**Article 34.** Fund

1. Medical establishments shall arrange funds for medical waste management.

2. Funds invested in the construction of infrastructure, operation and management of medical wastes come from the following sources:

a/ State budget:

- Health non-business budget.

- Environmental protection non-business budget.

b/ Capital sources of international organizations, foreign governments, non-governmental organizations.

c/ Other lawful capital sources.

**MINISTER OF HEALTH**

**Nguyen Quoc Trieu**

## **APPENDIX 1**

### **HAZARDOUS CHEMICALS FREQUENTLY USED IN MEDICAL ACTIVITIES**

*(Attached to Decision No. 43/2007/QĐ-BYT of November 30, 2007, of the Minister of Health)*

#### **Formaldehyde**

##### ***Photochemical substances:***

- Hydroquinone;

- Hydroxidekali;

- Silver;

- Glutaraldehyde

##### ***Dissolvents:***

- Halogen compounds: Methelene chloride, chloroform, freons, teichloro ethylene and 1.1.1-trichloromethane.

- Evaporating anaesthetics: Halothane (fluothane), enflurane (ethrane), isoflurane (forane).

- Sans-halogen compounds: cylene, acetone, isopropanol, toluen, ethylo acetate, acetonitrile, benzene.

### Ethylencoxide

#### **Chemical compounds:**

- Phenol
- Grease
- Cleansing dissolvents
- Ethanol alcohol; methanol
- Acide.

## APPENDIX 2

### SOME TISSUE INTOXICANTS FREQUENTLY USED IN MEDICAL ACTIVITIES AND MINIMUM TEMPERATURES FOR DESTRUCTION THEREOF

*(Attached to Decision No. 43/2007/QD-BYT of November 30, 2007, of the Minister of Health)*

Drugs	Destruction temperature (0C)
Asparaginase	800
Bleomycin	1,000
Carboplatin	1,000
Camustine	800
Cisplatin	800
Cyclophosphamide	900
Cytarabine	1,000
Decarbazine	500
Dactinomycin	800

Daunorubicin	700
Doxorubicin	700
Epirubicin	700
Etoposide	1,000
Fluorouracil	700
Idarubicin	700
Melphalan	500
Metroptrexate	1,000
Mithramycin	1,000
Mitomycin C	500
Mitozantrone	800
Mustine	800
Thiotepa	800
Vinblastine	1,000
Vincristine	1,000
Vindesine	1,000

### **APPENDIX 3**

#### WASTE TYPE SYMBOLS

*(Attached to Decision No. 43/2007/QD-BYT of November 30, 2007, of the Minister of Health)*

The symbol of biological hazard



The symbol of tissue intoxicants



The symbol of radioactive substance



The symbol of recyclable wastes



## APPENDIX 4

### LIST OF WASTES TO BE GATHERED FOR RECYCLING

*(Attached to Decision No. 43/2007/QĐ-BYT of November 30, 2007, of the Minister of Health)*

General waste materials neither stained with nor containing hazardous elements (contagious elements, hazardous chemicals, radioactive substances, tissue intoxicants), which are allowed to be collected for recycling, including:

a/ Plastic:

- Plastic bottles containing solutions without hazardous chemicals, such as NaCl 0.9% solution, Bicarbonatenatri, ringer lactat, molecular paste solution, kidney filtering fluid and plastic bottles containing other non-hazardous solutions.

- Other plastic materials not stained with hazardous elements.

b/ Glass

- Glass bottles containing solutions without hazardous elements.

- Glass ampoules containing injection drugs not containing hazardous elements.

c/ Paper: Paper, newspapers, cardboard, cardboard boxes, drug boxes and paper materials.

d/ Metal: Metal materials not stained with hazardous elements.



**Title of the Appendix**

Content of the appendix is placed here.