

Article

Hazardous Waste Management in the Department of Environmental Engineering, Faculty of Engineering, Chulalongkorn University

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Abstract. The aim is to develop landscape garden around the special room, reduce hazardous waste from instruction and research laboratory and manage hazardous waste contaminate of laboratory involves disposal of hazardous waste as required by the policy of Chulalongkorn University, The Center of Excellence on Hazardous Substance Management. In collection process was reduce hazardous waste. In February was the month with the elimination of which has been carried out by containing Mercury Wastewater (IV) in the amount of 180 Liters and solid waste containing Mercury (IV) contaminants at 37.50 kilograms and the removal hazardous waste of 2,718.75 baht. Other types of waste include, Petroleum Product (IX) volume of 25 Liters, wastewater containing Chromate(V) contaminants of 30 Liters, wastewater containing Special Waste(I) of 30 Liters, hazardous wastewater containing Heavy Metal (VI) contaminants of 17.50 Liters and Miscellaneous Aqueous Wastewater (XIV) or hazardous waste with water or solvent dissolve a volume of 15 Liters. In February 2559, the cost of sending hazardous waste was the highest 4,687.50 baht with the volume of 282.50 Liters. The Laboratory of The Department of Environmental Engineering, the cost of sending hazardous waste 6,062.50 baht. Chulalongkorn University operates the storage of hazardous waste by driven plan development, management of chemical and hazardous waste project of The Center of Excellence on Chemical and Hazardous Waste Management is responsible. Finally, hazardous waste management of environmental engineering department under Chulalongkorn University policy by the center of Excellence on Hazardous Substance Management helped save 5,758.08 baht or 94.98 % per year.

Keywords: Management hazardous waste.

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1. Introduction

Hazardous wastes are a by-product of human activity that causes one of toxic environmental pollutant and quantity of highly contamination waste involved, the extent of hazard with human, animals, plants, environment and ultimate effects on living organisms. The United States Environmental Protection Agency (USEPA) simplify hazardous waste is defined as any solid, liquid or gaseous substance which, by reason of any Corrosively, Ignitability, Toxicity, reactivity, physical, chemical, reactive, causes danger toxic or infectious characteristics, causes danger to health or environment when stored, transported or disposal off. The sources of hazardous wastes include industries, biological waste generation, laboratories etc.

The University Council Resolution number 675 on 27 July 2006, "Research development guidelines of Chulalongkorn University" chemical and hazardous waste development plans of Chulalongkorn University, the Department of Environmental Engineering had Opportunity to undertake research in the hazardous waste laboratory. Most of the hazardous waste contaminated resulting from Instruction laboratory and researcher laboratory. March the year 1997 the report of Hazardous Waste in Environmental Engineering Department is Incombustible Solid (Type XIII (b)) highest the amounts 300 kilograms [1]. The next is Heavy Metal wastewater (Type VI) contamination amounts 100 Liters. The least is Special waste (Type I) amount 6 kilograms. August, The Incombustible Solid (Type XIII (b)) amounts 160 kilograms. The next is Petroleum Product (Type IX) amounts 130 Liters and the least is Mercury wastewater (Type IV) contamination amounts 2 Liters [2]. In the year 2014 study guideline to solving problems, July, COD waste contamination mercury (Type IV) with the height the volume of 50 Liters. May is the chromate wastewater (Type V) with the volume of 37.5 Liters and special hazardous waste (Type I), the minimum the volume with 2 kilograms. August is the mercury wastewater (Type IV) with the volume of 37.5 Liters. October is heavy metal wastewater (Type VI) with the volume of 37.5 Liters [3]. In the year 2015 solving area problem, August, the product contains petroleum (Type IX) is highest the volume 232.50 Liters, the incombustible (Type XIII (b)), Amount of 180 kilograms, the water-soluble hazardous waste and other (Type XIV) with the volume of 170 Liters, the heavy metal wastewater (Type V) with the volume of 145 Liters, the Incombustible solids (Type XIII(b)) with amount 140 kilograms, the Incombustible Liquid (Type XIII(b)) with the volume 40 Liters[4].

2. Objectives

1. Manage hazardous waste contaminate of the laboratory involves disposal of hazardous waste as required by the policy of Chulalongkorn University.
2. Develop landscape garden around the special room.
3. Manage hazardous waste contaminate of the laboratory in Environmental Engineering the Department involves disposal of hazardous waste as required by the policy of Chulalongkorn University.

3. Methodology

Management of hazardous waste in the department Environmental Engineering, Faculty of Engineering, Chulalongkorn University is intended to provide the management of general hazardous waste contamination from Instruction and research laboratory.

3.1. Management General Hazardous Waste Contaminate in the Environmental Engineering Department

The Environmental Engineering Department's hazardous waste collection under Chulalongkorn University research policy plan. The type hazardous waste of environmental engineering department is divided into 14 categories.

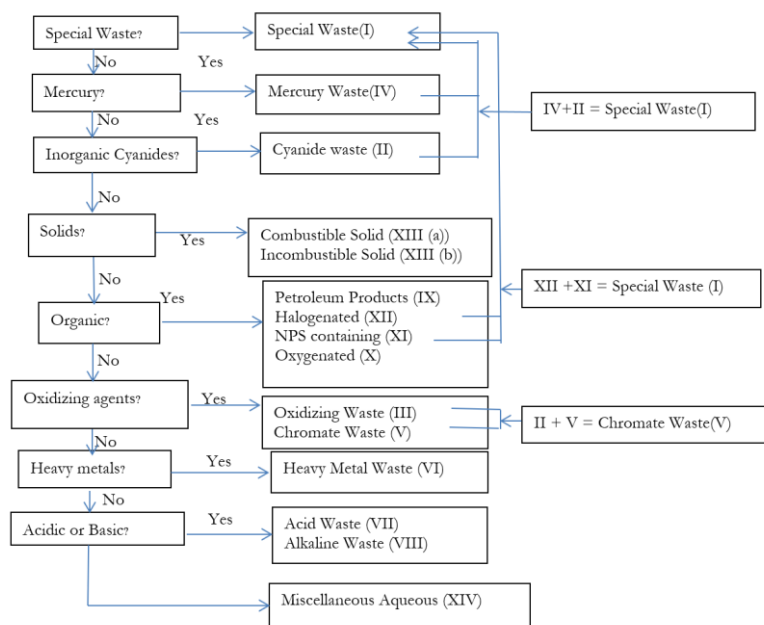
Table 1. Type of hazardous waste 14 categories.

Categories	Meaning
I: Special waste	Oxidation with water or Oxygen Carcinogen waste Toxic waste Organic wastewater more than 5 % Compound Waste(XI+XII) Compound waste(II+IV) Unknown Waste
II: Cyanide Waste	Cyanide Compound
III: Oxidizing Waste	Oxidizing Compound
IV: Mercury Waste	Mercury Compound
V: Chromate Waste	Chromate Compound
VI: Heavy Metal Waste	Heavy Metal Compound
VII: Acid Waste	Acid Compound
VIII: Alkaline Waste	Alkaline Compound
IX: Petroleum Products	Petroleum Compound
X: Oxygenated	Oxygenated Compound
XI: NPS Containing	NPS Compound
XII: Halogenated	Halogenated Compound
XIII(a): Combustible Solid	Combustible Solid
XIII(b): Incombustible solid	Incombustible Solid
XIV: Miscellaneous Aqueous Waste	Miscellaneous Aqueous Compound

Reference: *Chemical and hazardous waste management project, The Center of Excellence on Hazardous Substance Management, 2017* [5].

3.2. Grouping by Similarity Property of Hazardous Waste

Table 2. Grouping by similarity property of hazardous waste.



Reference: *Chemical and hazardous waste management project, the center of Excellence on Hazardous Substance Management, 2017* [5].

4. Experimental Framework

Manage hazardous waste contaminate of laboratory involves disposal of hazardous waste as required by the policy of Chulalongkorn University. Hazardous Waste Management is the development of environment and quality of the environmental engineering department. The management of hazardous waste experimental framework composed of 3 steps

4.1. Sorting of Hazardous Waste

Hazardous Waste segregate are easy to manage and reduce the cost of disposal and all hazardous waste contamination must be stored in the appropriate container. They are placed in the containers of compatible the hazardous waste contamination in secondary containment.

4.2. Collection and Store Similarly-Similar Hazardous Waste

Collect similar hazardous waste substances just like their similar treasure and fill in the form to send request hazardous waste data to head of hazardous waste management (the special room) division before 12th of the month. Head of the hazardous waste management (the special room) division is collection request all instruction and research hazardous waste contamination in environmental Engineering department on 12th of the month.

4.3. Cooperation to Disposal Process

The head of hazardous waste management (the special room) department of environmental engineering sends request data to www.chemsafe.chula.ac.th, the chemical and hazardous waste management project on 12th of the month. Head of hazardous waste management (the special room) division keeps the controlled plan, direction, controlling, improvement, chemical, and hazardous waste contamination until process release to The Center of Excellence on Hazardous Substance Management pick up to disposal. The Center of Excellence on Hazardous Substance Management arranges a time to pick up the materially within time duty. The head of hazardous waste management (the special room) contract The Center of Excellence on Hazardous Substance Management to pick up chemical and hazardous waste contamination on-duty time until complete chemical and hazardous waste contamination pick up. The last episode cleans up chemical and hazardous waste contamination's the special room. It is an opportunity to develop landscape garden around the special room (Fig. 1) and manual innovation instructional material of the special room (Fig. 2).



Fig. 1. Showing landscape garden around the special room.

Manual Innovation Instructional Material of the Special Room.

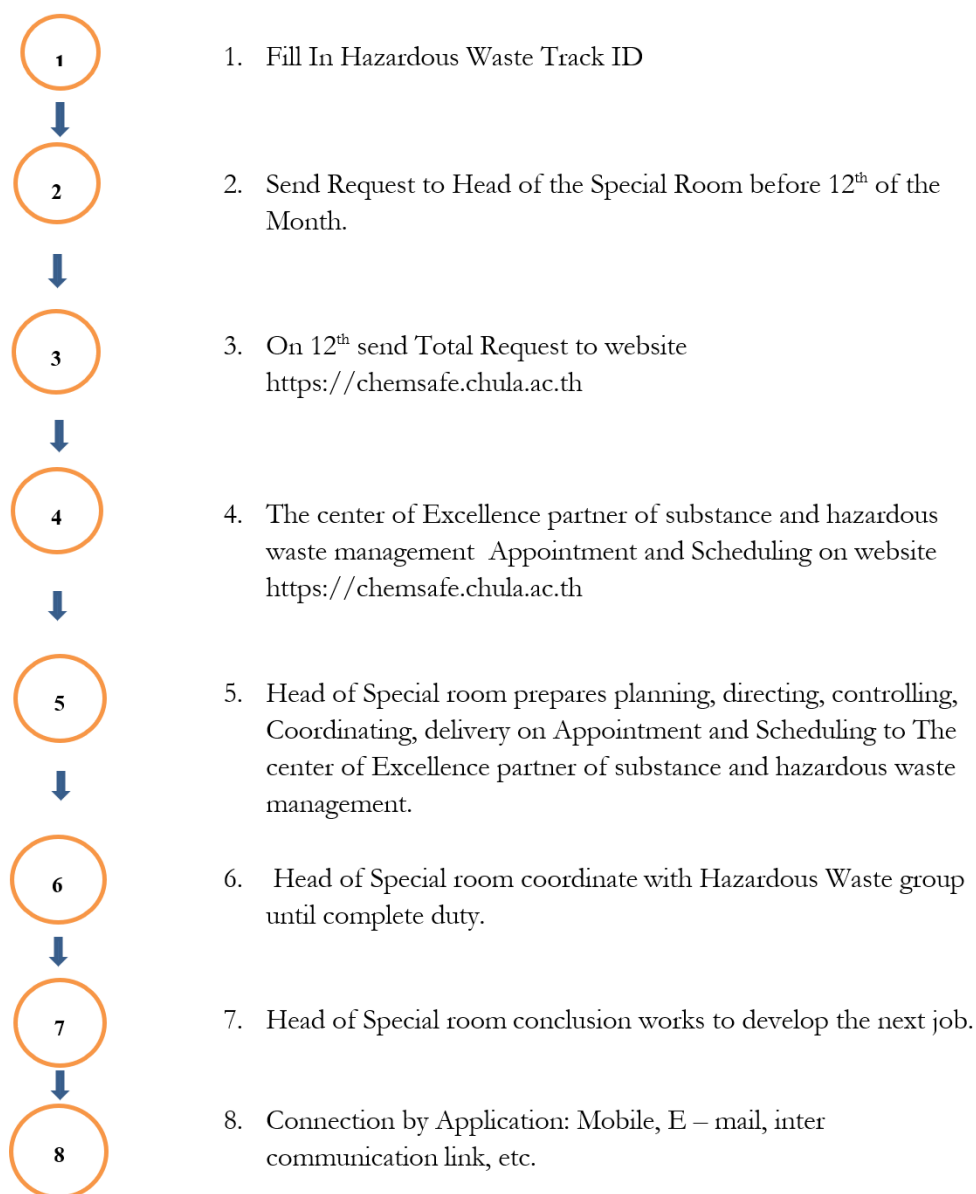


Fig. 2. Showing the steps to use Instructional Material of the Special Room.

5. Results

5.1. Management of Hazardous Waste in Environmental Engineering Department on 23 February 2016 (shown in Fig. 3.)

In Fig. 3, the Hazardous wastewater contamination of Mercury (Type IV, Liquid) and Hazardous waste contamination of Mercury (Type IV, solid) is 180 Liters and 37.5 Kilograms respective. The Special Waste (Type 1, Solid) is 30 kilograms and Special Waste (Type 1, Liquid) is 15 liters. The Chromate contamination wastewater (Type 5) is 30 Liters. The Oxidizing Wastewater (Type III) and The Petroleum Products (Type IX) are the same amounts 25 Liters. The Heavy Metal wastewater (Type IV) is 17.5 Liters. The Miscellaneous wastewater (Type XIV) is 15 Liters.

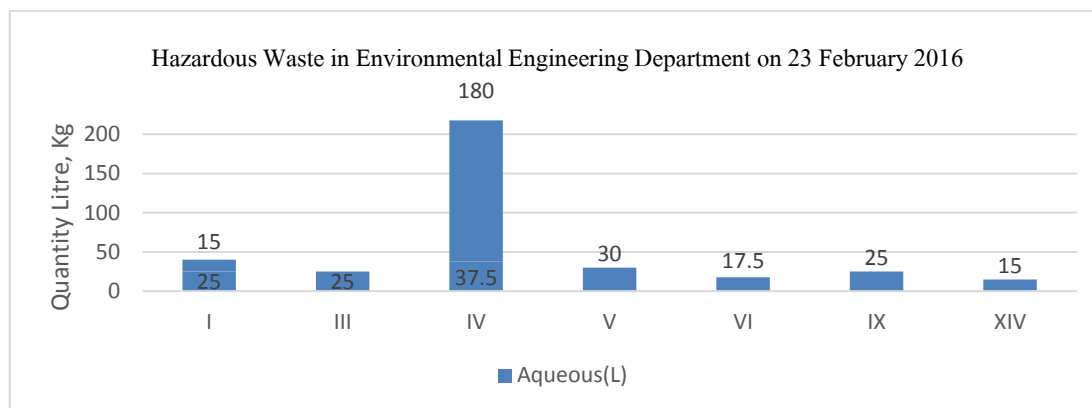


Fig. 3. Hazardous waste of Environmental Engineering Department on 23 February 2016.

5.2. Management of Hazardous Waste in Environmental Engineering Department on 31 May 2016 (shown in Fig. 4)

In Fig. 4, in May, the Hazardous Wastewater contamination of Chromates (Type V) are 25 Liters. The Hazardous wastewater contamination of Heavy Metal (Type VI) and The Petroleum Wastewater Products (Type IX) is the same amounts of 17.5 Liters. The Oxidizing Wastewater (Type III), The Heavy Metal Wastewater (Type IV), The Acids Wastewater (Type VII) and The Miscellaneous wastewater (Type XIV) are the same volumes of 12.5 Liters.

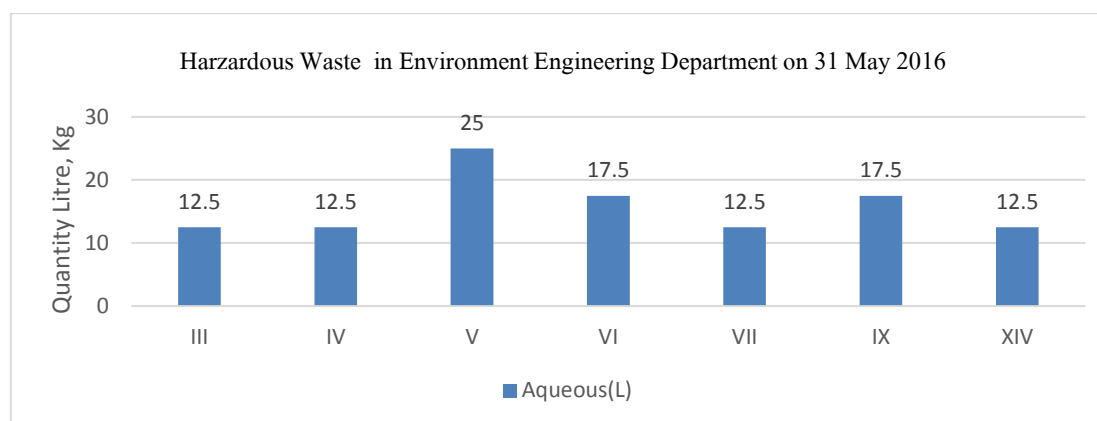


Fig. 4. Hazardous waste of Environmental Engineering Department at 31 May 2016.

5.3. Quantity of Hazardous Waste in Year 2016 (shown in Fig. 5)

In the year 2016, in February, The Hazardous wastewater contamination of Mercury (Type IV, Liquid) is the highest 180 liters. The Special Waste (Type 1, Liquid) and The Miscellaneous wastewater (Type XIV) are the least volumes of 15 liters. For the May, the Hazardous Wastewater Contamination of Chromates (Type V) is the highest 25 liters. The Miscellaneous Wastewater (Type XIV) is the least volumes 12.5 Liters.

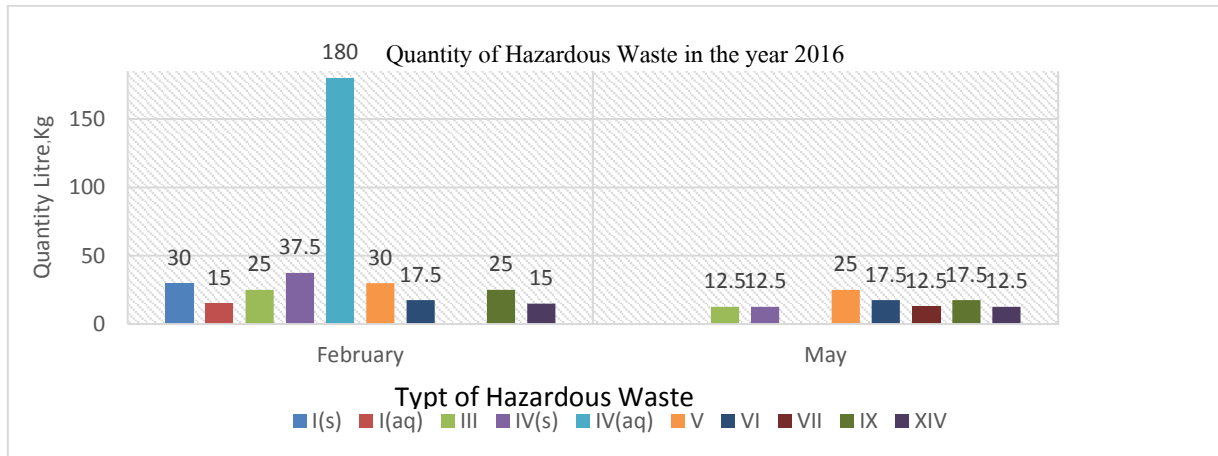


Fig. 5. Hazardous waste of Environmental Engineering Department in the year 2016.

Table 3. The expenditure of hazardous waste contamination of Environmental Engineering Department in the year 2016.

Expenditure(Baht)		Total Values(Baht)
February	May	
4,687.50	1,375	6,062.50
152.21	152.21	304.42
4,535.29	1,222.79	5,758.08
Save Money = 94.98%		

In the year 2016, there are 219 Hazardous Waste Disposal Laboratory [6]. The total costs of sending Hazardous Waste contaminates are 6,062.50 Baht. Management of the center of Excellence partner of substance and hazardous waste management can save money 5,758.08 Baht.

6. Conclusion

1. Environmental Engineering Department is to develop landscape garden around the special room.
2. Environmental Engineering Laboratory cloud reduced Chemical and Hazardous waste contamination.
3. Manage hazardous waste contaminate of the laboratory in Environmental Engineering the Department involves disposal of hazardous waste as required by the policy of Chulalongkorn University.
4. Management of the center of Excellence partner of substance and hazardous waste management can Environmental Engineering Department save money 5,758.08 Baht or 94.98 %.

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