

CONTRIBUTION TO DEVELOPPE AN INTEGRATED WASTE MANAGEMENT PROCEDURE FOR INDUSTRIAL SITE

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ABSTRACT

Waste management is managed in order to recycle wastes and reduce their negative impact on the environment and human health. A variety of wastes are created, including agricultural wastes, domestic waste, industrial trash, and industrial effluents. Waste management is an important pillar for sustainable environmental preservation to managing the environmental element of industrial operations. The goal of this research is to develop an integrated waste management procedure that will define the requirements for managing hazardous and non-hazardous waste in a way that has the least amount of environmental impact while also meeting all applicable state and international regulatory requirements

Keywords: Waste Management, Industrial sites, environmental regulatory requirements, impact
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1 INTRODUCTION

Integrated waste management is a waste disposal system that comprises sorting materials by kind and determining the best use for abandoned items, which may or may not include landfill disposal. (M. A. Bhat et al., 2020)

The development of wastes has increased because of the current modernization, industrialization, and increased population. domestic wastes, industrial wastes, municipal wastes, and paper waste are among the wastes. Due to the intense use of land for residential, industrial, and commercial reasons, the availability of open land space for garbage disposal has decreased. Waste collection, transportation, recycling, and disposal must all be improved in order to reduce the amount of waste on the planet. (Aalok et al., 2008)

Waste management is the collection, transportation, disposal, recycling, and monitoring of wastes (Burke, and Singh., 2005) Waste management can be costly, so it's critical to understand the many cost-effective, long-term, and safe waste management options (Hagggar, 2007).

Hazardous waste is defined as waste that has features that make it unsafe or capable of harming human health and/or the environment. (*Management of Municipal Solid Waste.*, 2000) These wastes are defined as any solid, semi-solid, liquid, or combination of solid, semi-solid, liquid, or combination of solid, semi-solid, liquid. (Basheer & Agrawal, 2013)

Waste management is carried out in order to recycle wastes and reduce the negative impacts of wastes on the

environment, health, and aesthetics (Gaja Jakshmi & Abbasi, n.d.). The wastes might be solid, liquid, or gaseous in nature. Waste management differs between rural and urban areas, municipal and industrial wastes, and developed and developing countries.

Components of garbage that still have useful physical or chemical qualities and can be reused or remanufactured are referred to as recyclables.

Solid Waste Management (SWM) is the intentional and systematic control of solid waste generation, storage, collection, classification, treatment, recycling, recovery, and disposal.

Waste minimization is the process of removing or reducing the quantity or toxicity of materials before they are discarded.

Waste Prevention - Programs, techniques, and actions designed to keep items out of landfills (Synonymous with Avoidance).

The recording of information from the waste generator regarding the quantity and type of trash produced, as well as information on who transported the waste and when is known as waste tracking. capturing information about the quantity and kind of trash received from the waste receiver, and matching waste information from both the generator and the receiver.

The industrialized world employs a variety of unique technologies to limit waste's negative effects or to utilize it (Cunningham & Cunningham., 2007)

2 PROCEDURE AND METHODS

2.1 Solid waste classification

Hazardous waste can be classified as

Explosives, first class

Gases, second class

The third category is flammable liquids.

The fourth category is flammable solids.

Oxidizing substances are the fifth class.

Poisonous & Infectious, 6th Class

Radioactive Substances, 7th Class

Corrosive Substances is the eighth class.

Mixed Substances (Night Class).

2.1.1 Hazardous waste (but not limited to):

Ashes of the fly, Sludge made of chemicals (from chemical storage tanks), Chemical spill, oil spill Oil, gasoline, and other substances were used. Old oil/waste oil batteries that have been used, rags and used oil filters Tube lights were used. Chemical residues on used PVC drums Laboratory waste, radioactive waste (e.g. particulate filters), WEEE (printers, cartridges, cables, computers, telephones, etc.), Medical waste (used syringes, gloves, dressings, etc.); PCBs such as semiconductors and converters; Aerosol containers; tins with paint residues All types of hazardous waste must be treated in an approved landfill before being disposed of; hazardous waste disposal must be done in an engineered landfill. (Enger & Smith, 2022)

2.1.2 Non-Hazardous waste (but not limited to) :

PVC drums with no chemical residues were used. Water filter candles and membranes were used. Paper waste (including cartoon garbage and other types of waste), and plastic waste (reusable plastic pallets and bags), Pallets made of wood, Organic (food) waste, metal scrap Sludge from a wastewater treatment plant, glass Anthracite was mixed with sand from RO and other trash, as well as dead animals. All sorts of non-hazardous garbage should be reused before being disposed of; non-hazardous waste should be disposed of in a general landfill. (Kaviraj & Sharma, 2003)

Waste Management Process Flow:

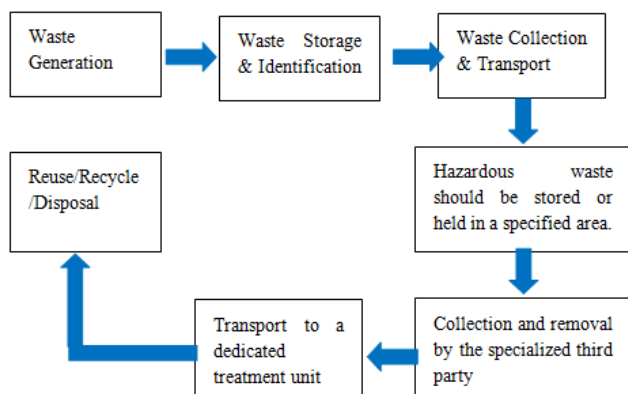


Figure 1: Waste Management Process Flow

2.2 Code of Practice

From the point of generation through final disposal, the actions involved in waste management have been divided into six functional elements:

- Waste creation
- Waste handling, storage, and processing on-site
- Waste collection
- Waste transfer and transportation
- Waste processing and recovery
- Waste disposal

2.3 REQUIREMENTS

Identifying, sorting, packing, labelling, storing, transporting, treating, and disposing of garbage are all part of waste management. It necessitates making efforts to limit waste output at the source.

Hazardous waste created during industrial processes must be collected and classified according to its nature. The trash will be stored in the generated area at first. The wastes must be put in appropriate containers and labelled according to applicable national and international standards, following industry best practices. Following categorization, the garbage must be transported to an approved waste storage facility constructed in compliance with local requirements.

A permanent hazardous waste storage facility with secondary containment shall be built and maintained on-site to confine hazardous waste materials and reduce the risk of injury to employees or the environment to the greatest extent practicable. Except for adding or withdrawing materials from the container, all containers used to hold hazardous waste materials must be kept always closed. To prevent unauthorized people or vehicles from entering the hazardous waste storage location, it must be completely fenced. Hazardous wastes must be stored in accordance with their compatibility.

Hazardous waste materials stored in drums or other transportable storage containers must have enough aisle space to enable inspection and transportation of the drums or containers. Drums must be stacked no more than two high on pallets or skids.

As part of the overall facility emergency plan, those who store, label, handle, or transport hazardous waste products must establish and implement an emergency plan to resolve situations involving these materials. Maintain appropriate spill control equipment and chemicals on-site to deal with both real and anticipated situations involving these items.

Wastes generated at the facility must not be moved outside the border for storage or disposal unless they are recycled, reused, recovered, or treated in accordance with the applicable local regulatory authority's regulations. All wastes must be put in waste-compatible containers in a designated area and transferred outside the facility after receiving regulatory authority consent and using a waste manifest system.

The following minimal information about the garbage to be stored or carried must be clearly labelled on the waste containers:

- The name of the hazardous or industrial waste.
- The name of the generator.
- The date on which the garbage was generated.
- The number of the manifest.
- Waste categorization

Shall carry hazardous and non-hazardous industrial waste to the appropriate waste disposal or waste treatment facilities using waste carriers that have been registered with the applicable local Regulatory Authority.

All motor vehicles transporting hazardous wastes must be equipped with labels that follow the United Nations chemical hazard classification system for dangerous goods transportation. Under normal transportation conditions, trash containers must be secured during transport to prevent movement or dislodgment.

All industrial wastes generated within the plant that are not intended for recycling or reuse must be treated and/or disposed of at approved waste treatment/ disposal facilities

within one to two hundred days of the waste being generated, and the disposal facility must provide a completed copy of the manifest within thirty to two months of receiving and accepting the waste.

On a monthly basis, industrial facilities that generate industrial waste must submit a waste generation and disposal report that includes the following information about the trash generated:

- The name of the waste-generating plant.
- A breakdown of the garbage produced.
- Waste categorization
- The amount of garbage produced during the period in question.
- Disposal deadlines.
- The number of the manifest.
- Records

All records relating to hazardous waste management must be kept for at least three years.

2.4 Waste Disposal Collection

Garbage skips and containers with different colors should be properly labelled and put near the source of waste generation. Hazardous material should never be mixed with trash. Waste should be separated according to its type.

Table 1: Suggested Color Coding for waste skips

Grey/Red Skips	For metal scrap and workshop, waste metals to be recycled
Yellow Skips	For hazardous waste

Blue Skips	For non-hazardous/general waste
Green Skips	For recycle waste

Each location where these skips will be put should be clearly marked with color-coded signboards. On the same bulletin board, information on contacting workers to empty the skip should be placed. Dedicated workers are in charge of contacting the person who will be responsible for emptying each packed skip. Please notify the site environmental staff if additional garbage collection receptacles are required.

➤ Sludge from Wastewater Treatment (Industrial effluent)

Sludge from wastewater treatment plants can be disposed of as non-hazardous waste in low-lying areas or by landfilling.

➤ Sludge and Sewage Water

Sewage sludge must be disposed of as non-hazardous after treatment at an STP; however, if the sludge analytical parameters are within limitations and the NPK ratio is high, sewage sludge can be reused for landscape in an unrestricted zone. Before disposal, sewage characteristics such as pH, R-CI2, and DO must be tested on an online or laboratory scale.

Some industries produce, but are not limited to, the following sorts of waste

All wastes generated during the operation and maintenance of some industrial facilities must be safely managed, disposed of, or recycled as follows:

Table 02. Industrial Waste management protocol

Type of the waste	Category	Handling & labelling	Storage Location (lot #)	Transportation	Treatment (Reuse, Recycle/Disposal)
Fly ash	Hazardous waste	Closed container with labelling at designated area	Ash pond, Scrap Yard	certified contractor by regulatory body	Engineered Landfilling approved by regulatory body
Chemical sludge (from chemical storage tanks)	Hazardous waste	Closed container with labelling at designated area	Scrap Yard	certified contractor by regulatory body	Neutralization process
Oil spill and contaminated soil	Hazardous waste	Closed container with labelling at designated area	Scrap Yard	certified contractor by regulatory body	Engineered Landfilling approved by regulatory body
Chemical spill and contaminated soil	Hazardous waste	Closed container with labelling at designated area	Scrap Yard	certified contractor by regulatory body	Engineered Landfilling approved by regulatory body
Used oil / Old Oil	Hazardous waste	Closed container with labelling at designated area	Scrap Yard	certified contractor by a regulatory body	Refine & Reuse
Used batteries	Hazardous waste	Contained with labelling at designated area	Scrap Yard	certified contractor by regulatory body	Recycle & Reuse
Used oil filters and rags	Hazardous waste	Contained with labelling at designated area	Scrap Yard	certified contractor by regulatory body	Engineered Landfilling approved by regulatory body
Used tube lights	Hazardous waste	Closed container with labelling at designated area	Scrap Yard	certified contractor by regulatory body	Engineered Landfilling approved by regulatory body

Used / Old Chemicals / Expired chemicals, Lab waste, Paint residues, Solvents	Hazardous waste	Closed container with labelling at designated area	Scrap Yard	certified contractor by regulatory body	Chemical treatment
Used PVC drums, Metal drums, Cans, Bottles with Chemical residues	Hazardous waste	labelling and store at designated area	Scrap Yard	certified contractor by regulatory body	Reuse after proper specialized wash
Medical Waste (used syringes, gloves, bandages, expired medicines etc.)	Hazardous waste	Closed container with labelling at designated area	Clinic	certified contractor by regulatory body	Incineration
Electrical Waste	Hazardous waste	Contained with labelling at designated area	Scrap Yard	certified contractor by regulatory body	Reuse if possible or landfilling
Electronic Waste	Hazardous waste	Contained with labelling at designated area	Scrap Yard	certified contractor by regulatory body	Reuse if possible or landfilling
Radioactive waste (e.g. used/damaged smoke detectors)	Hazardous waste	Closed container with labelling at designated area	Scrap Yard	certified contractor by regulatory body	Concealed
Used refrigerant gas cylinders / cans (empty)	Hazardous waste	Contained with labelling at designated area	Scrap Yard	certified contractor by regulatory body	Landfilling
Sludge from wastewater treatment plant	Non-Hazardous waste	Contained with labelling at designated area	Water treatment plant	Municipality approved vendor	General Landfilling
Screen scrapping from sea water inlet (e.g. dead organic matter)	Non-Hazardous waste	Contained with labelling at designated area	Intake	Municipality approved vendor	General Landfilling
Used PVC drums, Metal drums, Cans, Bottles without Chemical residues	Non-Hazardous waste	labelling and store at designated area	Scrap Yard	Municipality approved vendor	Reuse after proper wash
Used water filter candles and membranes	Non-Hazardous waste	labelling and store at designated area	Scrap Yard	Municipality approved vendor	General Landfilling
Paper waste (including carton waste etc.)	Non-Hazardous waste	labelling and store at designated area	Scrap Yard	Municipality approved vendor	Recycle/Reuse/General Landfilling
Assorted Plastic waste (mixed)	Non-Hazardous waste	labelling and store at designated area	Scrap Yard	Municipality approved vendor	Recycle/Reuse/General Landfilling
Plastic waste (plastic pallets and bags)	Non-Hazardous waste	labelling and store at designated area	Scrap Yard	Municipality approved vendor	Recycle/Reuse/General Landfilling
Wooden pallets	Non-Hazardous waste	labelling and store at designated area	Scrap Yard	Municipality approved vendor	Recycle/Reuse/General Landfilling
Metal scrap – when not contaminated by oil residue	Non-Hazardous waste	labelling and store at designated area	Scrap Yard	Authorized vendor	Recycle/Reuse
Organic (food) waste	Non-Hazardous waste	labelling and store at designated area	Scrap Yard	Municipality approved vendor	General Landfilling
Glass	Non-Hazardous waste	labelling and store at designated area	Scrap Yard	Municipality approved vendor	Recycle/Reuse/General Landfilling

Compost (from gardening activities)	Non-Hazardous waste	labelling and store at designated area	Scrap Yard	Municipality approved vendor	Recycle/Reuse/General Landfilling
General Waste (not covered above list)	Non-Hazardous waste	labelling and store at designated area	Scrap Yard	Municipality approved vendor	General Landfilling

2.5 Health and Safety

Corrosive, combustible, explosive, toxic, and capable of generating extremely deadly gases could be present in the waste. As a result, proper safety precautions must always be taken when managing trash. The background information gathered about the waste should aid in determining the scope of safety precautions to be taken and the protective equipment to be worn. Prior to handling the trash, the plant's health and safety department must be consulted.

2.6 Reduction, Reuse and storage Practices.

A trash exchange program also helps to reduce waste by managing water usage in processes and utilities by setting specific targets.

Employee education and involvement are critical in any of the change methods (reduction, reuse, and recovery), but they are more important in the case of reduction.

Reduction requires the commitment and involvement of all industrial business personnel. Source reduction tactics have a number of positive environmental effects, including lowering greenhouse gas emissions, saving energy, and conserving resources, as well as reducing trash volume.

Reuse is when a thing is used more than once, either for the same or a different reason.

Because reuse does not require reprocessing, it consumes less energy than recycling.

Packaging reuse is one of the reuse options (including boxes and bags).

Reusing printer toners, printing cartridges, and chemical PVC barrels (large and medium sizes) for other beneficial purposes after adequate washing with water.

Reusing plastic bags, gunny bags, and tires after rebuts toning for transportation purposes, as well as reusing waste oil after refining and conducting a reuse program.

The temporary retaining of trash before it is handled, disposed of, or kept elsewhere is referred to as storage. Hazardous waste must be held in containers, tanks, containment buildings, drip pads, trash piles, or surface impoundments that conform with EPA requirements prior to treatment or disposal (EPA Requirements (Reference 40 CFR Part 264)., n.d.)

Table 3: Waste Storage guideline according to EPA requirements

Type of Storage	Description
Containers	Any portable device in which hazardous waste is kept, transported, treated, disposed of, or otherwise handled is referred to as a hazardous waste container. The 55-gallon drum is the most typical hazardous waste container.

Drip Pads	The pressure-treated wood business uses a drip pad to absorb surplus wood preservative drippage. Drip pads are made of non-earthen materials with a curbed, free-draining foundation to transport wood preservative drips to a collection system for proper disposal.
Containment Buildings	Containment buildings are self-contained structures with four walls, a roof, and a floor that are used to store or treat non-containerized hazardous waste.
Waste Piles	A rubbish pile is an open, uncontained area where waste is treated or stored. To prevent waste leachate from contaminating surface or ground water supplies, hazardous trash piles must be positioned on top of a double liner system.

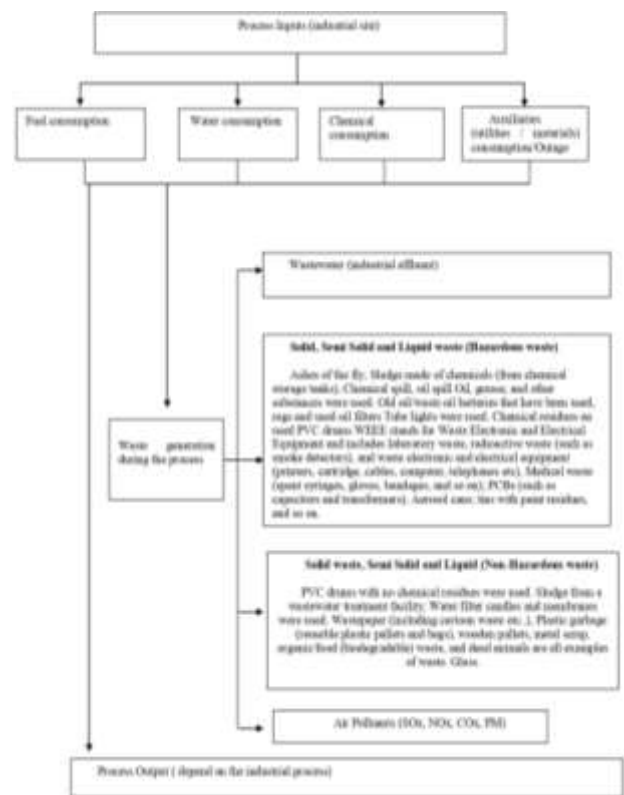


Figure 2: Process map of the integrated solid waste management

3 CONCLUSION

The accumulation of wastes has increased as a result of industrialization, globalization, and increased population density. Waste collection, transportation, recycling, and disposal must all be improved to reduce the amount of waste on the planet.

The aim of Integrated Waste Management for industrial is Waste reduction, reuse, and recovery.

The best method to relieve the strain on trash disposal systems is to limit garbage production. Prior to disposal, the emphasis is on reduction, reuse, and recovery.

- Reduction refers to the use of fewer throwaway items.
- Reuse is the practice of repurposing goods after they have served their original use.
- Recovery refers to recapturing the item's highest material or energy value.

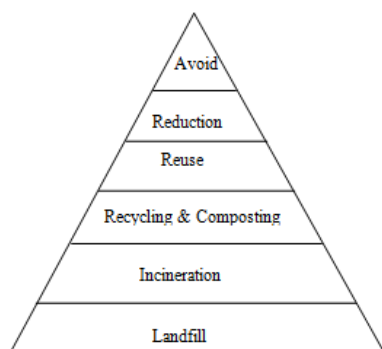


Figure 3: Nyquist Hierarchy of integrated solid waste management.

Identifying the level or levels at which the highest values of individual and collective materials can be recovered is the technique utilized to design an integrated waste management system. As a result, the list begins with reduction, which involves utilizing less and reusing more in order to save money on material production, resource costs, and energy. Ultimate disposal, or the final resting place for garbage, is at the bottom of the list (Figure 3).

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