International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 7; Issue 6(J); June 2018; Page No. 13712-13717
DOI: http://dx.doi.org/10.24327/ijcar.2018.13717.2463

Research Article

A STUDY ON HAZARDOUS WASTE MANAGEMENT OF VARIOUS METHODS OF HANDLING AND DISPOSAL OF INDUSTRIAL WASTES IN PHARMACEUTICALS INDUSTRIES FOR THE GREENER ENVIRONMENT

Ramesh. K*

Department of Civil Engineering, Prist University Puducherry

A R T I C L E I N F O

Article History:

Received 20th March, 2018
Received in revised form 27th April, 2018 Accepted 5th May, 2018
Published online 28th June, 2018

Key words:

Hazardous and non-hazardous waste, Recycling, Environmental Pollution, Resources conservation, Secured land filling, Plasma gasification, Co-Processing, Greener environment

A B S T R A C T

The case study of the "Hazardous Waste Management of Various Methods of Handling And Disposal Of Industrial Wastes In Pharmaceuticals Industries For The Greener Environment". The study was carried in a Pharmaceutical industry at Cuddalore and TamilNadu waste Management Limited at Gumidipoondi. In this case study, the handling of hazardous waste is monitored for the type of waste generation and its various disposal methods.

The case study of the Hazardous waste disposal method is indicating that which method is suitable for the Greener environment either secured land filling, Plasma gasification or the Co- Processing.

INTRODUCTION

Today the management of solid waste and wastewater is a major concern for humanity. In the last decade, traces of pharmaceuticals have been reported in the water cycle and have raised concerns among regulators, water suppliers and the public regarding the potential risks to human health. This study evaluated solid waste management in the state of Tamil Nadu and concluded that the main fate of hazardous waste has been incineration, Secured land filling, Plasma gasification or the Co- Processing, while the non-hazardous waste has been recycled or sent to landfills. However, complaints to the Environmental Agency have indicated that a significant number of companies just send their hazardous wastes to landfills or even to garbage dumps, thus highlighting the urgent need for adequate waste management in Tamil Nadu. Most of the pharmaceutical companies in Tamil Nadu use conventional wastewater treatment. This study contributes to enhancing our knowledge of the management of wastewater as well as of solid waste from the pharmaceutical industry.

Objective

This case study aims to determine the suitable method for the Hazardous waste disposal and to provide a background, the importance and significance of proper hazardous waste disposal, describe the correct methods to dispose of unwanted and expired medications.

Method

The information about the methods of proper disposal as well as the suitable method for the Green Environment. Data was collected by all available resources.

Waste

Waste and wastes are unwanted or unusable materials. Waste is any substance which is discarded after primary use, or it is worthless, defective and of no use.

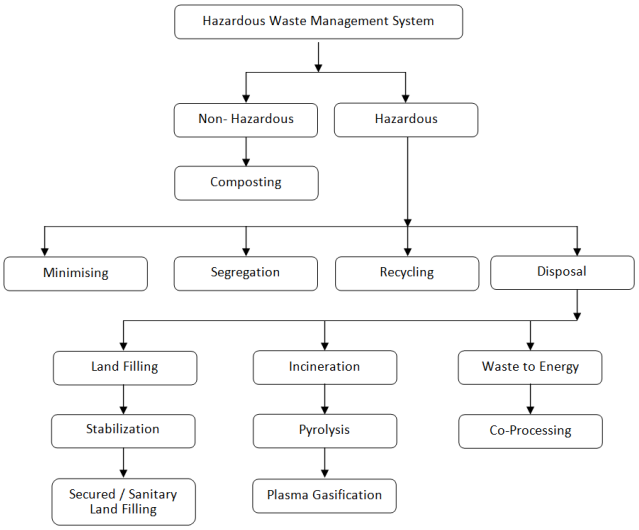
Examples include municipal solid waste (household trash/refuse), hazardous waste, wastewater (such as sewage, which contains bodily wastes (feces and urine) and surface runoff), radioactive waste, and others.

Hazardous Waste

Hazardous waste is a waste with properties that make it potentially dangerous or harmful to human health or the environment. The universe of hazardous wastes is large and diverse. Hazardous wastes can be liquids, solids, or contained gases. They can be the by-products of manufacturing processes, discarded used materials, or discarded unused commercial products, such as cleaning fluids (solvents) or pesticides.

Corresponding author:* **Ramesh. K
Department of Civil Engineering, Prist University Puducherry

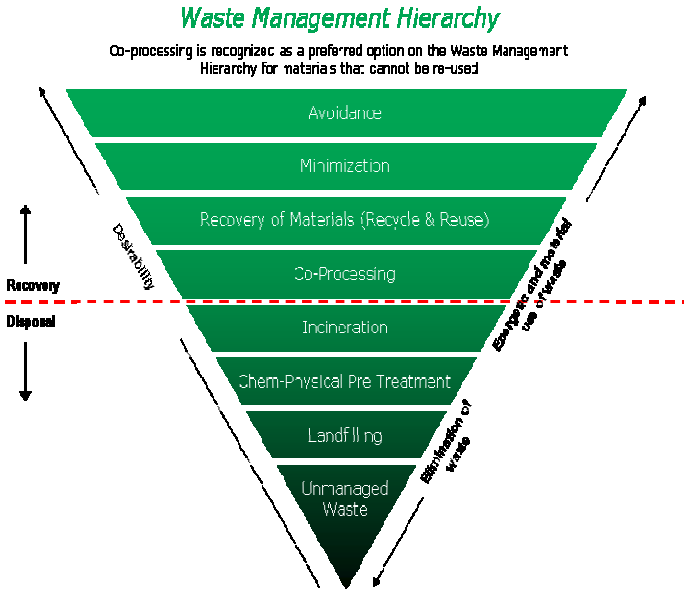
Type of Hazardous waste Disposal Methods



Pharmaceutical waste

Pharmaceutical waste is potentially generated thorough a wide variety of activities is a health care facility, including but syringes, and not limited to intravenous (IV) preparation, general compounding , spills/breakage, partially used vials, syringes, and IVs, discontinued , unused preparations, unused unit dose repacks, patients personal medications and outdated pharmaceuticals. Health care industries can generate hazardous waste from many sources, including disposal of pharmaceuticals. Pharmaceutical waste may also include expired drugs, patients personal medications, waste materials containing excess drugs (syringes, IV bags, tubing, vials, etc.

Waste Management Hierarchy



Picture 1 Waste Management Hierarchy

Pharmaceutical Hazardous Waste Categories

Hazardous wastes are classified on the basis of their biological, chemical, and physical properties. These properties generate materials that are either toxic, reactive, ignitable, corrosive, infectious, or radioactive

Hazardous wastes are divided into two categories:

1. listed wastes, and
2. characteristic wastes.

Listed wastes appear on one of four lists of hazardous waste (F, K, P and U). Pharmaceuticals are found on two of these lists, the P and U lists which both contain commercial chemical products.

Characteristic wastes are regulated because they exhibit certain hazardous properties – ignitability, corrosivity, reactivity and toxicity.

Waste categories in Industries

Table 1 Waste categories in Industries

Industrial Hazardous Waste	Industrial Non-HazardousWaste
ETP/CETP Sludge's	PlasticWaste
Paint Sludge	ResinWaste
Grinding Sludge	PaperWaste
Chemical Sludge	Off Specification waste
Tarry waste, Distillation Residue	Other nonhazardous waste suitable for pre-processing
Off specification waste	
Other liquid,s/sand solid hazardous waste; suitable for pre-processing.	

Characteristic Hazardous Waste

(1) Ignitability,(2) Corrosivity,(3) Reactivity, and (4) Toxicity.

9.1.Ignitability:

The objective of the ignitability characteristic is to identify wastes that either present a fire hazard under routine storage, disposal, and transportation or are capable of exacerbating a fire once it has started. There are several ways that a drug formulation can exhibit the ignitability characteristic

Corrosivity

Any waste which has a pH of less than or equal to 2 (highly acidic) or greater than or equal to12.5 (highly basic) exhibits the characteristic of corrosivity and must be managed as a hazardous waste. Generation of corrosive pharmaceutical wastes is generally limited to compounding chemicals in the pharmacy. Compounding chemicals include strong acids, such as glacial acetic acid and strong bases, such as sodium hydroxide.

Reactivity

Reactive wastes are unstable under "normal" conditions. They can cause explosions, toxic fumes, gases, or vapours when heated, compressed, or mixed with water. Nitro-glycerine is the only drug that is potentially reactive

Toxicity

Wastes that exceed these concentrations must be managed as hazardous waste. The test that determines the ability of these chemicals and heavy metals to leach in a landfill environment is called the Toxicity Characteristic Leaching Procedure, or TCLP. If the concentration determined by the TCLP exceeds the stated limits, the waste must be managed as hazardous waste

Hazardous-waste management

Hazardous-waste management**,** the collection, treatment, and disposal of waste material that, when improperly handled, can

cause substantial harm to human health and safety or to the environment. Hazardous wastes can take the form of solids, liquids, sledges, or contained gases, and they are generated primarily by chemical production, manufacturing, and other industrial activities. They may cause damage during inadequate storage, transportation, treatment, or disposal operations. Improper hazardous-waste storage or disposal frequently contaminates surface and groundwater supplies. People living in homes built near old and abandoned waste disposal sites may be in a particularly vulnerable position. In an effort to remedy existing problems and to prevent future harm from hazardous wastes, governments closely regulate the practice of hazardous-waste management.

Hazardous wastes have become an important environmental and public health issue which concerns many countries in the world. In the modern framework of hazardous waste management, a four-pronged strategy has been adopted:

1. Minimizing the quantity of waste
2. Recycling of industrial waste
3. Treatment of the waste
4. Collection, transport and disposal of waste in an environmentally sound manner.

Waste Minimization

The first priority in hazardous waste management is to reduce the quantity of waste to minimum. Three major waste reduction schemes which are often used can be summarized as below:

Process Modification

Often the industrial process can be altered in such a way that the use of raw materials is optimized, and the amount of-hazardous waste is reduced to barest minimum. For example, in zinc electroplating, the sulphate salt is substituted by the chloride compound with slight modification of the process; this can eliminate the cyanide problem.

Waste Concentration

The waste can be concentrated using evaporation, precipitation or decantation techniques which means that the volume of waste can be considerably reduced using these methods. Incineration, viz., oxidation of inflammable-waste is often practiced in order to reduce the volume of waste to be handled. It is an excellent method of waste disposal, but the cost of operation usually exceeds the net gains.

Waste Segregation

Segregating the hazardous waste streams from non-hazardous streams decreases the volume of hazardous wastes, thus, making it easier to treat.

Recycling Industrial Wastes

Many substances in refuse wastes have value. They include glass, wood fibre from paper products, and metal. Scientists have developed ways of recycling many wastes, so they can be used again. Almost all materials are recyclable. However, in some more energy will be expended in recovery than the recovered value warrants. The two broad ways of processing hazardous waste are waste reuse and waste recycling. We shall briefly deal with them.

Waste Reuse

In some cases, waste material can be used as a raw material with very little processing. Transfer of the waste "as is" without reprocessing, to another facility is known as waste reuse or waste exchange. Unwanted materials of commence such as outdated chemicals or untested materials not meeting the high-quality control requirements of purchasing industry, can be reused without processing. Process wastes such as cardboard for making paper pulp, copper or other metal salt solutions for metal recovery, oils that can be used as fuels. This includes a variety of other materials that can be reused as industrial feed stocks.

Waste Recycling

Recycling differs from reuse in that the waste must first be treated before it can be used in a manufacturing process. When a transfer of waste "as is" is not possible, reprocessing the waste for material recovery is known as recycling.

Disposal of Hazardous Waste

The final disposal of the hazardous wastes also needs to be carefully planned. There are four different ways in which hazardous wastes can be finally disposed.

1. Secured or sanitary Landfilling.
2. Incineration.
3. Co-Processing
4. Dumping at sea
5. Underground disposal

We shall now discuss each of the above method of disposal of hazardous wastes.

Secured or sanitary Land filling

The disposal of hazardous waste by land filling is an important method of disposal in many countries. Land filling means storing harmful substances under the ground. This involves hauling the refuse to an area allocated for this purpose. In India such areas range from unsanitary open dumps to properly operated sanitary landfills. Open dumps are a poor method of waste disposal because they cause environmental problems. For example, they can ruin the appearance of all area and provide a home for rats and other rodents who spread disease. If garbage is exposed, it rots and smells foul. Most dumps allow some burning, which fills the surroundings with smoke. In addition, rain water can drain through refuse and carry harmful substances to streams.

Incineration

Incineration burns waste products. This is another method many industries and large cities use if they do not have enough vacant areas for disposal sites nearby. Most hazardous wastes are detoxified in this process. This is also an excellent method of waste minimization, waste detoxification and disposal, but its cost of operation is very high, if the heat content of waste is not reutilized.

Dumping at Sea

Another method of disposal of hazardous wastes involves dumping wastes at deep sea, designed to prevent contamination of groundwater.

Disposal at sea, of waste generated on land, is based on the misconceived notion that-the enormous volume of water available for dilution, enables the seas to be used as a dump without permanent damage. However, this is an erroneous conviction. The decision to choose this method of disposal is generally based on financial considerations. The site of disposal is determined by the geographical location of the waste producer.

Underground Disposal

Some of the Hazardous wastes that cannot be disposed of either in above-ground landfill sites for hazardous wastes or in hazardous waste incineration plants. That type of Hazardous wastes disposed in underground.

Final disposal of hazardous waste

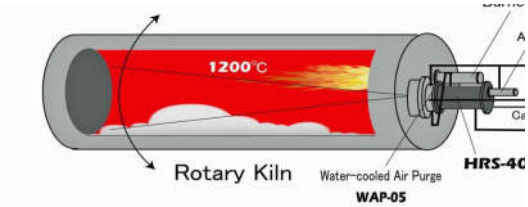
Historically, some hazardous wastes were disposed of in regular landfills. This resulted in unfavourable amounts of hazardous materials seeping into the ground. These chemicals eventually entered to natural hydrologic systems. Many landfills now require countermeasures against groundwater contamination. For example, a barrier has to be installed along the foundation of the landfill to contain the hazardous substances that may remain in the disposed waste. Currently, hazardous wastes must often be stabilized and solidified in order to enter a landfill and must undergo different treatments in order to stabilize and dispose them. Most flammable materials can be recycled into industrial fuel. Some materials with hazardous constituents can be recycled, such as lead acid batteries.

Recycling

Some hazardous wastes can be recycled into new products. Examples may include lead-acid batteries or electronic circuit boards. When heavy metals in these types of ashes go through the proper treatment, they could bind to other pollutants and convert them into easier-to-dispose solids, or they could be used as pavement filling. Such treatments reduce the level of threat of harmful chemicals, like fly and bottom ash[], while also recycling the safe product.

Portland cement or CO-Processing

Another commonly used treatment is cement based solidification and stabilization. Cement is used because it can treat a range of hazardous wastes by improving physical characteristics and decreasing the toxicity and transmission of contaminants. The cement produced is categorized into 5 different divisions, depending on its strength and components. This process of converting sludge into cement might include the addition of pH adjustment agents, phosphates, or sulfur reagents to reduce the settling or curing time, increase the compressive strength, or reduce the leach ability of contaminants.



Incineration, destruction and waste-to-energy Hazardous waste may be "destroyed". For example, by incinerating it at a high temperature, flammable wastes can sometimes be burned as energy sources. For example, many cement kilns burn hazardous wastes like used oils or solvents. Today, incineration treatments not only reduce the amount of hazardous waste, but also generate energy from the gases released in the process. It is known that this particular waste treatment releases toxic gases produced by the combustion of byproduct or other materials which can affect the environment.

Pyrolysis

Some hazardous waste types may be eliminated using paralysis in an ultra-high temperature electrical arc, in inert conditions to avoid combustion. This treatment method may be preferable to high temperature incineration in some circumstances such as in the destruction of concentrated organic waste types, including PCBs, pesticides and other persistent organic pollutants.

Co-processing

Co-processing is defined as the use of waste as raw material, or as a source of energy, or both to replace natural mineral resources (material recycling) and fossil fuels such as coal, petroleum and gas (energy recovery) in industrial processes, mainly in energy intensive industries (EII) like cement production.

Types of Co-processing

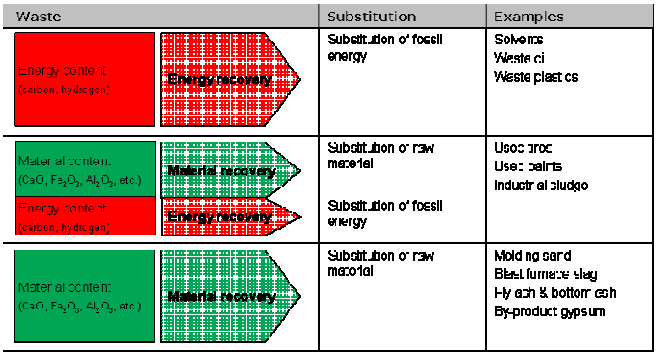


Figure 1 Types of Co-processing

Plasma Gasification

Plasma is the fourth of nature, by far the most common form of matter. Plasma is the stars and in the tenuous space between the makes up over 99% of the visible universe and perhaps most of that which is not visible.

In physics and chemistry, plasma is a state of matter similar to gas in which a certain portion of the practices are ionized. The basic premise is that heating a gas disassociates its molecular bonds, rendering it into its constituent atoms. Further heating leads ionization (a loss of electrons), turning it into a plasma containing charged particles, positive electrons.

Plasma Arc

Very high energy radiation breaks chemical bonds directly without series of chemical reactions

Plasma Gasification

Analysis Report

Table 1

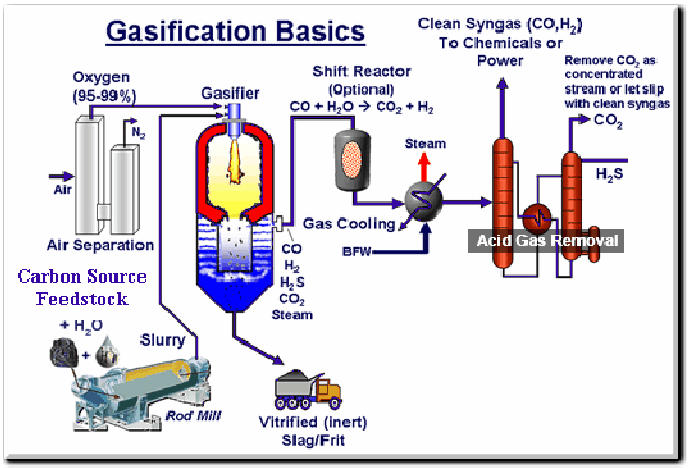
Ultimate Analysis	ETP Dried Sludge	Spent Carbon	Combined waste including Scrap
Carbon as C	18.80	22.22	30.20
Hydrogen as H	4.59	2.15	4.40
Oxygen as O	35.17	14.50	8.80
Nitrogen as N	4.17	1.85	0.3
Sulphur as S	0.45	0.62	2.6
Moisture content in the feedstock in %	1.2	40	5
Analyse Done By	SGS	KANKYO	KANKYO

Analysis Report of VTFD Salt and ETP sludge

Table 2 Analysis Report of VTFD Salt and ETP sludge

Ultimate Analysis	ETP Dried Sludge	Spent Carbon	Combined waste including Scrap
Carbon as C	18.80	22.22	30.20
Hydrogen as H	4.59	2.15	4.40
Oxygen as O	35.17	14.50	8.80
Nitrogen as N	4.17	1.85	0.3
Sulphur as S	0.45	0.62	2.6
Moisture content in the feedstock in %	1.2	40	5
Analyse Done By	SGS	KANKYO	KANKYO

Gasification Scheme



Benefits of this technology

- Plasma gasification provides a number of energy key benefits over incineration Systems
- It unlocks the greatest amount of energy from waste
- Feed stocks can be mixed, such as municipal solid waste, biomass, tyres, hazardous waste and auto shredder waste.
- It does not generate Methane, a potent green house gas.
- It is not incineration and therefore doesn't produce leachable bottom ash or fly ash
- Clean destruction of hazardous waste, preventing it from reaching landfills
- It has virtually no harmful environmental emissions.
- Production of clean alloyed slag which could be used as construction material
- Processing of organic waste in to combustible syngas for electric power and thermal energy.
- Production of value-added products (Metals) from slag.

Pollutants and its Impact of the Pharmaceuticals Hazardous waste Disposal method

Pollutants and its Impact		Type of Disposal					
		Recycling	Land Filling	Ocean Dumping	Incineration	Co-Processing	Plasma Gasification
Name of the Pollutants	Letchate	yes	yes	NO	yes	yes	NO
	SPM	yes	yes	NO	yes	yes	NO
	SO_2	NO	NO	NO	yes	yes	NO
	NoX	NO	NO	NO	yes	yes	NO
	O_3	NO	NO	NO	yes	yes	NO
	Co_2	yes	yes	yes	yes	yes	yes
	Toxic Gas	yes	yes	yes	yes	yes	NO
	Residue	yes	yes	yes	yes	yes	NO
	Syn Gas	NO	NO	NO	NO	NO	yes
	Slag	NO	NO	NO	NO	NO	yes
Pollution Impact	Land	yes	yes	NO	yes	yes	NO
	Air	yes	yes	NO	yes	yes	yes
	Water	yes	yes	yes	yes	yes	NO
	Environmen	NO	yes	NO	yes	yes	NO
	Heath	NO	yes	yes	yes	yes	NO
Resource Depletion		NO	yes	yes	yes	NO	yes
Economical		yes	NO	NO	NO	yes	yes
Suitability of Pharmaceutical Hazardous waste		yes	NO	NO	NO	NO	yes
Eco friendly for Green Environment		yes	NO	NO	NO	yes	yes

Advantages and Disadvantages of the various Disposal Method

Table 3 Advantages and Disadvantages of the various Disposal Method

Method of Disposal	Advantages	Disadvantages
Ocean Dumping	• Convenient and inexpensive • source of nutrients, shelter and breeding	• ocean overburdened • distruction of food sources • killing of plankton desalination
Sanitary Landfill	• volume can increase with little addition of people/equipment • filled land can be reused for other community purposes	• completed landfill areas can settle and requires maintenance • requires proper planning, design, and operation
Incineration by Plasma Gasification	• requires minimum land • can be operated in any weather • produces stable odor-free residue • refuse volume is reduced by half	• expensive to build and operate • high energy requirement • requires skilled personnel and continuous maintenance • unsightly - smell, waste, vermin
Open	• inexpensive	• health-hazard - insects,

Dumping		rodents etc. • damage due to air pollution • ground water and run-off pollution • expensive • some wastes cannot be recycled • technological push needed • separation of useful material from waste difficult
Recycling	• key to providing a liviable environment for the future	

CONCLUSION

After the completion of the Data collecting work the comparison and evolution of disposal methods was processed to find out the suitability for the Green Environment.
With all of the information provided in the form of written reports and/or oral presentations, the importance of proper hazardous waste disposal is essential for citizens and business owners alike. Hazardous waste is defined by waste that poses significant or potential threats to the public, health, or environment.

To meet the requirements for hazardous waste, the material needs to display at least one or more of the following hazardous traits: ignitability, reactivity, corrosivity, and/or toxicity.

Historically, hazardous wastes were regularly dumped into landfills. This unfavourable action caused the chemicals to seep into the ground and eventually enter our natural water systems. From there, our wild and marine life mammals became exposed to all sorts of chemicals which can in return cause issues for us.
The use of Incineration by burning the material in high temperatures is a great way to destroy toxic waste. Incineration actually destroys and terminates most HW. A benefit of society using this method is the fact that the flammable wastes can also be burned and used as energy sources. The method of Incineration releases toxic gases which can affect the environment, but current technology has developed more effective incinerator units that limit the amount of emissions released in the sky.

Another smart method is Plasma

By using these methods to dispose of hazardous waste, we can all enjoy a safer environment.

Plasma Incineration is the Best and eccofriendly Hazardous waste Disposal method for the Greener Environment

References

Reference -1

Status of Co-Processing of Waste In Cement Plants As Perhazardous And Other Wastes management Rules, 2016

Presented at 3rd International Conference on Alternate Fuels & Raw Materials in Cement Industry – Towards Realising Swachh Bharat Dream on 23rd & 24th March 2017 at New Delhi, India

Author: Dr B Sengupta,

Former Member Secretary,

Central Pollution Control board

Reference -2

Wastes Utilization in cement industry

Author: Ultra tech Cement Industries ARF Presentation

Reference -3

Functioning of afrf & importance of preprocessing for Co-processing

Author: Mr Kirankumar

GEPIL – Gujarat Enviro Protect & Infrastructure Limited
Reference-4
Analysis repor of the Pharmaceuticals Industry
Analysed by SGS - Chennai

How to cite this article:

Ramesh. K (2018) 'A Study on Hazardous Waste Management of Various Methods of Handling and Disposal of Industrial Wastes in Pharmaceuticals Industries for the Greener Environment ', *International Journal of Current Advanced Research,* 07(6), pp. 13712-13717. DOI: http://dx.doi.org/10.24327/ijcar.2018.13717.2463

****