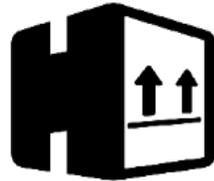
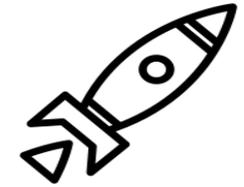




Heat Treatments for Medical Waste Management



KERONE

Complete Engineering Solutions...

What is Waste Management ...

Waste management are the activities and actions required to manage waste from its inception to its final disposal

This includes the collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process

Waste management deals with all types of waste, including Municipal Waste, Medical Waste, Electronics Waste

The Waste Hierarchy

Most favoured option

Reduce

lowering the amount of waste produced

Reuse

using materials repeatedly

Recycle

using materials to make new products

Recovery

recovering energy from waste

Landfill

safe disposal of waste to landfill

Least favoured option

Types of Wastes:

Municipal Solid Waste

Hazardous Waste

Medical Waste

Radioactive Waste

Electronic Waste



What is Medical Waste...

Medical waste is any kind of waste that contains infectious material (or material that's *potentially* infectious). This includes waste generated by healthcare facilities like physician's offices, hospitals, dental practices, laboratories, medical research facilities, and veterinary clinics.

Examples of Medical Waste :

Anything that is soaked in blood (gloves, gauze, gowns etc.)

Human or animal tissues created during procedures.

Cultures of infectious diseases/agents.

Any waste produced in patient's rooms with communicable diseases

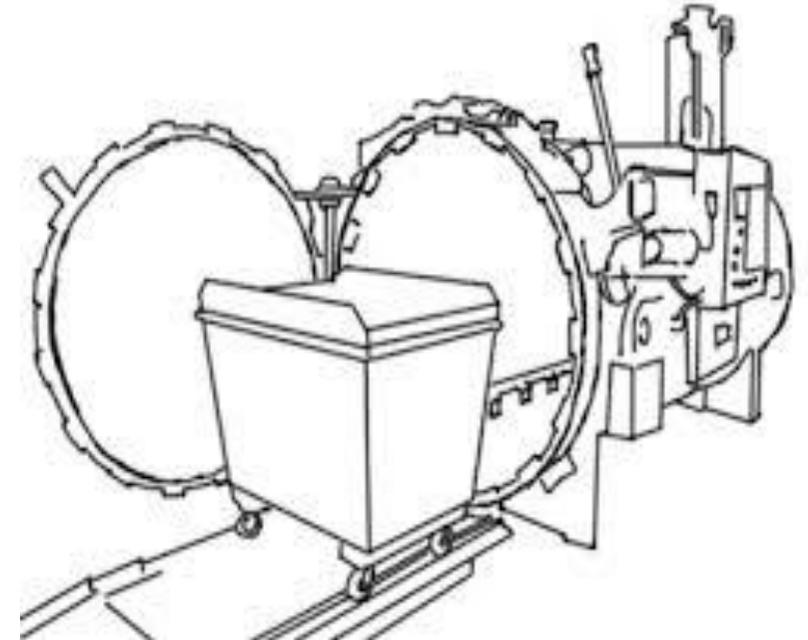
Discarded vaccines



Heat Treatments for Medical Waste Management

A principle of medical waste treatment is that heat kills pathogens and under the right conditions high temperatures it can break down hazardous chemicals. The heat treatment is divided into Low Temperature process & High Temperature Heating Process.

- ❑ Low heat temperature technology operates between 100 to 180 °C. The heat can be either moist or dry.
 - Microwave
 - Irradiation (indirectly)
 - Autoclave (steam)
 - Hydroclave
 - Hot Air Ovens
 - Encapsulation is not a heat treatment although sometimes heat evolves.
- ❑ High temperature operations carried out above 400 °C.
 - Pyrolysis
 - Incineration



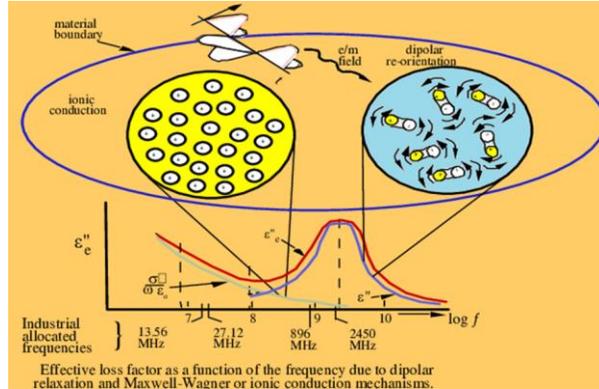
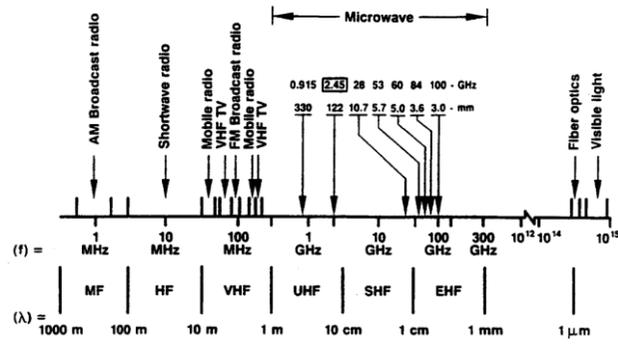
Categories of Medical Waste...

Waste Category	Type of wastes	Treatment and disposal options
Yellow	(a) Human Anatomical Waste: Human tissues, organs, body parts and fetus below the viability period	Incineration or plasma pyrolysis or deep burial
	(b) Animal Anatomical Waste: Experimental animal carcasses, body parts, organs, tissues, including the waste generated from animals used in experiments or testing in veterinary hospitals or colleges or animal houses	
	(c) Soiled Waste: Items contaminated with blood, body fluids like dressings, plaster casts, cotton swabs and bags containing residual or discarded blood and blood components	Incineration or plasma pyrolysis or deep burial. In absence of above facilities, autoclaving or micro-waving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery
	(d) Expired or Discarded Medicines: Pharmaceutical waste like antibiotics, cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials etc.	To common bio-medical waste treatment facility or hazardous waste treatment, storage and disposal facility for incineration at >1200 °C Or Encapsulation or Plasma Pyrolysis at >1200 °C. All other discarded medicines shall be either sent back to manufacturer or disposed by incineration
	(e) Chemical Waste: Chemicals used in production of biological and used or discarded disinfectants	Disposed of by incineration or Plasma Pyrolysis or encapsulation in hazardous waste treatment, storage and disposal facility.

Waste Category	Type of wastes	Treatment and disposal options
Yellow	(f) Discarded linen, mattresses, beddings contaminated with blood or body fluid	Non-chlorinated chemical disinfection followed by incineration or plazma pyrolysis or for energy recovery. In absence of above facilities, shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery or incineration or plazma pyrolysis
	(g) Microbiology, Biotechnology and other clinical laboratory waste: Blood bags, laboratory cultures, stocks or specimens of microorganisms, live or attenuated vaccines, human and animal cell cultures used in research, industrial laboratories, production of biological, residual toxins, dishes and devices used for cultures.	Local autoclaving or microwaving or incineration
Red	Contaminated Waste (Recyclable): (a) Wastes generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles and fixed needle syringes) and vaccutainers with their needles cut) and gloves	Autoclaving or micro-waving/hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent to registered or authorized recyclers or for energy recovery or plastics to diesel or fuel oil or for road making, whichever is possible. Plastic waste should not be sent to landfill sites.

Waste Category	Type of wastes	Treatment and disposal options
White (Translucent)	Waste sharps including Metals: Needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes both used, discarded and contaminated metal sharps.	Autoclaving or Dry Heat Sterilization followed by shredding or mutilation or encapsulation in metal container or cement concrete; combination of shredding cum autoclaving; and sent for final disposal to iron foundries (having consent to operate from the State Pollution Control Boards or Pollution Control Committees) or sanitary landfill or designated concrete waste sharp pit.
Blue	(a) Glassware: Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes (b) Metallic Body Implants	Disinfection (by soaking the washed glass waste after cleaning with detergent and sodium hypochlorite treatment) or through autoclaving or microwaving or hydroclaving and then sent for recycling.

Introduction of Microwave Heating



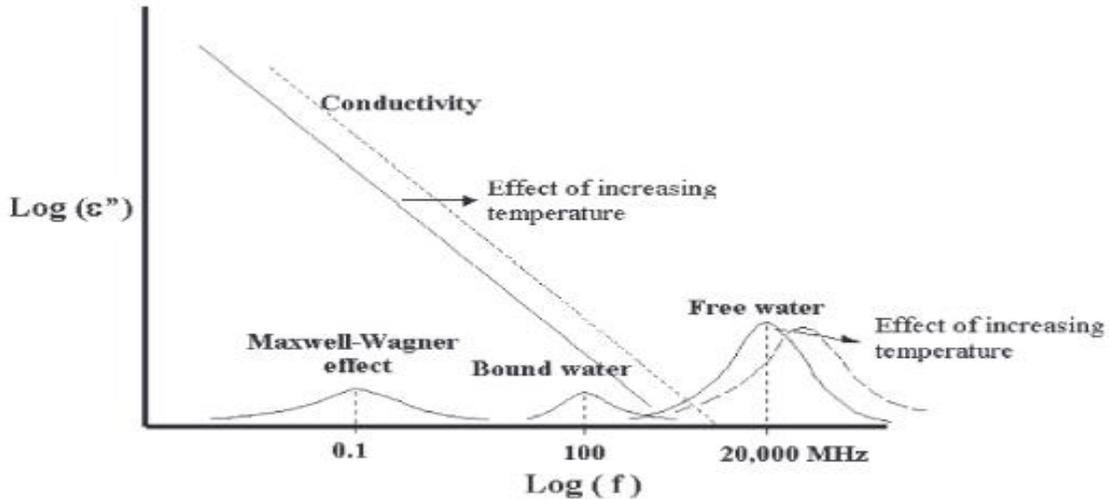
Microwave heating systems are member of Electromagnetic heating family.

Microwaves has frequency of 2.45Ghz and 950Mhz.

Microwave is generated from small device known as Magnetron.

Microwave heating system has property to heat from within.

Microwave heating systems heats volume of material hence also known as 'Volumetric Heating'.



Microwave Heat Treatment for Medical Waste Management

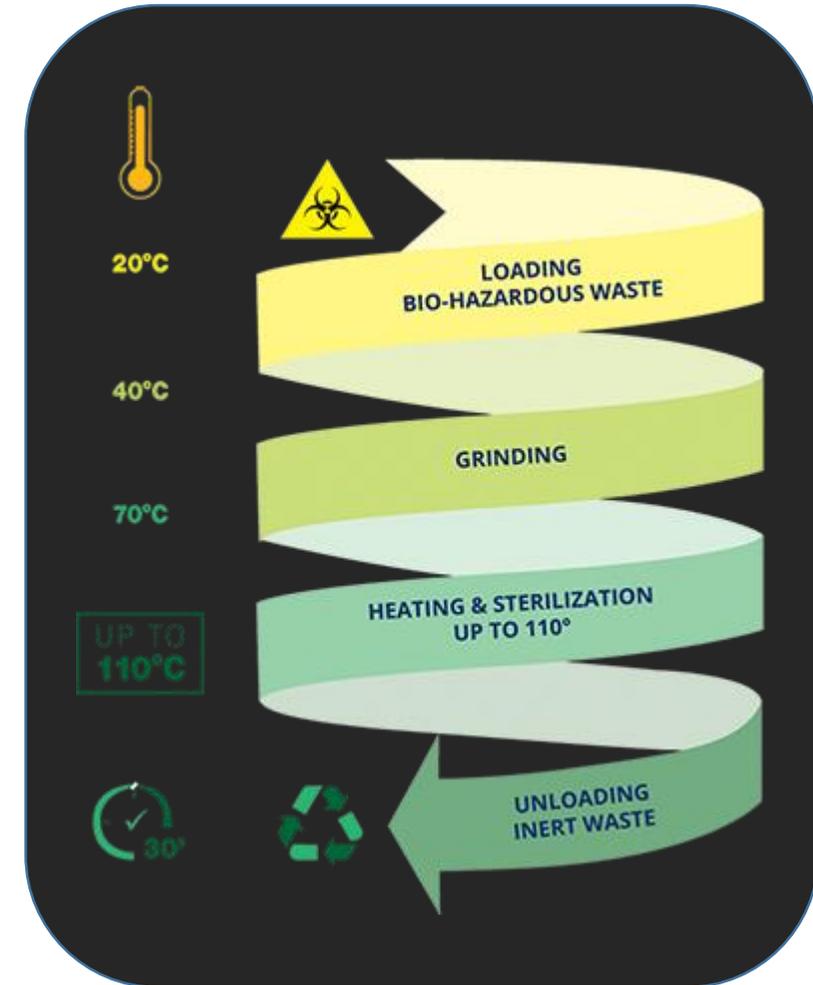
A microwave treatment is used to decontaminate medical waste.

These systems work best for waste that is not 100% dry or solid, as the moisture allows the heat to penetrate deeper, and the steam sterilizes.

The microwave unit transmits energy as microwaves and that energy turns into heat inside the wet waste.

The processing usually includes front-end shredding of the waste, both to increase the efficacy of the microwave treatment and to reduce the volume of the end waste for disposal.

The entire process takes place within a single vessel. Bacteriological and virological tests are periodically conducted to ensure the process is effective.



Microwave Heating in Rescue...

Microwave Heating System

Microwave heating system is generates the heat very fast within material.

Heating of materials are due to molecule movements hence no chamber warm up time is required.

Environmental friendly and green heating solution, no carbon emission.

100% energy utilization, as heating takes place within the material.

Better floor utilization index as it doesn't require large chamber area.

No Temperature loss in surrounding, ambient workplace.



Conventional Heating System

Conventional heating system have slow hating rate, heat is transferred via means of air.

Instance heating does not takes place, it requires warm-up of surrounding.

Produces carbon or toxic gases hence not much environmental friendly heating solutions.

100% energy utilization is not possible, as material is heated by surrounding hot air.

Poor floor utilization index as it require bigger chamber area for material to rotate.

Surrounding air temperature rises with rise in heater temperature.

Irradiation Heat Treatment for Medical Waste Management

Irradiation disinfects waste by exposing it to gamma rays that are fatal to bacteria for sterilization of equipment or treatment of waste, the radiation is intended to kill pathogens.

When UV is used for disinfection, the radiation in the UV-C spectrum, which is more germicidal is employed. Some irradiation treatment systems use electron beams.

Both gamma rays and electron beams can penetrate plastic bags used for waste collection, so the waste does not need to be removed from the bag before treatment.

Irradiation does not change the appearance of the waste so process designers often install mechanical grinding or shredding upstream. This also makes the waste pieces smaller, which tends to enhance the efficacy of the treatment..

Unlike some other treatment methods, irradiation requires a dedicated place – there are no mobile treatment modules that use radiation.



Medical Waste Management using Autoclave (steam)



Autoclaves are closed chambers that apply heat and sometimes pressure and steam, over a period of time to sterilize medical equipment.

For medical waste that will be disposed of, autoclaves can be used as heat treatment processing units to destroy microorganisms before disposal in a traditional landfill or further treatment.

Autoclaves are "chemical free" and that appeals to many stakeholders in a complex waste management environment.

Autoclaves are best for wastes that are unlikely to combust or give off substantial off-gas. While incinerators can be built with pollution abatement systems, autoclaves are smaller and it is not economical to unit make a treatment system for vapors emitting from the unit.

Autoclaved medical waste is usually compacted after it cools down. The compaction process may include shredding before the compression. The compaction process reduces the volume of the treated waste significantly.

Medical Waste Management using Hydroclave

Advanced Hydroclave technology provides numerous benefits and advantages compared with other treatment and disposal methods for clinical waste.

The hybrid design of the Hydroclaves uses less water and less energy than conventional autoclaves.

Unlike traditional autoclave technology which has to cool down and to heat up again, the Hydroclave temperature is retained at a minimum of 121°C during 40-minute cycles.

The Hydroclave is a safe and a closed-loop system; only hot, clean condensate is removed during the entire process, and recycled back to the boiler, making the Hydroclave very economical to operate.

The Hydroclave renders the waste safe, producing a finely shredded dry waste which is significantly lowered in size and weight.



Incineration for Medical Waste Management



Incineration is the process of control and complete combustion, for burning solid wastes. It leads to energy recovery and destruction of toxic wastes.

Waste with heating value lower than 3500 kcal/kg is burned in a single-chamber incinerator. Waste is typically heterogeneous, and if the combustible fraction is below 60 percent, it may not be acceptable for incineration.

Incineration can eliminate pathogens - even hard-to-kill bacterial spores - and can reduce the volume and mass of waste that goes to landfills considerably.

Incineration can break down and render harmless hazardous organic chemicals. With proper technology, little acid gas is released to the atmosphere.

Incineration Process

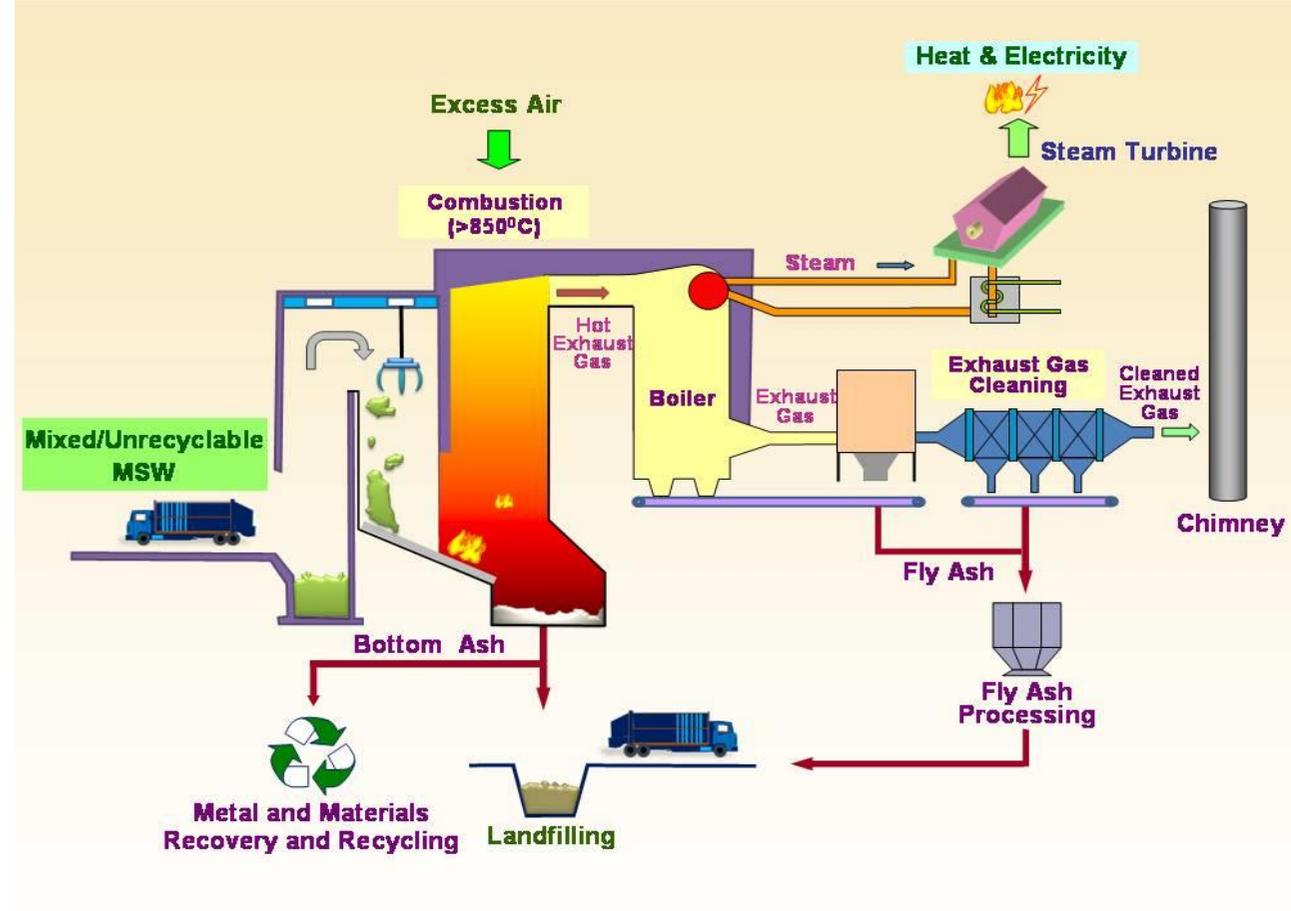
The incineration process is done via a grate system that combusts the waste, which is not refined and is crude. The boilers are equipped with hydraulic rams, which load the waste into an ignition cubicle.

The process involves the combustion of solid waste at 1000°C, it is converted into ash, gas & heat.

The incineration process can be enhanced by the addition of dolomite for controlling acid gas emissions. Waste with high calorific value is suitable for this process.

The incineration process can be applied to almost all medical waste types, including pathological waste, and the process reduces the volume of the waste by up to 90%.

Waste-to-Energy processes, incineration can be used to produce electricity and heat that can be used to power and heat nearby buildings.

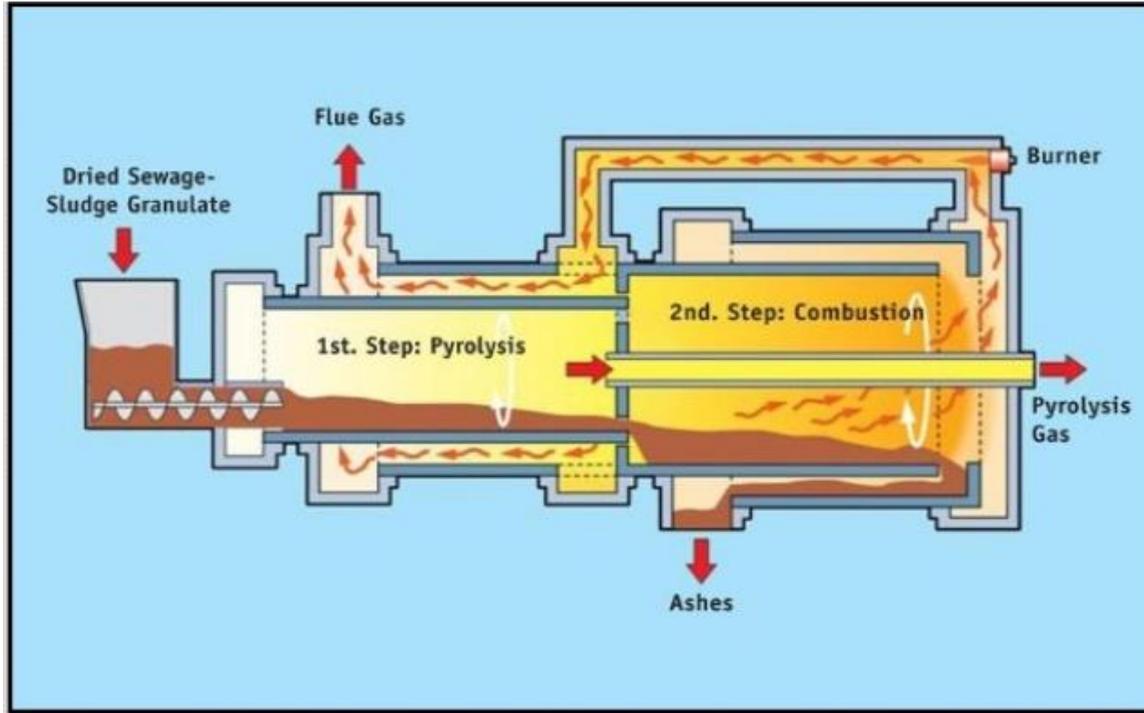


Incineration can be useful for...



- ❑ **Volume Reduction:** Depending on its composition, incineration reduces the volume of solid wastes to be disposed of by an average of 90%.The weight of the solid wastes to be dealt with is reduced by 70- 75%.
- ❑ **Stabilization of Wastes:** Incinerator output (ash) is considerably more inert than incinerator input(solid wastes), mainly due to the oxidation of the organic components of the waste stream.
- ❑ **Recovery of Energy from Waste:** This represents a valorization method, rather than just a pre treatment of Waste prior to disposal. Energy recovered from burning the wastes is used to generate steam for use in on site electricity generation.
- ❑ **Sterilization of waste :** This is of primary importance in the incineration of clinical or biomedical waste. Incineration of solid wastes will also ensure destruction of pathogens prior to final disposal.

Pyrolysis Treatment for Medical Waste Management



Pyrolysis can be defined as the thermal decomposition of organic material through the application of heat without the addition of extra air or oxygen.

Waste with heating value over 3500 kcal/kg is processed in a pyrolysis unit. In this process thermal decomposition of medical waste at high temperature take place.

Pyrolysis is an endothermic process which requires heat for an external source.

In this method solid waste material is heated in specially designed chamber which is called as pyrolysis reactor. In pyrolysis reactor, heating is carried out in closed environment which is almost oxygen free at an average temperature above 650o c which may rise to 1000 °C.

The end products are Hydrogen, methane, carbon mono-oxide, tar or oil, char, inert material.

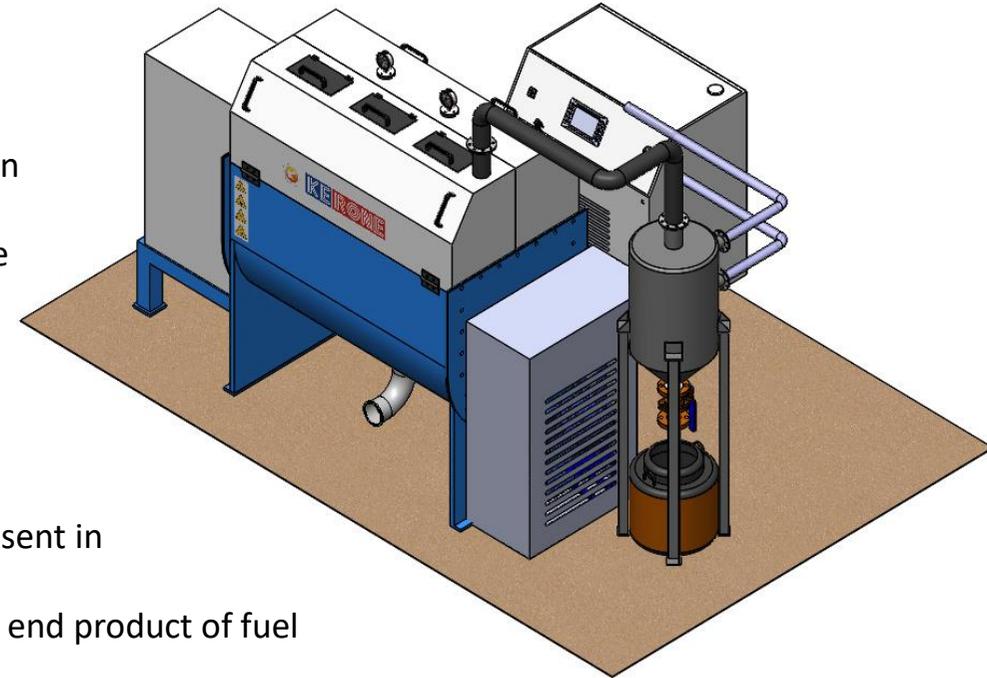
Methods of Pyrolysis..

❑ Dry Pyrolysis:

- Process of thermal decomposition without access of oxygen (O_2)
- Products of dry pyrolysis are gas with high heat of combustion, liquid and solid carbon residue.
- Type of dry pyrolysis depend on the temperature of the process i.e. Low Temperature Analysis, Medium Temperature Analysis, High Temperature Analysis.

❑ Oxidizing Pyrolysis:

- It's impossible to achieve a completely oxygen-free atmosphere.
- Thus, a small amount of oxidation occurs. If volatile or semi volatile materials are present in the waste, thermal desorption will also occur.
- Thermal decomposition of medical waste by its partial burning or direct contact with end product of fuel combustion.
- This method is used for neutralization of most wastes including "inconvenient" ones for burning are present in the waste, thermal desorption will also occur.



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