Contents

Introduction

Recovery. For us, the term recovery has multiple meanings. One is using the V-III™ in the process of energy recapture, or energy recovery. Another is reversing the harmful effects we have heaped on our environment for decades, by recovering the land used for landfills that continue to threaten us long after being shut down.

We are proud to introduce a state-of-the-art technology, with decades of uses in similar applications. It's called the Vortex III™, or V-III™ for short.

V-III™ is a third generation of vortex combustion technology. Previous versions have been used in various applications such as complete and safe incineration of nuclear waste materials, infectious waste, and various types of hazardous waste programs. Earlier versions of this system are currently installed in over 14 countries worldwide. Our Senior Engineer, who is the inventor of this technology, has adapted this system to work with municipal waste incineration, as well as medical, industrial, and other applications. Like the two versions before it, the V-III™ produces no harmful emissions, odors, or even smoke, and needs no scrubbers to clean the exhaust, meeting all EPA standards for air quality.

Background of waste management

For some areas of the country, the town dump was a place to go visit to get a glimpse of the bears foraging for their tasty treats. For others, it was an eyesore and blight on their community. One of the pitfalls of a growing and prospering society is the management of our refuse, waste, trash, garbage, or whatever you prefer to call it. How to get rid of our throw-away stuff has been something of intense emotion, political posturing and fighting, and of course, environmental concern.

The majority of Americans probably don't give the issue much thought beyond bringing their trash and recycling bins, cans, and receptacles back from the curb after the trucks have emptied them. Some have concerns because they live close to or downwind from a trash processing center, incinerator, or landfill.

The three "Rs" in waste management are: reduce, reuse, & recycle. Over the last couple of decades, we have begun to truly understand that our planet is finite in size and resources, and our environment is delicate, and we must protect it now and for the future.

To put things in perspective, recycling, landfills, and incinerators are the main components of waste management. In 2000, about 18% of municipal solid waste (MSW) was incinerated, and almost 75% of the incinerators generated energy, according to the EPA. In Japan, about 35% of their MSW is incinerated; Canada incinerates less than 5%. In all cases, the remainder of the waste is deposited into landfills where it will reside for generations.

Overview of current technology & environmental issues

Most incinerators are multi-chamber devices that burn the waste in a primary chamber, and then transfer the residue to a secondary chamber for additional burning. This process has the waste material resting for a period of time on grates or conveyors, allowing the smoldering process to generate fumes, odors, harmful gases and emissions, and even fly ash.

These systems require very expensive and complex scrubber systems to clean the exhaust so that the fly ash, odors, and harmful emissions are not allowed to enter the atmosphere.

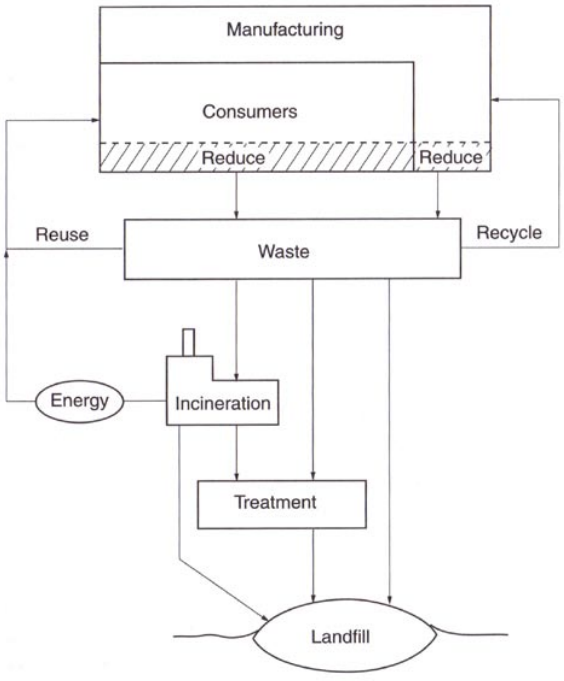
Typically, this type of municipal waste incinerators are massive, bulky configurations that are very offensive to view and to be downwind from. Most people have a certain perception of municipal incinerators, but are surprised at the small footprint and the input and energy production possibility of the V-III™ compared to the current technology.

The EPA has struggled with the issue of incineration for decades. With landfills becoming an increasing environmental threat, it is becoming necessary to turn to the only effective means of waste disposal. The V-III™ offers them an eco-friendly solution.

Integrated Waste Management

To better understand the overall process and system of waste management, we need to analyze the various components. Expanding on the three "Rs" concept mentioned earlier, the diagram below illustrates the flow of waste from the origins to disposition.

For our discussions, we will focus on the incineration portion. Disregarding the energy recovery, note the connection between the incineration and treatment, and between incineration and landfill. Typical incinerators are either single chamber with shaker grates, or multiple chambers. Most leave a substantial residue that requires further disposition, either through treatment or deposited to a landfill.



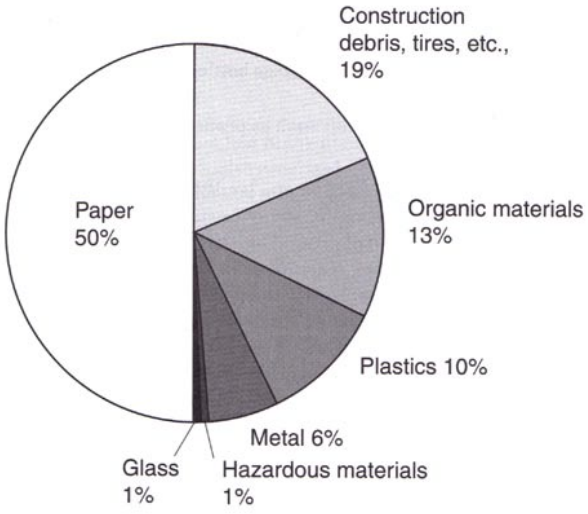
Breakdown of Municipal Solid Waste

It's important to fully understand just exactly what makes up the solid waste that we are getting rid of. Just what is MSW anyway?

First, we need to understand where the waste comes from:

- Residential – houses & apartments
- Commercial – stores, restaurants, office buildings, service stations, etc.
- Institutional – schools, courthouses, hospitals (non-medical), etc.
- Construction – building sites, road repair, building demolition, etc.
- Municipal Services – street cleaning, garden & park landscaping, wastewater treatment, etc.

Next, we need to understand the makeup of the waste itself. Analysis of several landfills offers the following breakdown of typical MSW:



Composition of municipal solid waste.

- Paper – including packaging, newspapers, telephone books, glossy magazines, catalogs, and similar. Paper is almost 100% cellulose, a carbohydrate which is highly combustible.
- Miscellaneous – including construction debris, tires, textiles, rubber, and disposable diapers.
- Organic materials – wood, yard waste, and food scraps.
- Plastic – including milk jugs, soda bottles, food packaging, garbage bags, polystyrene foam, PVC, and much more.
- Metal – including iron as well as aluminum and steel food & beverage cans & containers.
- Glass – consists of beverage bottles, food containers, cosmetic jars, broken windows from cars or homes, etc.
- Hazardous materials – a variety of items such as paint cans, pesticides, oven cleaners, industrial cleaning products, etc.

According to a recent study, every person in North America generates approximately 4 ½ pounds of garbage each day. With slightly more than 300 million people living in the U.S. and Canada, that comes to 246,375,000 tons/yr.

Thermal Value

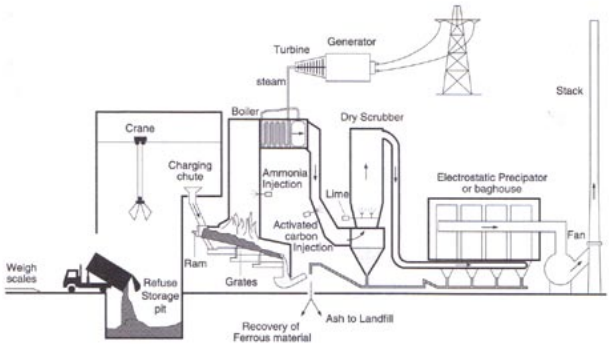
To appreciate the practicality of waste incineration, it's necessary to understand the thermal content of waste. Thermal value or the energy that can be obtained by burning a unit of weight is illustrated below:

- Paper products = approx. 6,000 BTU per pound
- Wood = approx. 8,600 BTU per pound
- Coal = up to 14,500 BTU per pound
- Gasoline = 21,000 BTU per pound

Tires have a thermal value that is more than 5 times that of standard MSW, giving it a high value to substitute for low volumes of MSW.

Incineration Issues

The next graphic shows a typical mass-burn waste to energy (WtE) incinerator. Note the size of the garbage truck in the bottom left. Note also the two types of scrubbers, the dry scrubber, and the electrostatic precipitator, or baghouse. Both of these clean the exhaust before it is allowed to enter the exhaust stack or flue.

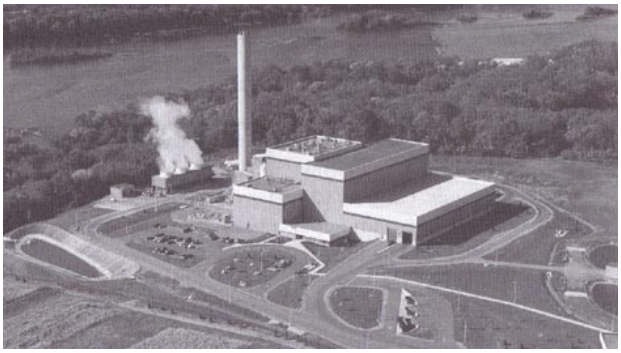


Schematic view of a mass-burn waste-to-energy incinerator

Even without the energy recapture portion, mass-burning incinerators used for municipal and industrial waste combustion, are generally very large and require expensive and complex exhaust cleaning systems.

While the scrubber systems typically clean the exhaust to a level that meets EPA standards for air quality, there are often reports showing results that are outside of the acceptable levels. Because of the extensive upkeep that these systems currently demand, quality control and ongoing maintenance and repair are often neglected.

Additionally, with these massive systems, there are serious and warranted concerns about the odors, fumes, emissions, and of course the unsightly nature of the facility.



Over the last decade or so, we have seen a rise in the desire to eliminate these incinerators, although there is no solution available to offset the volume of waste that is disposed of through this process. Other technologies such as plasma arc are being developed, but will not be fully operational any time soon, and have a cost of nearly 10 times that of even current incineration programs. The V-III™ offers the needed solution, and at a fraction of the cost.

Change in Attitude and Direction

Although there has been a change in the attitude concerning incineration, we are now getting indications that some are beginning to realize that landfills are not the solution, and that we may need to rethink our directives toward this type of waste management.

The environmental concerns are still at the forefront of our waste management policies and programs. However, with only two choices for waste disposal available, we are trending towards the solutions that can prove to be the lesser of the two evils.

NIMBY, or not-in-my-back-yard, has in some cases been a stronger means of preventing these systems from being built, or even to continue. In some regions, we are also seeing a change in the attitudes towards landfills, which is again, an excellent opportunity for us to be able to offer a solution for landfill reclamation, or part of a program for reclaiming land known as brownfields.

Research will show us statistics and data that supports all sides of these issues, but it generally comes down to local parameters. For instance, in the Chicago suburbs, we have several landfills; some have been shut down, and others are still active. Land filling methods from 20 or 30 years ago had no apparent concern for future growth and the limits to land space and environmental issues as we have today.

While this doesn't sound very definitive, we do have a basic and general understanding of the problems with both landfills and incineration. Incineration has tended to drop off the front pages as compared to landfills, but there is still a great deal of educating that we can and need to do to help authorities, as well as the citizens understand our technology, and how it can make a difference for their community.

Science behind this technology

What is it? Basic answer:
The V-III™ is a grateless, single-chamber vortex incinerator that burns shredded waste material in suspension in a 90 mph, 2,000˚ tornado, or vortex, and forces any particulate matter to be re-introduced to the vortex for continuous combustion. This system does not require typical scrubber or filter systems, since it doesn't give off any harmful emissions.

The process starts off in a fairly standard method with the MSW being introduced into a shredder that is configured for the makeup of the waste material collected. The single chamber of the incinerator is primed with a seven-foot natural gas flame that is introduced to the chamber tangentially, allowing the vortex to start in the recognizable form of a tornado.

The shredded waste is conveyed through a material handler that introduces the blended waste material and primary air into the combustion chamber, also tangentially, to travel in the same path as the vortex. As the waste material burns and travels towards the back of the chamber in the vortex, secondary air is added, also tangentially, to enhance the speed and the temperature of the vortex.

Without going into any proprietary details, the vortex incinerator, through a patented design process, re-introduces particulate matter that has any mass to it (even microscopic particles), back into the super-heated vortex to continue to burn until there is no mass remaining.

The waste material burns while in suspension, never allowing it to rest and smolder, therefore not capable of producing harmful emissions as a by-product as standard incinerators currently operate.

The shredded material and also the particulate matter, is able to become its own fuel, which enhances the complete combustion of all particulate matter, and increases the efficiency of the system, since the gas used as a primer can be shut off similar to gas fireplaces.

The re-introduction of the particulate matter into the vortex not only allows for complete combustion, but it prevents the production of harmful gases and emissions as standard incinerators do.

Most incinerators, as covered earlier, are multi-chamber devices that burn the waste in a primary chamber, and then transfer the residue to a secondary chamber for additional burning. These incinerators usually require complex scrubber systems, since the smoldering produces the harmful gases and emissions, as well as the fly ash.

As the vortex containing the combustible and non-combustible materials progresses towards the back wall, the non-combustible materials and some particulate matter such as ash are pulled into a cyclone separator and collected in a tray. Any of the heated air is then piped back into the chamber in a secondary process known as fume burning.

Features & Benefits

Many of the items listed below are inter-related. This is one of the overall features of the V-III™ - the blending of features to produce an even greater result. This is where the term "Synergistic Iteration" comes from.

Features

- High speed vortex – 90 mph
- High temperature – 2,000º
- Shredded waste material burns fully in suspension
- Single chamber, grateless incineration
- Patented method for re-introducing particulate matter into super-heated vortex
- Eliminates usual odors, fumes, smoke, and harmful emissions
- No costly scrubbers needed
- Virtually non-existent amount of ash residue produced

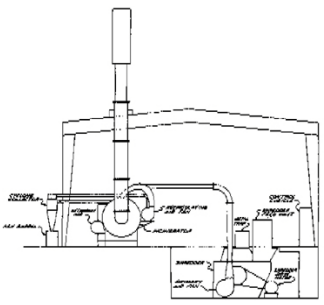
- Extremely low maintenance
- Small footprint - unit is 8 feet by 11 feet
- Unit can handle the waste needs of a population of 40,000 (residential, commercial, & institutional)
- Modular design – components such as shredders, boilers, & steam turbines, can be easily integrated
- Economic operation – 7 people minimum to operate for a 24 hour shift
- Energy recapture – using decades-old method of incinerators as combustion source
- Offers a wide array of applications

Benefits

- Unique combination of high speed and temperature produces an extremely efficient combustion process
- By forcing the particulate matter to be re-introduced into the vortex, material that still has any matter to it will burn until fully combusted, never being allowed to smolder and produce harmful emissions, odors, or smoke
- Since waste material burns in suspension, never resting on a grate or on the floor of the chamber, and the unit does not require expensive and complex scrubber systems, there is very little maintenance needed
- Since there is no fly ash produced, and very little if any ash residue produced, there are no secondary disposal concerns. There are non-combustible items, such as hard metals like ball bearings that are collected in a small trap that can be easily emptied.
- Small size allows the system to be installed in existing facilities, or keeps costs of site construction down
- Small communities will now have a chance to control their waste management issues, with a unit that can be installed closer to populated areas than current technologies
- With possibility of adding peripherals, design allows for easy integration of peripheral items such as shredders, without complicated redesign
- Modular configuration allows for easy retrofitting, or for replacement of any or all components for any reason
- One unit without the energy recapture option, can be operated on a 24 hour basis with 3 people on the busiest day shift, and 2 each on the remaining shifts
- With stack temperatures of around 2,000°, the V-III™ in combination with a boiler and steam turbine, can produce an efficient and high-powered steam output, to generate electricity. Waste to energy (WtE) has been used as a clean source of energy for more than 50 years.
- System is adaptable for a variety of applications, from municipal, industrial, hospital/medical/infectious waste, to landfill reclamation, to any process that requires clean, efficient combustion.

Site configuration/specs

Although each installation will be tailored to the existing needs of the community or organization, we offer optimal land-use examples, along with recommended "floor plans" and similar specifications. We also recommend the optimal entrance and egress for properties to ensure minimal impact on the surrounding community for traffic patterns for collection vehicles dropping off at the site.



Turnkey system

The V-III™ will be offered in two primary configurations. The first one will be integrated with only a shredder, and will be used only for

waste incineration. The second version will be like the first, but will have a boiler and steam turbine, or a customized boiler / steam turbine combination. This will be used for waste incineration and energy recovery in what is known as waste to energy, or WtE.

Peripheral components

Expanding on the turnkey configuration information, below are brief descriptions of the components of those set-ups. These peripheral components have been available for many decades, and are considered to be somewhat "off the shelf."

Shredders

Shredders have been in use since early in the 20th Century, and have played an important role in reducing waste volume for various applications. With the huge assortment of municipal waste shredders available, we can easily tailor a setup to reflect the exact needs and conditions for each installation.

Shredders are designed for various types of waste, and are available in front loading, top loading, pit, or floor level operations.

Heat recovery steam generator

HRSG, or boiler, is the system that takes the exhaust from the incinerator (or any combustion source) and converts it to steam that will be used by the steam turbine to produce the electricity. These systems are also designed to fit a variety of conditions, including temperature, BTU output, and thermal flow coming from the combustion source.

Steam turbine

The steam turbine uses the steam that is produced with the boiler, and produces clean electricity. With the extremely high stack temperatures that come from the V-III™'s exhaust, the system is able to produce impressive amounts of power from such a small footprint. There are smaller steam turbines that could be used if the V-III™ is used for mobile applications such as FEMA first response for disaster areas.

Nearly 80% of the electricity generated around the world uses a steam turbine, so we're in pretty good company. In some form, steam turbines have been around for hundreds of years, and those that produce electricity have been around nearly as long as electricity itself!

Applications

Predecessors to the V-III™ have been used in applications such as disposing of contaminated materials from a nuclear fuel rod facility, to infectious animal incineration, and various types of hazardous waste disposition. Below are areas that we have developed that continue to use this remarkable technology, but applied to today's most critical waste management issues.

Municipal waste

This is the most recognizable application for larger incineration systems. It is also the one area where we can have the most impact if we choose to change our attitudes and more importantly, our environmental and energy planning.

Industrial waste

Industrial waste is unique in that the makeup of the waste material tends to be very consistent, so it is easy for us to tailor an incinerator system that includes specific types of shredder devices, that may be different from that used in municipal operations.

Hospital / Medical / Infectious waste

There are still 56 incinerators involved with medical waste disposal around the country. We have a solution that is available now, that can save incredible amounts of money now, and reduce operating expenses down the road.

Landfill reclamation (brownfields)

There is a strong desire to try to reclaim much of the land that in the past has been thought to be lost forever. This is where we would like to discuss our concept of the 4th "R" in addition to the 3 that are used in understanding waste management.

In using the V-III™ for municipal, industrial, and hospital/medical/infectious waste incineration, we are able to not only reduce the volume of pollutants in the air, but we are eliminating from this process altogether.

As we use the V-III™ in the process of reclaiming landfills, we are actually reversing (the 4th "R") the harmful effects that we have heaped on our environment for the past several decades. No other process known today can actually claim to reverse what we have done for so long.

Understanding pollutants & air quality

In order for us to have a better grasp on how we can make an impact on our environment, we need to have a better understanding of the pollutants, the air quality standards, and how these are being enforced.

Polychlorinated dibenzodioxins (dioxins)

Dioxins are a critical issue, more so with the hospital/medical/infectious waste incineration applications. However, dioxins are probably the emissions that most people may have heard of, even if they aren't in the industry. Dioxins occur naturally as a result from things such as volcanoes and forest fires, or even from your back-yard open pit. Dioxins are also produced as a result of the incineration of chlorine-containing plastics, such as PVC and other products. Because of the larger than normal concentration of heavy plastics used in the medical field, such as "red bags" for disposal of contaminated or hazardous waste, medical waste incineration has been at the forefront of public scrutiny and legislation.

EPA air quality standards

As we all know, the EPA standards for air quality have become more stringent over the years, especially since they began in the early 1970's. It is very important to understand just what the current legislation is, and how we are addressing not only the monitoring of emissions, but what can be done to greatly reduce, and eliminate those harmful emissions altogether.

EPA air quality tests and emissions standards are available from either the state's EPA or the federal organization. More information on air quality standards is available for download from our website:
www.AmericanEnergyGroup.org/standards.pdf

Clean Air Act

This document is available for download from our website:
www.AmericanEnergyGroup.org/CleanAirAct.pdf

Summary

We are very proud to be able to offer a technology with such a successful history in connection with today's important issues. Not only is this the only true 100% American green technology, but it is a program that doesn't have to go through years of development and testing as do so many of our other potential solutions.

In addition, this is very unique in that it is part of our ***3e Certification™*** which encourages our municipalities, communities, and other organizations to take the right steps to ensure:

- Energy Independence
- Economic Strength
- Environmental Health.

For more information, visit:
www.3eCertification.com

Glossary of Terms

Affluent – the flue gases or exhaust present in the exhaust stack or flue sections.

BTU – British Thermal Unit. In North America, , the term "BTU" is used to describe the heat value (energy content) of fuels, and also to describe the power of heating and cooling systems, such as furnaces, stoves, barbecue grills, and air conditioners. When used as a unit of power, BTU 'per hour' (BTU/h) is understood, though this is often confusingly abbreviated to just "BTU".

Baghouse – Fabric collectors that use filtration to separate dust particulates from dusty gases. They are used as a dust collector in conjunction with other scrubber devices.

Bottom ash – Ash residue that comes to rest on the bottom of the incinerator. This is also referred to as sterile ash.

Combustion - Combustion or burning is a complex sequence of exothermic chemical reactions between a fuel (usually a hydrocarbon) and an oxidant accompanied by the production of heat or both heat and light in the form of either a glow or flames, appearance of light flickering.

In a complete combustion reaction, a compound reacts with an oxidizing element, such as oxygen, and the products are compounds of each element in the fuel with the oxidizing element. (In the V-III™ process, this fuel is used up in the continuous combustion produced as the particulate matter is forced to re-circulate back into the super-heated vortex.)

Dioxin - Dioxins occur as by-products in the manufacture of organochlorides, in the incineration of chlorine-containing substances such as PVC (polyvinyl chloride), in the bleaching of paper, and from natural sources such as volcanoes and forest fires.

Emissions - Exhaust gas or flue gas is emitted as a result of the combustion of fuels such as natural gas, gasoline, diesel fuel, fuel oil, coal, or in our case, an incinerator. It is discharged into the atmosphere through an exhaust pipe, flue gas stack or propelling nozzle.

Fly ash – Fly ash is similar to bottom ash in composition, but is typically lighter and tends to be lifted upward with the thermal air flow caused by combustion. Fly ash is considered a pollutant since it often gets discharged into the atmosphere if proper air scrubbing methods aren't in place.

Furan - Also known as furane and furfuran, it is a heterocyclic organic compound. It is typically derived by the thermal decomposition of pentose-containing materials, cellulosic solids especially pine-wood. Furan is a colorless, flammable, highly volatile liquid with a boiling point close to room temperature. It is toxic and may be carcinogenic.

Gas or gases - a gas is a state of matter (solid, gas, liquid), consisting of `particles (molecules, atoms, ions, electrons, etc.) without a definite shape or volume that are in more or less random motion. Plasma is a highly ionized gas that occurs at high temperatures. The term gas or gases is often associated with harmful emissions, but actually is a description of collection of particles.

Grate - A grate is a frame of iron bars to hold fuel for a fire, or some form of combustion.

Incineration - a waste treatment technology that involves the combustion of organic materials and/or substances. Incineration and other high temperature waste treatment systems are described as "thermal treatment." Current methods of incineration of waste materials convert the waste into bottom ash, flue gases, particulates, and heat, which can in turn be used to generate electric power. The flue gases are cleaned of pollutants before they are dispersed in the atmosphere.

Leachate - The liquid that drains or 'leaches' from a landfill; it varies widely in composition regarding the age of the landfill and the type of waste that it contains. It can usually contain both dissolved and suspended material.

Particulate matter - Also referred to as particulates or fine particles, particulate matter (PM) are tiny particles of solid or liquid suspended in a gas or liquid. They are described by their size. For instance, $PM_{2.5}$ represents particles less than 2.5 micrometers in aerodynamic diameter.

Plasma arc gasification - A waste treatment technology that uses electrical energy and the high temperatures created by an electrical arc gasifier. This arc breaks down waste primarily into elemental gas and solid waste (slag), in a device called a plasma converter. The process has been intended to be a net generator of electricity, depending upon the composition of input wastes, and to reduce the volumes of waste being sent to landfill sites. To date, this is an extremely expensive process that is still not ready for mass usage.

Scrubber systems are a diverse group of air pollution control devices that can be used to remove some particulates and/or gases from industrial exhaust streams. Traditionally, the term "scrubber" has referred to pollution control devices that use liquid to wash unwanted pollutants from a gas stream. Recently, the term is also used to describe systems that inject a dry reagent or slurry into a dirty exhaust stream to "wash out" acid gases. Scrubbers are one of the primary devices that control gaseous emissions, especially acid gases. Below are some of the terms used in relation to scrubbers:

- Dry scrubber
- Rotary atomizing wet scrubber
- Lime injection system
- Wet ESP
- Electrostatic precipitators

Secondary chamber - A grateless incinerator having a pair of combustion chambers including a primary chamber and a secondary chamber separated by a movable closure means. Incineration is started in the primary combustion chamber, and then ash including unburned residual matter is dropped from the primary chamber through the movable closure means to the secondary chamber which is located below. Smoke and gas generated by continuing combustion of the incompletely burned residual matter is returned through a controlled passageway to the incinerator downstream where it is again subjected to incinerating temperatures before it is directed through an exhaust duct to the atmosphere.

Tangential – A tangent is a line or a plane that touches a curve or a surface at a point so that it is closer to the curve in the vicinity of the point than any other line or plane drawn through the point. See diagram on page 7 for further clarification.