INCINERATION…….ONLY Future of Hazardous Waste Management

Hazardous wastes generated by the industries are required to be managed as per the Hazardous Waste (Management & Handling) Rules, 1989, as amended. About 4.4% of hazardous waste generated in the country is of the nature, which has to be incinerated. Besides, segregated organic residues, highly concentrated effluents such as mother liquors and toxic effluents not feasible for physico-chemical, biological treatment also require proper disposal through incineration.

Hierarchy of options in hazardous waste management, in sequence, is to switchover to cleaner technologies, cleaner production options and exploring the potential for re-using, recycling, recovering, renovation before sending to incineration and secured land filling.

Common incineration facilities are now in operation in the country. Incineration of hazardous waste from many industries is a task that requires comprehensive knowledge & skill in respect of chemistry, thermal engineering and environmental engineering. Therefore, the Central Pollution Control Board studied the common incineration facilities and formulated guidelines for proper design, operation and to meet the standards.

Thermal oxidation through incinerator is one of the proven technologies for destruction of hazardous waste in all the forms i.e. solid / semi solid / liquid and gaseous, based on the feeding system, so as to render them innocuous in the form of non-toxic and non-hazardous residues. Though it is a solution for destruction of complex hazardous waste, requires knowledge to judge the compatibility of various wastes for the purpose of homogenization of feeding waste, to operate and maintain thermal processes, pollution control devices, which demands skill & experience, in order to comply with the environmental regulations for common hazardous waste incineration facilities.

The Common incineration facilities are, in principle, expected to handle the hazardous waste in solid and liquid forms having high degree of variation in respect of characteristics due to different nature of member industries, which will have direct bearing on efficiency of combustion system and pollution control devices. Therefore, experience in other parts of the world, particularly in case of handling hazardous waste in solid form, drive us to adopt rotary kilns followed by secondary combustion chambers as a set-up for combustion part of the incineration system, unless other combinations demonstrate equally in delivering required efficiency.

COMBUSTION CHAMBERS (Rotary Kiln and Secondary Combustion Chamber)

- Incineration plants shall be designed, equipped, built and operated in such a way that the gas resulting from the process is raised, after the last injection of combustion air, in a controlled and homogenous fashion.
- Incineration plant shall be equipped with at least one auxiliary burner. This burner must be switched on automatically with the temperature of the combustion gases after the last injection of combustion air falls below specified temperature. It shall also be used during plant start-up and shut-down operations in order to ensure that the minimum specified temperature is maintained at all times during these operations and as long as unburnt waste is in the combustion chamber.
- During the start-up and shut-down or when the temperature of the combustion gas falls below specified minimum temperature, the auxiliary burner shall not be fed with fuels, which can cause higher emissions than those resulting from burning of gas oil /liquefied gas / natural gas.

- The burners may be pressure-atomized type with approved certification from the Bureau of Indian Standards or equivalent.
- In case of low calorific value liquid fuels are proposed to be injected into kiln, and then double fuel injection burners may carry auxiliary fuel or equivalent liquid waste in one injection tube and low calorific value waste feed in other.
- Kiln and secondary combustion chamber of the incinerator may be made of mild steel conforming to IS: 2062 and of suitable thickness lined with high-grade refractory and insulation, so as not to buckle in or bulge out.
- Combustion chambers (Kiln & secondary combustion chamber) shall be supplied with excessive air to ensure complete burning of wastes. The blower shall have the capability to provide appropriate supply of combustion air.
- An inventory of fuel oil for 5days continuous operation of the incineration facility may be kept in reserve.
- Incinerator facility shall have a window fitted with safety view glass to view the kiln (axially) and flame in secondary combustion chambers.
- As the common incineration systems will be handling wastes having varying heat value, and while ensuring TOC and LOI requirements in the ash/slag, there are possibilities for sudden rise of temperatures in the kiln. Therefore, the facilities may like to have thermal refractory bricks and insulation capable of withstanding a minimum temperature of 1,300^{o}C (typically, corundum / chromium bricks).
- Needful safety arrangement must be provided in case of high-pressure development in the furnace.
- Interlocking arrangements for CO and temperature controls (in primary and secondary chamber) with feeding devices shall also be provided.
- All the burners are to be equipped with flame control system (if no flame is detected, fuel injection has to be stopped, automatically - use of fast-stop-valve).
- Whenever the pressure in the combustion chambers becomes positive, immediately the feeding of waste shall be stopped and needful measures be taken to restore negative pressure.
- Exit doors shall be provided at suitable place, one each on the primary kiln and the secondary chamber of the incinerator for ease in inspection and maintenance.

Rotary Kiln Incinerator

- To maintain designed heat capacity of the kiln, quantity of the solid waste injection package (kg/single injection) shall be adjusted w.r.t. calorific value of the waste feed.
- When a high calorific value possessing solid waste is injected in packets, the size of each injection may be reduced, such that the peak CO concentration in the Kiln does not exceed too high in the initial stage, creating shooting of emissions to the secondary chamber, thereby crisis in ensuring the required retention time.
- Appropriate slope (in general, 3 degrees), rotation rates (around 10/hr) and solid waste residence time (1-10 hrs) may be adjusted for the kilns, in order to achieve total organic carbon (TOC) and loss on ignition (LOI) requirements in the ash/slag.
- To ensure life of refractory and insulation bricks, it is a practice to feed silica and glass in appropriate ratios to the kilns to form a cover over the refractory lining, as and when the thickness of the layer reduces.

- It has been reported that reduction of out-side surface temperature of the rotary kiln enhances the life of refractory bricks and lining. Thus may be explored, where feasible.
- In the rotary kiln, the temperature shall be maintained at 800+^{o}C in order to ensure complete burning of solid waste. Controlled flow of air shall be maintained for complete volatilization of solid waste.

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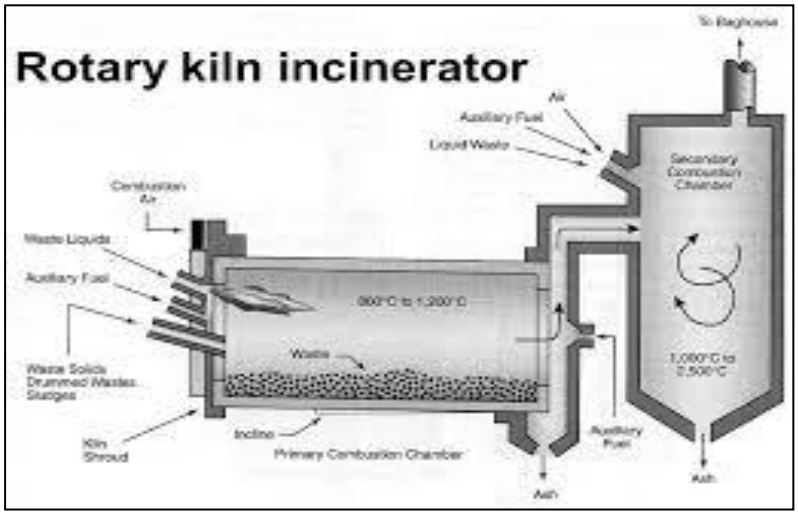
- Minimum temperature requirement in the secondary combustion chamber is 1100^{o}C. This may be ensured by averaging the temperature measurement of three detectors (not exactly positioned in the burner flame) at the same time with in the combustion chamber.
- The design and operating conditions shall demonstrate a minimum of 2 seconds residence time in the secondary combustion chambers, under critical feed conditions, so as to bring complete combustion of volatile matter evolved from the primary combustion chamber.
- Incase, the consistent compliance with standards based on continuous monitoring results over a period of two weeks, under critical feed conditions, is successfully demonstrated, then State Pollution Control Board / Pollution Control Committee, can recommend the proposal made by the incineration facility for relaxation in temperature and residence time, but in any case not less than 950^{o}C and 1.5 seconds, for the consideration and approval of the Central Board.



Plasma Gasification Technology

Need of Plasma Gasification Technology

Energy deficit, a massive waste disposal problem and a need for a cleaner, greener environment are responsible for the birth of the revolutionary technology – Plasma Gasification Technology that not just resolves the problem of waste management, but also provides means for producing clean energy.

Plasma Gasification Process

Plasma gasification is a gasification of matter in oxygen starved condition which dissociate the matter into its basic molecules

- Plasma gasification does not combust the waste

- It converts waste into syngas (CO, hydrogen & heat energy)
- Convert inorganic material into to inert slag
- There is no ash formation

Plasma based solution to Industrial Waste

- Low dioxin & Furans
- High Volume and mass Reduction
- Compact System
- No Tar formation
- No Ash formation
- Power Generation

Plasma Gasification Technology can offer a number of benefits when it comes to environment. They are:

- Helps the world reduce its dependence on fossil fuels
- Gasifies all types of waste
- No Tars, Dioxin and Furan formation.
- Easy to change the temperature of Reactor
- Produces 80 % lower volume of gas
- Generates less than 90 % solid residues
- Inorganics, silica, soil, concrete, glass, gravel, are vitrified into Slag & flow out
- Best, proven and clean Technology in the World
- Waste is completely destroyed and broken into its basic components.
- No Toxic Ash formation
- Generation of Green Power

Comparison between Plasma Gasification and Conventional Incineration

Sr. no.	Plasma Gasification	Conventional Incineration
1	Gasification of organic material into its basic molecules	Oxidation of organic material causing more pollution
2	Inorganics are vitrified into molten slag	Remain as it is incineration ash
3	Metals are melted	Remain as it is ash
4	HW is converted into Syngas	Forms CO2 and other toxic pollutants
5	High temperature reaction	Low temperature reaction
6	Gasification of waste	Combustion of waste
7	Plasma Gasification	Conventional Incineration
8	Vitrified Slag is non-toxic	Ash contains heavy metals
9	Syngas is used to produced power	Not viable to produce power due to low temperature

10	Generates less quantities of Slag	Generate huge quantities of Ash
11	Produces 80% lower volume of gas	Produces CO2 & other greenhouse gases
12	Does not produce Tars, Furans and Dioxins	Forms Tars, Dioxins and Furans

Conclusion:

Rotary kiln is the most proven technology in today's scenario of global Zero Landfill. Many companies are going for Zero Landfill and ultimately going for Incineration globally. This is again a new subject of Hazardous waste management. We shall cover the same in our upcoming readings.