Energy from Waste Incineration

Prerequisites for Concepts in a New Century

Icelandic Version - íslensk útgáfa

Printout of this Web Page
Five pages Acrobat A4 Portrait format (348 K)

The Concepts

Incineration is an efficient way to reduce the volume of waste and demand for landfill space. Incineration plants can be located close to the center of gravity of the area, where the generation of waste takes place, thus reducing the cost of transportation to a minimum. The ash from incineration provides an inexpensive aggregate for environment-friendly construction and reduces even further the need for landfill capacity.

All waste disposal alternatives eventually decompose organic materials into simpler carbon-based molecules. The balance between these carbonic gases and the time frame for the reactions is different for the various concepts. Incineration provides the best way to eliminate these carbonic gas emissions from waste management processes. Furthermore, the energy from waste incineration projects provides a substitute for fossil fuel combustion. These are two ways, by which incineration helps to reduce greenhouse gas emissions.

A widespread misunderstanding has it that separating certain materials from waste—paper, plastics, timber—for recycling as raw materials in fabriction industries is economic. This is wrong, it is not economic; not in Iceland in particular, because the areas and population are small. The truth is that these materials are not at all well seen by fabricators; they must be cleaned and reprocessed before they are used, while new raw materials, requiring no such additional handling, are available in abundance at lower prices. In addition, the materials in question (paper, plastics, timber) constitute excellent fuels—with high heat values.

More often than not, naive municipal officers are victims of reasoning supposed to 'proof' advantages of sorting. These people end up with sorted mountains instead of the unsorted bulk. In the end, the sorted piles are disposed of anyway, through incineration or even earth fill, which damages the environment. Same is valid for composting; the 'produced' soil is often sent to the earth fill (sample: Kirkjubaejarklaustur) and, in addition to being superfluous in our economic environment, it is a perfect nursery for obstinate plagues, such as anthrax, tetanus and scrapie (Creutzfeldt-Jakob-disease).

When controlled waste incineration was invented mid last Century, oil fuel was inexpensive and the energy won through the incineration was seen as no more than a ***welcome by-product****. But no longer. In this hungry World of a New Century, oil prices have increased umpteen times. State-of-the-art designs now replace obsolete concepts at a fast rate and today,* ***continuous waste incineration is capable of recovering more than twice as much energy as the old and user-friendly concept working in 24 hour cycles****.*

Following URLs lead through the ***Activities of the European Union****:*

> ***http://www.europa.eu.int***
> *select 'en' for English on the front page; then you get:*
> ***http://europa.eu/index_en.htm***
> *then select 'Environment' under 'Activities' and get:*
> ***http://europa.eu/pol/env/index_en.htm***
> *then select 'Waste' under 'Summaries of Legislation' and get:*
> ***http://europa.eu/scadplus/leg/en/s15002.htm***
> *and, finally, select 'Waste Incineration' under 'General Framework'*
> *and get:* ***http://europa.eu/scadplus/leg/en/lvb/l28072.htm***

The URLs end in the following ***printout document*** *in Acrobat A4 Portrait format (208 K):*

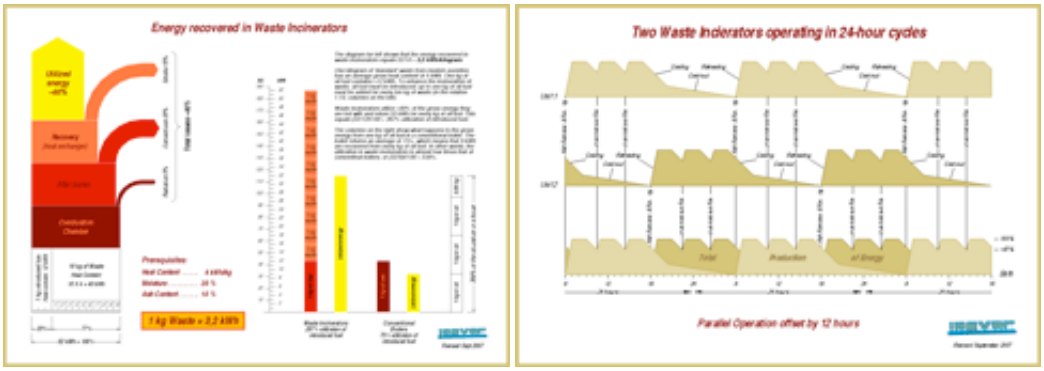
> ***EUs Guide Lines for Waste Incineration***

There are many options for waste incineration plant technology. The range of equipment varies from well-known and proven to experimental. The difference between success and failure of waste management lies in how these problems are dealt with. and inventing new techniques is costly. We know how to handle this; let us help you!

Incineration in 24-hour Cycles

Picture 1 (below, left) shows that an average of one (1) kilogram oil fuel must be introduced through the Thermal Reactor (after burner) for every ten (10) kilograms of 'standard' waste. This to remove smell and color from the exhaust. When incinerating in 24 hour cycles, some 60% of the gross energy input is recovered. The columns on the right compare the fuel efficiency of waste incineration to that of a conventional water or steam boiler.

Picture 1 (below, right) explains why waste incinerators working in 24-hour cycles produce less energy than those operating continuously. Some heat is lost during every intermediate refill (top and center in picture), while the entire combustion chamber must be cooled down to temperatures permitting it to be worked on when ash is removed and a fresh charge introduced. The energy lost through these intermediate and final cooling intervals must be deducted from the heat developed in the process and results in a substantially reduced total output. In continuous operation, all equipment is kept at constant temperatures until the processing is discontinued, with no losses through cooling and reheating. However, two incinerators working in 24-hour cycles side by side can be offset in time by 12 hours to obtain near continuous production of energy (Picture 1 right, bottom).



Picture 1 - Energy recovered in Waste Incinerators *(left) and* ***Parallel Operation*** *(right) - average figures*
(Hit the pictures, one by one, for Acrobat A4 landscape printout documents - 204 and 176 K respectively)

During fifteen years of successful cooperation with Hovalwerk AG í Liechtenstein (Hoval), IceBits ehf imported four waste incinerators with heat recovery; one was installed at Svinafell, two at Kirkjubaejarklaustur and one at Talknafjoerdur. All four work in 24-hour cycles and all have operated without technical problems from the outset. During the same period, competitors of the company brought to the country four incinerators—delivered by four different suppliers—to Vestman Islands, Isafjoerdur, Reykjanes and Husavik, all of which originated on the desks of designers with no field experience and have in common to be so called 'drawing board projects'.

Three of the incinerators mentioned first—those located in Vestman Islands, Isafjoerdur and Reykjanes—work continuously. They have not yet proved their ability to produce energy since another inexpensive heat source (gethermal) is available. The last one—at Husavik—works in 24-hour cycles, similar to the Hoval assemblies, and there the production of energy leaves a lot to be desired. This equipment was acquired specifically to improve the capacity of a new ***Kalina geothermal electric power plant****, which according to the previous Major of Town is also a 'drawing board project'.*

Picture 2 - Hoval Waste Incinerator working in 24 hour cycles *(left)*
State-of-the-art Waste Incinerator with Flue Gas Cleaning, working continuously *(right)*
(Hit the picture for Acrobat A4 landscape printout document - 416 K)

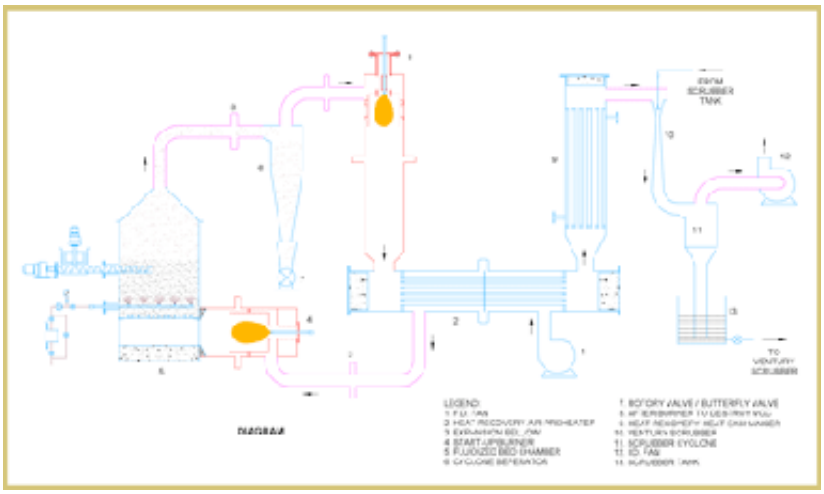
Hoval's waste incinerators with heat recovery were designed around mid last Century. As will be seen from ***the company's reference lists****, some one thousand (1000) units have been delivered all over the world, of which*

more than five hundred (500), or an average of two units per month, were sold during the last twenty years. But the concept belongs to a bygone era and present times demand better utilization of the energy than they can offer.

Further, it is obvious that concepts and work procedures in a fast changing world demand continuous operation, with mechanical devices for feeding and removal of the ash as well as automation and possibilities for remote control. The production of Hoval waste incinerators with heat recovery has been discontinued.

State-of-the-art Waste Incinerators

In a state-of-the-art incineration system, the primary incinerator chamber operates under a 'controlled air' concept, meaning that the quantity of oxygen is limited. A prerequisites for such operation is an effective control of the temperature on the inside wall of the combustion chamber. The starved combustion produces incomplete and combustible gases—such as methane (CH_4), ethane (C_2H_6) and carbon monoxide (CO)—as opposed to carbon dioxide (CO_2) and water vapour (H_2O) when combustion takes place at free air flow. The unique invention is comparatively simple in the structure, and yet it provides a very effective control of the temperature.



Picture 3 - Rotary Kiln Waste Incinerator - Diagram
(Hit the picture for Acrobat A4 landscape printout document - 144 K)

In other words; the incinerator must be suitable for an operation, in which the flow of air into the chamber is limited to approximately 30% to 35% of the total required for complete oxidization. This provides a gentle air flow through the combustion chamber, which, in turn, substantially reduces the volume of fly ash escaping from it.

Picture 4 - The Rotary Kiln - External and Inside Views *(left and right)*

Waste Incineration System by *TRANSPARENT Technologies Pvt Ltd (TTPL - Picture 3):*

***1. Material Feeding System**:*
Standard bags filled with waste, typically of 6 to 7 kg weight, are fed to the incinerator.

***2. Incinerator**:*
Incineration is a thermal process, which destructs the waste through combustion at a temperature around 800°C. This ensures that all organic materials are completely combusted. The primary chamber is a Rotary Kiln (Picture 4) turning at a moderate speed, thus providing adequate residence time for the combustion of any given waste. Completion of the combustion takes place in the Thermal Reactor (after burner) and all Volatile Organic

Combustibles (VOCs) are burnt there at temperatures exceeding 1000°C. The incinerator proposed by TTPL has a controlled combustion providing high efficiency (CE), which is defined as follows:

$$CE = CO_2 / (CO + CO_2) \text{ in } \%$$

The flue gas leaves from the top of the Thermal Reactor, while the ash falls by gravity into a water sealing tank. The water sealing provides a quenching effect to the hot ash, whch is removed from the bottom of the tank in a screw conveyor. This process gives a minimum of undesirable products.

***3. The Boiler / Economizer Assembly**:*
The heat energy in the flue gas is recovered to produce hot water or steam in the Boiler. The heat energy remaining in the flue gas after the generation of steam is used to preheat feed water for the boiler in an economizer (heat exchanger). Prior to processing, the boiler feed water is preheated using a Start-up Boiler.

Picture 5 - Rotary Kiln Waste Incinerator Plant with Vertical Thermo-Reactor

***4. Flue Gas Treatment (Particle Separation System)**:*
The flue gas from the economizer is fed to the Particle Separation System, consisting a Cyclone and a Bag Filter, in compliance with the EU Ordinances on Emission.

***5. Heat Recovery from the Steam**:*
The heat energy of the steam generated in the boiler heats water recirculated through the steam drum and the economizer. The remaining energy from the condensation of the steam in the steam drum is also recovered in the heat exchangers. The condensate is collected in a condensate tank and, finally, fed to the Boiler.

***6. The F. D. Fan**:*
The primary chamber of the incinerator system must be capable of operating under the 'controlled air' concept. In other words; the aim is to limit the air flow into the chamber to approximately 30% to 35% of the air required for complete oxidization. This is done to obtain a partially oxidized effluent consisting of CO, CO_2, H_2, N_2 and water vapour. A major requirement for such operation is an exact control of the temperature on the inside wall of the combustion chamber.

***7. The I. D. Fan**:*
The flue gas from the system is exhausted through the I. D. Fan. This fan is capable of working against the pressure drop in the Thermo Reactor (After Burner), Economizer, Boiler, Cyclone cum Bag Filter etc. A negative pressure is maintained at a particular point in a system.

***8. The Start-up Boiler**:*
To prevent condensation of the flue gas, the Boiler and the Economizer require preheating before incineration is started. The Start-up Boiler is used for the preheating.

***Special Features**:*
1. The Incinerator is lined on the inside with high temperature refractory material
2. The fuel input to the Incinerator Burner is controlled from the outlet temperature
3. All VOCs are completely destroyed in the Thermal Reactor (After Burner)
4. The fuel input to the Thermal Reactor (After Burner) is controlled and modulated from the chamber temperature
5. The Start-up Boiler preheats the Heat Recovery System to prevent condensation
6. The Heat Recovery Boiler and Economizer are specially designed to work with gases contaminated with dust (patented design)
7. The hot water temperature in the Heat Recovery System is maintained constant, irrespective of system variations
8. All Air Fans are designed for optimum efficiency and vibration levels well within required limits

9. The Rotary Valves are fabricated and machined with close tolerances for better performance and long life.

Flue Gas Cleaning

Please consult EU Standards for the Incinerator Exhaust and The Concept attached.

Institutional Framework

The success or failure of a Waste Incineration Scheme depends on the attitude of the multiple stake holders and on the legislative and institutional framework currently in force. Stake holders in an incineration plant project often have conflicting interests. The project can therefore become an environmental and economic issue with many groups. The stake holders' reaction to the project may differ depending on the institutional setting of the plant.

An incineration plant can be located in the waste sector or the energy sector, or it can be a fully privatized independent entity (preferable). In any case, the plant must be an integral part of the waste management system. Depending on the organizational affiliation of the plant, there is a need for firm irrevocable agreements regulating the supply of waste, the sale of energy and other price settings.

Conclusions

The proposed scheme is designed for the most economical running parameters and is the most suitable concept for the waste, which has been identified by the clients. Modern technologies, coupled with the increasing awareness of consistent quality, installation costs and operating expences, is associated with advanced processes and should be an impetus for all progressive managements to invest in the innovative systems introduced by TRANSPARENT Technologies Pvt Ltd.

***eMail* - *As-to-Qs* (Answers-to-Questions)**

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