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Power generation from incinerator

Mr Sarath Krishnan[1], Raees[2], Aswanidev P.S[3], Amjad Ali[4], Shibi C.K[5]

[1]Faculty of Mechanical Engineering, Eranad Knowledge City Technical Campus, Manjeri, Malappuram, Kerala, India.

[2, 3,4,5] Students of Mechanical Engineering (2014-2018 batch), Eranad Knowledge City Technical Campus, Manjeri, Malappuram, Kerala, India.

Email: [1]sarathkrish.krishnan@gmail.com, [2]raees619@gmail.com

Contact: [1]+919747492900, [2]+918606844098.

Abstract—**Solid waste disposal has become a major problem in India. Either it has to be disposed safely or used for the recovery of the valuable materials. Wastes like agricultural wastes, domestic wastes and industrial wastes can be used for the extraction of carbon. The carbon can be extracted from the fly ash which is the product of combustion of waste particles.In our project "POWER GENERATION FROM INCINERATOR", when the wastes are burnt in the chamber, they are converted into ashes and vapour. They are then condensed on the condenser where the carbon extraction settles down and taken in the form of semi liquid and is processed for the further usage. During the combustion process the hot vapour and steam is produced. So therefore, this vapour and steam is regulated to the turbine. The turbine due to steam starts rotating in turn the generator fixed to the turbine generates electricity.**

Keywords— Incinerator; Solid wastes; Condenser; Turbine; Steam; Generator ; Battery

I. INTRODUCTION

In addition to increasing waste generation, the global demand for energy will increase by 56 percent between 2010 and 2040, with the greatest demand in the developing world (US Energy Information Administration 2013). According to the World Bank, there are currently 1.2 billion people (20% of the world"s population) without access to electricity (World Bank- Energy Facts). In India alone, 300 million people lack any access to power and another 400 million Indians have limited access to power. Incineration is a waste treatment process that involves the combustion of organic substances contained in waste materials. Incineration and other high-temperature waste treatment systems are described as "thermal treatment". Incineration of waste materials converts the waste into ash, flue gas, and heat. The ash is mostly formed by the inorganic constituents of the waste, and may take the form of solid lumps or particulates carried by the flue gas. The flue gases must be cleaned of gaseous and particulate pollutants before they are dispersed into the atmosphere. In some cases, the heat generated by incineration can be use to generate electric power. Incineration with energy recovery is one of several waste-to- energy (WTE) technologies such as gasification, pyrolysis and anaerobic digestion. While incineration and gasification technologies are similar in principle, the energy product from incineration is high-temperature heat whereas combustible gas is often the main energy product from gasification. Incineration and gasification may also be implemented without energy and materials recovery. In several countries, there are still concerns from experts and local communities about the environmental effect of incinerators (see arguments against incineration).

Incinerators reduce the solid mass of the original waste by 80–85% and the volume (already compressed somewhat in garbage trucks) by 95–96%, depending on composition and degree of recovery of materials such as metals from the ash for recycling. This means that while incineration does not completely replace landfilling, it significantly reduces the necessary volume for disposal. Garbage trucks often reduce the volume of waste in a built-in compressor before delivery to the incinerator. Alternatively, at landfills, the volume of the uncompressed garbage can be reduced by approximately 70% by using a stationary steel compressor, albeit with a significant energy cost. In many countries, simpler waste compaction is a

common practice for compaction at landfills. Incineration has particularly strong benefits for the treatment of certain waste types in niche areas such as waste sand certain hazardous wastes where pathogens and toxins can be destroyed by high temperatures. Examples include chemical multi-product plants with diverse toxic or very toxic wastewater streams, which cannot be routed to a conventional wastewater treatment plant.

II. Literature Survey

A. The Environment Agency (ea), The Department of Energy and Climate Change (decc) U.K LONDON http://www.defra.gov.uk/publications/

The energy generation option selected for an incineration facility will depend on the potential for end users to utilize the heat and/or power available. In most instances power can be easily distributed and sold via the national grid and this is by far the most common form of energy recovery. For heat, the consumer needs to be local to the facility producing the heat and a dedicated distribution system (network) is required. Unless all of the available heat can be used the generating facility will not always be operating at its optimum efficiency. The use of CHP combines the generation of heat and power (electricity). This helps to increase the overall energy efficiency for a facility compared to generating power only. In addition, as power and heat demand varies a CHP plant can be designed to meet this variation and hence maintain optimum levels of efficiency.

B. Rohit Jadhav, Department of Mechanical Engineering, LTCoE , Mumbai University, India.

The solid waste is connected in the hopper which is connected to drum. The curing is required at the start of process for burning. After curing, the solid waste is introduced in furnace. The heat is transferred to the heat junction of thermopile which are connected in series around the drum. The cold junction is in the dome where it is connected to bulb to see power output. The pollutants created in the furnace go through oxidation and reduction in catalytic converter. The catalytic converter stops the fly ash to pass through it and maintains the heat in furnace. The chimney is used to path the exhaust gases to atmosphere. The trolley is used for transportation purposes where it can cover more ground. It is wheel based incinerator for waste disposal of houses, colleges, and small industries. It can be designed and fabricated. It can be used to convert waste into carbon.

C. Robert William Styron, Marietta Jianm Yang Wang, Houghtom Mich US PATENT Number: 6,068,131

A froth flotation method is provided for removing carbon from fly ash which utilizes an environmental friendly conditioning agent. The conditioning agent preferably comprises biodegradable oil which is added to slurry containing raw fly ash and water. The conditioning agent renders the carbon in the fly ash hydrophobic such that upon aeration of the slurry, air bubbles attach to the carbon particles and carry them to the surface of the slurry in the form of froth, such that the carbon may be removed. A fly ash sample from Baltimore Gas and Electric was obtained which contained 7.41% LOI (Loss on Ignition, which is almost equivalent to carbon content). About 220 g of the sample was mixed with one liter of water in a Denver flotation machine. About 0.1 g of lard oil was added and mixed with the slurry. After 5 minutes of mixing, 0.15 g of do froth 250 Flotation Frothier (propylene glycol methylether) was added and the mixing continued for another minute. Air was then introduced into the machine to float the carbon for 5 minutes. The cell product, which contained the materials that didn't float, was filtered, dried and designated as the clean ash. The froth product was placed in the froth flotation machine again and air was introduced to refloat the material for another 6 minutes. The materials in the cell were filtered, dried, and designated as the middling. The second froth product was filtered, dried and designated as the carbon concentrate.

III. Design and Fabrication

The Experimental Model Mainly consists of Frame, Combustion chamber, Pressure gauge, Condenser, Blower, Turbine, Generator, Battery, Storage tank, Gate valve. Each component has been explained in following sections.

A. Combustion chamber

The combustion chamber is a component where the combustion of waste particles takes place. It is also known as a burner, combustion chamber or flame holder. Combustors play a crucial role in because it converts the waste into fly ash and vapor, which is then converted to carbon in the condenser. In our project the combustion chamber or burner has the opening where the waste is fed. The pressure gauge is fixed in the chamber which is used to measure the pressure inside the chamber.

B. Pressure Gauge

Many techniques have been developed for the measurement of pressure and vacuum. Instruments used to measure and display pressure in an integral unit are called pressure gauges or vacuum gauges.Everyday pressure measurements, such as for vehicle tirepressure, are usually made relative to ambient air pressure

C. Condenser

A **condenser** is a device or unit used to condense a substance from its gaseous to its liquid state, by cooling it. A condenser is the apparatus which cools hot vapors, causing them to condense into liquid laboratory-scale condensers, as opposed to industrial-scale condenser.

D. Blower

A Blower or a centrifugal fan is a mechanical device for moving air or other gases.The terms "blower" and "squirrel cage fan", (because it looks like a hamster wheel), are frequently used as synonyms.These fans increase the speed and volume of an air stream with the rotating impellers. Centrifugal fans use the kinetic energy of the impellers to increase the volume of the air/gas stream which in turn moves them against the resistance caused by ducts, dampers and other components.

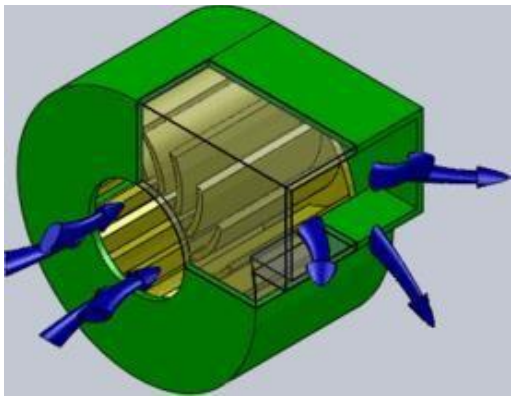

Fig 1 Blower

E. Turbine

A steam turbine is a device that extracts thermal energy from pressurized steam and uses it to do mechanical work on a rotating output shaft. Its modern manifestation was invented by Sir Charles Parsons in 1884. Because the turbine generates rotary motion, it is particularly suited to be used to drive an electrical generator – about 90% of all electricity generation in the United States (1996) is by use of steam turbines. The steam turbine is a form of heat engine that derives much of its improvement in thermodynamic efficiency from the use of multiple stages in the expansion of the steam, which results in a closer approach to the ideal reversible expansion process. An ideal steam turbine is considered to be an isentropic process, or constant entropy process, in which the entropy of the steam entering the turbine is equal to the entropy of the steam leaving the turbine.

Fig 2. Turbine

F. Generator

Basic Operation of a DC Generator A single conductor, shaped in the form of a loop, is positioned between the magnetic poles. As long as the loop is stationary, the magnetic field has no effect (no relative motion). If we rotate the loop, the loop cuts through the magnetic field, and an EMF (voltage) is induced into the loop.When we have a relative motion between a magnetic field and a conductor in that magnetic field, and the direction of rotation is such that the conductor cuts the lines of flux, an EMF is induced into the conductor. The magnitude of the induced EMF depends on the field strength and the rate at which the flux lines are cut.

G. Battery

Here we are using a Lead-Acid battery for storage of electricity generated from the Experimental setup.

H. Storage tank

In this project to store the extracted carbon a small tank is used where the extracted carbon flows from the furnace.

I. Gate valve

A gate valve, also known as a sluice valve, is a valve which opens by lifting a round or rectangular gate/wedge out of the path of the fluid. The distinct feature of a gate valve is the sealing surfaces between the gate and seats are planar, so gate valves are often used when a straight-line flow of fluid and minimum restriction is desired.

Fig 3. Gate Valve

IV. WORKING PRINCIPLE

The main component of this project is Combustion chamber where the waste is burnt for the extraction of carbon. The combustion chamber, Condenser, blower are mounted in the main frame. The blower is fixed in the combustion chamber to supply air for the combustion process. The pressure is measured using pressure gauge. When the wastes start burning they are converted to fly ash and vapour due to combustion. This fly ash and vapour are cooled down in the condenser by spraying water. So the carbon settles down in the condenser and flows down to the storage. The hot vapour and steam from the combustion chamber is made to flow through a tube to the turbine, where the turbine rotates due to the hot vapour

and steam. Due to this the power is generated. The generated power is then stored in a battery for further usage.

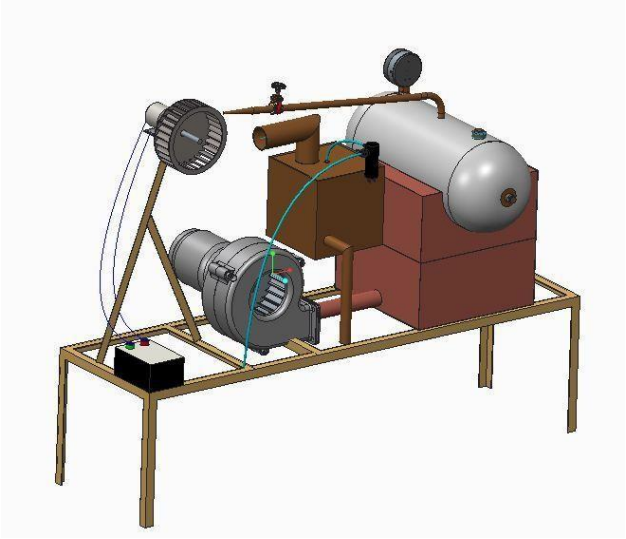

Fig 5. 3D Diagram Of Project

V. TESTING AND DISCUSSIONS

- The designed system is working perfectly and power is producing adequately.
- Approximately an electrical Energy 500- 600 Wh of power is produced per unit kilogram of waste incinerated.Which in turn means 500-600 kwh of power per tonne of the waste incinerated.
- So for municipal waste management approximately 3000 kwh of power can be produced.
- With the use of a catalytic convertor the exhaust will be much cleaner rather than the harmful toxic exhaust of the normal incinerator.
- The pressure reading on the steam producing unit should less than the specified value so that it will not lead to hazardous results.
- A Magnetic separator can be added so as to separate ferrous materials from the carbonic ash thus produced.

VI. CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between the institution and the industries. We are proud that we have completed the work with the limited time successfully. The **DESIGN AND FABRICATION OF POWER GENERATION FROM INCINERATOR** is working with satisfactory conditions. We can able to understand the difficulties in maintaining the tolerances and also the quality. We have done to our ability and skill making maximum use of available facilities. In conclusion remarks of our project work, let us add a few more lines about our impression project work. Thus we have developed a **"POWER GENERATION FROM INCINERATOR"** which helps to design a machine which uses waste as a raw material for power generation with the help of incinerator. This also extracts carbon which can be used for further uses.

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