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Agricultural Incinerator Based on Solar Power

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Abstract – *Agricultural remains the mainstay of India's economy. Feeding a population of nearly 1.33 billion and over 60% of the Indian population depends on agricultural and other allied activities for their livelihood. Every year India generates about 250 million tonnes of agricultural produce and about 350 million tonnes of agricultural waste. From long ago, Indian farmers used to burn agricultural waste after the harvesting season so that they can clear their landfill to take fresh planting which has a negative impact on environment and economy. As Agro-Waste including bagasse, cotton and soybeans waste, wheat and rise husks, coffee husk and ground nuts is wasted. Open burning of Agro-Waste contribute towards the emission of fumes, smoke and greenhouse gases like CO2, CH4, N2O and air pollutants which tends to a serious implications on health.*

As a result of growing concerns about Agricultural waste generation and increase in population, decreasing availability of land for waste disposal, respectively waste management from sugarcane factories and the problems related to organic waste disposal after primary production of grains. Incineration represents an alternative method for the treatment of agricultural waste. Incineration is a treatment technology for waste to convert it into energy by control burning at high temperature so as to minimize the pollution. The purpose behind the current incinerator is to reduce the volume of the waste, pollution and to provide an alternative fuel instead of throwing or dumping an Agro-Waste. It burns the waste with a required amount of air and leaves some adverse footprints on the environment. The paper presents the theoretical aspects related to Agricultural waste incineration and the production of wood gas.

Key Words: ***Agricultural Waste***1, ***Greenhouse Gases***2, ***Incineration***3, ***Wood Gas***4, **Pollution**5.

1. INTRODUCTION

The burning of the agricultural dry residue in open environment leaves carbon footprint in the environment. The other way in which the management of dry residue is done by landfilling. This leads to the decomposition of woods by fungus and it indirectly results into the carbon prints. The burning of dry residues results into the release of particulate matter into the atmosphere which lead to the pollution. It creates a lot of pollution on burning the dry waste in the presence of oxygen in open environment. Spreading of diseases as the waste is dumped on the open space is one of the major problem associated with the landfill. Ample amount of area is required to landfill huge amount of waste. There is need to reduce the mass of solid waste. The efforts taken by the farmers is quite high but the output is very low comparatively.

The Agricultural Incinerator is a device that converts agricultural wastes (carbonaceous materials) into synthetic gas. The Incinerator is designed to burn agricultural waste rather than dumping or throwing. Using a sufficient amount of air for combustion to produce a flammable wood gas which is almost similar to that of the LPG. Incineration process generates wood gas and biochar/ash. As, wood gas can be used to run the farming equipment like water and fertilizer pump, engines, generator, crop protection equipment's and biochar/ash as a fertilizer to enrich the soil.

Now a days there is a need of alternative fuel as well as. In industrial sector, there are many processes where heating is involved. Alternative fuel such as wood gas can serve the same purpose. There are some agricultural purpose incinerator in the market but the cost of equipment and the maintenance cost is very high and there is no profit involved from it to the farmer. So the solar power incinerator is designed with low maintenance involved in it. It will help to reduce landfill area along with that it generates pure wood gas which can be used in many applications related to the industries as well as domestics. During this process there is a generation of coal and ash as a by-products. These by products also find its own applications in many sectors.

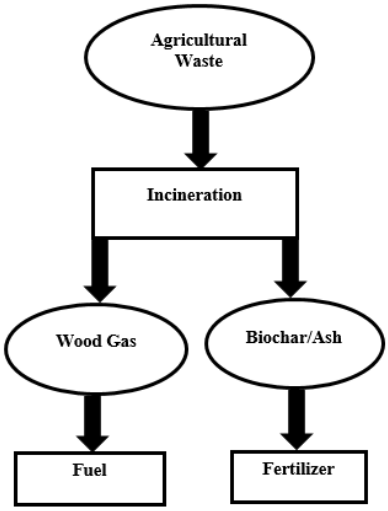

Fig1: Incineration Process Diagram

2. EXIXTING SYSTEM

The incinerator right now in use is for only commercial purpose at city level or at industry level. Incineration technology is particularly popular in countries like Denmark, Sweden, China, Japan and Australia for waste management (Waste to energy approach) to generate electricity as an energy recovery from waste. The purpose behind the current incinerator is to reduce the heavy cost of technology and to bring it useful for agricultural purpose to provide an alternative for fuel.

Some incineration practises in India:

In India the first incineration plant was setup by MILJOTECKNIK Volunteer, Denmark for the treatment of municipal and agricultural waste at Timarpur (New Delhi). It had a capacity of 300 tonnes per day and at an installation cost of about 250 million but the plant was shut down after 6 months as it was out of operation due to heavy maintenance and poor operation.

Another incineration plant in Delhi named as 'Okhla Incineration Technology' which was India's first four functional (W2E) waste-to-energy plant, but due to emission of hazardous gases and air and water pollutants people staying in nearby areas have moved to court to for having a governments attention regarding health and environment problems.

Because of high running cost and unsuitable waste other plant at Ghazipur runs very short for 15 days.

The existing system of an incineration does not prefer to adopt by government and regional people because of health risk, high expenses, maintenance and pollution. Seeing the past data of incineration it tells that once the incineration plant is constructed, it requires ample amount of land and no guaranty that it will run without any problem.

Some drawbacks of the existing incineration system are as follows:

1. Incineration technology including its installation and maintenance is an expensive process.
2. Releases out smoke, fumes, air pollutants and harmful gases which causes health and environment risk.
3. High temperature and heavy maintenance results into long term problem.
4. It's a classical short term solution for destroying a materials and convert it into energy having ash/biochar as a by-product.
5. Medical waste and Municipal solid waste (MSW) incineration contains a hazardous particulate which results in concentration of toxic substances in ash.

3. PROPOSED SYSTEM

The proposed system deals with the construction of a cost effective and minimum maintenance incinerator which runs on a solar power to burn the agricultural waste. It burns the waste with the required amount of air (Air supply and control by fans/blower) and releases less air pollutant.

AGRICULTURAL INCINERATOR AND ITS VARIOUS PARTS

3.1 Furnace

Furnace is an outside part of an incinerator where agricultural wastes are placed and it is burned with the help of limited amount of air, having an outside diameter of 550 mm and the height of 1200 mm. The outside cylinder (furnace) is made of mild steel sheet and it is welded with a stand at bottom to provide support for incinerator.

3.2 Char Chamber

Dry agricultural waste including grass is paced here and given a supply of air for gasification through metal fan/blower fastened on it. It has a diameter of 400 mm and a length of 750 mm and is placed at the center of incinerator body with a space of 150 mm from all circular direction. It is made up of stainless steel and has an opening and closing operating door for waste putting operation.

3.3 Fan Assembly and Solar Panel

Metal axial type fan having a diameter of 6 inch is mounted on a wall to provide sufficient amount air needed for gasification of waste. Metal fan runs on polycrystalline solar panel of 10W, 12V rating. A manually operated switch is used to control the speed of the fan. Speed controller helps to provide a required amount of air for burning to enter into the chamber.

3.4 Copper Capillary Tube

A Copper Coil Capillary tube with a diameter of 1inch and of 700 mm in length is used to connect from Incinerator reactor

(wood gas generator) to storage tank. So as to store wood gas and it is provided with nozzle both at storage cylinder and Incinerator Reactor.

4. METHODOLOGY

1. Firstly, the dry waste will be placed in the lower outside container (Furnace) which will be burnt in the required amount of air.
2. While the upper compartment will be airtight where the dry waste will be burnt in the absence of oxygen.
3. The gases produced by the anaerobic (i.e. In absence of oxygen) burning of waste are stored in the container (Wood Gas a mixture of several Flammable gases)
4. While the gases produced by the combustion process of the dry waste are separated by the diffusion method & stored in the separate container.
5. The ash produced in lower compartment is removed out.
6. The solar powered fan / blower is used in the lower compartment in order to put the sufficient amount of the air (Oxygen) into the system for the burning purpose.
7. Whereas the bio-char produced in the burning of the dry waste in upper compartment can be used as the source for enrichment of soil.
8. Whenever the fuel inside the lower chamber is utilized then refilling of the lower chamber with the fuel is need to carry out.
9. However whenever the dry residues waste in the upper chamber completely gets converted into the charcoal then refilling is again carried away by removing the formed charcoal.
10. This formed charcoal can be used as the fuel for the lower chamber as well.

5. RESULT & ANALYSIS

1. The two products obtained are-

Charcoal / bottom ash (*calorific value 33kJ/g)* + Wood gas (*calorific value 5.78MJ/kg)*

2. Properties and uses of Wood Gas:

- Composition

Type	Percentage
Carbon monoxide	18-22%
Carbon dioxide	9-12%
Nitrogen	45-55%
Hydrogen	13-19%
Methane	1-5%
Oxygen	0.2-1%
Heavier Hydrocarbons	0.2-0.4%
Water Vapor	4%

Fig2: Wood Gas Compositions

- There is the production of the combustible gas named wood gas, which is a flammable gas & can be stored & used as per the application.
- It has a lower heat of combustion of 5.7MJ/Kg against Gasoline having 44.1MJ/Kg and natural Gas having 55.9MJ/Kg.
- Its composition is strongly depends on gasification process, medium used for combustion and moisture content.
- It can be used as a fuel for stoves, furnaces and vehicles in place of petrol, diesel and LPG.
- Vehicles like trucks, buses, motorcycles, tractors, trains and ships were equipped with wood gasifier during World War 2 mostly in Germany.
- Wood gas can be used as a power generator in automobile sector and in industrial area.
- Hence this wood gas is also called as the engine fuel.

3. Uses of the Bio-char/Ash:

- Bio char obtained by burning agricultural waste (organic/inorganic) can be used to enrich the soil.
- It is used to enhance the quality of soil by improving the fertility of soil.
- It is suitable to use with construction material to minimize the excessive use of cement and concrete

which helps to increases the compressive strength of the cement when mixed with it.

- The charcoal obtained is used for filtration of water.
- It have certain medical applications like- It can be used for cleaning teeth.
- Medicines, capsules, etc.

6. CONCLUSIONS

After the completion of this project we came to the conclusion that for completing any project successfully we need have a proper planning of everything starting from design to its functionality. We also need to carefully recognize the user's requirements as well as engineering requirements and its targets. Above all a proper team working is also very crucial as completing the project on time is our first priority and not to undermine the fact that unless we don't have the right materials and components in right time we can't achieve the targets that we have set at the beginning of our design.

In today's era a market based economy is the success factor for any walks of life and work and to have that position we need to have a distinctive way of approach towards a product.Innovation is one of the tool that has always been helpful in achieving that state, hence in our model the changes that we would made that there will the use of lighter material for reducing its overall weight also finding out the most efficient technique to store & pressurize the wood gas is one of the greatest challenge that can be overcome.

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