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FABRICATION OF GASIFIER

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ABSTRACT: In Gasification process converts organic or fossil fuel based carbonaceous materials into carbonmonoxide, hydrogen and carbon dioxide. This is achieved by reacting the material at high temperatures, without combustion, with a controlled amount of oxygen and/or steam. The resulting gas mixture is called syngas (from synthesis gas) or producer gas and is itself a fuel. The power derived from gasification and combustion of the resultant gas is considered to be a source of renewable energy if the gasified compounds were obtained biomass.

1. INTRODUCTION

Modern agriculture is an extremely energy intensive process. However high agricultural productivities and subsequently the growth of green revolution have been made possible only by large amount of energy inputs, especially those from fossil fuels. With recent price rise and scarcity of these fuels there has been a trend towards use of alternative energy sources like solar, wind, geothermal etc., However these energy resources have not been able to provide an economically viable solution for agricultural applications. One biomass energy based system, which has been proven reliable and had been extensively used for transportation and on farm systems during World War II is wood or biomass gasification. Biomass gasification means incomplete combustion of biomass resulting in production of combustible gases consisting of Carbon monoxide (CO), Hydrogen (H2) and traces of Methane (CH4). This mixture is called producer gas. Producer gas can be used to run internal combustion engines (both compression and spark ignition), can be used as substitute for furnace oil in direct heat applications and can be used to produce, in an economically viable way, methanol – an extremely attractive chemical which is useful both as fuel for heat engines as well as chemical feedstock for industries5 . Since any biomass material can undergo gasification, this process is much more attractive than ethanol production or biogas where only selected biomass materials can produce the fuel. Besides, there is a problem that solid wastes (available on the farm) are seldom in a form that can be readily utilized economically e.g. Wood wastes can be used in hog fuel boiler but the equipment is expensive and energy recovery is low as a result it is often advantageous to convert this waste into more readily usable fuel from like producer gas. However under present conditions, economic factors seem to provide the strongest argument of considering gasification. In many situations where the price of petroleum fuels is high or where supplies are unreliable the biomass gasification can provide an economically viable system – provided the suitable biomass feedstock is easily available (as is indeed the case in agricultural systems)

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2. DESCRIPTION OF EQUIPMENTS

2.1 GASIFIER REACTOR

The gasifier partially combusts biomass feedstock with oxygen to form hydrogen and carbon monoxide. The gasifier operates at a temperature of approximately 1,560 °F and a pressure of 130 PSIG. Due to the high combustion temperature, the gasifier vessel is constructed with a refractory lining to protect the integrity of the steel shell. Dolomite, medium pressure steam and a recycled portion of syngas and ash are also introduced into the bottom of the gasified to form and stabilize the bubbling fluid bed. The upper portion of the gasifier vessel allows the bed material and syngas to separate, reducing the amount of solids carryover with the syngas. As described above, three in-feed screw conveyors are used to feed dried biomass and dolomite bed material to the bottom of the gasifier. Since the pressurized in-feed screw conveyors are exposed to hot gases from the gasifier, they are designed with water cooling coils for protection. Syngas is discharged at the top of the gasifier vessel and routed to the gasifier cyclone for particulate (char, bed material, un-reacted biomass, etc.) recovery.

2.2 ASH DISCHARGE SYSTEM

A portion of the dolomite bed material and ash from fuel combustion are periodically removed from the bottom of the gasifier and discharged to an ash removal screw conveyor. The water cooled screw conveyor is exposed to the gasifier pressure and discharges dolomite and ash to a lock hopper where the material is depressurized. The dolomite and ash then discharge to a conveyor hopper for pneumatic transfer to an ash storage silo where material is accumulated for disposal.

2.3 DUST COLLECTION CYCLONE

Syngas exits the gasifier and is routed through a refractory lined cyclone separator vessel where ash and entrained bed material are removed. The bulk of the entrained particulate is removed from the syngas in the cyclone. The cyclone is efficient enough to keep particulate concentrations below a level acceptable for the tar reformer. The particulate dust is returned through the cyclone dropleg to the fluidized bed of the gasifier for further carbon conversion.The Fabrication of gasifier is consists of the following components to full fill the requirements of complete operation of the machine.

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3.EXPERIMENTAL SETUP

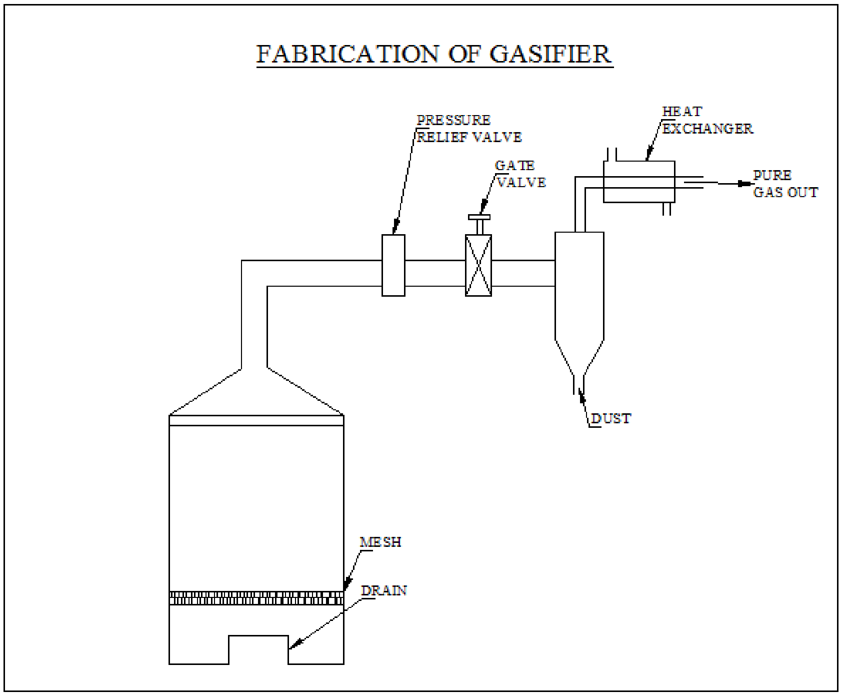

Fig 2.1 Fabrication of Gasifier

3.1 WORKING PRINCIPLE

Cyclonic separation is a method of removing particulates from an air, gas or liquid stream, without the use of filters, through vortex separation. When removing particulate matter from liquids, a hydrocyclone is used; while from gas, a gas cyclone is used. Rotational effects and gravity are used to separate mixtures of solids and fluids. The method can also be used to separate fine droplets of liquid from a gaseous stream.A high speed rotating (air) flow is established within a cylindrical or conical container called a cyclone. Air flows in a helical pattern, beginning at the top (wide end) of the cyclone and ending at the bottom (narrow) end before exiting the cyclone in a straight stream through the center of the cyclone and out the top. Larger (denser) particles in the rotating stream have too much inertia to follow the tight curve of the stream, and strike the outside wall, then fall to the bottom of the cyclone where they can be removed. In a conical system, as the rotating flow moves towards the narrow end of the cyclone, the rotational radius of the stream is reduced, thus separating smaller and smaller particles. The cyclone geometry, together with flow rate, defines the cut point of the cyclone. This is the size of particle that will be removed from the stream with a 50% efficiency. Particles larger than the cut point will be removed with a greater efficiency and smaller particles with a lower efficiency.

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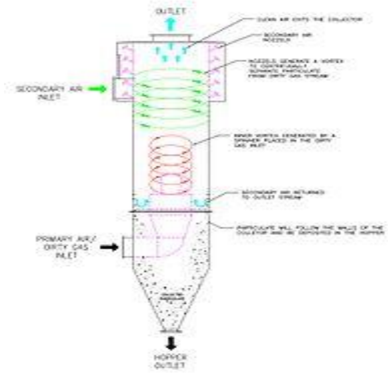

Fig 2.2 Air flow

Airflow diagram for Aerodyne cyclone in standard vertical position. Secondary air flow is injected to reduce wall abrasion.

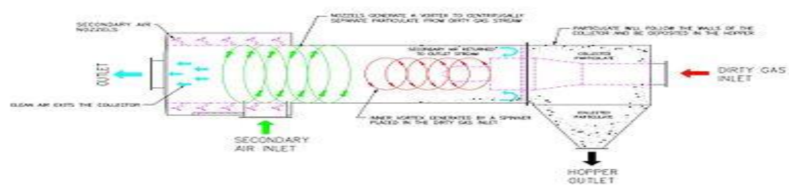

Fig 2.2 Air flow diagram

Airflow diagram for Aerodyne cyclone in horizontal position, an alternate design. Secondary air flow is injected to reduce wall abrasion, and to help move collected particulates to hopper for extraction.An alternative cyclone design uses a secondary air flow within the cyclone to keep the collected particles from striking the walls, to protect them from abrasion. The primary air flow containing the particulates enters from the bottom of the cyclone and is forced into spiral rotation by stationary spinner vanes. The secondary air flow enters from the top of the cyclone and moves downward toward the bottom, intercepting the particulate from the primary air. The secondary air flow also allows the collector to optionally be mounted horizontally, because it pushes the particulate toward the collection area, and does not rely solely on gravity to perform this function.Large scale cyclones are used in sawmills to remove sawdust from extracted air. Cyclones are also used in oil refineries to separate oils and gases, and in the cement industry as components of kiln preheaters. Cyclones are increasingly used in the household, as the core technology in bag less types of portable vacuum cleaners and central vacuum cleaners. Cyclones are also used in industrial and professional kitchen ventilation for separating the grease from the exhaust air in extraction hoods. Smaller cyclones are used to separate airborne particles for analysis. Some are small enough to be worn clipped to clothing, and are used to separate respirable particles for later analysis.Similar separators are used in the oil refining industry (e.g. for Fluid catalytic cracking) to achieve fast separation of the catalyst particles from the reacting gases and vapors.

3.2 MERITS

- Cleaner energy, 0% harmful emissions
- Funds and finance
- A fuel with a future - Readily available and easily and renewable
- Reduce Dependency on Fossil Fuels
- Reduces Landfill Size
- Can be Used to Create Added value

4.CONCLUSION

Biomass gasification offers the most attractive alternative energy system for agricultural purposes. Most preferred fuels for gasification have been charcoal and wood. However biomass residues are the most appropriate fuels for on-farm systems and offer the greatest challenge to researchers and gasification system manufacturers. Very limited experience has been gained in gasification of biomass residues.Most extensively used and researched systems have been based on downdraft gasification. However it appears that for fuels with high ash content fluidized bed combustion may offer a solution. At present no reliable and economically feasible systems exist. Biggest challenge in gasification systems lies in developing reliable and economically cheap cooling and cleaning trains.

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