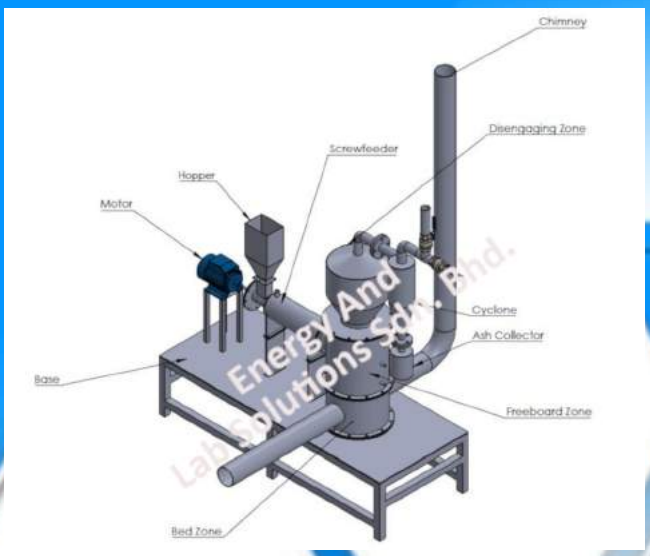
BIOMASS
(Fluidized Bed Gasifier)



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INTRODUCTION

Biomass Types

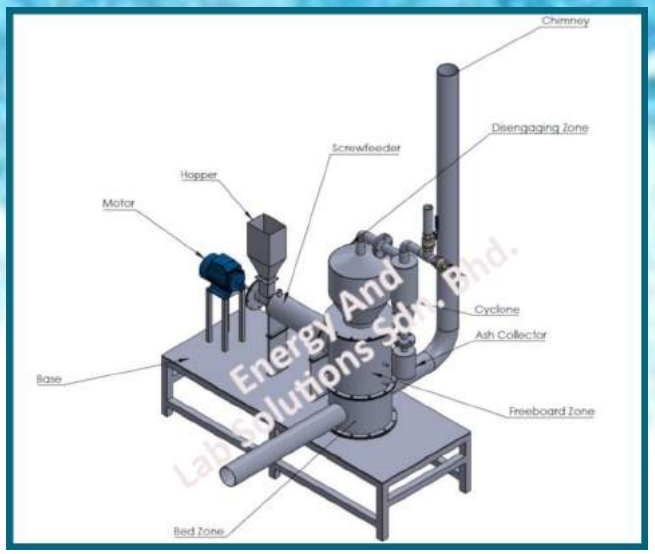
Biomass is a term of all organic material that comes from plants (including algae, trees and crops). Biomass is produced by green plants that convert sunlight into plant material through photosynthesis, and includes all land, and water-based vegetation as well as all organic wastes. The biomass resource can be considered as organic matter, in which the energy of sunlight is stored in chemical bonds. Biomass has always been a major source of energy.

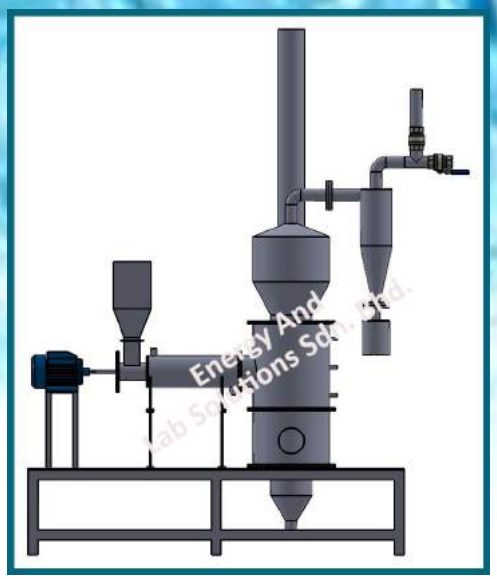
Biomass types can be defined in different ways, but one simple method is to define as:-
i) Plant Derived
ii) Animal Derived

The plant derived biomass resources can be further divided into woody and non-woody biomass. Woody biomass includes trees and tree residues, and energy plantation, etc., while non-woody biomass includes agricultural residues, aquatic, and marine plants, etc. On the other hand, animal derived biomass can be considered as municipal solid waste, sludge, etc.

Biomass Gasification

Biomass gasification is the process of partial combustion of biomass under controlled air supply, thus the producing a mixture of gases called as "Producer Gas". It is a thermo-chemical (heat & chemical) process in which solid biomass is converted into a gaseous fuel by a series of chemical reactions. Producer gas consists of a mixture of combustible gases such as hydrogen (H_2), carbon monoxide (CO), and methane (CH_4) while there are incombustible gases such as carbon dioxide (CO_2) and nitrogen (N_2). The producer gas obtained by the process of gasification can have end-use for thermal application or for mechanical / electrical power generation. Producer gas can be used for decentralized power generation, water pumping and for a variety of thermal applications.





PARAMETER	SPECIFICATION
Model	DG-50
Gasification Type	Open top downdraft
Type of Fuel	Biomass fuel (wood chips, biomass pellets, etc.)
Fuel Consumption Rate	20 - 50 kg/hr
Fuel Feeding Interval	3 - 4 hr
Biomass Feeding System	Manual
Size of Fuel	Diameter : 10mm - 50mm Length : 10mm - 50mm
Moisture Content of Fuel	<20 % (wet basis)
Gas Cleaning	Cyclone separator
Gas Cooling	Condenser
Ignition	LPG torch

• OPERATION & MAINTENANCE OF GASIFIER

Following the proper operation and maintenance procedures for a gasifier system is not only important for ensuring the optimal operation and long system life, but it is also necessary from the stand point of safety and health.

• RUNNING INSTRUCTIONS

1) Feed the charcoal initially for the first run till the nozzle height, and then feed the biomass fuel on the top of charcoal till the top of gasifier.
2) Feed proper size of biomass at the specified moisture content. This is very important aspect, since oversize of biomass can cause bridging/blockage of the gasifier.
3) In order to economically, and safely operate the gasifier, it is preferable that the operator keeps a logbook to record the amount of biomass (and charcoal) which is fed into the system.

• GUIDELINES FOR CONTINUOUS OPERATION

1) Charge the firewood every 4 hours, or as the per requirements.
2) Remove the ash from the ash-pit at every regular interval.

• GUIDELINES FOR CHARGING DURING OPERATION

1) Ensure that while charging the gasifier, the main blower is switched off.
2) Open the lid, or top door of the hopper of the gasifier.
3) Charge the fuelwood pieces of appropriate sizes into the gasifier hopper with the help of buckets.
4) Ensure that the wood pieces are dry and not very big. Uses the wood pieces of recommended sizes.
5) Charge the required amount of wood at once to have an easy operation.
6) Cahrage the gasifier at regular intervals of 4 hours or as per requirements.
7) Close the gasifier top.
8) Switch on the main blower.
9) To recharge, follow the above steps repeatedly.

• START-UP PROCEDURES

1) Start the main blower, position the air-valve up to half open, and also keep the flaring port open for at least 5 minutes so the trapped gases inside the gasifier can be removed easily.
2) Open the top covers and open the ignition port cap.
3) Switched on the air blower for 2 - 3 minutes to flush the gas trap in the gasifier.
4) Ignite the biomass fuel using LPG gas torch until the biomass ignite.
5) Close the top cover.
6) On the blower and regulate the flow rate of blower using valve.
7) After 5 - 10 minutes, ignite the syngas at the flare port. Regulate the airflow rate of the blower till the gas gets ignited and make sure the flame sustains for 5 - 10 minutes in the flare port.
8) Transfer the gas towards cleaning & cooling train. When the good quality gas starts coming in the flare port, open the valve of the cleaning and cooling train, and close the valve of the flare port. Allow the gas pass through the trail so that it can be cleaned as well as cooled before feeding it for example into the gas engine or gas burner.

• STANDARD OPERATING PROCEDURE (SOP)

BEFORE OPERATION

1) Safety first.
2) Make sure the equipments is in good working condition.
3) Clean the ash, char and unburned feedstock inside the gasifier before feeding the new feedstock.
4) Make sure all the thermocouples are connected and working properly.
5) Make sure blower is working properly.
6) Switch on the blower to check airflow inside gasifier. Open all valve and make sure there is no air flow. Then switch of the blower.
7) Weight and add in the feedstock inside the boiler.
8) For starting ignition, make sure the feedstock does not cover the ignition hole.

DURING OPERATION

1) Close all valves.
2) Switch on all equipments (blower, temperature reader and fan).
3) Start ignition through the ignition hole. When the feedstock start to burn, stop the ignition process.
4) Supply and control the air volume flowrate on the rotameter. Use to control airflow. Start the airflow 20m3/hr. Airflow depends on type of feedstock.
5) Add feedstock inside the boiler. Make sure NOT to look inside the firebox directly as the heat can cause harm.
6) Close the valve to stop flare for flare gas open.
7) Connect the sample gas to the gas analyzer. ON the switch to collect the sample gas.
8) Collect the gas composition data in the gas analyzer.

AFTER OPERATION

1) Stop the air supply.
2) Collect the ash and char after the system cooled down.
3) Housekeeping.

• MAINTENANCE OF THE GASIFIER

Along with proper operational procedure, regular system maintenance is also required to keep the system in a condition fit for long and continuous operation.

• DAILY MAINTENANCE

1) Clean ash-pot of the gasifier.
2) Clean the heat exchanger by removing the dust and liquid collected in it by opening the end-plug from the bottom of the heat exchanger.
3) Clean the cyclone separator by removing the dust collected in it by opening the end-plug from the bottom of the cyclone separator.

• SAFETY MEASURES

Some measures that need to be taken to ensure the safety of operators as well as the equipments are listed below:-

1) Wear suitable personal protection equipment (face mask, goggle, shoe and etc.).
2) Make sure there is no flammable material nearby.
3) Place the fire extinguisher of appropriate size and capacity on the wall near the gasifier. Ensure that the extinguisher is easily accessible . It is also advisable to install a carbon monoxide (CO) alarm near the gasifer system.
4) While charging fuel, do not lean and look inside the gasifier hopper through the fuel-charging door. Combustible gases can suddenly comes out, catch fire and cause injuries.
5) Ensure that the blower is not connected to the electricity supply and the air supply valves are in closed position while charging fuel inside the gasifier.
6) During power cuts, close all air supply valves and open the gas flare pipe. Close the gas flare pipe after releasing the accumulated gas in the gas duct.
7) Do not look at the firebox through the air nozzles with the naked eye when the end-plugs are removed from nozzles. This is because, sometimes flames shoot out through them.
8) Empty the ash pot tank only after ensuring that the fire in the firebox chamber has been extinguished completely.
9) If the body of gasifier is hot , do not sprinkle it with water to cool it because sudden cooling damages the firebox lining.

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