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Pilot Study of Downdraft Gasifier

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Abstract— Now a days world needs a non-renewable energy source like fossil fuel, at ugly rates, that has hyperbolic the significant development in renewable energy sources. Biomass is one such supply of renewable energy that is copiously out there in worlds within the sort of industrial and agricultural products. Gasification is the process of that convert the biomass into the fuel like combustible gas. These produced gases can be used in various applications. Downdraft Gasifier is one of the best suited types of gasifier for gasification process to produces the combustible gases from biomass. Because of its simple design and advantages like flexibility in feed stock, good process management, minimum tar produced. the concept of gasifier style ought to be in such some way that it will convert the solid biomass such as wood chips. Wooden blocks, Soyabean husk etc. wastes into the shape clean product gases.

Index Terms— Gasification, Downdraft Gasifier, Biomass Gasification

I. INTRODUCTION

In all over the world biomass is one of the most important sources of energy. In rural area India renewable energy scenario indicate that; about 30% of population depends on conventional form of energy and more than 72% of population in India depends upon it for its energy required. Gasification is the process of converting solid biomass into the gases fuel in different gasifier. The combustible gases are depending on the types of biomass fuel used in gasifier. The combustible gases contain the CO2, CH4, CO, H and very minor quantity of hydrocarbons.

At first, in the initial step called pyrolysis, the natural issue is disintegrated by heat into vaporous and fluid unpredictable materials and burn (which is essentially a nonvolatile material, containing high carbon content). In the subsequent advance, the hot singe responds with the gases (for the most part CO2 and H2O), prompting item gases to be specific, CO, H2 and CH4. The maker gas leaves the reactor with poisons and in this manner, expects cleaning to fulfill necessities for motors. Blended in with air, the cleaned maker gas can be utilized in gas turbines (in enormous scope plants), gas motors, gas or diesel motor.

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II. LITERATURE REVIEW

Grandhi et. al. (2018) is to present the comparative study of various configurations and style a 5.0 kW research laboratory scale throat less biomass gasifier mistreatment associate degree analytical technique. The chemical process potency depends on many parameters like equivalence quantitative relation, chemical process agent, gasifier configuration, etc. draft gasifier could be a most fitted gasifier for biomass chemical process thanks to inherent blessings like feedstock flexibility, higher method management, low tar formation, and easy to construct.

Fernandes et. al. (2018) presenting the steps concerned within the style, construction, and to test the gasifier specific solid compound cell system. The look decisions square measure supported reported natural philosophy simulation results for the whole gasifier gas cleanup-SOFC system. The created SOFC system is tested and also the measured parameters square measure compared with those given by a system simulation. Moreover, an in depth energy analysis is performed to see the elements liable for poor potency. it's finished that the SOFC system demonstrates affordable agreement with the simulated results. Moreover, supported the energy results, the elements inflicting major irreversible performance losses square measure known.

Gnanendra P.M et. al. (2016) presents the experimental study of top downdraft gasifier and examining propagated rate of gas quality in gasifier. In this study author add the secondary air in reactor and set the range of air flows, set the flame in secondary air nozzle. It observed that; if moisture is high then propagation rate is low. Gas calorific value is measured base on the secondary to primary air in gasifier.

Susastriawan et. al. (2017) study and scope of downdraft gasifiers for gasification which is centered around structure upgrades and their impact on the presentation of the gasifiers. The outcome shows that structure of gasifiers is a significant boundary in asification, other than biomass feedstock attributes and procedure boundaries. The downdraft gasifier is appropriate for little scope biomass gasification because of its simple manufacture and activity. The nature of maker gas (warming worth and tar content) and the gasification productivity are yield boundaries in the downdraft gasifiers that are influenced by some significant boundaries. Other than biomass attributes and procedure boundaries, the structure of downdraft gasifiers is additionally a significant boundary in process of gasification.

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Mehta et. al. (2010) studies the ability and level of biomass gasification innovation utilized in thermal application in India and force age to meet the renewable energy prerequisites. The gasifiers delivered in India run from 10-550 kW capacities with regards to control age. The Ministry of New and Renewable Energy (MNRE) has advanced the biomass gasification program through sponsorships. At present the total introduced limit is 703 MW. The techno monetary possibility of gasification innovation for warm application has been good when contrasted and substitution of oil fuel. For the most part, the introduced frameworks are double fuel based and the fuel substitution changes from 50-60 % at field level. A lot of surplus yield buildup is either scorched because of inaccessibility of room or remains underutilized because of different reasons. This yield buildup can be used for power age of gasification at a high productivity.

III. PRINCIPLE OF GASIFIER

Gasifier is relatively simple device and the mechanics of their operation, such as gas cleanup and feeding, also are uncertain and the prosperous operation of gasifier, however, is not so modest. On no account rules exist because the thermodynamics of gasifier operation are not well understood. Up till now, nontrivial thermodynamic principles dictate the air supply, temperature and other operating variables of the reactors that we build and it is a tribute to the persistence of experimentalists that so much progress has been made in the face of so little understanding. However, it has been the experience in related fields (such as oil, coal combustion and gas) that once the mechanisms at work are understood and it is able to develop cleaner, more efficient processes. Providentially, much of the knowledge acquired in these fields can be applied to enhance our understanding of gasification processes [6]-[7].

3.1 CAD Model of Downdraft Gasifier

Figure 1, 2, 3, and 4 shows the CAD model of downdraft gasifier which is designed in Cero software. It consists of Hopper, Grate, Ash tray, reactor, Air blower. Hopper is made up of MS material with 16 gauge sheet. It is used to store the biomass fuel. The Biomass fuel is feed using the hopper [14]-[15]. The biomass fuel is held on grate and ash is collected in the ash tray. For air blower small 12V fan is used to provide the sufficient quantity of air for combustion.

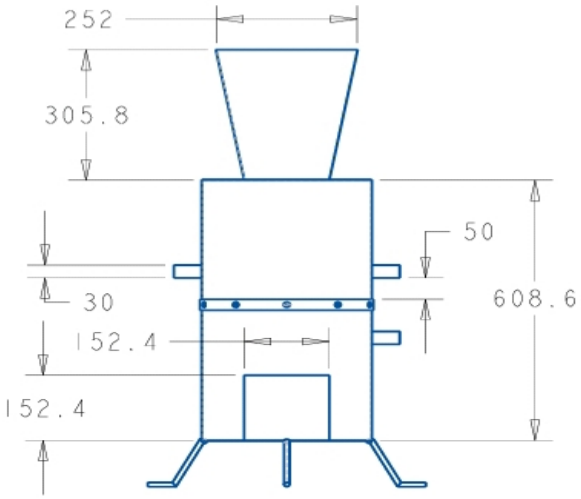

Figure 1: Front View of Gasifier

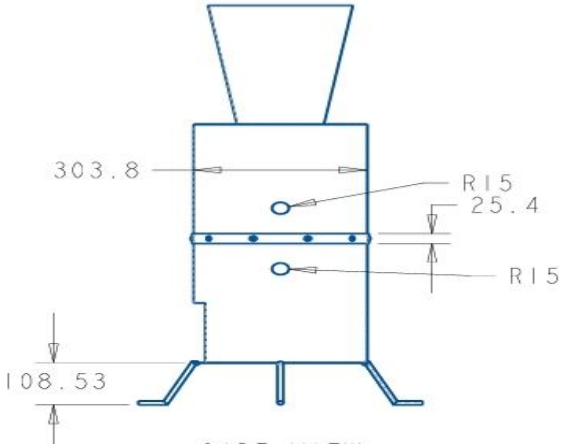

Figure 2: Side View of Gasifier

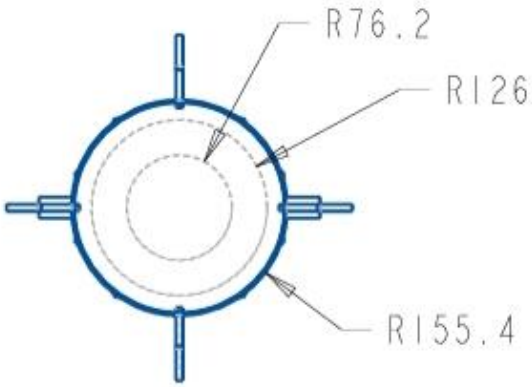

Figure 3: Top View of Gasifier

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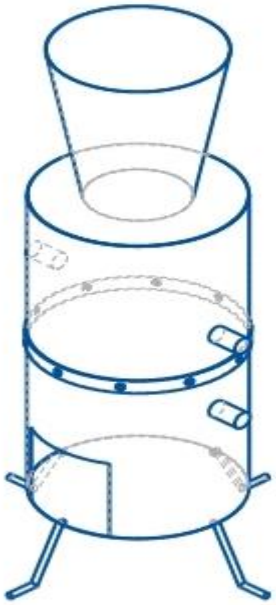

Figure 4: Isometric View of Gasifier

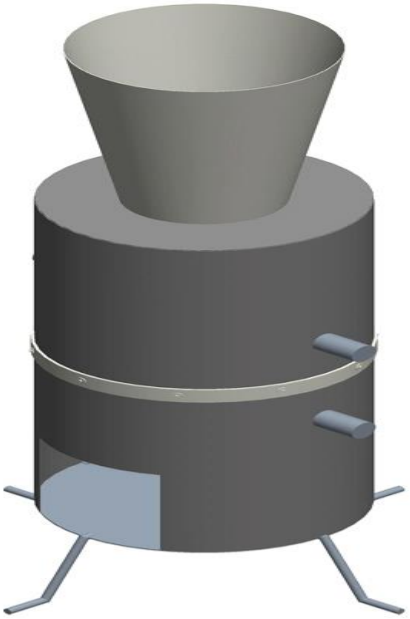

Figure 5: Assembly of Downdraft Gasifier

IV. Operation of Downdraft Gasifier

In light of the low tar content downdraft gasifier has been fruitful for working motors. In the downdraft gasifier air contacts the pyrolyzing biomass before it contacts the roast and supports a fire like the fire which is created the warmth from the consuming volatiles keeps up the pyrolysis and after this marvel happens with in a gasifier [8] and the restricted air gracefully in the gasifier is quickly used, so the fire gets more extravagant as pyrolysis continues and toward the finish of the pyrolysis zone and the gases comprise for the most part of about equivalent pieces of CO2, H2O, CO, and H2 and we call this fire in a constrained air flexibly "flaring pyrolysis‖ and the blazing pyrolysis delivers the majority of the flammable gases produced during downdraft gasification and at the same time devours 99% of the tars and it is the key instrument for gas age in downdraft gasifier [9].

Components of Downdraft Gasifier

- Hopper
- Reduction Chamber
- Ash tray
- Reactor
- Saw Dust Filters
- Grete
- Cotton Filter

Composition of Producer Gas

- Carbon monoxide (CO)
- Carbon dioxide (CO2)
- Hydrogen (H2)
- Methane (CH4)

V. Technical Difficulties

Improvement of more affordable quality tests, emanation testing with a wide scope of biomass feed stocks. Studies on creating explicit markets, for example, mining, civil water supplies, and so on which can indicate biodiesel as the fuel decision for naturally touchy regions. Co-item use like debris created in a useful way[10]-[11]. Endeavors are centered around reacting to fuel framework execution, material similarity and low fuel dependability under long haul stockpiling. Proceeded with motor execution, discharges and sturdiness testing in an assortment of motor sorts and sizes should be created to build buyer and producer certainty [12] . Natural advantages offered by biomass over diesel fuel should be promoted. Studies are expected to lessen cost and distinguish possible markets so as to adjust cost and accessibility [13].

Materials Used In Downdraft Gasifier

- Wooden Block (55 mm* 55 mm, Rectangle Shape).
- Soyabean Husk
- Coconut chips
- Cow dung

Advantages of Downdraft over Updraft

- Gas with less tar
- More suitable with some thermal applications
- Fuel specific

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- Minimum bulk density of 256 kg/m^3
- Ash content of less than 5%.
- Gas comes out of the gasifier at 194-275 Celsius

VI. CONCLUSION

Solid biomass can possibly meet the vitality prerequisite of India. Downdraft fixed bed gasifier is the most viable alternative for warmth and force applications. The development of downdraft gasifier is likewise straightforward. Downdraft requires shorter opportunity to touch off. The downdraft gasifier is more secure according to natural perspective. Applications like creation of methanol, utilizing of maker gas in energy unit and water system framework for little scope offers the incredible potential. It is one of the most appealing options frameworks of vitality. In the wake of assessing numerous papers, a proposed pilot plan has been intended to get the necessary downdraft gasifier.

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