FABRICATION OF SOLAR POWERED AND MANUAL BIOMASS BURNER STOVE

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Abstract - Since the dawn of recorded human history, cooking has been done over open flames and with simple stoves. These stoves, which come in a variety of sizes and designs, depend on biomass for fuel. Biomass fuels are still used for cooking by around 2 billion people.
As an upgraded biomass stove is created, tested, and evaluated for performance. The stove's mobility and insulated combustion chamber make it special. In addition, a conical flame collector with vents was added to make it easier for primary and secondary air to circulate. The efficiency of heat transfer, the proportion of heat used, fuel consumption, and burning rate all affect how well a stove performs. The efficiency of wood in stoves was tested using the University of California Berkeley (UCB)/Shell Foundation approach, which is based on ISO (International organisation for standardisation) norms. Compared to the conventional three-stone stove, the upgraded biomass stove had a maximum thermal efficiency of 55%, however the percentage of heat utilised (PHU) was only 44%. When cooking, the addition of a supplementary air inlet via the combustion chamber improved heat retention and boosted fire output.

Keywords: improved biomass stove, heat transfer efficiency, combustion chamber

I. Introduction

Nearly 90% of the total energy utilised worldwide is converted through combustion processes, which have historically dominated global energy consumption. The main areas of heat and power supply services, such as food preparation, space heating, ventilation, air conditioning, electricity production, and transportation, have been the focus areas where the greatest amount of energy has been consumed. Due to the introduction of various additional fuels such as coal, peat, natural gas, crude, and refined oils as combustion fuels, the use of biomass resources for combustion was reduced to 11%. Billionaires all over the world utilise modest biomass cook stoves with ratings of 5 kW or less for a variety of uses. Because biomass fuel is a plant derivative that develops through the photosynthesis reaction and maintains the amount of carbon dioxide, unlike the combustion of fossil fuels, biomass fuel releases zero net carbon dioxide. Since the dawn of time, people have cooked using open fires and crude stoves. These stoves, which come in a variety of sizes and designs, need biomass as fuel. A third of the world's population, or close to 2 billion people, still use traditional heating and cooking methods and biomass fuels. Aside from the unavailability of newer technologies, the current approach cannot continue.

Additionally, the apparently endless Nigerian fuel crisis has highlighted the necessity for energy specialists to focus on developing workable substitutes for kerosene and cooking gas for residential cooking. Developing nations continue to strive to secure adequate energy to meet basic human requirements, while many industrialised countries tend to concentrate on domestic energy security or

decarbonizing their energy mix. Access to affordable and dependable energy services is essential in emerging nations for eradicating poverty, boosting productivity, increasing competitiveness, and fostering economic progress. Despite this, billions of people lack dependable access to current energy services, such as clean cooking facilities or power. This project aims to make three-stone open-fire stoves more energy-efficient by increasing their thermal efficiency.

Children and women spend a significant portion of the day gathering biomass, including fuelwood. This frequently has a negative impact on constructive endeavours and education. Many women in rural sub-Saharan Africa carry roughly 20 kg of fuelwood daily over an average distance of 5 km. Beyond the significant time lost in gathering them, using conventional fuels in conventional stoves or open fireplaces is not only ineffective but also unhealthy. Due to inadequate circulation and incomplete combustion, there are significant emissions that lead to high levels of indoor pollution. In addition to respiratory conditions, cancer, tuberculosis, poor birth weight, and eye diseases, exposure to this polluted air causes other conditions as well. According to the WHO, indoor biomass stove smoke causes 4 million premature deaths per year among women and small children in poor nations.

- Someone suffering from a lung or heart condition, such as emphysema, asthma, angina, heart failure, or ischemic heart disease.
- An older adult, which increases your risk of lung or heart disease compared to younger people.
- Taking care of young people, notably teenagers, whose respiratory systems are still growing and who, compared to adults, breathe more air (and air pollution) per pound of body weight, are more likely to engage in outdoor activity, and are more likely to have asthma.
- Someone who has diabetes, as underlying cardiovascular disease is more common in this group.
- A pregnant woman, as there may be negative consequences on your health and the health of the unborn child.

II. Method and Material

2.1 Working

Basically put, the design features two fans—one for air intake and the other for exhaust. In contrast to the exhaust fan, which rotates counterclockwise and draws out any internal smoke, the inlet fan rotates clockwise, supplying air to support combustion. This technique provides air while removing smoke, resulting in extremely effective burning. Both fans are driven by treadle mechanics produced by the user's foot movement.

2.2 Material

Material (Mild Steel): A ferrous metal consisting of iron and carbon is known as mild steel. It is a cheap material with qualities that make it appropriate for the majority of general engineering applications. Low carbon mild steel is referred to as "ferromagnetic" because of the high iron content that gives it good magnetic characteristics. In addition to being sturdy and lightweight, it also offers great heat transfer capabilities. Because mild steel plates are so effective at producing a non-stick surface, you can cook almost anything without fear of it coming out tasteless. By "pickling," mild steel can be cleaned. This chemical surface treatment eliminates pollutants, rust, scale, and stains. Mechanically grinding away surface rust and then applying a surface protection, like zinc primer and metal paints and sprays.

BLOWER FAN (12V,1amps): An exhaust fan is a type of ventilator that is used to ventilate out moisture, undesirable aromas, smoke, particles, and other air impurities in order to regulate the environment inside a building. A heating and cooling system may also include exhaust fans. Exhaust fans are frequently seen in bathrooms and kitchens, but they can also be found in a wide variety of other places because they are extremely simple to install. Users will need a few tools for installation, and they must be comfortable working with electricity in order to wire the fan in place. Exhaust fans aid in the fast removal of smoke and improve the indoor air quality. They contribute to increased comfort because exhaust fans maintain air circulation and eliminate extra moisture, which improves indoor comfort in general. When a space becomes too warm from activities like cooking, exhaust fans can quickly cool it down.

SOLAR PANEL (12V,5watt): It is highly practical to generate electricity for many uses by using solar panels. Off-grid living would have to be the logical choice. Off-grid living entails residing somewhere that is not connected to the main electric utility grid. Solar power systems are a great asset for cabins and homes in remote areas. Electric utility pole and cable installation from the closest main grid access point no longer requires exorbitant costs. If properly maintained, a solar electric system can potentially be less expensive and provide power for up to three decades. By reducing greenhouse gas emissions, solar panel installation in homes contributes to a decrease in global warming. Solar panels are clean and do not cause any kind of pollution.

III. CALCULATIONS – CHARGING & DISCHARGING

GIVEN: Battery 12v, 4.5Ah

3.1 CHARGING TIME OF SOLAR ENERGY

Formula Used

Charging time of battery = battery / charging current

Required charging current for battery = battery Ah * 10%

Where, Ah = amphere hour rating of battery

To calculate battery charging current:

For 4.5Ah, as we know that that charging current should be 10% of Ah rating of battery

Therefore, charging current of 4.5Ah battery = 4.5Ah*(10%100) = 0.45A

But due to losses, we take 0.45 – 0.47Ah for battery charging purpose instead of 0.45Ah

Suppose we took 4.6Ah for charging, charging time for 4.5Ah = 4.6/0.46 = 9.78hrs

(But this is an ideal case)

Practically it has been noted that 40% of losses occur in case of battery charging

Then,

4.5*(40/100) = 1.8Ah

Therefore

4.5+1.8 = 6.3Ah

Now charging time of battery = Ah / charging current

6.3 / 0.46 = 13.69 or 14 hours (in real case)

Therefore 4.5Ah battery would take 14 hours to fully charge in case of required 0.46A charging current

3.2 DISCHARGING TIME OF SOLAR ENERGY

Daily Consumption, 2hours per day

Load P=V*A

V = 12, A = 2

P = 24W

RUN TIME

Battery 4.5A, 12 V

Therefore, P = 54W

RUN TIME =54/24 LOAD = 2.25 hours

IV. CONCLUSION

In this work, the improved biomass stove's framework was developed using solid edge. After the design was finished, the stove's construction was successfully completed with mild steel. The exhaust gases are expelled and the combustion is increased by the fans. One fan is coupled to the pedalling motion and revolves counter clockwise to improve combustion, while the second fan rotates counter clockwise under the power of a solar panel to help clear exhaust fumes.

V. REFERENCES

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