International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 4 Issue: 2 38 - 40

# Thermal Analysis of Gas Burner

Manish Walecha
[1]Department of Mechanical Engineering,
,P.R.Pote (Patil Department) Engineering
College,Amravati India SGBAU,Amravati
*Manish_walecha@reddifmail.com*

Viki A. Revaskar
[2]P.G. Student, of Mechanical Engineering
P.R.Pote (Patil Department) Engineering
College,Amravati,India SGBAU, Amravati
*viki.revaskar@gmail.com*

***Abstract:*** **-** L.P.G is the most convenient and clean fuel for domestic use and is very popular in these days. The LPG stove industry is about 36 years old and is mainly concentrated in the small-scale sector. LPG is an exceptional energy source due to its origin, relative advantages and applications. No wonder LPG is known as The Ideal Fuel for Modern Living. it is a necessary to explore the ways to further improve the thermal efficiency and the emission characteristics of the existing LPG cooking stoves.

There is tremendous demand for fossil fuels at the same these fuels are depleting at a rapid rate. So, efforts should be made to conserve it. The objective of this experimental investigation was on the performance of LPG cooking stove see the effects using different design burner heads. The combustion efficiency of the stove recorded by the flue gas analyzer was 86.9%. Next prime important task was the Perfect material selection for different components.

***Keywords:-****L.P.G fuel, Aluminum vessel, LPG cooking stoves.*

*****

**PRIME DESIGN PARAMETERS WERE-**

- Gas inlet pipe should be smooth
- Diameter of the jet (do)
- Length of the mixing pipe (L)
- Number and diameter of flame port holes (dH)
- Height of the burner head. (H)

**Design considerations-**

- Specific gravity of gas
- Calorific value
- Volume of biogas produced
- Composition of the gas produced
- Gas pressure
- Flame speed (velocity)

## SCOPE OF THE PROJECT

This research work shall focus on Thermal analysis and performance evaluation of burners for determination of features affecting thermal efficiency experimentally. The burner is modeled using tool Creo, and thermal analysis of gas burner with ansys.Validation of thermal results with experimental results.

## LITERATURE REVIEW

Worked on improvement of thermal efficiency of LPG stove indirectly to save fuel. They combine effects of porous media and insulation of combustion chamber of stove to reduce heat losses by radiation. The conventional burner used for the test had 68 % designed thermal efficiency, but actual efficiency was found to be 49 %. Two different methods were implemented by authors to improve performance of a burner. One of them was use of porous media and another was the use of insulation to combustion chamber to reduce radiation losses. Porous media is readily used in commercial burners, it improves rate of heat transfer and improves thermal efficiency. In order to create a porous medium, authors fill the mixing chamber with ball bearings. In another case they insulate the bottom base and side of mixing chamber. In both cases they perform the water boiling test as per BIS guidelines separately and in another test they perform same test for combined effect of insulation and porous media. In each case rise in thermal efficiency has been found out. Porous media gives rise in efficiency by 10 %, while insulation alone gives 6 %. In third case of combination, thermal efficiency was found to rise by 18 %. They innovates a very simple, effective, safe and economical method to improve efficiency of a burner. In all the three cases, heat energy wasted by heat radiations was reused.

## OBJECTIVES OF THE PROJECT

Form the above literature review it is found that for domestic range of LPG stove cooking burners, thermal efficiency is the prime parameter for deciding its performance. Many researchers have worked for thermal efficiency and emission characteristics of a burner, using PMC (Porous Medium Combustion) for various gaseous

fuels. A considerable work has been done for Methane and Natural gas combustion burners. In case of domestic LPG stoves, efficiency is evaluated and efforts are done to improve it by addition of PMC. Comparatively less work is done in the area of design of a LPG stove burner.

## EXPERIMENTAL SET UP AND TEST PROCEDURE

The fuel and air flow rates are monitored using the carioles flow meters with suitable valves. Air–fuel mixture moves to the burner through a mixing tube made of Teflon. Adjustable stand has been attached with a radiation shield. The PRB used for the present work is based on two-layered PMC. The two layered PRB consists of a combustion zone and a preheating zone. Combustion zone is formed with high porosity (90%), highly radiating Sic porous matrix, and the preheating zone consists of low porosity (40%) ceramic matrix of 120 mm diameter. Inside the burner casing, a wire mesh is provided to support the ceramic block. The burner casing was fabricated at IIT Guwahati using alumina powder and sodium silicate binder. The schematic of the burner casing is shown in Fig. 1. Thermal efficiencies of the LPG cooking stoves were estimated by conducting the water boiling test as per the guidelines described in Bureau of Indian Standard (BIS):4246:2002. Procedure is briefly described in the following section.

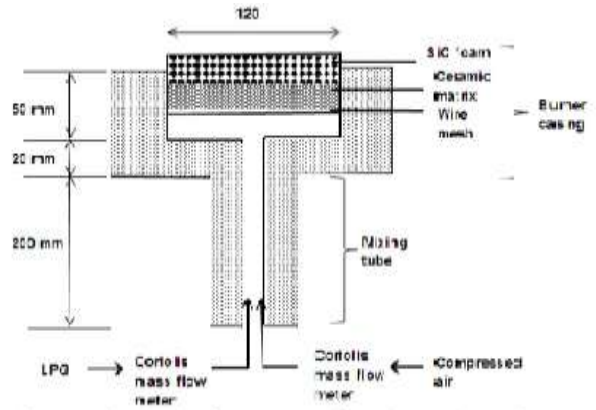


Fig. 1. Schematic of porous radiant burner(PRB).

A 19.5 kg LPG commercial cylinder was connected to a regulator and then with a carioles flow meters (accuracy± 0.01 g). The fuel flow rate was monitored using the carioles flow meters with suitable control valves. Aluminum vessel along with lid and stirrer for the experiment was selected and filled with known amount of water (5-10kg) at room temperature. Weight of the vessel and water were noted with the help of a weighing balance (accuracy ± 0.5 g). Initial temperature (*T*1) of the water was measured using glass in mercury thermometer (accuracy ± 0.5°C). Once the flame stabilized in the burner, vessel was kept above the burner. Water was heated up to 80°C, and for uniformity in temperature, stirring was started and continued until the end of the test the burner was switched off when the temperature of water reached (*T*2) 90± 0.5°C.. The time taken to raise the temperature of the water from initial temperature to 90°C was also noted. Following formula The percentage of thermal efficiency ηth of the stove.

$$n_{th} = \frac{(mw * cw + mp * cp)(T1 - T2)}{mf * cv}$$

To compare the thermal efficiencies of conventional burners with PRB, a market survey was carried out to get the various types of burners used in conventional commercial LPG cooking stoves. Three types of burners are used (Fig. 3).The efficiencies and emissions of PRB and conventional burners were calculated using the same procedure. The CO and Nox emissions were measured using TESTO 350 XL portable flue gas analyzer.

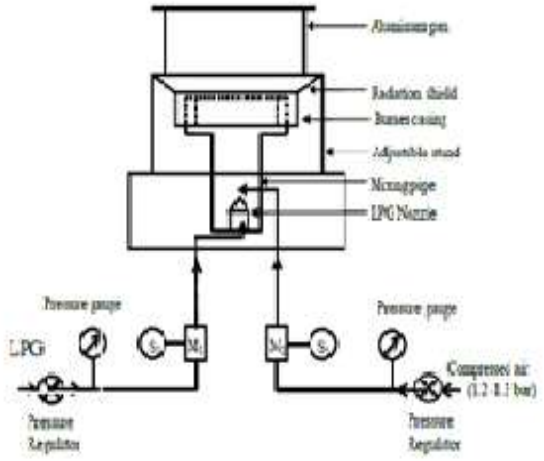


fig. 2 schematic of the experimental set-up

The experiments were repeated three times and average of the three values was taken as final reading. The burner head was removed and replaced by different design. Different burner head designs used in this work are shown in Figure 3. Also, burners of different materials were employed to study the effect of burner material on LPG stove performance. The purpose of this was is to find out most efficient burner design. Usually, burner head of regular design made up of cast iron is used in LPG cooking stove shown in Figure 3(a) is used in LPG stove. Burner head shown in Figure 3(b) is of regular design but made up of cast iron. Figure 3(c) and 3(d) shows flat face and flower face burner respectively. Both of these burners are made up of brass. The test procedure as described above was followed for all burner designs.

Figure: 8 Different Burner Head Designs

## RESULT AND DISCUSSION

Burner of domestic LPG stove is designed based on blend of geometrical parameters and flame stability criterion. Geometrical parameters normally associated with design of a burner while flame stability criterion is to be considered for a complete combustion and better utilization of fuel. Total burner port area is a key parameter to decide the combustion quality. Hence for a range of power output burner port area is calculated. And then by varying the number of ports, varying port area is obtained.

Variation in thermal efficiency directly relates the influence of port area on its performance.

The experiments were conducted at constant power output and about constant ambient temperature, to study its effect on burner performance. It shows significant impact on burner efficiency.Thermal efficiency found to directly relate with ambient temperature. This is due to temperature gradient between the atmospheric temperature and the burner surface. As temperature increases, the temperature gradient between burner surface and atmosphere decreases, reducing convective heat loss and resulting in higher thermal efficiency.

## CONCLUSION

With a plenty of advantages, LPG is has proven to the most popular fuel. Along with auto fuel and several industrial applications it is used primarily for domestic cooking worldwide. Due to its availability at subsidized price, it conquers the major market of cooking fuel in India. Rising population and depleting sources of fuels, justifies the importance of conservation of this ideal fuel. This may be possible if the fuel is at least used to its maximum efficiency. The stoves manufactured in India are generally labeled with maximum thermal efficiency in a range 65- 68 %. But the running efficiency is less.

## REFERENCES

[1] Center for Energy Studies Institute of Engineering Tribhuvan University Pulchowk, Lalitpur July 2001, “Efficiency Measurement of Biogas, Kerosene and LPG Stoves”

[2] Walter M. Berry, I. V. Brumbaugh, G. F. Moulton, and G. B. Shawn “Design Of Atmospheric Burners” Technologic Papers Of The Bureau Standards.

[3] Obada David Olubiyi, “Design, Construction And Performance Evaluation Of A Biogas Burner”, An Msc Thesis Submitted To The Postgraduate School, Ahmadu Bello University Zariain Partial Fulfilment Of The Requirements.

[4] Apinunt Namkhat and Summering Jugjai, “ The Effect of Primary Air Preheat on the Primary Aeration of a Self- aspirating Burner” The First TSME International Conference.

[5] V.K. Pantangi, Subhash C. Mishra, P. Muthukumar, Rajesh Reddy, “Studies on porous radiant burners for LPG (liquefied petroleum gas) cooking applications”

[6] N. K. Mishra, P. Muthukumar, Subhash C. Mishra, “Performance Tests on Medium-Scale Porous Radiant Burners for LPG Cooking Applications” International Journal of Emerging Technology.

[7] Mohd. Yunus Khan and Anupriya Saxena, “Performance Of LPG Cooking Stove Using Different Design Of Burner Heads” International Journal of Engineering Research & Technology.

[8] Mohd. Yunus Khan and Anupriya Saxena, “Performance of Insulated LPG Burner with Ball Bearings as Porous Medium”.

[9] Pankaj P. Gohil and Salim A. Channiwala, “Experimental Investigation of Performance of Conventional LPG Cooking stove”, Fundamental J. Thermal Science and Engg.