
ANALYSIS OF HEATING FURNACE USED FOR BENDING OPERATION BY USING LIGHT DIESEL OIL(LDO) AS A FUEL

Mandar.P.Sathe¹, Prof.V.H.Bankar²

ABSTRACT :

Previously in Gammon India Ltd., LPG fuel was used for bending process. For the commercial purpose and Industrial use gaseous fuels such as LPG and LNG have been widely used. In this project, the main purpose is to suggest the alternative fuel for the same operation i.e. bending process. Now, Light Diesel Oil (LDO) as an alternative fuel is been suggested for bending operation of plates in heating furnace. LDO is also beneficial to use due to low cost as compared to LPG.LDO also causes less pollution. The Industry in which this heating furnace is used is an tower manufacturing industry. The towers manufactured here are used widely for electric power transmission and also for mobile phone networking.

INTRODUCTION :

In India, the problem which sometimes occurs very much is the shortage of LPG.Due to rise and fall in the cost of LPG in the International market, the effect of change in cost of production of the product occurs. Thus, as per the low cost and easy availability of fuel, LDO is suggested as an alternative fuel for heating furnace instead of LPG.Analysis of many fuels is done and from them on the basis of some factors like easy availability, low cost, calorific value, flash point etc. LDO is finally selected.Also,Duel fuel supply burner(6422-4 burner) is also implemented in the final system of the heating furnace. Due to this production process and the production cost will not get affected.

CONCEPT DESIGN

FINAL SYSTEM



Final System running on LDO

Final System running on LDO consists of:-

[1] Blower With Motor:-



This is used to give supply of air in the in the fuel for burning so that air fuel mixture is given to the work piece for heating.

[2] Gas Incoming pipe with Valve:-



This is the pipe which supply the LPG fuel through it. Valve is attached to this pipe to stop or supply the gas.

[2] Filter (Red Color):- To purify the gas coming .Its main purpose is to remove impurities from the gas and supply the pure gas.

[3] pressure regulator (blue color):- This is used to maintain the particular pressure applied.

[4] pressure gauge: to know the amount of pressure of gas being supplied.



PRESSURE GAUGE

[5] SOLENOID VALVE:-



Solenoid valve is used to start/stop the supply of fuel according to the Rated supply given to the valve.

[6] Dual Fuel BURNER:-



This is 6422-4 Dual Fuel supply burner. To give the supply of the flame of burning fuel to the workpiece.

[7] HEATING FURNACE:-



This is the main location or spot where the heating of the plates or work piece takes place.

CALCULATIONS:-

The Furnace has dimensions of 1500 mm*200 mm .Width of the furnace is 20 mm.The plates heated for bending are of Mild Steel (M.S) material. Rest of the data are as given below. Find out the Efficiency of the furnace.

Exit flue gas temperature = 410 °C

Ambient Temperature = 40°C

Calorific Value of LDO = 10,700 K-Cal/Kg.

Weight of the Stock = 50 Kg. (For 1 plate).

Area of heating = 1500 * 200 = 300000 Sq.mm

Average Fuel Consumption = 8500Lit/Month

FOR OIL-FIRED FURNACE(USING LDO):-

1.) Heat Supplied by fuel(Qs):-

$$Q_s = mf * C.V.$$

where:- mf= Fuel consumption/hr=8500 lit/month(26 days)=8500 / 624=13.6217 lit/hr

$$= 13.6217 * 0.86 = 11.7147 \text{ kg/hr (1 lit. of LDO=0.86 Kg of LDO)}$$

$$= 11.7147 / 60 * 60$$

$$mf = 3.2540 * 10 \text{ kg/sec}$$

$$C.V = \text{Calorific Value} = 10,700 \text{ k-cal/kg} = 10,700 * 4.1868 \text{ (1k-cal/kg=4.1868kj/kg)}$$

$$C.V = 44798.76 \text{ kj/kg}$$

$$Q_s = 3.2540 * 10 * 44798.76$$

$$Q_s = 145.7794 \text{ K-W}$$

2.) Heat absorbed by plates(Qplates):-

$$Q_{\text{plates}} = m_{\text{plate}} * C_P \text{ plate} * (T_{P2} - T_{P1})$$

$$= 200 * 0.416 * (800 - 40)$$

$$= 63232 \text{ KJ / 15 min (1 Batch)}$$

$$= 63232 / 15$$

$$= 4215.466 \text{ KJ/min}$$

$$= 4215.466 / 60$$

$$Q_{\text{plates}} = 70.257 \text{ K-W}$$

$$\% \text{ of Heat utilised for Plate Heating} = Q_{\text{plate}} / Q_s * 100 = 70.257 / 145.7794 * 100$$

$$= 48.20 \%$$

3.) Sensible Heat loss in Flue Gas (QSensible) :-

$$Q_{\text{Sensible}} = m_g * C_{PG} * (T_g - T_a)$$

Where:- m_g = Mass of combustion gas formed = $m_a + m_f$

1 kg of LDO= 14.2 kg of air required for combustion.

So, to burn 3.2540*10 Kg/ sec of LDO= m_a

$$m_a = 14.2 * 3.2540 * 10$$

$$m_a = 0.04620 \text{ Kg/sec}$$

$$m_f = 3.2540 * 10 \text{ Kg/sec}$$

$$m_g = 0.04620 + 3.2540 * 10$$

$$m_g = 0.049 \text{ Kg/sec.}$$

Combustion Gas Temperature (T_g) = 410 °C.

Atmospheric Temperature (T_a) = 40 °C.

Specific Heat of LDO Combustion = 1.005 KJ/Kg-K. (CPg.)

So, $Q_{\text{Sensible}} = m_g * C_{\text{PG}} * (T_g - T_a)$

$$= 0.049 * 1.005 * (410 - 40)$$

$$Q_{\text{Sensible}} = 18.22 \text{ K-W}$$

$$\begin{aligned} \% \text{ Heat lost in Combustion} &= Q_{\text{Sensible}} / Q_s * 100 = 18.22 * 100 / 145.7 \\ &= 12.49 \% \end{aligned}$$

4.) Heat loss Due To Moisture (Q_m) :-

$$Q_m = m_m * C_{\text{Pm}} * (T_g - T_a)$$

$$m_m = \text{Mass of moisture} = 9 * H_2 \% * m_f$$

$$= 9 * 15/100 * 3.2540 * 10 \quad (\text{LDO contains 15\% of } H_2)$$

$$m_m = 4.3929 * 10 \text{ Kg/sec.}$$

C_{pm} = Specific heat of moisture = 4.18 KJ/Kg-K.

$$Q_m = 4.3929 * 10 * 4.18 * (410 - 40)$$

$$Q_m = 6.7940 \text{ K-W}$$

$$\begin{aligned} \% \text{ Heat lost in moisture (} Q_m) &= Q_m / Q_s * 100 = 6.7940 * 100 / 145.7794 \\ &= 4.66 \% \end{aligned}$$

5.) Unaccounted Heat:-

$$\text{Unaccounted Heat} = Q_s - (Q_{\text{Plate}} + Q_{\text{sensible}} + Q_m)$$

$$= 145.7794 - (70.257 + 18.22 + 6.7940)$$

$$= 50.5084 \text{ K-W}$$

% of Unaccounted Heat = Unaccounted heat * 100 / Q_s

$$= 50.5084 * 100 / 145.7794$$

$$= 34.6471\%$$

6.) Efficiency of Oil Fired Furnace (η_f) :-

a.) Sensible heat loss in flue gas = 12.49 %

b.) Loss of heat due to moisture = 4.66 %

c.) Unaccounted Heat = 34.6471 %

$$\begin{aligned} \text{Total Heat Loss} &= 12.49+4.66+34.6471 \\ &= 51.79\% \end{aligned}$$

$$\begin{aligned} \text{Efficiency of Oil Fired Furnace (nf)} &= 100-51.79 \\ \text{nf} &= 48.20\% \end{aligned}$$

CONCLUSION:

- 1) The Alternative fuel i.e. LDO is more beneficial and profitable to use due to low cost and easy availability of the heating furnace.
- 2) Efficiency of Heating Furnace by using LDO is 48.20 %
- 3) By using LDO, the Efficiency of Heating Furnace is upto the mark.

Bibliography :

- [1]. Ganeshan V., '*Internal combustion engine*' third edition Published by the Tata McGraw-Hill Education Private Company Limited, 7 West Patel Nagar, and New Delhi 110008.
- [2]. R.K.Rajput., ''A Textbook On Thermal Engineering.''
- [3]. V.H.Bankar, Mandar.P.Sathe. '*Analysis of the Burning fuels to suggest Alternative fuel of Heating Furnace for Bending operation.*' International Organization of Research And Development (IORD) Vol.2, Issue 2, (Jan-Feb 2015), E-ISSN:2348-0831, PP 90-95.
- [4]. Meghare D., Kannake D. R., Sontakke S. S. '*Experimental investigations on LPG as alternative Fuel for two wheeler*' International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 1, July 2012 ISSN: 2277-3754.
- [5]. Mr.Niraj N. Raja, Dr.M.BASAVARAJ. '*An experimental investigation on performance characteristics of diesel engine using in palm oil bio-diesel as an alternate fuel,*' (IGRAME).ISSN(ONLINE) : 2321-3051 Vol.2 Issue 3, March 2014, Pgs:237-242.
- [6]. Prabin K. Sharma, Harihar Kuinkel, Praveen Shrestha, Suman Poudel. '*Use of Acetylene as an alternative fuel in I.C. Engine*' Rentech symposium compendium [Vol.1. March 2012]
- [7]. R.K.JAIN., ''Experimentally Investigated Effect Of Flame Temperature on Performance of Rotary Furnace.''
IPASJ International Journal of Mechanical Engineering.(IIJME) VOL.2, Issue 3, MARCH 2014.
- [8.] www.energyefficiencyasia.org