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Comparison of Calorific Values of Various Fuels from Different Petrol Stations

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Abstract:- The current research work is performed to determine the calorific value of different fuel (petrol samples) available in the state of Telengana (Inda). Different samples were collected from various fuel stations sold by different companies, to show different calorific values which is considered to be one of the key parameters to determine the quality of the fuel.

Keywords: - Combustion, Equivalent mass, Calorific value, petrol

I. INTRODUCTION

Combustion in essence is chemical combination of a combustible fuel with oxygen and this in turn results in the production of heat energy. Combustion is achieved by combining the two key elements of combustion a fuel and oxygen, at an elevated temperature or an ignition temperature [1].The main aim of the project is to calculate the calorific value of different fuel (petrol) available at different pumps owned by different companies, by calculating the calorific value we can understand the adulteration by comparing the different values and will also get an idea about the best fuel available in the market.

The calorific value of any fuel in solid or liquid state can be calculated with the help of Bomb Calorimeter, by using a simple formula;

"$(m_1+m_2)*(T_C+T_1-T_2)*C_W/mf$" [2] (1)

Where;

m_1 and m_2 => mass of water and equivalent mass of bomb, T_1,T_2 are initial and final temperature. m mass of fuel sample, T_C radiation losses.

1.1 Calorimeter

A calorimeter is an instrument used for the process of measuring the heat generated during chemical reactions or during combustion of fuel. Different types of calorimeter are there in use some of them are scanning calorimeter, isothermal micro-calorimeter, titration calorimeter, and accelerated rate calorimeters. A calorimeter is just a simple equipment consists of a thermometer attached to container full of water (distilled water) suspended above a combustion chamber. The calorimeter was first used in 1780 by Antoine Lavoisier; he used a pig (guinea pig) to do the experiment of measuring heat produced in his experiment the heat from guinea pig's melted down snow surrounding the calorimeter which showing respiratory gas exchange is combustion, the process was similar to that of burning a candle.

1.2 Bomb Calorimeter

The bomb calorimeter is simple equipment which helps in finding out the calorific value of fuel, the combustion inside the calorimeter take place at high pressure (30 atm), so the calorimeter is made up of heavy metals. The pressure inside the bomb is due to the presence of the pumped in oxygen, this pumped in oxygen will help in the process of combustion. The energy used for the combustion process in the bomb calorimeter is electrical energy; for each experiment a 2g of sample is used the sample is filled inside the crucible. The electrical circuit is then completed with the help of a nichrome wire.

Figure 1: Bomb calorimeter

Figure 2: Oxygen bomb crucible

The energy produced during the combustion process is noted down and then put in to the formula and calculated. The introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper.

It is suggested that every bomb-calorimetric determination be first corrected (where such correction is significant) so as to give the value of A£/r, the change of "intrinsic" energy for the pure isothermal reaction under the pressure condition of 1 normal atmosphere for both reactants and products [3]

1.3 Nichrome Wire

Nichrome is an alloy of nickel, chromium and sometime iron and other element or substances. Nichrome wire is mainly used as a resistance wire, also used in some dental restoration/ fillings and other applications. The nichrome has a high melting point of 1,400°C (2,550 °F) which is why it is used in the calorimeter, due to its resistance to oxidation and stability at high temperatures, it is widely used in electric heating elements, such as in appliances and tools. Nichrome is an alloy of 80% nickel and 20% chromium; by mass the properties of nichrome vary depending on its alloy.

Material property	**Value**	**Unit**
Modulus of elasticity	2.2×10^{11}	Pa
Density	8400	$kg \cdot m^{-3}$
Melting point	1400	°C
Electrical resistivity at room temperature	$(1.0—1.5) \times 10^{-6}$	$\Omega \cdot m$
Specific heat	450	$J \cdot kg^{-1} \cdot K^{-1}$
Thermal conductivity	11.3	$W \cdot m^{-1} \cdot K^{-1}$
Thermal expansion	14×10^{-6}	K^{-1}

Table 1: Properties of Nichrome wire

II. PROCEDURE

Fill the crucible with fuel weigh the crucible and find out the weight of fuel. Insert in to the bomb. Connect the fuse with nichrome wire and fill the bomb with oxygen and place it inside the jacket. Seal the bomb carefully so that no water enters inside the bomb. Fill the bomb with oxygen. Fill the jacket with 2000ml of water, and assemble the calorimeter and run the motor for five minutes. Switch on the power. Ignite the bomb at the sixth minute. Measure the temperature every minute using a thermometer until a constant temperature reached. Note down the values. Repeat the steps for all four samples. Calculate the calorific value of samples using the formula

$$(m_1+m_2)*(T_C+T_1-T_2)*C_W/mf$$

Plot a graph using the results obtained.

III. OBSERVATION

Samples	m_1	m_2	T_2	T_1	T_C	C_W	m_f
Sample 1	2000 g	755 g	31.6 $^{\circ}$C	26 $^{\circ}$C	0.5 $^{\circ}$C	1	2 g
Sample 2	2000 g	755 g	31.5 $^{\circ}$C	26 $^{\circ}$C	0.5 $^{\circ}$C	1	2 g
Sample 3	2000 g	755 g	32.7 $^{\circ}$C	26 $^{\circ}$C	0.5 $^{\circ}$C	1	2 g
Sample 4	2000 g	755 g	32.8 $^{\circ}$C	26 $^{\circ}$C	0.5 $^{\circ}$C	1	2 g

IV. RESULT & DISCUSSIONS

Sample 1:

$$\frac{(2000+755)*(0.5+31.6-26)*1}{2} = 8402.75 \text{ cal/g}$$

Sample 2:

$$\frac{(2000+755)*(0.5+31.5-26)*1}{2} = 8265 \text{ cal/g}$$

Sample 3:

$$\frac{(2000+755)*(0.5+32.7-26)*1}{2} = 9918 \text{ cal/g}$$

Sample 4:

$$\frac{(2000+755)*(0.5+32.8-26)*1}{2} = 10055.75 \text{ cal/g}$$

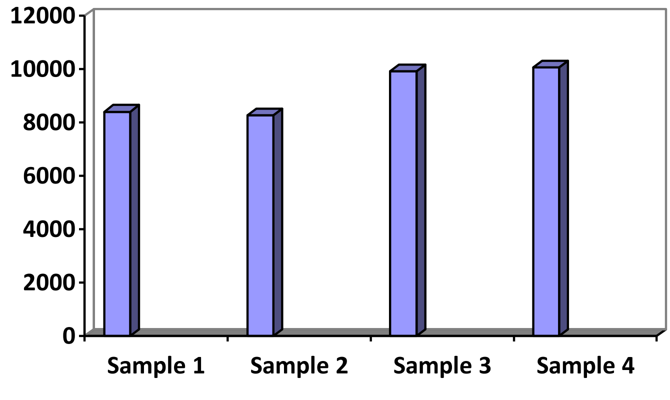

Figure 3: Profile of Calorific values of different samples

It is observed from the result that, among samples 1-4, sample 3 and sample 4 gives calorific value of 9918 and 10005 cal/g. It is duet to increase in temperature of samples. As the temperature of the sample increases the calorific value gets increased. In turn calorific value follows the following order Sample 4 > Sample 3 > Sample 1 >Sample 2 whereas adulteration in the Sample 4 petrol is less.

V. CONCLUSION

The calorific value of various petrol samples were determined using bomb calorimeter, where samples 4 and 3 was found to be optimum.

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