

The background of the page is decorated with a series of thin, wavy, orange lines that create a sense of movement and depth, resembling a stylized landscape or a series of overlapping waves.

Project Introduction

FIREWOOD™

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1 Prologue

1.1 Customer Traits

It is reasonable to assume that, due to the inherent nature of the products offered by Firewood™, its customers must exhibit one common trait, namely **the need for a mobile, localised source of heat energy**. This definition, despite not immediately coming across as inherently flawed, ignores a very important parameter of the energy source, this being the (average) thermal power output.

1.2 Power Calculations

Consider a typical *BIC* lighter equipped with 4.5g of butane fuel. Said fuel amount is capable of maintaining a (more or less) constant power output throughout the duration of 30min. The fuel source used in most lighters is *butane*. Upon combustion, one mole of said fuel releases a fixed amount of energy into the environment. This energy is defined by the *enthalpy of combustion* ...

$$\Delta H_{c(mol)} = -2.88 \cdot 10^3 \text{ kJ} \cdot \text{mol}^{-1}$$

Given the molar mass of butane ...

$$M = 58.124 \text{ g} \cdot \text{mol}^{-1}$$

A full tank of butane contains:

$$\begin{aligned} n &= \frac{4.5 \text{ g}}{58.124 \text{ g} \cdot \text{mol}^{-1}} \\ &= 7.74 \cdot 10^{-2} \text{ mol} \end{aligned}$$

And is thus capable of delivering a fixed amount of total energy:

$$\begin{aligned} \Delta H_c &= \Delta H_{c(mol)} \cdot n \\ &= -2.23 \cdot 10^2 \text{ kJ} \end{aligned}$$

Spreading that energy output out over a 30-minute burn time, the average power output equals ...

$$\begin{aligned} \bar{P} &= \frac{E}{t} = \frac{2.23 \cdot 10^2 \text{ kJ} \cdot 10^3}{30 \text{ min} \cdot 60 \text{ s}} \\ &= \frac{2.23 \cdot 10^5}{1.7 \cdot 10^3} \\ &= 123.8 \text{ W} \end{aligned}$$

Assuming that the fuel consumption is not constant, the power formula may be expressed in a continuous form:

$$P(t) = \frac{dE}{dt}$$

Thus, the average power output becomes ...

$$\bar{P} = \frac{1}{T} \cdot \int_0^T P(t) dt$$