

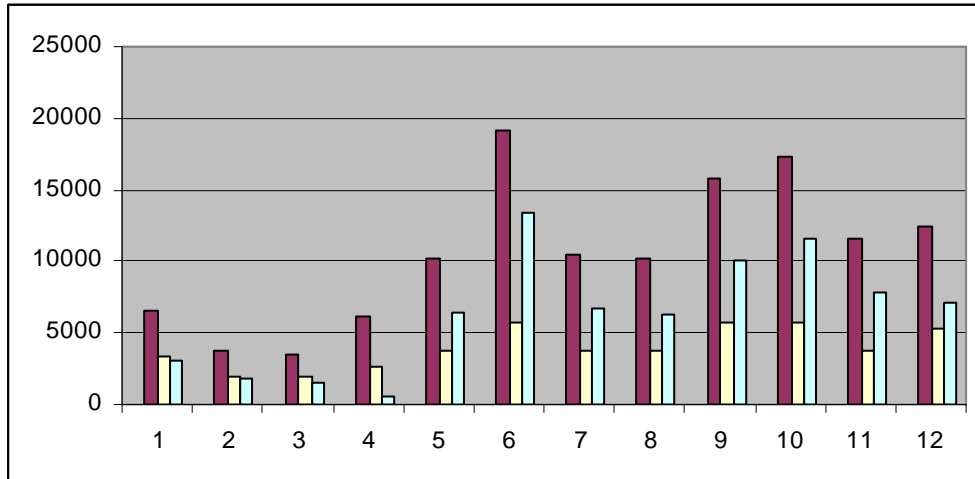
Determination of the Thermal Energy in Relation to Electric Energy in a Bulb Lamp

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Figure 1. Comparison between pre-experiment total energy thermal energy and luminous energy



Conclusions

According to the results shown in figure 1, in low temperatures the electric and luminous energies are almost the same in relation to the total energy consumed. As the temperature increases, the wasted thermal energy decreases and the luminous energy increases. On the other hand, in high temperatures, the shorter the time between turning on and off (pre and post experiment time) of the lamp, the less energy is wasted as heat .in fashion that when the temperature difference is between 10 to 15 the proportion increases more than 1/5 times it should be mentioned that this proportion was measured in short distance from the bulb lamp.

In non-experimental current conditions, the more the distance is the less the luminous energy becomes and the proportion doubles amounting to 3.

Abstract

It is obvious that most of a bulb lamps energy is wasted changing into heat while only a small portion of this energy is consumed as luminous energy. In the present study, the thermal energy has been studied in relation to the electric energy in a 100 w bulb lamp taking advantage of electric and thermal energy relation .to this end, first the heat capacity of the oil used in the study was determined by a thermometer. Than come of the oil was poured in a thermometer and a bulb lamp was put in the oil completely covered by the oil. The total energy was calculated by the voltage and the electric currency in the lamp. Finally considering the thermal changes of the oil and the specific heat, the researchers determined the amount of the thermal energy saved in the oil .the total luminous energy amount and the thermal energy in relation to luminous energy amount was calculated in a 100w lamp.

Introduction

Specific heat capacity is the amount of the heat given to 1kgr substance in order to increase the temperature by 1 centigrade to measure the heat capacity of a substance the following relation can be used:

$$Q = mc\Delta\theta \rightarrow c = \frac{Q}{m\Delta\theta}$$

Therefore, if the amount of the heat given to the (Q) substance as well as, the amount of its mass (m) and temperature change is known, the specific heat capacity saved in that substance can be measured as the voltage figures of a standard electric appliance are printed on it to show the difference between optimal potential and nominal voltage of

the appliance, it is possible to find the electric energy consumed by it using the following relation:

$$w = I^2 rt \quad w = Ivt \quad w = Pt \quad w = \frac{V^2}{R} t$$

In these relation ,the consumed electric energy (w)current(I) potential difference(v) nominal electric power(P)resistance force (R) and time(T) are respectively calculated in Jul, Amp, volt, watt, ohm and second units.

Discussion

To fulfill the goal of the present study, first the specific heat capacity of the oil used in the experiments was determined. Then some special amount of the oil mass was poured in the thermometer. Consequently ,the find temperature of the oil was measured using a simple electric circuit running electric energy in it and changing some of it into thermal energy (by the thermometer's element) in a specific time period. Since the current (I) potential difference (V), pre-experimental temperature (θ_1), post- experimental temperature (θ_2), oil mass (m) and time period (T) are known, the specific thermal energy was calculated. The some procedures were carried out in different time periods and the mean of them was measured to take the average thermal energy (1.53) of the oil into consideration to continue the experiments. Table 1 shows the result of the experiment procedures done in the present study.

$$\begin{cases} w = Ivt \\ Q = mc\Delta\theta \end{cases} = Q = w \Rightarrow mc\Delta\theta = Ivt \Rightarrow c = \frac{Ivt}{m(\theta_2 - \theta_1)}$$

Table 1. The results of oil specific thermal energy with 400 Amp currency and 9/40 volt potential difference.

| Specific heat (C) | Post-experiment time T ₁ | Pre-experiment time T ₁ | Post-experiment temperature θ_2 | Pre-experiment temperature θ_1 | Experiment number |
|-------------------|-------------------------------------|------------------------------------|--|---------------------------------------|-------------------|
| 1/62 | 30/00 | 0 | 59 | 52 | 1 |
| 1/62 | 30/00 | 0 | 59 | 52 | 2 |
| 2/37 | 50/00 | 0 | 63 | 57 | 3 |
| 1/42 | 50/00 | 0 | 70 | 60 | 4 |
| 1/14 | 60/00 | 0 | 77 | 62 | 5 |

When the thermal energy was calculated for the oil used in the experiments, the oil was poured in the thermometers flask and a standard 100 W bulb with 220 volt (nominally) was put in the oil in away that were put in the thermometers flask to prevent the energy transference between the environment and the lamp and to increase the energy transfer between the oil and the lamp. As a result, according to the potential difference between the ends of the lamp (V), the currency in it (I), and different time periods (T), the coming energy was measured using the pre and post temperature, mass (m) and specific resistance force (C) of the oil .

$$\left| \begin{array}{l} Q = mc(t_2 - t_1) \\ W = ivt \end{array} \right. \Rightarrow l = W - Q \Rightarrow ivt - mc(Q_2 - Q_1)$$

Table 2. The results of measuring oil specific heat with a 100W lamp in a thermometer flask.

| Exp. No | θ_2 | θ_1 | T | V | I | w | Q | L=W-Q | L/Q |
|---------|------------|------------|--------|--------|------|----------|---------|----------|-------|
| 1 | 21.00 | 30.00 | 58.11 | 220.00 | 0.51 | 6519.94 | 3420.00 | 3099.94 | 0.91 |
| 2 | 40.00 | 45.00 | 31.00 | 220.00 | 0.54 | 3745.76 | 1900.00 | 1845.76 | 0.91 |
| 3 | 45.00 | 50.00 | 29.37 | 210.00 | 0.56 | 3453.91 | 1900.00 | 1553.91 | 0.82 |
| 4 | 83.00 | 90.00 | 48.15 | 210.00 | 0.61 | 6168.02 | 2660.00 | 3508.02 | 1.32 |
| 5 | 90.00 | 100.00 | 79.51 | 210.00 | 0.61 | 10185.23 | 3800.00 | 6385.23 | 1.68 |
| 6 | 20.00 | 35.00 | 146.75 | 210.00 | 0.62 | 19106.85 | 5700.00 | 13406.85 | 2.35 |
| 7 | 35.00 | 45.00 | 80.78 | 210.00 | 0.62 | 10517.56 | 3800.00 | 6717.56 | 1.77 |
| 8 | 45.00 | 55.00 | 77.96 | 210.00 | 0.62 | 10150.39 | 3800.00 | 6350.39 | 1.67 |
| 9 | 55.00 | 70.00 | 121.37 | 210.00 | 0.62 | 15802.37 | 5700.00 | 10102.37 | 1.77 |
| 10 | 70.00 | 85.00 | 132.90 | 210.00 | 0.62 | 17303.58 | 5700.00 | 11603.58 | 2.04 |
| 11 | 85.00 | 95.00 | 88.94 | 210.00 | 0.62 | 11579.99 | 3800.00 | 7779.99 | 2.05 |
| 12 | 91.00 | 105.00 | 95.59 | 210.00 | 0.62 | 12445.82 | 5320.00 | 7125.82 | 1.34 |

In find stage, the luminous energy was measured according to the potential difference at the two ends of the lamp table 2 showed the results. Table 3 shows the results of the experiments were depicted after the pre-experiment total energy, thermal energy and luminous energy were compared.