VERIFICATION OF STEPHEN LAW

(BY INCANDECENT LAMP)

Introduction :- This experimental set up is designed to verify the Stephen iaw of 4th power by tungston lamp 12V 21W. The set up consist one lamp with stand (covered), one low voltage dc regulated power supply (0 - 12V @ 2.5Amp) with two digital meters and terminals upon panel.

Brief :- The set up is similar to the experiment designed upon tungston lamp taken as black body radiator. The lamp is heated up using a dc source (given 0 - 12v) and two meters connected in electrical circuit read the current and voltage. Applying Ohm's law we obtain the resistance R_T for the given votage (current) as V/I, and same time we evaluate the value of power P = V.I. Neglecting the loss due to convection of heat in surrounding air the Stephen's law is written as

$$P = \sigma C T \alpha$$

or $$\text{Log } P = \text{Log } (\sigma C) + \alpha \text{ Log } T$$

where P = V.I, σ is Stephen's constant 5.67×10^{-8} $\omega m^{-3} K^{-4}$, α is slope quite close to 4 and C is physical constant for radiator given 6.42×10^4 m^2 for lamp.

Thus plotting a graph between Log T v/s Log P equal to slope of stright curve gives value α close to 4 (3.95) which verify the law. From the plot the value of Log (σC) as an intercept on Log P axis which gives the value of σ, and C is known as given.

Experiment procedure

1. Connect given lamp leads with dc terminals. Keep the supply control to minimum i.e. fully counter - clockwise direction.

2. Switch on power.

3. Very slowly adjust the heater supply to few mV say 0.05V. Note the heater current for corrosponding heater voltages. Calculae the heater resistance, R_R, at room temperature using Ohm's law as rersistance R = V/I.

4. Note the room temperature. Add it with 273 to evaluate the absolute temperature at room temperature T_R.

5. Adjust heater voltage to 3V. Note the heater current after 3 minute. Adjust heater voltage furthur with 1V increament say 4V,5V and so upto 10 volt. Note the heater current for each heater voltage setting. Calculate the resistance R_T at different heater voltage setting.

6. Now calculate the temperature T at different heater voltage using emperical relation as given below. Calculate power P = V.I

$Rt/R_R = [T/(273 + T_R)]^{(1.2)}$, in ^0K, an emperical relation

7. Calculate Log P, and Log T.

8. Plot a curve between the Log P and Log T. The slope of the curve (nearly 3.95) verify the stephen law.

The table at next page may be used for calculations.

Stephens law by lamp - 3.

V volt	I amp	R (V/I)	R_T/R_R	T^0	log T	P (V.I)	log P
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Rt/R_R	1	2	3	4	5	6	7	8
T^0K	300^0K	535^0K	750^0K	952^0K	1147^0K	1335^0K	1518^0K	1697^0K

Rt/R_R	9	10	11	12	13	14	15	16
T^0K	1872^0K	2043^0K	2213^0K	2379^0K	2543^0K	2705^0K	2865^0K	3024^0K

R_R at 27^0C.The R_R may be measured by a good quality DMM, otherwise it may accounted as 0.5Ω approx for given lamp.

Stephens law by lamp - 4.