DETERMINATION OF PEAK TEMPERATURE INSIDE A CAR CABIN AND THE FUEL CONSUMPTION DURING A/C COMPRESSOR OPERATION AT VARIOUS ENGINE AND VEHICLE SPEED

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ABSTRACT
In this paper an attempt is made to determine the peak temperature inside the car cabin all through the day for the purpose of further determine the fuel consumption during the period of car air-conditioner compressor running for reaching the comfort temperature from the selected
Temperature at various engine rpm and also at various vehicle speeds.

Keywords: Car cabin, Compressor, Vehicle speed, Air conditioner,

INTRODUCTION
Like other air conditioner systems, the automobile air conditioner must provide adequate comfort cooling to the passenger in the conditioned space under a vide variety of ambient conditions. In automobile air conditioning load factors are constantly and rapidly changing as the automobile moves over highways at different speeds and through all kind of surrounding. As the car moves faster there is greater amount of infiltration into the car and the heat transfer between the outdoor air and the car surface is increased. The sun baking down on a black top road will raise its temperature to 50 C- 60 C approximately and thus increases the amount of heat transmitted into the car. When driving through a grassy terrain, much less radiant heat is expected than when passing through sandy flats or rocky hills. Therefore the car is subjected to varying amount of heat load when its orientation changes during the journey.

An automobile engine utilizes only 35% of available energy and rest are lost to the cooling and exhaust system. If one is adding conventional air conditioning system to the automobile, it further utilizes about 5% of the total energy. Therefore automobile becomes costlier, uneconomical and less efficient. Addition of conventional air conditioner in a car also decreases the life of the engine and increases the fuel consumption.
Understanding and recognizing the fact a series of experiments have been planned to determine the fuel consumption by the selected car when it is parked in the open sun with the engine running at different rpm with the air conditioner “ON” and also when it moves over highways at different speeds and through all kinds of surroundings. At present experiment has been performed on the selected car to determine the peak temperature inside the when parked in the open sun all through the day on a broad sunlight day running duration for reaching the comfort temperature from the set temperature at different engine rpm. The results were analyzed.

EXPERIMENT

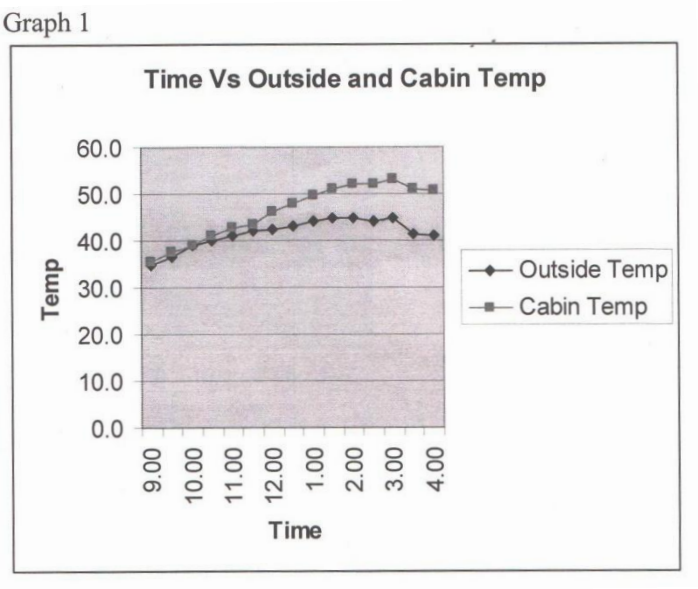
The car chosen for the experiment was Premier Padmini 118NE model.

1. The car was parked on a broad sunlight day and the temperature of the surrounding and the car cabin is noted every ½ hour from 9 am – 3pm. The readings were tabulated (Table 1) and the results were discussed.

Table 1.Car cabin temp during the day time between 9 am – 4 pm

Sl.No	Time	Outside Temp ^{0}C	Cabin Temp ^{0}C
1	9.00	35.0	35.6
2	9.30	36.5	37.7
3	10.00	39.0	39.1
4	10.30	40.0	40.9
5	11.00	41.0	42.6
6.	11.30	42.0	43.6
7.	12.00	42.5	46.1
8.	12.30	43.0	48.1
9.	1.00	44.0	49.7
10.	1.30	45.0	51.1
11.	2.00	45.0	51.9
12.	2.30	44.0	52.0
13.	3.00	45.0	53.0
14.	3.30	41.5	51.0
15.	4.00	41.0	50.6

Graph 1



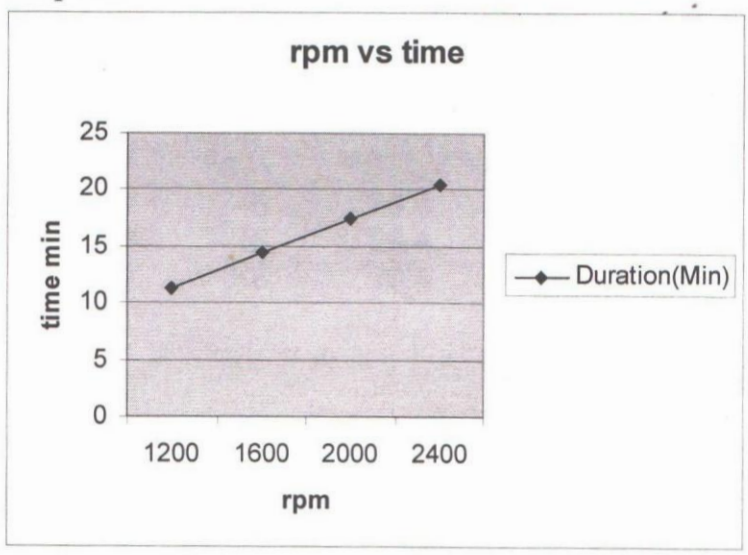
2. The second experiment is pertaining to the determination of fuel consumption during the period when the air conditioner compressor is "ON" until the cabin temperature reaches the comfort temperature of 25^{0}C from 46^{0}C (The average of the cabin temperatures determined in

the first experiment) for different engine rpm. The reading were tabulated (Table 2) and the results were discussed.

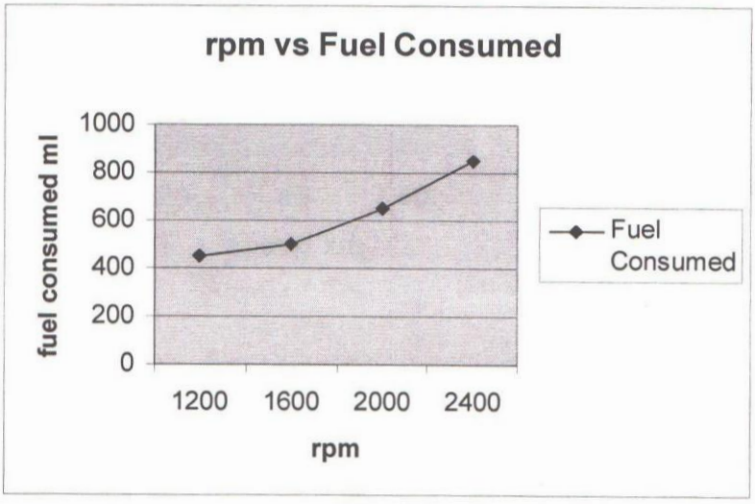
Table 2.Fuel Consumption

SL. No	Engine RPM	Cabin Temp		Time			Fuel Consumption		
1	1200	46	25	0.00	11.23	11.23	1000	550	450
2	1600	46	25	0.00	14.46	14.46	1000	500	500
3	2000	46	25	0.00	17.42	17.42	1000	350	650
4	2400	46	25	0.00	20.47	20.47	1000	150	850

Graph 2



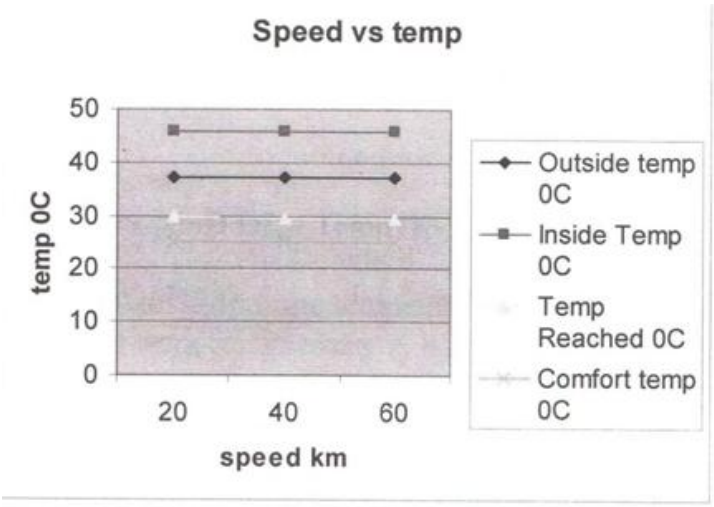
Graph 3

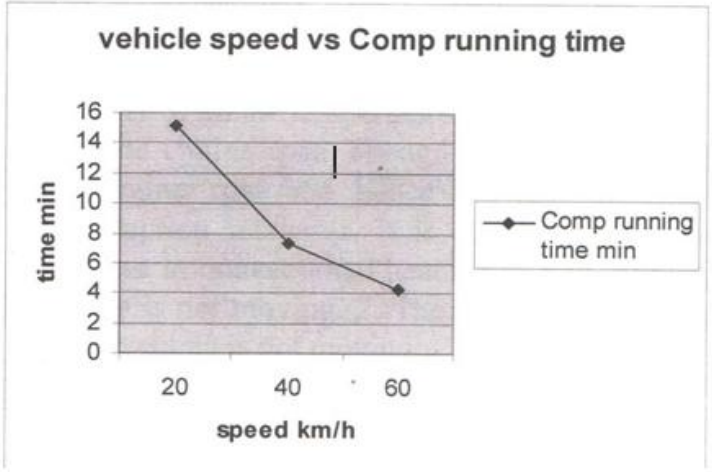


3. The Third experiment is pertaining to the determination of fuel consumption during the period when the air conditioner compressor is "ON" until the cabin temperature reaches the reachable temperature from 46^0C ((The average of the cabin temperature determined in the first experiment) for different vehicle speed. The reading were tabulated (Table 3) and the results were discussed.

Table 3.Fuel Consumption for different vehicle speed

SL. No	Vehicle Speed km/h	Outside Temp ^{O}C	Inside Temp ^{O}C	Temp Reached ^{O}C	Comp On – Time min	Comp Off – Time min	Fuel Consumption ml		
							Initial	Final	Consumed
1	20	37	46	29.8	0.00	15.15	1000	590	410
2	40	37	46	29.4	0.00	7.30	1000	610	390
3	60	37	46	29.4	0.00	4.30	1000	670	330





RESULTS AND DISCUSSIONS

1. From 9 am - 4 pm the temperature variation both outside and inside the car were noted every ½ hour. The readings are tabulated (table 1) From the graph 1 it is observed that up to 10.30 am the temperature variation both inside and outside the car remains almost similar after which the cabin temperature deviates and increases comparatively which the cabin temperature deviates and increase comparatively with the outside temperature deviates and increases comparatively with the outside temperature. The reason being that after 10.30 am the rise in temperature is due to greenhouse effect.

2.In the second experiment from the graph 2 and 3 it is observed that the compressor running time and the fuel consumed for the same duration when the temperature drops from 46^0C to 25^0C increase with the engine rpm. Though the compressor rpm increase with the engine rpm and hence the refrigerant flow rate the fuel consumption increases. It is due to two reasons. 1. Due to the decrease in convectional heat transfer in the condenser coil as the vehicle is not moving. 2. The slow addition of heat into cabin as the vehicle is not moving.

3. In the third experiment it is observed that both the compressor running time and the fuel consumption decrease with the vehicle speed. The reason is due to increased convectional heat transfer in the condenser coil and also due to lesser heat transfer to the cabin due to the vehicle movement.

CONCLUSION

1. The vehicle fuel efficiency can be achieved when the vehicle is operated fewer than two conditions.

a. When the temperature difference between the outside and the cabin is minimum
b. When the vehicle is running at 60 km/h.

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