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Foreword

Welcome to ESTEEM Volume 2. In this issue, we address a gamut of topics from the engineering disciplines to language education. We hope that ESTEEM, by publishing articles from a diverse range of disciplines, will encourage debate and exchange among researchers from assorted academic backgrounds.

I would like to thank our advisor, Prof. Madya Mohd Zaki Abdullah for his distinctive imprint on this edition. His leadership of the journal in its 2nd year of growing impact and reputation has been outstanding. His vision, commitment to excellence, and attention to detail are widely recognized by the Penang academic community as determining factors in the journal's success so far. We will do our best to continue and expand on this tradition of excellence.

Since its launch in 2003, ESTEEM is indeed fortunate to have a dynamic Editorial Team. These people have provided the journal with an outstanding service of reviewing submissions for publications. The journal follows the established policy of a blind review process consisting of at least two peer reviewers per submission. We depend upon their knowledge and judgement in advancing the scope and utility of this journal. Without their support and enthusiasm none of this would have been possible. Also, my thanks to all the contributors, both the successful and not so successful.

Our vision of the ***ESTEEM*** journal is that it should be the journal that belongs to you, the academic and research community. This includes all engineers and academicians working to unravel the mysteries of research, teaching and learning, in all its facets. We wish the journal to be responsive to your needs and your interests. Please feel free to contact any of us in the editorial board to give us your ideas and suggestions for the development of the journal. We look forward to working with you all in expanding this emerging venue for communicating high quality research on the many aspects of academia.

Finally, I would like to take this opportunity to invite all authors and readers to contact me at **esteem@ppinang.uitm.edu.my** to share their comments and advice on how to further enhance the journal's value to the wider research community in knowledge and how to move ESTEEM to the next level of excellence.

The Chief Editor
May, 2005

A Study of Temperature Variation in Closed Cars

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ABSTRACT

This paper emphasizes on the danger of leaving any living things in enclosed car. Various interior temperatures are taken from vehicles parked under direct sunlight. Results show that the most critical time is during the first 20 minutes, where the temperatures can increase to between 15 and 30 degree Celsius from its initial temperature, which is equivalent to between 50% and 100% increments. Results also show that color or size do not necessarily reduce the increment of the interior temperature.

Introduction and Literature Review

When a human body is exposed to extreme temperatures serious harm can occur. From the medical point of view, heat exhaustion (the negative effects which exposing to an excessive degree of heat causes) and heat stroke can occur rapidly in enclosed vehicles. These do not only hanppen to the elderly but infants too, are at risk (Gibbs, et. al, 1995). A child's body is much smaller than an adult's and children are not able to withstand the extreme heat. Their core body temperature heat up three to five times faster than adults (Arkansas, 2002). As the result, death results, attributed to hyperthermia or heat stress (Copper, 2002).

A study done by Gibbs, L.I., et. al. (1995) in Louisiana discovered that at about 34°C (93°F) ambient temperature, the temperature in a closed vehicle rose to 52°C (125°F) in 20 minutes and reached a stable temperature in 40 minutes. An average rise of temperature was calculated over 25°C (45°F) in less than 1 hour.

A research conducted in Little Rock, Arkansas (2002), a research showed that 75% of the temperature rise occured within 5 minutes of

closing and leaving the car. The interval temperature of a vehicle rose to 55°C (131°F) eventhough the outside temperature is 36°C (97°F) Furthermore, according to the Royal Automobile Club (Copper, 2002), as many as 500 children are left in locked cars each year. Although this might not be true in Malaysia, in Australia leaving your children in the car during summer can be fatal. In a study conducted (Copper, 2002), with the initial temperature of 40°C (105°F) and the temperature changes between 48°C (115°F) to 62°C (144°F) after 20 minutes.

Finally, most of the previous studies use digital data loggers as the medium to collect data, it involved the use of a wireless and remote measurement system. This was to ensure that the pressure and temperature trapped in enclosed-vehicles were well controlled and not interfered by the activities of recording the changes.

Objectives and Hypothesis of the Studies

The main objective is to comprehend the patterns of temperature and pressure changes in enclosed vehicles. Secondly to support the past studies, done by Gibbs, L.I. et.al (1995), Lowder, S. (1997) and Null. J. (2002 & 2003), that temperature can rise quickly and rapidly in cars with closed windows, and most significantly, it is fatal. Thirdly, this research serves as as a safety alert to all drivers as it proves that heat stress has negative effects upon the human body and inhalation.

We hyphothesize that the size of a car *and* the colour of a car's exterior influence the increment of the temperature in a closed car, due to the greenhouse effect which can occur.

Scope of Project

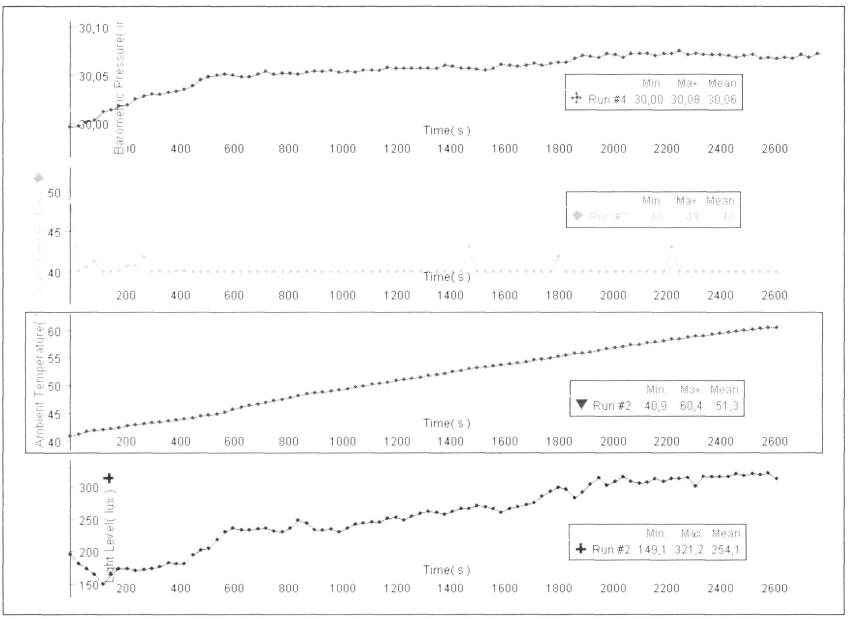
All of the experiments were conducted at the MARA University of Technology, Penang Branch Campus **open-spaced** car parks. The vehicles that were used consist of two(2) national cars and two(2) imported cars. The cars were categorized by their colours (dark versus light). The differences in colours and sizes are purposedly done in order to make comparisons between them in terms of heat absorption. 'Dark' indicates dark blue or dark grey, while 'Light' indicates light purple or light brown. Ambient temperature and the amount of clouds during the experiments done were also observed. The average temperature for

Malaysia is between 24°C and 34°C, and in this study, Unser is larger in capacity (1800cc) compared to Iswara (1300cc).

Research Methods

Two Pasport Xplorer Dataloggers (PS-2000) which are 3-in-1 Temperature-Sound-Light Sensor, were used for the experiment with a DataStudio Lite Software with 0.001 Hg in resolution. The level of temperature, sound and light changes were recorded automatically and simultaneously in the datalogger itself. Both of the Xplorer Dataloggers were placed on the front seats and were set to record the temperatures every 30 seconds starting from the moment the sensors.were switched on Care was taken not to place the Dataloggers in direct sunlight.

The inputs were uploaded to the computer by linking directly from the datalogger. Graph1 shows an example of a direct output from the Xplorer Datalogger.



Graph 1: Example of Direct Outputs from the Xplorer Dataloggers

At the beginning of the experiments, a duration of 40 to 45 minutes was chosen as our maximum time of observations, however after

conducting a few trials, the results obtained shows that the temperature did not reach its peak or its stable temperature level. Due to these findings, we lengthened the duration to between 60 minutes and 90 minutes, and the condition was satisfied.

Analysis of Data

Iswara Light and Iswara Dark

The temperatures were measured digitally every 30 seconds, in an open space car parked at 12.15 noon for about 45 minutes.

Figure 1 shows a graphical comparison between temperature and exposure time for both cars (only based on data taken every 5 minutes) and results shows that the temperature in Iswara Light is higher than Iswara Dark. However, temperatures in both cars are proportionate with time; just that the temperature in Iswara Dark temperature did not change in 5 minutes earlier. Our analysis shows that, the temperature in Iswara Light increased 58.9% compared to Iswara Dark, 62.4%. The temperature intersected at time equals 33 minutes. After that, the pattern changed and the temperature of Iswara Dark became higher than Iswara Light. As predicted, the temperature of Iswara Dark remained higher than that of Iswara Light due to the nature of heat convection within a closed vehicle, where the sunlight penetrates the windscreens of the vehicles, warms the entrapped air, thus keeping the cold air out.

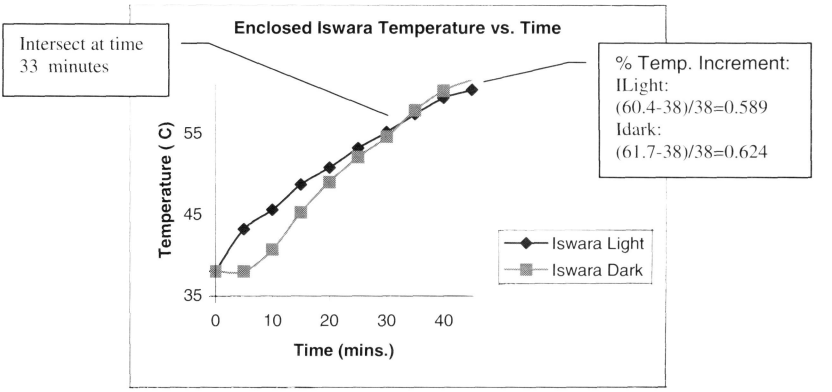


Figure 1: Enclosed Iswara Temperature Versus Time (taken on April 21, 2004-midnoon)

Unser Light and Unser Dark

During the first 10 minutes, the temperature of Unser Light is higher by 5°C than Unser Dark (refer to Figure 2). After this point, the temperature in the Unser Light t increased linearly with respect to time until time equals 25 minutes, when temperature changes against time is small or minimal. Meanwhile, temperature in the Unser Dark increased at a slower rate after 50 minutes. So, we conclude that the Unser Light absorbed less heat compared to Unser Dark.

From 0 to 25 minutes, the temperatures in the Unser Light's and Unser Dark increased by 78.9%.and 98.4%, respectively. Between 25 and 70 minutes, the temperature increment for Unser Light and Unser Dark are 10.2%.and 37.5%. The overall increment of temperature for Unser Light and Unser Dark are 92.8% and 146.4% respectively (refer Figure 2).

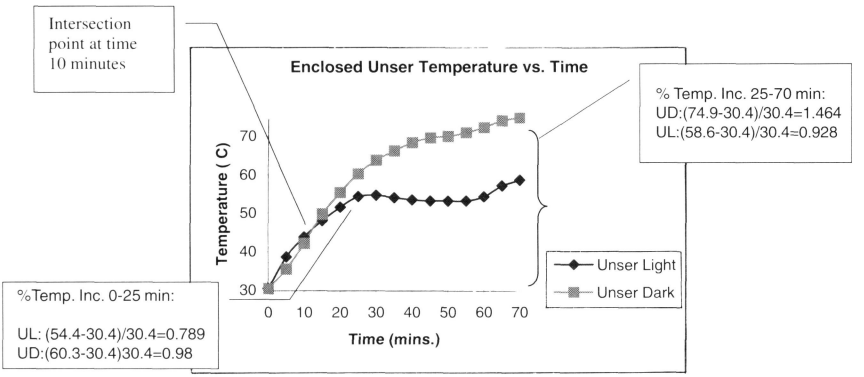


Figure 2: Enclosed Unser Temperature Versus Time
(taken on April 21, 2004-midnoon)

Figure 1 and 2 show that the darker colored cars show less increment in temperatures during the first 10 to 30 minutes. All experiments show that temperature increases about 10° to 15°C from its initial temperature during the first 5 minutes, which is equivalent to 48% to 72% of its total increments. They reach their maximum levels after 40 to 50 minutes.

The experiments were done on the May 13, 2004 and May 14, 2004 with ambient temperature about 34°C and with initial interior temperatures varyng for each car. All cars showed that within the first 15 to 20 minutes, their temperatures had increased between 10° and 15° Celsius from their

initial interior temperatures. After 40 to 50 minutes, all cars showed increments of 25° Celsius, which reaches 71°-73° Celsius, regardless of colour.

Comparisons Between the Two Types of Vehicles

Comparisons were done between initial temperatures and temperatures at time equal 20 minutes, which is the most critical time where the temperatures can increase by15 to 30 degree Celsius from its initial temperature (equivalent to 50% to 100% increments). Table 1 showed that at time equal 20 minutes, all temperatures reached at least 40.9°C. This is the starting point when a person left inside an enclosed car, their core body temperatures rises above 40.5°C (105°F) and this triggers heat stroke (Quinn, 2005). The average maximum for lighter-coloured cars was 65.9°C, while for darker-coloured cars was just 66.4°C (Table 1).

Conclusion

After analyzing the data, we conclude that color is not the main factor of temperature increment in enclosed cars parked under direct sunlight. The rapid increments (see Table 1: UL1 versus UD1, and IL2 & IL3 versus ID1), clearly show that a darker colored car need not necessarily warm up quicker than a light colored car.

Finally, the results agree with (Null J., 2002 and Cooper, K., 2002) that size is not a major factor of temperature increment. *All* cars (refer to Table 1) show that regardless of size, interior temperatures can rise to double or more of its initial temperature, which is between 60°C to 75°C by the end of 70 minutes. Hence it is fatal to leave someone, elderly or children, in enclosed cars parked under direct sunlight.

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Table 1: Summary of Temperature Differences for the 11 Trials for Iswara and Unser

Table 1: TEMPERATURE CHANGES IN CLOSED CARS PARKED UNDER DIRECT SUNLIGHT (21 APRIL2004-17MAY2004)									
vehicles	Date/Time	met.factors	initial	20 min	max	diff (max-min)	diff(20 min)	%diff=(diff/(max-min))*100 (time=20 min)	Reach peak(min)
IL1	12nn/21april04	cloudy/dry	38,0	58,8	60,4	22,4	20,8	92,9	45
IL2	9,23/13may04	cloudy/dry	38,0	49,0	62,2	24,2	11,0	45,5	45
IL3	12nn/21april04	cloudy/dry	38,0	49,0	61,7	23,7	11,0	46,4	45
ID1	9,23/13may04	cloudy/dry	40,9	50,8	60,4	19,5	9,9	50,8	43,5
ID2	10,30/13may04	cloudy/dry	50,9	65,9	71,6	20,7	15,0	72,5	50
UD1	9,40/14may04	thin cloud/dry	30,4	51,6	58,6	28,2	21,2	75,2	58
UL1	9.40/14may04	thin cloud/dry	30,4	55,5	74,9	44,5	25,1	56,4	58
UD2	10.45/15may04	thin cloud/dry	44,9	67,6	73,4	28,5	22,7	79,6	45
UD3	14.18/14may04	thin cloud/dry	35,9	53,1	63,3	27,4	17,2	62,8	60
UL2	15.36/14may04	thin cloud/dry	46,7	69,4	70,2	23,5	22,7	96,6	25
UD4	15.37/14may04	thin cloud/dry	47,7	70,7	70,8	23,1	23,0	99,6	20

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