ENPH 257 Interim Report

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James Wu	92277235
Jiayi Tang	15992639
Gosha Maruzhenko	14649164
Lewis Mason	52118163

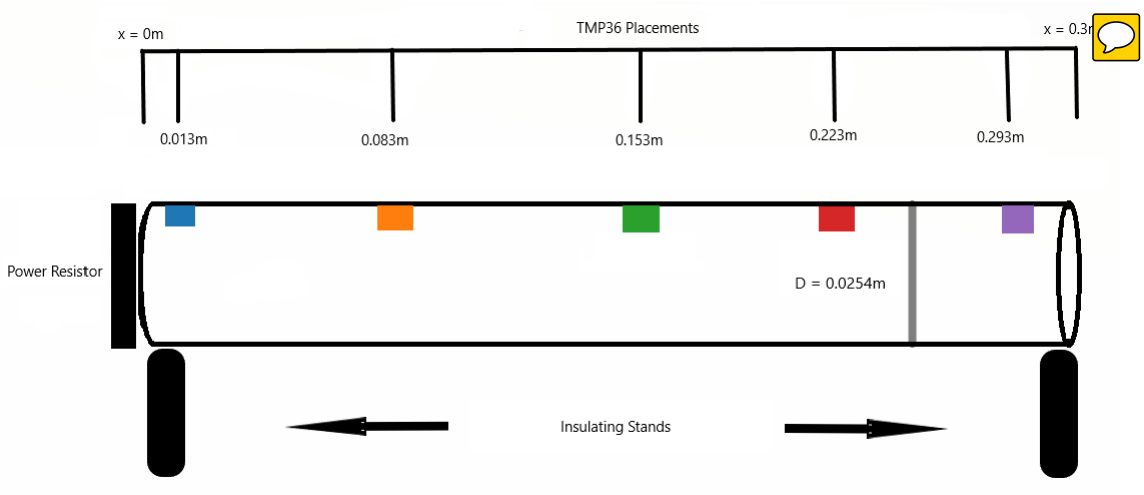

Figure 1: The experimental setup used to observe thermal waves through an aluminum rod and to determine coefficients related to heat transfer of that rod. A power resistor heat source was connected to a DC power supply and the temperatures were read by TMP36 ICs.The colours on the diagram relate each TMP36 to a specific curve on the following graphs.

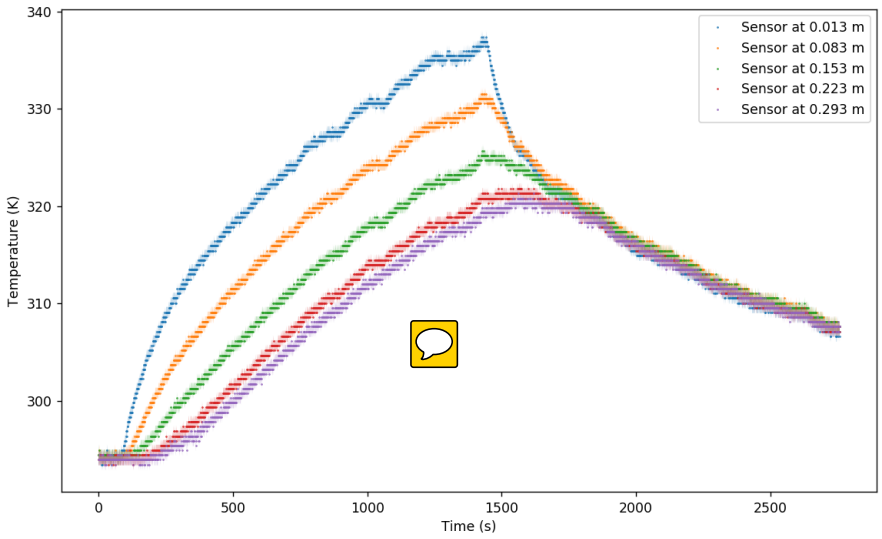

Figure 2: (Full Waveform) Temperature of the bare rod at the five sensor locations as a function of time. The rod was heated for 1360 seconds with a power resistor and then let cool. The shaded band around the data points represents the uncertainty in our data ($\pm 0.6K$ around each data point).

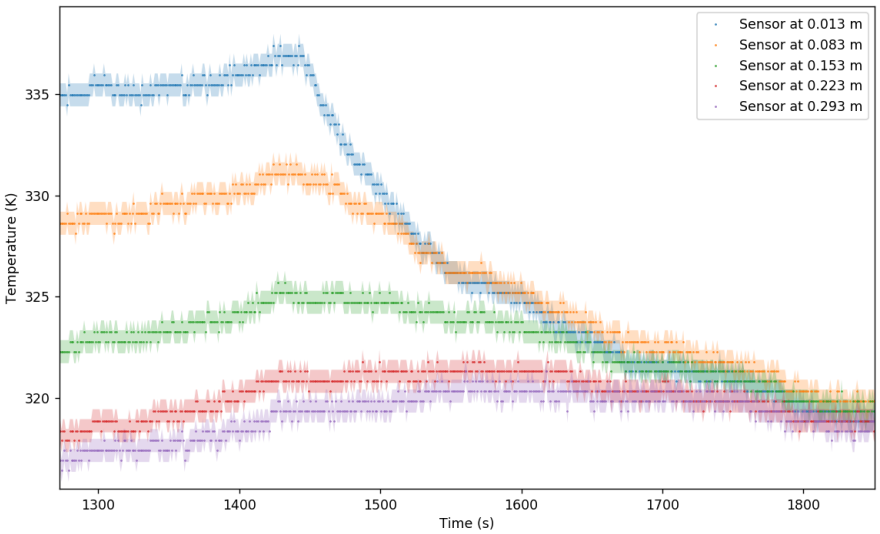

Figure 3: (Zoom) Detail of temperature observations around the time that the power resistor was turned off. A thermal wave is observed since the fourth and fifth sensors are heating while the first three sensors are cooling.

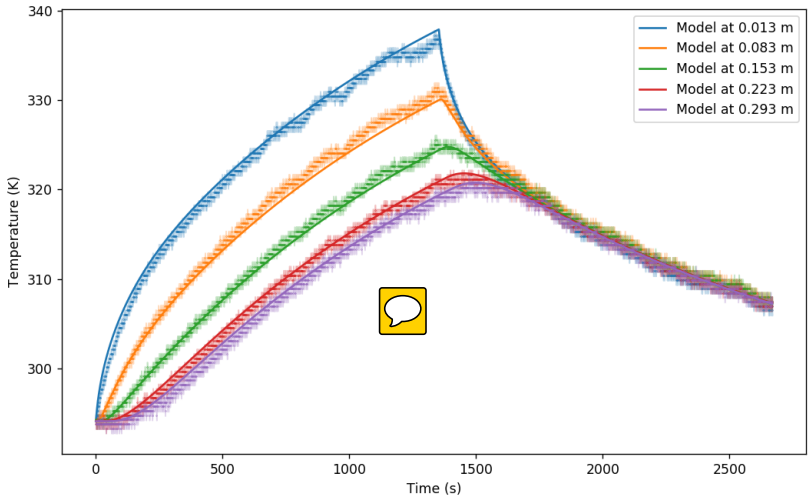

Figure 4: (Model vs Observation) Numerically-modelled predictions for temperature as a function of time compared to observations. Values for K, K_c, ϵ, and P_{in} were adjusted by an algorithm to minimize the sum of the square of the differences between data points (r_n) and predictions (m_n). In the following equation, N is the number of data points. The function to minimize is given by: $\sum_{n=1}^{N}(r_n - m_n)^2$.

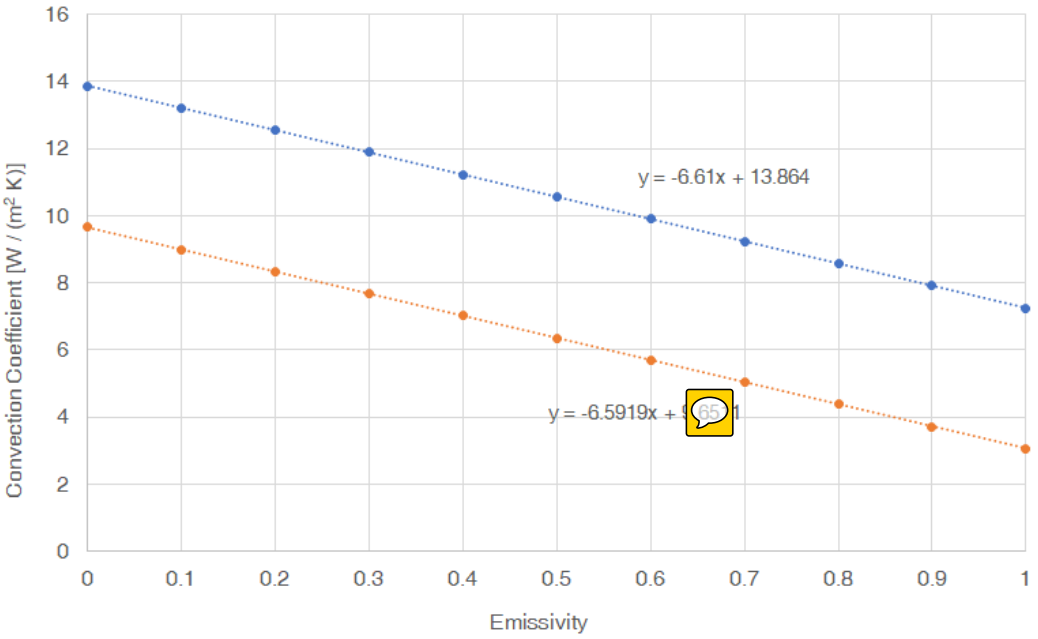

Figure 5: (Convection Coefficient vs Emissivity) Relationship between convection coefficient and emissivity for a bare rod (orange) and a black spray-painted rod (blue). With the two trends being approximately straight lines, the difference in the y-intercepts was used to gain more accurate values of the emissivity and convection coefficient for the bare rod.

Table 1: ~~Final~~ Results for a Bare Aluminum Rod

Parameter	Symbol	Value	Uncertainty
Power In	P_{in} (W)	13.13	± 0.4
Aluminum Specific Heat	c_{Al} (J/KgK)	900	*Looked up*
Source Efficiency	η (%)	71	± 2
Convection Coefficient	k_c (W/m^2K)	8.44	± 1
Emissivity	ϵ (W/m^2)	0.2	± 0.2
Aluminum Thermal Conductivity	k (W/mK)	170.5	± 7