

Calculated Results

$$\text{Time} = \frac{1.00 \times 10^{-8} \text{ sec}}{\text{Division}}$$

$$\text{Wave Speed in Incoloy} = 5.67 \frac{\text{mm}}{\mu\text{s}}$$

Calculated Tube Thickness

Div # 290 Delta 0

Div# 403 Delta 113

Div# 519 Delta 116

Div# 634 Delta 115

Div# 756 Delta 122

Average = 116.5

$$\begin{aligned} &= \frac{(116.5 \text{ Divisions}) \left(\frac{2.00 \times 10^{-8} \text{ sec}}{\text{Division}} \right) \left(5.67 \frac{\text{mm}}{\mu\text{s}} \right)}{2} \\ &= 6.61 \text{ mm} \end{aligned}$$

$$\begin{aligned} \% \text{ Error} &= \frac{(6.60 \text{ mm (actual thickness)} - 6.61 \text{ mm})}{6.60 \text{ mm}} \times 100\% \\ &= 0.2\% \end{aligned}$$

Conclusions

The test results suggest that the the signal sensitivity is related to the difference between the operating temperature of the furnace tube and the melting temperature of the sacrificial stand-off. This may be due to the effect of melt viscosity on the pooling of the molten metal under the stand-off or it may be due to the rate of melting of the stand-off. Further high-temperature investigations are underway to elucidate these issues.

5.0 PROJECT SCHEDULE AND BUDGET

The project expenditures through the end of the current reporting period were about \$75,000 or %76 of the total allocated budget. The accomplishments of the program to date are as follows:

1. Development of a novel sacrificial stand-off that can be used for contact ultrasonic measurements at high temperature.
2. Optimization of a casting procedure for production of sacrificial stand-offs having a high signal to noise ratio.
3. Fabrication of an automated probe assembly.
4. Development of an electronic control module for operation of automated probe.
5. Confirmation of the probe assembly for detecting the thickness of a simulated coke layer on a flat plate.
6. Confirmation of the probe assembly for detecting the thickness of an ethylene cracking furnace tube at elevated temperatures under controlled temperature conditions.

The work for the next period will involve further investigations into the loss of ultrasonic energy across the interface between a transducer and the tube wall and the completion of the initial design of the water-cooled lance.