



Predicting Diesel Particulate Filter Performance

DCL R&D Progress Report
Adhoc/Deep Conference 1997

Introduction

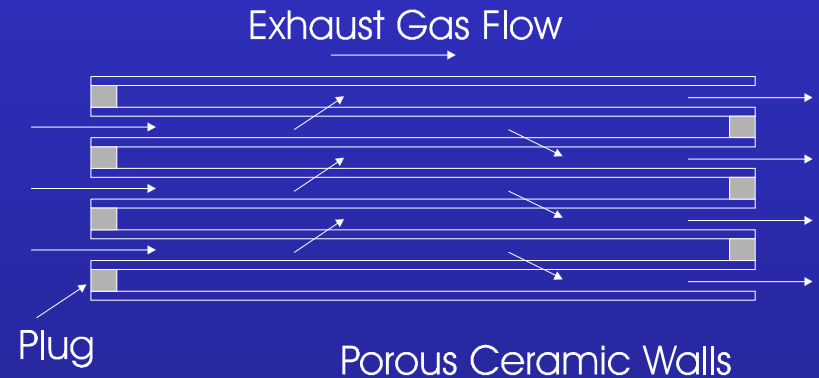
- Diesel Particulate Filter
 - Effective for Reduction of DPM
 - Requires Careful Study of Each Application
- Computer Model
 - Effective Tool for Predicting DPF Performance

Outline

- Physical Description
- Operational Description
- Model Concept
- Results

Description

- Ceramic Matrix
 - SiC or Corderite
- Alternately
Blocked Channels
- Wall Flow Device



History

- Excellent Filtration Efficiency
- Application Sensitive
- Inconsistent Field Experiences

History

- Excellent Filtration Efficiency
- Application Sensitivity
- Inconsistent Field Experiences
- Requirement: Accurate Identification of Possible Applications
- Requirement: Accurate Selection of DPF

Filter Operation

- Direct Interception & Brownian Diffusion
Filtration Mechanisms
- Conditional Combustion of Soot
(Regeneration)

Modes of Operation

- Accumulation
- Regeneration

Regeneration

- Regeneration: Combustion of Soot
- Regeneration Limit: Combustion Decreases Trapped Mass of Soot
- Regeneration Event: Rapid Combustion Significantly Reduces Amount of Soot in Filter
- Problem: Predict Regeneration

Possible Decision Making Tools

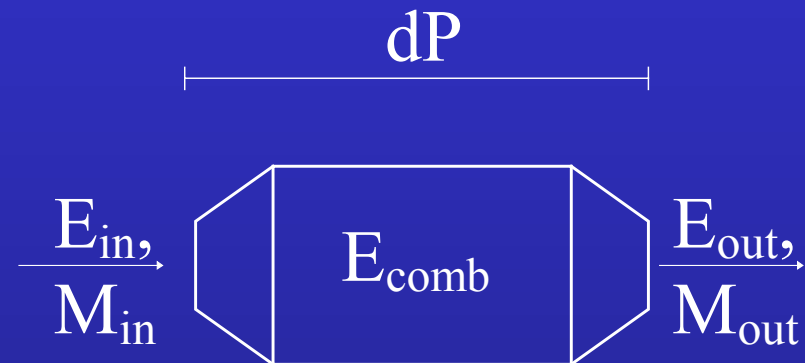
- Arbitrary Sizing Rule
- Threshold Temperature Rule
- Engine-Dynamometer Simulation
- Computer Modeling

Model Goals

- Improved Accuracy
- Extended Range of Applications
- Inexpensive Operation
- Comparison of Different Technologies

Model Description

- Zero or One Dimensional
- Heat Transfer
- Reaction Rate
- Pressure Loss



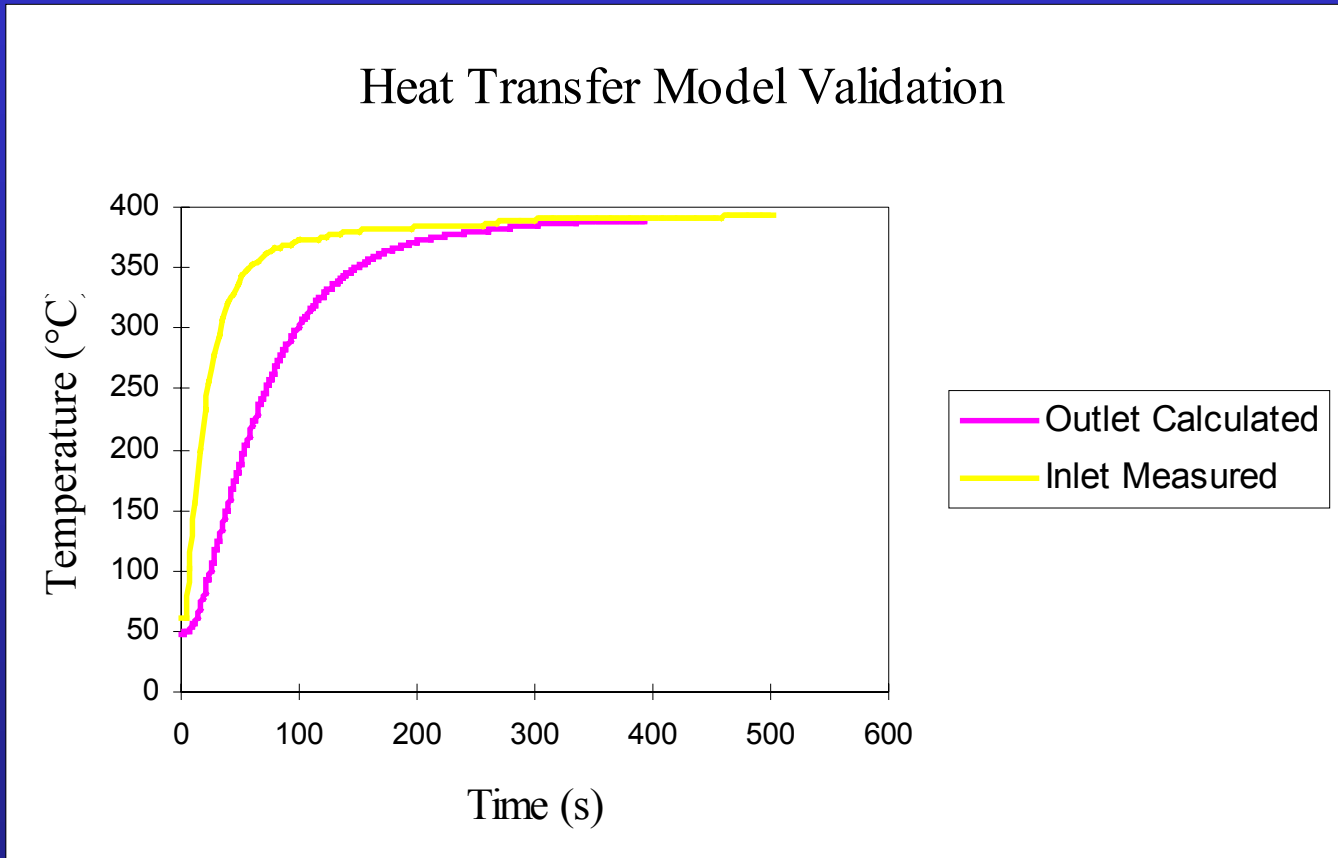
Model Inputs

- Exhaust Flow Rate
- DPM Concentration
- Oxygen Concentration
- Filter Characteristics

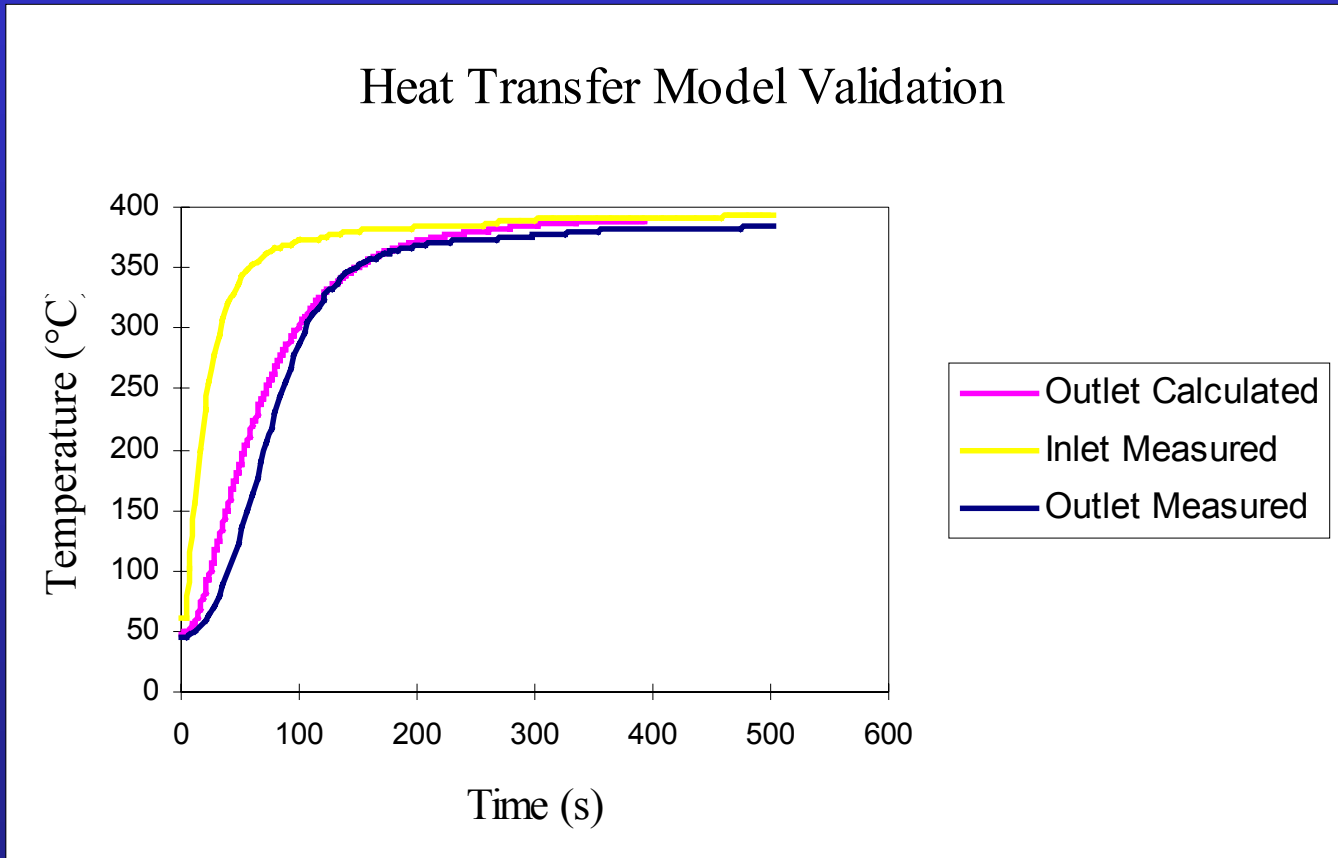
Model Outputs

- Filter Temperature
- Stored Mass of DPM
- Filter Pressure

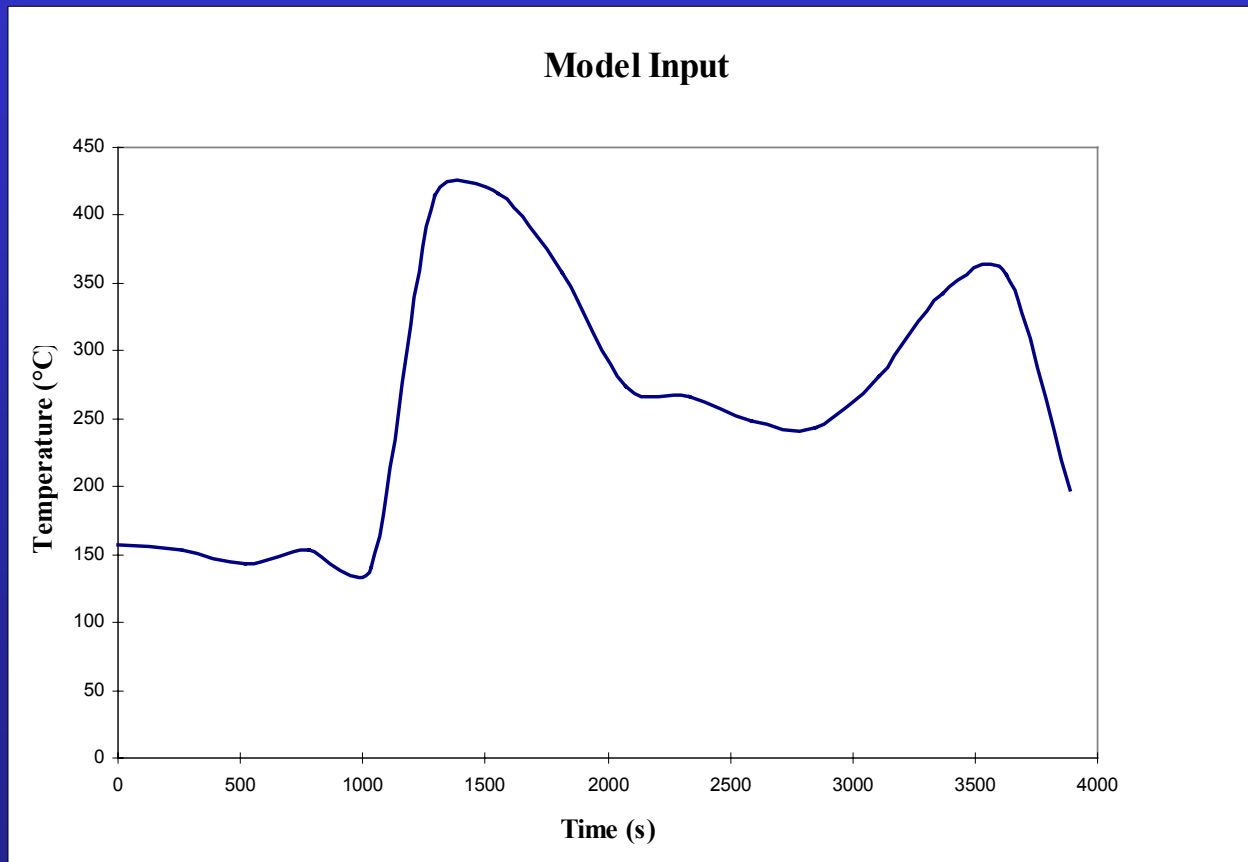
Model Validation



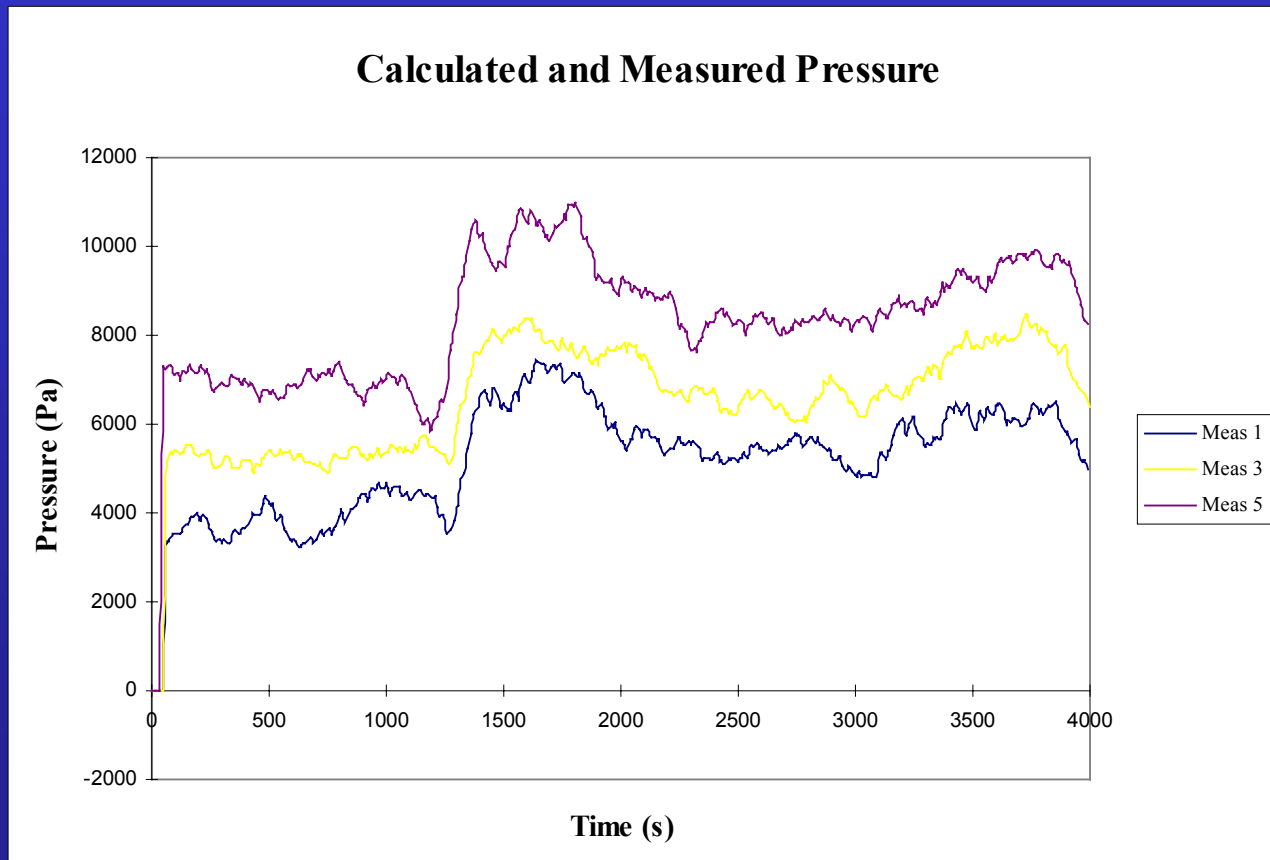
Model Validation



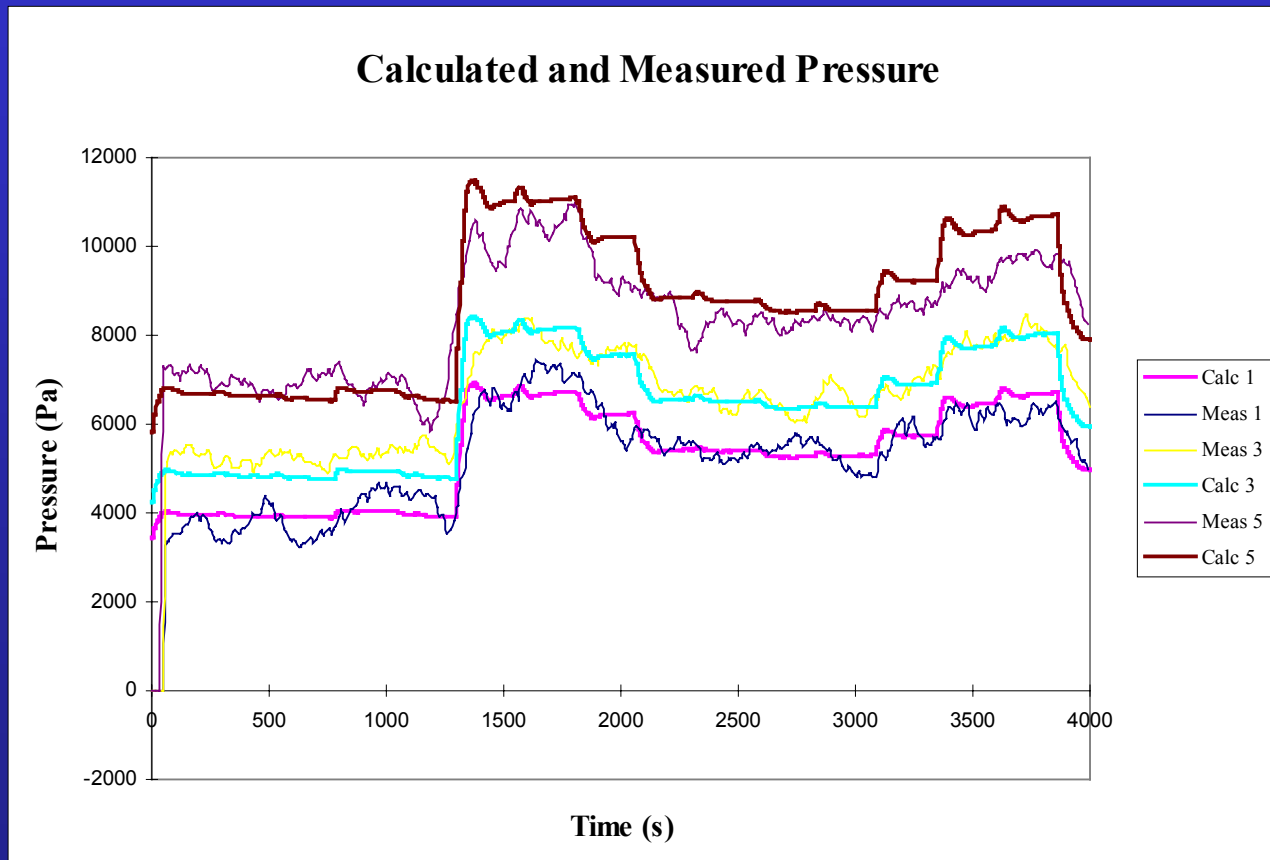
Model Input



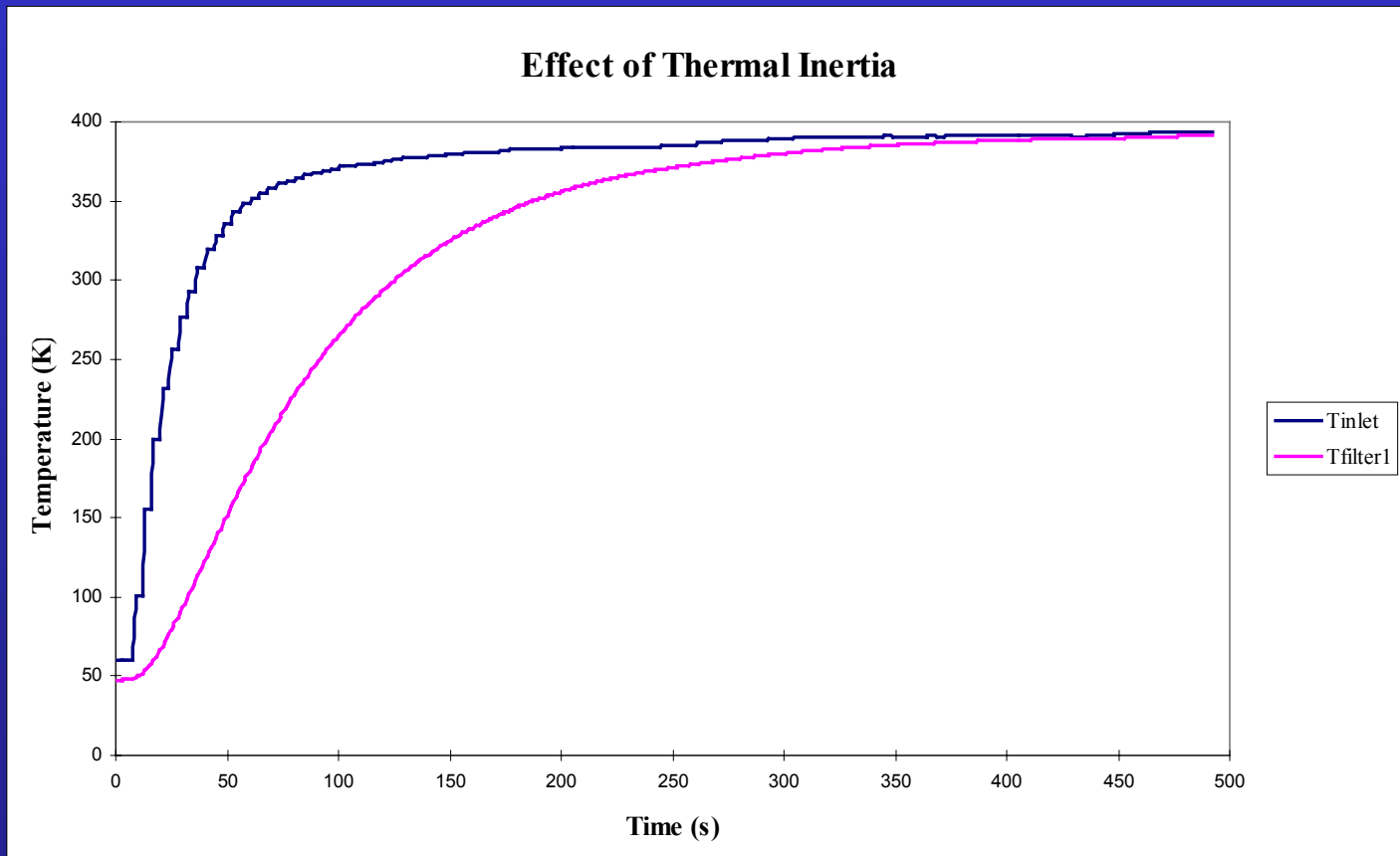
Results



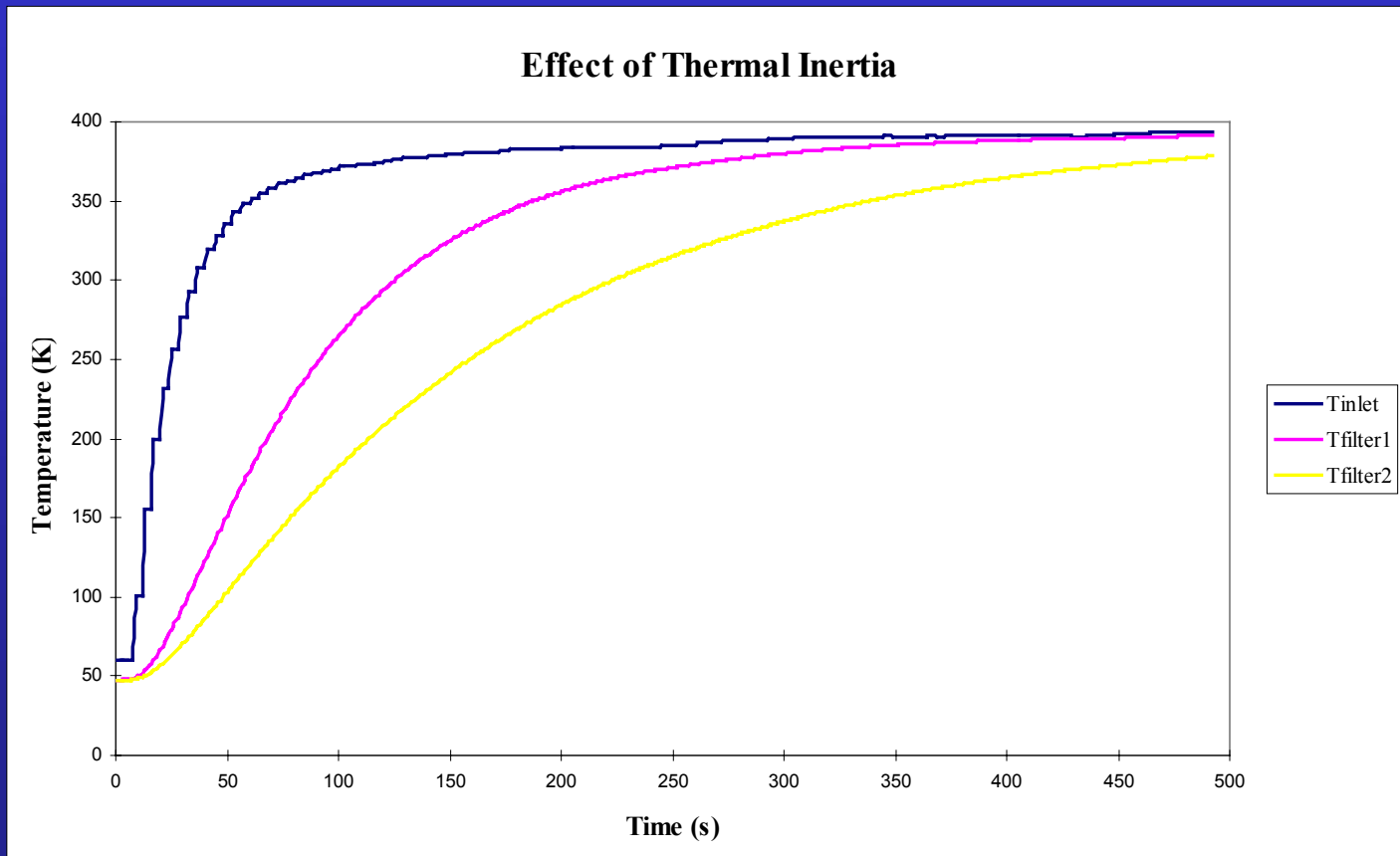
Results



Effect of Thermal Inertia



Effect of Thermal Inertia



Summary

- Identification of Suitable Applications
- Prediction of Filter Performance
- Comparison of Different Technologies
- Improved Understanding of Filter Operation

Conclusions

- Improved Reliability of Products
- Increased Range of Applications for Products
- Accurate Selection of Appropriate Technology