Department of Mechanical Engineering, IUPUI
ME 414 Thermal-Fluid Systems Design
Fall 2004

Project 2: Heat Exchanger Design

Team 3

Summary

- Shell Pressure Change
- Tube Pressure Change
- Heat Transfer
- Weight

Requirements

- Shell & Tube Heat Exchanger
- Remove 1.2 Megawatts
- Process Water
  - Inlet Temperature of 125 °C
  - Outlet Temperature of 100 °C
- City Water
  - Summer Inlet Temperature of 25 °C

Project Management Tools

- Statement of Work
- Work Breakdown Structure
- Gantt Chart
- Responsibility Matrix

Design Steps

- Researched Initial Inputs
- Calculated Heat Exchanger with Q_{out}=1.2MW
- Selected Range for 8 Inputs
- Ran Matlab to Calculate Combinations

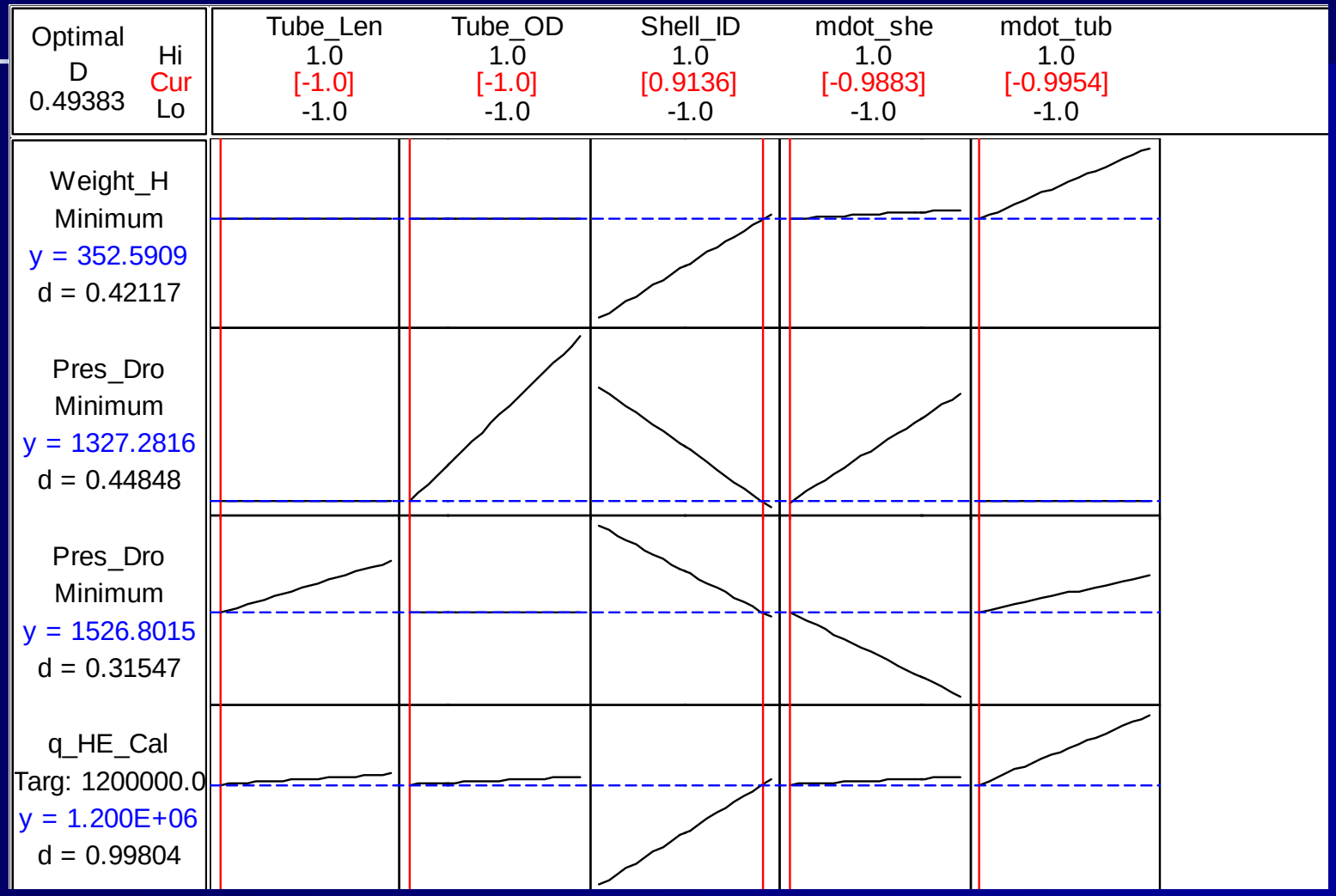
Design Steps

- Utilized Calculated Output Values for Statistical Analysis in Minitab
- Eliminated Insignificant Initial Input Ranges: Baffle Space, Tube Square Pitch, Tube Material
- Ran Response Optimization
- Refined Values Based on Optimization

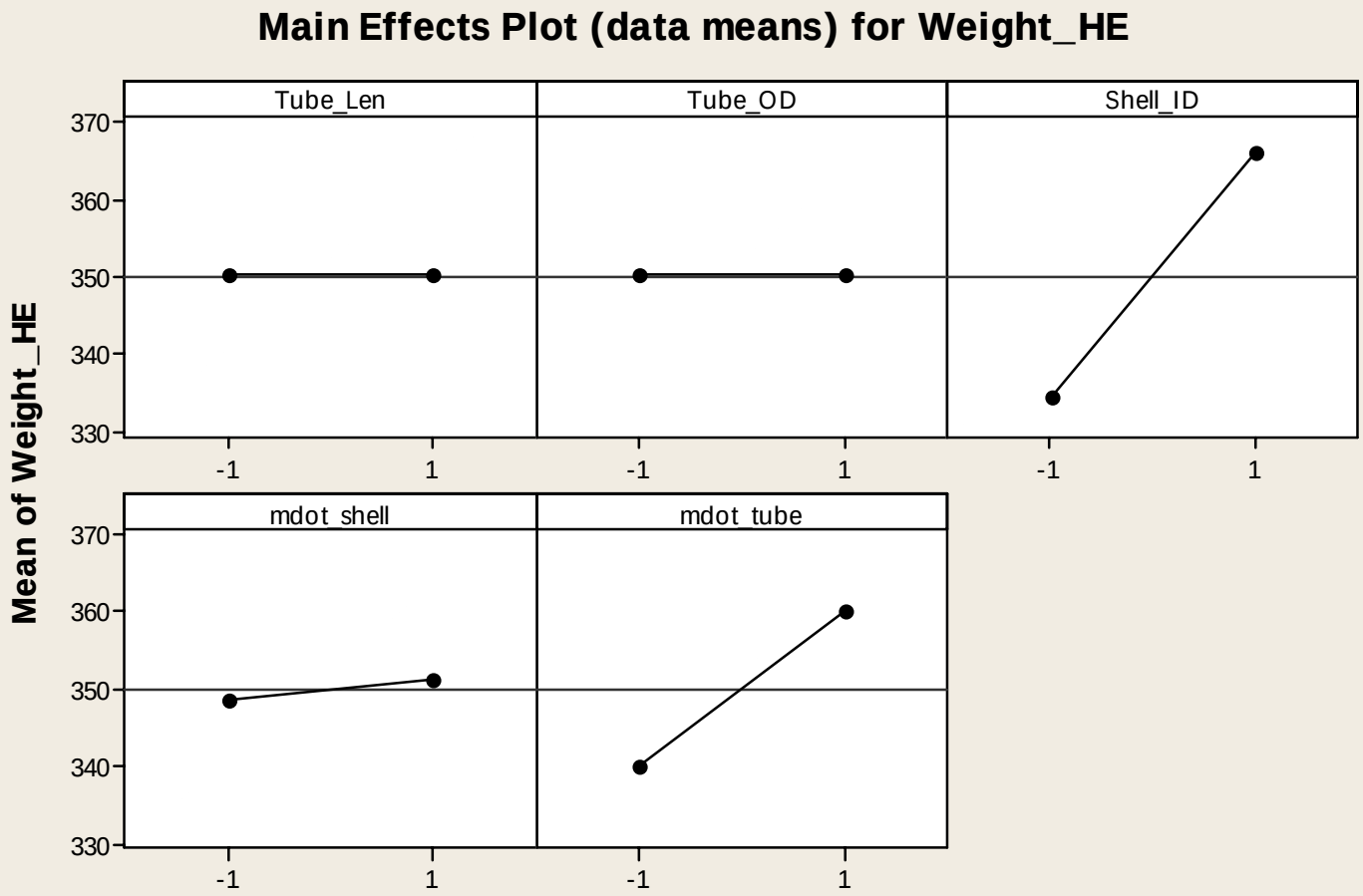
Optimization Ranges

- Tube Length = $5 < X < 5.3$
- Tube O.D. = $7.5*10^{-3} < X < 7.7*10^{-3}$
- Shell I.D. = $.2132 < X < .2240$
- Shell Mass Flow Rate = $20 < X < 22$
- Tube Mass Flow Rate = $3.4 < X < 3.6$

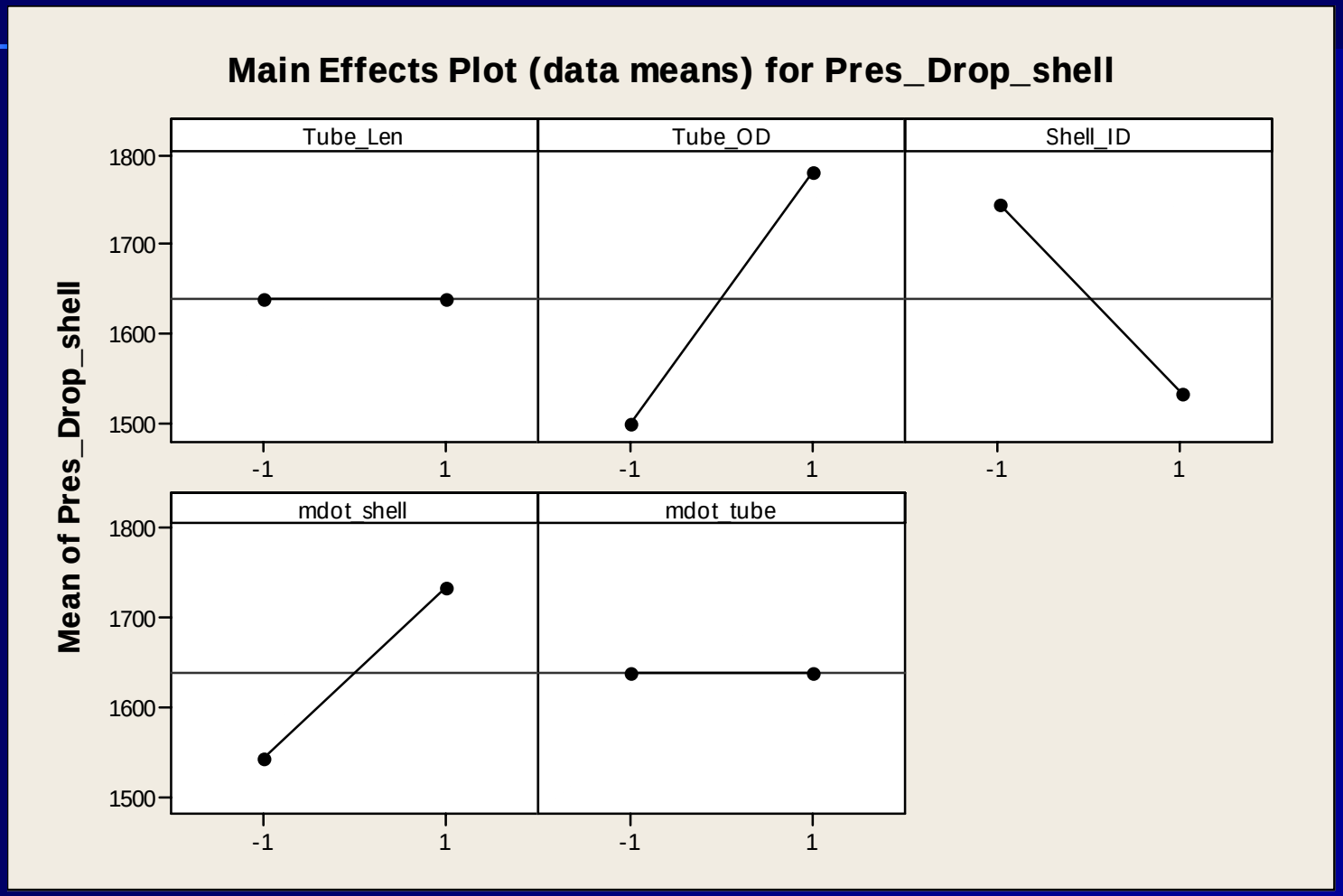
Optimization Chart



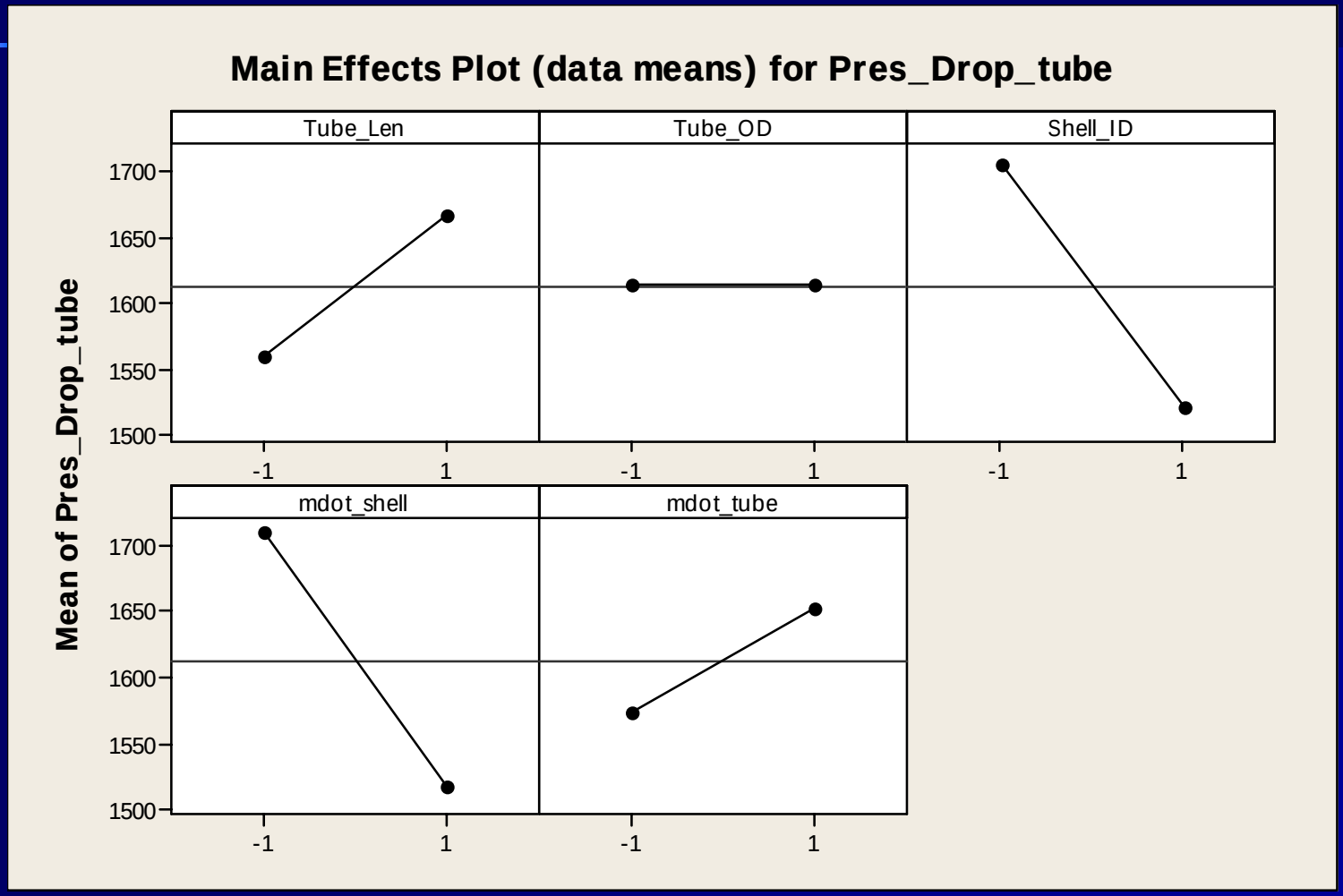
Main Effects Plots



Main Effects Plots



Main Effects Plots



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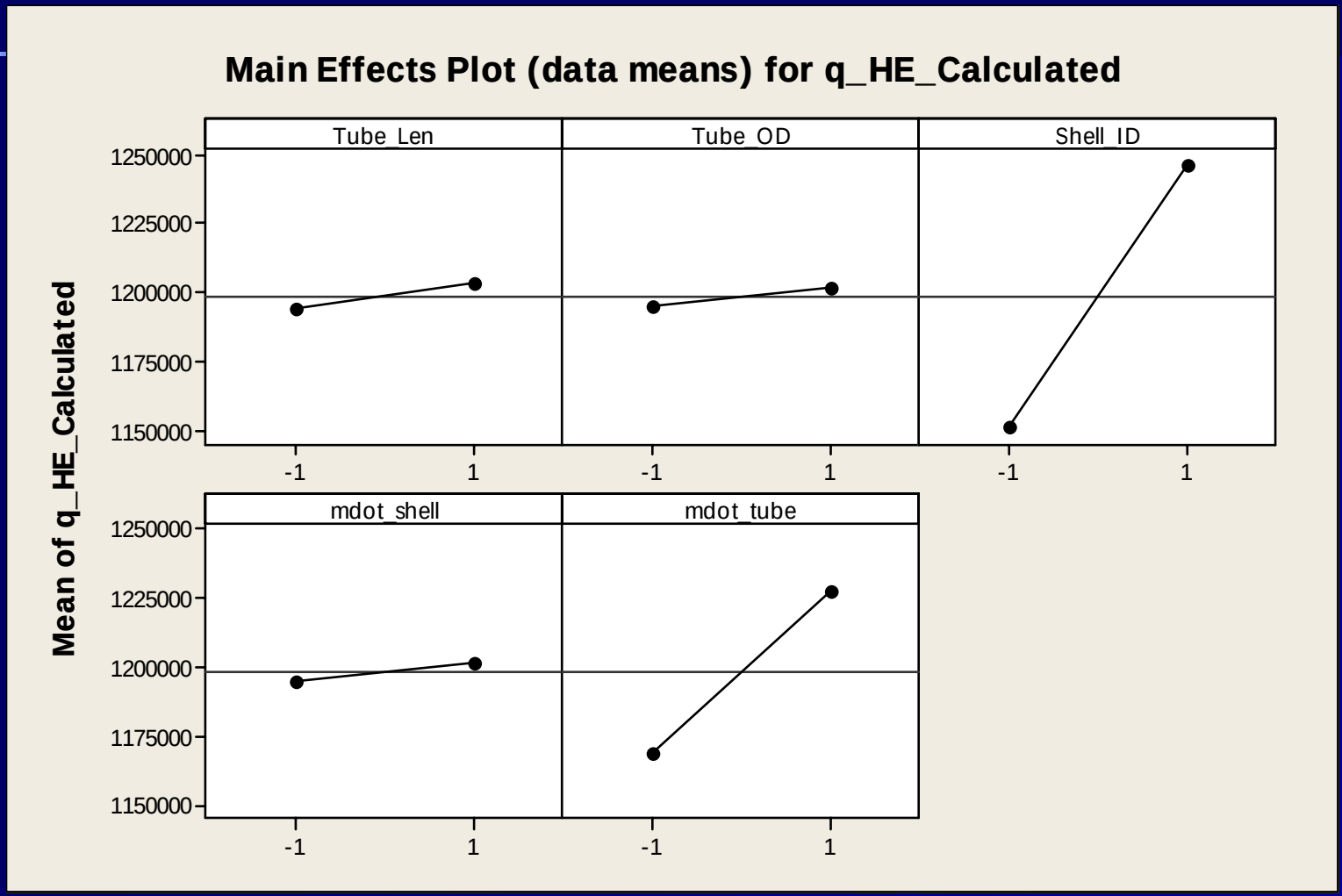

Optimized Values

- Tube Length = 5
- Tube O.D.=$7.5*10^{-3}$
- Shell I.D.=.2240
- Shell Mass Flow Rate=20
- Tube Mass Flow Rate=3.4
- Weight=353.85 kg
- Shell Pressure Drop = 1,317.95 Pa
- Tube Pressure Drop = 1,519.96 Pa
- q = 1,203,992.94 W

The End