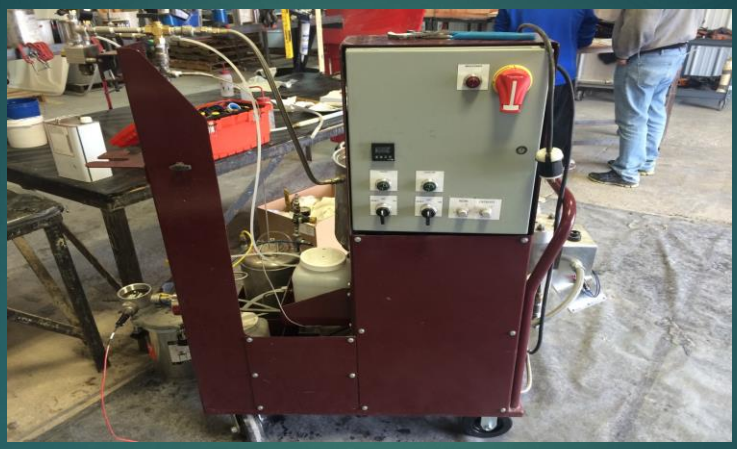
Redesigned Material Mixer

1



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Outline

2

- Executive Summary
  - Background
  - Objective
  - Motivation
  - Deliverables
- Problems/Solutions
- Project Requirements
- System Design
  - New & Old
- System Integration & Testing
- Project Management
  - Cost breakdown
  - Accomplishments
  - Project Risk
- Conclusion
  - Lessons learned
- Demonstration

Executive Summary

3

- Background
  - MIRteq supplies a range of resins for the thermoplastic and thermoset molding industries.
  - They produce high quality, closed molded products at room temperature.
- Examples:

Executive Summary

4

- Objective/Problem
  - MirTeq developed a positive displacement gear pump system that injects resin & catalyst into custom molds.
  - Consistency (Resin temp/motor)
  - User safety
  - Flow meter feedback
- Value proposition/ top-level description
  - Potentiometers
  - Analog output sensor
  - Heating Control System
  - Motor /Drive Recommendations

Executive Summary

5

- Motivation
  - Working with a company
  - Challenge factor
  - Real life experience
- Deliverables
  - Prototype (Redesigned Material Mixer)
  - Final project report
  - Project presentation

Executive Summary

6

- Summary of Schedule
  - Total 17 weeks
  - 12 weeks prototype
  - 5 weeks writing report/presentation
  - 510 hours total (group)
- Summary of cost
  - $1863 (during assembly)

Project Problems & Solutions

7

Problems

- Operator Safety
- Analog Signal Nosie
- Product Consistency

Solution

- User Interface
  - Potentiometer Dials
- Analog Signal Filter
  - Low-Pass RC Filter
- Resin Heater
- Motor Pump Recommendations
  - Tune VSD's

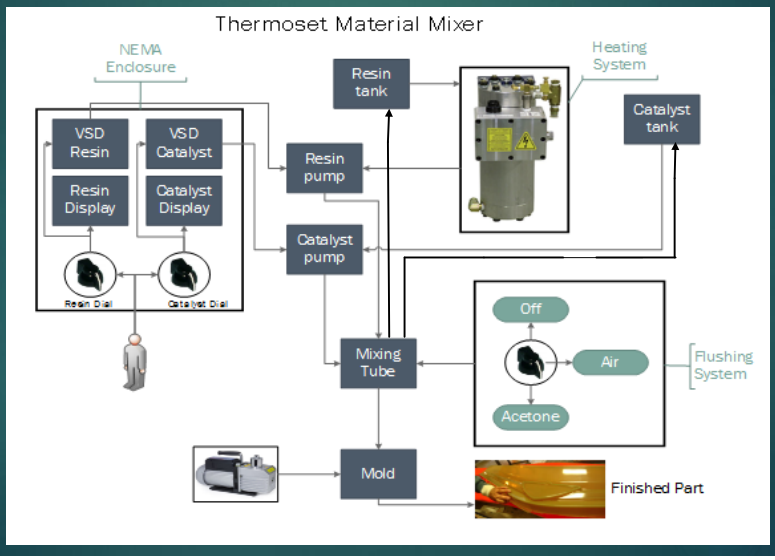
Original System Operation

8

Overview

9

- Top Level View



Project Requirements

10

Operational Requirements	
Shall control the mixture of resin with potentiometer	Demo
Shall control the mixture of catalyst with potentiometer	Demo
Shall allow the resin and catalyst pump to be independently operated	Test
Shall maintain resin temperature	Test

Project Requirements

11

Performance Requirements	
Shall decrease the setup time by at least (1) minute over existing system	Demo
Shall reduce the variance on the Flow meter Feedback system 98%	Test
Shall meter resin to an accuracy of (98)%	Test
Shall meter catalyst to an accuracy of (98)%	Test

Project Requirements

12

Characteristic Requirements	
Shall be housed in a cabinet size of existing enclosure	Inspect
User Interface input shall be potentiometers	Inspect

Functional Requirements	
Shall maintain resin temp via a heating control system	Demo
Shall monitor resin temp via thermostat/ temp. display	Demo

Previous User Interface

13

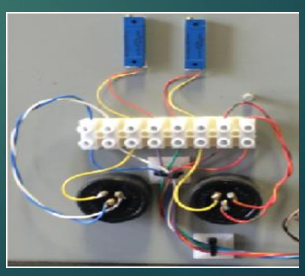
- Unsafe
  - Live wires
- Efficiency
  - Time consuming process
  - Chance of User errors

Resin Output		
Pounds	Grams	3% Catalyst
0.5	227	6.80
0.6	272	8.16
0.7	318	9.53
0.8	363	10.89
0.9	408	12.25
1	454	13.61
1.1	499	14.97
1.2	544	16.33
1.3	590	17.69
1.4	635	19.05
1.5	680	20.41

New Design

14

- The new user interface consist
- Four variable resistors,
  - (2) 2k potentiometer dials
    - wired to the VSD's
    - control the flow rate
  - (2) 1k potentiometer
  - The 1k variable resistors (trim resistors)
    - Set Minimum flow of the resin and catalyst
    - Resin: .6 pound/minute Catalyst: 272.16 grams/minute
  - Improves safety and efficiency
  - Prevents pumps from overheating

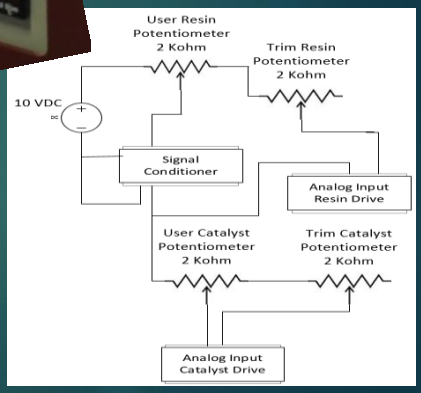


Testing & Validation

15

- Testing/Demo
  - Dials limited resin and catalyst flow rate.
  - Dials controlled the resin & Catalyst
  - Resin dial limits voltage of catalyst dial
- Flow Rate

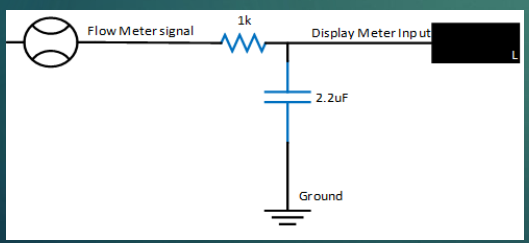
	Min:	Max:
Resin	.6pounds/ minute	3 pounds/ minute
Catalyst	272.16 grams/minute	1360.7 grams/minute

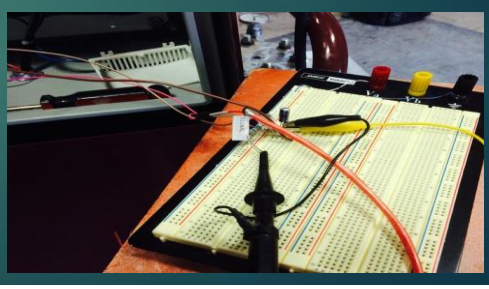


Analog Signal Filter

16

- Design
  - 1k resistor in series with a 2.2uF capacitor wired to ground
  - The flow meter signal connects to the non capacitor side of the resistor. The display input connects to the resistor capacitor side of the circuit.

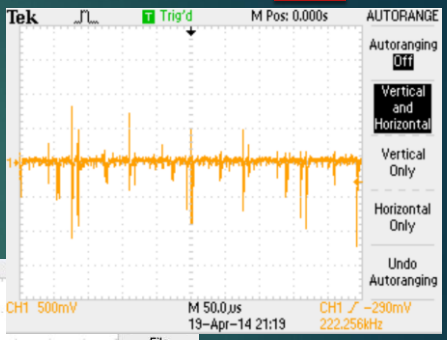


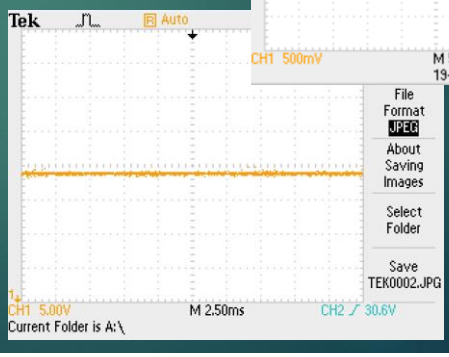


Testing & Validation

17

- Without Filter
  - Frequency = 1 / 75µs
  - Caused by Inverter
- With Filter
  - Eliminated Noise
- Display Meter Settings
- Changes Filter band
  - .01 to .1
- Change Filter
  - 25 tenth of a second = 2.5s

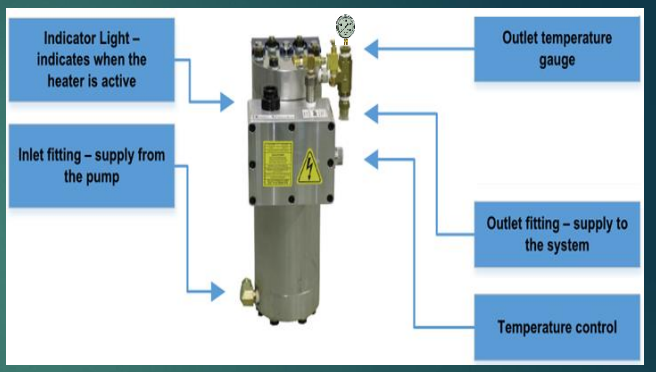




Resin Heating Control System

18

- Discussed Requirement
  - stable temp. 90-100 degrees F
    - 3.5V = 95°F
  - Controlling the temperature = controlling viscosity
  - Allow desirable flow rate
    - Resin 1 pound/minute Catalyst 453.6 grams/minute

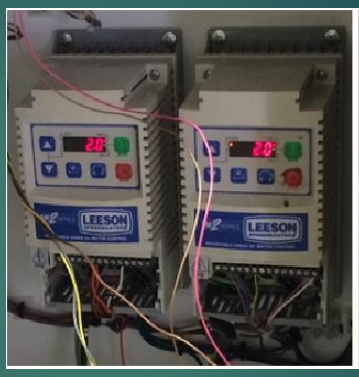


- Recommendations:
  - Hot plate
    - Heat the Resin tank
  - Thermostat
    - Read temp.
  - Thermocouple
    - Controls Resin temp.
- Validation Process
  - Demo
  - Room Temp.

Motor Recommendations & Drive Tune

19

- Resin & Catalyst Pump
  - Resin
    - Max output = 3 lbs/min
    - Min output = .59 lbs/min
  - Catalyst
    - Max output = 40.82 g/min
    - Min output = 3.9 g/min
  - Set ½ HP
- Recommendation
  - Set ¼ HP



Project Management

20

- Cost Breakdown

Cost Breakdown		
Hardware Items	**Estimated Cost**	**Actual Cost**
Misc. Filter Components		
1kΩ Resistor	$10.00	$0.00
2.2uF Capacitor	$10.00	$0.00
Heating System components		
CFH-4000 Heater	$200.00	$1775.00
User Interface Components		
1.29inch Knob/Dial	$5.00	$8.40
(2) Variable Resistors 2kΩ	$20.00	$34.65
(2) Variable Resistors 1kΩ	$20.00	$43.58
Total Cost	**$265.00**	**$1862.63**

Project Management

21

- Project Accomplishments
  - User Interface – March 14th
  - Analog Signal Filter – April 28th
  - Resin Heater – April 28th
  - Resized Motor – April 25th
  - Project Report – April 29th

Risk Management

22

Cost
- (Profit loss - Machine downtime)
- Scheduling time - non work hours

Schedule
- Machine non-functional
- Pre-schedule meeting time with MIRteq

Technical
- Inadequate knowledge of old system
- Testing and troubleshooting redesigned system

Conclusion/Lesson Learned

23

- Important Lessoned Learned
  - Communication
  - Scheduling
- Project Deliverables complete
  - User Interface
  - Analog Signal Filter
  - Resin Heating System
  - Motor / Safety Recommendations

24

Questions ?

DEMO

25