

Cylinder Oven An Exploration and Application in Design

Senior Project ELET 4208 Project Group Spring 2009 Team 12

Represent By:

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Ideal Specialty Gas and Analytical Services [ISGAS]

- Chemical company located in Houston that specializes in Calibrated standards
- Company provides analytical services for a wide range of chemicals
- Developed Gas Chromatography methods data for selected standards
- Modified Gas Chromatography instruments to analyze specific liquid or gas standards





Cylinder Oven

- The cylinder oven is used to clean any impurities that may have been left behind in various types of chemical cylinders. The cylinder oven is also used to sulfur prep cylinders that are to be used for Sulfur mixes.
 - Cylinder oven may be set to any specific range of required temperature
 - Has pulling Vacuum capabilities
 - Cylinder oven is able to coat interiors of cylinders for sulfur mixes with layers of sulfur to keep the sulfur within the mix
 - Purging abilities with pure Nitrogen gas.



Objectives

- Increasing efficient labor and production on the cylinder oven
- Reducing human errors and discrepancies
- Accurate timing and sensory functions
 - Elimination of production cost resulting in human errors





- Current Cylinder Oven
 - Is operated manually by a trained Technician/Operator
 - Each process must be stopped and started by technician that controls the solenoid manually
 - Oven temperature is not automatically controlled, must be monitor at all times
- New Improvements
 - Each process for prepping the cylinder is automatically controlled by the user setting on the microcontroller
 - Sensor are installed to monitor pressure and temperature settings
 - Automated solenoid valve controlled



ISGAS Oven Procedures

Sulfur Cylinder Prep Procedure

- Place cylinders in the oven and attach Stainless Steel CGA fittings
- Close the oven and turn all heaters on
- Turn on vacuum and let oven get up to temp. (100F 110F)
- Purge and vacuum with Nitrogen 4 times.
- □ Fill with 100 psi of Pickle mix. (Replaced with Nitrogen)
- Close all cylinders turn off oven, open doors, and rapidly cool cylinders.
 - The pickle mix must sit in cylinder overnight, then vent.
- Purge and vacuum with Nitrogen two more times.
- Take cylinders out of oven and roll them behind the oven.









Current State of program

Introduction
Menu
Stage 1
Stage 2
Emergency Shutdown







ISGAS Design



ISGAS cylinder oven



Sulfur cylinder with regulator set at 100 psi with needle valve



Top portion of the oven with stainless steel lines with quicker neck connection



Solenoids with manual and timer control





















Components Requirements

□ Microcontroller / LCD Pressure sensor Temperature sensor Solenoids □ 12 volt battery Modified Power strip Heating gun □ Vacuum pump □ Air compressor





Construction Materials

- □ 3/4 inch thick plywood
- Radiant Barrier insulation
- Metal structure frames
- □ Wheels
- Copper coil pipes
- Gauge
- Hatch lock
- Brass Fittings
- Hinges
- Screws
- Handle
- Locking mechanism



Components and Construction Material Costs



| <u>ltems</u> | <u>Quantity</u> | <u>Price</u> | | |
|-------------------------------------|-----------------|--------------|--|--|
| Construction Material | | | | |
| Plywood | 6 | \$52.47 | | |
| Metal frames | 1 | \$18.97 | | |
| 1/4 inch steel/copper coil piping | 1 | \$28.97 | | |
| Quicker-neck valve Connector | 0 | TBD | | |
| Valve gauge | 1 | \$11.27 | | |
| 1/4 fittings and adaptors | 20 | \$66.74 | | |
| Radiant barrier Insulation material | 1 | \$21.99 | | |
| Handles | 1 | \$1.29 | | |
| Hinges | 4 | \$4.76 | | |
| Weather Strip | 1 | \$4.48 | | |
| Wheels | 8 | \$21.59 | | |
| Hardwares | | | | |
| Vacuum pump | 1 | ISGAS LOAN | | |
| Cylinder | 1 | ISGAS LOAN | | |
| Cylinder stand | 1 | \$4.99 | | |
| Air Vent | 1 | \$12.88 | | |
| Air compressor | 1 | ISGAS LOAN | | |
| Electronic Components | | | | |
| Microcontroller | 1 | \$63.00 | | |
| Thermal sensor | 1 | \$3.90 | | |
| Pressure sensor | 1 | \$80.00 | | |
| Surge protector | 1 | \$5.39 | | |
| Solenoid valves | 1 | \$80.00 | | |
| Heater components | 1 | \$59.99 | | |
| Wires | 2 | TBD | | |
| Automative relay switch | 1 | \$24.99 | | |
| BiPom Relay microcontroller addon | 1 | \$24.99 | | |
| Totals | | \$592.66 | | |





Financial Cost

Estimation:

Components/Construction Materials - \$592.66
 Lab Expenses - \$436.50
 Labor Costs - \$51,162.50
 Total Estimation - \$52,191.66



| icros | oft Pro | oject - Senior_Project_Fall_2008_and_Spring_2009_Full(4-22-09) | | | | | | |
|--------------|--------------|--|------------|-------------|-------------|----------------|---|-------------------|
| <u>F</u> ile | <u>E</u> dit | View Insert Format Iools Project Report Collaborate Window | Help | | | | Type a que | stion for help |
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| | | | | | | - · · · · | | 1 ¹ 00 |
| | 0 | lask Name | Duration | Start | Finish | Predecessors 7 | 22 1 8 15 22 29 5 12 19 26 | 3 10 17 2 |
| 107 | \checkmark | Test and install solenoid behind the oven | 1 day | Tue 3/10/09 | Tue 3/10/09 | 9 106 | team 12 | |
| 108 | \checkmark | Test the 8051 microcontroller's components | 1 day | Wed 3/11/09 | Wed 3/11/09 | 9 107 | Team 12 | |
| 109 | \checkmark | Prepare power point presentation | 1 day | Thu 3/12/09 | Thu 3/12/09 | 9 108 | Team 12 | |
| 110 | \checkmark | Review over presentation material | 1 day | Fri 3/13/09 | Fri 3/13/09 | 9 109 | jimmy Nguyen,Zhuo W | ang |
| 111 | \checkmark | Spring Break | 5 days | Mon 3/16/09 | Fri 3/20/09 | 9 110 | – | |
| 112 | \checkmark | ⊟ Week 9 | 4 days | 1on 3/23/09 | Thu 3/26/09 | | ** | |
| 113 | \checkmark | Pick up heating element, relay and temperature sensor | 1 day | Mon 3/23/09 | Mon 3/23/09 | 9 111 | jimmy Nguyen,Zhu | Jo Wang |
| 114 | \checkmark | Begin Programming | 1 day | Tue 3/24/09 | Tue 3/24/09 | 9 113 | Team 12 | |
| 115 | \checkmark | Design circuit | 1 day | Wed 3/25/09 | Wed 3/25/09 | 0 114 | team 12 | |
| 116 | \checkmark | Test heating element and temperature sensor | 1 day | Thu 3/26/09 | Thu 3/26/09 | 9 115 | FTeam 12 | |
| 117 | \checkmark | Week 10 | 4 days | 1on 3/30/09 | Thu 4/2/09 | l | T | |
| 118 | \checkmark | Research on circuit design | 2 days | Mon 3/30/09 | Tue 3/31/09 | 9 116 | Team 12 | |
| 119 | \checkmark | Implement circuit design | 1 day | Wed 4/1/09 | Wed 4/1/09 | 9 118 | Team 12 | |
| 120 | \checkmark | Continue programming | 1 day | Thu 4/2/09 | Thu 4/2/09 | 9 119 | FTeam 12 | |
| 121 | \checkmark | Week 11 | 4 days | Mon 4/6/09 | Thu 4/9/09 | l | | |
| 122 | \checkmark | Intergating the circuit and testing | 1 day | Mon 4/6/09 | Mon 4/6/09 | 9 120 | Team 12 | |
| 123 | \checkmark | Continue with program | 1 day | Tue 4/7/09 | Tue 4/7/09 | 122 | Team 12 | |
| 124 | \checkmark | Pressure test the copper lines for leaks | 1 day | Wed 4/8/09 | Wed 4/8/09 | 9 123 | Team 12 | |
| 125 | \checkmark | Oven heat test | 1 day | Thu 4/9/09 | Thu 4/9/09 | 9 124 | FTeam 12 | |
| 126 | \checkmark | Week 12 | 4 days | 1on 4/13/09 | Thu 4/16/09 | | | |
| 127 | \checkmark | Final check on all components | 1 day | Mon 4/13/09 | Mon 4/13/09 | 9 125 | Team 12 | 1 |
| 128 | \checkmark | Interfacing Temperature and Pressure Sensor | 1 day | Tue 4/14/09 | Tue 4/14/09 | 9 127 | team 12 | 2 |
| 129 | \checkmark | Integrate all components and hardware | 1 day | Wed 4/15/09 | Wed 4/15/09 | 9 128 | Team 1 | 2 |
| 130 | \checkmark | Pretest program | 1 day | Thu 4/16/09 | Thu 4/16/09 | 9 129 | FTeam 1 | 1 2 |
| 131 | \checkmark | E Week 13 | 5 days | 1on 4/20/09 | Fri 4/24/09 | | | |
| 132 | \checkmark | Install oven door and weather strip | 1 day | Mon 4/20/09 | Mon 4/20/09 | 130 | Team | 12 |
| 133 | \checkmark | Install air ventilation | 1 day | Tue 4/21/09 | Tue 4/21/09 | 132 | tean 🔓 | n 12 |
| 134 | \checkmark | Implement and test temperature code | 1 day | Wed 4/22/09 | Wed 4/22/09 | 133 | tear h | n 12 |
| 135 | \checkmark | Program and implement pressure sensor | 2 days | Thu 4/23/09 | Fri 4/24/09 | 9 134 | 🖶 Tea | im 12 |
| 136 | | E Week 14 | 4 days | 1on 4/27/09 | Thu 4/30/09 | | T | |
| 137 | √ | Testing phase and verfiying | 1 day | Mon 4/27/09 | Mon 4/27/09 | 135 | t Te | am 12 |
| 138 | √ | Work on final report | 1 day | Tue 4/28/09 | Tue 4/28/09 | 137 | l l l l l l l l l l l l l l l l l l l | eam 12 |
| 139 | \checkmark | Work on final presentation | 1 day | Wed 4/29/09 | Wed 4/29/09 | 138 | - L - L - L - L - L - L - L - L - L - L | eam 12 |
| 140 | | Final Project Presentation | 1 day | Thu 4/30/09 | Thu 4/30/09 | 139 | h h | leam 12 |
| 141 | - | □ week 15 | 1 day | Mon 5/4/09 | Mon 5/4/09 | | | |
| 142 | | Final Report Due | 1 day | Mon 5/4/09 | Mon 5/4/09 | 9 140 | | Team 12 |
| 143 | | End of semseter | 0 days | Tue 5/5/09 | Tue 5/5/09 | 142 | • | ≱ 5/5 |
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Thank You!

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