Solar Autoclave for Rural Areas

Midpoint Presentation

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Presentation Overview

- Final Design
  - Trough Materials
  - Boiler Materials
  - Pressure Vessel Modifications
  - Pressure Vessel Design
- Bill of Materials
- Gantt Chart
- References

Final Design

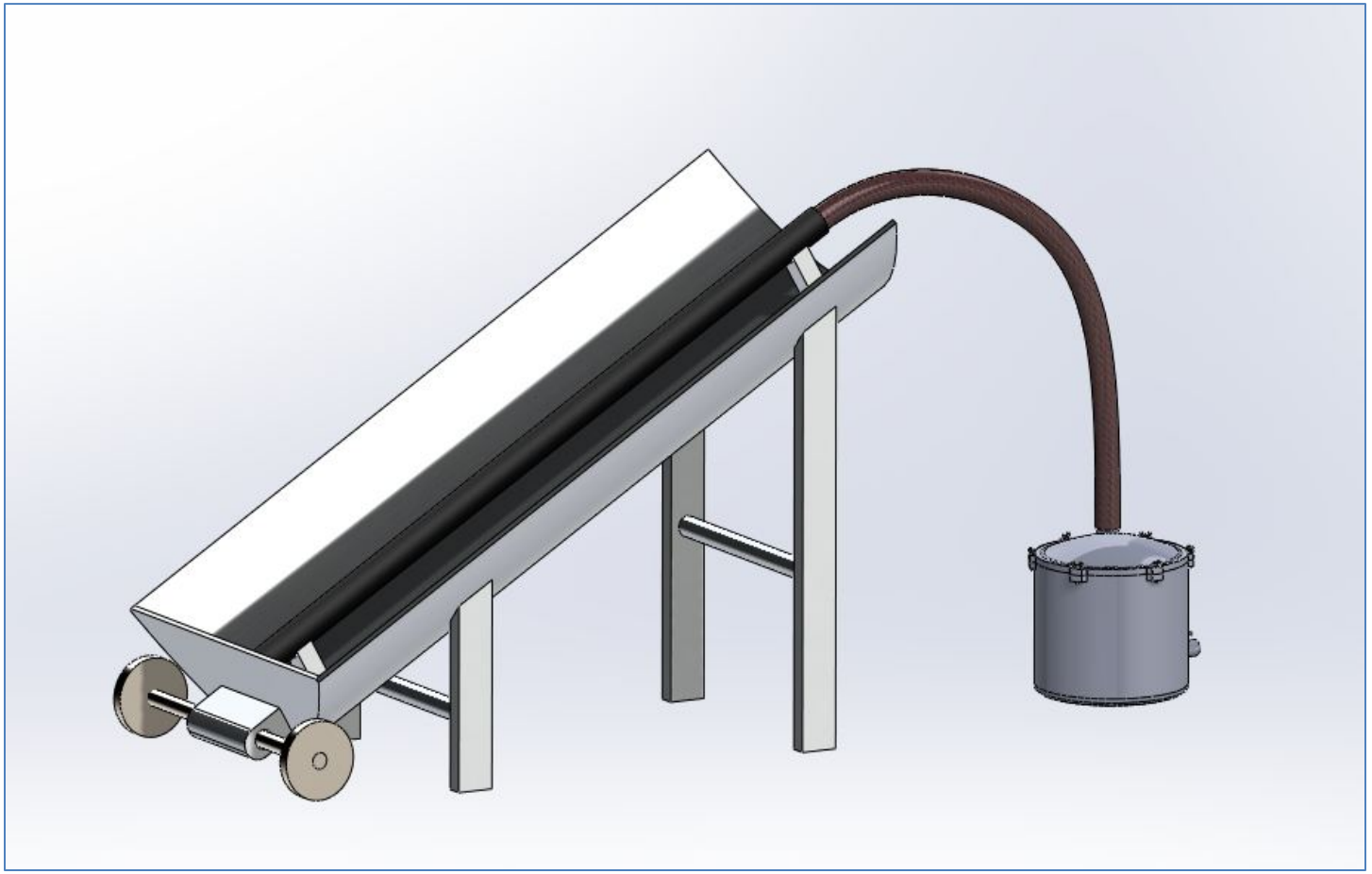

Figure 1: Final Design

Final Design

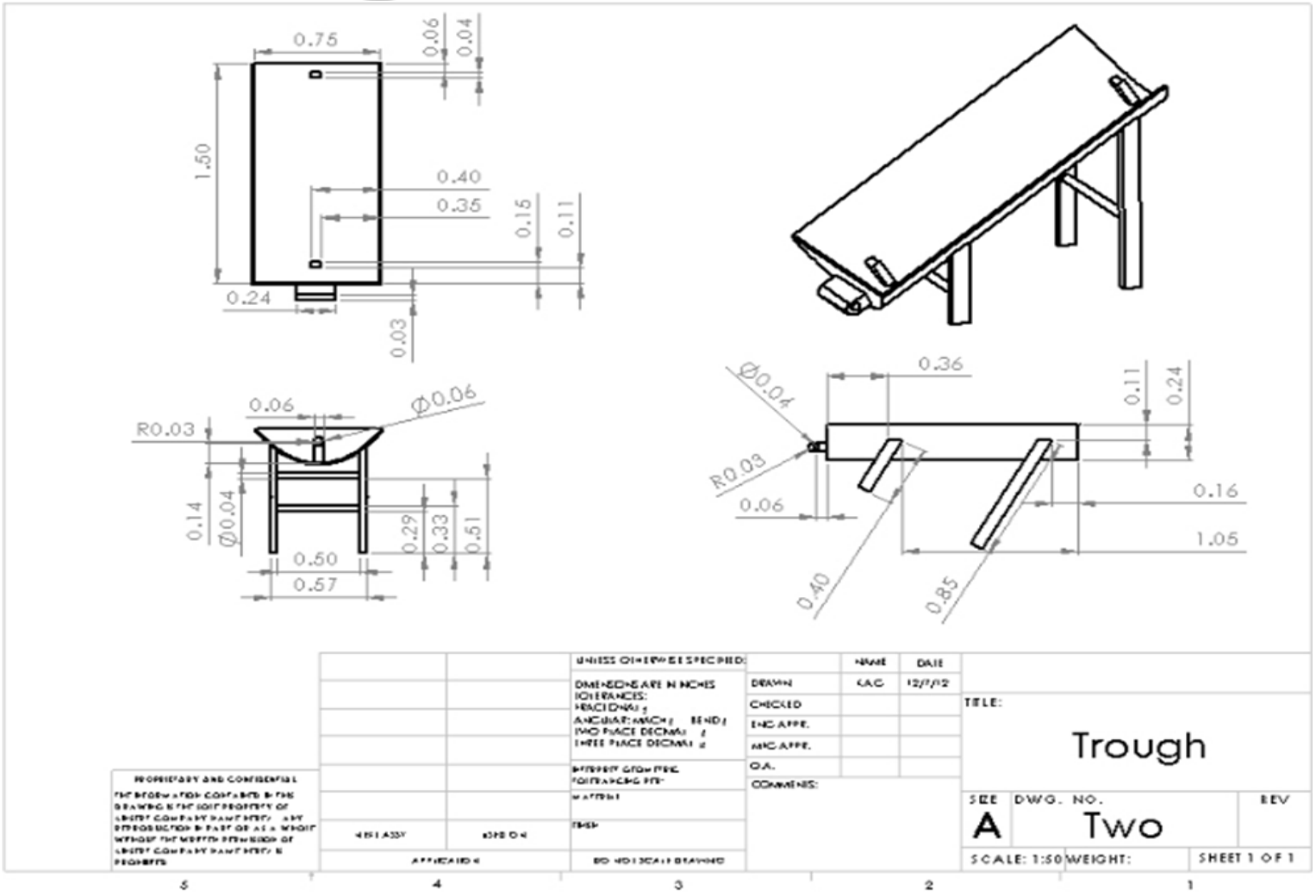

Figure 2: Dimensions for Trough

Trough Materials

- Sheet metal: Zinc 24 gauge (8ft by 4ft)
- Particle board: 5/8” (8ft x 4ft)
- Screws: 2-1/2 inch Zinc Plated (100 count)
- Spray adhesive: “3m super 77 16.75 f. oz. multi purpose spray adhesive”
- Mylar: “Viagrow 25ft mylar 2mil reflective film”

Manufacturing of the Trough

- Cut particle board to shape trough
- Screw in bolts trough sheet metal to particle board
- Apply adhesive
- Place Mylar
- Begin frame design

Figure 3: Parabolic Trough

Materials for the Boiler

- Schedule 40 Galvanized Pipe
- 1-1/4”x10’ long cut to 2 meters, tap and dye for threading
- Max Pressure 300 psi
- Max Temperature 350˚F or 176˚C

Figure 4: Spring pressure cap

Volume Chart

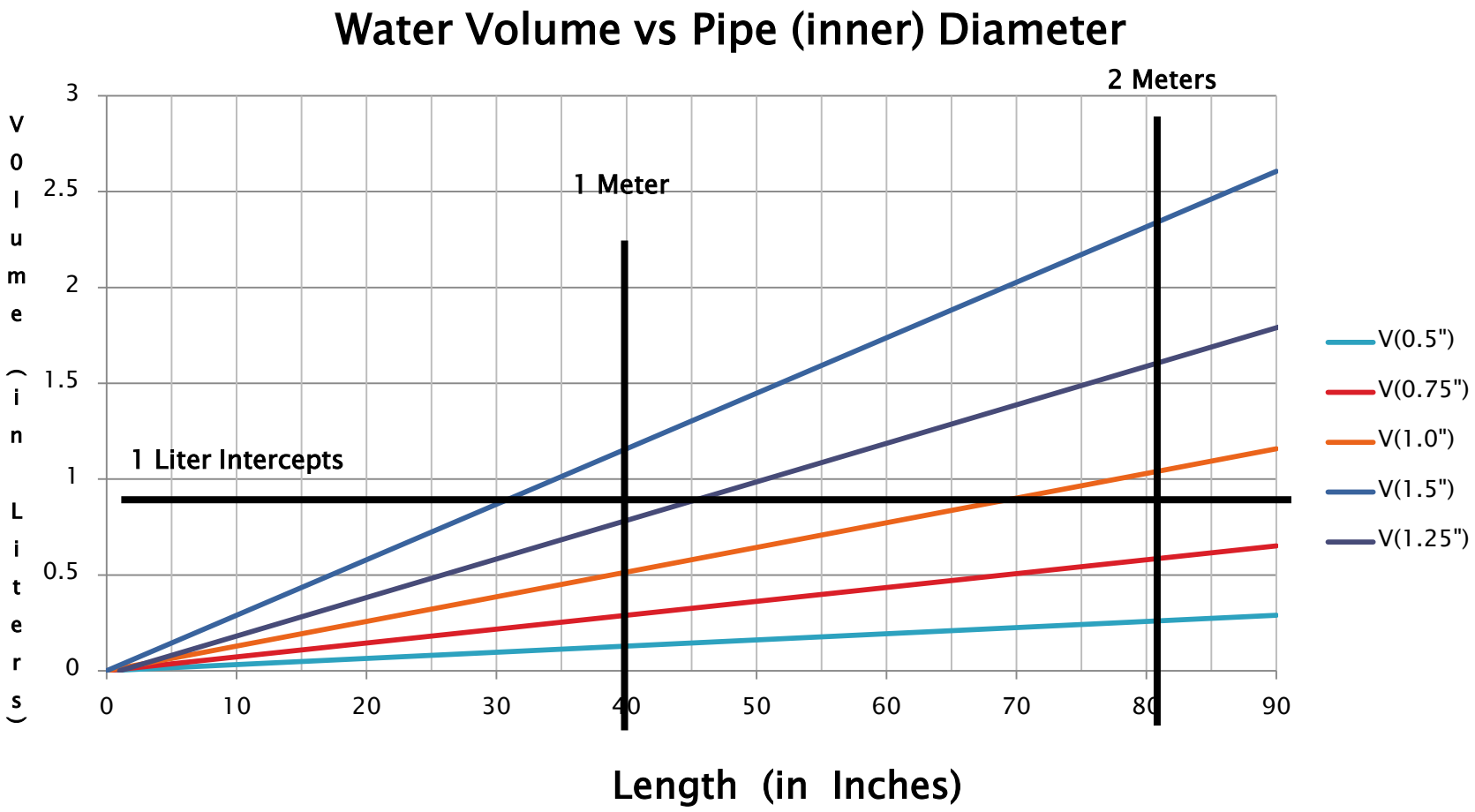

Figure 5: Reference Chart

Materials for Boiler

- 1-1/4” cap for the bottom end of the boiler
- Max pressure 300 psi
- Max Temperature 350˚F or 176˚C

Figure 6: Bottom Cap for Boiler

Materials for Boiler

- 1-1/4" x 1/2" x 1-1/4" Reducing Tee
- Max pressure 300 psi
- Max Temperature 350˚F or 176˚C

Figure 7: Boiler T Fitting

Materials for Boiler

- 1-1/4" Galvanized Plug
- Max pressure 300 psi
- Max Temperature 350˚F or 176˚C

Figure 8: Water Plug

Materials for Boiler

- 1/2" x 260 in. PTFE Tape
- Max temperature 500˚F or 260˚C

Figure 10: Teflon, for Water Tight Seal

Hose Fitting

- Dixon Hose Barbs

Figure 11: Hose Fitting

Hose Material

- Gates Durion – Silicone Heater Hose
- Max pressure 60 psi
- Max temperature 400˚F or 205˚C

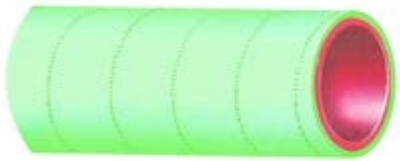

Figure 12: Hose

Pressure Vessel

- Mirro Matic 394M 4 Qt. Pressure Cooker
- Modifications:
  - Hose fitting on top
  - Temperature/Pressure gauge on top
  - Valve on bottom
  - Insulation

Figure 13: Pressure Vessel Base

Pressure Vessel

- Mirro 9898 Pressure Regulator
- 5-10-15 psig
- Automatically regulates pressure

Figure 14: Pressure Regulator

Pressure Vessel

- 1/2” Brass Ball Valve with NPT Full-Port
- Max pressure 600 psi
- Max temperature 300°F or 149°C

Figure 15: Brass Ball Valve

Pressure Vessel

- Miscellaneous materials for fittings:
  - 1/2” Rigid or IMC Conduit Nipple
  - 1/2” Anvil Galvanized Locknut
  - 2-1/2” Galvanized Flat Washer

Figure 16: Conduit Nipple

Figure 17: Locknut

Figure 18: Washer

Pressure Vessel

- Honeywell TD-165 1/4” NPT Connection Tridicator
- Monitors internal temperatures and pressures

Figure 19: Temperature & Pressure Gauge

Insulation

- Foil-backed fiberglass pipe wrap insulation
- R value of 3

Figure 20: Fiberglass insulation

Pressure Vessel Design

- Pot
- Lid
- Gasket
- Valve
- Hose fitting
- Temperature/Pressure gauge

Figure 21: Pressure Vessel

Pressure Vessel Design

- Gasket materials
  - Cork
  - Leather
  - Silicone
  - Metal jackets

Figure 22: Metal Jacket Gasket

Bill of Materials

		Material	Quantity	Unit Cost ($$)	Source	Details	Cost ($$)
Trough	1	Sheet Metal	1	20.00	Copper State	Zinc 24 gauge (8ft*4ft)	20.00
	2	Particle Board	1	17.32	Home Depot	5/8'' (8ft*4ft)	17.32
	3	Screws	1	19.99	Home Depot	2-2inch Zinc Plated (100 count)	19.99
	4	Spray Adhesive	1	5.77	Home Depot	3m super 77 16.75 f.oz.	5.77
	5	Mylar	1	18.96	Home Depot	Viagrow 25ft mylar 2mil reflective film	18.96
Boiler	6	Schedule 40 Galvanized Pipe	1	36.75	Home Depot	1.25''*10' long cut to 2 meters	36.75
	7	Cap	1	6.64	Amazon	1-1/4”	6.64
	8	Reducing Tee	1	11.42	Amazon	1-1/4" x 1/2" x 1-1/4"	11.42
	9	Galvanized Plug	1	3.95	Amazon	1-1/4"	3.95
	10	Brass Ball Valve	1	14.96	Amazon	3/4" Male to Female Brass Ball Valve	14.96
	11	Tape	1	0.97	Home Depot	1/2" x 260 in. PTFE Tape	0.97
	12	Hose	6	8.20	O'Reilly	Gates Durion Silicone Heater Hose	49.20
Pressure Vessel	13	Hose fitting	1	25.50	Amazon	Dixon 3/4"X1/2"	25.50
	14	Hose fitting	1	25.50	Amazon	Dixon 3/4"X1/2"	25.50
	15	Valve	1	8.56	Home Depot	1/2" Brass Ball Valve	8.56
	16	Insulation	1	5.98	Home Depot	3" x 25' Foil-backed Fiberglass	5.98
	17	Pressure Regulator	1	17.95	Amazon	5-10-15 psig	17.95
	18	Pressure/ Temperature gauge	1	22.97	Honeywell	TD-165 1/4" NPT connection	22.97
	19	Miscellaneous	1	15.00	Home Depot	Locknuts, Conduit Nipple, Washers	15.00
	20	Total	24	**327.39**			**327.39**

Figure 23: Bill of Materials

Gantt Chart

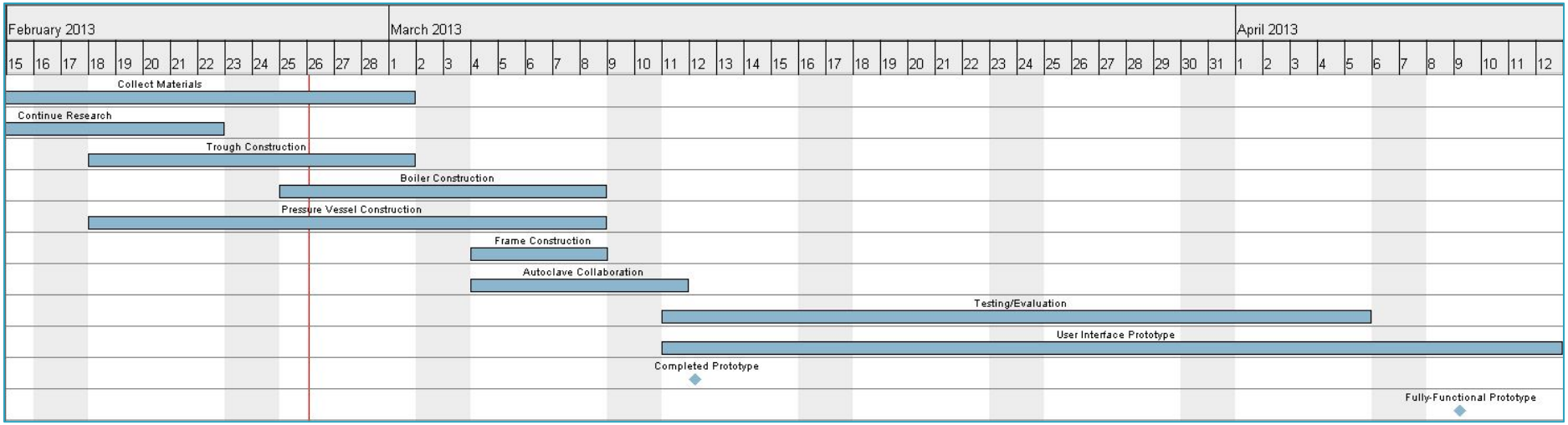

Figure 24: Gantt Chart

References

- **Sponsor**: Dr. Brent Nelson
  - brent.nelson@nau.edu
- **Text:**
  - Michael J. Moran and Howard N. Shapiro. Fundamentals of Engineering Thermodynamics 6th. 2008. Print.
  - Richard Budynas and Keith Nisbett. Shingley's Mechanical Engineering Design 9th. 2010. Print.
- **Project Website:**
  - http://www.cefns.nau.edu/interdisciplinary/d4p/EGR486/ME/13-Projects/SolarAutoclave/
- **Web Sources:**
  - Centers for Disease Control and Prevention:
    - http://www.cdc.gov/hicpac/Disinfection_Sterilization/13_0Sterilization.html
  - Global Challenge:
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  - Solar Sterilisator:
    - http://www.solare-bruecke.org/projekte-Dateien/Solarsterilisator/summary%20english.html
  - TravelState.gov:
    - http://www.travel.state.gov/
  - Science Direct:
    - http://www.sciencedirect.com/science/article/pii/S1364032110001206

Questions?