Polyethylene Pipes Systems

Project Update
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Agenda

1. Previous Stage
2. Current Progress
   1. FTIR Measurements
   2. Prototype Assembly and Testing
   3. Web Site and Lab Notebook
3. Next Steps
   1. Prototype Testing
   2. Sample Production and Testing
4. Gantt Chart
Previous Stage

- Defined goal: Maximize the strength to cost ratio of the tubes produced through heat-welding
- Finalized design for heat-welding device
- Strength and Cost Modelling
Fourier Transform Infrared Spectroscopy (FTIR)

- We used Attenuated Total Reflectance (ATR), which is a form of FTIR.

- Peaks of Infrared Spectrum correspond to frequency of vibrations between bonds of atoms in materials.

Image adapted from Pekin Elmer’s Technical Notes on FTIR-ATR, www.perkinelmer.com
FTIR Results

- Peaks observed comparable to those obtained from literature\(^2\)
- No significant traces of additives
- Processed Bag show lower peak intensity

2. Table adapted from “Physical and mechanical behaviour of hot rolled HDPE/HA composites” by A. Pandey, E. Jan, P.B. Aswath, published 12, April 2006.
Prototype Assembly

- Still need to attach free roller
- Make a hand-crank
- Better attachment for heating element
- Insulate heating element
- Add teflon tape to avoid bag sticking to roller
- Attach force gauge
Prototype Testing
IT WORKS!!!!

121°C
Prototype Testing

- Voltage: 55V
- Resistive Heater Temperature > 300°C
- Roller Temperature > 125°C
- Time to reach temperature ~ 20-30 min

Our estimate from last presentation:
- resistive heater needed to be 350°C to heat roller to 124°C.
Sample Production and Testing

- Heat-weld bags for different combinations of Temperature (T), Time (t), and Pressure (P)
- Test mechanical strength of heat-welded samples in Instron
  - ASTM Standards for Weld Integrity
- Determine microstructure of heat-welded samples
  - XRD, SEM, FTIR
Web Site and Lab Notebook

Polyethylene Pipe Systems
The Environmentally Friendly Pipes

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PEPS: The Environmentally Friendly Pipes

February 20th, 2010
Temperature/Pressure/Time Dependence of welding 2-layers of HDPE bags

Introduction
From our previous experiments, it was observed that the quality of the samples that we heat welded together were affected mainly by three main parameters—time of heat welding, temperature at which heat welding is performed and the pressure applied while heat welding. We therefore performed tests to obtain the combination of the three parameters which provided the best heat welded samples.

Materials
Iron
Mass Balance
Thermocouple
Polyethylene Bags
Stop watch
Aluminum Foil

Procedure
Aluminum foil was used to cover the bottom of the iron. A stable required temperature is measured using the thermocouple. A cloth was used to cover the top of the mass balance and the 2-layers of polyethylene bags to be welded together placed on it. The iron is placed on top of the two layers while ensuring the required pressure is measured on the mass balance. The stop watch is used to measure the time elapsed for heat welding. For each of the experimental results listed below two parameters were kept constant, while the other one was varied.

Observations/Results
Previous Gantt Chart

1. Decisions/Designs:
   1.1 Choose Project: 100% complete
   1.2 Initial Conceptualization of problem: 100% complete
   1.3 Brainstorming of possible solutions: 100% complete
   1.4 Picking a heat source: 100% complete
   1.5 Creation of Final Design

2. Testing:
   2.1 Early "proof-of-concept" testing: 75% complete
   2.2 Prototype Testing: 0% complete

3. Design Construction:
   3.1 Idea Mock-Ups: 25% complete
   3.2 Creation of components: 0% complete
   3.3 Final Prototype: 0% complete

4. Documentation:
   4.1 Create Website: 100% complete
   4.2 Update Website with Progress: 0% complete
   4.3 Maintain Lab Notebook: 40% complete
   4.4 Final Presentation: 0% complete

Last time
Current Gantt Chart

1. Decisions/Designs:
   - 1.1 Choose Project: 100% complete
   - 1.2 Initial Conceptualization of problem: 100% complete
   - 1.3 Brainstorming of possible solutions: 100% complete
   - 1.4 Picking a heat source: 100% complete
   - 1.5 Creation of Final Design

2. Testing:
   - 2.1 Early "proof-of-concept" testing: 75% complete
   - 2.2 Prototype Testing: 5% complete

3. Design Construction:
   - 3.1 Idea Mock-Ups: 75% complete
   - 3.2 Creation of components: 25% complete
   - 3.3 Final Prototype: 0% complete

4. Documentation:
   - 4.1 Create Website: 40% complete
   - 4.2 Update Website with Progress: 75% complete
   - 4.3 Maintain Lab Notebook: 40% complete
   - 4.4 Final Presentation: 0% complete

TODAY