Title: Mechanical Testing System Coupled with an Environmental Chamber for Hydrogels

Names:
Team: Gabriel Martinez-Diaz, Darcee Nelson, Charlie Haggart, Mike Piche
Client: Prof. Weiyuan John Kao
Advisor: Paul Thompson

Date: 10/2/02 – 10/8/02

Problem Statement: To update an existing procedure to make dog-bone stencils, approved by
the American Society for Testing Materials (ASTM), and to test an environmental chamber, built
in BME 301, to be used with a mechanical testing system in order to test the mechanical
properties of hydrogels including stress, strain and creep.

Restatement of Team Goals:

Tensile Testing
1. Talk to Bill Hagquist in the ME shop about seals
2. Design and build new part of chamber to fit over the bottom grip apparatus
3. Check BME funding for ordering materials

Creep Testing
1. Talk to Dr. Kao about design constraints
2. Research weights and grip components of design
3. Start preliminary design sketches.

Summary of Accomplishments:

Tensile Testing
1. Met with Bill Hagquist to discuss modifications of the chamber necessary so that no
moisture would come into contact with steel portions of the Instron 1000 machine, as specified by
John Dreger in the 1313 Eng. Hall testing laboratory. Discussed an entirely new design, which
would essentially render the current chamber useless, and would require a new set of grips, as
well as new materials and labor to construct a new, more mobile, dynamic chamber. Options of
modifying the current chamber were also discussed. Bill said that this would be possible, and less
expensive, but would not be as robust as a completely new design.
2. Met with Dr. Kao to discuss current progress with the chamber. Agreed that modifying
the current chamber was a better alternative for now, which includes machining a new bottom piece
for the chamber that would protect the Instron 1000 from the testing solution.
3. Discussed possible solutions to hold the PVC hose during testing, including using knobs
and/or shaft collars.
4. Talked to Corrine Bahr and Dr. Kao about BME Funds. Found that the BME department can
only provide $100 unless more money is applied for. Dr. Kao said that funding through his lab
was a possibility.

Creep Testing
1. Researched displacement/linear, and ultrasonic transducers. Found that displacement/linear
transducers are accurate but very expensive. Ultrasonic transducers are accurate and cost
efficient.
2. Talked to Professor Webster about feasibility of design ideas and other possible ways to measure displacement. Measuring displacement using an ultrasonic transducer/receiver would require additional circuitry that would have to be protected from the aqueous testing environment, but would be possible to do. Prof. Webster suggested using potentiometer components from a computer mouse that would measure displacement from outside the aqueous solution. This design would require a basic computer program to obtain measurements.

**Statement of Team Goals:**

Tensile Testing
1. Begin work on modifying the environmental chamber.
2. Define IPNs for tensile testing, to be testing with chamber
3. Begin work on midsemester presentation.

Creep Testing
1. Use PDMS stencils to make hydrogel samples for initial creep testing.
2. Perform preliminary creep testing using a basic set-up to get an idea of creep properties of hydrogels (i.e. Length of creep test, approximate testing loads, approximate elongation, etc.)
3. Compare and contrast designs mentioned above as well as other design ideas including using scales and “eyeballing” displacement, or using a digital camera to take measurements.
4. Design sketches.
5. Meet with Dr. Kao to share design ideas.

**Project Schedule:**

<table>
<thead>
<tr>
<th>Date</th>
<th>Tasks</th>
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<tbody>
<tr>
<td>9/4 - 9/10</td>
<td>Define team roles and outline semester goals</td>
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<tr>
<td>9/11 - 9/17</td>
<td>Make a schedule for semester, update PDS, and set-up meeting with client</td>
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<tr>
<td>9/11 - 9/20</td>
<td>Testing of existing chamber (temp, seals, visibility, compatibility with Instron 1000)</td>
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<td>9/17 - 9/24</td>
<td>Brainstorm designs for creep testing apparatus, and for modifications of chamber for Tensile testing</td>
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<tr>
<td>9/25 – 10/17</td>
<td>Make modifications to chamber for tensile testing, develop and finalize designs of creep testing apparatus</td>
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<tr>
<td>10/14 - 10/17</td>
<td>Work on midsemester presentation</td>
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<td>10/18</td>
<td>Midsemester presentation</td>
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<tr>
<td>10/19 - 11/5</td>
<td>Update PDMS stencil procedure, obtain more EPON masters, finish/test modifications of Chamber for tensile tests, build creep testing apparatus</td>
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<td>11/6 - 11/29</td>
<td>Tensile testing and creep testing/data analysis</td>
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<td>11/30 - 12/12</td>
<td>Preparation of final paper and poster presentation</td>
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<tr>
<td>12/13</td>
<td>Poster presentation</td>
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<tr>
<td>12/14 - 12/20</td>
<td>Final meeting with advisor</td>
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_Last updated: 10/7/02_

**Difficulties:** none at this time

**Activities:**
Team: Friday team meeting, 2 hr

Gabriel: Discussion on EPON masters, 0.5 hr
Work on PDS, emails, and notebook (Miscellaneous), 1 hr
Preparation for client meeting, 1 hr
Meeting with client, 1 hr
Preparation of goals/progress report 1 hr

Total: 6.5 hr
Cumulative Time: 30.5 hr

Darcee: Meeting with Mike and researching linear and ultrasonic transducers, 2 hrs
Meeting with Prof. Webster, 0.5 hrs
Writing progress report, 1 hr

Total: 5.5 hr
Cumulative Time: 29.0 hr

Charlie: Notebook work, 1 hr
Meeting with Dr. Kao, 1 hr
Meeting with Bill Hagquist, 1 hr

Total: 5 hr
Cumulative Time: 28.5 hr

Mike: Meeting with Darce, 1.5 hrs
Meeting with Prof. Webster, 0.5 hrs
Researching ultrasonic transducers, 1 hr

Total: 5 hr
Cumulative Time: 27.5 hr