

11.45 – 13.30 Friday, 2 July 2010

Demonstration 3:

Engineering-Labs.net <--

Remote Labs

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REV2010
[Demonstration](#)



In this demonstration, we will explore

- ways to use the capabilities of remote experimentation in classes and home assignments
- where remote labs have advantages and limitations
- how to put experimental equipment on-line

Examples will include

- controls systems
- chemical engineering equipment

Engineering labs for undergraduate education have been on-line at UTC since 1995. You will see and operate the remote experiments with different systems. You will learn what would be needed for you to get some of your laboratories on-line.

You will conduct experiments as students conduct them and learn what the opportunities and limitations are.

Explore the various laboratory pedagogies of

Modeling & Simulation

-
- + Time Freedom
 - + Location Freedom
 - = Computer-mediated sensation
 - = MATLAB UI
 - = Simulink UI
 - = Control Station UI
 - = Excel UI

Local Experiments

-
- + "Hands on"
 - + Watchable in small groups
 - + Multi sensory
 - = Control Panel UI
 - + Known data rate
 - Time Constrained
 - Location Constrained
 - Personnel Constrained

Remote Experiments

-
- + Time Freedom
 - + Location Freedom
 - = Computer-mediated sensation
 - = Simulink UI
 - = Control Station-like UI
 - = Watchable in disperse groups
 - + Known or stochastic data rate
 - Coordination Constrained

<http://www.engineering-labs.net>

REV2010

Engineering-Labs.net --> **Demonstration: Remote Labs**

Jim Henry, UTC

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0. Follow instructions

1. Sit in alphabetical order by first name
2. Divide yourselves into 5 equal-sized (or nearly so) teams
3. Tell your team mates some lie about yourself
4. Select team roles: Boss, Surfer, Driver, Watcher, Speaker, Go-fer, Analyst

From left to right, as seen by the leader, your team names are

<u>AC-Motor-driven generator output controller</u>		TeamA
<u>Barometric units device controller</u>		TeamB
<u>Cylindrical tanks holding water controller</u>		TeamC
<u>Distillation controller</u>		TeamD
<u>Flow rate controller</u>		TeamF

Ask the leader to take a photograph of your team
Quickly introduce yourselves to the whole assembly

System Identification

Teams **A, B, C & F**:

Run a "Step" input

Suggestions: Initial steady-input = 33%, step-height input = 33%

Be ready to report your observations

Analyze for Gain (K), time-constant (τ) and dead-time (t_o) (don't forget units!)

Use Ziegler-Nichols (or something else) to estimate controller gain (K_c) and integral-time (τ_{sub-I})

Teams **D**:

Run an experiment with Controller gain=0

Be ready to report your observations

Feedback Control

Teams **A, B, C & F**:

Run a "PI controller" input to show your customer **FAST** and **ACCURATE** control at set point

Be ready to report your observations

Teams **D**:

Run an experiment with another Controller gain

Be ready to report your observations

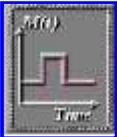
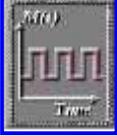
Welcome to the Controls Laboratory Experiments for the Voltage System

[Auf Deutsch](#) [En Espanol](#)

Running on the Internet since April, 1997

Select an Input Function:

[Equipment Pictures](#)

 Constant	 Step	 Sine
 Pulse	 Custom	 Ramp
 Relay		

Select a Feedback Control:

 Proportional	 Proportional-Integral
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**** CONTINUOUS IMPROVEMENT ***

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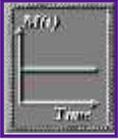
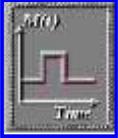
Last updated 1 February 2002

Feedback welcome & invited to [Send E-Mail to Lab-Master](#)

[Home Page of The University of Tennessee at Chattanooga](#)

Welcome to the Controls Laboratory Experiments for the Pressure System
Running on the Internet since June, 1995

Select an Input Function:**Equipment Pictures**

 <u>Constant</u>	 <u>Step</u>	 <u>Sine</u>
 <u>Pulse</u>	 <u>Custom</u>	 <u>Ramp</u>
 <u>Relay</u>		

Select a Feedback Control:

 <u>Proportional</u>	 <u>Proportional-Integral</u>
--	--

**** CONTINUOUS IMPROVEMENT ***

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Last updated 6 April 2000
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FRC- Experiments

NOTICE: You will need a [FREE LabVIEW Plug-in to run these experiments. Click HERE](#)

<p><u>FRC Constant and Step Response Control Panel</u></p>	<p><u>FRC Sine Control Panel</u></p>
<p>2 Tank Water Level Control</p>  <p><u>Click here to see live video</u></p>	
<p><u>2 Tank Water Level Control Constant Input or Step Input</u></p>	<p><u>2 Tank Water Level Control Sine Input</u></p>
<p><u>2 Tank Water Level Control Proportional Feedback Control</u></p>	<p><u>2 Tank Water Level control Proportional-Integral Feedback Control</u></p>

University of Tennessee at Chattanooga
Engineering Laboratories on the Web

Constant Input**Distillation Station****Enter this Information about you:**

||||

Name <input type="text" value="* Required *"/>	Location <input type="text" value="* Requested *"/>	E-mail address <input type="text" value="* Requested *"/>
--	---	---

Enter these Parameters for the Experiment:

|||||

Length of experiment (min): <input type="text" value="15"/>	Reflux value (%): <input type="text" value="30"/>
Feed Pump Setting: <input type="text" value="3"/>	Reboiler Heat Input (Watts): <input type="text" value="2000"/>

Copyright 1996-2000 Jim Henry
Designed for Remote data input to LabVIEW program "Distillationpanel-FV.vi"
Last updated 6 April 2000
Feedback welcome & invited to [Send E-Mail to Lab-Master](#)

REV2010 using the UTC Distillation Column

After you have read these instructions, use Internet Explorer, go to <http://distillation.engr.utc.edu/REV2010/REV2010-Distillation.htm>

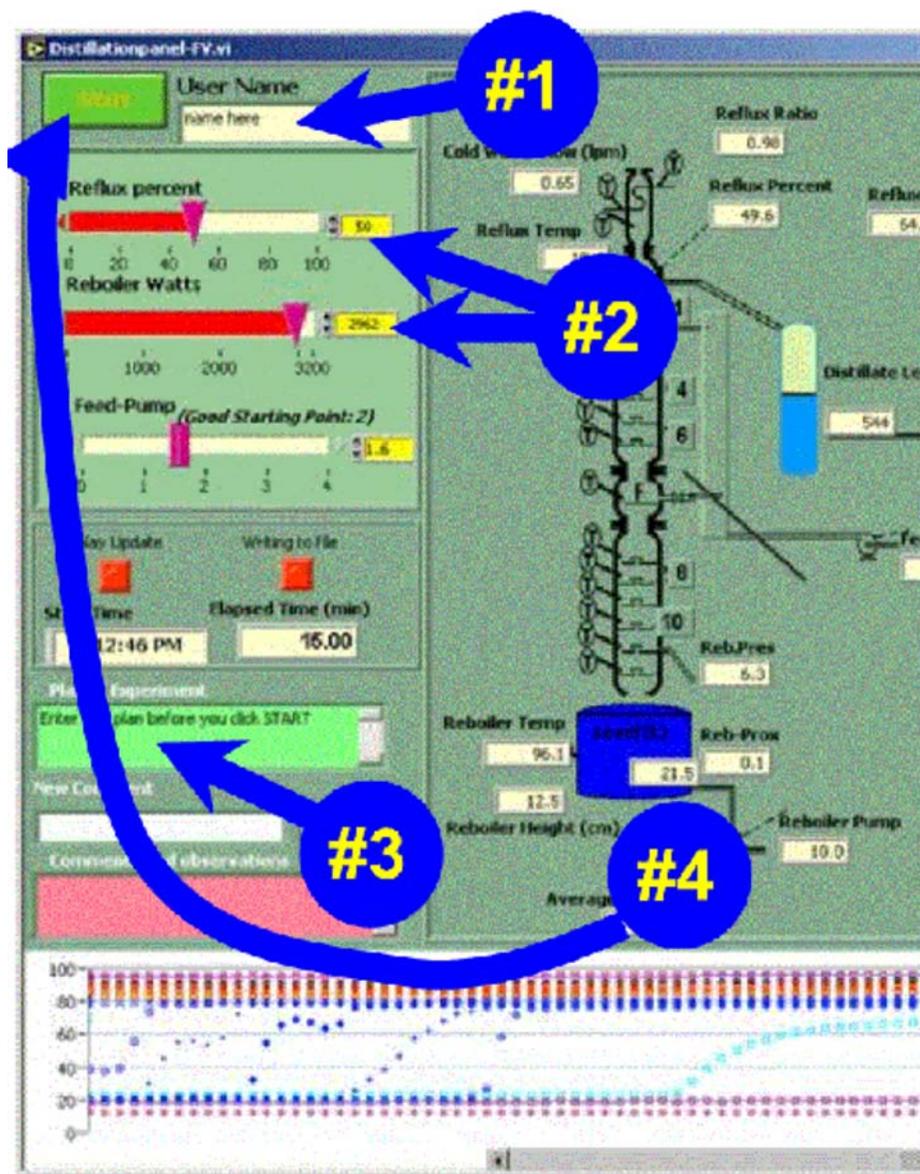
Step 1: Install the [LabVIEW Run-Time Engine 7.1 - Windows/2000/NT/XP](#)

(click on that link, click on [LVRunTimeEng.exe](#) You may be asked to register; it is free and you won't be spammed. Download and then install.)

Step 2: Once you install the proper Internet Explorer plug-in, you will see a panel like the one below.

Enter the information as indicated at the circles.

1. Put in your name like this: REV-2010-Lynn-Doe (Use your name with hyphens)
2. Put in the Reflux Percent you want and put in the Reboiler Power you want
3. Put in some plan for your experiment.
4. Click start



Suggestions for a starting place:

A. If the column is "cold," you will have to warm up everything. This takes about 15-30 minutes.

- a. Put in your name, your plan ("Warm-up") and 3000 Watts and click "Start"
- b. Run until the trays have all been heated up (to at least 70 degrees)

B. Decide what Reflux Percent (Suggestions: 40%, 70% or 90%) you want, set the Feed-Pump to zero and click "Start"

Once you open the distillation control panel, left-click on the panel image. You may see a small yellow box in the middle that says "Control Granted." If you don't see it, right-click on the panel image and choose "Take control" if it is available to you. Once you have taken control, your computer (and you) have control of the distillation column for 3 hours. If you close that browser window or go away from that window, you lose control if there is someone else waiting. So: **DO NOT CLOSE THE BROWSER WINDOW WHILE YOU ARE RUNNING AN EXPERIMENT.**

The experiments will run for 15 minutes. You can change Reflux Percent or Reboiler Watts at any time in the run.

If you want to run for longer than 15 minutes, you may immediately click [START] after the preceding run is completed. You may do this as often as you wish.

Example runs are at [First 15-minute run](#) (the reboiler is heated to about 80 degrees) and [Second 15-minute run](#) (where the reboiler starts boiling and trays 12, 11, ... 6 are heated up) and [Third 15-minute](#) run (where, at about 8 minutes, you see all the column is up to operating temperature).

To analyze the experiment you will need

- A. the initial volume of the mixture in the reboiler
- B. the initial concentration of the mixture in the reboiler
- C. the distillate flow rate as a function of time, $d(t)$
- D. the distillate composition as a function of time, $y(t)$
- E. the reboiler composition as a function of time, $x(t)$

A. and B. will need to be given to you by the operator or you can request your desired values of the operator.

C. can be calculated by you [as shown on this page](#)

D. and E. are to be calculated by you from the (assumed) vapor-liquid equilibrium temperatures at those points

To watch Live Video, click here </Labs/Videocams.htm>



Distillation control panel

[UTChattanooga](#) Distillation System

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REV2010 Procedure

- 1 -- Enter your name and school in the "User Name" box
- 2 -- Put the Reflux to 100%. Put the Feed Setting at 0
- 3 -- Put the Reboiler Heat at 3000 Watts.
- 4 -- Enter name: REV2010-Name (either student name or team name)
- 5 -- Enter "Plan of Experiment "
- 6 -- Click START
- 7 -- Heat the column up until the entire column is hot.
- 8 -- Change the Reboiler heat to the assigned Reboiler Watts
- 9 -- Wait until you observe that the column is a steady state
- 10 -- Change the reflux % to your assigned reflux %
- 11 -- Observe tray 1 temperature and distillate pumped volume until the tray 1 temperature approaches 100 degrees
- 12 -- Click STOP

**VERY NEW -- Watch data
as it is collected**

Click [HERE](#) and then click on the ID number for your experiment.

Do this for EACH 15-minute run.

This allows you to observe more accurately the temperatures, etc.

NEW

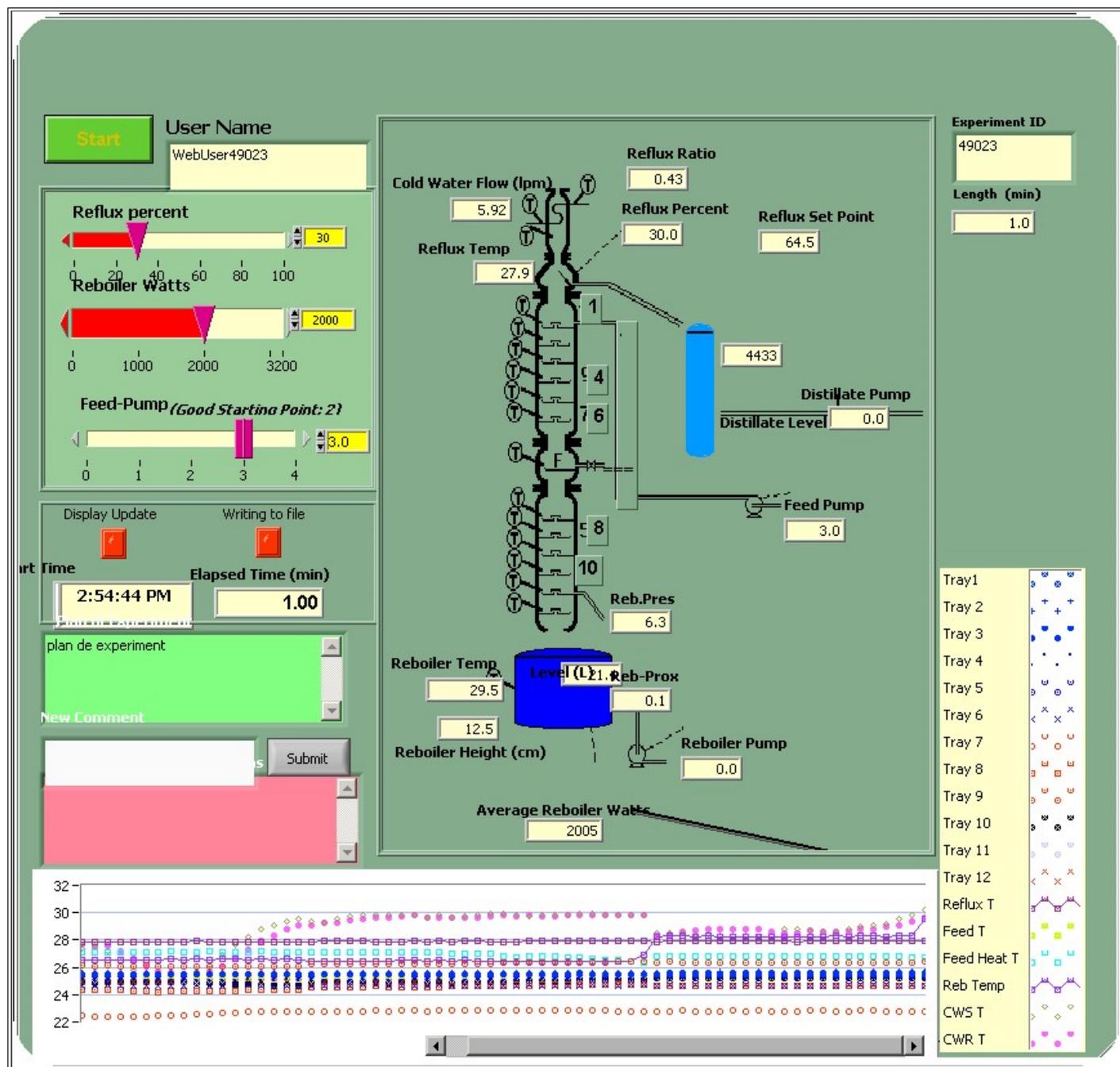
[Plot this data in Excel](#)

[Video Cameras](#)

Your experiment will run for 15 minutes and then automatically stop.

You can IMMEDIATELY click [START] again to string together several 15 minnute periods for a complete experiment.

Right-click on the control panel to take control or release control, if you want



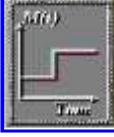
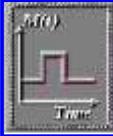
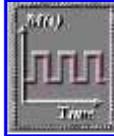
See your data at <http://chem.engr.utc.edu/Weblab/>
search for your name to find your experiments

Or see your data here [/Distillation/](#) and search for the date & time of your run.

Welcome to the Controls Laboratory Experiments for the Flow System
Running on the Internet since February, 1996

Select an Input Function:

[Equipment Pictures](#)

 Constant	 Step	 Sine
 Pulse	 Custom	 Relay

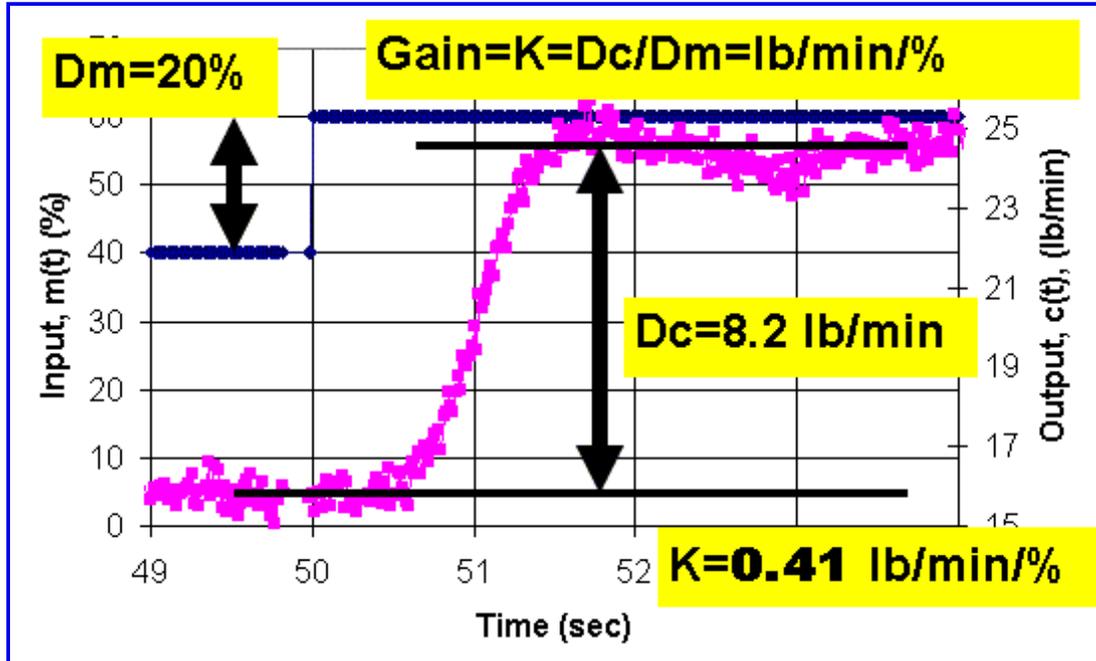
Select a Feedback Control:

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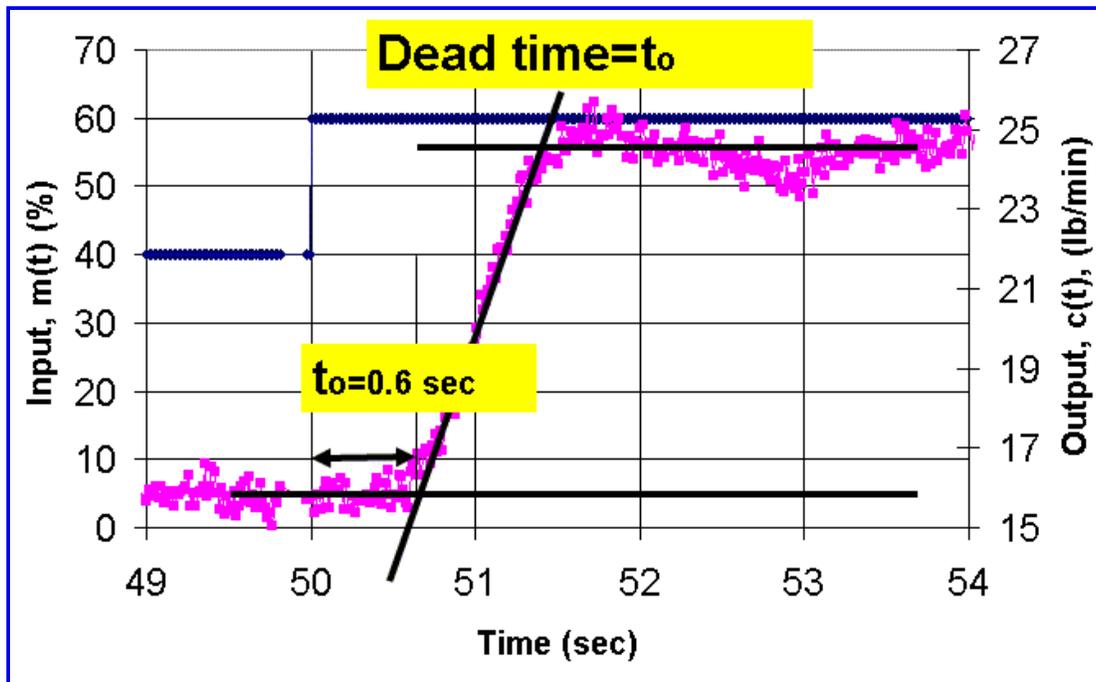
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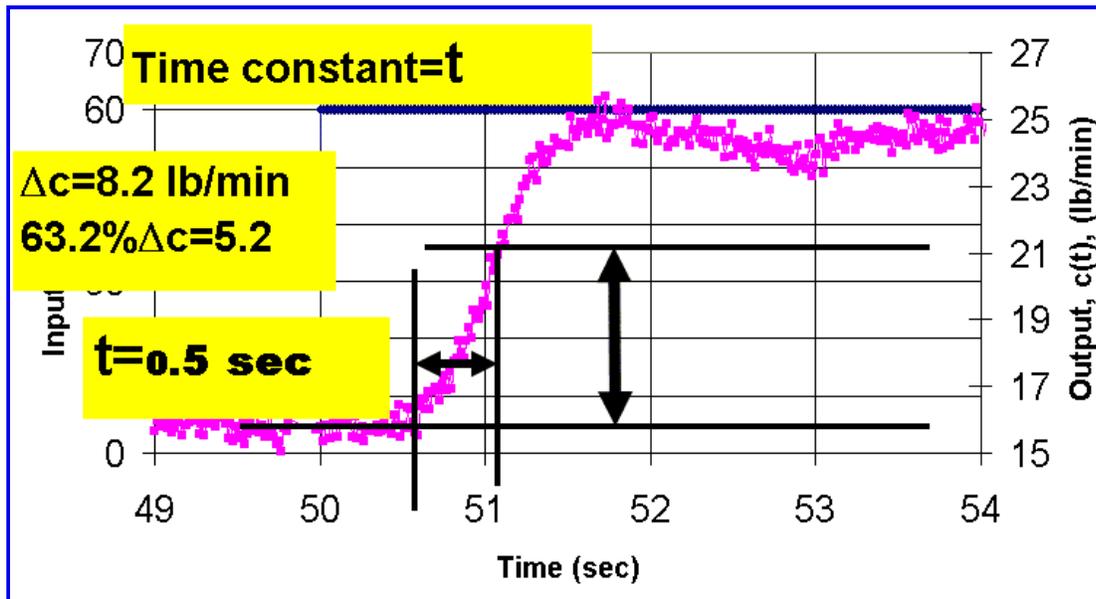
329
--Week-3-method--



[Click here to get Excel file to make this "Gain" graph](#)



[Click here to get Excel file to make this "Dead Time" graph](#)



[Click here to get Excel file to make this "Time Constant" graph](#)