Troubleshooting Distillation Controls – course outline

NB: this is a provisional course outline and may be subject to change.

Module 1 – Distillation control overall schemes troubleshooting

- Assembling control loops into an overall scheme: what works, what causes instability, and what impairs efficiency
- The three most common causes of control assembly failure: no material balance control, fighting between temperature controllers, and level control on a small stream
- What may happen in the absence of adequate material balance control?
- The three most common column control schemes: pros and cons
- Is it better to connect the column temperature (or composition) control to the boilup or to the reflux?
- Is there a control scheme that can handle ambient disturbances better?
- What can go wrong with controlling a liquid level on a small stream?
- What makes violation of this principle the No. 1 control problem in refineries (and in many chemical plants)?
- Is your fractionator immune?

Module 1 – Troublesome temperature controls and sidedraw controls

- How does subcooling affect internal reflux flow rate and its control?
- Is internal reflux control useful?
- Why distillation control schemes often break down in the presence of a side draw and what can be done to make them work
- Can internal reflux control help?
- Temperature control: is it better to have the control thermocouple in the liquid or in the vapour?
- Best temperature control tray location: is there a reliable method that can find?
- Using simulations to search and find
- Application to several case studies: what does this method reveal about the tower in each case, and how it can guide the solutions
- What is the effect of non-key components?
- Issues with enhanced distillation column controls: azeotropic distillation and extractive distillation, and what has achieved success in controlling them
- Analyser controls: is it the panacea for composition control?
- What has been the experience with an analyser control cascading onto a temperature control?

Module 2 – Pressure and condenser process controls troubleshooting

- What makes good pressure control so critical?
- A vapour top product: how pockets in vapour lines destabilise pressure controls
- Flooded condenser pressure controls for total condensers: how can the piping connections to the reflux drum make or break the control stability?
- Why can flooded condenser pressure controls break down in the presence of non-condensables, undersized equalizing lines, slots in the dip pipe entering the reflux drum, and what can help avoid these issues?
- Does inert padding help, and at what cost?
- Understanding hot vapour bypasses: why some work while others don’t
- Hot vapour bypass good and bad practices
- Flooded reflux drums: pros and cons
- Manipulating the coolant rate: when can it be troublesome?
- How manipulating the cooling water flow can accelerate fouling and corrosion

- Liquid product with a small vapour vent stream: why controlling the cooling water may sometimes be unavoidable, and what can be done to overcome shortcomings
- Interference between vacuum and coolant controls

Module 2 – Reboiler process controls troubleshooting

- Reboilers heated by condensing steam or vapour: a control valve is in the steam inlet line versus valve in the condensate outlet line
- Is the dynamic response with the steam inlet valve always better?
- Reboiler seal loss with the condensate outlet valve and how it is avoided
- When does the condensate outlet valve scheme have a major energy-efficiency advantage?
- Fouling, corrosion, and thermal stresses: which of the schemes can handle each of these issues better?
- Steam trap unreliability issues with the steam inlet valve scheme: how to overcome
- Startup and low rate operation with the steam inlet valve scheme: reboiler “stall”, instability, and how to prevent
- Hammering: how a scheme incompatible with your condensate system can lead to instability and hammering
- Equalising lines to the condensate pot: checking out for poor configurations that can induce instability, hammering
- Tube leaks: which scheme is better suited to handle a potential tube leak in different circumstances?
- Reboilers heated by sensible heat: why are the controls of these far less troublesome, and a brief discussion of their few issues
- Case studies: control systems that did not work

Module 3 – Extra discussion session

This session provides an opportunity to briefly discuss plant issues with the instructor and with other participants. Participants who wish to take this opportunity are encouraged to prepare presentation materials in a simplified form that everyone in the audience can easily follow.

Avoid elaborate P&I’s and detailed drawings, but have detailed information available of the configuration of lines connecting to drums and seal pots (enter from the top or bottom, via slotted pipes or bare nozzles, into the vapor or liquid space, etc).

Participants who wish to discuss plant issues need to inform IChemE ahead of the course so they can be allocated discussion time in this session. This information should be accompanied with a problem statement and sketch to be forwarded to the instructor so he can review ahead of the session.

Please note

The following topics are outside the scope of this course and will not be covered:

- advanced controls of distillation columns
- constraints controls
- batch distillation controls
- reactive distillation controls
- controls of dividing wall columns
- setting tuning constants
- control valve selection
- actuators
- control hardware.