ISC Project Note – No. 24

Control of Distillation Column Bottom Level

Having lived with manual control of a critical distillation column level for several years, our client had come to believe that automatic control was not possible. However, after experiencing product quality issues, ISC were approached to resolve the problem.

Investigation of the process revealed three problem areas. These are listed below:

- ***Level measurement technology incompatible with application environment***
- ***Controller design inappropriate for application***
- ***Reflux flow (regularly & unnecessarily) disturbing column level***

An alternative level measurement (capacitor) technology was recommended to the client. A new sensor was purchased and fitted at a convenient time. This change gave very reliable level measurement for the first time in the plant's history. The production and maintenance crews rapidly gained confidence. They could monitor the bottom level in the control room instead of regularly having to go to the plant and view it through the column sight glass.

A dynamic model of the plant was developed and embedded into a simulation environment. This was validated against data gathered from the plant. The original controller was replaced with one appropriate for the application (significant delay). The performance of the new controller proved very adequate for the application in the model environment. Model step responses can be seen overleaf (Figures 1 and 2). The confidence gained encouraged the transfer of the new controller to the plant where, with minimal tuning, the process was placed under closed loop control for the first time.

The control performed well, maintaining the process within required limits of operation on a continuous basis. However, reflux flow disturbances were causing some level variability around the set-point. These disturbances were due to interaction with the 'on-off' control strategy employed for reflux. A superior de-coupled reflux control strategy was designed in the simulation environment. The improvement in plant operation from the prior changes, however, diminished client desire for further refinement. Hence de-coupled reflux and level control has not yet been implemented to eliminate the source of disturbance.

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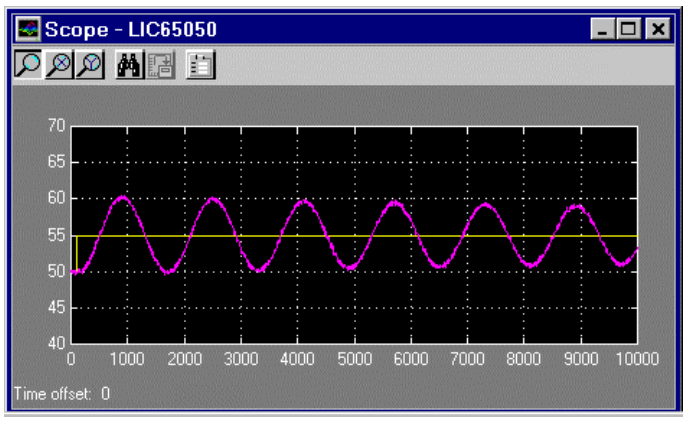

Figure 1 (original Level step response)

The distillation column model response to a level set-point step change with the original controller structure and settings can be seen in the trend plot above (Figure 1). Although the oscillations eventually decay, the disturbances in the actual plant ensured that the level was extremely unstable under control. This instability together with the unreliable measurement resulted in a plant that was impossible to control automatically.

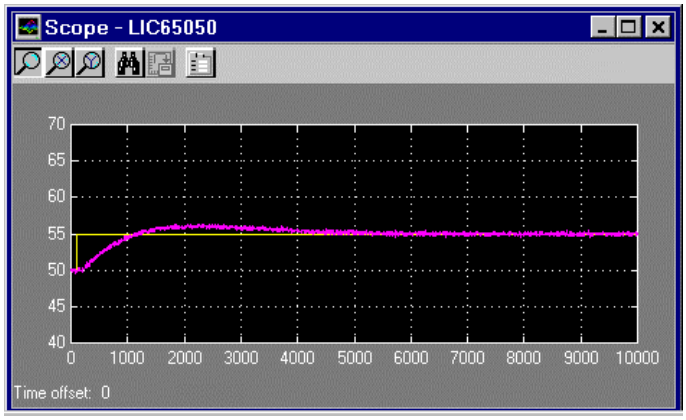

Figure 2 (Level step response after re-design)

The model's response to the same set-point step change can be seen above (Figure 2) with the re-designed controller structure. Coupled with the reliable level measurement, this change enabled automatic control to be used on a continuous basis.

ISC Limited supplies process control consultancy services to the process industries. The services supplied include control design for new plant and plant extensions, process troubleshooting, training and technology transfer. Industries served include Oil, Petrochemical, Chemical, Pharmaceutical, Paper and Food.

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