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Controlling the mundane naphtha stabilizer, Part 2

Part 1 of this editorial (September issue) discussed a debutanizer control strategy (Fig. 1). Given that feed composition varies with ambient conditions, one could argue that unless you have advanced control with a more precise inference of C_5 in LPG controlling rectifying section tray temperature is not a good idea.

I have further investigated this issue using data from a crude unit stabilizer and Petrocontrol's generalized distillation shortcut inferential package. The results are shown in Fig. 2. The figure first compares lab values of C_5 in LPG against the model to illustrate the validity of this investigation. The inferential blue-line model is in good agreement against lab results for a period of two months without any bias change. The inference oscillates at a frequency of 24 hr, obviously due to day-night ambient temperature differences, reflecting LPG composition change with weather as discussed previously. And, while the general correlation of purity with tray temperature is clear enough, sometimes even at a constant temperature the LPG purity can drift. This last effect cannot be blamed on pressure variations. Pressure was constant throughout the period. It must be due to non-constant reflux ratio and crude-to-crude LPG composition variation.

Did operator actions of changing tray temperature controller setpoint make sense? At the beginning of the period of Fig. 2 we see the LPG impurity trending up, and operators responded incorrectly by increasing tray temperature from 70.5°C to 71°C. Still, 71°C was not a bad overall decision and for about three days the C_5 in LPG was kept at 0.7%. Then, in a series of changes over about one month, operators set the tray temperature gradually lower, down to 70°C. No one noticed that it was a money-losing operation, even though the lab values of C_5 in LPG were quite low. Products were within specification and there were no complaints. On day 40 of the period the tray temperature went up one degree, to 71°C. Someone must have finally noticed LPG going to the wrong place. The temperature then continued to be nudged up gradually to 72°C.

The moral of this story is simple. If a debutanizer should be operated at 1% C_5 in LPG but is operated at 0.2%, then that difference of 0.8% is translated to a much higher LPG yield penalty, not to mention other inconveniences of too much C_4 in naphtha, and that is a strong economic incentive to implement APC on the column. With or without APC, the DCS control configuration should be as shown in Fig. 1, with a rectifying section tray temperature controller. Without APC one would need frequent lab support, plus frequent operator training, and then it would be possible to keep the LPG C_5 content at an average 0.6%. With the addition of a closed-loop reliable inference model that average could be brought up to 0.9 or 1%, because besides being more precise than the operator, APC would eliminate the day-night cycles. **HP**

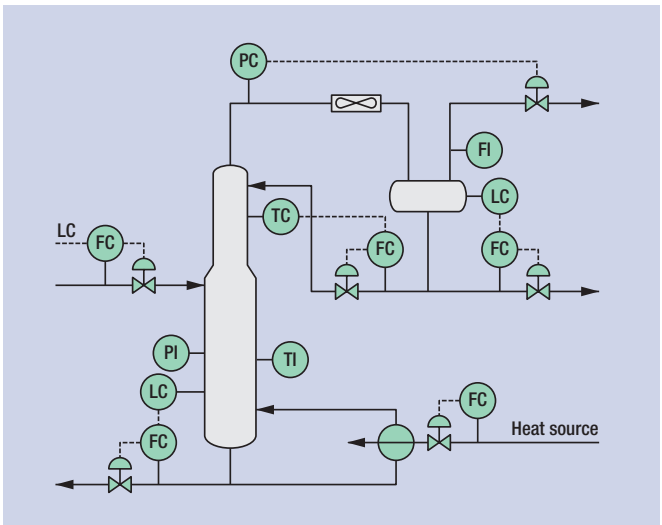

FIG. 1 Control configuration for a stabilizer used to remove LPG from naphtha.

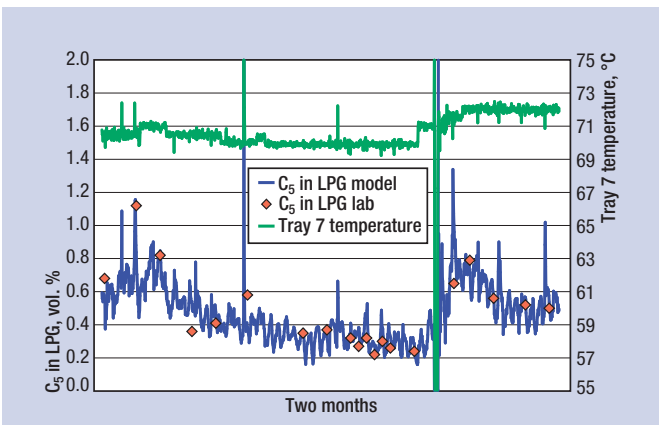

FIG. 2 C_5 in LPG inferential model vs. lab values.

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