Originally appeared in HYDROCARBON PROCESSING® June 2010, pg 15. Posted with permission.

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Total- or partial-draw configuration

Ever wonder why some main fractionators are designed with partial-draw trays, whereas others are total draws? A typical partial-draw with pumparound configuration is shown in Fig. 1. Liquid is taken from the draw tray into a side stripper, and stripped, typically by steam, to become a side product. Pumparound is a device for removing heat from the column. It circulates liquid from the draw tray, via heat exchange, back to the column several trays above the draw. The now subcooled liquid exchanges heat by condensing vapor on these three or four trays, and thus, the pumparound section trays are used solely for heat exchange, having no separation effect.

The total internal reflux coming down onto this tray is higher than the pumparound plus product draw, and excess internal reflux flows over the weir down to the tray below, hence, the name: partial-draw tray. The excess internal reflux must be significant, or else the section below the draw tray becomes ineffective.

Pumparound heat removal is typically controlled by changing pumparound flow, and if the cooling circuit is not against a heat-availability limit that is an effective control mechanism. Side-product flowrate is set by the operator, or it could be an APC manipulated variable, whereas the draw is on stripper level control. The challenges APC engineers face are in determining how much heat is to be removed, how much side product to draw, what to do when the cooling circuit is indeed against a heat removal pinch limit and how to estimate internal reflux below the draws. Estimating the internal reflux from heat balance is imprecise because it involves subtracting two big numbers: condensation due to pumparound cooling minus product draws, and the precision gets worse going down the column.

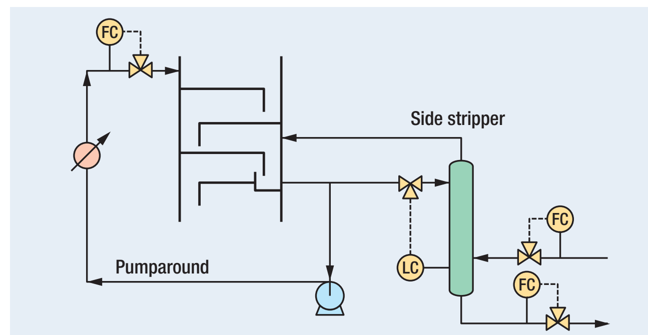

FIG. 1 Partial-draw configuration.

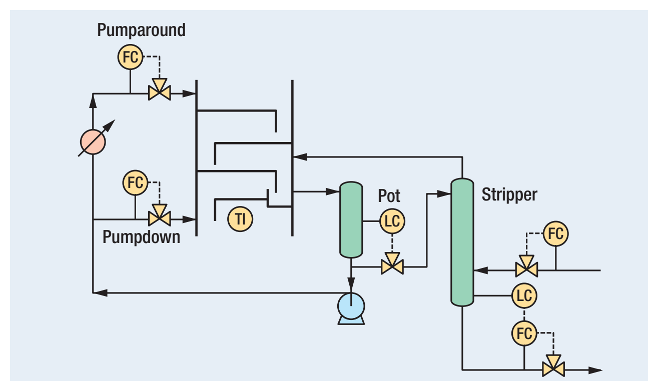

FIG. 2 Total-draw configuration.

Can this uncertainty be improved? Fig. 2 shows a total-draw configuration, where all of the liquid on the draw tray is taken out to a draw pot. The pumparound pump in this configuration handles not only pumparound material but also pumpdown of internal reflux. Excess material not pumped from the pot is taken into the stripper and becomes the side product. The main improvement here is that internal reflux is being measured and there is no longer a need to estimate it. Another difference is the indirect manipulation of side draw. To increase side draw, the operator or APC must decrease pumpdown.

And there are other improvements. Holding a steady internal reflux profile on the column stabilizes the temperature profile and, in turn, product cutpoints. Further, total-draw tray configuration usually incorporates a temperature point just below the draw tray, which helps with the cutpoint inference. There is no reason why part-draw configurations would not incorporate a similar temperature point, but for some odd reason that is not traditionally common.

I come now to the original question. Have you ever wondered why draw trays on some units are partial whereas on other units they are total? Crude-unit atmospheric fractionators are mostly part draw, while vacuum fractionators are by and large total draw. FCC and coker fractionators often incorporate mixed designs, with some draw trays being part draw while others are total draws. Is there any rhyme or reason? If total draw designs are easier to control why aren't they implemented?

What about mixed designs? I would say that even if most draws are partial, configuring a lower-draw as a total-draw tray does offer advantages. Some crude units are configured with the lowest side draw: HGO as a total-draw tray and that helps stabilize the overflash. On the other hand, I cannot see how an upper total-draw tray, while the lower draws are from part-draw trays might be useful. **HP**

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