Originally appeared in HYDROCARBON PROCESSING® March 2009, pg 86. Posted with permission.

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CDU overhead double-drum configuration

Fig. 1 shows one of many CDU overhead configurations, with naphtha cutpoint control accomplished by a column top temperature controller manipulating a top pumparound (TPA) circuit heat removal. This configuration is heat efficient although heat efficiency comes at the expense of top section separation. The TPA internally uses four trays, not for separation, but for internal condensing and heat transfer.

To regain those lost trays process designers often specify two overhead drums per the configuration of Fig. 2. Heat previously removed by the TPA circuit is now removed by a reflux condenser against crude, more or less at the same temperature levels. Vapor from the reflux drum is further condensed into a product drum. On the whole—a thermodynamic system that not only gives us more top section trays, but the reflux drum is also a separation stage.

Examine now the DCS control of Fig. 2. Naphtha cutpoint is controlled by manipulating reflux instead of TPA duty. Excess reflux drum material is blended into the naphtha product. Is it a good idea to mix reflux into the product? Reflux is heavier than naphtha, and mixing it into the product creates an undesirable heavy tail. Ten percent of the reflux is light kero material, and downgrading kero to reformer feed in today's prices carries a penalty of about $7 per bbl. Even if there is a price reversal, good separation between kero and naphtha would be profitable, and that is why the double drum is there in the first place.

Another feature I dislike about Fig. 2 is the method of inferring naphtha cutpoint. The temperature most indicative of naphtha cutpoint is not the TC on top of the column but rather the blue TI on the reflux drum.

What I consider a thermodynamically correct way of controlling a double-drum overhead system is illustrated in Fig. 3. The combination of reflux drum level control on the reflux, and naphtha cutpoint control on the reflux condenser elminates excess reflux. For good dynamic response, tune the blue level controller tightly. IE, apply a strong controller gain, but beware of making the reset action too aggressive and driving the controller unstable.

Fig. 3 permits recycle of product naphtha into the reflux drum but that is used only in abnormal situations. Such recycle may become necessary during hot summer hours, when even maximum reflux condenser operation cannot maintain the naphtha cutpoint at target. Bear in mind that the recycle of naphtha into the reflux drum is in the category of reflux going down the column and is not thermodynamically damaging, but it is not desirable because it replaces high-temperature cooling against crude by low-temperature cooling against air. **HP**

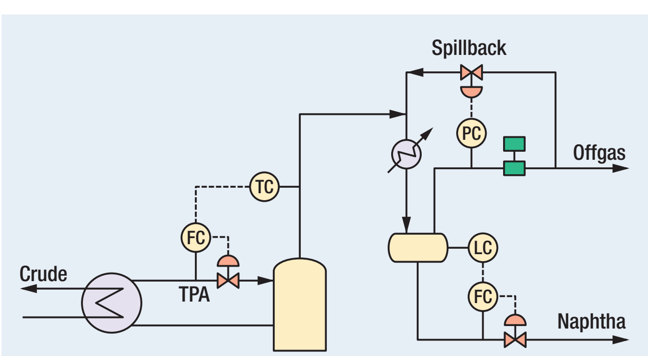

FIG. 1 Single-drum overhead.

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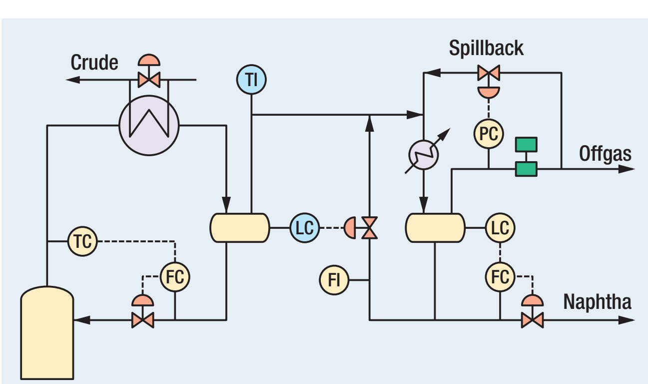

FIG. 2 Double-drum overhead.

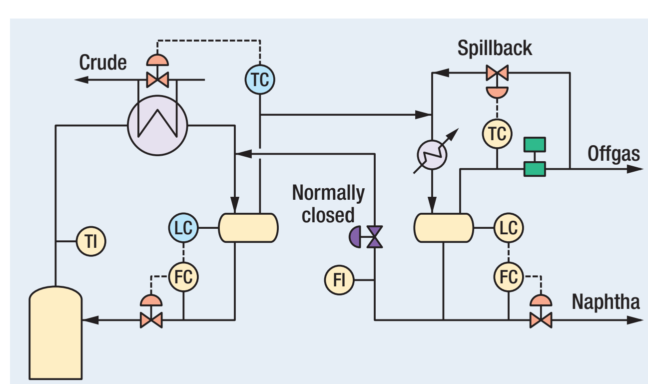

FIG. 3 Ideal double-drum control.