ProTips™

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Thermosyphon Reboilers

In ProTreat®, the regenerator's built in reboiler type is a kettle as shown in Figure 1. However, a kettle type reboiler is not the only type used. Thermosyphon type reboilers are also quite prevalent in the industry and this issue will go into how to model this type of reboiler in ProTreat.

In a kettle reboiler, the column bottom liquid all flows to the kettle drum where it is indirectly contacted by either steam, hot gas from a direct-fired burner, or hot oil which partially vaporizes the feed. The vapor portion is then returned to the column bottoms sump while the liquid portion is taken off as the lean amine. The vapor is directly generated by boiling on the surfaces of heated tubes, and as such, a kettle reboiler can be thought of as a close approximation to a theoretical stage.

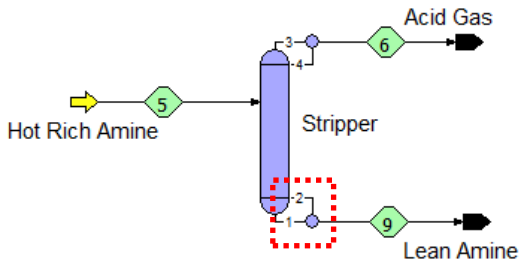

Figure 1. PFD for Kettle Type Reboiler in ProTreat®

Another commonly used reboiler type is a thermosyphon. The circulation in a thermosyphon reboiler is driven by the density difference between the incoming liquid and the two-phase mixture that recirculates back to the column. The recirculation flow may be driven purely by the thermal conditions, or may require the use of a pump on the tower bottoms if the natural liquid head is insufficient to drive the flow at the desired rate. The entering liquid is partially vaporized, but unlike the kettle type, all of the resulting vapor-liquid mixture is returned to the column. This two phase mixture is then separated in the sump with the vapor flowing upward and the liquid flowing out with the liquid coming from the bottom tray. This reboiler type is shown in Figure 2.

The setup of a thermosyphon adds a closed loop, and as such, requires the addition of a recycle block in ProTreat®, shown in Figure 2 as a Tear Stream. The initial estimate for this Tear Stream should be a fairly close representation of the converged results to achieve smooth and quick convergence for the loop.

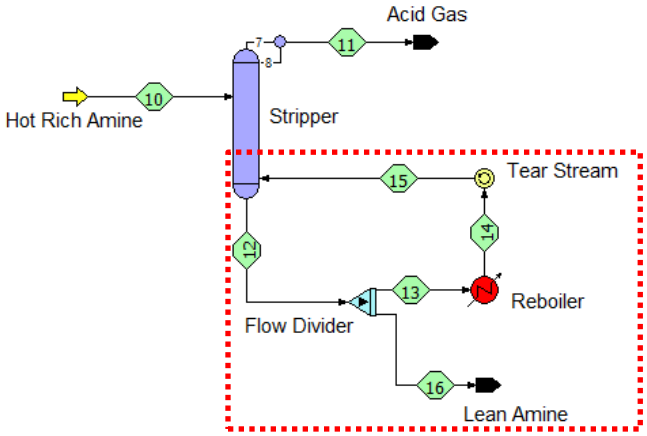

Figure 2. PFD for Thermosyphon Type Reboiler in ProTreat®

Reboiler duty of can then be set and the percent flow varied in the Flow Divider to obtain the desired lean loading. As shown in Figure 3, at a set duty, the percentage being recirculated has a large effect with the thermosyphon type (◆) and the kettle type (■). A more detailed discussion on the differences between kettle and thermosyphon reboilers can be seen in The Contactor™ Volume 7 Issue 2.

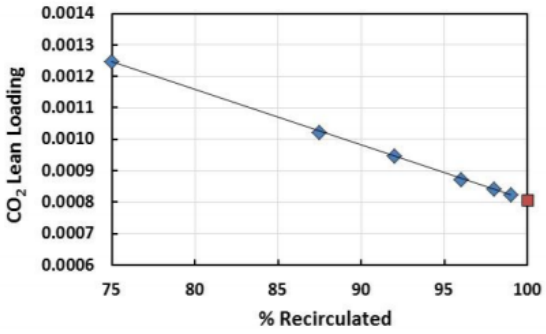

Figure 3. CO_2 Lean Loading as a function of Recirculation Rate. Kettle (■); Thermosyphon (◆)

PROTIP: The cross exchanger blocks, HTXR or HX, can also be utilized to be able to model the utility side of the exchanger. This can be used to represent different heating media including hot glycol and direct-fired heaters.