



Focus on five costly distillation errors and how to prevent them

Distillation columns are one of the biggest energy users in plants, yet the efficiency of these towers can be extremely low. Although there are many ways to recover heat, through intercoolers and heat integration, the actual column also can be operated to make the necessary split at reduced energy consumption. Here're five common ways distillation columns can waste energy.

1. *Operating at the wrong pressure* — Higher column pressure costs you the ability to separate and thus energy. Higher pressure reduces vaporization so a column must operate at higher temperature. Therefore, more energy is added to the reboiler at higher pressure than at lower pressure to get the same separation. To save energy, run column pressure at the lower end of your operating range, just high enough to cool your overhead and hydraulically move products. One way to do this is to reduce the pressure drop across the column by installing distillation trays or packing that has little differential pressure (more efficient trays also can reduce energy requirements). This allows you to run the same overhead pressure with less reboiler work. Or reduce pressure in the entire tower. For those in areas of the country that experience wide variation in outside temperature (and thus have the ability to cool better in the winter), look at seasonable adjustments in tower pressure.

2. *Putting your feed in the wrong location* — Tower separation is typically determined by the reboiler, condenser, and feed system. Most engineers concentrate on getting the two ends, condenser and reboiler, to do the right thing but forget about the feed system itself. In some cases, where multiple feed entrances are possible, always look at the proper tray to introduce your feed. The feed location depends heavily on the composition and your final product spec. Introducing a feed at the wrong location means the trays around the feed entrance will operate inefficiently and thus require the tower to work harder, use more energy, to perform the required separation. If your feed composition changes or if it has changed since the tower was designed, run tower simulations to see if you can introduce your feed on a different tray to reduce energy cost.

3. *Over-purifying your products* — In a distillation column, your primary control protects the most valuable product. For example, if you have a specification of less than 5% unwanted material in the overhead liquid, you typically will set a target to achieve that. However, it's very common for a plant to produce 2% to 3% unwanted material in shipped product even when allowed 5%. This commonly happens because operators are taught to respond immediately to results close to the limit but are less likely to make changes when the results are far below the target. Although you never want to produce off-spec material, running a distillation column far below target takes a lot more energy than running a column to produce very near the target. With the advanced control schemes and equipment available today, look at your column to determine if you can run a "tighter" specification range for a lot less energy.

4. *Using too much reflux* — It seems to make sense that a higher reflux ratio would create better separation, but more traffic in the tower requires energy. I have seen many towers operate at the same reflux rate no matter how much feed is running to the tower. Typically, a distillation tower can operate at many different reflux rates and produce acceptable products. The key is to find the most stable low energy rate you can.

Modifying reflux rates isn't a simple task as a tower running reduced reflux needs more operator attention.

5. *Recycle* — One of my favorite sayings is “get the right molecule in the right place on the first try.” The worst type of recycle is when you unintentionally create a large external loop. However, anytime you have to reprocess material or create internal recycle, you waste a lot of energy. Check your system to see if it's possible to eliminate or reduce recycling. Besides off-spec products, systems that use absorbing and systems that collect feed from several different sources are prone to unnecessary recycle.

A quick check of your distillation column operation may save you a lot of energy. Be sure to periodically check the distillation column conditions to make sure you are operating efficiently.

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