

# SEPARATIONS SAVVY

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## Is your process possessed by an azeotrope?

Many of us have heard whispers of the word 'azeotrope' in the back of our college lecture halls, but its relevance in chemical separations is hauntingly real. You may recall that an azeotrope is a complex chemical mixture, formed when two or more chemicals have the same liquid and vapor phase composition. Unfortunately, this kind of mixture effectively renders distillation useless. And no amount of heat or boiling can change that. Boo!

To further complicate the situation, breaking or even recognizing when azeotropes are present is not always straightforward. It requires a comprehensive analysis of literature data, which frighteningly often does not exist. When no data is available, the next step is experimentation and subsequent analysis. Therefore, turning to companies with expertise in mass transfer and separations is critical.

It takes a substantial amount of experience to develop and conceptualize the proper approach to this type of experimentation and analysis. Recently, [Chemical Processing](#) published an e-book on distillation showcasing this level of expertise. It includes several case studies detailed inside.

### The importance of pilot testing

Very often, pilot plant testing is required to test the actual feedstock and show that the conceptual design first offered will meet required specifications. We love when drums of the actual feedstock that customers use are sent to us, so we can search for hidden, minute amounts of contaminants, often invisible at first (more ghoulish language)!

The differences between an ideal feedstock upon which the concept design was developed and the real feedstock make-up can affect the path chosen to break the azeotrope, but pilot testing uncovers those trace components and finds solutions.

### Breaking azeotropes: Homogeneous and Heterogeneous

Azeotropic distillation experts talk about heterogeneous azeotropes (the simplest ones to break) and homogeneous, when two substances are totally miscible. When the two substances are homogeneous, such as acetonitrile and water, or THF and water, pressure swing distillation can be used; two distillation columns at different pressures will break the azeotrope.

On the other hand, when two substances are heterogeneous azeotropes (substances non-miscible), a liquid separation agent is often used to form a ternary azeotrope, which then aids in the distillation process. Two examples of heterogeneous azeotropes are n-butanol and water or methylene chloride and water. Keep an eye out for those azeotropes.

Working with non-ideal separations, such as azeotropes, may require multiple distillation columns, and several decades of chemical process design experience. If you are suspicious that an azeotrope might be lurking in your process, chat up one of our representatives at [kochmodular.com](http://kochmodular.com). No ghosts there; it is manned by real, live chemical engineers!



### Encyclopedia Azeotrope

**Homogeneous Azeotropes** consist of liquids that are miscible and form a solution.

**Heterogeneous Azeotropes** are incompletely miscible and form two liquid phases.

**Miscible** is when two solutions are capable of mixing in any ratio without separation of two phases.

