Flowsheet:

Esterification

Process description

Esterification proceeds by a simple, continuous process in a reactive distillation column.

Alcohol vapour enters the base of the column and travels upwards, performing three functions:

- Firstly, it provides the necessary reactant for esterification.
- Secondly, it strips the reaction by-product water from the organic liquid, thus driving the equilibrium reaction virtually to completion. This is particularly important as the esterification reaction is reversible.
- Thirdly, it provides physical agitation at each reaction stage, ensuring good contact between reactants and catalyst.

The liquid acid reactant enters the top of the column and travels downwards, counter-current to the alcohol vapour. The liquid travels via a series of proprietary design reaction trays which provide sufficient liquid residence time to ensure virtually complete equilibrium conversion to the ester product.

The solid catalyst remains on each reaction tray, eliminating the need for its downstream separation from the ester product stream. Additionally, the catalyst can be replaced while the plant is online without any interruption of the process or loss of production.

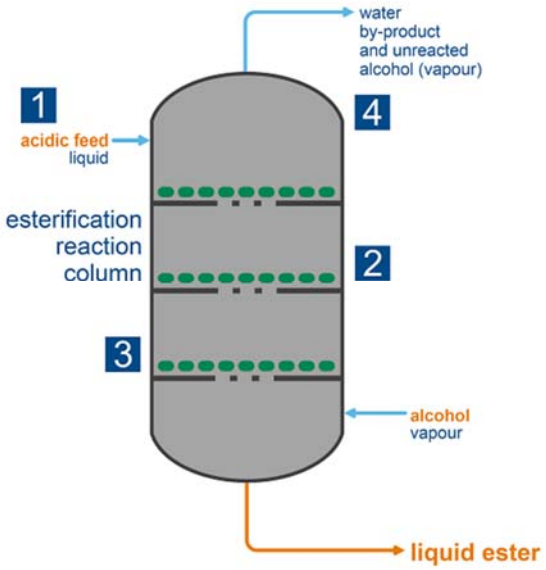
Vapour leaving the top of the column contains the bulk of the excess alcohol and all the reaction water. These are subsequently separated, with the dry alcohol recycling to esterification.

A liquid ester stream, which also contains residual alcohol, exits the bottom of the esterification column for downstream processing or refining. If no further reaction steps are required, the alcohol can be removed from the process stream to yield product-grade liquid ester.

In several of Johnson Matthey's **DAVY** processes, however, the liquid ester proceeds to hydrogenolysis. In such cases, the residual alcohol can remain in the process stream as it does not interfere with the hydrogenolysis reaction.

Flowsheet

Figure 1



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Process Technologies

Figure 2

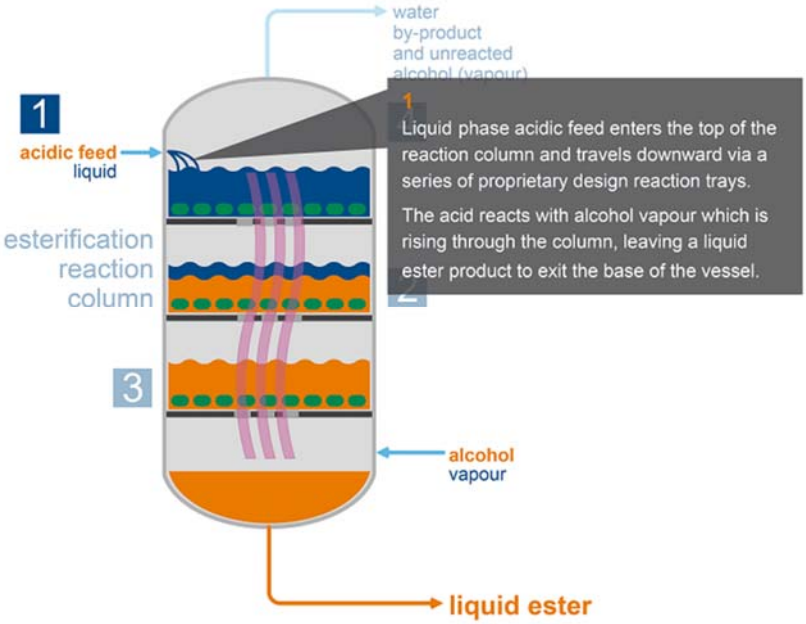


Figure 3

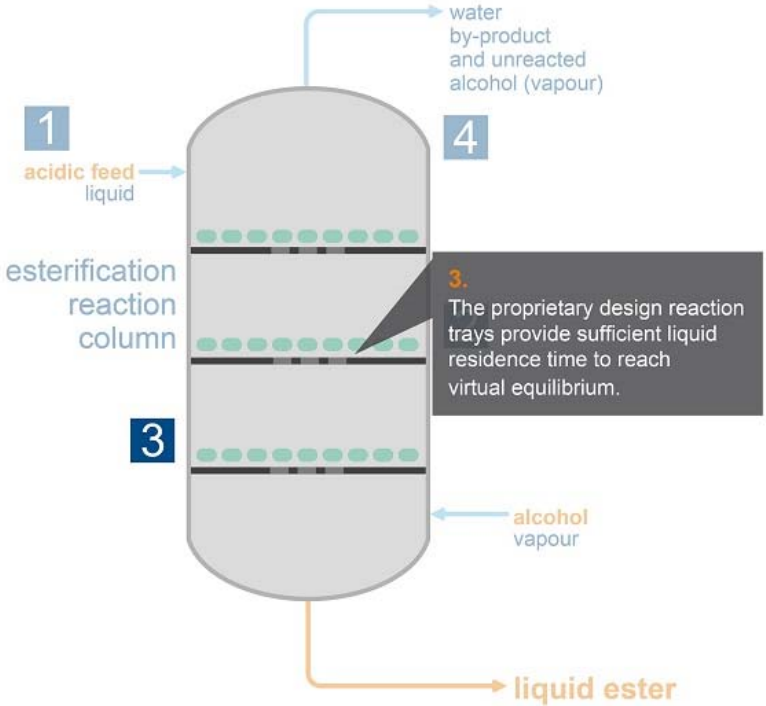


Figure 4

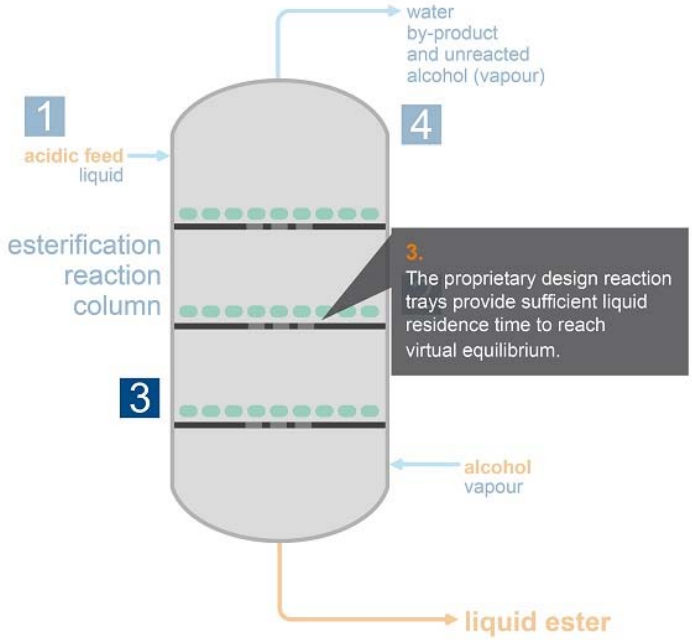
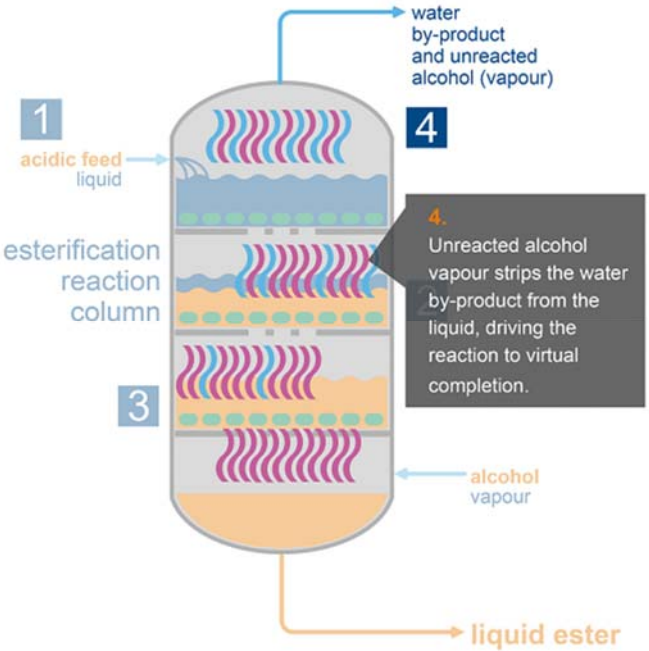


Figure 5



The Johnson Matthey advantage

Johnson Matthey's **DAVY** esterification technology offers many advantages, when used either as a stand-alone chemical conversion step or in conjunction with downstream hydrogenolysis.

Process efficiency	• The dehydrogenation reaction produces hydrogen in abundance which can be purified and compressed for export as a valuable feedstock/commodity in its own right. • Among other uses, hydrogen serves as the ultimate clean fuel.
Low material and equipment costs	• Esterification neutralizes the acidic feed, which eliminates the need for downstream process equipment to be constructed from expensive, high-grade stainless steel.
Minimized side reactions	• The optimized reaction conditions employed in the **DAVY** esterification reaction column minimize side reactions. This achieves close to 100% selectivity to esters.
High esterification yield	• Excess alcohol vapour removes water vapour by-product, driving the esterification equilibrium forward.
Low-cost catalyst in downstream processes	• Esterification neutralizes acidic process feedstocks. This allows downstream processes to employ a superior copper-based catalyst, whereas an acidic environment would require an expensive precious metal-based catalyst.
No catalyst separation required	• A proprietary solid catalyst remains in the reaction column and so does not mix with the final liquid ester product. This eliminates the need for catalyst separation prior to downstream processing. • The catalyst can also be changed at 100% load without any downtime or loss of production.
Reduced effluent	• Using a solid catalyst means there is no need to treat used liquid-phase catalyst.

The information contained within this document was previously published on a former **DAVY**™ website.

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