Johnson Matthey
Davy Technologies

Licensed Processes
Butanediol & Co-Products

Core Technologies

Explore the Davy technologies that underpin our BDO process:

esterification

hydrogenolysis

Related Processes

JM Davy also employs esterification and hydrogenolysis in our world-class natural detergent alcohols (NDAs) process:

natural detergent alcohols (NDAs)

Our n-methyl-2-pyrrolidone (NMP) flowsheet produces intermediate GBL by the same pathway as our BDO process, before converting it to final product:

n-methyl-2-pyrrolidone (NMP)

We also produce biodiesel using a process derived from our BDO and NDA flowsheets:

biodiesel

Select each section header below to expand, or click here to expand/collapse all sections

Go to full process & technology matrix

Introduction

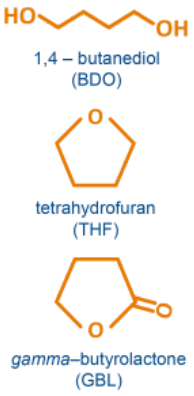
JM Davy are the leading technology provider for butanediol (BDO) plants worldwide.

We offer a more economical process by using low-cost raw materials, producing BDO from butane via maleic anhydride (MAH), or from sugar via succinic acid (SAC), with the latter process making bio-based BDO possible.

JM Davy's process is also designed with an esterification step prior to hydrogenolysis. This achieves greater efficiency, and a higher-quality product.

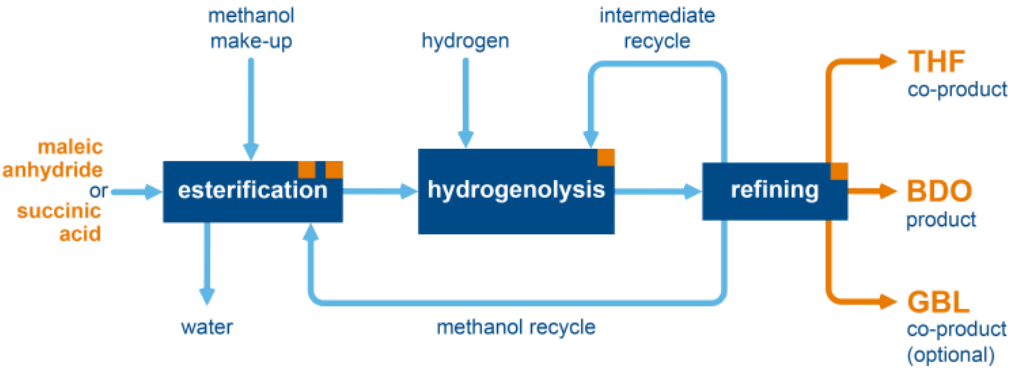
In addition, our process can make BDO's derivatives, tetrahydrofuran (THF) and γ-butyrolactone (GBL), in variable ratios which are adjustable according to market need.

This flexible product output enables our licensees to respond quickly to changing market conditions by manufacturing the right product at the right time for the polymers and solvents industries.



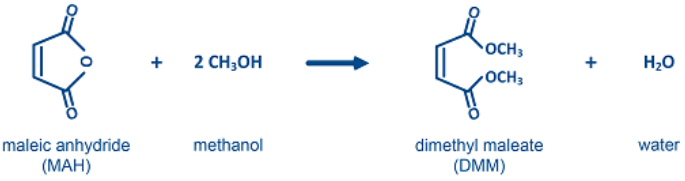
Process Flowsheet

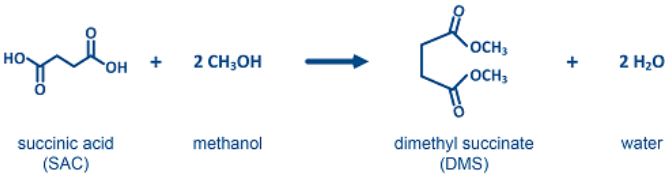
Roll over the orange squares to see more information



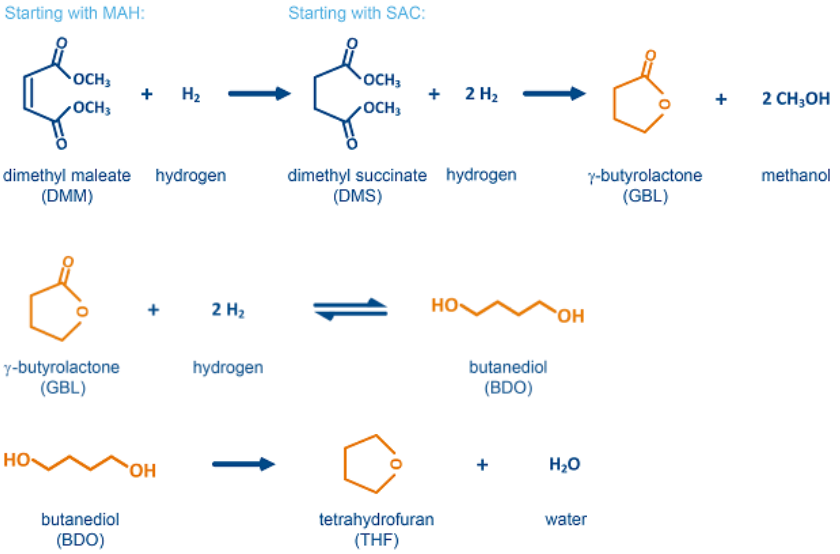
Key Reactions

Esterification converts maleic anhydride/succinic feed to dimethyl maleate/succinate intermediate:





A series of vapour-phase hydrogenolysis/hydrogenation reactions then produces the three final products:



Process Description

BDO and its derivatives are produced in two stages: maleic anhydride or succinic acid is first esterified to dimethyl maleate/succinate and then hydrogenolysis converts this intermediate to the crude BDO/THF/GBL product mix.

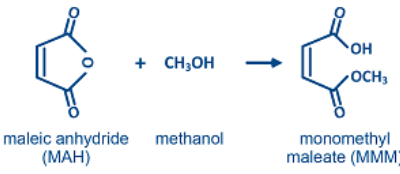
The purpose of the esterification step is to convert the acidic feed to a non-acidic intermediate ester, which is much easier to convert to butanediol compared to an acidic feed. In addition, our esterification reaction system removes the reaction water produced prior to hydrogenolysis, enhancing process efficiency.

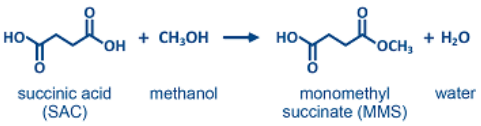
Process feedstock

The process feedstock is either molten maleic anhydride (MAH), obtainable by the oxidation of butane or benzene, or succinic acid, which is mainly produced via bio-fermentation.

Esterification

Esterification proceeds in two stages. First, an autocatalysed exothermic reaction with methanol converts the feed to a mono-ester:



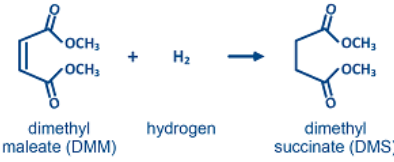


The mono-ester then enters the esterification reaction column, where further reaction with methanol in the

Hydrogenolysis/hydrogenation

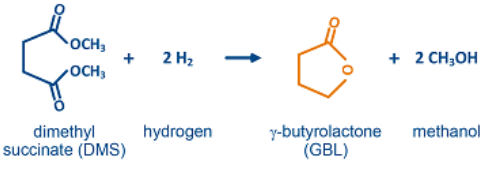
A series of vapour-phase hydrogenolysis and hydrogenation reactions produces the three final products.

For maleic anhydride feed, hydrogenation of the dimethyl maleate intermediate proceeds rapidly to produce dimethyl succinate (DMS):

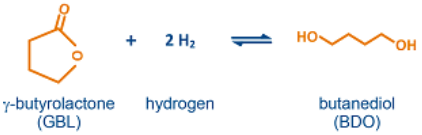


The DMS then undergoes hydrogenolysis to form γ-butyrolactone.

If succinic acid is used as the process feed, DMS passes directly from esterification to hydrogenolysis:

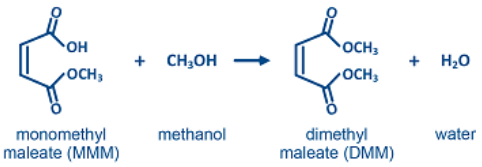


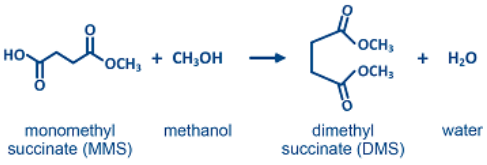
Subsequent conversion of GBL to butanediol proceeds by an equilibrium reaction:



Finally, and depending upon the prevailing reaction conditions, a proportion of the BDO dehydrates to form tetrahydrofuran:

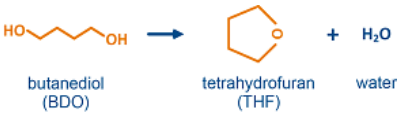
presence of a proprietary solid catalyst forms dimethyl ester:





The dimethyl ester then passes directly to hydrogenolysis without any further process steps.

The reaction water is stripped out of the dimethyl ester and taken overhead of the reaction column.



Refining

Distillation produces high-purity product, while methanol is recovered and recycled to the esterification stage. Any unreacted DMS is recovered and recycled to hydrogenolysis.

If there is no desire to co-produce GBL, this too can be recycled to yield further BDO.

\+ Process option: product ratio flexibility

The JM Davy Advantage

JM Davy's use of an esterification step prior to hydrogenation has transformed BDO production. The benefits of this innovation are numerous, from reduced capital costs to milder, safer operating conditions and improved conversion.

The main process advantages are highlighted below. For more detailed benefits related to our technology, go to our esterification and hydrogenolysis pages.

\- Flexible product ratios:

- Our technology produces BDO and its derivatives in variable ratios according to market need.

\- Low material and equipment costs:

- The esterification step neutralises the acidic feed. This enables the hydrogenolysis and refining systems to be made of inexpensive carbon steel.

\- Net savings over conventional processes:

- The combined savings of cheaper construction materials and catalysts more than compensate for the cost of the added esterification step.

\- Simplified catalysis, process efficiency:

- The esterification and hydrogenolysis catalysts remain in their respective reaction vessels, eliminating the need for catalyst separation and neutralisation at any stage of the process.
- The esterification catalyst can also be changed at 100% load without any downtime or loss of production.

\- Low-cost, higher-performance catalyst:

- The non-acidic hydrogenolysis environment also allows use of a base-metal catalyst instead of a high-grade precious metal catalyst. This delivers superior performance at lower cost.

Core Technologies & Related Processes

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