LP Oxo℠ Technology

Driving return with fuel-grade butanol at your existing refinery

Powering the future of fuel production

You can integrate fuel-grade butanol production into your existing refinery processes using Low Pressure (LP) Oxo^{SM} Technology. We're here to help you efficiently and cost-effectively implement the technology to drive greater return from your refinery.

Adding value through integrated operations

LP Oxo^{SM} Technology is used to produce alcohols from olefins. Incorporating this technology into the refinery flowsheet can deliver significant value to overall refinery and gasoline blending operations:

- **Increased blended gasoline production and quality** – Diverting propylene from alkylation allows increased butene alkylate and new butanol production which can result in an increase in both the octane rating and production capacity of blended gasoline.
- **Increased operation flexibility** – Use of low vapor pressure butanol in gasoline blending enables increased utilization of existing refinery lights in the blended gasoline product while still meeting Reid Vapor Pressure (RVP) requirements.

Key benefits of incorporating LP Oxo^{SM} Technology in a refining process lie in the alkylation step (see Figure 2). This step is often a challenge as it uses acid and generates hazardous waste – all to produce lower-grade octane alkylate. By contrast, using LP Oxo^{SM} Technology in this phase can:

- Expand and upgrade refinery gasoline production with a lower environmental health and safety impact
- Upgrade lower value refinery grade propylene to fuel-grade alcohol
- Minimize supply concerns by using on-site resources

Figure 1: LP Oxo^{SM} Technology

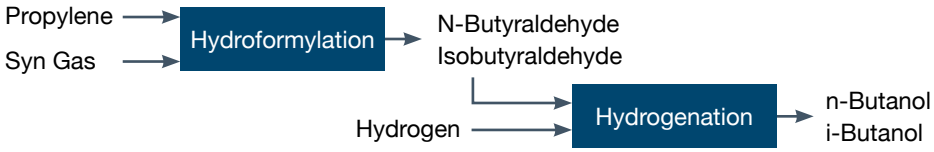
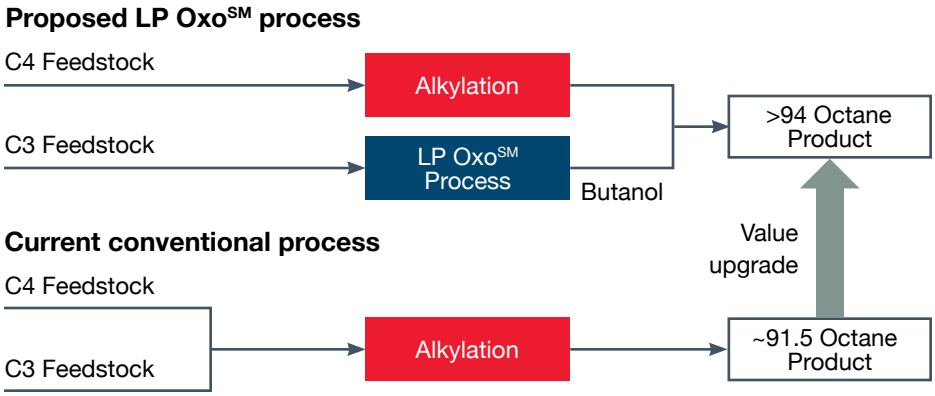


Figure 2: Upgrade alkylation process with LP Oxo^{SM} Technology



Delivering the benefits of fuel-grade butanol

LP Oxo℠ Technology – backed by Dow and Johnson Matthey Davy Technologies Limited (JM) – is changing the way the industry looks at using butanol from propylene as a gasoline additive. As shown in Table 1, fuel-grade butanol derived from LP Oxo℠ Technology offers attractive advantages including:

- **Essentially zero sulfur and zero benzene content**
- **Enhanced conversion volume:** One barrel of propylene yields 1.08 barrels of butanol
- **Higher octane:** 94.5 rating (R+M)/2
- **Produced without strong acid:** Inherently safe with low environmental impact

In addition to being used as a fuel additive in gasoline blending operations, the high-quality mixed butanols produced by LP Oxo℠ Technology in the alkylation step can also be used to enhance ethanol-gasoline blend performance and handling properties.

Get ahead with LP Oxo℠ Technology

Dow and JM offer licensees with engineering development and design, as well as technical assistance that may be required during project start-up and beyond. Please contact your Dow representative or your JM representative to request more information.

Table 1: Butanol blending vs. ethanol blending

	Butanol	Ethanol
Sustainability	Non-renewable	Renewable
Energy content	High energy density contributes to **85%** of gasoline miles per gallon (MPG) rating	Low energy density contributes to 60% of gasoline MPG rating
Vapor pressure	**Low:** Allows for use of more volatile components in gasoline blend, while reducing volatility and evaporative emissions	High: Leads to higher volatile organic compound (VOC), limits blending of lighter refinery components and makes it difficult to achieve Summer specs
Physical properties[1]	**Similar to gasoline:** Could help prevent phase separation and engine damage	Different from gasoline: Can cause stability and corrosion problems
Octane rating	**94.5:** Above premium grade gasoline	99.5
Water solubility	**Low:** Minimizes absorption during transportation/storage and allows butanol/ethanol blending at refinery without downstream issues	Water absorption presents problems for transportation/storage of gasoline/ethanol blends and blending at distributor/end-use is required

[1]Physical properties include: polarity, water solubility and corrosivity.

Proven technology

LP Oxo℠ Technology was jointly developed by Dow and JM. Over the past 45 years, it has evolved into the premier method to produce alcohols, such as butanol, from olefins.

Today, LP Oxo℠ Technology is licensed in 54 projects at 41 plants in 15 countries around the world. It is also used in three plants owned by Dow and Dow affiliates.

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