Products & Technology

LyondellBasell

IDEAL EMP
By LyondellBasell

Introducing *IDEAL* EMP

The renewable* blendstock for alcohol-free gasoline

**IDEAL* EMP has 42% renewable content by weight

IDEAL EMP is the renewable, non-alcohol alternative to ethanol and butanol

LyondellBasell (LYB) has been a pioneer in the development of high-octane gasoline components since the 1970s. These components have been incorporated into gasoline to help meet increasing demand for higher-octane, cleaner burning fuels that improve air quality and reduce carbon emissions.

IDEAL EMP
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LyondellBasell now offers *IDEAL* EMP, a high-octane blend component for alcohol-free gasoline.

IDEAL EMP is the first choice for alcohol-free gasoline

- Provides 10% more energy than butanol (mass basis)
- Delivers twice the octane as butanol at same oxygen level
- Lowers gasoline vapor pressure (RVP)
- Reduces exhaust emissions
- 42% Renewable content
- Reduces carbon emissions

IDEAL EMP: The first choice in renewable biofuels

- *IDEAL* EMP is a renewable, non-hygroscopic, non-alcohol gasoline component produced from bio-ethanol and natural gas liquids
- *IDEAL* EMP can lower gasoline carbon footprint by >10%

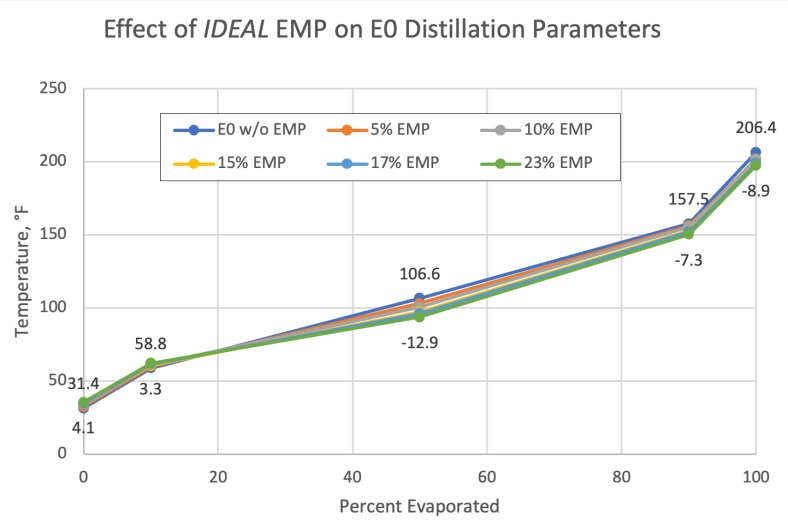
IDEAL EMP provides significant advantages over alcohols:

2X more octane*	3X more energy*	5X lower Blending Vapor Pressure (BRVP)	10% less aromatics in gasoline*
Fully Compatible with fuel infrastructure	No Water Sensitivity no phase separation	No Azeotropes with gasoline components	Lower tailpipe and evaporative emissions

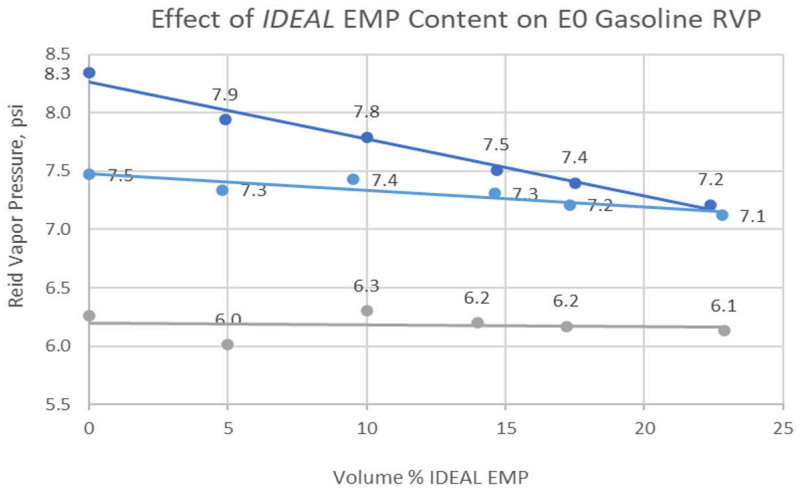
*At the same oxygen content

IDEAL EMP properties closer to gasoline

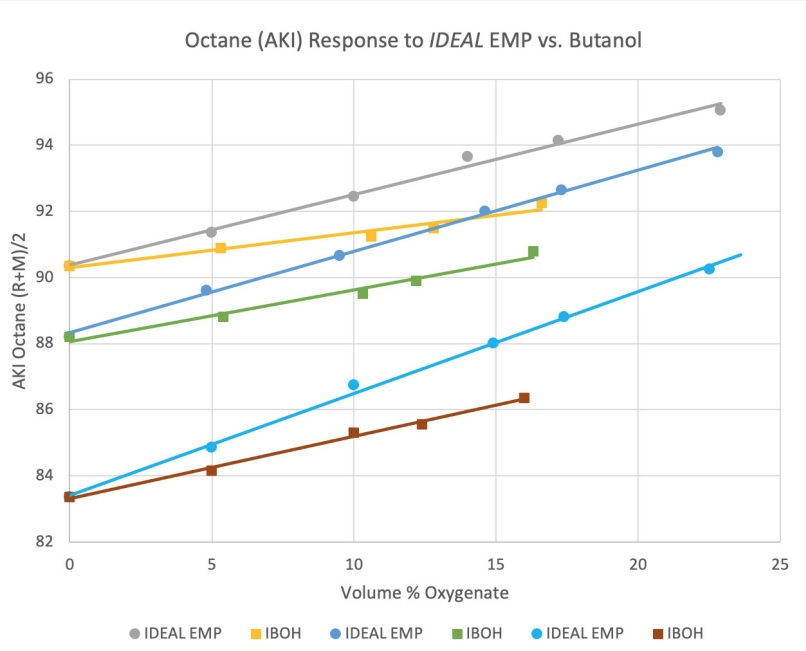
- ASTM D86
- *IDEAL* EMP has little impact on gasoline distillation
- T50 and T90 lowered by less than 13°F at max dosage (22.3%)
- Does not change gasoline specification or properties



- ASTM D5191
- *IDEAL* EMP reduces gasoline vapor pressure (RVP)
- Brings >8 psi gasolines into RFG compliance
- Ideal for low RVP jurisdictions and summer gasoline



- ASTM D2699 & D2700
- *IDEAL* EMP delivers superior octane response
- Produces > 87 AKI gasolines from regular CBOBs and RBOBs
- Produces > 92 AKI gasolines from premium CBOBs and RBOBs
- Lowers the wholesale cost of finished gasolines



About us

We are LyondellBasell (LYB) – a leader in the global chemical industry creating solutions for everyday sustainable living. Through advanced technology and focused investments, we are enabling a circular and low carbon economy. Across all we do, we aim to unlock value for our customers, investors and society. As one of the world's largest producers of polymers and a leader in polyolefin technologies, we develop, manufacture and market high-quality and innovative products for applications ranging from sustainable transportation and food safety to clean water and quality healthcare. For more information, please visit www.lyb.com or follow @LyondellBasell on LinkedIn.

IDEAL EMP properties

Property	Units	RBOB 87	IDEAL EMP	Ethanol	Butanol
Energy Source	Type	Crude oil	NGL & biomass	Biomass	NGL or biomass
Octane number	RON	report	120	130	113
	MON	report	102	96	94
	AKI (R+M)/2	87 min.	111	113	103.5
Reid Vapor Pressure (Summer)	kPa	48-54	28	138	44
	psi	7.0-7.8	4	20	6.4
Density	Kg/m3	0.755	0.736	0.782	0.802
	Lbs/gal US	6.30	6.14	6.53	6.69
Boiling Point	°C	77-121	72	78	108
	°F	171-250	161	172	226
Net Energy Content	MJ/Kg	42.3	36.4	27.2	33.0
	MJ/L	31.9	26.8	21.3	26.5
	BTU/lb	18,175	15,646	11,685	14,187
	BTU/gal US	114,500	96,069	76,300	94,911
WTW CO2 equivalents (GREET)	CO2e/MJ	95	63-73	57	NA
Oxygen content	wt.%	0.0	15.7	34.8	21.6
Max. allowed, vol.% (EPA with waiver)	@ 3.7 wt.% oxygen	NA	23.6	10.6	16
Sub Sim limit for ethers and isobutanol	@ 2.7 wt.%oxygen	NA	17.2	7.8	12.5
Octane boost at max limit (AKI)		NA	19.1	11.4	12.9
Water Solubility @20"C	wt.% fuel in water	<0.05	1.1	100	8.5
Sulfur content	ppm	10 max	0	0	0
Benzene Content	vol.%	0.62 max	0	0	0

- Higher octane than butanol
- Low RVP, no waivers needed
- Excellent distillation properties
- Cost-effective blend component
- Can blend 17.2 vol.% up to sub-sim limit
- 42% renewable content
- Higher energy than alcohols
- Lower water affinity than alcohols
- Lower oxygen content than alcohols
- No sulfur or benzene
- Can blend 23.6 vol.% at 3.7 wt.% oxygen
- ISCC+ Certifications possible

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