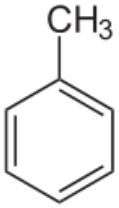
VIRENT BioForm TL™ *Toluene*



Overview

The BioForming® process converts plant-derived feedstocks into a BioFormate® product that is analogous to petroleum reformate. Similarly to conventional petroleum reformate, Virent's Bioreformate product can be used as a gasoline blendstock or processed to high purity aromatic chemicals using conventional aromatics processing technology. Virent's products are indistinguishable from the petrochemical analogs, except for C-14 dating for bio-content. Using conventional aromatics processing Virent has produced renewable paraxylene, mixed xylenes, toluene, and benzene.

Key Properties

Composition

BioForm TL™ toluene meets typical industry standards for high purity toluene, including TDI/nitration grade. Common impurities are present at levels at or below those in conventional petrochemical toluene.

Interchangeable

BioForm TL is a direct drop-in replacement for petrochemical toluene, meeting typical industrial specifications for high purity toluene.

Green House Gas (GHG) Reduction

BioForm TL helps meet sustainability goals. Depending on the feedstock used to produce BioForm TL, it will reduce the GHG up 70% versus petrochemical toluene. Radio carbon dating implies the carbon content of BioForm TL is bio-based.

TSCA Listing

BioForm TL is TSCA listed. Product registrations in other regions, including REACH, will be obtained prior to commercialization. Consult the SDS for additional information.

Property	Method	Typical Industry Specification	VIRENT	
			Specification	Actual[2]
Toluene	ASTM D4492[1]	≥ 99.7 - 99.9 wt%	**≥ 99.9 wt%**	**99.84%**[3]
Benzene	ASTM D4492[1]	≤ 10 – 900 ppm	**≤ 300 ppm**	**200 ppm**
Total non-toluene aromatics	ASTM D4492[1]	≤ 1000 - 1400 ppm	**≤ 1000 ppm**	**590 ppm**
Nonaromatic hydrocarbons	ASTM D4492[1]	≤ 200 - 3000 ppm	**≤ 1000 ppm**	**990 ppm**
Sulfur	ASTM D5453	1 – 10 ppm	**≤ 1 ppm**	**Pass**[4]
Appearance	ASTM D2090	Clear and sediment-free	**Clear and sediment-free**	**Pass**
Color, maximum	ASTM D1209 Pt-Co Scale	20	**20**	**<5**
Mean Biobased Content	C-14	N/A	**> 99%**	**100%**[5]

(1) Method modification available upon request
(2) Production Lot C0401D-OP27601
(3) Improved distillation will achieve specification.
(4) Estimated based on feedstock and co-products.
(5) Based on co-product analysis

Applications

Toluene is used to manufacture toluene diisocyanate, a key component of polyurethane foams for bedding, furniture and automotive use. It is also used as a building block for explosives such as TNT and for dyes. In addition toluene is commonly used as a solvent for paints, paint thinners, inks, adhesives, lacquers, and other applications. Toluene is also used as a fuel blendstock. It serves as an octane booster when blended into gasoline.

For additional information:
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