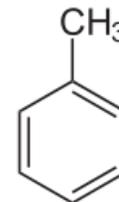




VIRENT BioForm TL™ Toluene



Overview

The BioForming® process converts plant-derived feedstocks into a BioFormate® product that is analogous to petroleum reformat. Similarly to conventional petroleum reformat, 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, benzene and Aromatic 100.

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.

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.

Customer Evaluation

Leading producers of toluene derivatives have evaluated BioForm x and found it to satisfy all testing requirements to date.

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

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