



# Formulating with DMSO in Paint Strippers

**Gaylord Chemical Company L.L.C.**

Leading Producer of [Dimethyl Sulfide \(DMS\)](#) and [Dimethyl Sulfoxide \(DMSO\)](#)

# **Our History**

# Company History



**1962** Gaylord Chemical's predecessor company (The Crown Zellerbach Corporation) **commercialized DMS and DMSO production**

**2007** Gaylord's management team purchases the chemical business from Temple Inland Corporation

**July 2010** Safe and successful startup of the grass roots Tuscaloosa, Alabama USA DMS facility

**December 2010** Safe and successful startup of Tuscaloosa, Alabama USA DMSO facility

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**Our plant relocation has provided real benefits:**

- Significant increase in **production capacity**
- Reliable and **committed raw material supplier**



# Company Profile



Gaylord Chemical is headquartered in Slidell, LA

**Established DMS supplier** for ethylene and catalyst presulfiding applications for over 30 year

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Continuous “on-purpose” DMS producer for trade sales since 1962

DMS manufacturing facility is located next to Hunt Refining gasoline / distillates refinery in Tuscaloosa  
- Estimated 72,000 bbl/day

Largest global capacity for DMS

Since startup in 2010, our DMS facility has manufactured the purest DMS in the world

# **DMSO use in Paint Strippers**



# Regulatory Overview

Methylene chloride is prohibited for use in paint stripping formulations in the European Union (2011).

The US EPA has proposed in January 2017 a prohibition on the use of methylene chloride and restrictions on N-methylpyrrolidone (NMP) in these same formulations.

Prioritization to develop alternative formulas based on less toxic solvents within the industry.

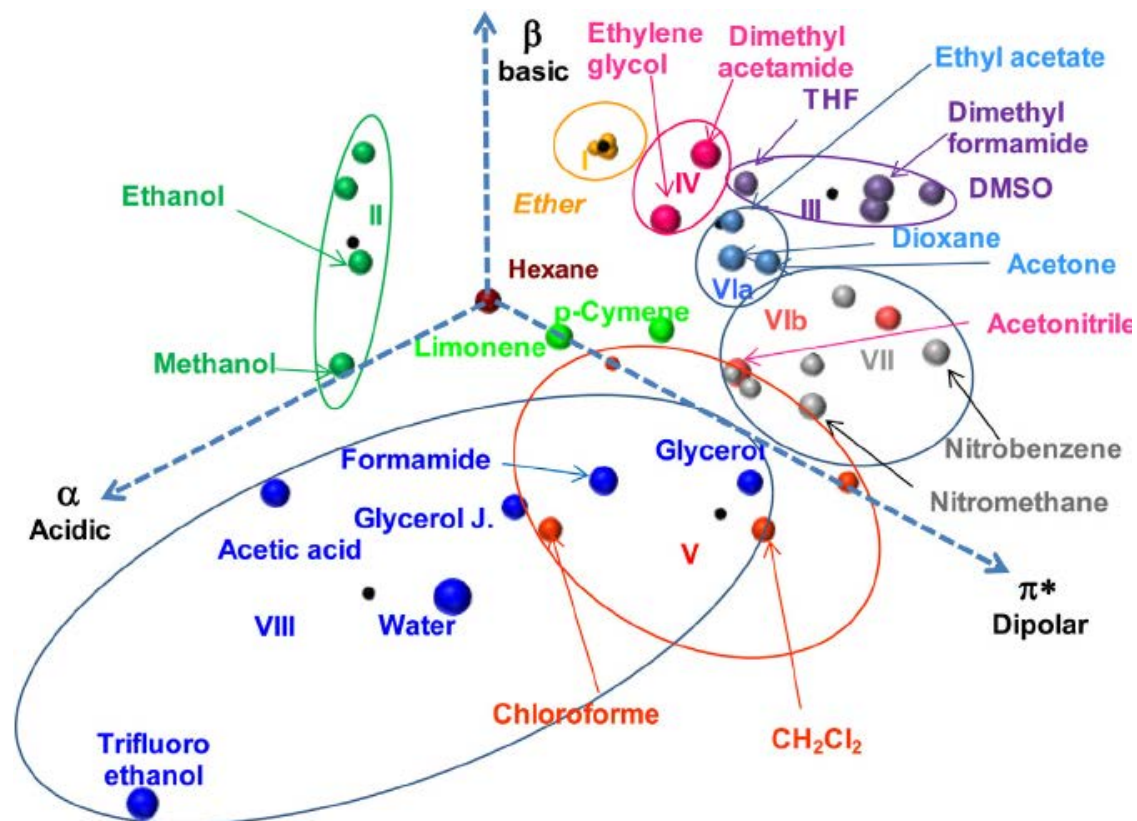
# DMSO Product Basics

Property	Result
Molecular weight	78.13
Boiling Point (760 mm HG)	189C (372F)
Melting Point	18.5C (72 F)
Vapor Pressure (25C)	0.62 mm HG
Flashpoint (TOC)	95C (203 F)

## Features of DMSO:

- Miscible with **water**
- **Low level** of toxicity
- Highly **polar** dipolar aprotic solvent
- Environmentally **safe**
- **Compatible** with a wide range of organic and inorganic compounds

Hansen Parameter Solvent Map





# DMSO Safety Data

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Toxicological Indicator	DMSO	DMAc	NMP
Oral LD-50	14,500-28,300 mg / kg rat	4,300 mg / kg rat	3,914 mg/ kg rat
Dermal LD-50	40,000 mg / kg rat	2,240 mg / kg rat	8,000 mg/ kg rabbit
Inhalation (rat)	none @ 2,900 mg / m <sup>3</sup>	2,475 mg / kg @1 hr	NA
Reproductive toxin	no	yes	yes
Proposition 65	no	no	yes

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DMSO has a low level of acute and chronic toxicity. DMSO is not a carcinogen (NTP, IARC) and is not a reproductive or developmental toxin.

Although DMSO has many solvent properties that resemble other polar solvents, it is **safer to work with** (dermal, oral, and inhalation exposure).





# DMSO Benefits

A safer alternative to existing solvents

Lower volatility than methylene chloride-based products

Regulatory compliance

Odor & cosmetic advantages relative to methylene chloride



# Safety and Handling

**Hand Protection:** Butyl rubber or nitrile gloves

**Storage:** HDPE / HDPE, mild & 304, 316 Stainless Steel, AL 6061-T6

**Gaskets / Polymers:** PFTE, Kalrez®

Please refer to our website for additional detailed information regarding materials of construction, storage conditions, piping and unloading conditions.

# Formulation Considerations

## Cosolvent

Dibasic Esters (DBE, DME)

Propylene carbonate: (Jeffsol)

P-series glycol ethers: (DPM, TPM)

Ethyl lactate

AR-100,150,200

D-limonene / citrus terpenes

*t*-butyl acetate

Water

Oxsol?

Benzyl alcohol?



safe, miscible



safe, miscible



solvent power, miscible



safety



cost



smell



VOC content



VOC content, solvent strength

## Performance view



solvent strength



solvent strength



cost



solvent strength



odor



DMSO solubility



flashpoint



strip performance



safety, availability



# Formulation Considerations

## Additives

Viscosity modification

Activators

Inhibitors

Fragrance

Surfactants nonionics

## Suggestions

Methocel OS, Klucel H, Carbopol 934

Monoethanolamine (MEA), triethanolamine

Acids and peroxides are not recommended

Cobratec 928 (copper, zinc at lower pH)

Alox products (mild steel, low pH)

Pine oil, limonene, citrus oil

Igepal OD-410 (Rhodia), Triton(Dow)

Ethomeens (Akzo Nobel), Ninol (Stepan)

# Formulation Considerations

<b><u>Sample Formulation</u></b>	
<b><u>Raw Material</u></b>	<b><u>Amount</u></b>
DMSO	38-44%
AR-150ND®	15-23%
DBE®	19-30%
EEP	8-17%
Methocel® 311	1%
Ethanolamine	0.5%
Rhodasurf® DA-630	0.5%

**Preparation:** Ethanolamine and DMSO are combined at room temperature, and Methocel® 311 is added with stirring. As the mixture thickens, DBE, EEP and AR150 are added sequentially. Rhodasurf® DA-630 is added last; Final product has a viscosity of ~7000 cps. Package in HDPE.

*AR-150ND®* is a product of the ExxonMobil Corporation.

*DBE®* (dibasic ester blends) are products of DuPont. Monsanto markets a similar product line (DME® blends)

*EEP* (3-ethoxyethylpropionate) is produced by Eastman Chemical Company

*Methocel®* thickeners are produced by Dow Chemical.

*RhodaSurf® DA-630* is a product of Rhodia.



# Relative Performance

DMSO and NMP-based products **perform similarly** on paints

**Both** require 2-3 times as long to work than MC-based products

DMSO-based products are especially effective at **stain/varnish removal**

**Formulation considerations** nearly identical for DMSO & NMP



# For more information



[www.gaylordchemical.com](http://www.gaylordchemical.com)

**Thank you!**