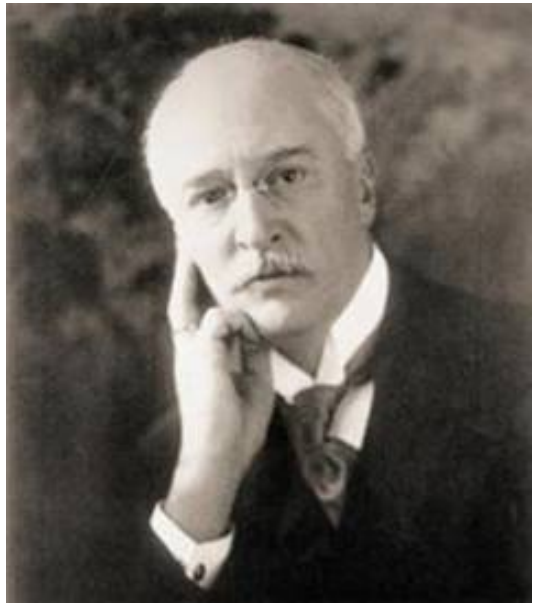
B100 Overview

September 2007

Biodiesel Overview

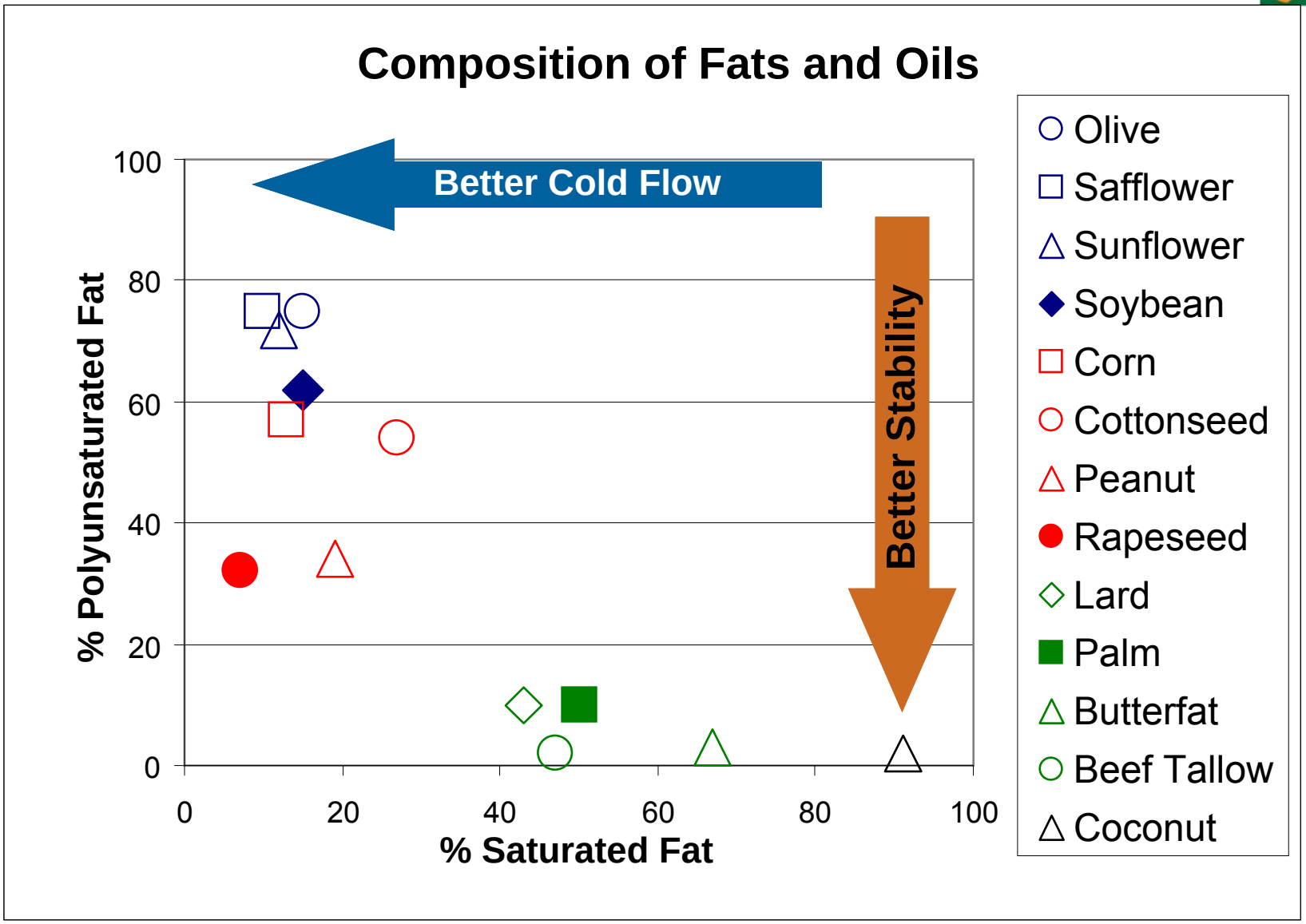
- Biodiesel is a clean burning alternate fuel that is simple to use, biodegradable, nontoxic, and essentially free of sulfur and aromatics.
- It is produced from domestic, renewable resources, which decreases dependency on foreign oil and contributes to the economy.
- Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend (Bxx).
- It can be used in diesel engines with little or no modifications.
- Rudolf Diesel first demonstrated an engine that ran on oil extracted from peanuts at the World Exhibition in Paris, France in 1900.



Rudolf Diesel

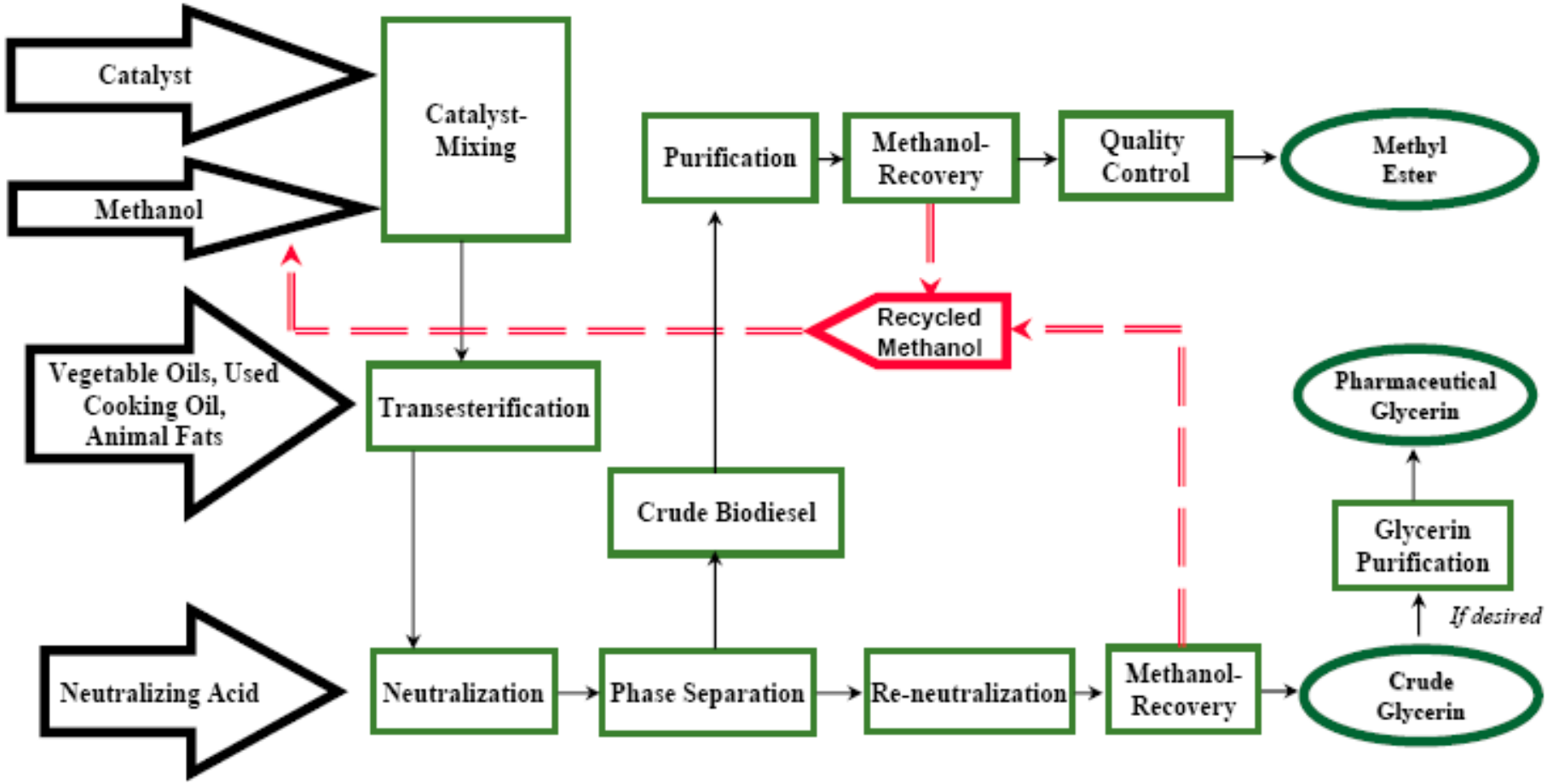
What is Used Today?

- In the United States, most commercial biodiesel is made from soybean oil, while in Europe, rapeseed oil is more commonly used.
- Common acronyms are used for specific bio oil sources:
  - Soybean Methyl Ester (SME)
  - Rapeseed Methyl Ester (RME)
  - Palm Oil Methyl Ester (PME)
  - Vegetable Oil Methyl Ester (VOME)
  - Canola Methyl Ester (CAME)
  - Coconut Methyl Ester (CME)



Information from National Renewable Energy Laboratory

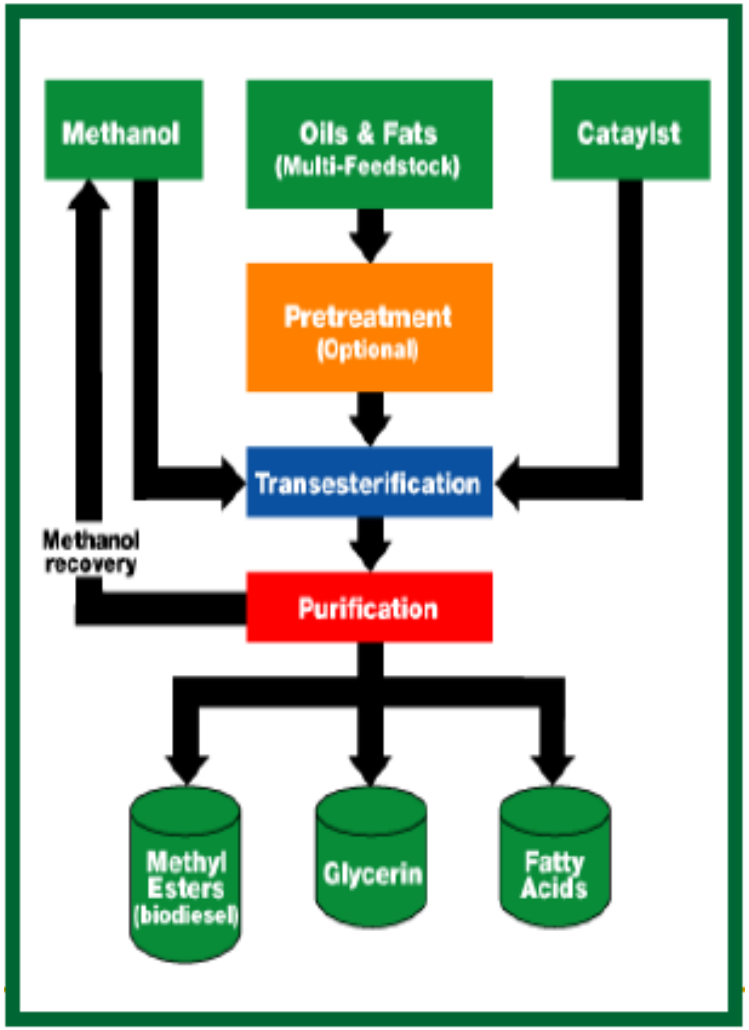
Biodiesel Production Process



The Biodiesel Reaction

Combining

Vegetable Oil
or
Animal Fat
(100 lbs.)
+
Methanol or
Ethanol
(10 lbs.)

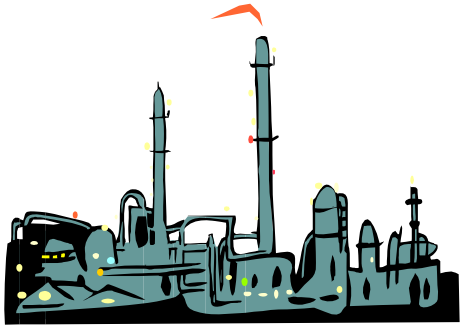


Yields

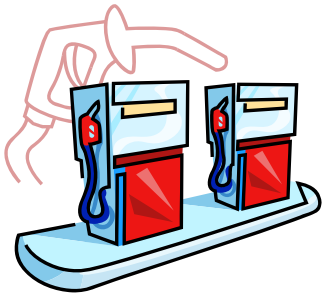
Biodiesel
(100 lbs.)
+
Glycerine
(10 lbs.)

Biodiesel Supply Chain

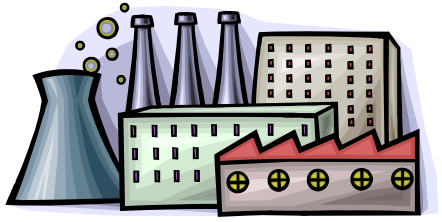
Feedstock producer



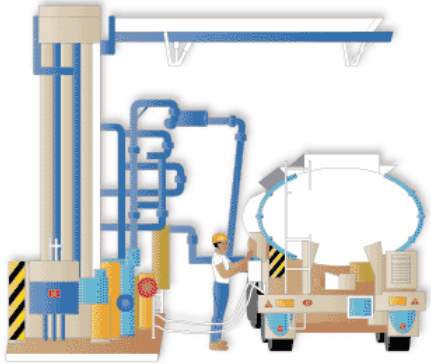
Refinery (ULSD)



Diesel filling station

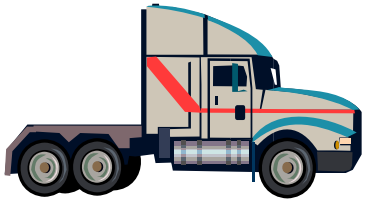


Biodiesel producer



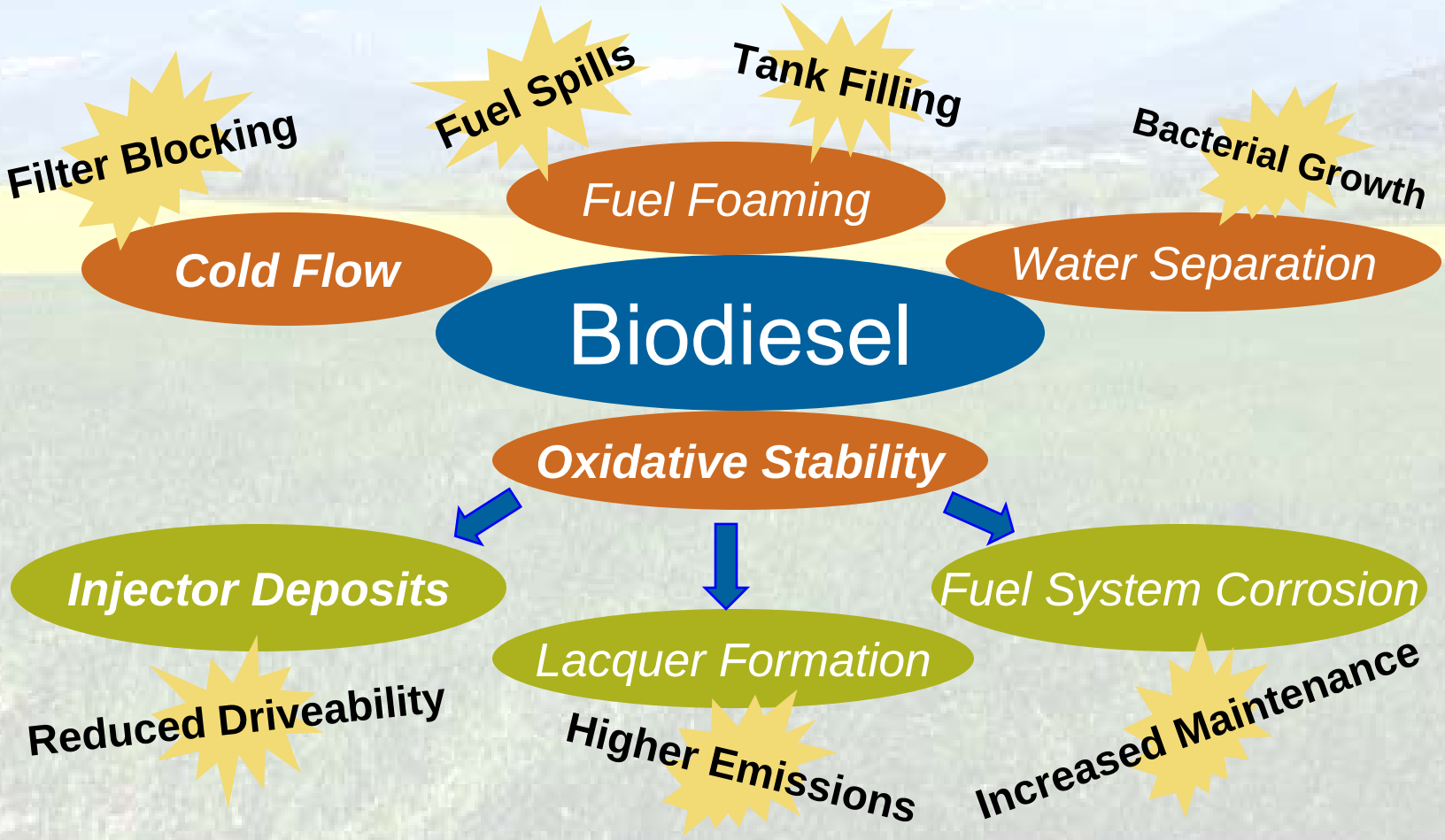
Terminal

(ULSD/Biodiesel blend B0–B100)



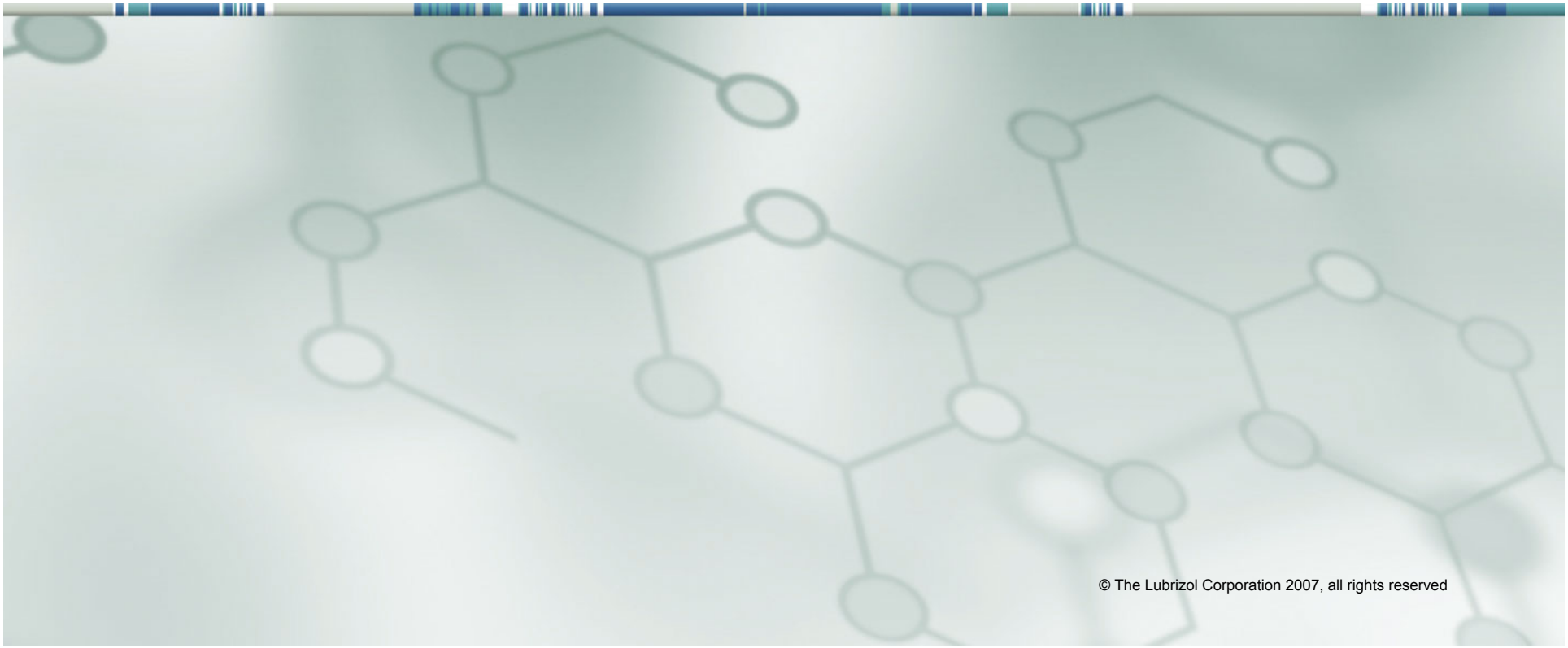
End user

Potential Impacts on Vehicle Operability



Lubrizol's Biodiesel Product Offerings

Additives To Meet Biodiesel Producer Needs



Fuel Additives For B100 Biodiesel Producers

Cold Flow Improvers (100-9,000 ppm w/w)		Soy (SME)	Palm (PME)	Rapeseed (RME)	Tallow (TME)	Coconut (COME)	Canola (CAME)
Pour Point Depressant (PPD)	FloZol® 502	√ (undistilled)					
	FloZol® 503			√			
	FloZol® 510					√	
	FloZol® 515	√ (distilled)			√		√
	FloZol® 520		√				
Cold Filter Plugging Point (CFPP)	FloZol® 502	√ (undistilled)					
	FloZol® 503			√			
	FloZol® 510					√	
	FloZol® 515				√		
	FloZol® 520	√ (distilled)	√				√

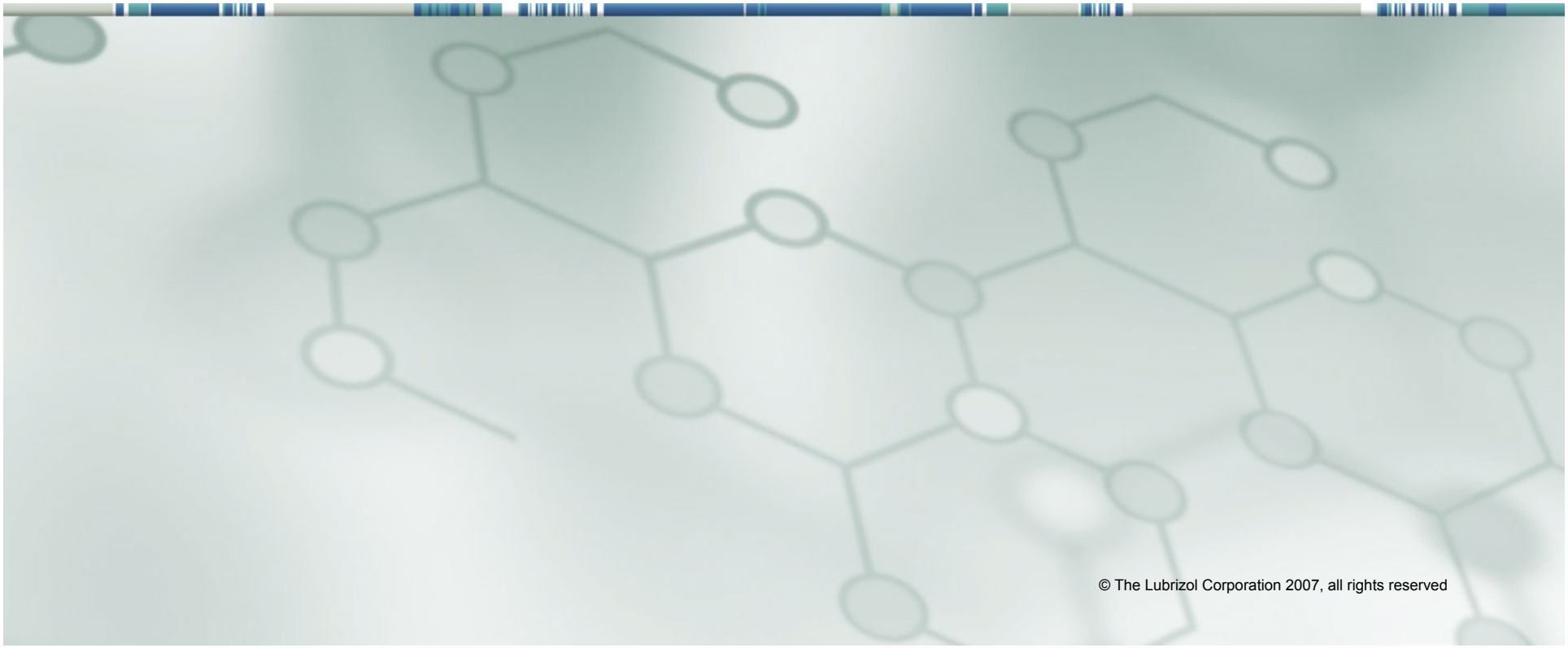
Lubrizol's FloZol® products may perform differently even within the same feedstocks, so testing is advised.

Fuel Stabilizer/Antioxidant
Lubrizol 8417U (U.S. Source) 300-1,500 ppm w/w
Lubrizol 8417A (E.U. Source) 300-1,500 ppm w/w

Biocide
Lubrizol 8417B 250-1,000 ppm w/w
(Not available in the U.S.)

Lubrizol's Biodiesel Product Offerings

Antioxidant/Stabilizer



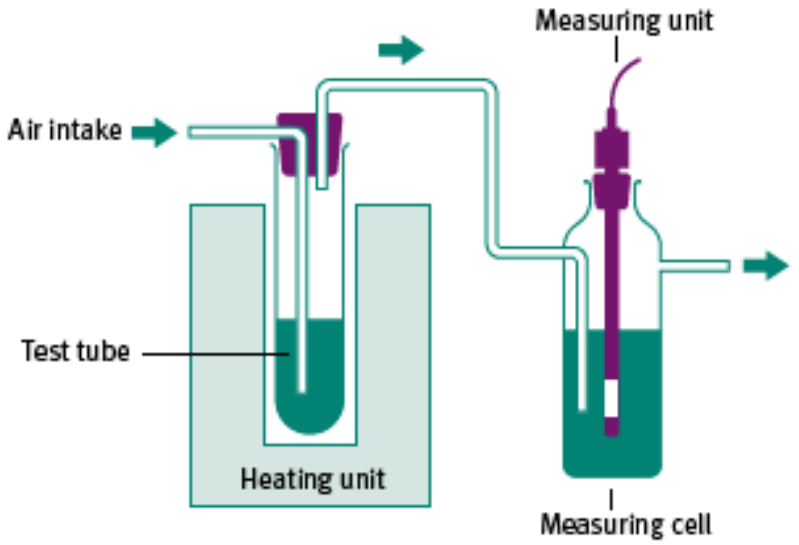
Impact of Biodiesel Oxidation

- Unsaturated fatty acids found in typical feedstocks are the source of these stability concerns. Unsaturated fatty acids react with oxygen, forming peroxides, and result in a variety of degradation byproducts, including corrosive, low-molecular weight acids and biopolymers.
- These byproducts often cause sludge and lacquer in diesel fuel injection systems and fuel filter plugging. For these reasons, vehicle and fuel injection equipment manufacturers have expressed concern about the control of oxidation stability.

How is Oxidation Measured?

The Rancimat Oxidation Stability Test (EN14112).

- This test consists of air bubbling through biodiesel maintained at 110° and then into a sample of water.
- When biodiesel starts to oxidize, volatile acids escape with the air and are collected in the water, increasing its conductivity.
- The time it takes from the start of the test to the sharp rise in conductivity is known as the induction time, induction period or the Oil Stability Index (OSI).



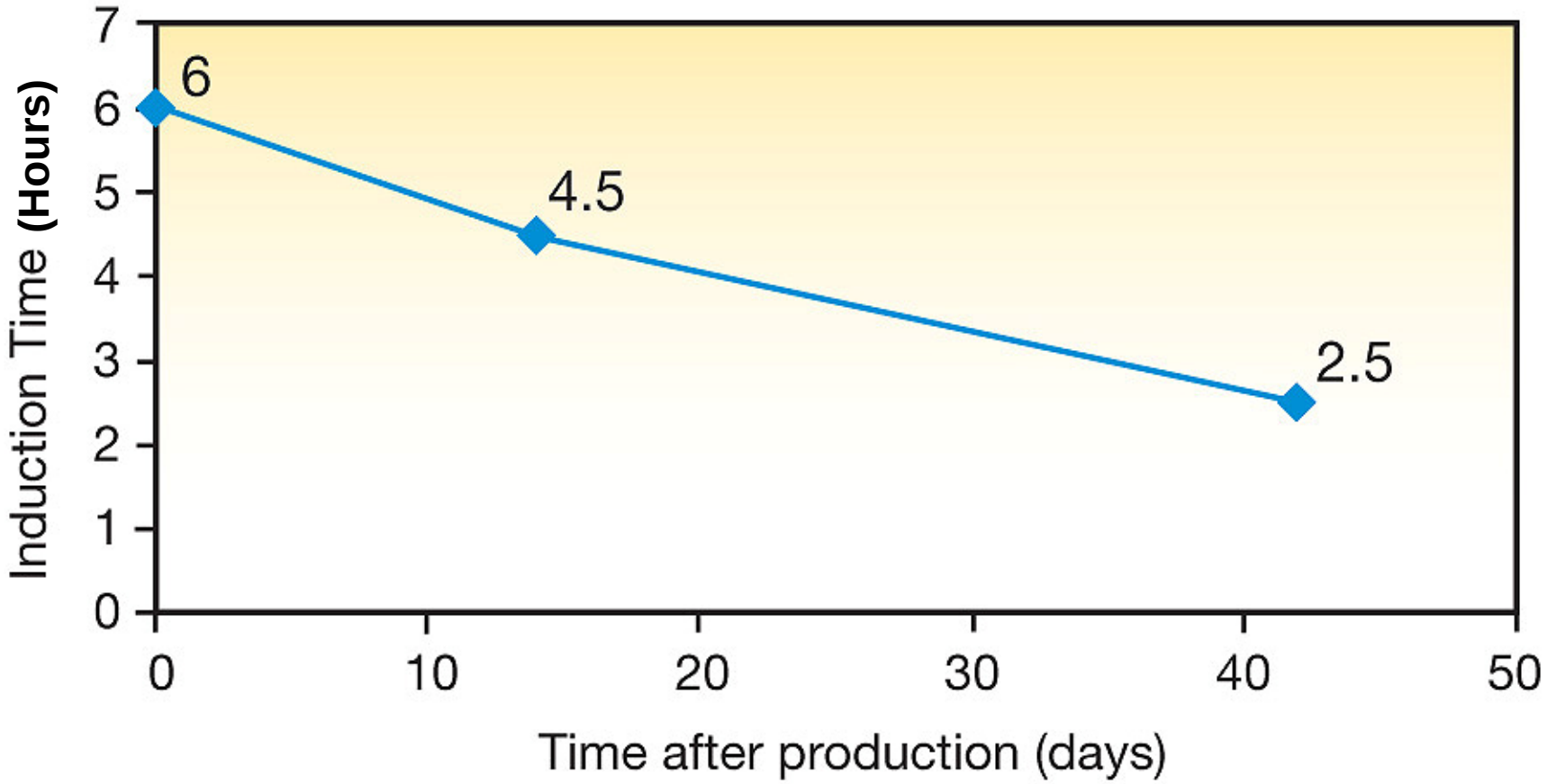
How is Oxidation Measured? (continued)

Specifications:

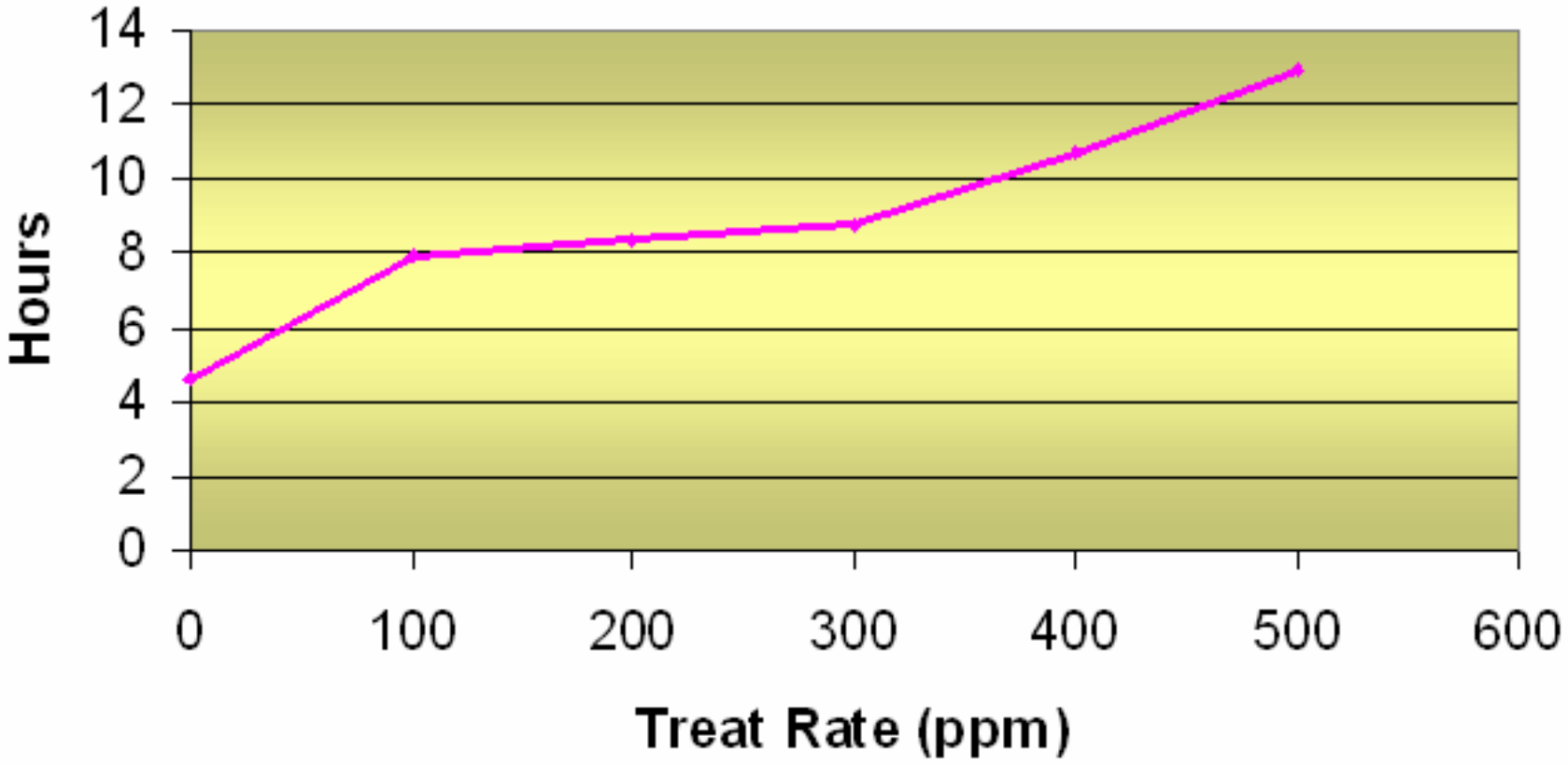
- U.S. - ASTM D6751, which requires a minimum induction time of 3 hours.
- Europe - EN14214, which requires a minimum induction time of 6 hours.

- Some more stable, fresh biodiesels can meet this but might deteriorate over time so still need treatment because fuel usage might not be immediate.
- Less stable, fresh biodiesel may have an induction time measured in minutes.
- Traditional diesel is generally excellent, so this is not normally measured. Induction time is likely to be in days.

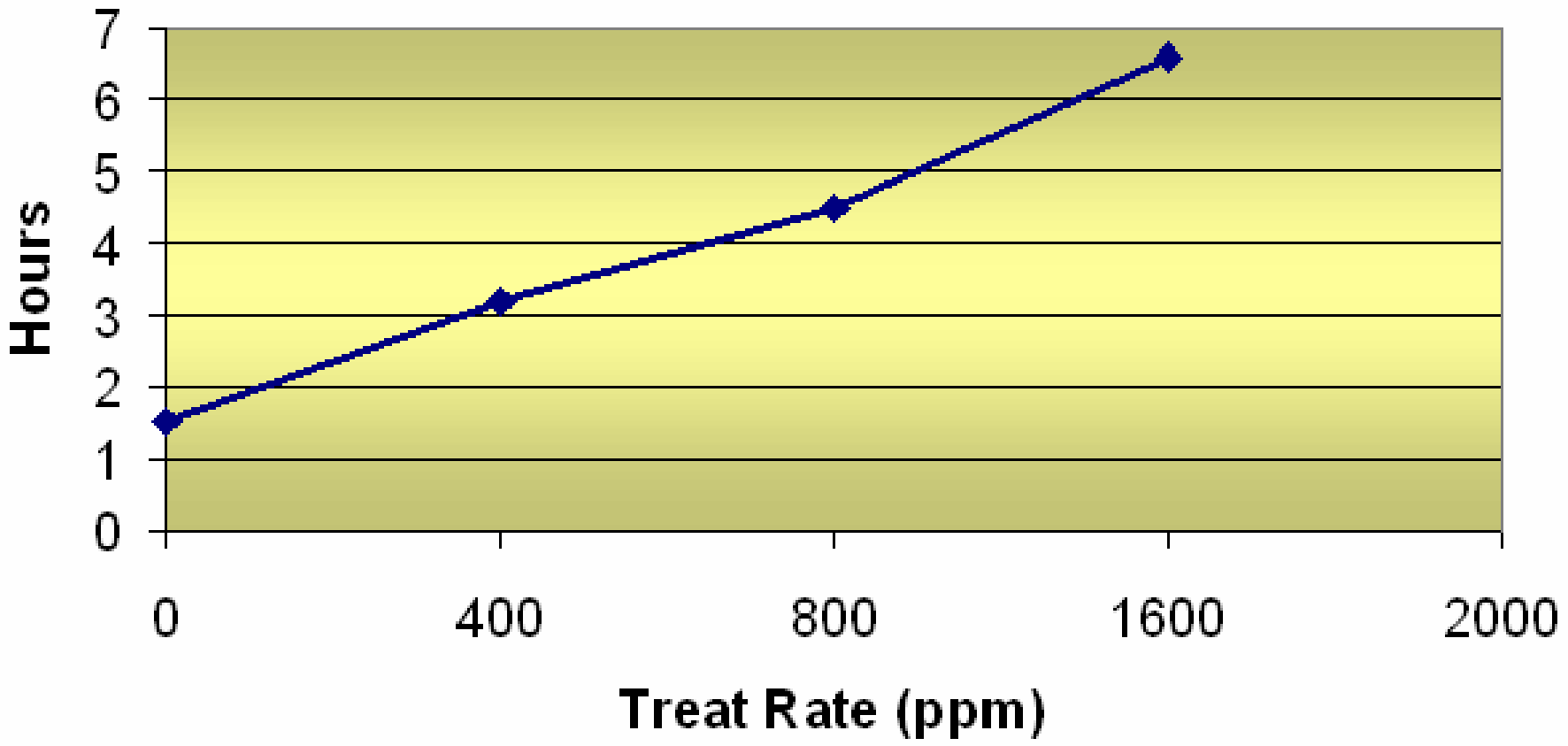
(RME) Rancimat Deterioration Over Time Untreated



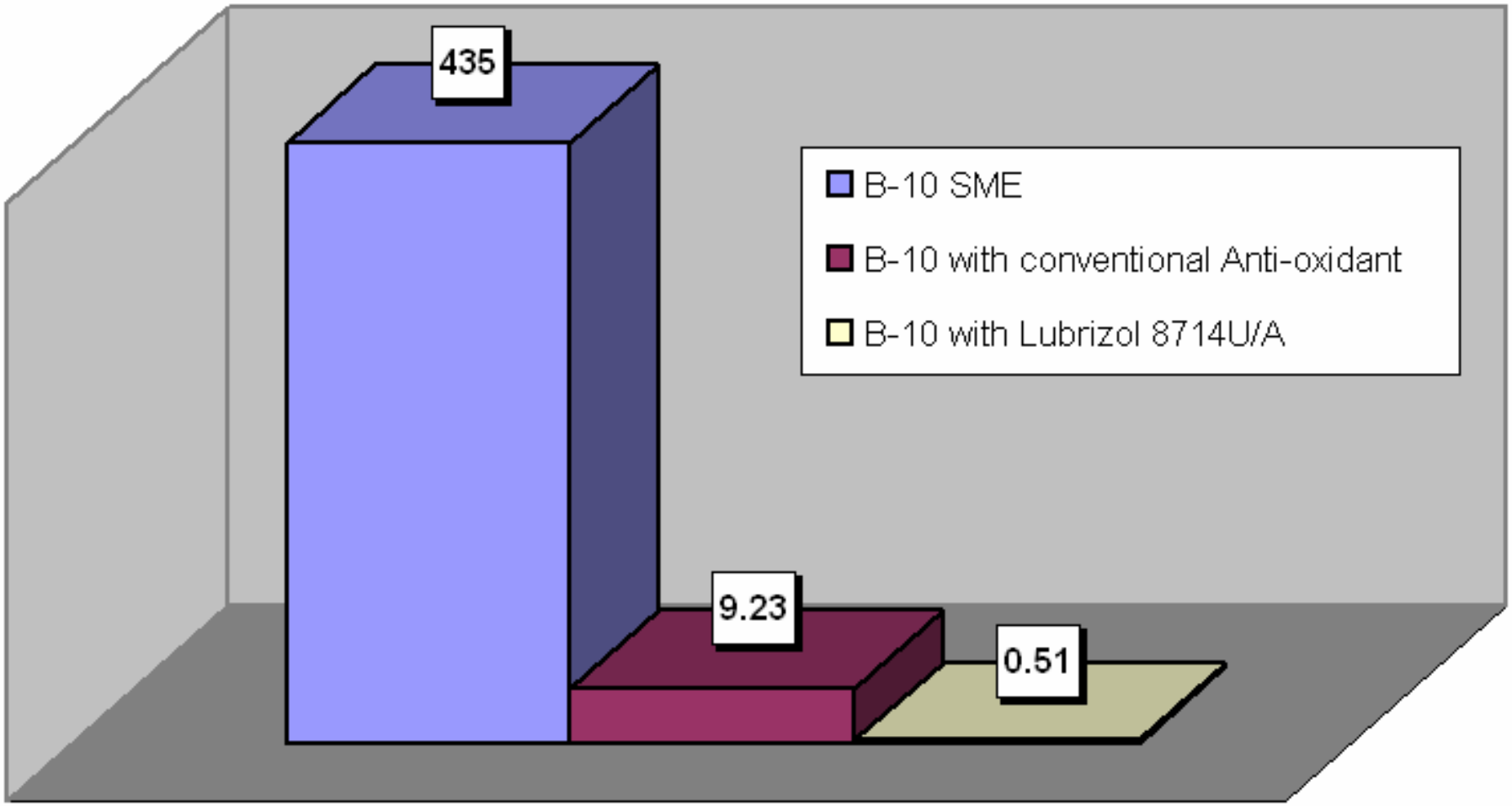
(RME) Rancimat Hours Treated with Lubrizol 8417U/A



(SME) Rancimat Hours Treated with Lubrizol 8417U/A

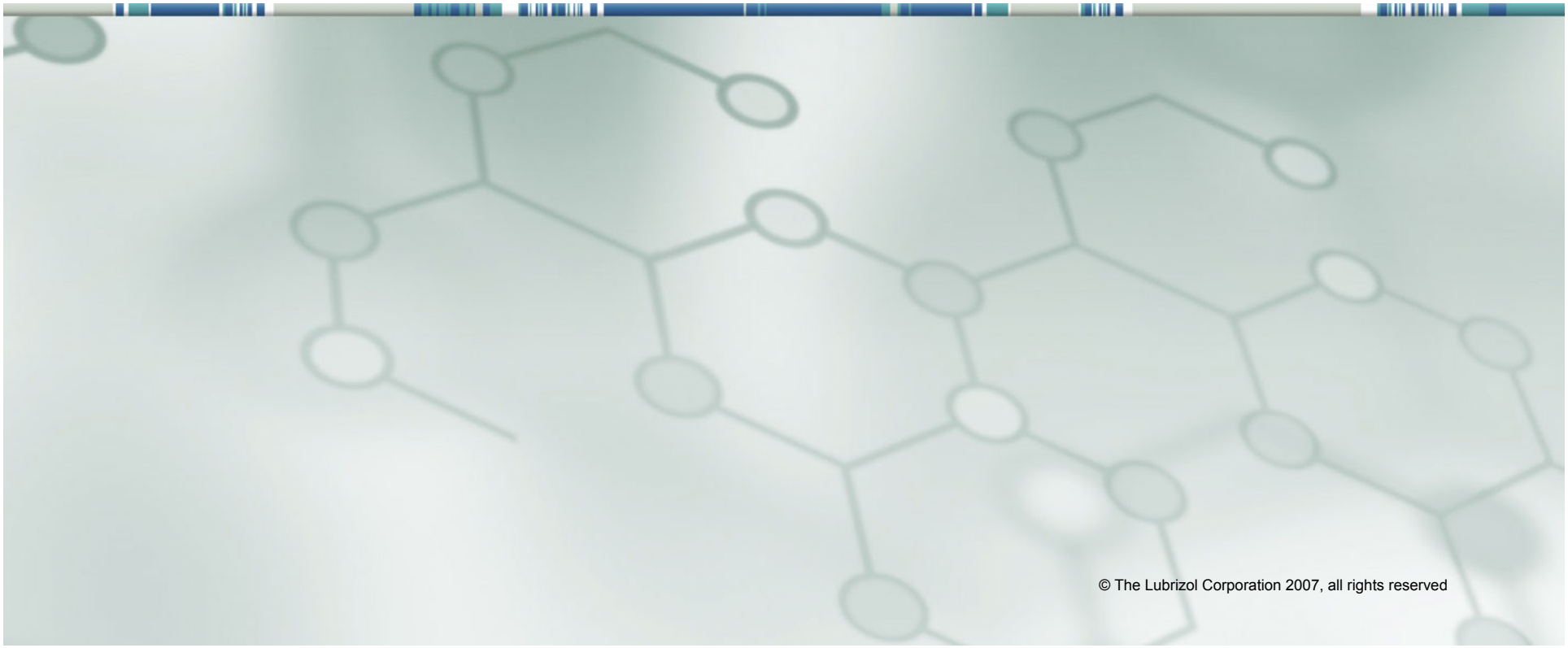


B-10 D2274 Oxidation Stability
(milligrams of insolubles)



Lubrizol's Biodiesel Product Offerings

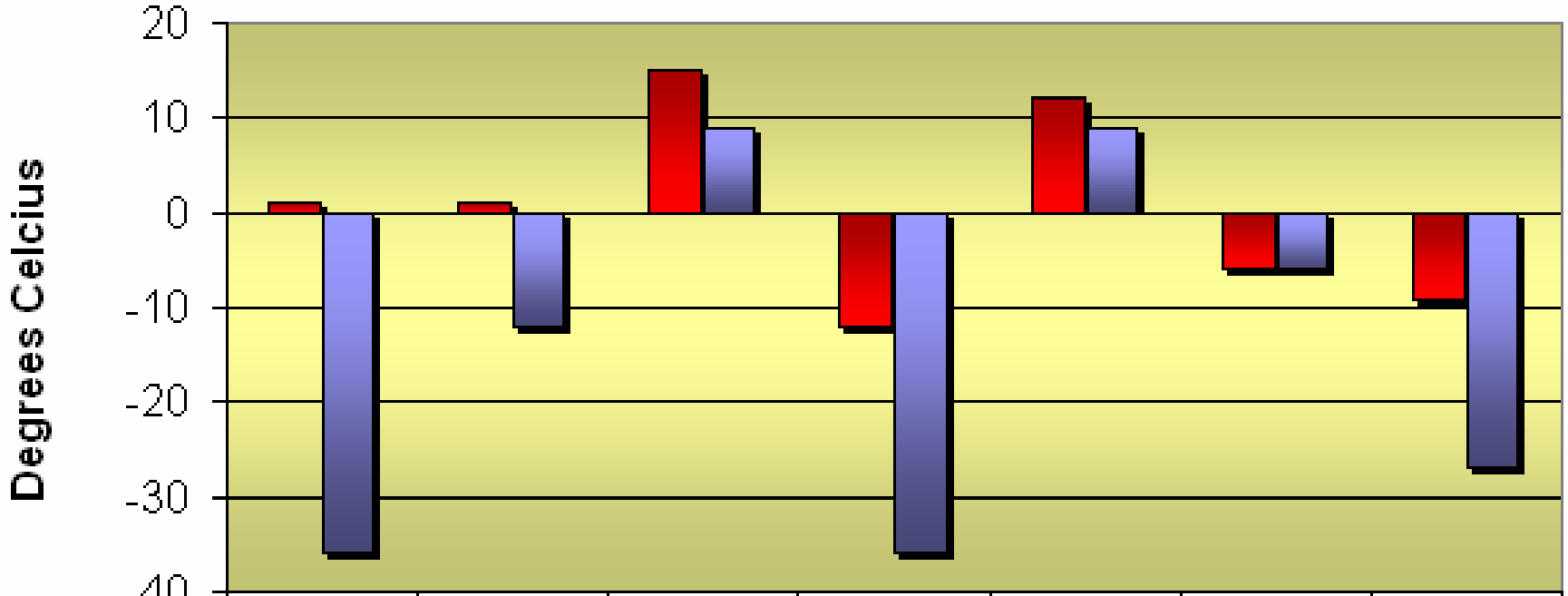
Summary of FloZol® Cold Flow Improvers



FloZol® 500 Series Cold Flow Improvers

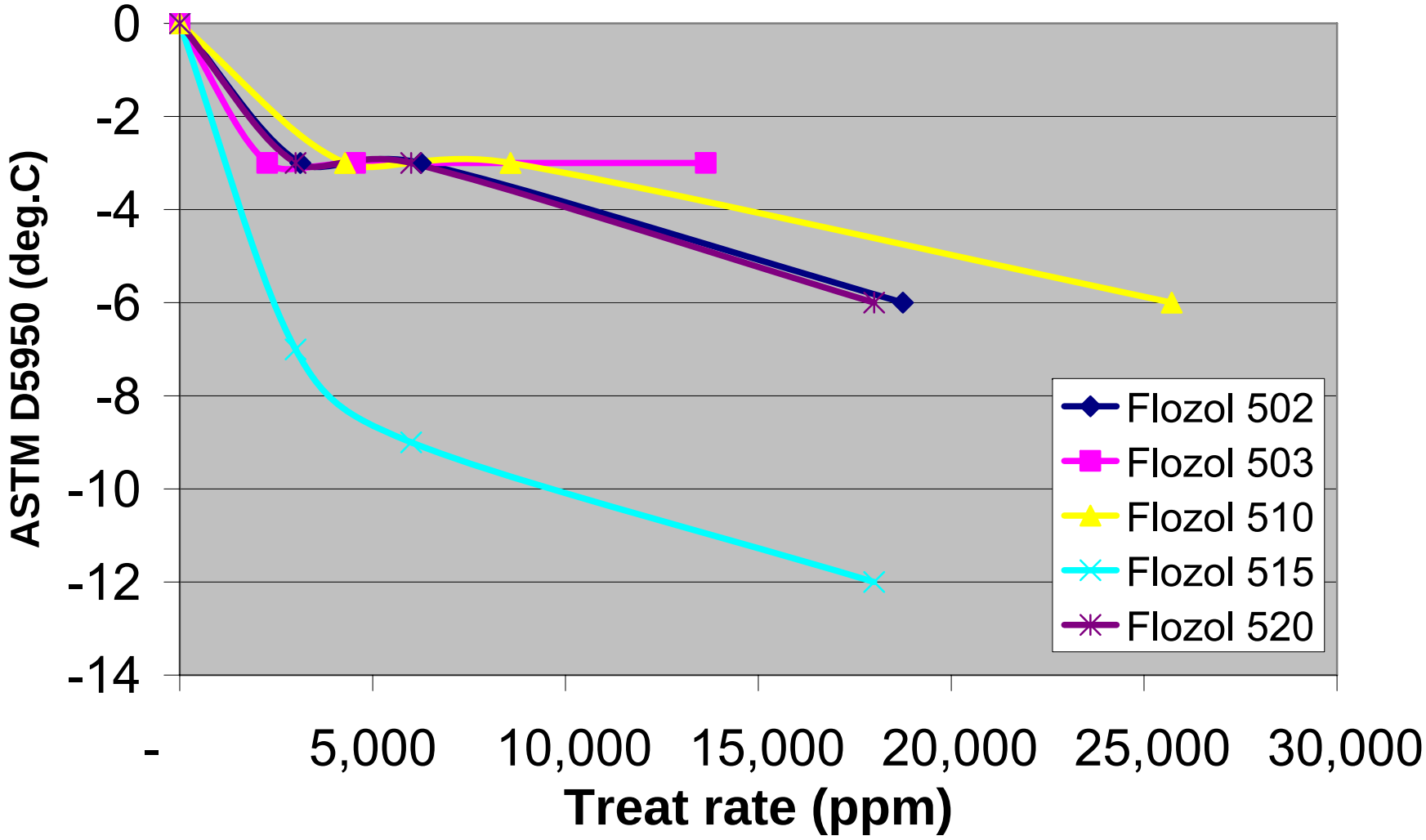
- Prevent fuel gelling in low temperatures by lowering the cold filter plugging point (CFPP) and pour point of various B100 feedstocks.
- The impacts of these additives on pour points and CFPP across a variety of FAME types has been tested

Additive Impacts on Pour Points in Multiple FAME Types (Variable Treat Rates)

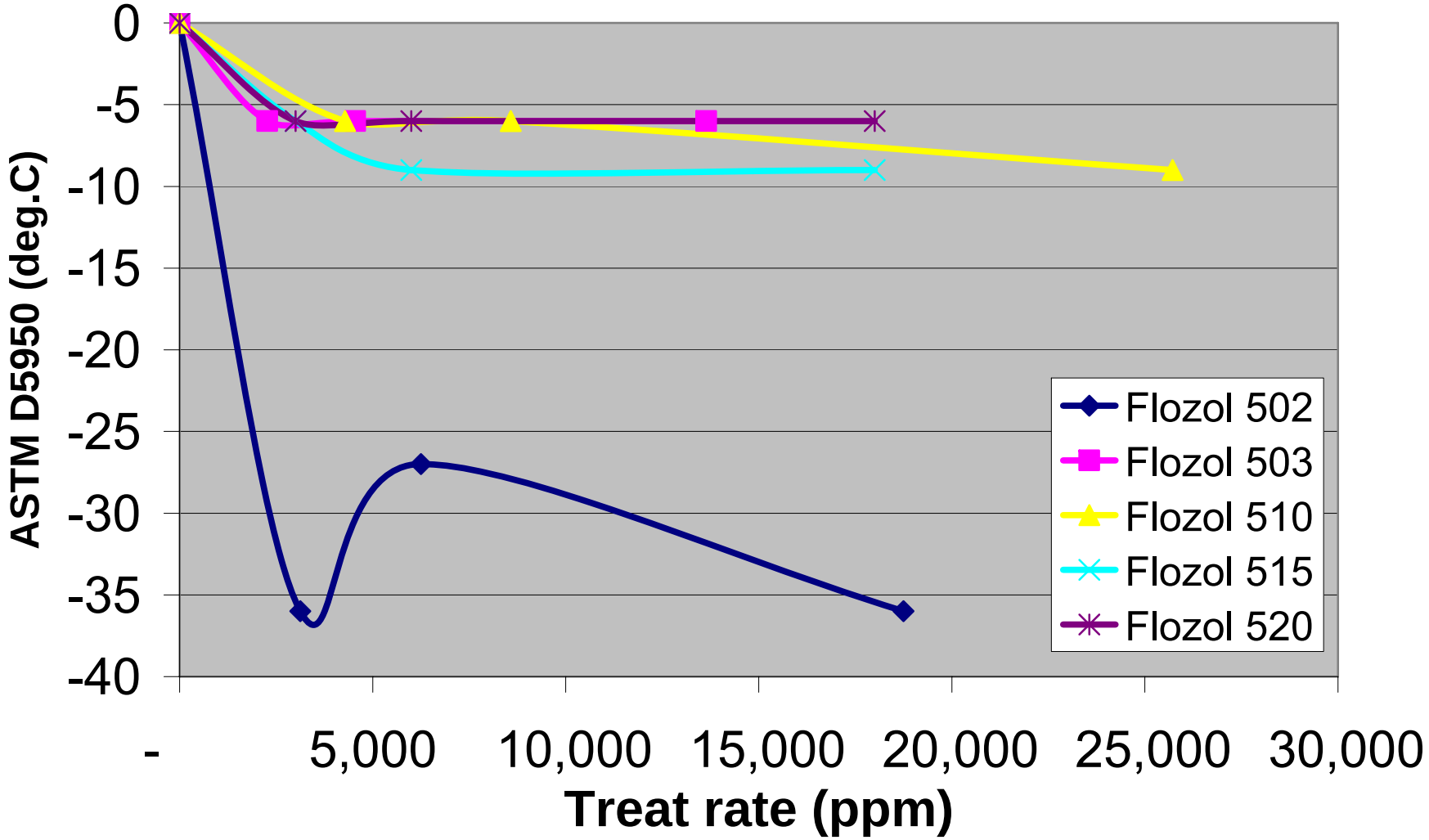


	SME dist.	SME undist.	PME	RME	TME	CME	Canola
Untreated	1	1	15	-12	12	-6	-9
Treated	-36	-12	9	-36	9	-6	-27

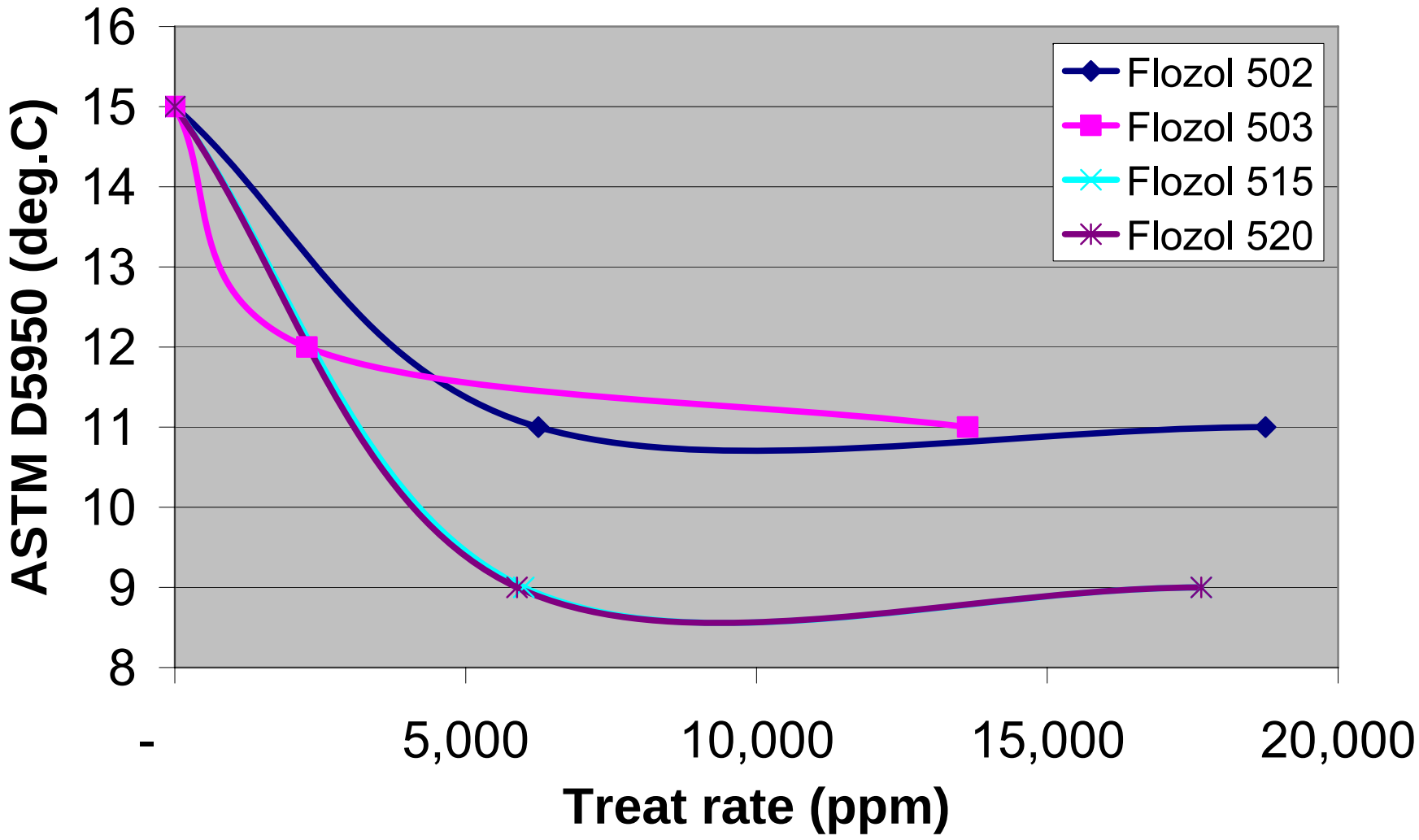
Soy Methyl Ester Using Distilled Feedstock - Pour Point



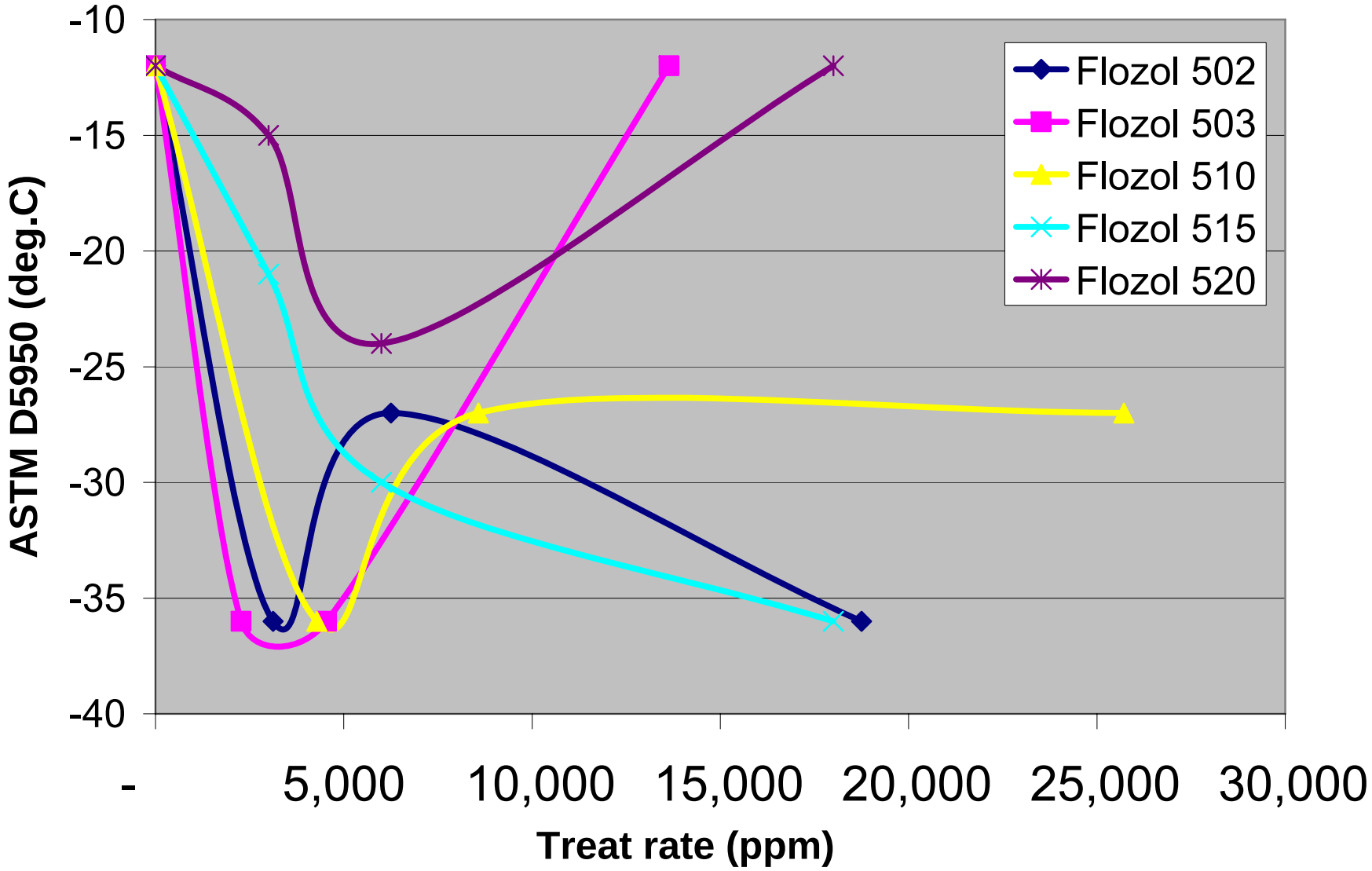
Soy Methyl Ester Using Undistilled Feedstock - Pour Point



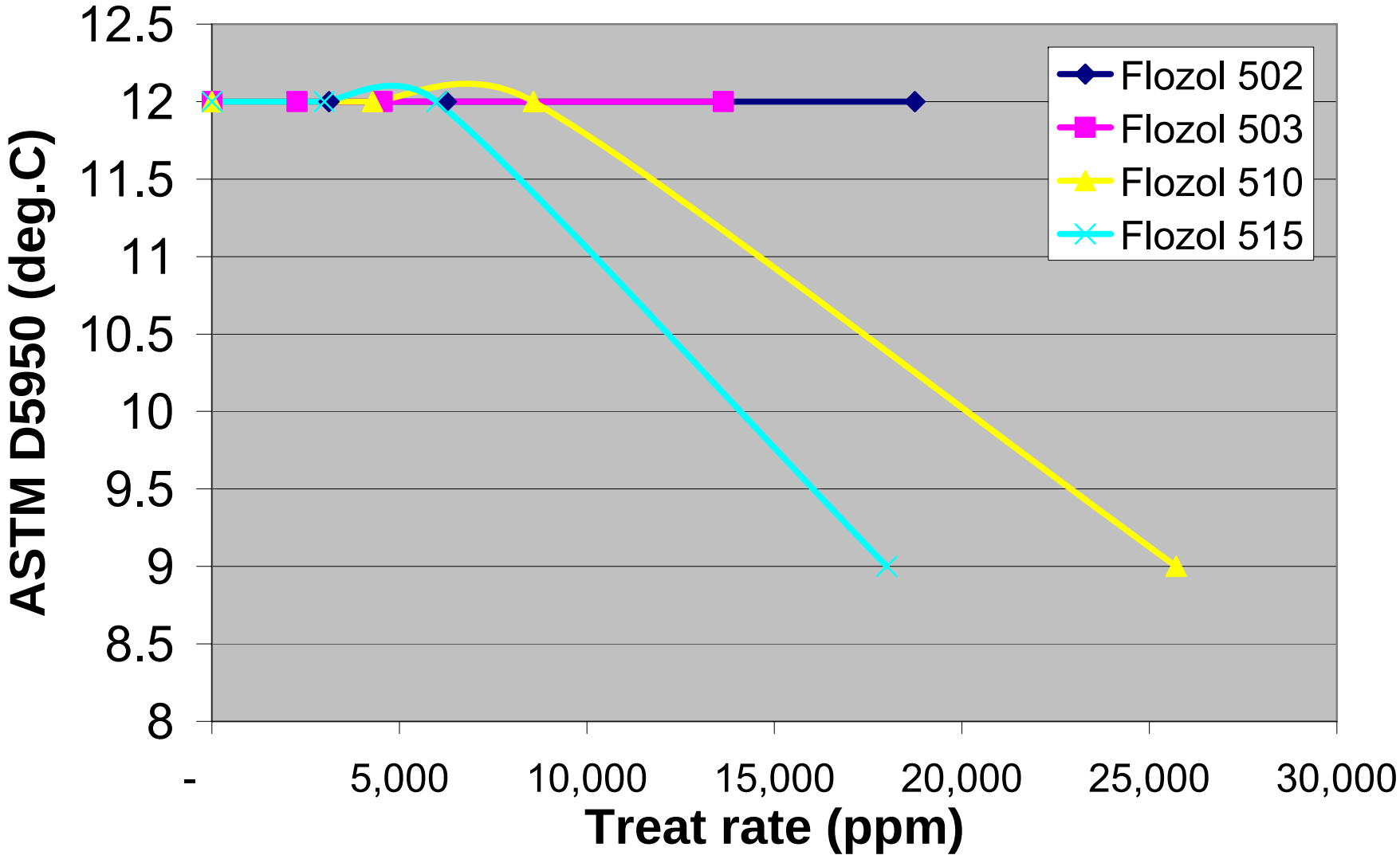
Palm Oil Methyl Ester #1 - Pour Point



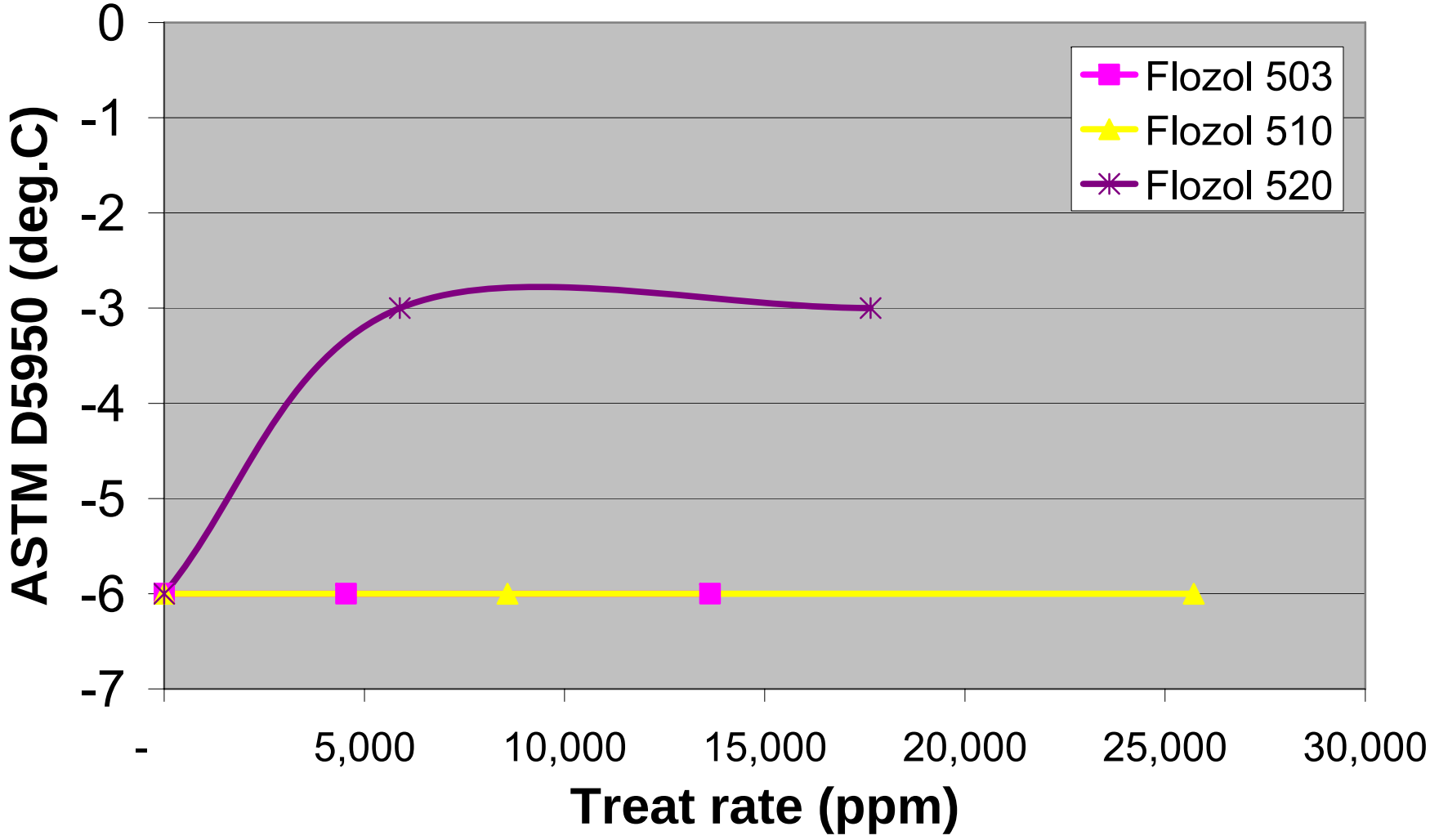
Rapeseed Methyl Ester - Pour Point



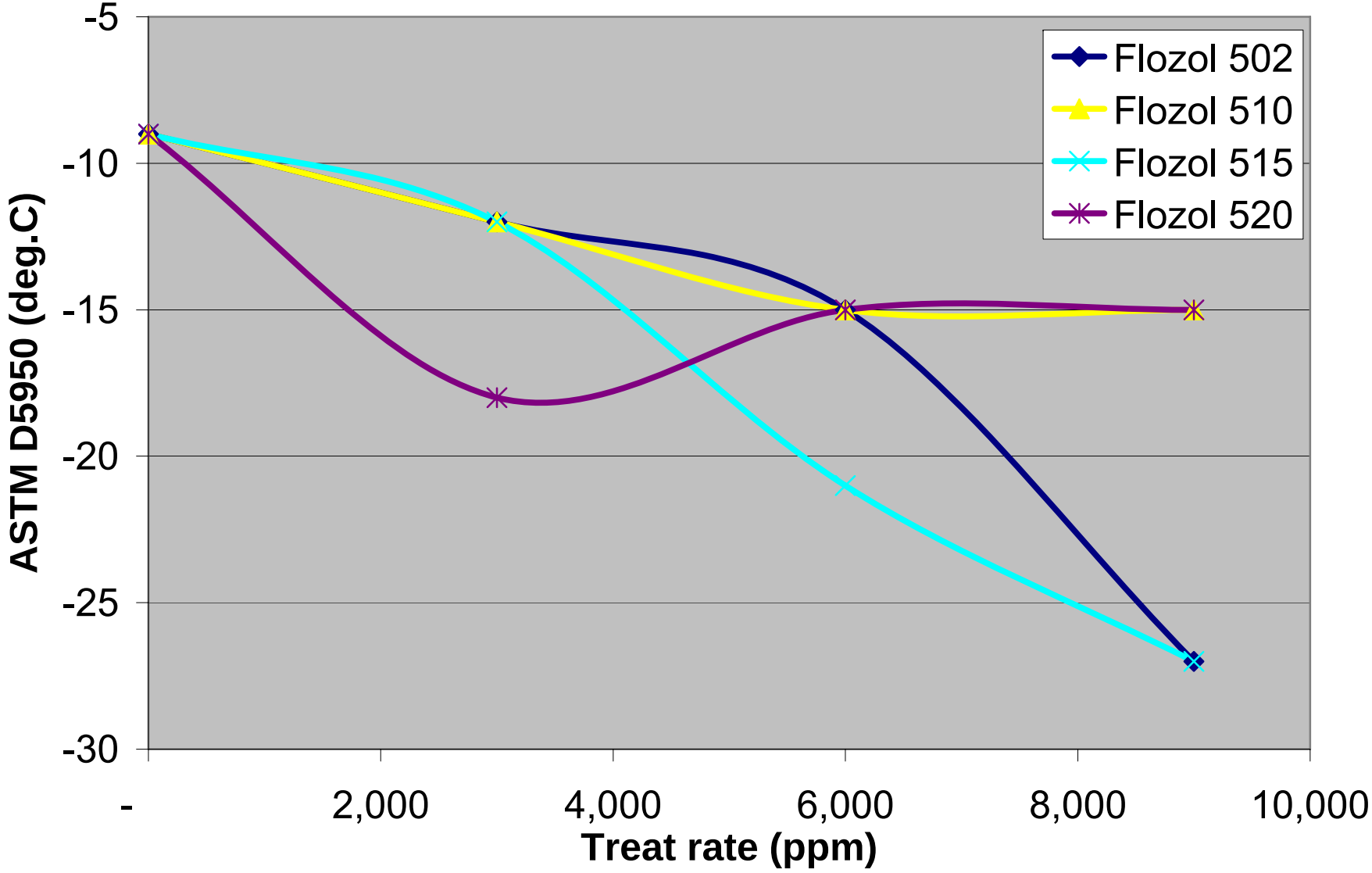
Tallow Methyl Ester - Pour Point



Coconut Methyl Ester- Pour Point

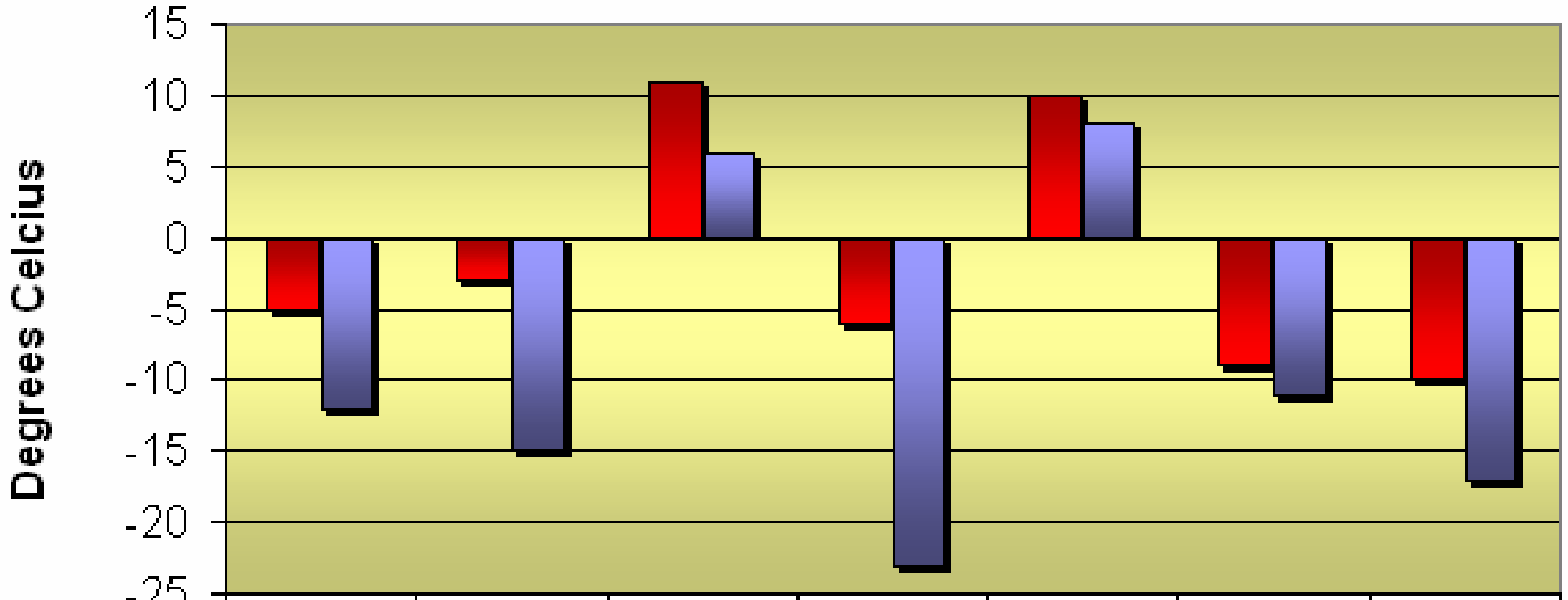


Canola Methyl Ester - Pour Point



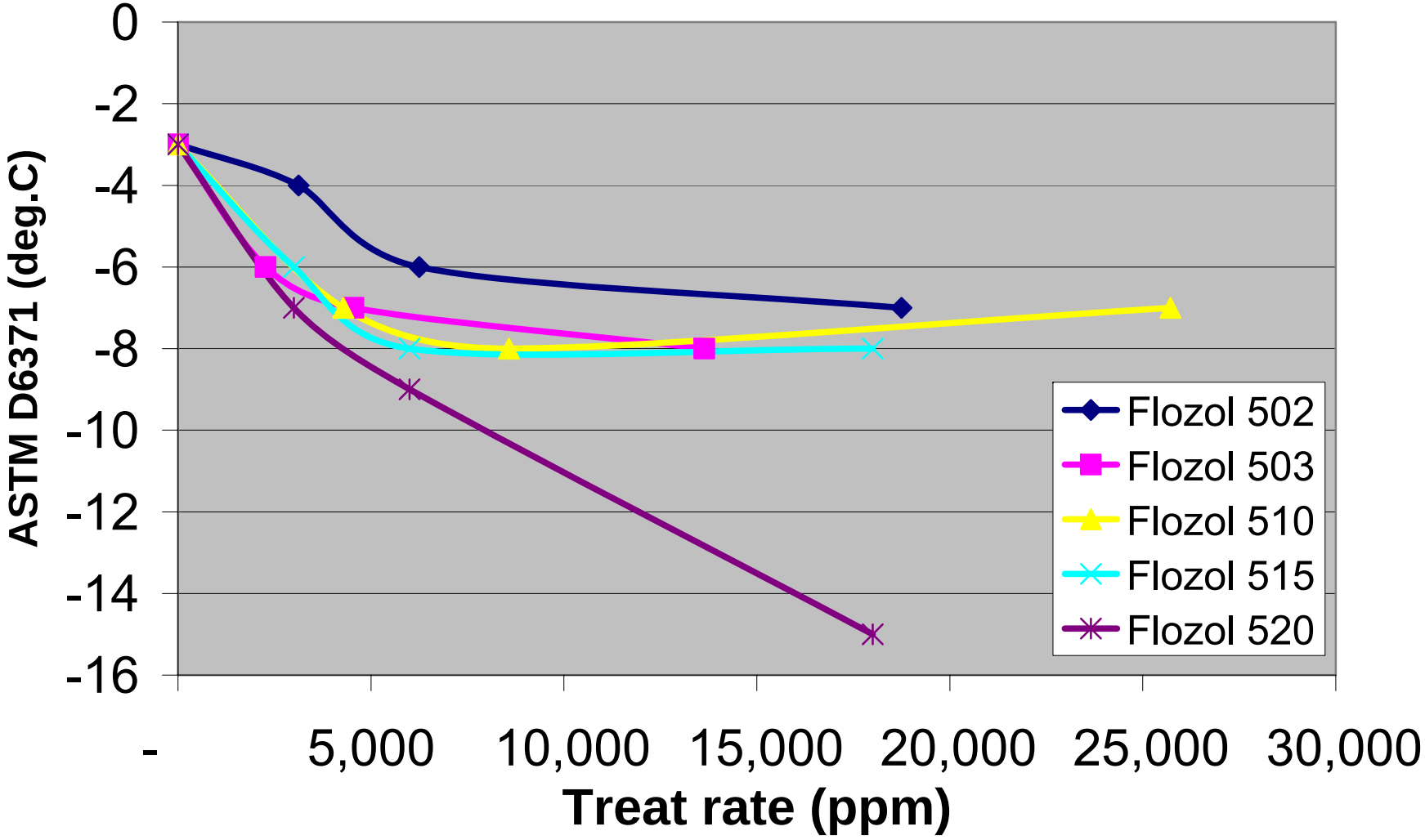
Additive Impacts on CFPP in Multiple FAME Types

(Variable Treat Rates)

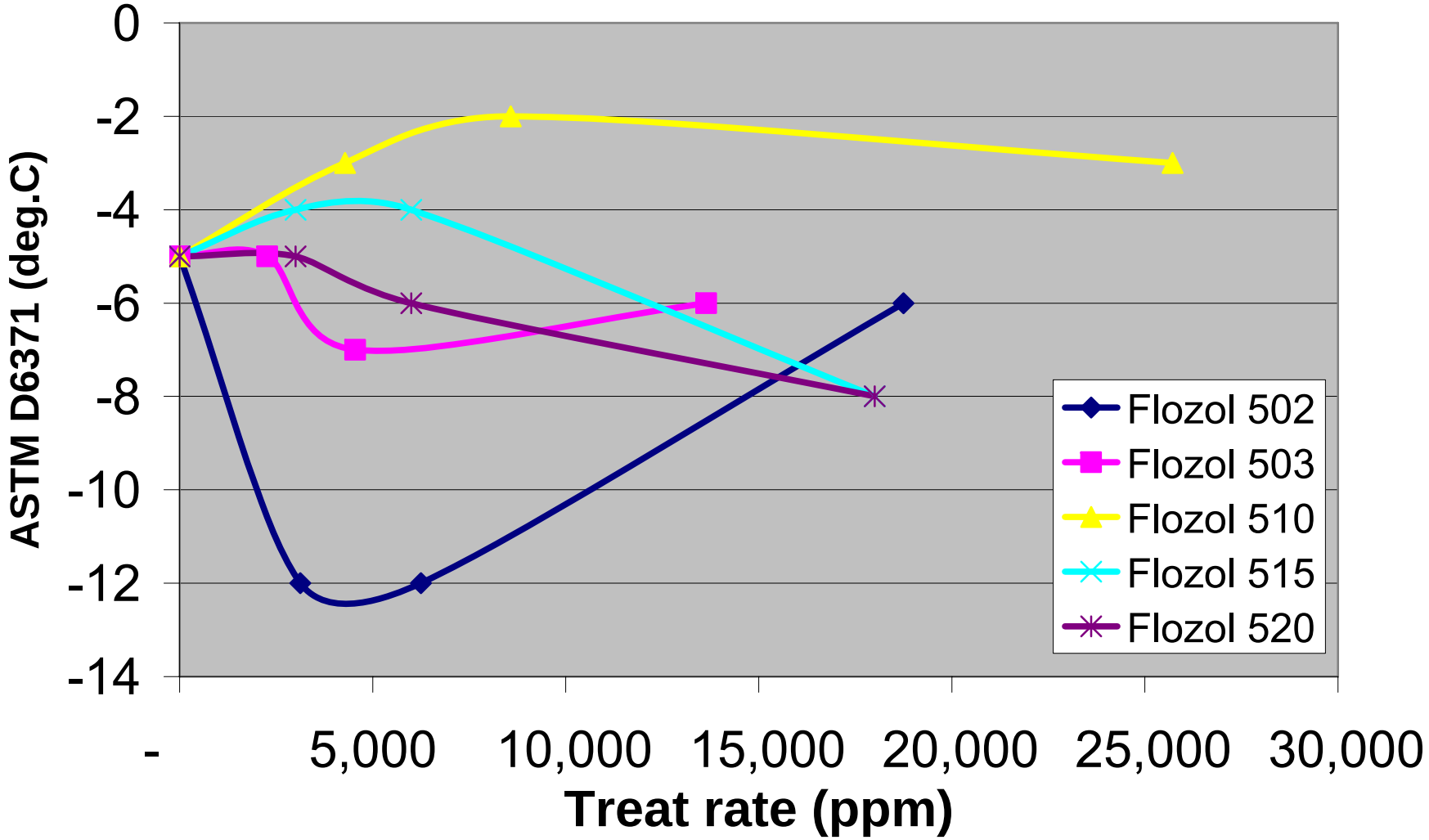


	SME dist.	SME undist.	PME	RME	TME	CME	Canola
Untreated	-5	-3	11	-6	10	-9	-10
Treated	-12	-15	6	-23	8	-11	-17

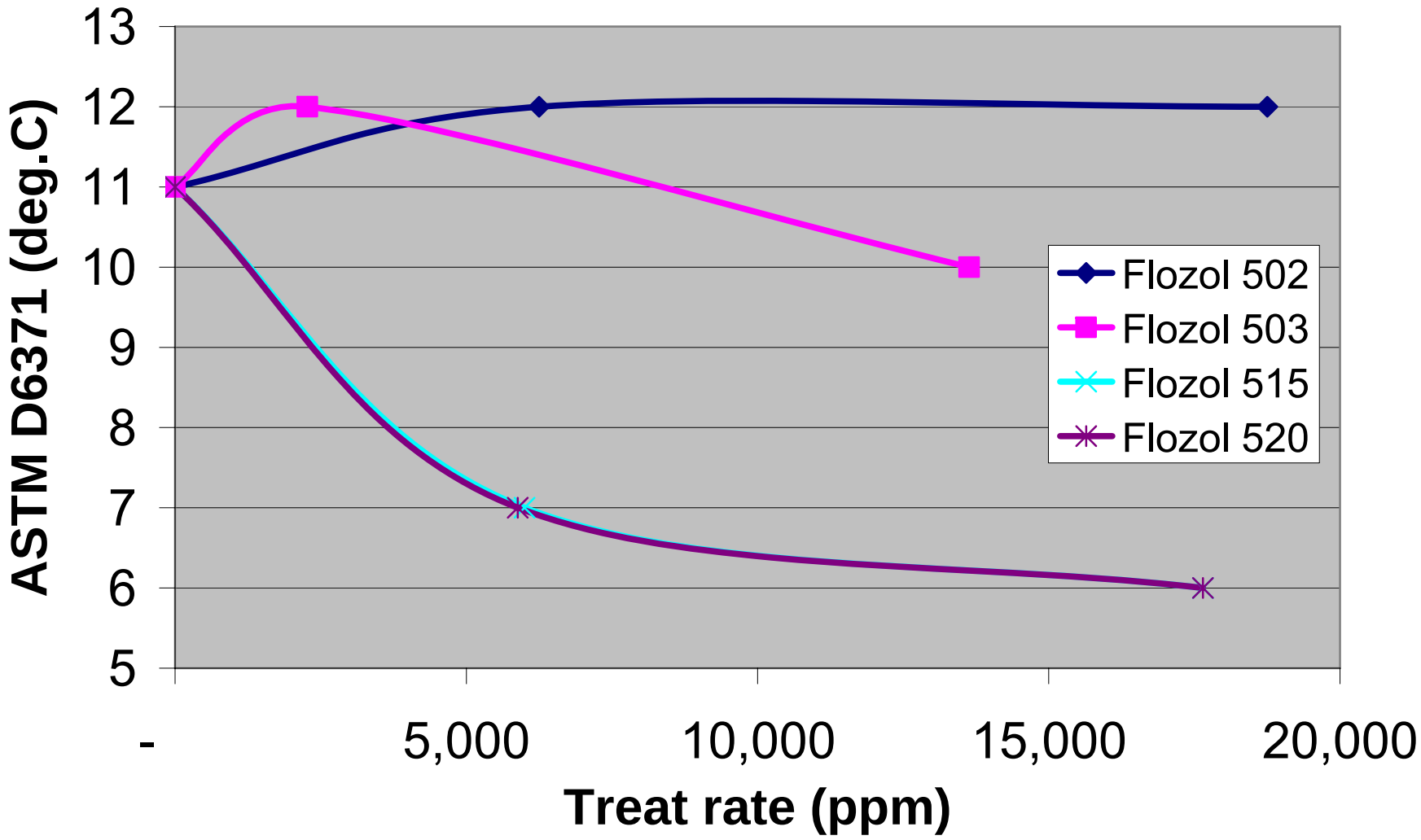
Soy Methyl Ester Using Distilled Feedstock - CFPP



Soy Methyl Ester Using Undistilled Feedstock - CFPP

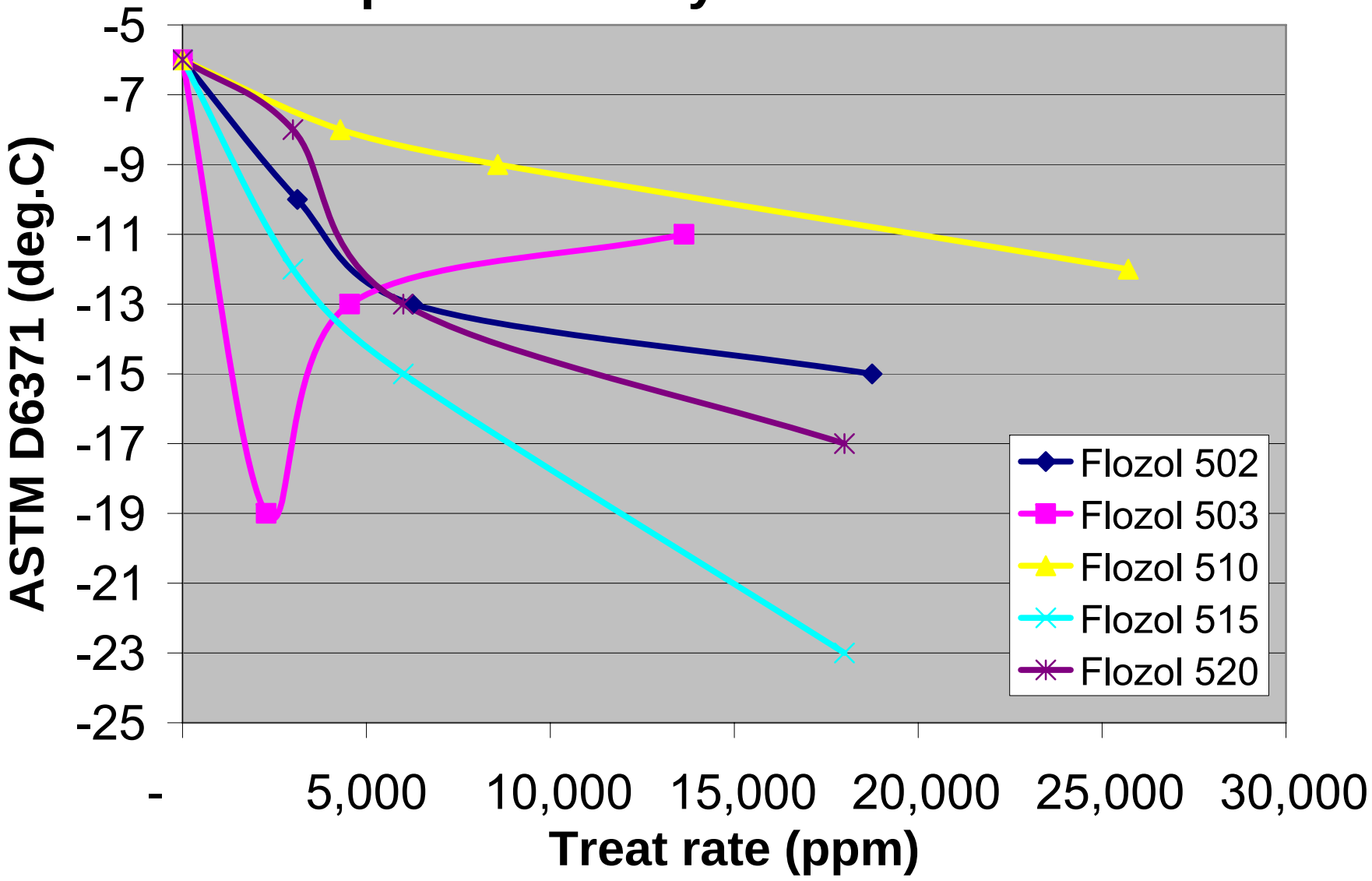


Palm Oil Methyl Ester #1 - CFPP

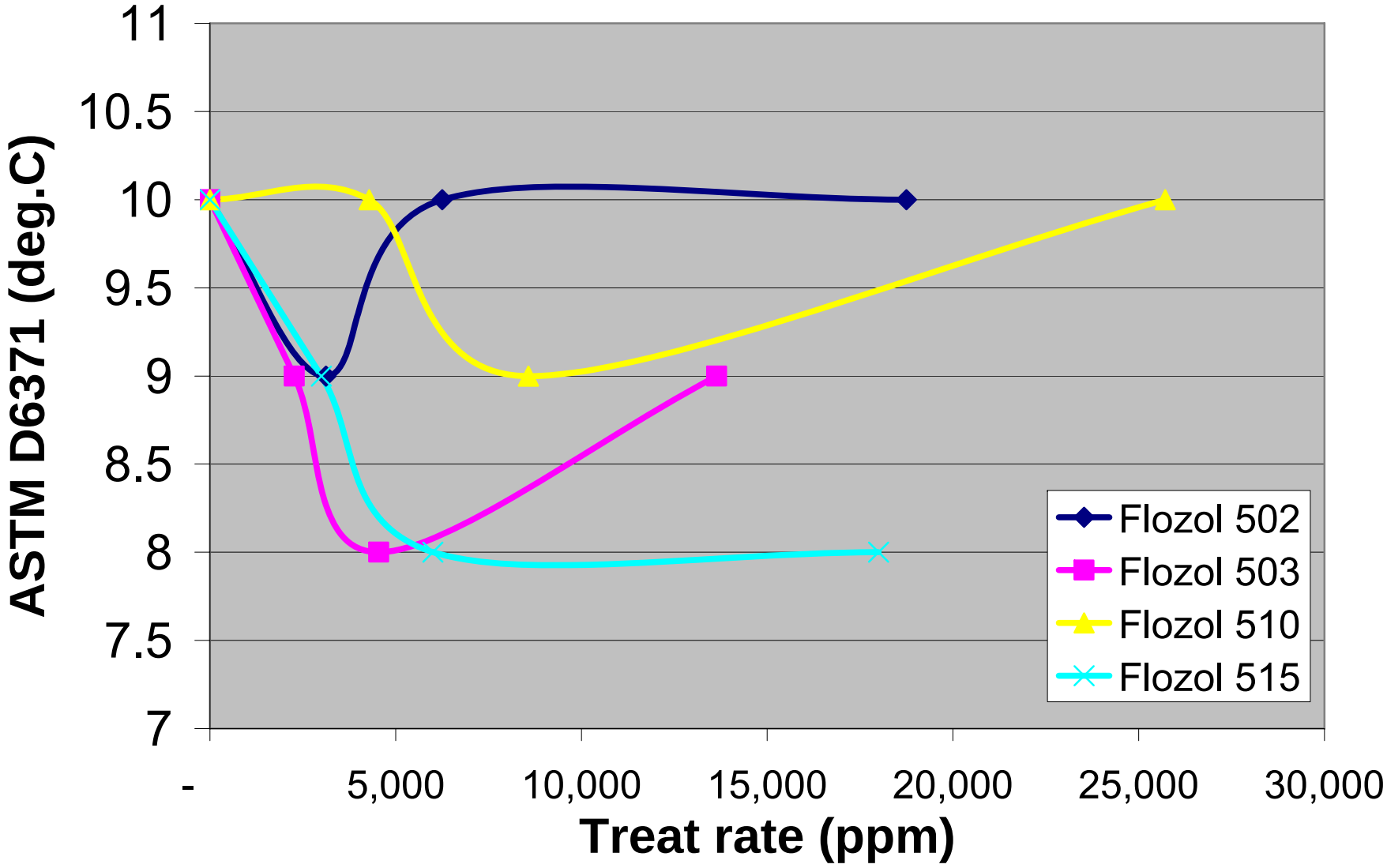


Bio Qualified

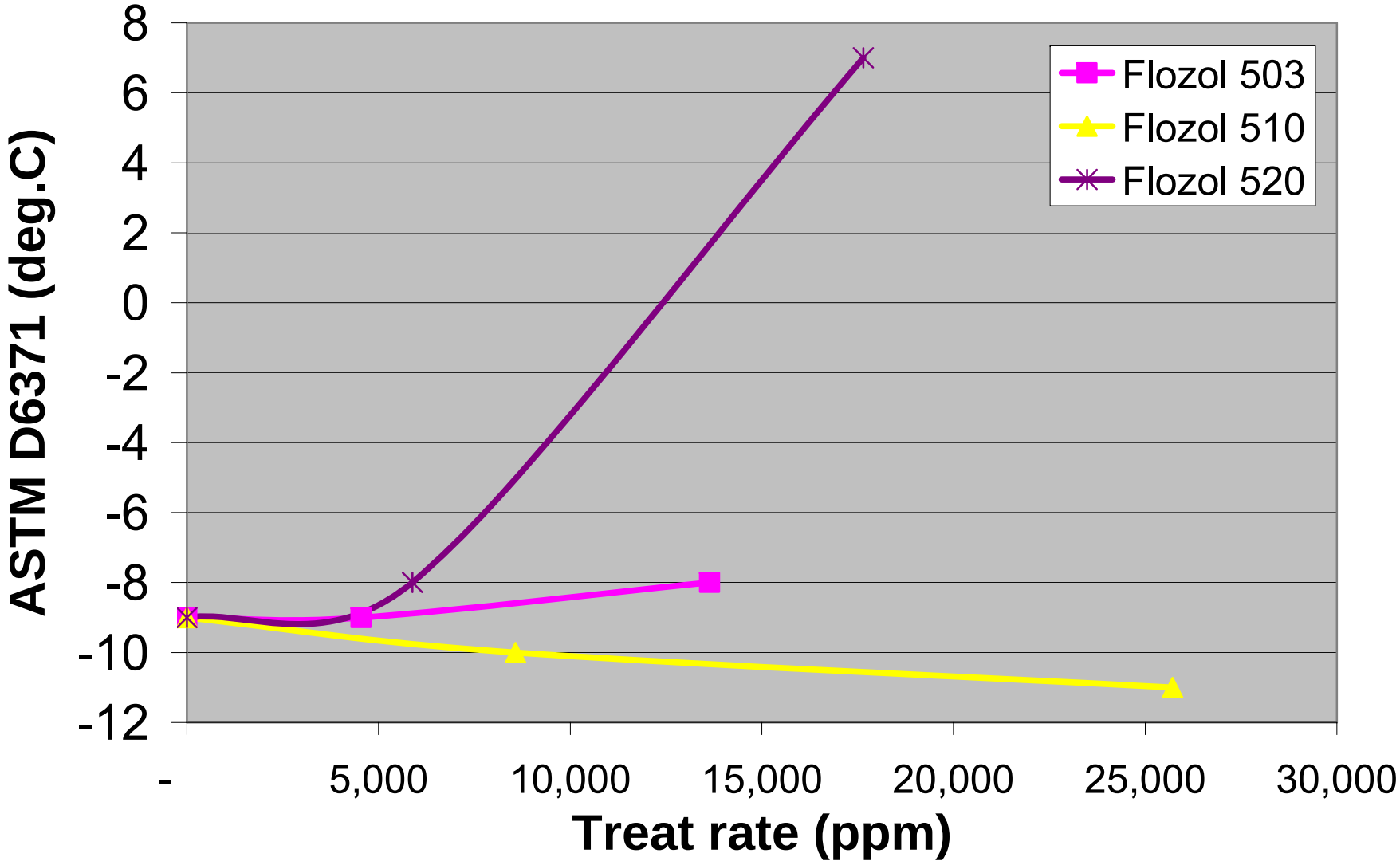
Rapeseed Methyl Ester - CFPP



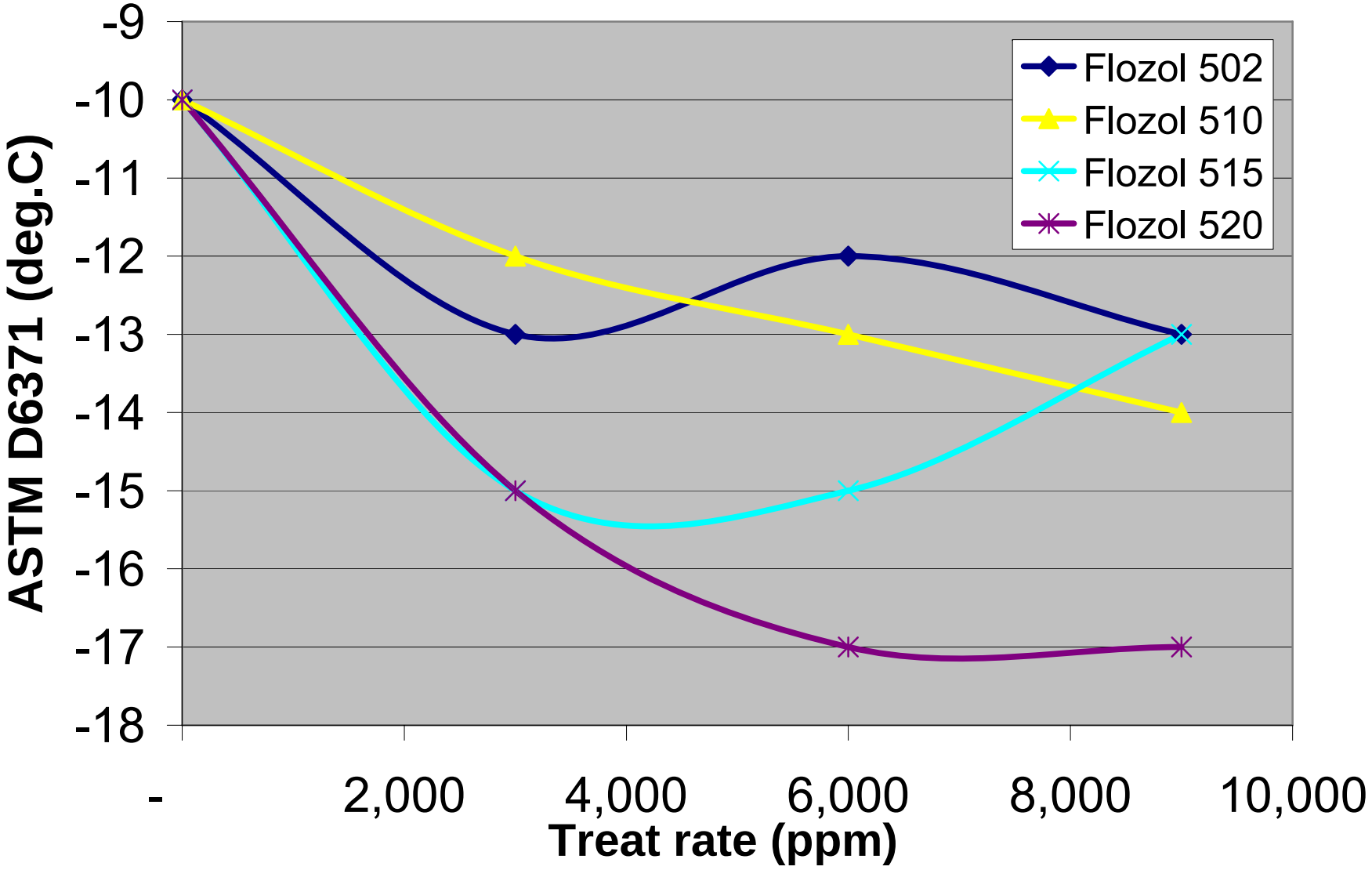
Tallow Methyl Ester - CFPP



Coconut Methyl Ester- CFPP



Canola Methyl Ester - CFPP



BioQualified™ Advantage

Introducing BioQualified™ Fuel Additives from Lubrizol

For a Lubrizol additive to become a BioQualified additive, it must meet a number of Lubrizol-established criteria that ensure its effective design, manufacture, testing, and safe, effective performance for biofuel use.

BioQualified additives provide assurance of:

1. Performance
2. Biofuel Compatibility
3. Quality
4. Ease of Use

BioQualified™ additives provide assurance of:

Performance

- Additives have been tested and proven effective for specific biofuel applications.
- All biofuel additive performance claims are supported with specific documentation and test data.

BioQualified™ additives provide assurance of:

Biofuel Compatibility

- Designed by the experts in fuel additive technologies specifically for various biofuels, with strict adherence to Lubrizol's "no-harm" philosophy.
- Screened for compatibility with biofuels, fuel distribution systems and vehicle fuel systems.

BioQualified™ additives provide assurance of:

Quality

- Manufactured and quality tested in an ISO9000 quality manufacturing system
- Designed and manufactured under Responsible Care Codes of Practice
- Made with the same consistent, high quality you've come to expect from Lubrizol.

BioQualified™ additives provide assurance of:

Ease of Use

- Additive comes with application guidelines for mixing, pumping, storing, and formulation.
- Additive documentation includes cautions, suggestions, limits, calculation tools, treat cost calculator, and treat rate calculator.

Questions?