



**QUALITY WORKS.**

**LANXESS Hybrid PU-CSC Grease.  
Innovative technology that works harder and lasts longer.**

**Presented at the September 9<sup>th</sup>, 2021 Toronto STLE Section Meeting**

Mr. Wayne Mackwood – Global Head of Detergent and Grease Technology (Presenter)  
Dr. Andrew Keane – Global Marketing Analyst (Presenter)

**LANXESS**  
Energizing Chemistry

# Lubricant Additives Business at a glance

## Key Facts

**Head of Business Unit:** Martin Säwe  
**Customers:** more than 800 worldwide  
**Products:** more than 660

## Products

- Basestocks
- Additives
- Additive packages
- Finished fluids

## Applications



# Lubricant Additives Business

**Manufacturing:**

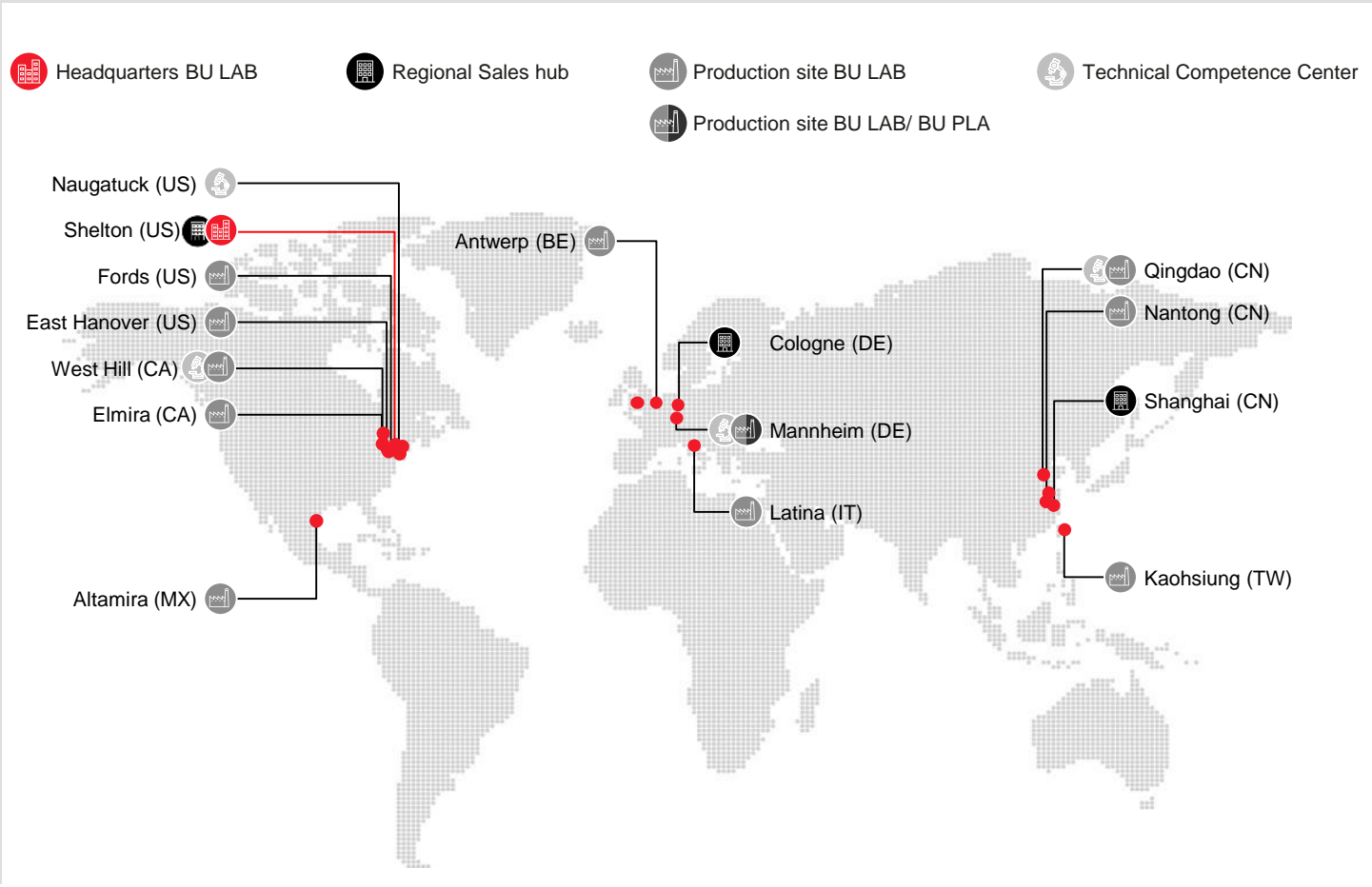
- 12 production sites in 9 countries

**Technical Competence Centers:**

- Mannheim, Germany
- Shanghai, China
- Naugatuck, CT, USA
- West Hill, Canada

**Global Sales with regional footprint:**

- Cologne, Germany
- Shelton, CT, USA
- Shanghai, China



# Lubricant Additives Business – Cutting edge integrated portfolio for lubricants

## Top line with comprehensive offering

HV PAOs

Synthetic esters

Phosphate esters

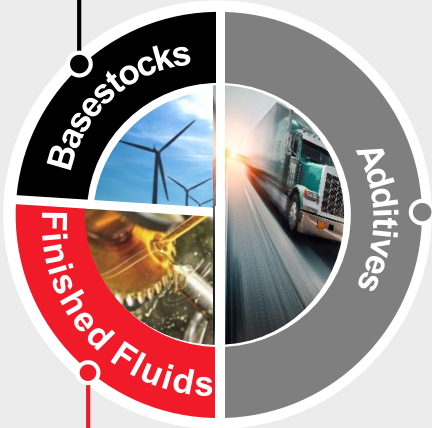
Fire-resistant hydraulic fluids

Refrigeration fluids

Aerospace fluids

Anderol Specialty Lubricants

**High performance greases**



Antioxidants

Detergents

Extreme-pressure

Anti-wear

Corrosion inhibitor

Specialties

Packages

## Brands

X **Additin**<sup>®</sup>

X **Calcinat**

X **Durad**<sup>®</sup>

X **Everest**<sup>®</sup>

X **Hatcol**<sup>®</sup>

X **Hybase**<sup>®</sup>

X **Lobase**<sup>®</sup>

X **Naugalube**<sup>®</sup>

X **Reolube**<sup>®</sup>

X **Royco**<sup>®</sup>

X **Synton**<sup>®</sup>

X **Anderol**<sup>®</sup>

Lubricant Additives Business offers an integrated and specialized portfolio for lubricants

# Overview

- PU-CSC Technology
- Performance Benchmarking and Field Trials
- Applications and Sustainability
- Commercial Topics
- Summary



# Hybrid PU-CSC Grease Technology

# Continuous Innovation at LANXESS

## Goal to enhance / develop new grease technology

- How to improve characteristics of Calcium Sulfonate Complex (CSC) grease technology?
- How can we reduce or replace thickener content?
  - Process efficiency
  - Improved pumpability etc.
- How to improve performance of a different thickener technology by incorporating CSC technology?
- LANXESS is an expert in CSC technology with 30+ yrs of experience
- LANXESS is also an expert in Poly Urethane technology with 40+ yrs of experience
- We examined any enhanced performance benefits of combining our both technologies

# Hybrid PU-CSC Grease | Introduction

## Innovative Thickener Technology

- A new thickener by combining two thickener types of Calcium Sulfonate Complex and Polyurea. Combines the best of the two options by synergistically enhancing their properties
- This hybrid grease is more than just a blend of existing thickeners. The two thickeners are formed in-situ, together producing a product with synergistic advantages
- U.S. and foreign patents pending



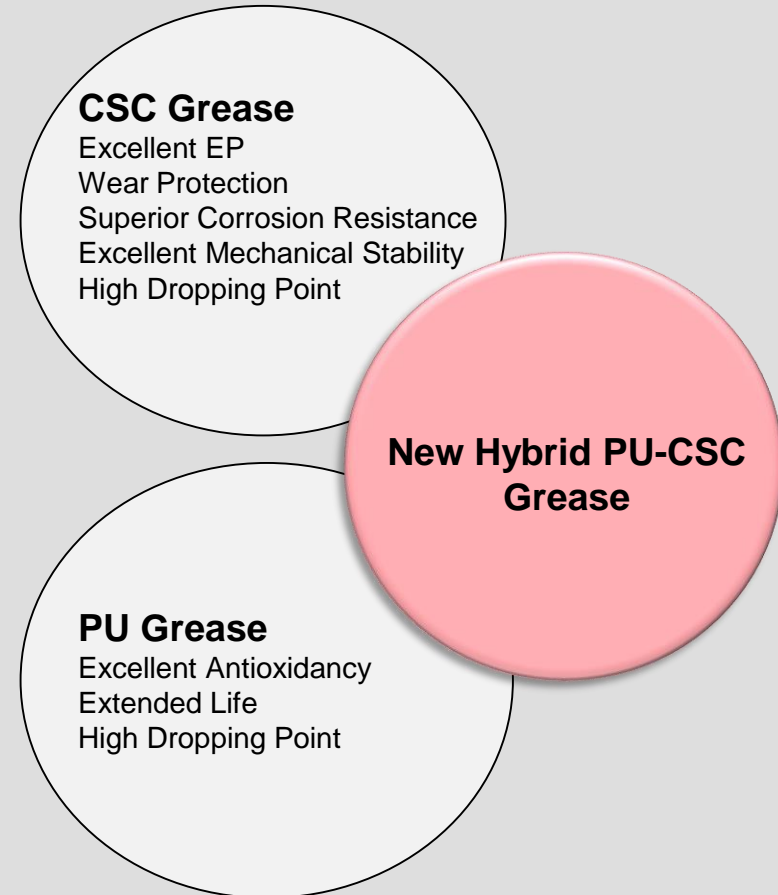
Finished grease



# Hybrid PU-CSC Grease | Key Benefits

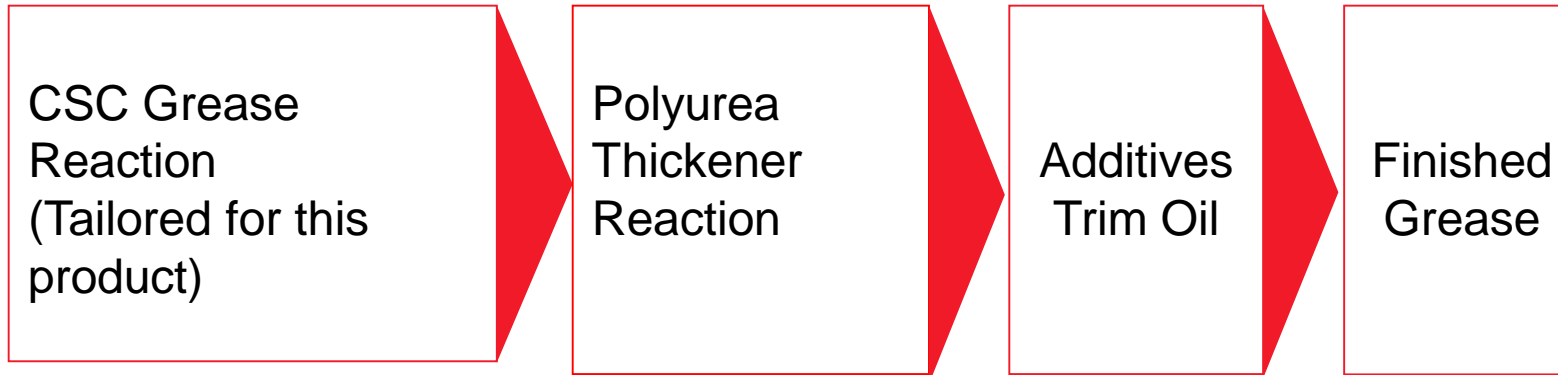
## Summary

- Inherit all strengths of CSC complex grease. For general use, doesn't require the use of additional additives except antioxidant
- Outperform Polyurea grease in many ways, such as anti-wear, EP, corrosion resistance, and mechanical stability
- Synergistic advantages from both type thickeners



# Hybrid PU-CSC Grease | Technology

## Hybrid PU-CSC Thickener Technology



### Compared with CSC grease

- Consumption of overbased calcium sulfonate is decreased
- Reduced ash content
- Combined properties make use of the best of both thickeners

Example of new Hybrid PU-CSC Grease

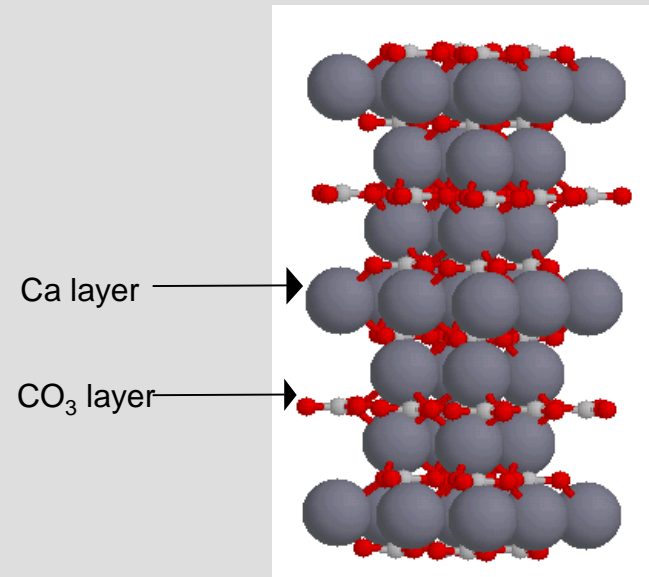


# Hybrid PU-CSC Grease | Technology

## Hybrid PU-CSC Grease Benefits

- **Compared with CSC grease**
  - Less thickener content, less ash
  - Improved oxidation stability
  - Extended grease life
- **Compared with PU grease**
  - Improved performance over PU grease technology in many ways, such as mechanical stability, corrosion resistance, high load carrying performance and anti-wear

- Calcite calcium carbonate still is the key for finished grease performance



Calcite “layered” structure

# Hybrid PU-CSC Grease | Typical Data

## Performance for Hybrid PU-CSC Grease, G-2300-1.5

Properties	Test method	Typical Data
Appearance	Visual	Tan/Smooth
Dropping Point,	ASTM D2265	> 316
Worked Penetration, 60Strokes, mm/10	ASTM D217	295
Based Oil Viscosity, cSt	ASTM D445	160
<u>Mechanical Stability, Prolonged Penetration Change %</u> Worked 100K Strokes, Worked 10k Strokes with 80/20 water, 50/50 water	ASTM D217	3.3 6.3 / 3.3
Roll Stability@80 °C, 4h, Pen change %	ASTMD 1831 modified	1.4
4-Ball EP, Weld Point, Kg	ASTM D2596	400
4-Ball Wear, mm	ASTM D2266	0.42
Fretting, Mass loss, mg	ASTM D4170	1.75
Salt Fog Corrosion, 1 mil d.f.t., hours	ASTM B117	> 1000
EMCOR Corrosion Test, rating, Distilled Water/Synthetic Water	DIN51802	0/0
Bomb Oxidation, MPa drop after 1000 hours	ASTM D942	0.09
Oil Separation, %loss	ASTM D6184	0.6
Water Washout at 79 °C, %loss	ASTM D1264	1.9

***G-2300-1.5 shows superior mechanical stability, load carrying, wear/corrosion/water resistance***

# Hybrid PU-CSC Grease | Additional Typical Data

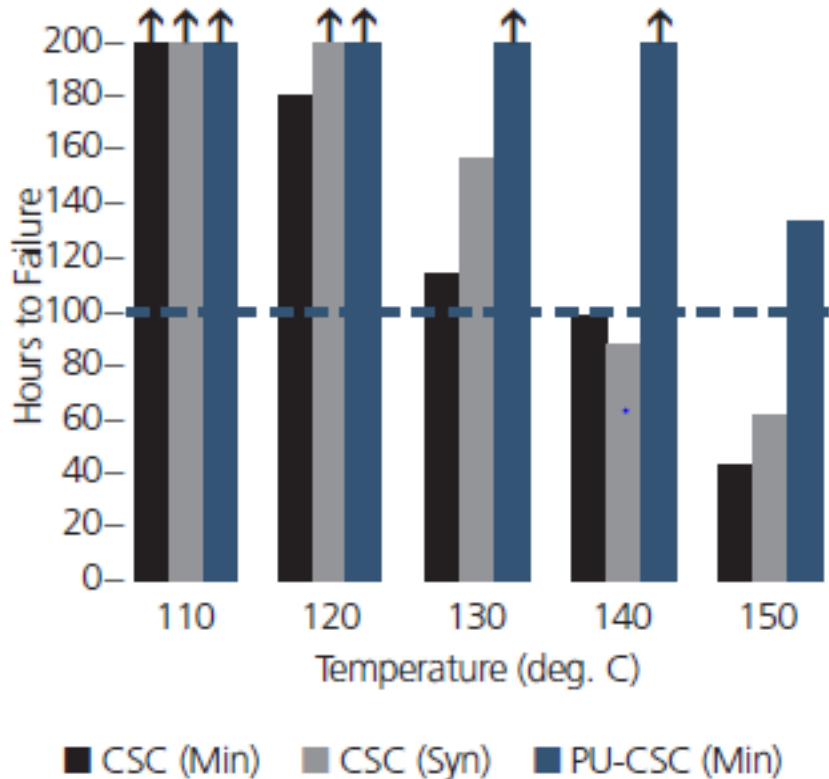
## Performance for Hybrid PU-CSC Grease, G-2300-1.5

Properties	Test method	Typical Data
Evaporation Loss@150C, 22h,%	ASTM D2595	1.52
Wheel Bearing Leakage, grams	ASTM D4290	1.1
Mobility @ -18 °C, g/min	US Steel Method	11
Timken OK Load, kg	ASTM D2509	25
Copper Corrosion, rating	ASTM D 4048	1a
Rust Test, rating	ASTM D1743	Pass
<u>Friction Test (SRV), ball on plate (lapped, Rz = 0.5)</u> amplitude: 1,5mm frequency: 50 Hz duration: 2 h load: 300 N temperature: 80 °C (Running-in: 2 min, 50 N)	ASTM D-5707	μ (min): 0.104 μ (max): 0.156 μ (15): 0.106 μ (30): 0.106 μ (90): 0.109 μ (120): 0.109 wear scar (ball) [mm]:0.55 x 0.48 wear depth (plate) [μ]:0.56

**Take away – all performance of G-2300-1.5 matches or exceeds equivalent CSC grease**

# Hybrid PU-CSC Grease | Comparison with CSC Grease

## FE9 High Temperature Bearing Life



### Test condition:

Load: 1500 N

Shaft Speed: 6000 rpm

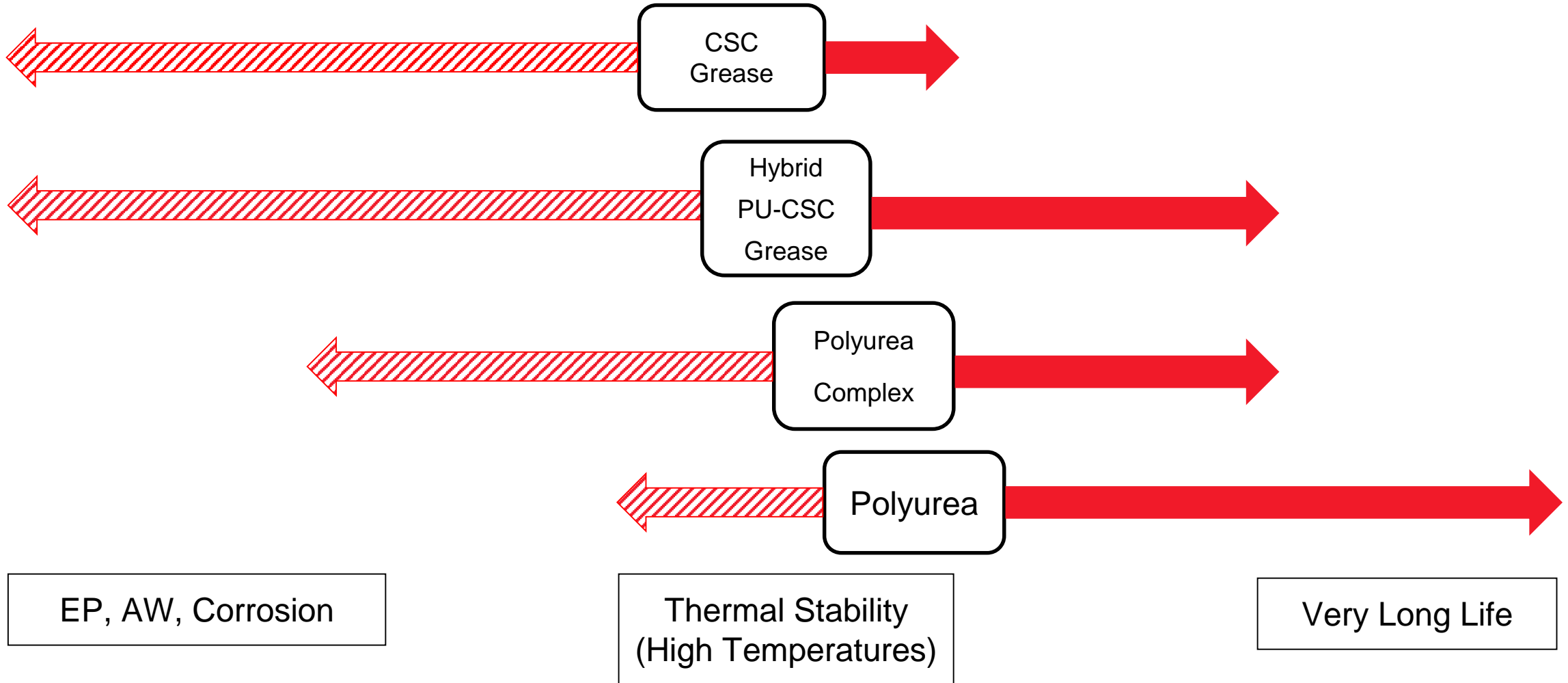
Temperature: Screening

Volume of grease: 2 cm<sup>3</sup> Installation "B"

Note: The tests were intentionally stopped at 200 hours, as per the method. They likely could have run much longer, given test availability.

*Hybrid PU-CSC grease increase max operating temp and increases life at given temp*

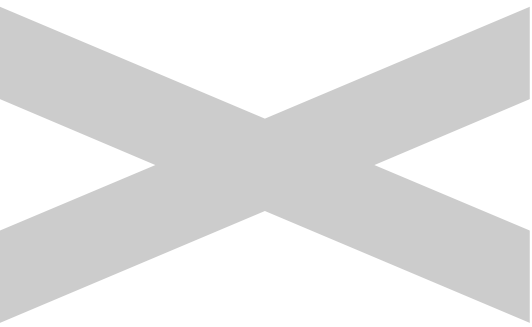
# Operating range based on conditions





**Hybrid PU-CSC**

**Benchmarking and Field Trials**





# Comparative Testing | CN, JP PU Grease, CN CSC Grease

## G-2300-1 Outperforms both PU and CSC grease

Performance	Test Method	G-2300-1.5	G-2300-1	CN-PU Grease	JP-PU Grease	CN CSC Grease
NLGI Grade	ASTM D217	1.5	1	1	1	1
Color	Visual	Tan	Tan	Yellow	Yellow	Tan
Appearance	Visual	Smooth	Smooth	Smooth	Smooth	Smooth
Dropping Point, °C	ASTM D2265	>316	> 316	261	> 265	305
Consistency, 60 Strokes, 25 °C, mm/10	ASTM D217	300	323	328	319	326
Mech Stability, 100K, Change mm/10	ASTM D217	10	5	26	2	11
Mech Stab, 10K, 20% Water, Change, mm/10	ASTM D217	19	8			-70
4-Ball Wear, mm	ASTM D2266	0.42	0.4		0.86	0.44
Oil separation, 100 °C, 30h	ASTM D6184	0.6	4.2	6.5	4.8	
4-Ball EP Test, Weld Point, Kg	ASTM D2596	400	400	315	160	400
Water Washout @ 80 °C, loss %	ASTM D1264	1.9	2.7	2.8	5.2	3.8
Low Temperature mobility @ -20 °C, g/min	US Steel Method	10.8	12.1	6.9	4	2.9
Wheel Bearing leakage, gram	ASTM D4290	1.1	3.5	4.8		7.3
Copper Corrosion, 100 °C, 24h	ASTM D4048	1b	1b	1b	1b	1b
Ash content, %	SH/T0327		5.8	0	0	14.6

# Hybrid PU-CSC Grease | Field Trial in Continuous Caster

## Bench Testing of Competitor CSC grease

- Hybrid PU-CSC grease
  - G-2300-1.5
  - Better low temp performance
  - Lower ash (= longer life)
  - Improved mechanical stability with water
- Extensive testing showed complete compatibility between products
  - Penetration, EP, Wear, Cu Corrosion, Oil Separation all remain same with several mixtures and 100 K work

## Field Trial

- Segregated set of bearings for ~ 2.5 months, fed separately from a drum
- Design is 168 ml/h with 20 minute intervals
- Competitor running at 252 ml/h at 20 minute intervals
- Goal was to collect samples in service regularly

# Hybrid PU-CSC Grease | Plant Trial Results

Continuous Caster, isolated sector, 2.5 months

## Field Trial

- Managed to collect samples 2 weeks in and 6 weeks later – not much leaking from bearings
- Collected sample testing (PU-CSC)
  - Excellent mechanical stability - penetration was stiffer by 3 – 6%
  - EP remained good – between 250 – 315 kg
  - Remained grease like, versus competitor which was emulsified
- Observed reduced consumption with PU-CSC
  - Lubrication interval increased from 20 minutes to 30 to ultimately 35 minutes
    - > No observed impact in performance or equipment life
    - > Significantly less consumption versus competitor
  - Design consumption for trial period – 210 kg
  - Competitor consumption for period - 360 kg (+71% vs design)
  - Hybrid PU-CSC grease consumption - 140 kg (-33% vs design, -61% vs competitor)

**PU-CSC clearly outperformed an existing CSC grease**  
**Significantly reduced consumption and remained more grease-like than the competitor**

# Summary of key properties

## LANXESS PU-CSC has expanded properties versus CSC or PU grease alone

Property	LANXESS CSC	Polyurea	LANXESS PU-CSC
Thickener components	Ca Sulfonate + Calcite Ca Carbonate + Ca12HSA + Ca Acetate + Ca Borate	Polyurea	Ca Sulfonate + Calcite Ca Carbonate + Ca12HSA + Ca Acetate + Ca Borate + Polyurea
Texture	Smooth	Smooth, buttery	Smooth
Dropping Point	> 300 C	>300 C	> 300 C
Upper Operating Temperature	160-180 C, spikes to 250 C	160 – 200 C, spikes to 250 C	160-180 C, spikes to 250 C
Thermal Stability	Excellent	Excellent	Excellent
Oxidation Stability	Poor (without antioxidant)	Excellent (inherent)	Good to Excellent
Water Resistance	Good to Excellent	Good	Good to Excellent
Mechanical Stability	Excellent	Poor to Excellent	Excellent
Corrosion Protection	Excellent (inherent)	Poor (without additives)	Excellent (inherent)
EP / AW Properties	Excellent (inherent)	Poor (without additives)	Excellent (inherent)
Take Away	Superior grease technology for hot, wet, and high load applications	Superior grease technology for high temperatures and extended life	Superior grease technology for long life under hot, wet, and high load conditions



# Hybrid PU-CSC

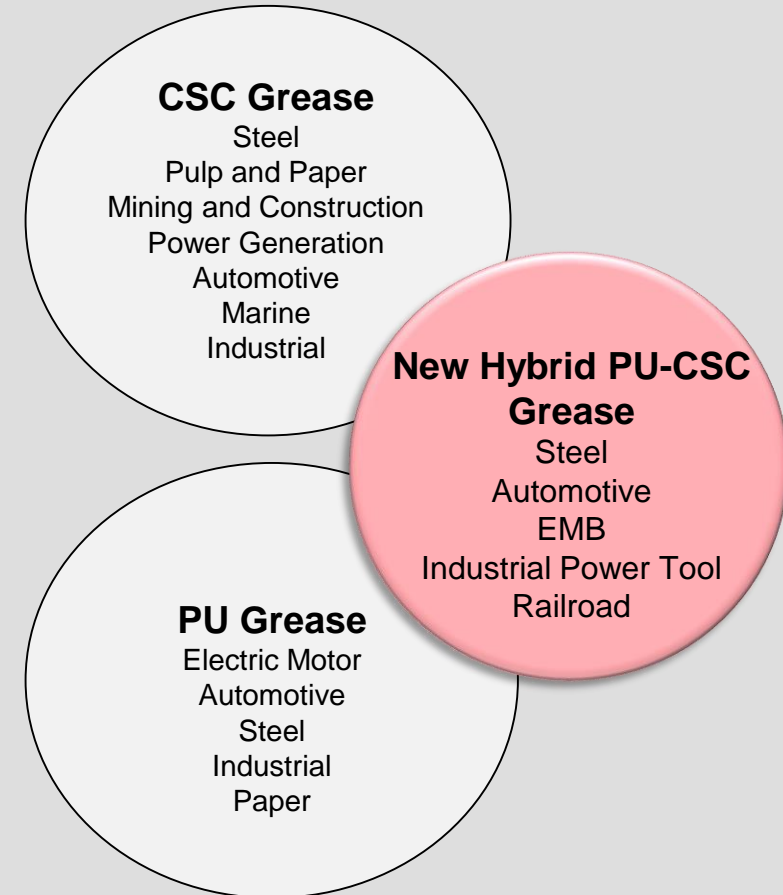
## Applications and Sustainability



# Hybrid PU-CSC Grease | Application Potential

## Summary

- **CSC grease is used extensively across many industries**
  - Steel, Mining, and Marine are large users of CSC grease
  - Generally favored in areas where it is hot, wet and under high loads
- **PU grease is used in areas where it is hot in extended life / sealed for life is needed**
  - Electric Motors and CV Joints are two predominant applications
- **Hybrid PU-CSC grease provides an improved grease across several industries and applications**



# Hybrid PU-CSC Grease | Sustainability

## Extended Component and Lubricant Life

Core Property	Sustainability Impact	Grease Thickener Type		
		CSC	PU	Hybrid PU-CSC
Extreme Pressure	Component Life	✓✓✓		✓✓✓
Water Resistance	Component Life	✓✓✓	✓✓	✓✓✓
Corrosion Resistance	Component Life	✓✓✓		✓✓✓
Mechanical Stability	Comp. + Lube Life	✓✓✓	✓✓	✓✓✓
High Temp	Lube Life	✓✓	✓✓✓	✓✓✓
Extended Life	Lube Life	✓	✓✓✓	✓✓✓

*Grease thickener technology that combines performance benefits of PU and CSC*

### Sustainability Traits

#### Extended Component Life

- ✓ Reduced Maintenance
- ✓ Extended Maint. Intervals
- ✓ Reduced Part Consumption
- ✓ Reduced Failures
- ✓ Higher Operating Reliability
- ✓ Reduced Downtime
- ✓ More Consistent PM Scheduling

#### Extended Lubricant Life

- ✓ Reduced Lube Consumption
- ✓ Extended Lube Intervals
- ✓ More Consistent PM Scheduling



# Hybrid PU-CSC Production and Registration



# Hybrid PU-CSC Grease | Production Site

Nantong, CN

## LANXESS Nantong Production Site

- March 2012 Groundbreaking
- September 2013 CSC Grease Production started
- CSC Grease production modeled after West Hill Plant
- R&D Shanghai

## Manufactured Products

- Grease, Lubricants, Urethanes

## Certifications

- ISO 9001, ISO 14001, ISO 45001, ISO 50001, OHSAS 18001, State Work Safety Standardization
- Sustainability Metrics



# Hybrid PU-CSC | Global Commercialization

## A Unique Grease Market Offering

- PU-CSC retains properties of CSC
  - Mechanical stability, Extreme-Pressure, Anti-Wear, Corrosion Resistance
- While adding benefits of PU
  - Natural Antioxidancy – longer life and higher operating temps
  - Lower thickener content – enhanced low temp properties / less Ash content

**Thickener Technology that draws upon strengths of CSC and PU – a new tool for the Grease Industry**

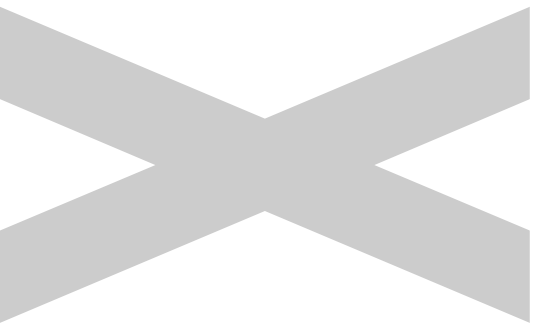
## Global Regulatory Inventories

- Registration established for several key inventories
- Completion of Global registration in progress

Regulatory Listing	USA – TSCA	Canada – DSL	China – IECSC	Japan – ENCS	Philippines – PICCS	Taiwan – TECI	EU-REACH	K-REACH	Australia - AICS	New Zealand – NZIoC
Status	✓	✓	✓	✓	✓	✓	In Progress	In Progress	In Progress	In Progress



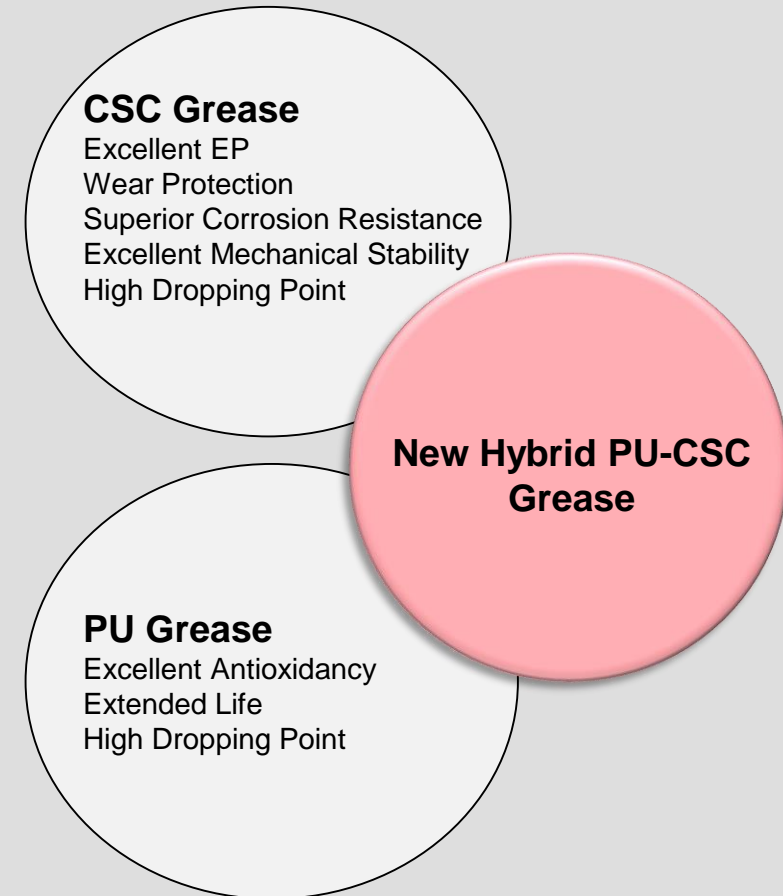
# Summary



# Hybrid PU-CSC Grease | Summary

## Summary

- Exciting new Grease platform
- Potential to replace existing PU Grease
- Potential to extend CSC Grease into new markets and applications
- Currently developing a short list of market general PU-CSC formulations
- Retain the ability to tailor formulations
- Flexibility to meet demanding specifications



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