

# Developing Grease Technology to Meet Key Performance Requirements with Specific Focus on Mining

2<sup>nd</sup> Asian Industrial Lubricants Conference

| November 13, 2019 | Singapore | Anuj Mistry



# Agenda

- 1 | Lubricating Grease Chemistry and Market Overview**
- 2 | Grease Components - Optimized Lubrication**
- 3 | Lubrication Requirements for General End-User Applications**
- 4 | Mining Application Grease Requirements, Challenges & Solutions**
- 5 | Grease Technology Evolution and Opportunities in Mining**
- 6 | Summary – Effective Mining Equipment Lubrication**



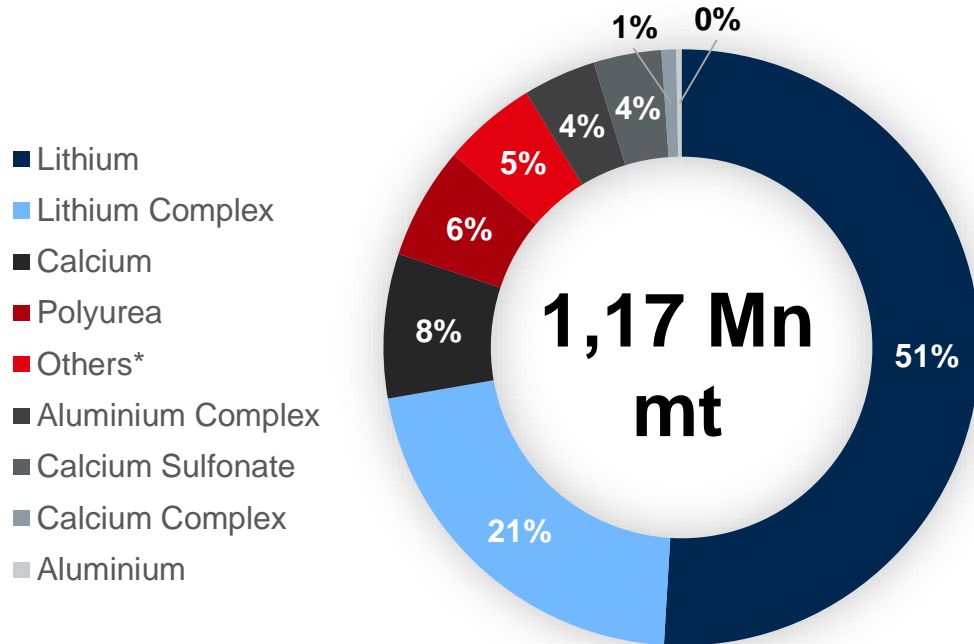
# 01 Lubricating Grease Chemistry and Market Overview



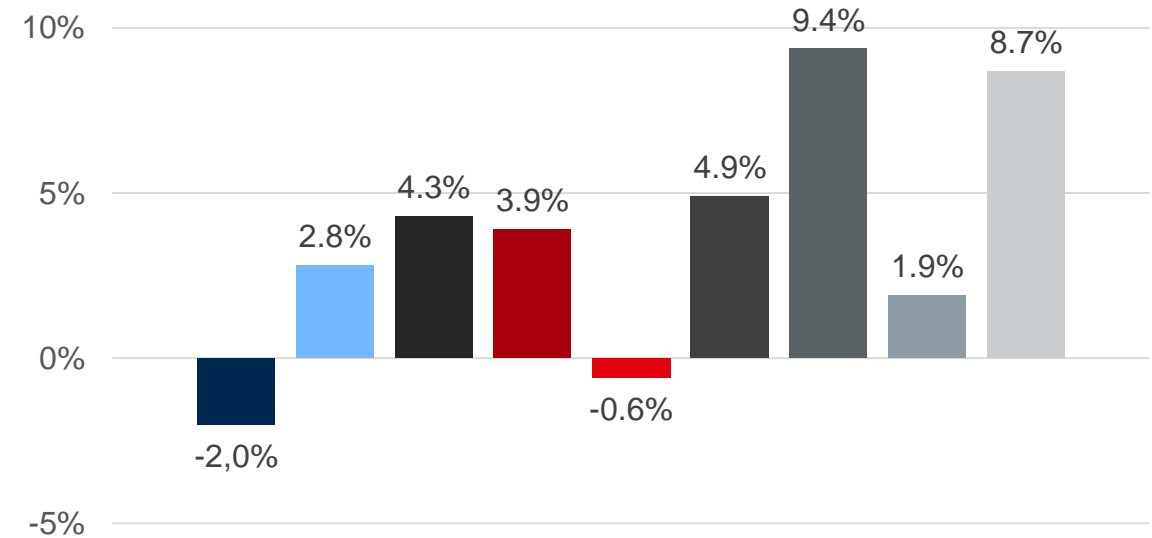
# Grease Market 2018 & Evolution since 2014

## by Chemistry

Market Volume



CAGR 2014 - 2018

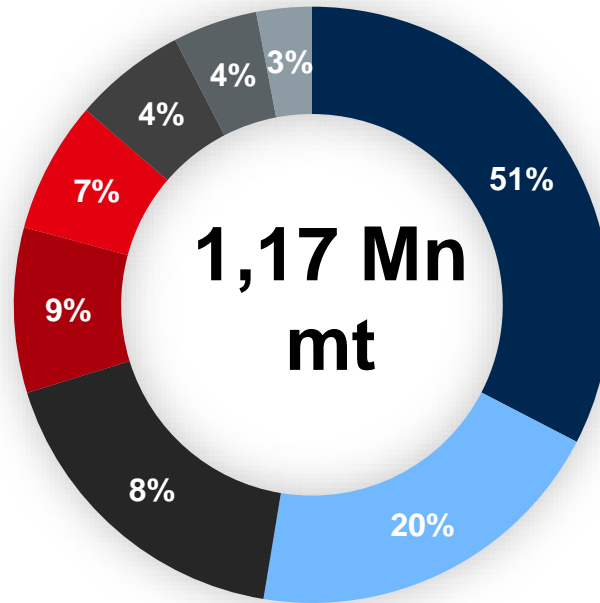


# Grease Market 2018 & Evolution Since 2014

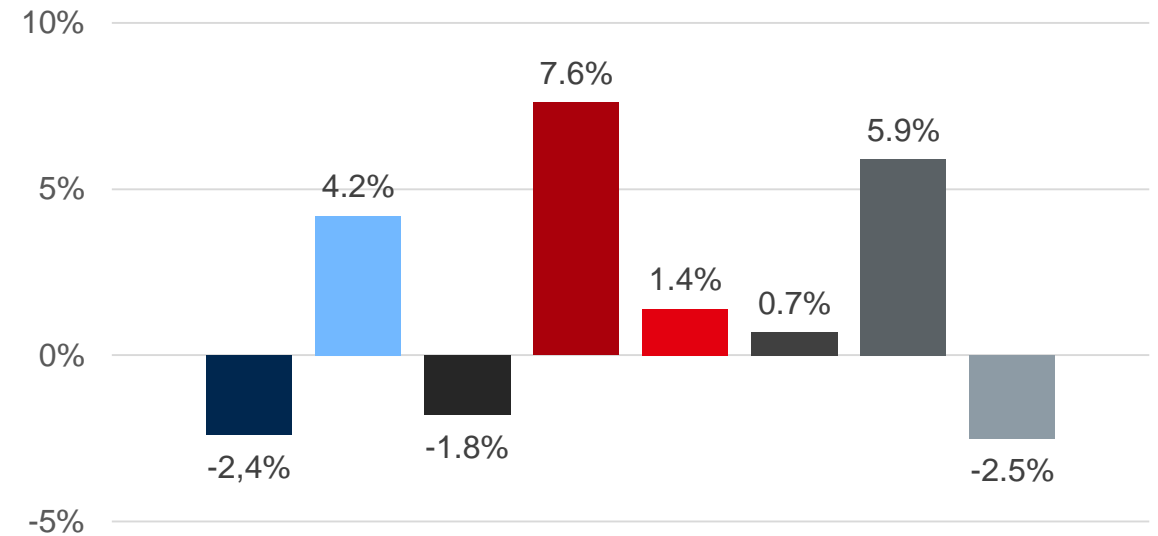
## by Region

### Market Volume

- China
- Europe
- North America
- India / India Subcontinent
- Japan
- Pacific / Southeast Asia
- Africa & Middle East
- Caribbean, Central & South America



### CAGR 2014 - 2018

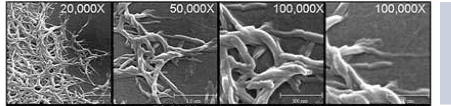
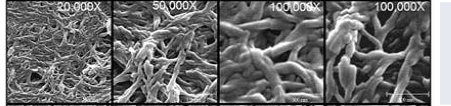
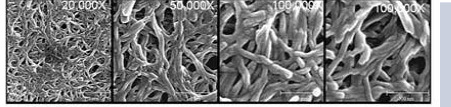
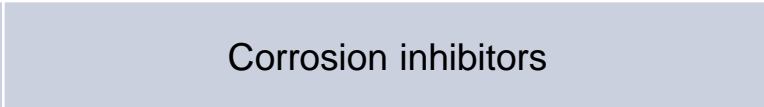




## 02 Grease Components - Optimized Lubrication



# Grease Components - Optimized Lubrication

Thickener Types	Base Oils	Additives
Lithium 12-hydroxy stearate	Mineral	Anti-oxidants
Lithium-calcium mixed soap	Polyalphaolefin (PAO)	Rust inhibitors
Calcium soap	Alkylated Aromatics	Extreme Pressure
	Diester & Polyol Ester	Anti-Wear
Lithium complex	Polyalkylene Glycol (PAG)	Corrosion inhibitors
	Perfluoroalkyl Ethers (PFPE)	Tackifiers
Polyurea	Dimethyl & Phenyl Methyl Silicone	Solid lubricants (MoS2, graphite, zinc oxide, PTFE, PE, dyes)
	Vegetable Oils	
Calcium sulfonate	<p style="color: red;">The choice of thickener, base oil type, base oil viscosity, and additives is important</p>	
Calcium sulfonate complex		
Bentones, silica		
Aluminum Complex		

# Grease Components - Optimized Lubrication

Application Expectation	Core Grease Requirements
Wide operating temperature range	Oxidation resistance, good rust protection, good pumpability, good low temperature torque, high temperature thickener
Low operating temperature	Low NLGI grade, low thickener content, low base oil viscosity, base oil of low pour point, good rust protection
High operating temperature	Oxidation resistance, high temperature thickener, high NLGI grade, high base oil viscosity
Water ingress	Tackiness, low washout and spray-off, appreciable consistency, good rust protection
Extreme pressure at critical points	Consider solid additives, high base oil viscosity, high EP and low wear characteristics
Multipurpose	Good oxidation resistance, good rust protection, water resistance, Antiwear and EP characteristics



## 03 Lubrication Requirements for General End-User Applications



# Lubrication Requirements for General End-User Applications – Steel Mills



**Caster Bearings, Roll Stands, Coilers, Hot Mill Rolling**



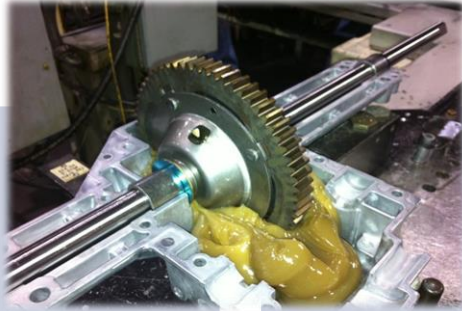
**Heat, Load, Water, Pumpability, Reversibility, Shear Stability**

**Lithium Complex, Aluminium Complex, Calcium Sulfonate Complex, Bentone**

**Mineral oil synthetic base, Typically NLGI 1, 1.5**

**High base oil viscosity**

# Lubrication Requirements for General End-User Applications – Industrial



## Lawn and Garden

**Mechanical Stability**

Lithium Complex,  
Bentone

Mineral oil  
synthetic base

Typically NLGI 2

## Post Tensioning

**Corrosion  
Protection**

Calcium

Mineral Oil

Typically NLGI 2



## Forge Press

**Heat, Mechanical  
Stability,  
Pumpability**

Lithium

Mineral Oil

Typically NLGI  
1, 1.5

## Garage Doors

**Corrosion  
Protection,  
Mechanical Stability**

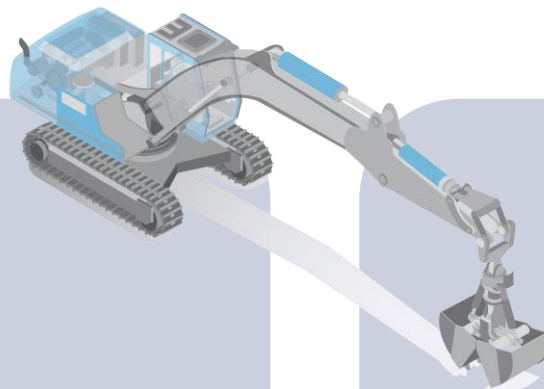
Lithium

Synthetic Oil

Typically NLGI 2



# Lubrication Requirements for General End-User Applications – Construction & Agriculture



## Agriculture

**Chemical Resistance**

**Corrosion Protection**

**Mechanical Stability, Wet Environment**

**Shock Loads**

**Grease Pumpability**

**Calcium Sulfonate Complex, Lithium Complex, Polyurea**

**Mineral Oil**

**Typically NLGI 2, NLGI 0/00**

## Construction

**Corrosion Protection, Mechanical Stability**

**Shock Loads**

**Lithium, Lithium Complex, Calcium Complex Sulfonate**

**Mineral Oil, Semi-Synthetic**

**Typically NLGI 2**

## 04 Mining Application Grease Requirements, Challenges & Solutions



# Mining Application Grease Requirements, Challenges & Solutions

## Equipment



Excavators

Shovels

Draglines

Loaders

Graders

Haul Trucks

Conveyer Belts

Longwall

Processing Plants

## Applications



Pins & Bushings

Hoist Bearings

Slew Bearings

Electric Motor Bearings

Ball Joints

Centralized Lube System

Airlock

Open Gears

## Challenges

Heavy Loads

Shock Loads

Wet Environments

High Temperature

Corrosion

Low Temperature  
Pumpability

**THERE IS NO TIME FOR EQUIPMENT DOWNTIME**



# Mining Application Grease Requirements, Challenges & Solutions

CHALLENGES	THICKENER CONSIDERATION	BASE OIL VISCOSITY	ADDITIVATION	NLGI GRADE
Heavy Loads	Calcium Sulfonate Complex, Lithium Complex, Aluminum Complex	High	MoS <sub>2</sub> , other solids	1.5, 2
Shock Loads	Calcium Sulfonate Complex, Lithium Complex, Aluminum Complex	High	MoS <sub>2</sub> , other solids	1.5, 2
Wet Environments	Calcium Sulfonate Complex, Aluminum Complex	Medium to High	Polymers	1.5, 2
High Temperatures	Calcium Sulfonate Complex, Polyurea	High	MoS <sub>2</sub> , other solids	1, 1.5, 2
Low Temperature Pumpability	Calcium Sulfonate Complex, Aluminum Complex	Low to Medium	-	1, 1.5
Corrosion	Calcium Sulfonate Complex, Lithium Complex, Aluminum Complex	Medium to High	Anticorrosion	1, 1.5, 2
High Speeds	Polyurea, Calcium Sulfonate Complex	Low to Medium	Anti-Oxidants	2

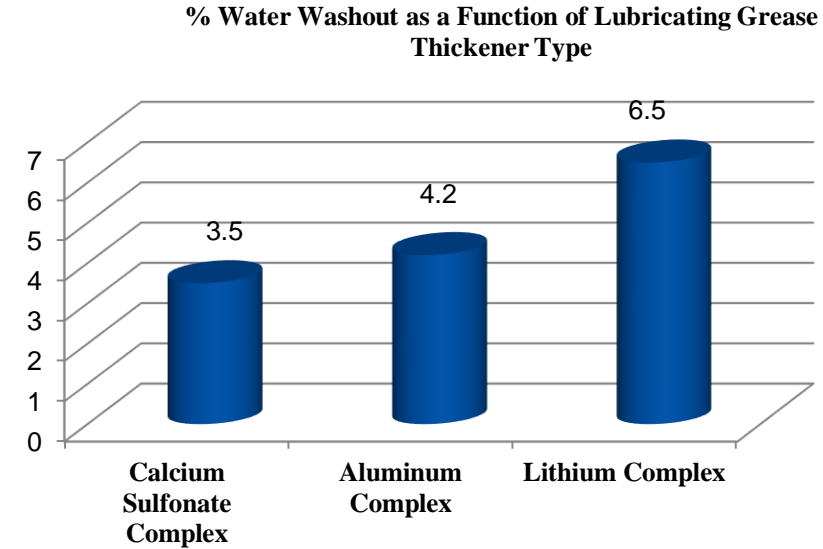
## 05 Grease Technology Evolution and Opportunities in Mining



# Grease Technology Evolution and Opportunities in Mining

## Grease Performance

- **ASTM D1264 – Water Washout**



- **ASTM D 1831 Modified Roll Stability - Ability of grease to withstand water environment under severe mechanical shear; grease consistency change is measured.**



Type of Grease Thickener	Modified Shell Roll Stability % Change
Calcium Sulfonate Complex	-10 (hardened)
Aluminum Complex	-2.7 (hardened)
Lithium Complex	+ 7.7 (softened)

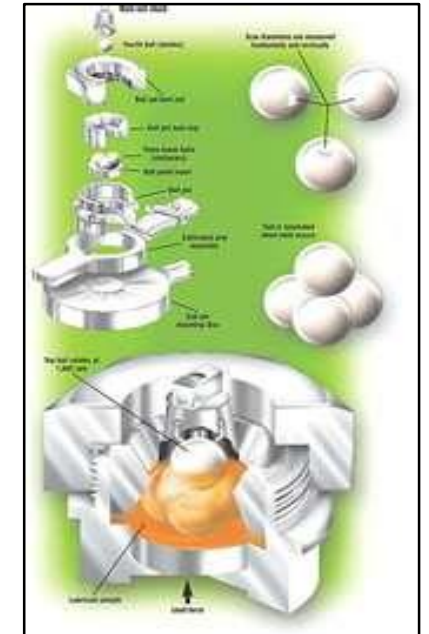


# Grease Technology Evolution and Opportunities in Mining

## Grease Performance

- ASTM D2596 – Weld Load & Load Wear Index**

Grease Type	Weld Point (kgf)	LWI (kgf)
Unadditized Lithium Complex Grease	160	20
Unadditized Aluminum Complex Grease	160	25
Unadditized Calcium Sulfonate Complex Grease	500	60
EP Additized Lithium Complex Grease	500	65
EP Additized Aluminum Complex Grease	400	50
EP Additized Calcium Sulfonate Complex Grease	>800	160



- DIN 51819-2 FE-8 Bearing Wear Test**

### CALCIUM SULFONATE COMPLEX NLGI 1 WITH 10% WATER

Tapered roller bearing, of type 31312 @ 1500 RPM, 10 KN Load

PASS – 524 HRS, 0.003% WEAR, NO BLEED, LOW TORQUE



# Grease Technology Evolution and Opportunities in Mining

**Lithium Complex** - require additives for sustained load carrying, heat, mechanical stability and water handling

**Aluminum complex** - exhibit reversibility, require additives for sustained load carrying, heat, mechanical stability and water handling

**Polyurea** - exhibit exceptional thermal stability, low oil bleed behavior, oxidation stability and mechanical stability

**Calcium Sulfonate Complex** - Provides holistic solutions

- High soap content – high mechanical stability and high load carrying capacity
- Inherent corrosion protection and extremely tolerant to wet environments
- Excellent for handling water, heat and load

## 06 Summary – Effective Mining Equipment Lubrication





## Summary – Effective Mining Equipment Lubrication

- Mining Industry Today
  - Very demanding
  - Associated equipment is much larger and faster
  - Equipment availability at all times is key to success.....no time for equipment downtime!
- Grease Technology
  - Lithium and aluminum based greases will continue to play a key role.
  - Sustainable solutions through Calcium Sulfonate Complex and polyurea will continue to grow
  - Effective use of solid lubricant additives will make a difference



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Thank you very much for your attention.

