Differentiate Your Lubricant with UCON™ OSP

Christine Walker, Product Marketing Manager
The Dow Chemical Company
cmwalker@dow.com

Office: (989) 636.0670
About Dow

- Founded in 1897 by Herbert H. Dow in Midland, Michigan
- Dow's businesses deliver a broad range of technology-based products and solutions to customers in approximately 180 countries and in high growth sectors such as packaging, electronics, water, coatings and agriculture.
- In 2013, Dow had annual sales of more than $57 billion and employed approximately 53,000 people worldwide.
- Dow’s more than 6,000 products are manufactured at 201 sites in 36 countries across the globe
Dow Wants to be Your Innovation Partner!

Dow’s Operating Segments
- Advanced Materials, $11.8B*
- Agricultural Sciences, $5.7B*
- Performance Materials, $14.6B*
- Performance Plastics, $16.2B*
- Feedstocks & Energy, $11.3B*

What We Need?
Talented and highly motivated PhD level professionals

R&D Strategy Elements
- Right Expertise
- Right Operating Discipline
- Right Portfolio & Pipeline

Key R&D Thrusts
- Energy
- Fluids for Concentrating Solar Power
- ELEVATE™ CO2 EOR
- Conformance Control
- Dow Water & Process Solutions
- Agricultural and Health Sciences
- Olefin Block Copolymers
- Technology Integration

Major R&D Regions & Employees
- North America: 3737
- Europe: 741
- India, Middle East, Africa: 139
- Asia Pacific: 620
- Latin America: 288

Employees & Investment
- $5500 & $1.7 billion

History
- 1897: Formation of The Dow Chemical Company
- 1942: Dow establishes its first business outside the U.S.
- 1997: Dow’s 100th Anniversary
- 2010: Approximately 50,000 employees worldwide; $53.7 billion in sales; Worldwide Partner of the Olympic Games
Dow Lubricants – Business Snapshot

• Worked for the past 70 years to develop the application space for polyalkylene glycols (PAGs). Dow is global Leader

• Best positioned in the market to tailor PAG base stocks to a variety of unique application requirements desired by customers.

• Re-energizing our strategy, driving toward greater customer intimacy and building on established technical leadership to drive product innovation

• Seeking to partner with customers to drive greater collaboration

• Leading development of eco-friendly, energy efficient, performance fluids & lubricants

• Leading Global Brands
  
  UCON™  SYNALOX™
Application Expansion of PAG Technology

- **Fire safety**
- **Production Efficiencies**
  - Reduced fiber waste
  - Improved fiber quality
  - MWF cooling and lubrication efficiencies
- **Reduced fiber waste**
- **Improved fiber quality**
- **MWF cooling and lubrication efficiencies**
- **Long life**
  - **synthetic lubricants**
- **Equipment Reliability**
  - **Anhydrous fire resistant fluids as ester alternatives**
- **Energy Efficiency, Longer fluid life, environmental responsibility**
  - **OSPs are Oil Miscible!**
  - **Time**
  - **EO Derivatives**
  - **Water Glycol Fluids & Quenchants**
  - **Textile & Metalworking Fluids**
  - **PO Derivatives**
  - **Compressor and Gear Oils**
  - **BO Derivatives**
  - **Gas Turbines, Crankcase, Driveline, etc**
  - **1960**
  - **1980**
  - **2014**

**Dow**
Dow Lubricants Global Footprint

Manufacturing
R&D / Tech Service

Midland, MI
Dow World Headquarters

Terneuzen, Netherlands (Lubricant R&D/TS&D)
Horgen, Switzerland
Lubricant R&D/TS&D

Tarragona, Spain
Guaruja, Brazil (Lubricant TS&D)
Pune, India (Lubricant TS&D)
Guangzhou & Shanghai, China (Lubricant TS&D)
OPTIMAL JV, Kertih, Malaysia

South Charleston, WV
Freeport, TX (Lubricant R&D/TS&D)

200+ Products

DOW RESTRICTED - For internal use only
Total Value - Dow’s PAG Technology

• Dow is integrated into EO, PO and BO – security of supply
• Dow can tailor design PAG polymer solutions to meet your needs using our flexible assets and polymer expertise
• Global Existing Supply Chain
• Non-Varnishing
  – Instill confidence in long-term system integrity
  – Eliminates potential for varnish and sludge formation
• Faster Air-Release
  – Reduced potential for micro-dieseling and cavitation
• Cooler operation
  – Bearing temperatures are often reduced versus hydrocarbon oils due to lower frictional losses, enabling smaller sumps and extending fluid life
• Lower Friction
  – Resulting from lower viscosity, this increases overall efficiency
• Inherently Biodegradable and Low Toxicity
• Water Tolerant
• Proven Experience with Turbo Machinery
  – Operating under more severe conditions & tight clearances
UCON™ Oil-Soluble Polyalkylene Glycol (PAG) Lubricant Technology
UCON™ OSP

UCON™ OSPs are a new Group V base oil and are also multifunctional performance enhancing additives

UCON™ OSPs are compatible with most hydrocarbon, vegetable and other synthetic oils

As Performance Enhancing Additives in Hydrocarbon Oils they can:

- Improve deposit control, reduce varnish potential (extend oil life and reduce maintenance costs)
- Act as friction modifiers and provide improved energy efficiency
- Provide solvency for additives that are difficult to formulate with
- Acts as seal swell additives for some grades

As Base Oils they offer:

- Excellent oxidation stability and low temperature properties
- High viscosity indices
- Availability in key ISO viscosity grades from ISO 32 to ISO 680
**UCON™ OSPs Compared to Traditional PAGs**

- Significant potential for PAG polymer design
- Changes in polymer chemistry can expand functionality & improve performance

**Co-base Oil**
- Upgrade group I-III mineral oils
- Upgrade PAO’s
- Engine/transmission

**Additives**
- Deposit control additive
- Friction modifier
- Viscosity builder in mineral oils

**Arbitrary scale but higher values preferred**
# Ideal Applications & Uses for UCON™ OSP

## Base Oil Uses

<table>
<thead>
<tr>
<th>Application</th>
<th>OSP-18</th>
<th>OSP-32</th>
<th>OSP-46</th>
<th>OSP-68</th>
<th>OSP-150</th>
<th>OSP-220</th>
<th>OSP-320</th>
<th>OSP-460</th>
<th>OSP-680</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulics</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas Compressors</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial Gas Turbines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial Gears</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto Engine Oils</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal Deformation</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

## Additive Uses

<table>
<thead>
<tr>
<th>Additive</th>
<th>OSP-18</th>
<th>OSP-32</th>
<th>OSP-46</th>
<th>OSP-68</th>
<th>OSP-150</th>
<th>OSP-220</th>
<th>OSP-320</th>
<th>OSP-460</th>
<th>OSP-680</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friction Modifier</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity Modifier</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Deposit Control Additive</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seal Swell Additive</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
UCON™ OSPs - Outstanding Air Release Attributes

- UCON™ Oil-Soluble PAGs (OSPs) have very fast air release times, which minimizes air entrainment.
- Fluids with rapid air release times can reduce cavitation, therefore improving equipment reliability in applications such as turbines, hydraulics and gears.
- UCON™ OSPs can allow OEMs to design equipment with smaller reservoirs, enabling lower capital and operating costs.
UCON™ OSPs - Excellent Deposit and Varnish Control

• Extends lubricant life and the reliability of machinery

• When used as an additive or co-base oil in hydrocarbon oils, UCON™ OSPs can solubilize the polar oxidation by-products from hydrocarbon oils due to their own polar nature

• Unlike ester-based deposit control additives, UCON™ OSPs are hydrolytically stable and provide the formulator with an excellent alternative choice
Biodegradability Matters

• Lower viscosity UCON™ OSP grades are biodegradable, (some readily biodegradable) making them well-suited for environmentally sensitive applications (UCON™ OSP-18, OSP-32, OSP-46 and OSP-68)

• Higher viscosity grades are bio-resistant to preserve longevity of fluid in operation such as water-based metalworking fluids (UCON™ OSP-220, OSP-320, OSP-460 and OSP-680)

• UCON™ OSPs are environmentally benign (non-toxic to aquatic environments)
Examples of UCON™ OSP Applications

Hydrocarbon based Hydraulic, Compressor or Turbine Oil
- Deposit control and equipment reliability

Hydrocarbon based Auto-engine and Transmission oils
- Friction control and fuel economy
- Deposit control and extended lube life
- Replace your seal swell ester

Hydrocarbon based gear oil (especially PAO gear oils)
- Deposit control and extended lube life
  - Seal swell and hydrolytic stability if replacing an ester

Metalworking Fluids
- Friction control and reduced tool life
- Fluid and equipment cleanliness
Examples of UCON™ OSP Applications Continued

OSP-Based Hydraulic Oil
- Excellent air release – may reduce equipment design costs
- Deposit control and equipment reliability

OSP-Based Compressor Oil
- Friction control and energy efficiency
- Deposit control and extended lube life

OSP-Based Gear Oil
- Friction control – energy efficiency
- Lower fluid temperatures – higher volumetric heat capacities
- High film thickness in EHD
New High-Performance Grease Powered by UCON™ OSP

- The wrong grease may be costing you extra for machine maintenance and replacement parts; the right grease can allow equipment to run longer without a maintenance problem while lowering your total operating costs

- UCON™ OSPs are a field-tested and customer-validated breakthrough, revolutionizing synthetic grease technology for steel mills and other heavy industries

- Even under the harshest conditions, UCON™ OSPs create a film barrier that delivers long-lasting lubricity and friction control

- UCON™ OSP is the leading alternative to petroleum oils and synthetic hydrocarbons for better lubricant performance

- UCON™ OSP-based grease is being used in racing and steel industry applications

“Performance greases powered by Dow UCON™ OSP can double your lubricant life for less. Plus, OSP-based grease offers superior friction and deposit control, enabling you to get more out of your equipment.”¹ To speak with a grease expert, email us at ffrlube@dow.com.

References
1 Dr. Govind Khemchandani, Senior Technical Specialist, The Dow Chemical Company
CIG (Customer Information Group):
- E-mail: CIGChemicals@dow.com
- Phone: 800-447-4369

- Can provide:
  - MSDS
  - Sales Specifications
  - Certificate of Analysis
  - Process sample requests

www.dowosp.com

Also accessible from www.ucon.com
- Contains:
  - OSP Video
  - Product Literature
  - News Articles
  - Presentations
  - Case Studies
Dow recently extended its partnership with RCR, one of NASCAR’s preeminent racing teams, and RCR driver Austin Dillon into the 2014 season and beyond.

The performance benefits of Dow’s UCON™ OSPs are among the many elements generating success this season for RCR, its driver -- rookie phenom Austin Dillon – and the return of the iconic No. 3 racecar.
UCON™ Oil Soluble PAG Technology Enabling Winning Performance for RCR’s No. 3 Dow Chevrolet SS

- Provides an opportunity for Dow Lubricants to quickly test and validate the performance of new lubricants under very demanding conditions
- Mutually-beneficial program addresses racing industry challenges such as how grease has to perform/endure in high temperatures and in extremely harsh environments
- Designed a UCON™ OSP-based grease to help combat dry-out during use and does not affect the seal materials when the drive plate is lubricated
- RCR used the new Dow solution in their Chevrolets and dyno tested, as well as track tested it
- UCON™ OSP-based grease was found to be suitable for seals and increased durability was registered when compared to the performance of conventional mineral oil-based automotive greases
Come Visit Dr. Andrew L. Randolph on Wednesday Morning at the Dow Booth

ECR’s Engine Technical Director will be at the Dow booth (305) on Wednesday from 9-11am

During a 28 year career at General Motors and in NASCAR, Dr. Randolph’s work has ranged from fundamental engine research to mass-production engine development, from Wankel rotaries to Pro Stock drag engines.

He is a strong advocate of applying scientific principles to engine development, and is widely regarded internationally as one of the foremost applied combustion experts in the world.
Thank You!