Additives for Aerosols
Rust Preventives & Lubricants

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Agenda

• Introductions
• Role of the additive supplier
• Rust Preventive
  – Additives & Performance
• Lubricity
  – Additives & Performance
• Trends
The Lubrizol Corporation: Formulating Solutions For The Specialty Chemicals Marketplace

Using the right mix of people, ideas and market knowledge, Lubrizol:

- Provides advanced chemical technology to global transportation, industrial and consumer markets
- Creates unique, hard-to-duplicate formulations resulting in successful solutions for our customers
- Pursues our growth vision to become one of the largest and most profitable specialty chemical companies in the world

Formulation is the Foundation of Every Successful Solution We Deliver
Business Portfolio: 2007 Revenues of $4.5 Billion

Engine Additives
- Passenger Car Engine Oils
- Heavy Duty Diesel Oils
- Marine Diesel Oils
- Fuel Additives

Driveline and Industrial Oil Additives
- Gear Oils
- Automatic Transmission Fluids
- Industrial Fluids
- Compressor Fluids

Lubrizol Additives

Lubrizol Advanced Materials

- Noveon® Consumer Specialties
  Ingredients for Personal Care and other consumer markets

- Performance Coatings
  Resins and Polymers Coating Additives

- Engineered Polymers
  Estane® Engineered Polymers
  TempRite® Engineered Polymers

Note: Revenues by product line in millions of dollars.
Industrial Additives

- Greases
- Industrial gear oils
- Antiwear hydraulic fluids
- Metalworking fluids*
- Compressor lubricants

* Rust Preventive & Lubricant Additives are found in the Metalworking fluids group
Lubrizol’s Role as Additive Supplier

• Provide the compounder / blender with chemistry (additive) & application expertise

• Work directly with customers
  – Additive selection
  – Formulation support
  – Performance testing

• Collaborate with aerosolizers to understand propellant and additive compatibility

• Improved success rate & speed to market
  – Utilize available resources in tough economic times
Rust Preventive (RP) Additives

• Provide protection to metals
  – Films deposited prevent corrosion by displacing water and providing physical barrier to the atmosphere
  – Additive selection determined by carrier (diluent), desired performance (time) and film type
    • Removal of films can be achieved with appropriate cleaning methods
  – Chemical composition can provided enhanced performance
    • ‘Smart barrier’

• Lubrizol has a knowledge base that spans 80+ years from the start of the ALOX corporation in 1926
Chemical Corrosion Process

- In nature iron exists in oxide form
  - Metal will always try to return to the natural oxide state
  - RP additives shield the metal from the natural atmosphere to prevent oxidation reaction from occurring

\[3 \text{Fe} + 2 \text{H}_2\text{O} + \text{O}_2 \rightarrow \text{Fe}_3\text{O}_4 + 2 \text{H}_2\]

- Corrosion mechanism varies by substrate
Additive Selection

• Item to be protected
  – Metal
  – Surface features
  – Geometry

• Application environment
  – Indoor or outdoor?
  – Humidity/salt atmosphere/acid atmosphere?
  – Tightly stacked parts or coiled metal?
  – Amount of subsequent handling

• Desired film type and thickness
  – Hard, semi-permanent
  – Soft/waxy
  – Oily
Additive Selection - Diluent Type

- Type of diluent determines additive range

- **Solvent**
  - Rapid evaporation / film deposits quickly
  - Ability to provide hard or waxy residual film

- **Oil**
  - Residual film maintains oily nature
  - Possible film migrations / housekeeping concerns

- **Water-based**
  - Slower evaporation rate
  - Potential to deposit any film type
  - Reduction of flammability & VOC concerns
Additive Selection – Performance Measurement

• Variety of laboratory methods are applied to compare rust preventive performance under controlled conditions and predict field use results
  – Humidity Cabinet
  – Salt Spray
  – Acid Fume
  – Stack Stain
  – Water Displacement
  – Water Separation
Humidity Cabinet (ASTM D 1748)

- Accelerated testing for indoor storage
  - 120°F (49°C) water temperature
  - 100% relative humidity
  - Selected substrate panels & panel surface
  - Run to Failure
    - Fail: One or more dots larger than 1mm or 4 or more dots of any size. (disregard outer 1/8 inch of panel)
Salt Spray (ASTM B 117)

• Accelerated testing for outdoor storage and salt atmosphere conditions
  – Run at 95°F (35°C) atmospheric temperature
  – 5.0% NaCl solution
  – Selected substrate panels & panel surface
  – Run to Failure
    • Fail: One or more dots larger than 1mm or 4 or more dots of any size (disregard outer 1/8 inch of panel)
Acid Fume

- Accelerated testing for indoor storage under acid atmosphere conditions
  - Selected substrate panels & panel surface
  - Coat panel with RP solution
  - Place in 4N HCl acid atmosphere
  - Test chamber @ 72°F (22.2°C)
  - Run to failure
    - Fail: Any sign of stain or rust
Stack Stain Test (Mil-C-22235A)

• Accelerated testing to determine the effect of water contamination, heat and metal to metal contact on coiled or stacked metal surfaces
  – Selected substrate panels & panel surface
  – Coat panels with RP solution
    • Neat
    • Contaminated with water
  – Stack panels in a sandwich arrangement
  – Store @180°F (82.2°C) for 24 hours
  – Fail
    • Any sign of stain or rust
Water Displacement (Mil-PRF-16173E)

• Test to show the ability of a rust preventive to displace water from a metal surface
  – Selected substrate panels & panel surface
  – Submerse panel in distilled water for 5 seconds
  – Submerse panel in RP solution for 15 seconds
    • Neat
    • Water contamination
  – Static humidity chamber @ 77°F (25°C) for 1 hour
  – Fail
    • Any sign of rust, mottling or surface stains
Water Separation

• Test to measure the ability of a rust preventive to separate water carryover from rinse operations
  – 75 mL of RP solution
  – 25 mL water
  – Invert six times in a 100 mL graduated cylinder
  – Record time to separate 25 mL of water

• Modifications are possible to better simulate specific real world conditions

• ASTM D-1401 can also be run upon request
Lubricity Additives

• Additives that create a barrier between two surfaces
  – Tribology
    • The science and technology of interacting surfaces in relative motion, including the study of friction, lubrication, and wear
  – Deposited films contain chemically active or chemically inactive additives
  – Additive selection determined by carrier (diluent), application and desired performance

• Lubrizol has a knowledge base related to lubrication that spans 80+ years from our start in 1928
Additive Selection

• Chemically inactive
  – Friction modification achieved by creating a barrier that separates two surfaces
  – Lower surface tension provides complete coverage during application

• Chemically active
  – Additives react chemically with metal surface to form a protective film
    • Physical/chemical adsorption
    • Thermal decomposition
  – Film fills in surface asperities
    • Reduces friction
    • Prevents metal to metal contact
    • Prevents welding and surface wear
Lubricity Performance Tests

- MicroTap
- Falex:
  - Tap torque #8 – ASTM D5619
  - Pin & V – ASTM D3233A
  - Pin &V – ASTM D3233B
  - Wear – ASTM D3704
- 4 Ball Wear – ASTM D4172
- 4 Ball EP – ASTM D2783
- Timken O.K. Load – ASTM D2782
- SLT/Draw Bead Simulator
- Twist Compression Tester
Additives Trends

• Industry trends drive new additive development
  – Give the customer (consumer) what they want

• Key drivers
  – Regulatory
    • VOC regulations
    • REACH & other new chemical inventory lists
    • Elimination of specific chemistries
  – Going “Green” (or at least renewable)
    • Cost & availability of petroleum feedstock's
    • Government preference programs
    • Desires and requests from workers’ unions and major manufacturers
    • Value of improved health, safety and environmental profile
Summary

• Broad range of available additives
  – Covered Rust Preventives & Lubricity Additives
  – Others: biocide & fungal control, corrosion inhibitors, emulsifiers, anti-mist, thickeners, additives for grease, dispersants
    • Additives can improve/modify a products form & function

• Additives suppliers assist in the product selection and proof of performance process
  – This service is in place to support your development efforts

• Lubrizol produces technologies that improve the quality and performance of our customers’ products.
Thank You!

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