Flow Improver Solutions for Pipeline Drag Reduction

Pipeline Technology Conference
Hannover, Germany
19-20 April 2010

ConocoPhillips Specialty Products Inc
(Désiré Murenzi).
What are We Going to Talk About?

A technology that helps to increase pipeline capacity by as much as 60% and/or reduce operating pressure by as much as 80%.

ConocoPhillips’ DRA = Fast Value Multiplier
Drag Reduction
Equipment
Applications & Benefits
ConocoPhillips Specialty Products Inc. (CSPI)
CSPI Product Portfolio & Services
CSPI References
CSPI Contact information
- **Drag**
  Frictional pressure (energy) loss of a fluid flowing in a pipeline.

- **Drag Reducer**
  Suspension of an ultra-high molecular weight polymer in a carrier fluid (water, alcohol...)

*Flow Improver Solutions*
Drag Reduction Theory

Drag Reduction occurs due to suppression of the energy dissipation by turbulent eddy currents near the pipeline wall during turbulent flow.
Effect of Drag Reducer on System Curve

- **Pump Curve**
- **System Curve**
- **System Curve...with DRA**

**Add DRA**

- Pressure Decrease
- Flow Increase
Life Cycle of a Drag Reducer

Neat Product

Surface generation
Solvent softening

Active

Dissolution

Degradation
Shear forces
Acceleration

Inactive
## CSPI DRA Key Characteristics

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissolution in the hydrocarbon</td>
<td>Readily</td>
</tr>
<tr>
<td>Effective in turbulent flow</td>
<td>Min. Re5000</td>
</tr>
<tr>
<td>Performance</td>
<td>&gt; 80% DR</td>
</tr>
<tr>
<td>Typical concentrations</td>
<td>&lt; 50 ppm</td>
</tr>
<tr>
<td>Handling</td>
<td>Mechanical agitation</td>
</tr>
<tr>
<td>Handling temperatures</td>
<td>-20 to 44°C</td>
</tr>
<tr>
<td>Hazard to transport, store &amp; handle</td>
<td>Non-hazardous</td>
</tr>
<tr>
<td>Environmental regulations</td>
<td>Friendly product</td>
</tr>
<tr>
<td>Effect on hydrocarbon properties</td>
<td>None</td>
</tr>
<tr>
<td>Does it coat the pipe line wall</td>
<td>No</td>
</tr>
<tr>
<td>Effect on refining processes</td>
<td>None</td>
</tr>
<tr>
<td>Treated fluids</td>
<td>Oil, Water, Multiphase</td>
</tr>
</tbody>
</table>
Main Factors Affecting Performance

- Turbulence
- Hydrocarbon temperature
- Hydrocarbon viscosity
- Water content
- Gas content
- Shear points
• Drag Reduction
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Reliable & Low Cost Injection Equipment

20-foot container

Stand-alone skid
• Drag Reduction
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DRA Applications

Where?

In what fluids?

- Crude oils (light to very heavy)
- Multiphase (Oil, Water, Gas)
- Refined Products
- Water transfer
- Condensate
- NGL
<table>
<thead>
<tr>
<th>ConocoPhillips’ DRA Benefits</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue Increase</strong></td>
<td>Flow capacity increase</td>
</tr>
</tbody>
</table>
| **Asset Life Extension**      | Pressure reduction  
Pipeline integrity, |
| **Cost saving**               | Shut down pump stations  
Use fewer pumps  
Cheaper logistics  
Demurrage avoidance... |
| **Operating Efficiency**      | Flexibility (Use only when needed) |
| **Effective HSE**             | P/L vs. Other means (Road, Rail...) |
| **Capital Avoidance**         | No mechanical expansion.  
P/L design with smaller diameter & thickness  
Less pumps & pump stations |
| **Low cost solution**         | vs. Alternatives (FSO, New P/L...) |
| **Quality Assurance**         | No effect on treated fluid properties |
| **Side Benefits**             | On Corrosion, Convection Heat Transfer, Wax |
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ConocoPhillips Specialty Products Inc (CSPI)

- Wholly-owned by ConocoPhillips
- Applications in more than 35 countries
- ISO 9001:2000 certified
- Global leader in drag reduction technology
- Global customer support & product supply
- Millions of barrels treated every day with CSPI Drag Reducers
History of CSPI Flow Improvers

1973
Commenced patent protection

1979
First commercial product of a gel flow improver

1980

1990

1994
First commercial product of a suspension DRA for crude oil (LiquidPower™)

2000

2001
Launch of the first flow improver for multiphase applications (LP™ 111 Flow Improver)

2002
RP™ II Flow Improver introduced

2008
ExtremePower™ Flow Improvers launched for heavy crude oil

2009
CSPI celebrates 30th Anniversary of commercial use of flow improvers

37 Granted U.S. Patents with Foreign Equivalents
Flow Improver Solutions

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<table>
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<th>Use</th>
</tr>
</thead>
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<tr>
<td>LP™ 100 / LP™ Winter</td>
<td>Most common – works well in most crude &amp; multiphase systems</td>
</tr>
<tr>
<td>LP™ 111</td>
<td>High performance (Low dosage) - crude &amp; multiphase applications</td>
</tr>
<tr>
<td>LP™ 300</td>
<td>Heavy crudes – used in U.S. and Middle East</td>
</tr>
<tr>
<td>LP™ Arctic Grade</td>
<td>Effective in environments with temperatures as low as –40°C</td>
</tr>
<tr>
<td>LP™ H₂O</td>
<td>High water cut production lines; water flood injection lines; water transport lines</td>
</tr>
<tr>
<td>RP™ II</td>
<td>Gasoline, diesel and other distillates - EPA approved</td>
</tr>
<tr>
<td>ExtremePower™</td>
<td>New Technology DRA for very heavy crudes</td>
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CSPI Flow Improver
Current and Past Users Around The World

- AIOC
- Alyeska
- BP
- BPA
- BHP
- BTC
- Buckeye
- CACT
- ChevronTexaco
- Coastal
- Colonial
- ConocoPhillips
- CLH
- CNOOC
- Ecopetrol
- Enbridge
- ENI (Agip)
- EPMI
- ESSO
- ExxonMobil
- Exspan
- HPCL
- Husky
- Inter Pipeline Fund
- Jayhawk
- Kaneb
- KazTransOil
- Kinder Morgan
- Koch
- Lakehead
- Maersk
- MEGI
- Marathon Ashland
- Navajo
- NCRA
- Nègusneft
- Norsk Hydro
- Ocensa
- OMY
- Pacific Energy
- Parco
- PDO
- PDVSA
- Pemex
- PetroEcuador
- Pertamina
- Petrobras
- PetroChina
- Petronas
- Plantation
- PLB
- PLC
- Qatar Petroleum
- Repsol YPF
- Saga
- Santa Fe
- Sarpom
- SFDM
- Shell
- SIGEMI
- Sinclair
- Sintez
- Sonatrach
- SPSE
- Suncor
- Sunoco
- Tamoil
- TengisChevroil
- TNK
- Total
- Transneft
- Trapil
- Unocal
CSPI Flow Improver - Typical Performance

• **Crude Applications:**
  – Typical injection rates: 1-50 ppm
  – Typical DR%: 30-80
  – North Sea Example

• **Refined Product Systems:**
  – Typical injection rates: 1-20 ppm
  – Typical DR%: 50-80
  – Examples: Spain, France, Saudi
Flow Improver Solutions

CSPI Flow Improver - Typical Performance

• Water Injection Application
  – Typical injection rates: 1-50 ppm
  – Typical DR%: 30-80
  – UK Example

• Multiphase Systems
  – Typical DR%: 10-50
  – North Sea Example
CSPI Flow Improver – Energy Saving & P/L Integrity

**Use of fewer pumps:**
- Lower energy cost
- Lower maintenance cost
- Lower operational cost
- P/L integrity & life extension

**Shutdown / avoid additional PS:**
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- Lower maintenance cost
- Lower operational cost
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Contact Us

ConocoPhillips Specialty Products Inc.
P.O. Box 2197
Houston TX 77252-2197
USA
Telephone: +1-832-486-2834

ConocoPhillips Specialty Products Inc.
Medialaan 50
1800 Brussels
Belgium
Telephone: +32.2.263.0520

ConocoPhillips Specialty Products Inc.
UL. Gasheka 6, 13th Floor
Moscow, Russia, 125047
Telephone: +7-095-785-2859

On the Web:
www.LiquidPower.com
www.ExtremePowerFlowImprovers.com
Thank you!

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