

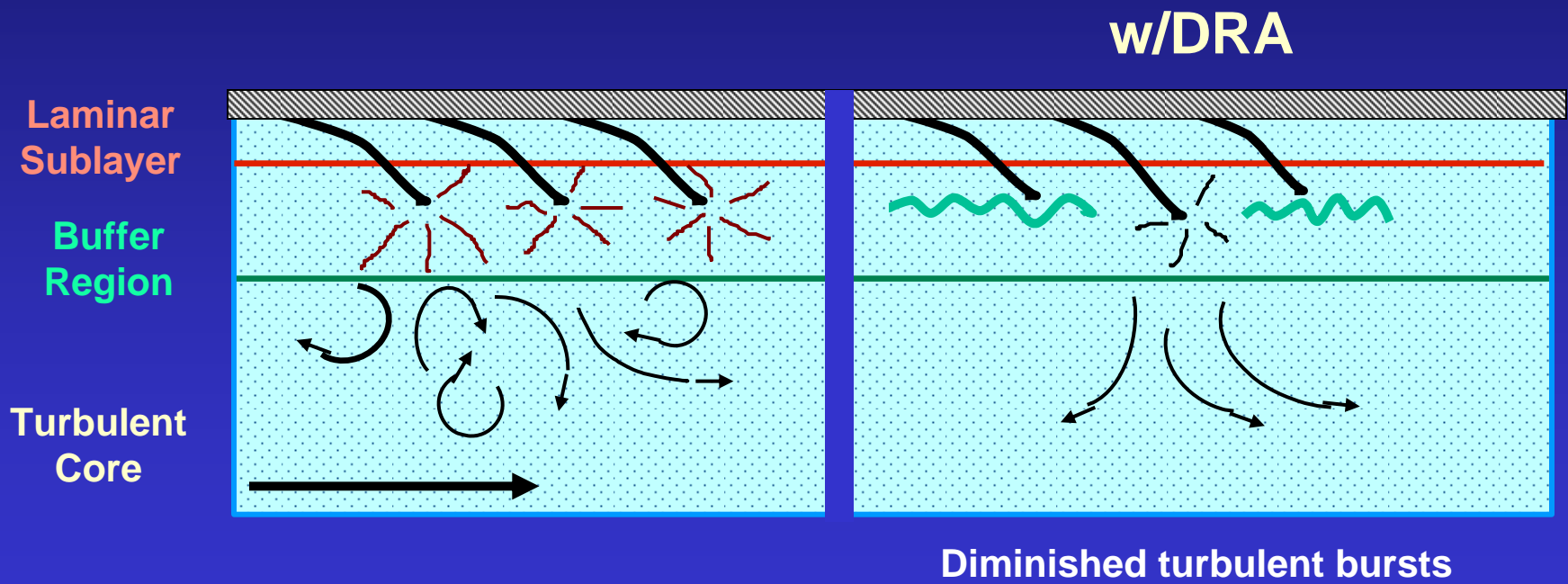
Heavy Oil Drag Reducing Agent (DRA): Increasing Pipeline Deliveries of Heavy Crude Oil

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ConocoPhillips Specialty Products Inc.



Drag Reduction Mechanism



DRA's (Traditional)

Light/Moderate
Crude Oil



- Low viscosity
- High Turbulence
- **Excellent performance**

Heavy Crude Oil



- High viscosity
- Low turbulence
- **Poor or no performance**

The Key to Performance:

Interaction between the DRA polymer and the crude oil

| Crude Oil Sample | LiquidPower™ Flow Improver Compatibility | ExtremePower™ Flow Improver Compatibility | API Gravity |
|---------------------------------|--|---|-------------|
| West Texas Intermediate | High | Moderate | 41.6 |
| West Texas Sour | High | Moderate | 31.6 |
| Basrah | High | Moderate | 31.0 |
| Corocoro | None | High | 25.1 |
| Albian | None | High | 22.4 |
| Marlim Blend | High | High | 22.2 |
| Maya | None | High | 21.9 |
| Bow River | None | High | 21.8 |
| Apiay | Moderate | Moderate | 21.8 |
| WCS (Western Canadian Select) | None | High | 20.9 |
| Castilla | None | High | 18.0 |
| Merey | None | High | 16.0 |
| SJVH (San Joaquin Valley Heavy) | None | High | 13.0 |
| Petrozuata | None | High | 9.1 |

Apiay – El Porvenir Pipeline

16-inch, 120 km, 91,000 barrel linefill



Source: World Energy Atlas 2007 Edition

Batching 2 crude oils:

Apiay (“light”, 21 °API)

Castilla blend (“heavy”, 18 °API)

~35% “light” / 65% “heavy”

Base Capacity: 94,000 BPD avg.

LP™ 300 Flow Improver:

103,000 BPD

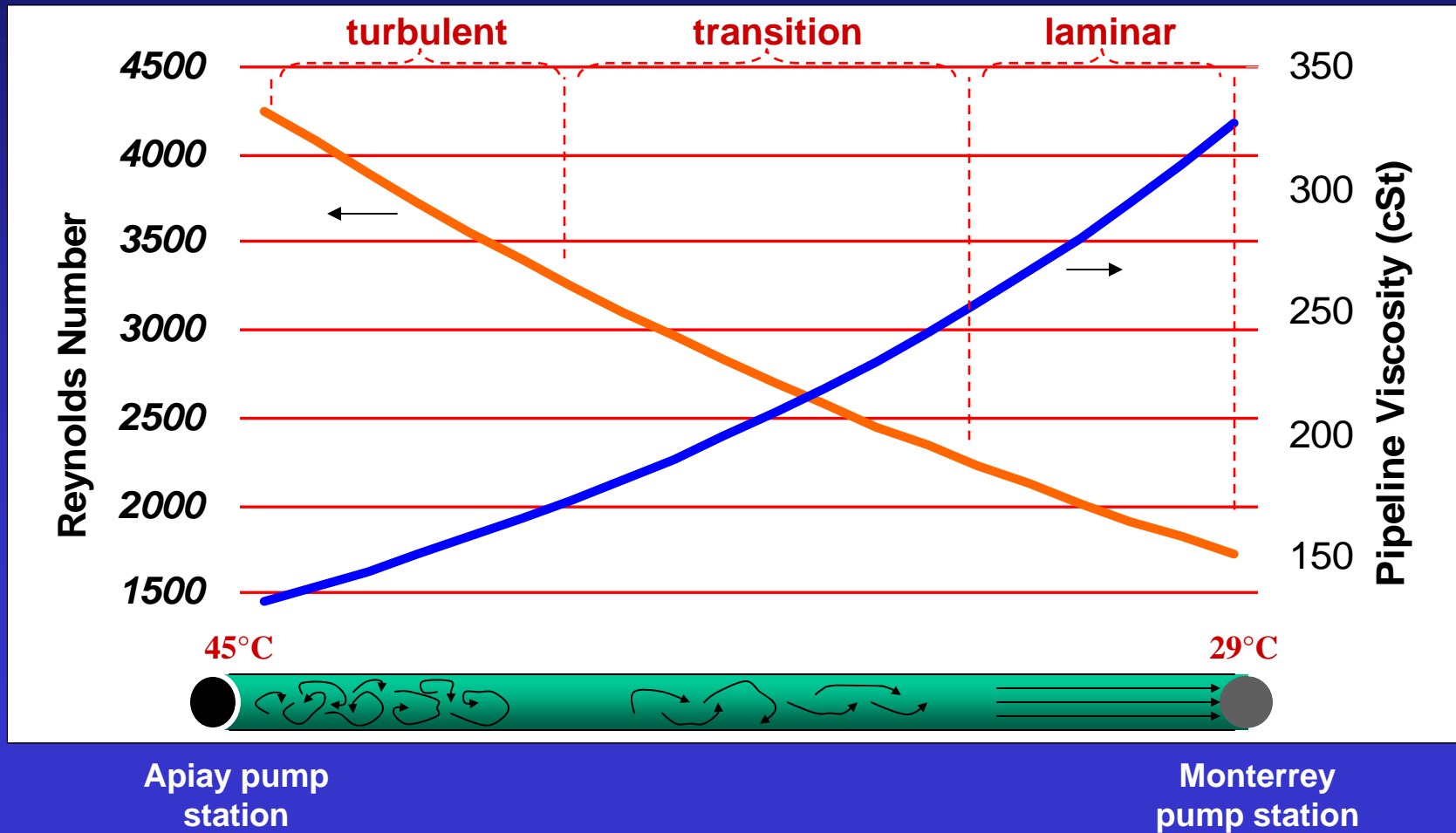
(in Apiay batches only)

Apiay-El Porvenir pipeline samples were evaluated for interaction in the lab.

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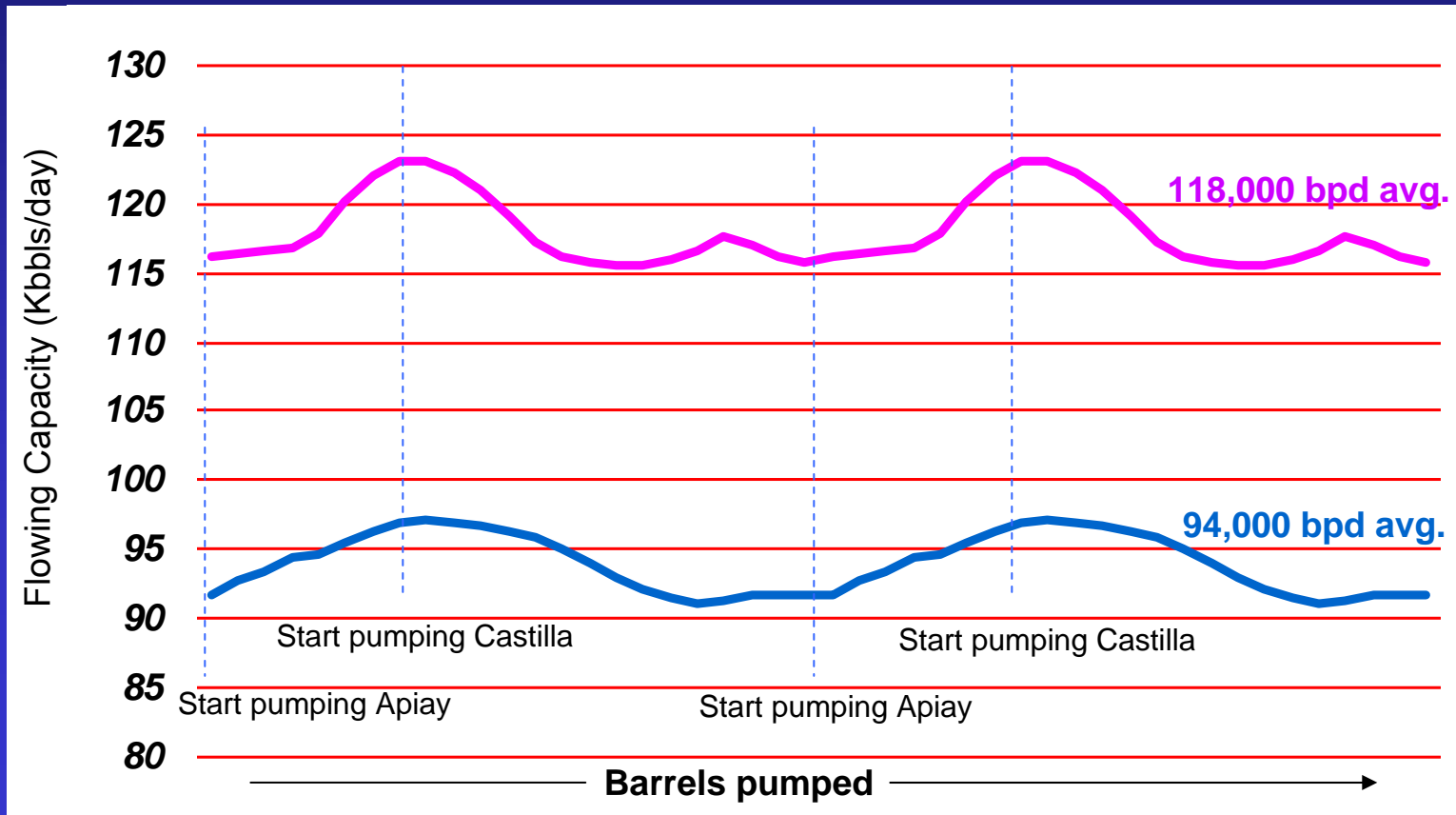
Pipeline Regime Profile

With Castilla blend



Pipeline Model – Capacity Trend with Batch Cycle

Basis: 70Kbbls Castilla blend → 31Kbbls Apiay →



Field Test Results

October, 2007

Performance exceeded model

Achieved 26-32% throughput over baseline operation

| Pipeline System Condition | Baseline (Thousands of BPD) | ExtremePower™ DRA Dosage (ppm _v) | LP™ 300 DRA Dosage (ppm _v) | Model (Thousands of BPD) | Result (Thousands of BPD) | Percent Flow Increase |
|--|-----------------------------|--|--|--------------------------|---------------------------|-----------------------|
| Test Pipeline Operations – ExtremePower™ injected into Castilla Blend | | | | | | |
| 100% Castilla Blend | 91.2 | | | | | |
| ExtremePower™ injection | | 70 | | 107 | 110.4 | 21.0 |
| Normal Pipeline Operation – ExtremePower™ injected into each crude | | | | | | |
| 65% Castilla Blend/35 % Apiay | 93.6 | | | | | |
| ExtremePower™ injection in each crude | | 68 | | 118.0 | 121.0 | 29.3 |
| Normal Pipeline Operation – ExtremePower™ injected into Castilla, LP™ 300 injected into Apiay | | | | | | |
| 65% Castilla Blend/35 % Apiay | 93.6 | | | | | |
| LP™ 300 in Apiay | | | 40 | * | 103.0 | 10.0 |
| Combination injection 1 | | 47 | 47 | 113.0 | 118.0 | 26.0 |
| Combination injection 2 | | 75 | 75 | 118.0 | 123.4 | 31.8 |

Refinery Impact Testing

◆ Desalter Testing

- Tested at 40 ppm to 300 ppm
- No negative impact on dewatering rates

◆ Wastewater Quality

- Lab – Oil & Grease levels did not increase
- Refinery – COD and Oil & Grease values unchanged during testing

◆ Distillation Products

- WCS crude oil distilled → Gasoline, Jet Fuel, Diesel cuts
- Refinery lab testing showed no difference in quality of product cuts from treated versus untreated oil

◆ Thermal Decomposition

- 700 °F thermal degradation
- No organic acids; all decomposition products benign

Summary

★ New DRA, ExtremePower™ Flow Improver developed

- Strong interaction with heavy crude oil (<23 °API)
- Performs in transition flow ($N_{RE} \geq 2100+$)

★ Successful field trial and application with Ecopetrol

- 50 ppm_v ⇒ ~25% flow increase

★ No refinery impact observed from lab testing and field application.

Acknowledgements

CSPI would like to thank both Ecopetrol and Delrio for partnering with us on the flow improver test, working with us through the test protocol development, injecting ExtremePower™ Flow Improver into the pipeline and allowing CSPI to share the results of the test and field application.

