



Heavy Oil Drag Reducing  
Agent (DRA):

Increasing Pipeline Deliveries  
of Heavy Crude Oil

# Topics

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- Industry need
- Introduction to DRA
  - Nature
  - Mechanism
  - Application
- Scenario 1: Increased delivery of heavy crude oil
- Scenario 2: Enhanced viscosity
- Summary

# Industry Need

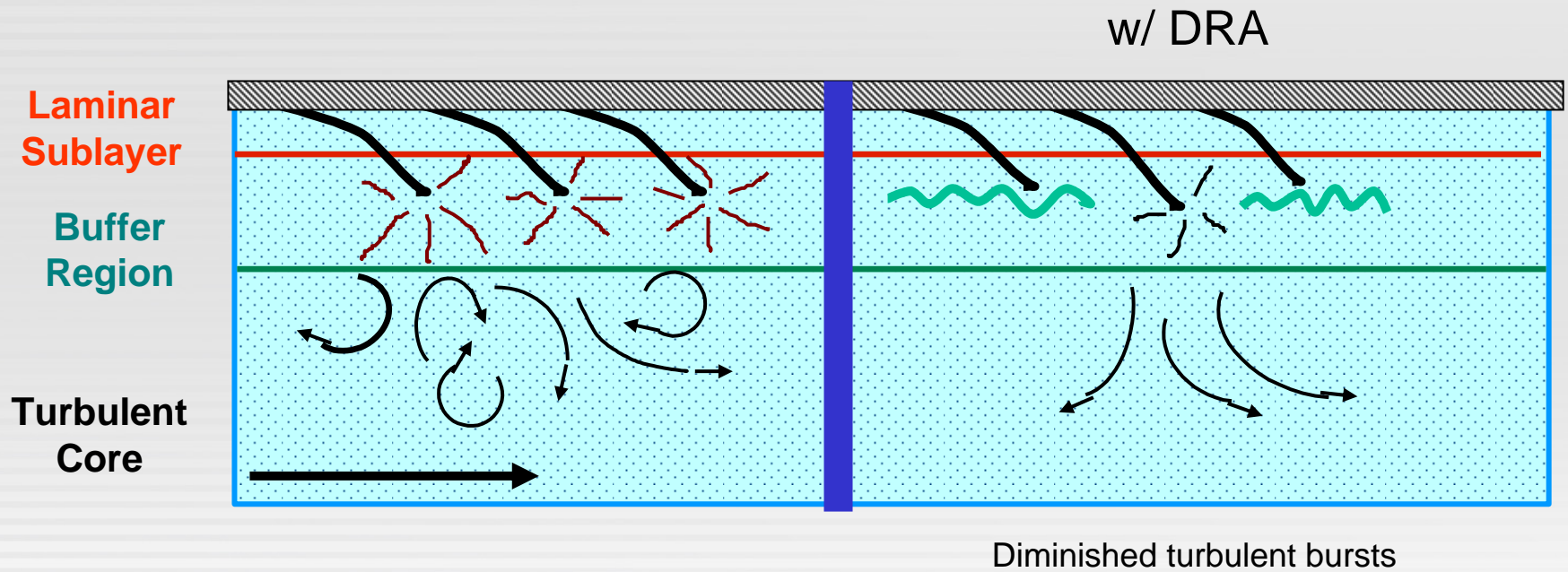
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## Heavy Oil is a Transportation Challenge

- Capacity
  - Most lines were designed for light crude oil
- Cost
  - Higher viscosity = lower throughput volumes
    - OpEx increases <overall & per unit>
  - Capital
    - Large CapEx projects
- PL System Performance
  - Scheduling
    - Light/heavy batching
      - Variable operating regime

# Drag Reduction Mechanism

## Ultra High Molecular Weight Polymers



# Traditional DRA

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Light / Medium  
Crude Oil



- Low viscosity
- High turbulence
- **Excellent performance**

Heavy Crude Oil



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

# Heavy Oil DRA – Key to Performance

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

Interaction between the DRA polymer and the crude oil

# Scenario 1:

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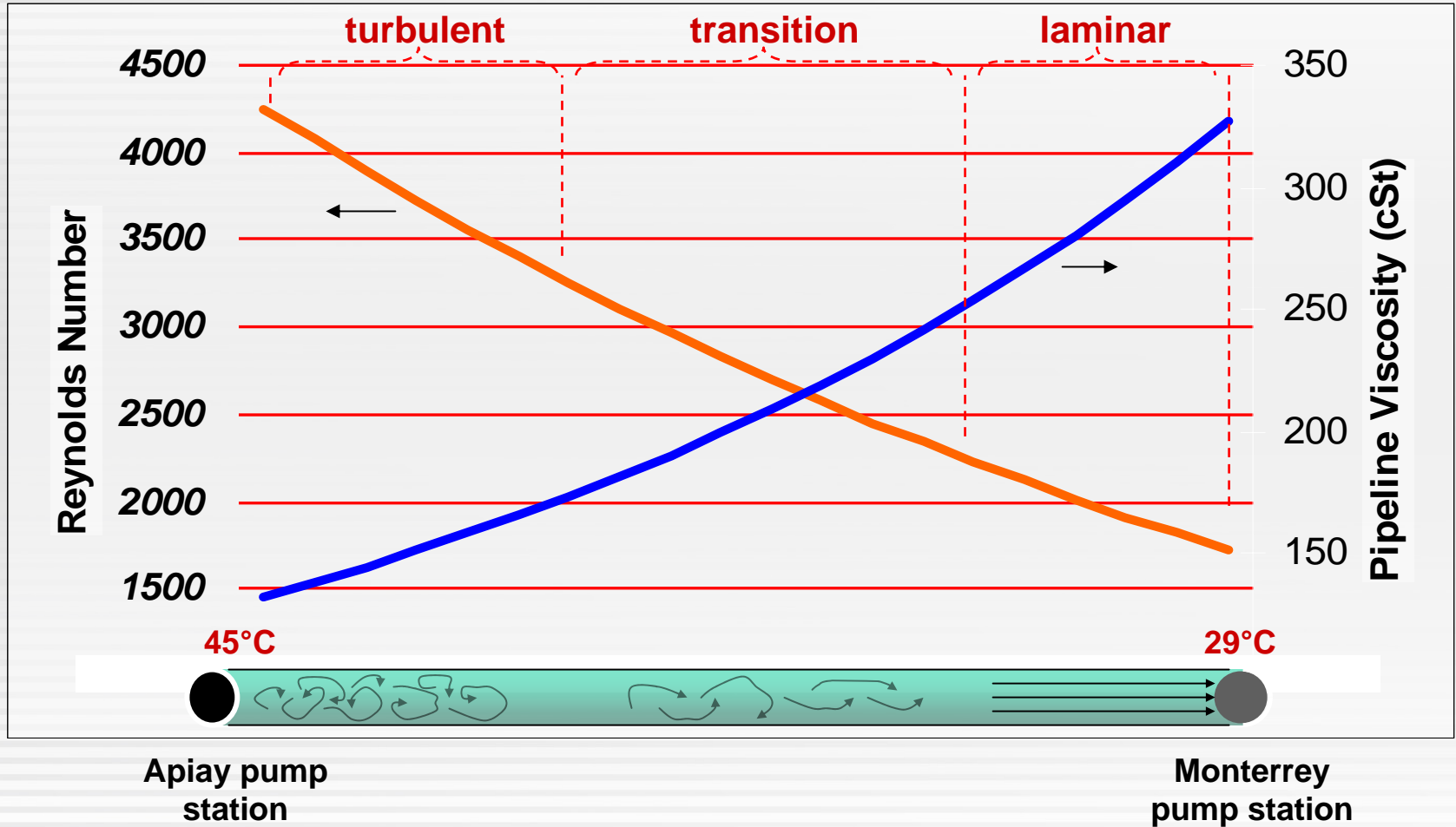
## Increased Delivery of Produced Heavy Crude Oil to Market

# Apiay – El Porvenir Pipeline

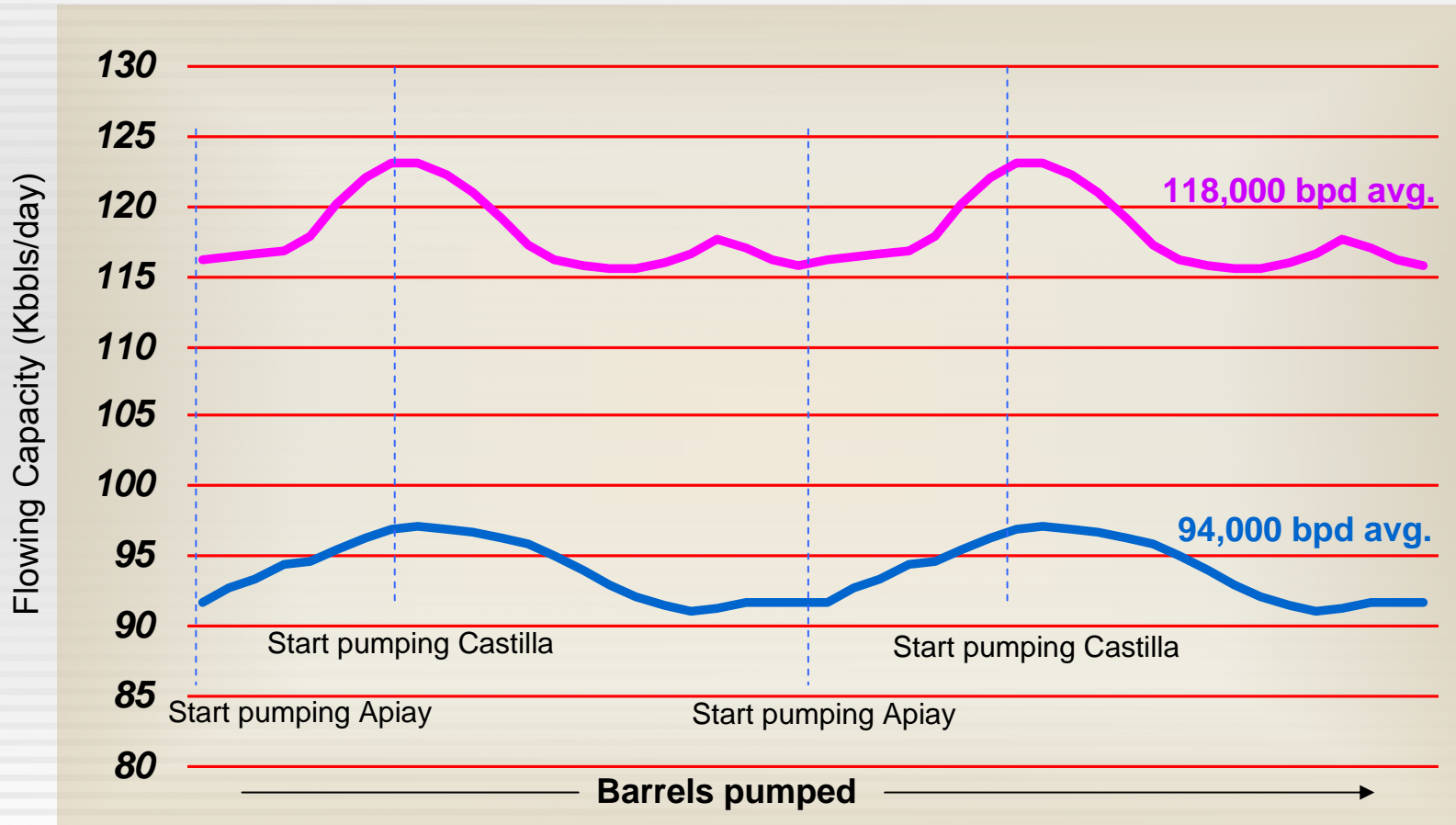
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- 16 – Inch, 120 km, 91M BBL Linefill
- Batching
  - Apiay (“light”, 21 °API)
  - Castilla blend (“heavy”, 18 °API)
  - PL Schedule
    - 35% light / 65% heavy
- Baseline Capacity
  - 94M BPD avg.
  - 103M BPD using LP™ 300 Flow Improver in Apiay

# Pipeline Regime Profile



# Pipeline Model – Capacity Trend with Batch Cycle



# Field Test Results

Pipeline System Condition	Baseline (Thousands of BPD)	ExtremePower™ DRA Dosage (ppm <sub>v</sub> )	LP™ 300 DRA Dosage (ppm <sub>v</sub> )	Model (Thousands of BPD)	Result (Thousands of BPD)	Percent Flow Increase
<b>Test Pipeline Operations – ExtremePower™ injected into Castilla Blend</b>						
100% Castilla Blend	91					
ExtremePower™ injection		70		107	110	21
<b>Normal Pipeline Operation – ExtremePower™ injected into each crude</b>						
65% Castilla Blend/35% Apiay	94					
ExtremePower™ injection in each crude		68		118	121	29
<b>Normal Pipeline Operation – ExtremePower™ injected into Castilla, LP™ 300 injected into Apiay</b>						
65% Castilla Blend/35% Apiay	94					
LP™ 300 in Apiay			40	*	103	10
Combination injection 1		47	47	113	118	26
Combination injection 2		75	75	118	123	32

## Scenario 2:

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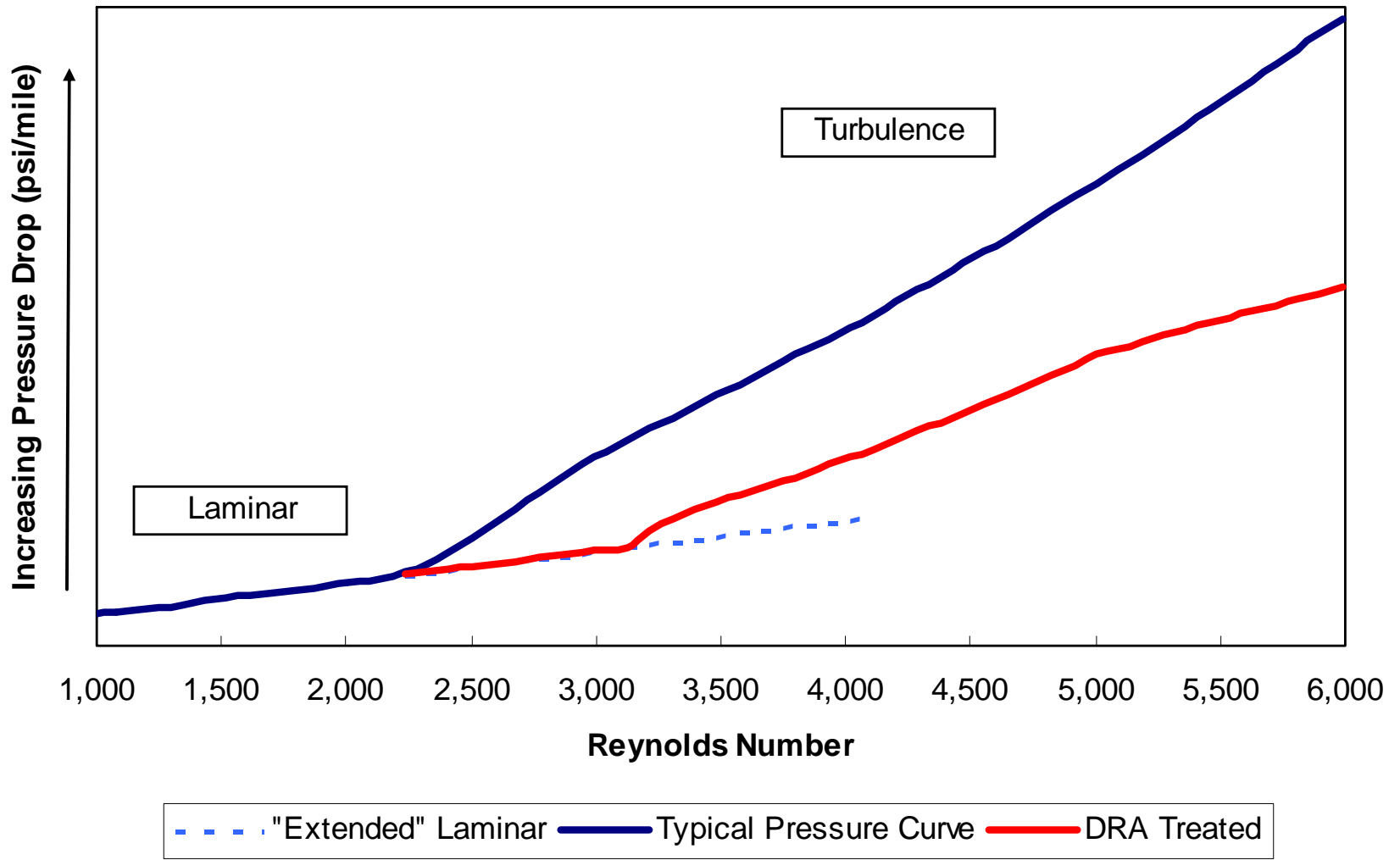
# Increased Delivery of Heavy Crude Oil to Market via Viscosity Optimization

# Introduction

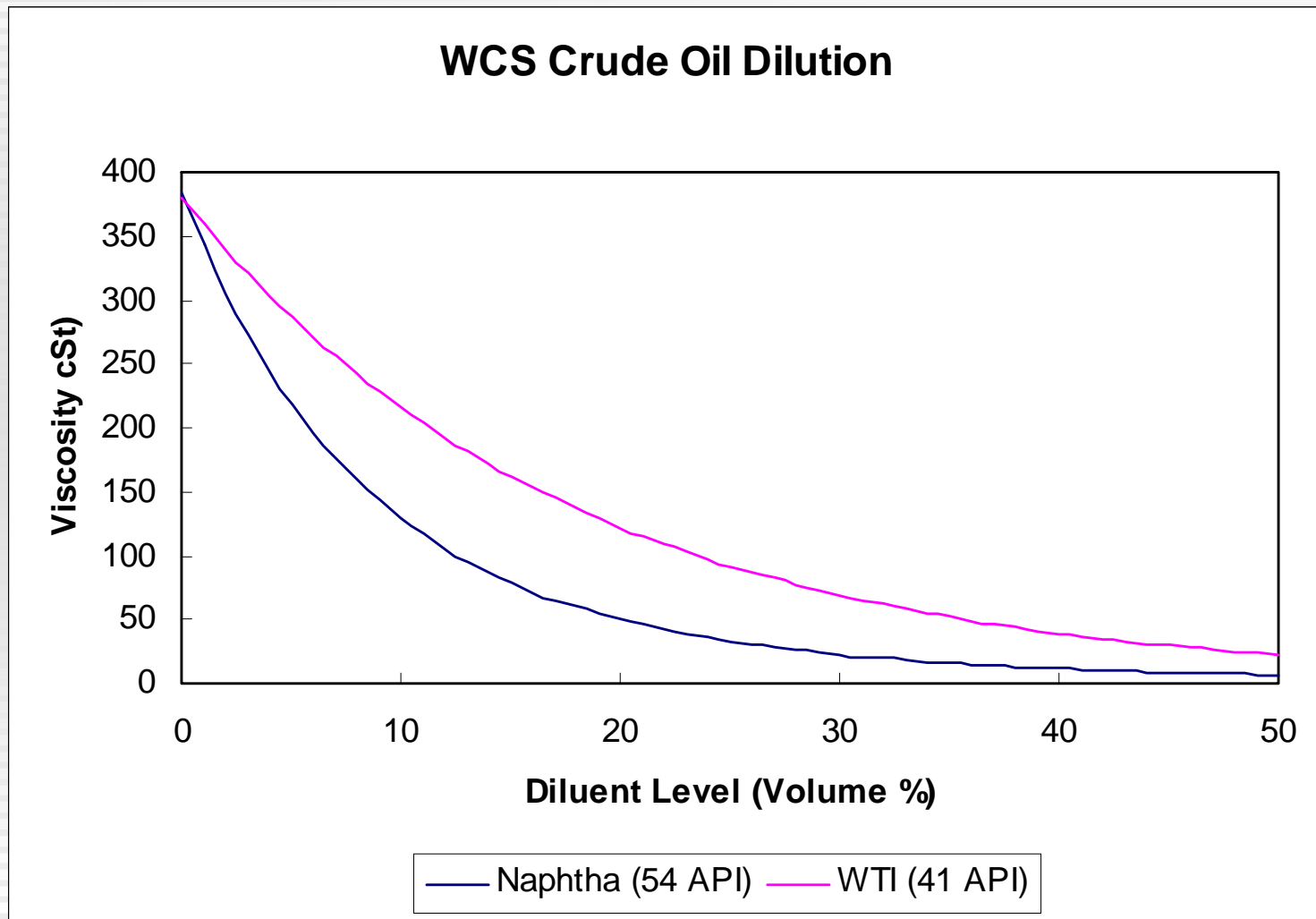
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- Concept introduction
  - “Extended” laminar
- Diluent selection
  - Light crude oil may be better than naphtha
- Paradigm challenge
  - Increase throughput with more diluent

# General Pressure Relationship in a Pipeline

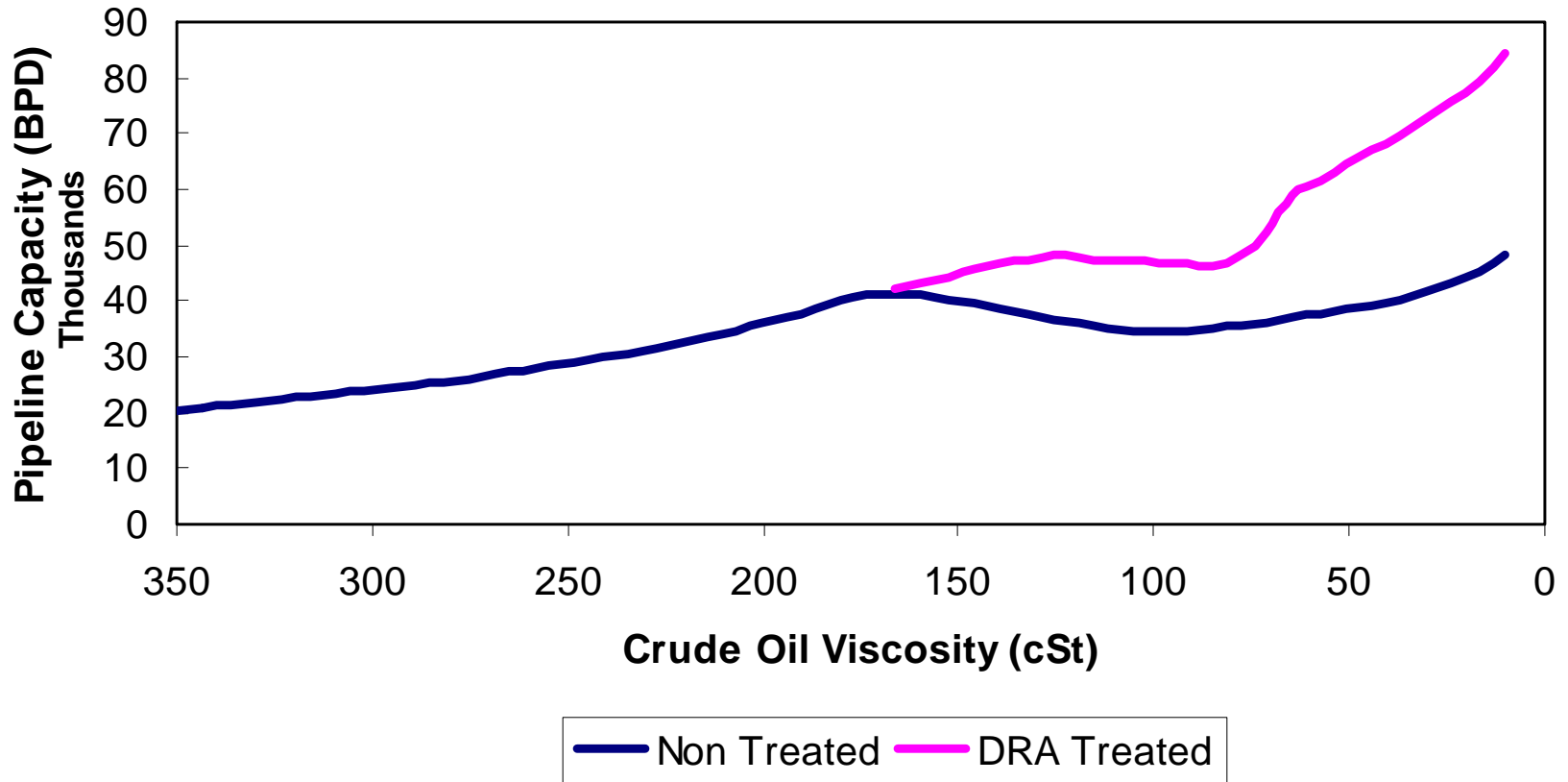


# Impact of Common Diluents on Viscosity



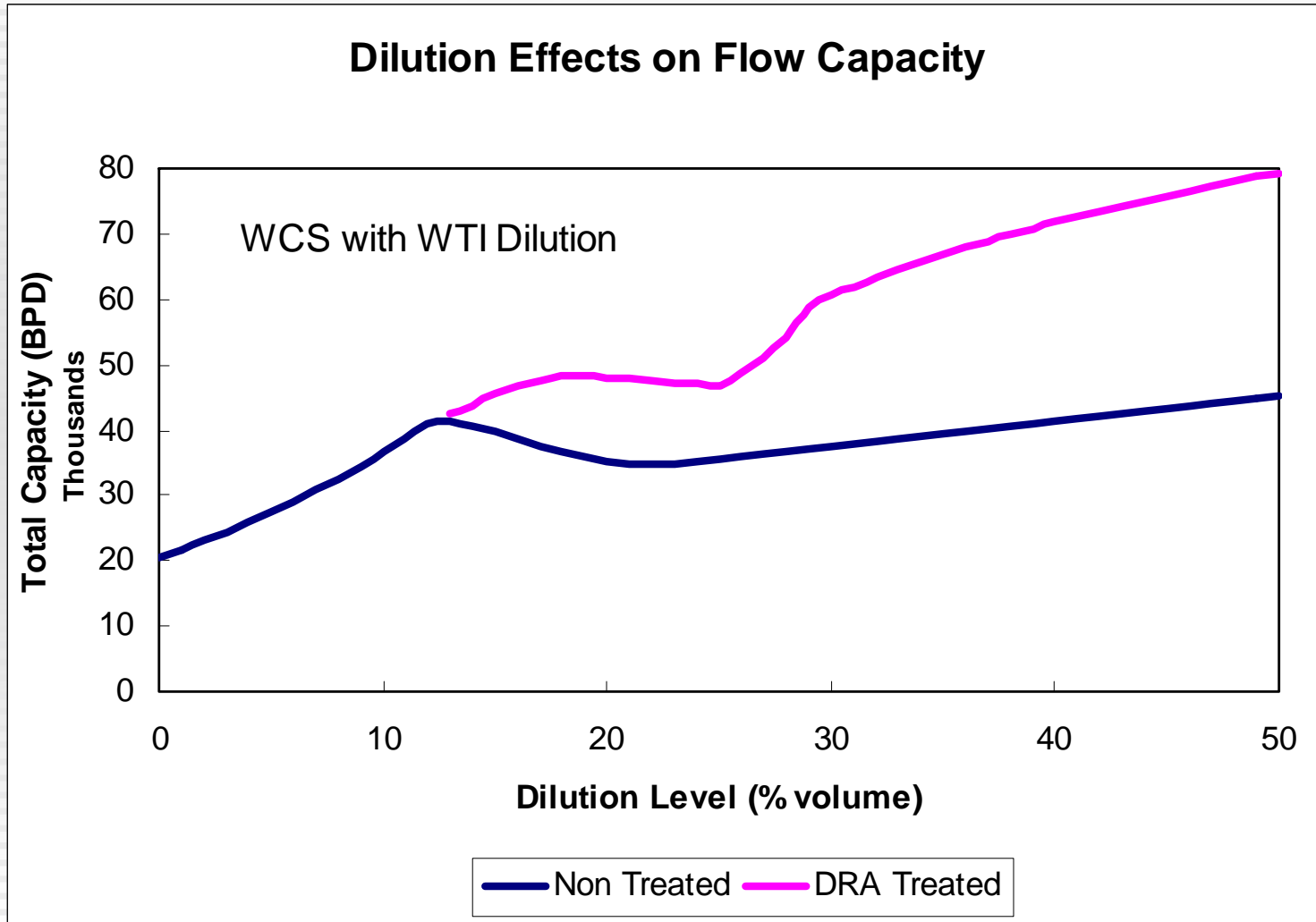
# Effect of Viscosity on Capacity

## Example Pipeline Throughput Versus Viscosity



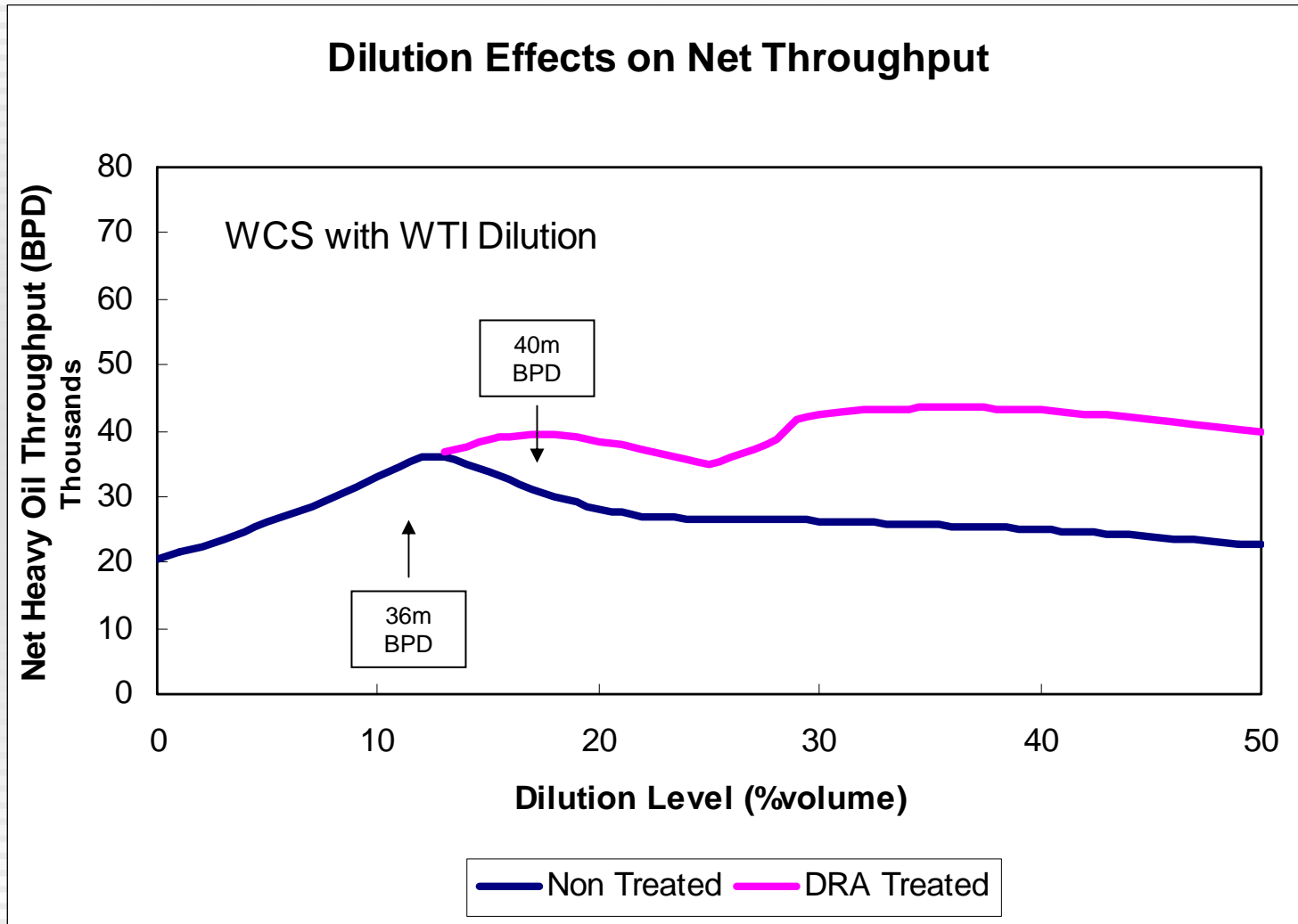
*Hypothetical Pipeline – 10 in., 50 Miles*

# Effect of WTI Diluent Level on Capacity



*Hypothetical Pipeline – 10 in., 50 Miles*

# Net Heavy Crude Oil Capacity



*Hypothetical Pipeline – 10 in., 50 Miles*

# Summary

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- New DRA developed for heavy crude oil
  - ExtremePower™ Flow Improver
  - Strong interaction with heavy crude oil (<23 °API)
  - Performance in transition flow ( $N_{RE}$  2100+)
- Results
  - Production line
    - 20 - 30% flow increase achieved
  - Enhanced viscosity
    - Low Reynolds # performance
      - Heavy crude oil made us go there

# Acknowledgements

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We would like to thank the API organization and attendees as well as our business partners.

Questions?

# Contact Us

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**ConocoPhillips Specialty Products Inc.**

[www.ExtremePowerFlowImprovers.com](http://www.ExtremePowerFlowImprovers.com)

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