Friction Reduction

Its all about getting to the destination quicker!

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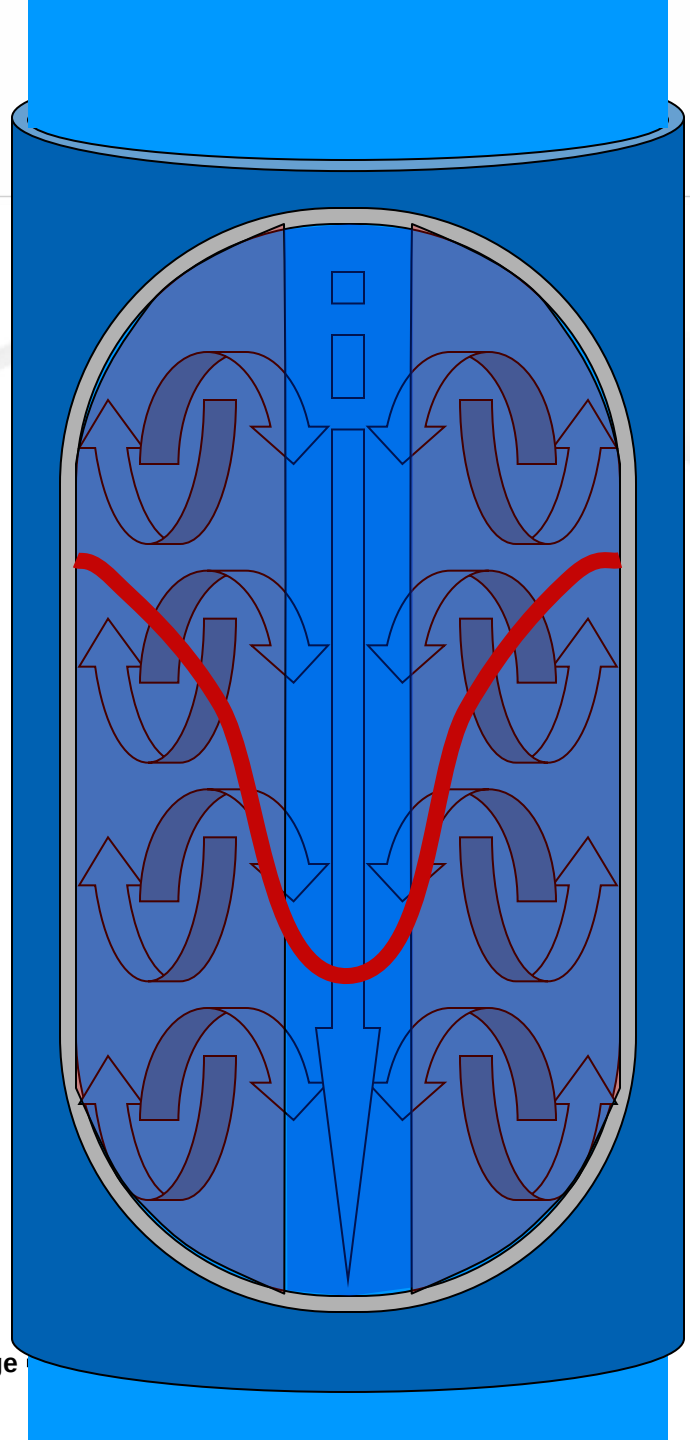
water quality solution

What is Friction in Pipe?

- It is the resistance to flow in the pipe
  - Effected by three things:
    - Pipe Characteristics
    - Obstructions
    - Fluid Characteristics
  - Defined by two numbers
    - Pressure in relation to flow
    - Reynolds Number
- Nemesis in many markets

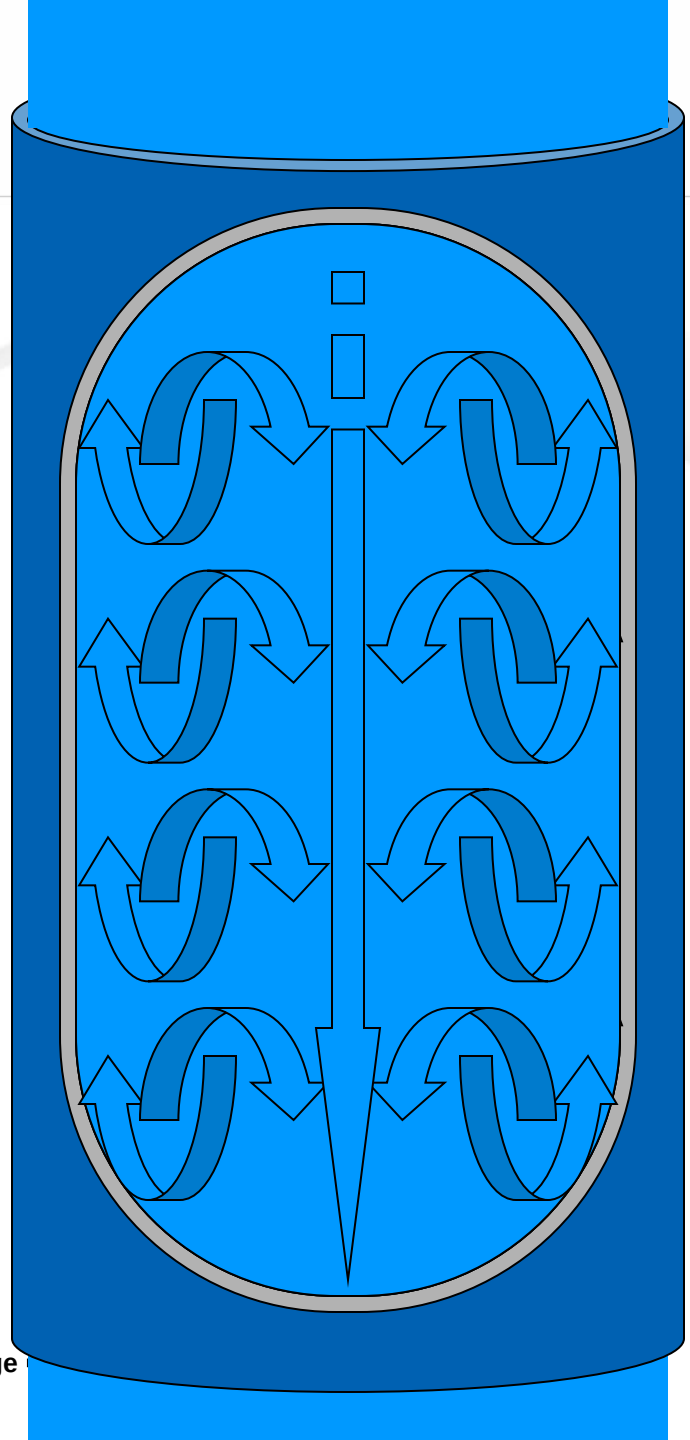
A Flow Profile



- Boundary Layers
  - Turbulence starts
  - Little or slow flow
  - Slight changes, big effects in friction

- **Flow Shaft**
- **Laminar flow**
- **High flow rate**
- **Need to maximize**

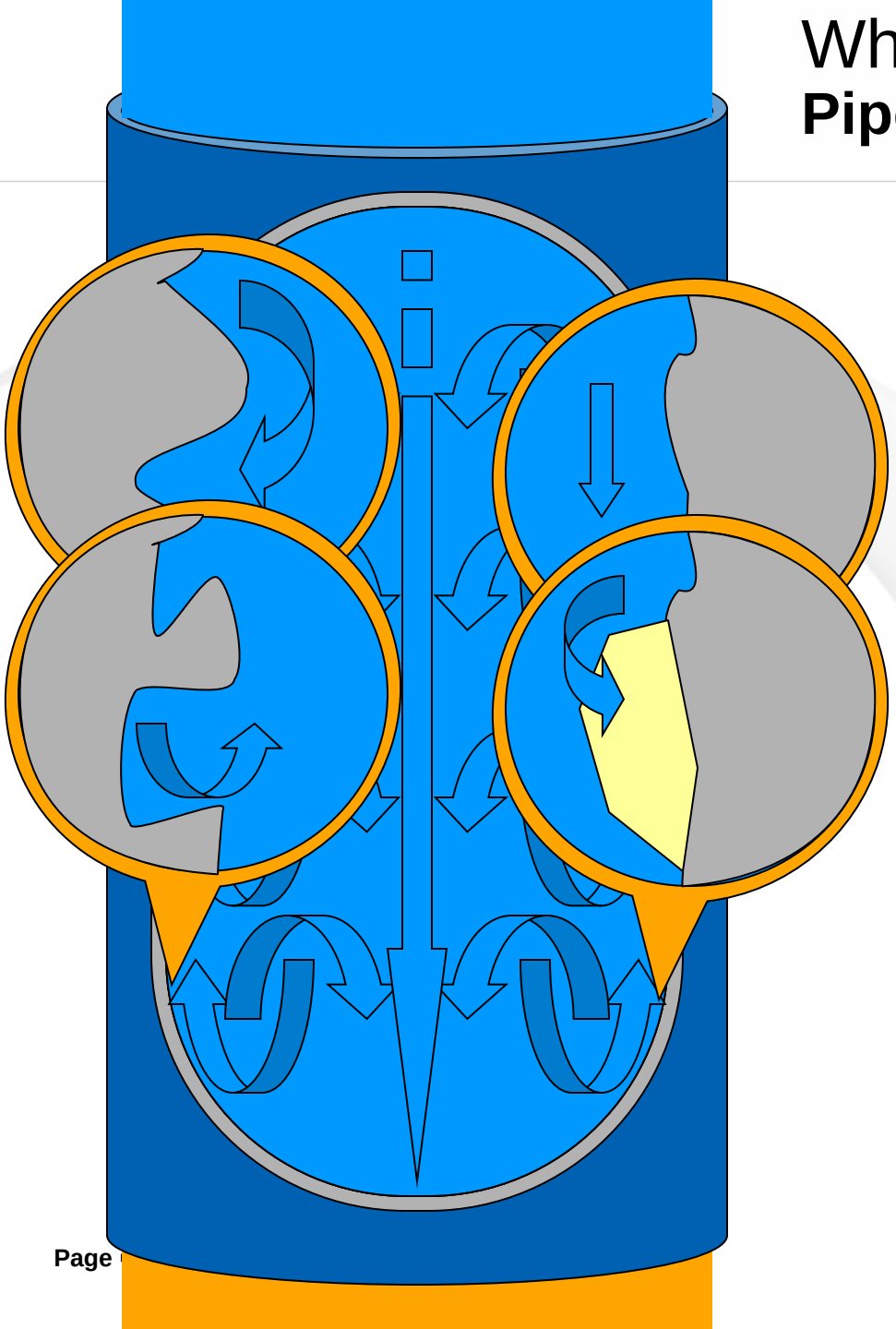
A Flow Profile



- Changes in System
  - Change Boundaries
  - Change Flow Shaft
  - May mask other problems in the pipe
- Defined Change?
- Change over Time

What Causes Friction?

Pipe Characteristics



Pipe Roughness

Construction

Corrosion

Deposits

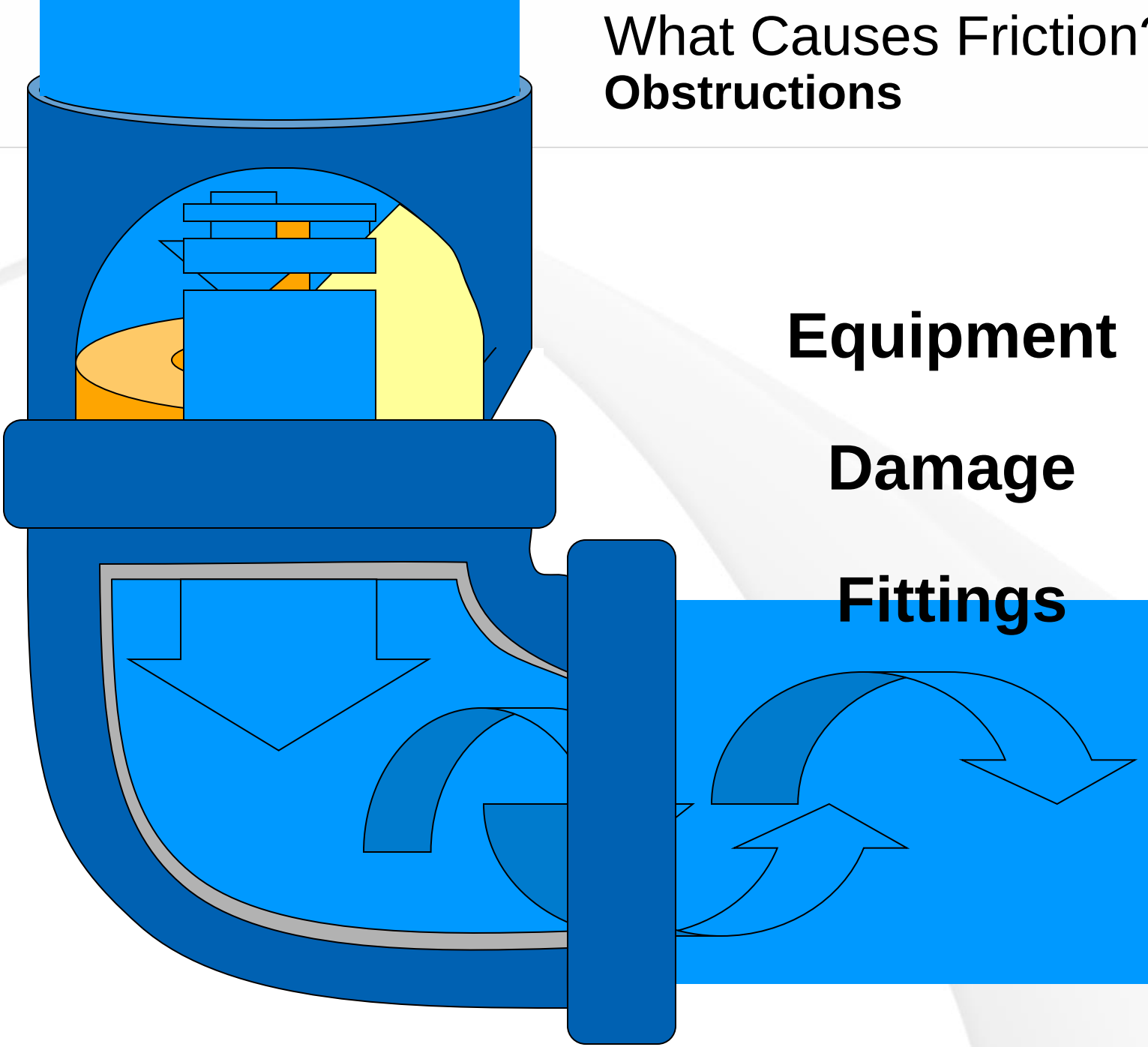
Physical Dimensions

Diameter

Length

What Causes Friction?

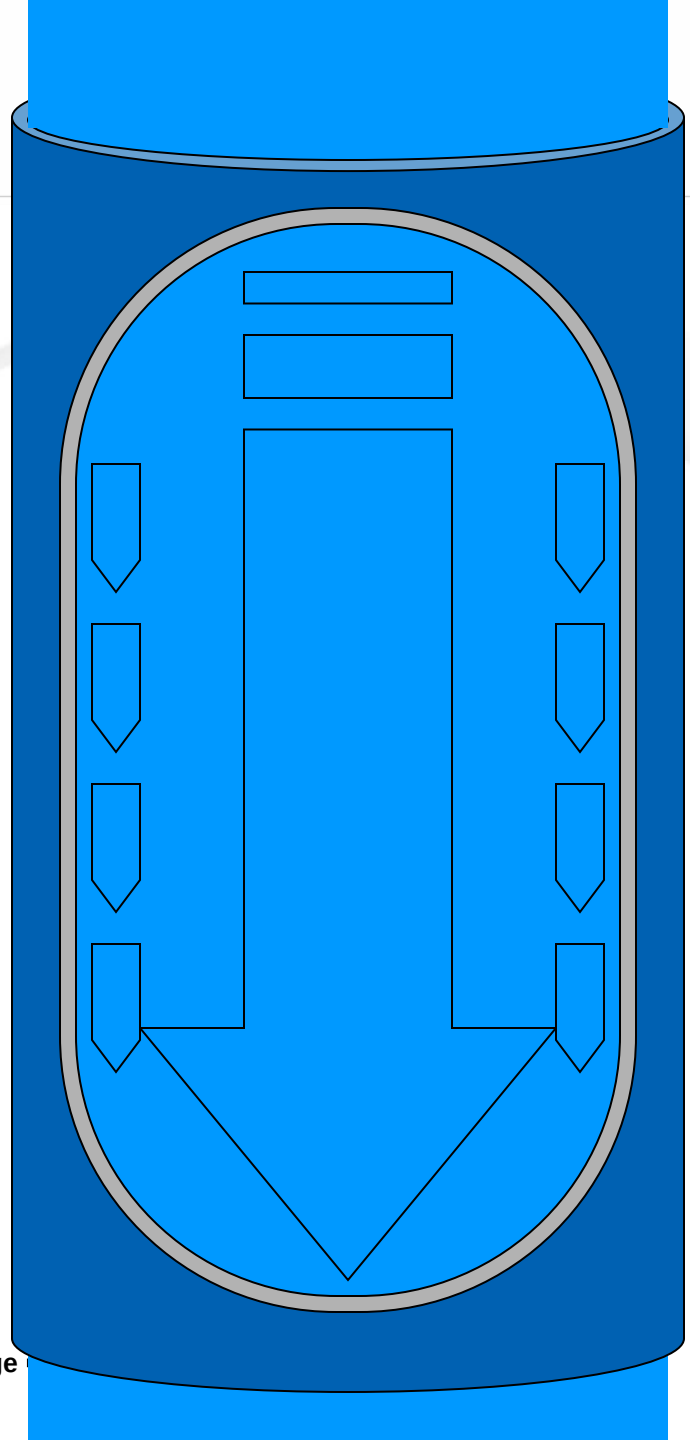
Obstructions



Equipment

Damage

Fittings



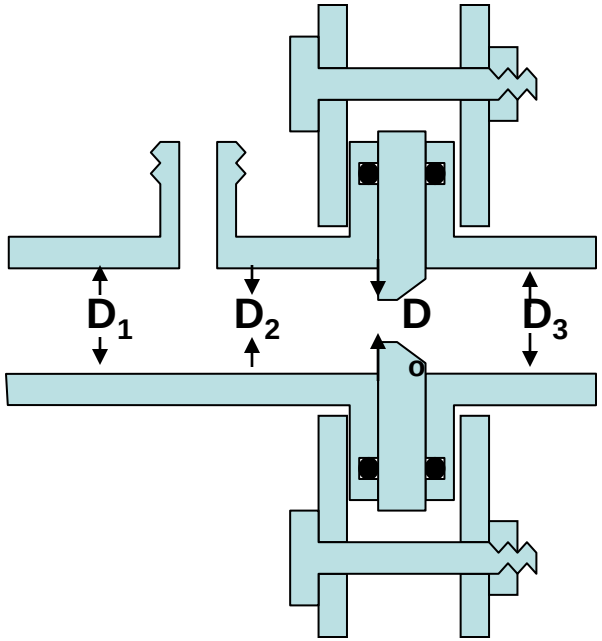
What Causes Friction?
Fluid Characteristics

- Density
  - Brines worse
  - Temperature
  - Physical Solids (particle interaction)
  - Form
    - Solid, Liquid, Gas
- Composition
- Viscosity

Measuring Friction
Pressure

- Measures Cumulative Effects
  - Sensitive to change
  - Indifferent to cause
- Typically Dynamic, Rarely Static
  - Can require process knowledge
  - Effected by interaction
- Can Reflect Obstruction or Endpoint Alone

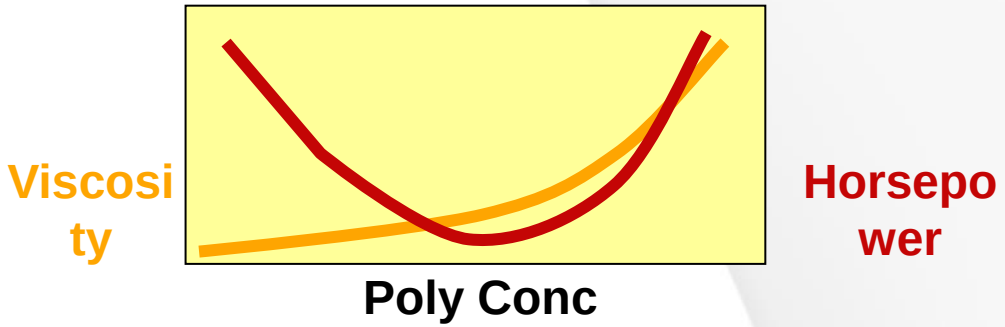
Measuring Friction
Reynolds Number



- Measures Turbulence
  - <2000 Laminar
  - 2000-4000 Transition
  - >4000 Turbulent
- Dimensionless
- Widely Accepted Calc
- Design and Engineering

The Practical Stuff

- Reynolds Number may not work for friction if viscosity is above 500 - 750 cps
  - May show laminar flow, but viscosity itself too high
  - Won't be injecting that much polymer in most cases
  - Exception for stimulation work
- Pressure needs to be high enough to show a significant change
  - Field guys read pressure
  - In laminar flow may not show a decrease



What Polymers Do

- Change Fluid Character
- Modify Boundaries
- May Modify Pipe Roughness
- Can Increase Corrosion in Steel
- Can Floc Solids

Adventech DST Products

- DST 500 Series

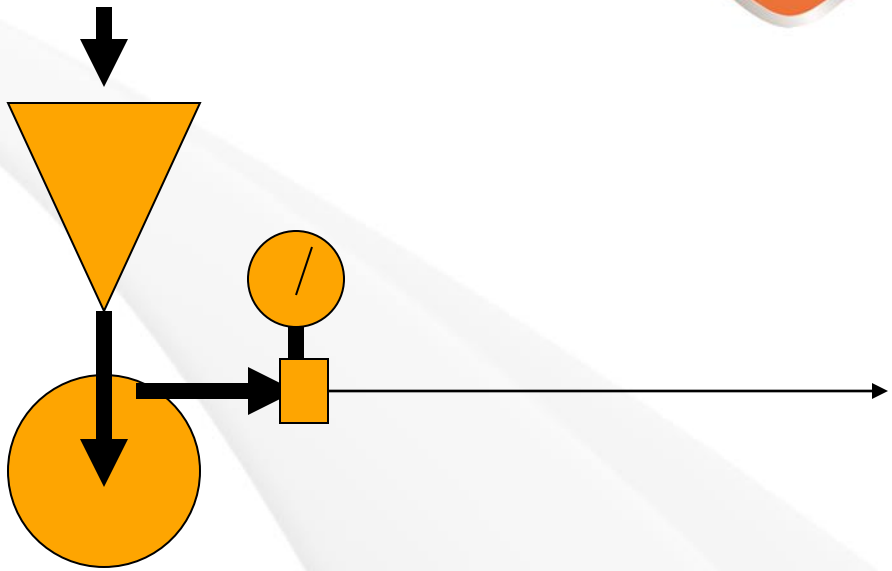
- **Cationics**
- **“L” Emulsion**

- **500 Series**
  - **L 510**
  - **L 520**
  - **L 530**
  - **L 525**
  - **L 515**
  - **L 535**

- **Anionics**
  - **High MW for viscosity**
  - **Low MW for less damage**
  - **…..works in acid, brine, and fresh**
  - **…..best in high brines**
  - **…..best in fresh water**
  - **…..antiscalants**

Lab Data

- Funnel, pump, pressure gauge, small diameter line
- Water first to set baseline
- Mix and pump polymer solution at 30 seconds
- Wait 2 minutes and pump the rest of the solution
- Compare reduction of pressure polymer to water
- Flush water to achieve water pressure again and repeat



Applications

- Fluid through pipe
  - Injection of any kind
    - Frac jobs
    - Waterflooding
    - Deep well disposal
  - Transport
    - Produced water (friction)
    - Produced oil (drag)
    - Chemical - Umbilical(?)

- **Slurry through pipe**
  - **High Solids**
    - **Mineral**
    - **High particle interaction**
    - **Deep well disposal**
  - **Low Solids**
    - **Line plugging (Ag)**
    - **Long distance**

What to Look for in Good Candidates

- Desire to increase flow at a pressure limit
  - Fixed pipe system or expensive to replace
  - Older systems at limits
  - Need for faster injection to reduce timeline/cost
  - Cheaper expansion alternative
- Desire to decrease pressure at a required flow rate
  - May show as a need for less horsepower on pumps
  - Cost reduction on horsepower
  - Safety factors on older systems
- Systems with solids
  - Plugging and settling in pipe (dispersant action)
  - Abrasion (lubrication and reduced horsepower)
  - Caking for high solids systems (lubrication and reduced interaction)

Cautions

- Corrosion – Crosslink w/ polymer
  - Iron
  - Copper
  - Aluminum
  - Especially with H2S
- Downstream effects of polymer
  - Use of product
  - Could be good – use cationic in a produced water line and oil separation should be good at discharge
  - Interaction with polymer w/ solids
- If system is laminar or low pressure added viscosity could add horsepower
- Watch for polymer dosage lines – usually small diameter carrying high viscosity polymer long distance – to become a friction problem themselves

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