

Protocol for Testing DRA Formulations

1. Laboratory Evaluation

Objective: Assess the effectiveness of DRA formulations in controlled environments.

1.1. Materials and Equipment

- Crude oil sample (matching field conditions).
- Flow loop setup:
 - Pipeline diameter: 1–2 inches.
 - Length: 10–20 meters.
 - Flow sensors, pressure sensors, and temperature controllers.
- Homogenizer or high-shear mixer.
- Analytical instruments:
 - Rheometer or viscometer.
 - Surface tension analyzer.
 - Particle size analyzer.

1.2. Flow Loop Testing

1. Setup:

- Fill the flow loop with crude oil.
- Adjust temperature to simulate pipeline conditions.

2. Baseline Measurements:

- Measure flow rate, pressure drop, and viscosity without DRA.

3. Testing:

- Inject DRA at concentrations (e.g., 10, 20, 50 ppm).
- Record flow rate, pressure drop and drag reduction percentage.

4. Analysis:

- Calculate drag reduction percentage using:

$$\text{Drag Reduction (\%)} = \left(\frac{\Delta P_{\text{baseline}} - \Delta P_{\text{DRA}}}{\Delta P_{\text{baseline}}} \right) \times 100$$

- Assess the effectiveness across different concentrations.

2. Pilot Testing

Objective: Evaluate DRA performance in a controlled section of the pipeline.

2.1. Selection of Pipeline Section

- Choose a section with representative conditions (e.g., flow rates, temperatures, and crude oil type).
- Ensure easy access for sampling and monitoring.

2.2. Implementation

1. Injection System:

- Install a metering pump to inject the DRA.
- Place injection points at areas of high turbulence (e.g., near pumps).

2. Monitoring:

- Install pressure and flow sensors upstream and downstream of the injection point.

3. Baseline Testing:

- Operate the pipeline without DRA for 24–48 hours.
- Record flow rates, pressures, and any deposition data.

4. DRA Testing:

- Inject the DRA at optimized concentrations (from lab tests).
- Monitor changes in flow rate and pressure.

5. Data Analysis:

- Compare pressure drops and flow rates with and without DRA.



3. Field Deployment

Objective: Scale the DRA application to the entire pipeline system.

3.1. Optimization

- Determine the optimal injection rate and concentration from pilot tests.
- Use inline mixers for uniform distribution.

3.2. Continuous Monitoring

- Install sensors along the pipeline to monitor drag reduction effectiveness over time.
- Check for potential side effects, such as deposition or emulsification.

3.3. Documentation

- Record operational parameters, DRA dosage rates, and observed performance improvements.