Capillary Injection Systems
Capillary Injection System Animation
Capillary Injection System Overview

Installation Overview

- Chemical Delivery System
  - Usually ¼” or 3/8” Stainless Steel Tubing
    - Can be ½” or 5/8”
  - Usually Internally Installed
    - Can be Externally Banded
- Precision Injection Placement Downhole
- BOP Assembly Allows Snubbing
- Combination Chemical – Foamer/Inhibitors

Our Heritage:
Built for Purpose/Built from Scratch
Capillary Injection Advantages

- Maximize well production while protecting tubulars
- Reduces well intervention cost due to treating scale, paraffin, corrosion, and salting and **Liquid Loading**
- Requires no batch treating or shut-in time
- Reduces chemical costs with precise placement and metering of production chemicals
- **Low Cost Artificial Lift Method**
  - **Wellflo, WFT Proprietary, Cerberus**
Capillary Injection
Disadvantages

- Capillary String Through Wellhead
- Capillary String Must be Pulled to Service Well
- Depth Limitations (20,000’)
- Downhole Deviation
- Potential Plugging Issues
- Requires Preventative Maintenance
**Capillary and Chemical “Lift” Definitions**

**Foam Lift** – Utilization of chemical surfactants in conjunction with a well’s gas flow to modify the apparent density and surface tension of its produced liquids in effort to lower the system’s critical velocity.

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Capillary and Chemical Applications

- Liquid Loading
- Corrosion Control
- Scale Control
- Paraffin Control
- \( \text{H}_2\text{S} \) Control
- Combination Products

Capillary Injection is a Chemical Delivery System
Adding Foamer

- Reduces surface tension and density of the produced water.
- Reduces the required gas velocity needed to lift water.
- Most common means of treating with soap:
  - Soap Sticks
  - Batch Treatments
  - Continuous Backside Injection (with no packer)
  - These are Only effective to the end of the production tubing
  - Capillary Injection – Continuous Downhole Injection
Conventional Capillary Installation

Many Chemical / Injection Options Available

Production Enhancement Chemicals Include:

- Foamer
- Fresh Water – Salt / Solids
- Corrosion Inhibitor
- H2S Scavenger
- Paraffin Inhibitor

Foamer Example
Capillary Injection Surface Hanger
Downhole Injection Valve RCI-1

- **Material**
  - Monel Alloy Steel

- **Dimensions**
  - 12” L X 1.0” O.D.

- **Working Pressure**
  - Maximum 8,400 psi Differential

- **Temperature**
  - 450 Degrees F

**Purpose:**
- Prevents Chemical Siphoning
- Prevents Gas Back Flow
- Allows for Precise Chemical Injection

**Set Pressure Determined By:**
- Hydrostatic Weight of the Chemical in Capillary Tubing
- Flowing Bottomhole Pressure
- Injection Pump Pressure @ Surface
- Set By Hand On Location
Field Chemical Test Process

Utilizing Actual Field Producing Liquids and Ratios...

• Foam qualities are measured utilizing the industry standard test method (high speed blenders)

• Foam Height vs concentration
  – MIX 200 mls produced sample with foamer
  – Height of Foam after initial MIX

• Foam ½ life vs concentration
  – Record time for 100 mls water to reshow
  – Looking for 1 min/3,000’…No more than 2.5 min/3,000’

• Observations are included (water vs hydrocarbon ratios and emulsion tendencies)
Capillary Coiled Tubing General Overview

- **Standard Sizes**
  - ¼” X 0.035”
  - 3/8” X 049”

- **Standard Metallurgies**
  - 316L (annular preserved in packer fluid – low chlorides, low temps)
  - Duplex 2205 (Low chlorides, low pH, Low temps)
  - Alloy 825
  - Alloy 625 (high chlorides, higher pH high temps)

- **Standard Tensile Strength**
  - (Tensile Strength usually exceeds 120,000 psi)
  - (Minimum 90,000 psi yield strength)
Sample Well Results

10,550' Wilcox Well
10,450', 2-3/8", 4.6 ppf, L-80 tbg
4% CO₂, 20 ppm H₂S
BHT = 250°F, WHFT = 100°F

Production Rate below Critical Flow Rate
Significant Liquid Loading Occurs
Operator starts dropping Soap Sticks and Swabbing Well Regularly
Operator starts Capillary Injection of Combination Foamer, Corrosion Inhibitor.
Production Rate Exceeds Critical Flow Rate for Foam System
1. Arrive on Location

2. Load spool into Powered Spool Drive

3. Custom Set CC1-A Valve to Customer Specs

4. Injector Head & 10K psi BOP Tandem

5. Hanger Assembly prior to Hook Up

6. Complete Injection Assembly ... 1 Lift to Wellhead

7. Going In the Hole

8. Close to Bottom...10,000’ - +/- 2 hrs elapsed time

9. Tubing Cut .. Attached to Chemical Tank +/- 2.5 hrs elapsed time