Using Natural Gas Liquids to Recover Unconventional Oil and Gas Resources

DE-FE-0031782

NETL HYDRAULIC FRACTURING TECHNOLOGIES PROJECT REVIEW MEETING

Mark Moody
14 October 2020

MarkWest Sherwood Gas Processing Plant, New Milton, WV
Introduction

• The project objective is to unlock oil from the “oil window” of the Utica/Point Pleasant (UPP) shale in Ohio using Y-Grade (unrefined) Natural Gas Liquids (NGL)

• A large portion of the Appalachian shale play is composed of tight, oil-rich reservoirs which have proven to be uneconomical using current completion technologies

• The oil molecules are too large to move through the low permeability rock, rendering the oil inaccessible

• Oil and Gas Exploration Companies are looking for the key to unlock this huge oil resource

NGLs might be a big part of the solution
Using NGL in the “Oil Window” of the UPP

• Why use Y-Grade NGLs?
  ▪ Liquid fuels production in the U.S. has increased by 5.5 million barrels per day between 2009 and 2016
  ▪ Natural Gas Liquid (NGL) production from shale wells and tight oil formations has accounted for 29% of this growth
  ▪ The Energy Information Administration (EIA) forecasts NGL production from Appalachian shale wells will increase 350% from 2013 to 2040
  ▪ Battelle reservoir simulations indicate that NGLs recover greater volumes of oil than CO₂
  ▪ The cost of using NGLs as a stimulation fluid can be partially recovered as the injected NGLs are produced back with the oil and gas
  ▪ There is a surplus of locally produced NGLs

• NGLs are currently underutilized in the Appalachian Basin
Project Schedule

- The period of performance of this project is 3 years, Oct. 2019 through Sept. 2022
  - The first year of the project will consist of research, lab work, modeling and computer simulations to determine the best treatment design
  - Treatment and monitoring will be performed during year two
  - Analysis and reporting will be performed during year three
- This is a proof-of-concept project
- Production results from the Y-Grade NGL treatment will be compared to production from the McCoy Unit #5 well and the COSH Mill Creek well to determine if Y-Grade NGLs are effective treatment fluid for the oil window of the UPP and other similar unconventional oil and gas reservoirs
Project Team

- Project Manager; Battelle Memorial Institute
- Ohio Division of Geological Survey
- Linde Gas North America
Utica/Point Pleasant Drilling Activity

As of September 5, 2020

Total of 3,293 wells:

- **501** Permitted; (Not Drilled; Cancelled)
- **159** Drilled; (Drilling; Well Drilled)
- **2,594** Producing; (Producing; Plugged Back)
- **18** Inactive; (Drilled Inactive; Shut In)
- **13** Lost Hole or Final Restoration
- **3** Dry and Abandoned
- **5** Plugged and Abandoned
UPP “Oil Window” with Frac Type
Proposed Field Test Sites

- Battelle plans to plug back two (2) Coshocton County Rose Run wells to the Utica/Point Pleasant formation
  - One well will be perforated and treated in the UPP
  - The other well will be a micro seismic monitoring well.
- The test site wells are approximately 2-1/4 miles SE of the COSH Mill Creek #A-1 well drilled by Anadarko in 2012
  - The Cosh Mill Creek well was completed with 16 stages utilizing large volume slickwater frac jobs.
- The test site wells are approximately ¾ miles west of Northwood Energy’s McCoy Unit #5, a Rose Run well which was plugged back and completed in the UPP in 2013 with a large volume slickwater frac job.
Project Map
NGL Treatment Design

- In their natural state, Y-Grade NGLs have poor proppant transport capacity
- The project will research ways to increase the viscosity of the Y-Grade fluid by gelling or foaming
- As an alternative, a small-volume frac job consisting of a viscous, sand-laden fluid can be pumped ahead of the Y-Grade NGL
  - N2 foam or cross-link gelled water
  - The Y-Grade NGL can be pumped as a formation treatment following the frac job

Petrophysical Analysis of COSH Mill Creek A-1 and Doughty D-1 Well Logs
Treatment Design Workflow

Factor Affecting Optimization of NGL Frac Parameters and Predicting Recovery:
- Geology and Geomechanics of Shale
- PVT of Target Oil Zone
- Fracturing Fluid Rate
- Proppant Type & Rate
- Number of Stages and Perf Clusters

1. Hydraulic Fracture Simulator
2. Predicting Frac Geometry
3. History Match Pressure and Microseismic Data
4. Transfer Hydraulic Fracture to Flow Simulator
5. Perform Multiphase Flow Simulation
Fracture Modeling – Predicted Rates and Pressures

Mill Creek A-1
Bottomhole Rate, Conc., and Pressures

Predicted Surface and Bottom Hole Rates, Pressures and Proppant Concentrations
Simulated Permeability from log and core analysis.
Fracture Modeling – Fracture Width

Mill Creek A-1
Fracture Width

Model Based on:
1,000 Bbl 75 Quality N2 Foam Frac
100 Sacks 100 mesh and
400 sacks 40/70 mesh sand
Fracture Modeling – Proppant Concentration

Mill Creek A-1
Proppant Concentration

Proppant Concentration in pounds per square foot.
Field Test Well Preparation - Shoman Etal Unit #1

Hopco Shoman Etal Unit #1 pad and well head

September 5, 2020
Field Test Well Preparation - Shoman Etal Unit #1

Hopco Shoman Etal Unit #1

Rigging up to plug back and cement the well across the Utica/Point Pleasant formation

September 11, 2020
Field Test Well Preparation – Doughty #D-1

Hopco Doughty #D-1 Well Head
Field Site Visit

July 13, 2020

Moved workover rig on location
October 1, 2020
Project Status

• Geotechnical Characterization of the Utica/Point Pleasant has been completed
• Stimulation and NGL Treatment Design is in progress
  ▪ Nitrogen DFIT
  ▪ 1,000 Bbl 75 Quality N2 Foam Frac
  ▪ 1,000 Bbl Y-Grade NGL Injection Treatment
• Field test wells were prepared
  ▪ Both field test wells have been plugged back and cemented across the UPP formation for stimulation, treatment and micro seismic monitoring
• Procurement of contractors and vendors is in progress
• Y-Grade NGL injection test scheduled for summer of 2021
Questions???

Mark Moody
moodym@battelle.org
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# Project Schedule

<table>
<thead>
<tr>
<th>Task Name</th>
<th>FY2020</th>
<th>FY2021</th>
<th>FY2022</th>
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<tbody>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
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<td>Task 1: Project Management &amp; Planning</td>
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<td>1.1 Project Management</td>
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<td>1.2 Workforce Readiness Plan</td>
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<td>3.1 NGL Test Design</td>
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<td>3.2 Site Prep, Procurement &amp; Scheduling</td>
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<td>5.1 Numerical Simulations</td>
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<td>6.2 Economic Analysis</td>
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<td>6.3 NGL Recovery Potential In UOG Fields</td>
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(Project Month) 3 6 9 12 15 18 21 24 27 30 33 36
# Project Milestones

- Field activity-based project with key milestones related to the NGL treatment testing.

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<th>Task/Subtask</th>
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<th>Planned Completion Date</th>
<th>Verification method</th>
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<td>Update PMP, Data Mgmt. Plan</td>
<td>9/30/2019</td>
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<td>Utica Characterization Task</td>
<td>6/30/2020</td>
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<td>Site Access Agreement</td>
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<td>Testing Health &amp; Safety Plan</td>
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<td>Complete Field-Testing Design &amp; Plan</td>
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