Automating Gas-Lift Injection Rates

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39th Gas-Lift Workshop
Houston, Texas, USA
May 16 – 20, 2016
Agenda

• Traditional Method of Optimization
• Gas Lift Challenges
• Single Well Optimization
• Constraints & Disruptions
• Multi Well Optimization
• Dynamic Lift Optimizer
• Case Study / Typical Business Results
• Conclusion
Traditional Solution

- Manual operations
- Lack of insight into well production
- Optimization is trial and error
- Difficult to respond to changes
- Slow, open loop
- Operating in a dynamic environment
Challenges with Manual Operations

- Inability to make real-time adjustments to gas lift rates in response to well variability
- Inability to effectively distribute lift gas to the most profitable wells
- Inability to meet my production targets

“
I’m not maximizing production with the most economical use of my lift resources
”
Optimize Single Well

- Oil production is a non-linear function of gas rate.

- At low rates, oil production increases with gas lift rate.

- At high rates, oil production decreases because of the increase of back pressure in the flow system.

- Determine gas rate required to maximize production.
System Constraints & Disruptions

- **Constraints**
  - Availability of compressed gas
  - Separation Capacity
  - Water disposal
  - Production minimums

- **Disruptions**
  - Equipment outages
  - Well slugging
  - Well workovers & shut-ins

How much should I produce from each well if I cannot maximize them all?
Solution: Optimize the Platform

- Optimal gas distribution

Graph showing production rate vs. gas injection rate for Well #1, Well #2, Well #3, and Well #4, with a total platform curve.
Key Process Enablers

- Measurement of well production
- Insight into facility constraints
- Regulation of lift gas
- Optimizer
Dynamic Lift Optimizer

- Online, real-time, closed loop optimization engine
- Gathers real time data from the field
- Tests the various combinations of lift gas rates against operating constraints and converges on an optimum
- Sends new lift gas rates to the automation system either as an advisory or as a new set point
- Makes the most of available gas and allocates gas to wells where it is most profitable
DLO Software Architecture

- OSI PI Historian
- PI AF
- DLO Engine
- Optimizer (Lingo)
- Customer DCS/SCADA
- Real-time Dashboard (HTML)
- Well Curve Fitting Tool

Processes:
- Process Data
- Well Test Data
- Hierarchy
- Site Structure
- Well Status
- Limits
- Prices
- Well Curves

Inputs:
- Field Instruments
- Operator Inputs

Models:
- Well Performance Models (e.g. Prosper)
Optimizer Hardware Architecture

- **Historian Server**
- **Operator Consoles**
- **Local Control Network**
- **Control System**
- **Corporate Network**
- **Optimizer Dashboard (Web-based)**
- **Historian Interface & Optimizer Engine**
- **DLO Engineering Station Curve Fit Tool**

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**Optimizer Consoles**

**Corporate Network**

**History Interface & Optimizer Engine**
Dynamic Lift Optimization Cycle

Stop/Start
- Read inputs
- Pre-process data

Opportunity
- Write results
- Deviation checks

Optimization
- Base cases

Deviation checks
- Pre-process data

Base cases
- Validate / Filter

Where should we be operating?

Do we still believe the well models?

Where are we now? What ‘space’ do we have?

What do the constraints cost?

From Historian (PI) Database

To Historian Database
Automation Best Practice…

- Automate well testing to maximize well performance insight
- Optimize gas lift injection flow rates to each well automatically
- Respond to process constraints automatically
- Prioritize gas lift supply to the wells with the highest profitability
- Provide real-time analytical insight into process
Customer Result

Installed on approximately 200 wells covering several projects

- Achieved an average of over 10% production increase when decline considered
- $15 million annual impact from case study
Conclusions

- Online Optimization offers extremely beneficial business impacts
  - Achieved base improvements and reduced the decline trajectory
- Getting the well test data needed to performance match the well models is crucial
- Having a local champion, someone on the ground, to continuously work with operations to get the things needed is crucial
- Reliable measurements for lift gas rates and well tests are required (does not mean no variation – means no systematic problems)
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