

Autonomous Control of Well Downtime to Optimize Production and Cycling in Sucker Rod Pump Artificially Lifted Wells

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Problem Statement

- Matching a well's capacity to production
- Needing to reduce cycles without losing production on idling wells
- Manually updating wells to determine the optimal downtime
- Limited resources to spend time on this manual process





Objectives

- Using a host software solution develop algorithms that:
 - Automatically determines the optimal downtime for wells
 - Reduces cycles where possible
 - Ensures well is maximizing production
 - Solution must run fully autonomous and not require any human intervention once input requirements are met





Downtime for Rod Pump Wells

- Allows wells to maximize production without running 24 hours a day with incomplete fillage
- When downtime is too short wells cycle more frequently than necessary
- When downtime is too long wells lose production
- Downtime should be as long as possible without losing production





Solution: Idle Time Setpoint Optimization

Develop algorithms that vary the well's downtime and self asses if the setpoint changes have helped or hindered production

- Reduce cycles: reduce bad pump strokes
- Increase runtime: capture production by reducing backpressure on reservoir

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Autonomous Control Process

- **1.Identify issues** Host software will identify changes from normal operations, leading to possible issues with wells
- **2.Diagnose the problem** Through physics-based diagnostics and data analytics, host software will determine what the problem is
- **3.Recommend corrective action** Host software will help you take corrective action to resolve or mitigate the problem
- **4.Achieve closed-loop autonomous control** Our most recent step on our journey introduced autonomous control for rod lift wells to help with the continuous optimization of setpoints to increase production and minimize failures.



Methods

- Algorithms that autonomously increased and decreased the wells downtime were developed to achieve the optimal downtime
 - Algorithms measure cycles, runtime, and inferred production
 - If cycles are increasing without increasing production, the downtime is increased, if cycles are decreasing but production is also decreasing, downtime is decreased
 - The well's downtime is continuously autonomously changed by the algorithms
 - Downtime is considered optimized when the downtime is as long as possible without losing production
 - Even when downtime is optimized, algorithms continually change the downtime to ensure the well conditions have not changed

Trial Summary

- ~100 rod pump well in Bakken
- Majority of wells were able to increase idle time and reduce cycles
- Production consistent throughout trial
- No wells identified as under producing
- Cycles reduced by ~15% on trial wells







Case Study #1

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- Idle time increased for 30 minutes to 100 minutes
- Cycles decreased form ~30 to ~8 cycles per day
- Reduced incomplete fillage strokes by 40,000 per year
- No drop off in production

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Idle Time -O- Cycles Yesterdays Inferred -O- Runtime 250 Idle time 50 00 25 Same Stand Store Store Stand Strand Str 15 Cycles Runtime Brees among of the second parts Inferred Production and and a property and a selection and a selec 10/26/2020 11/25/2020 12/25/2020 1/24/2021 2/23/2021 3/25/2021 4/24/2021

Case Study #2

- Idle time increased for 50 minutes to 300 minutes
- Cycles decreased form ~25 to ~5 cycles per day
- Reduced incomplete fillage strokes by 36,500 per year
- No drop off in production

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Case Study #3

- Idle time increased for 90 minutes to 345 minutes
- Cycles decreased form ~8 to ~4 cycles per day
- Reduced fluid pound strokes by 20 per day
- No drop off in production

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Case Study #4

- Idle time increased for 160 minutes to 215 minutes
- Cycles decreased form ~8 to ~5 cycles per day
- Found that well was operating close to optimal downtime
- Algorithm did not significantly change downtime to ensure maximum production

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Conclusion

- Host algorithms can be used to optimize downtime in SRP wells that cycle frequently
- Many wells can reduce cycles per day without losing production
- Fewer incomplete fillage strokes increases efficiency and reduces failures



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Sources



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