ALII (ARTIFICIAL LIFT INTAKE ISOLATION) TOOL, A NEW TECHNOLOGY FOR ISOLATING THE PRODUCTION TUBING ON PUMPING WELLS FOR SAFE AND EFFICIENT ROD AND PUMP CHANGES

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ABSTRACT
The Artificial Lift Intake Isolation (ALII) tool is a new technology for rod pumping wells that when activated isolates the production tubing. The tool provides positive well control prior to breaking wellhead containment providing significant cost savings, safety and environmental protection.

The tool is a simple two-part system, the first being the valve portion which is run just below the client's pump-seating nipple in the production tubing string. The second is the actuator, which runs on the bottom of the insert rod pump. Tool activation is accomplished by simply running a rod pump with the actuator attached. When the pump is seated, the valve is opened for production; and when unseated the valve closes, isolating the tubing. The tool can be cycled multiple times.

No additional equipment is required for tool operation and 100% positive shut off is provided which eliminates the need for kill fluids and eliminates the chance of formation gases or other fluids being released at the surface. There is no need for control lines to open and close the tool and there is the capability for utilizing the pump jack to cycle the tool open and closed. The tool also provides the capability for pressure testing the tubing when in the closed position.

A number of benefits accrue through application of the tool to pumping wells and includes cost savings from reduced rig time to surface and re-run rod pumps, reduced trucking costs, reduced storage costs for kill fluids and minimizes the number of non-pumping days.

Increased safety is realized as the tool provides positive well control prior to a well workover eliminating the chance of formation gases or other fluids being released at the surface. Environmental advantages include reducing the environmental footprint by decreasing water usage saving the local water supply.

Status
The tool is field tested and ready for full deployment. Three tools have been installed in a Canadian, light oil field where harsh conditions exist and have operated successfully for three years. There have been no tool failures of any type. Examples of some of the chemicals and fluids introduced to the ALII Tool were - Methanol, CaCl, KCl, Propane, Butane, Methane,15% HCL Acid, 50% HCR Synthetic acid, crude oil, Nalco 9217 inhibitor, Nalco 6222 biocide, Kill mud consisting of – (Barite, Aquagel, Pac – R, Berezan D+).

Currently six ALII Tool's are being run in a steam flood field where even harsher conditions exist and have operated successfully for six months. At present there have been no tool failures of any type. Plans are underway to deploy an additional forty-four tools with the potential for the installation of as many as 2000 tools.

TOOL DESCRIPTION AND OPERATING FEATURES

The ALII-S2 Tool is a two-part system. Part #1 is the tool valve, which is run just below the tubing seating nipple within the production tubing string. The second part is the actuator, which is run on the bottom of the insert rod pump (Figure 1). The tool is therefore easy to install and is user friendly.

The tool functions as a shut off valve within the tubing string. The valve is open when the pumping unit and downhole pump are operating. The valve closes whenever the insert pump is pulled from the seating nipple providing complete shut off within the tubing string. This allows for a pump change or rod string repair without the need for kill fluids. It provides safety from unwanted flow of oil or gas via the tubing string and can be utilized for pressure testing the tubing. Benefits accrue from reduced rig time, kill fluid usage and enhanced safety.

It is available in multiple sizes: 2 3/8" to 5 ½" (73mm to 139.7mm) and has been tested and able to resist external pressure up to 10,152psi (70,000 kpa). It is suitable for high temperature thermal wells (Max 650 degrees F). The tools are custom built for each field and can be manufactured using various metals including L-80, 13 chrome, P 110, Inconel, depending on individual conditions at the field where being applied.

Sand screens (Figure 2) are available for conditions where sand production is an issue. The screens allow oil and gases to pass into the intake, while preventing sand inflow except very fine particles. A broad portfolio of sand screens (from strainers to wire wrapped screen) are available and can be deployed with the tool.

The tool can be run in deviated and horizontal wells and can be opened by applying pressure if required. This feature also allows for pressure testing of the production string prior to opening the tool. The tool has been designed from a durability perspective to outlast the production tubing string of the well and has been tested extensively for it's opening & closing capability to 75 times.

The tool can be re-dressed and re-used when doing a work over allowing for rapid redeployment. There is no need for control lines to open and close the tool and the capability exists for using the pump jack to cycle the tool open and closed if needed. Should the need arise conventional well kill techniques can be implemented. There is no need for any special equipment to operate the valve adding to the simplicity of tool operations.

TECHNOLOGY IMPACT AND BENEFITS

Application of this new technology provides multiple benefits including cost savings, improved safety and positive environmental impact. The tool is extremely environmentally friendly and is committed to reducing the environmental footprint by decreasing the use of local water supply significantly. Operator safety is enhanced by isolating the tubing from the flow of reservoir fluids and in particular hazardous gases.

Specific areas of benefit include:

- Operational and service cost savings from reduced rig time on site.
- Reduced trucking, labor and water hauling expenses.
- Reduces water usage providing environmental impact in arid regions.
- Provides for blowout prevention and enhances worker safety.
- Increased well production through minimization of well down time.
- Improved safety from exposure to formation gases.
- Prevents production damage to the producing formation due to excess kill fluids.
- Tubing integrity can be checked without removing tubing.

The many benefits of the technology application have been documented and quantified in a field test in a Northern Alberta, Canadian Field.

Case Study #1 - Northern Alberta, Canadian Field

The new tool technology has been installed and tested in three wells within a 900 well field in Northern Alberta, Canada. This is a remote light oil field where tripping of downhole pumps and diagnosing tubing issues can be expensive. The wells are approximately 3200 foot wells and are all completed with

pumping units and downhole sucker rod pumps. Numerous cost and other savings were realized through multiple well workover categories including rig time, lost production and water handling.

Well Workover Cost Without the New Technology – A detailed assessment of the cost savings provided by the new technology was calculated using actual well data from test wells with and without the new technology. The time required and cost components of a single well workover were carefully measured. Eleven well cost categories ranging from workover rig time required to wireline truck costs were documented. Figure 4 illustrates the categories and the cost associated with each. The total cost of the workover (without the technology) was determined to be $124,790. The time required to perform the workover was sixty hours resulting in lost production as well as other direct well workover costs.

Well Workover Cost with the New Technology – In a similar fashion, the cost of a workover was carefully documented with application of the new tool technology. As a starting point the total time of the workover was cut in half from sixty hours to thirty hours. A number of cost savings accrued due to the reduced time required. A total cost savings of $82,909 was estimated (Figure 5). Primary savings were realized from reduced rig time, elimination of kill fluids and avoiding lost production.

Case Study #2

A second field test of the new tool technology was recently implemented also in a Northern Canada oil field where a steam flood is being implemented. It is a 4700 well field at a depth of approximately 1500 feet. Wells are equipped with downhole rod pumps and pumping units as in the first case study. At this field test there are 20 tools currently being tested with the potential to grow to over 2000 tools.

The field test has been underway for six months and the tools are working as designed without any failures. While cost savings have not been yet calculated, a qualitative look at the data suggests the savings will equal or exceed the first case study.

Water Savings - Data was collected on the first six test wells in the Canadian field and extrapolating to the 4700 wells. A yearly water reduction was calculated based on actual experience. I was determined that 10 million gallons of total water would be required for well workovers without application of the new technology. When the tool is utilized it reduces the water usage by 80% down to 2.0 million gallons. Along with the reduced water usage is a cost reduction realized from reduced trucking, storage and purchase of water for kill fluids. The total cost savings associated with this limited water usage was calculated at $487,000 (See Figure 3).

SUMMARY

The Artificial Lift Intake Isolation (ALII) tool is a new technology for rod pumping wells that is finding successful application in multiple wells in Northern Canada. Efforts are underway to expand the new technology to fields throughout the United States and the Middle East. When activated the tool isolates the production tubing providing positive well control prior to breaking wellhead containment resulting in significant cost savings, safety and environmental protection.

The benefits of the technology accrue through application of the tool to pumping wells providing for reduced workover days, positive environmental impact through conservation of water and increase safety through the positive tubing shut off features of the technology.

Cost savings realized through case study documentation is +$75,000 per well. The tool's simple two-part system requires no additional equipment for tool operation and 100% positive shut off is provided which eliminates the chance of formation gases or other fluids being released at the surface.

There is no need for control lines to open and close the tool and there is the capability for utilizing the pump jack to cycle the tool open and closed. The tool also provides the capability for pressure testing the tubing when in the closed position. Tool durability has been confirmed through both laboratory and field-testing and is available in multiple size diameters and with special alloys if required for harsh environments.

Operator response to the tools performance in the field has been very positive with ease of use noted aligned with significant savings.

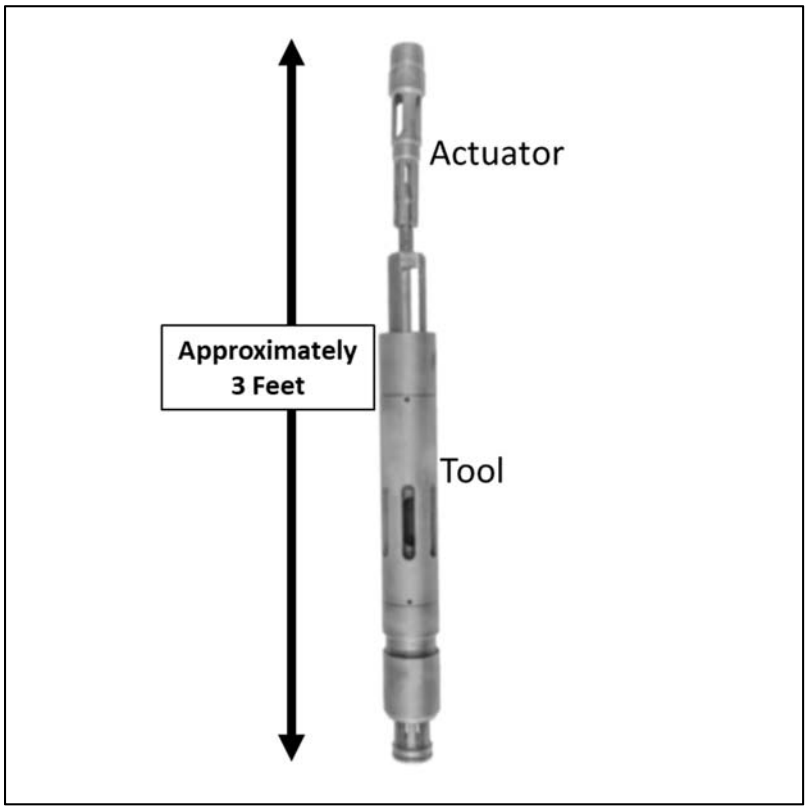

Figure 1 – Downhole Shutoff Tool and Actuator

Figure 2 – Sand Screens Available for Tool Application in Unconsolidated Formations

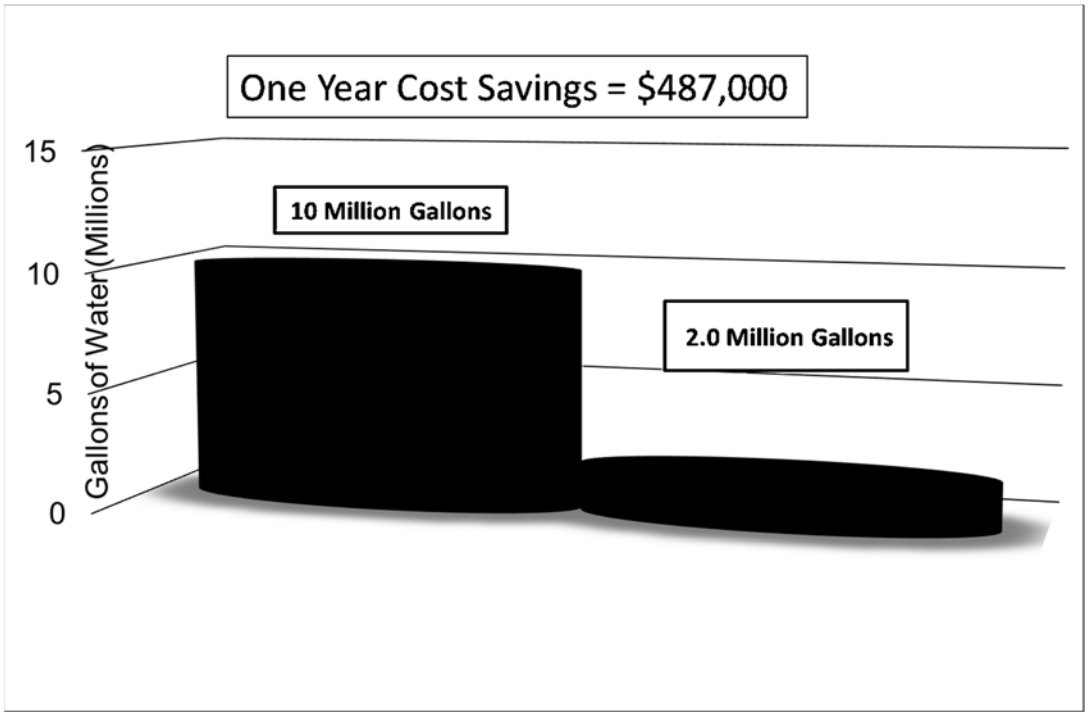

Figure 3 – One Year Cost Savings and Water Usage Reduction Realized during Northern Canada Case Study – 4700 Well Field.

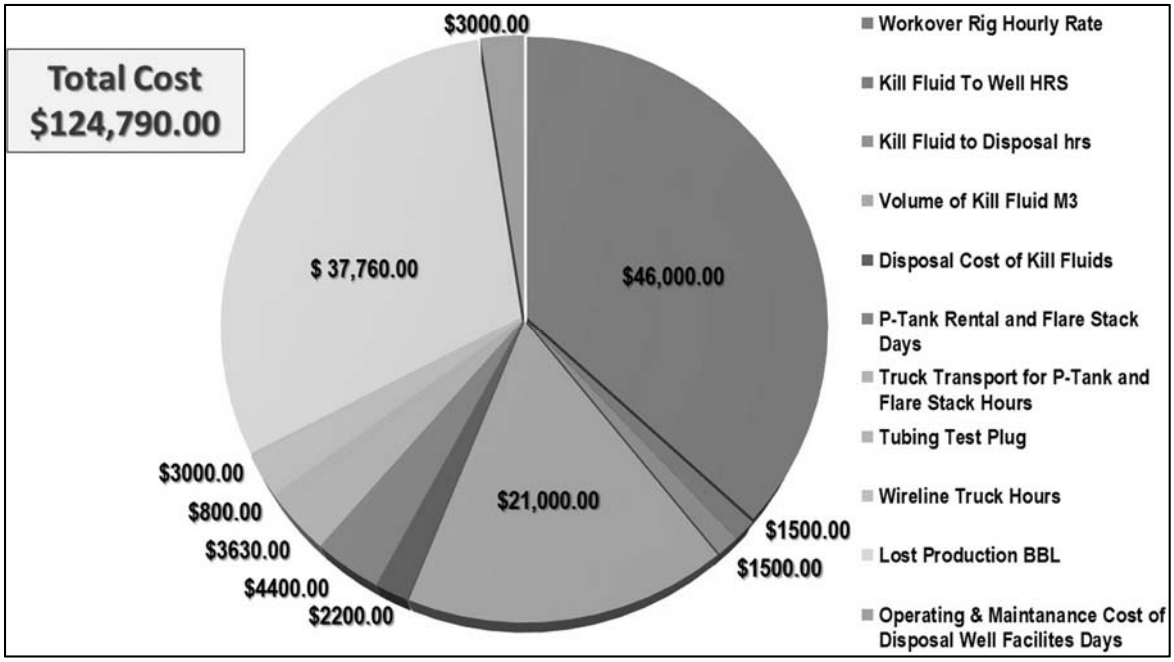

Figure 4 – Well Workover Costs, Northern Canada Case Study, Costs without the New Tool Technology.

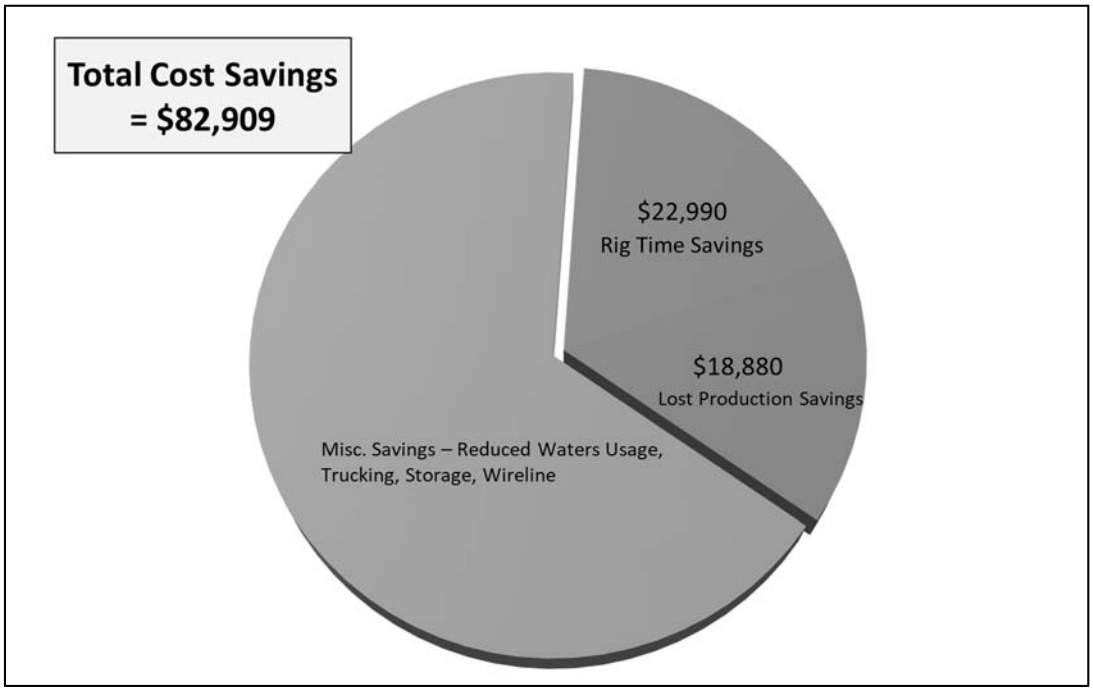

Figure 5 – Cost Saving Realized from Utilization of New Technology Tool – Thirty Hours of Rig Time with Tool – Northern Canada Case Study.