MATURE ASSETS IN THE PERMIAN BASIN SHOW SIGNIFICANT PRODUCTION INCREASES WITH PLUNGER LIFT

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ABSTRACT

There are thousands of marginal wells in the Permian Basin with potential to produce significantly more oil and gas with the assistance of plunger lift. Working with multiple operators in the Permian Basin, PLSI has installed plunger lift systems in these type wells and realized significant increases in oil and gas production. The common characteristic is fluid downhole which never makes it to the surface production facilities. This fluid loads up the wellbore downhole which increases hydrostatic back pressure on the formation that holds back production. By installing a plunger lift system, we have seen wells that were producing a few barrels of fluid per day double oil or gas production. This paper will present production data from operators showing increases in production and revenue with minimum expense that resulted in significant increases in net operating income.

INTRODUCTION

With oil and gas prices showing improvement in the last year, it may be an opportune time to look at low cost options to increase production. Plunger lift is recognized as the most economical form of artificial lift technology on the market, but many times is also the most misunderstood. The technology involves using energy (gas and pressure) from the well to move liquids to surface. Additionally, the capital costs are a fraction of other lift methods and the well generally will not need to be killed to install the system. Killing a flowing well will at times result in the well not recovering to its previous flow rates. Most flowing wells will experience liquid loading as they decline and a plunger lift system is an economical way to get these wells unloaded and keep them producing at higher rates. Additionally, many marginal wells that are rod pumped and have some associated gas and bottom hole pressure are good candidates for plunger lift or stage lift resulting in lease operating expenses many times being reduced by up to ninety percent. There are also many existing plunger lift wells installed over the years that due to lack of maintenance and operator knowledge have seen production rates decline. This paper will present wells in all three categories that with minimal expense saw significant production increases.

FLOWING WELLS

There are many flowing oil and gas wells in the Permian Basin that suffer from fluctuations in production due to liquid loading issues down hole or paraffin, scale or salt issues up the tubing. Paraffin, scale and salt can be addressed with ongoing chemical treatment plans, scheduled paraffin cutting and water or oil treatments. The liquid loading issues can be harder to resolve. Wells will begin to accumulate liquids in the bottom of the wellbore as flow rates decline below the Critical Rate. Once this starts to occur the problem only gets worse over time. Many times operators try to remove the liquids by swabbing them out manually or dropping surfactants down either the tubing or casing in an effort to lighten the gradient of the fluid column to regain previous flow rates. Many times they will shut the well in for pressure buildup and later try to blow the liquids to surface. This is a process referred to as “Intermitting”- to produce the well by an On/Off method using accumulated gas and pressure to purge the tubing of liquids. However you choose to address all of these production issues, the one common aspect is that they all require time, money and personnel on a repeated basis. The installation of a plunger lift system can be very cost effective in addressing all of these issues that can result in a significant increase in revenue with minimum expense.

ROD PUMPED WELLS
Everyone is aware that in the Permian Basin, rod pump is "King". The technology is widely accepted and most often chosen as the preferred artificial lift choice. This is true because it is generally understood by most field personnel and the market is well developed with equipment, service and engineering support. Simply put, people tend to "go with what they know" and are reluctant to try a technology they are unfamiliar with. This attitude is compounded by the fact that most engineering schools emphasize rod pump design and tend to ignore plunger lift technology in their degree programs. That said, there are many wells in the Permian Basin that were rodded up that could easily be produced with plunger lift at a fraction of the cost. Additionally, many wells were rod pumped when their early production rates were much higher and as they mature and decline to lower rates they continue to be rod pumped simply because that is how they have always been produced. The decision to switch these wells to plunger lift versus rod pump can result in a substantial decrease in lease operating expenses (LOE) of up to ninety percent and significant increases in net operating income (NOI).

EXISTING PLUNGER LIFT WELLS
Many existing plunger lift wells in the Permian Basin installed over the years are not operating at their potential due to the lack of two main factors: 1. Maintenance of the system, and 2. Operator knowledge of how to properly operate the system for maximum production. Most systems are sold with the lease operators only receiving limited instruction about the technology. The number one complaint among operators is the lack of training for field personnel on how to operate and maintain their systems. Additionally, many times the original lease operator moves on and the replacement operator inherits the system with little understanding and hence, simply allows the system to slowly deteriorate and production rates to fall. Depending on priorities in the field, these systems are often times allowed to simply be unproductive for long periods of time. This neglect results in a company's loss of potential revenue that could have easily been avoided with a simple training and maintenance program.
The remainder of this paper will give a brief description of the various wells in this study and the efforts undertaken to get them to successfully run a plunger lift system as well as the associated costs. The number of days it took to recover the lease expenses and the projected ongoing annual increase in revenue will also be presented at current market prices for oil and natural gas. Charts at the end of this paper summarize the various wells. At the request of most of the operators, the identity and specific location of each well was not to be disclosed to the public.

FLOWING WELL RESULTS
Well #1was a flowing well in Crane Co, TX. The well had some erratic production, but also had to have paraffin cut every two weeks. After the installation of plunger lift, the well's production improved and the paraffin cutting expense was eliminated.
Well #2 was a flowing well in Midland Co, TX. The well was being intermittently produced by shutting in and opening every few days. Plunger lift automated the production process and significantly increased the average daily production.
Well #3 was a gas well in Lea Co, NM. The well was under packer and production was intermittent by shutting in for pressure buildups. The tubing was perforated so the casing could be charged and utilized for lift gas and a collar stop set above the perforated holes. The packer fluid was isolated from the formation with a tubing plug in the packer and the well swabbed off.

ROD PUMPED WELL RESULTS
Well #1was a multi-zone vertical well in Regan Co, TX. The well had rod part issues due to a deviated wellbore. Rods were pulled and a plunger lift system installed. The average daily production increased and rod parts and pulling expenses were eliminated.
Well #2 was a multi-zone vertical well in Sterling Co, TX, with sufficient gas to run a plunger lift system. The well had some recurring workover expenses that were eliminated. There was an increase in average daily production attributable to a decrease in downtime from workovers.
Well #3 was a single zone well in Howard Co, TX. The well was a plunger lift test well, chosen during a scheduled workover. The well struggled to run on a conventional system, so a multi-stage lift was installed and the well was able to produce.

EXISTING PLUNGER LIFTED WELL RESULTS

Well #1 was an existing plunger lift well in Regan Co, TX with multiple zones being produced. The plunger had ceased to run for a while. Wireline fished the plunger and broached the tubing. A new plunger, wellhead controller, arrival sensor and throttle pilot were installed. The well was setup to operate on pressure. Production was restored. The lease operator was instructed on monitoring and maintenance of the system.

Well #2 was a single zone vertical in Ector Co, TX. Production had been slipping downward over several months. A better sealing plunger was installed. The trim in the motor valve was leaking and was repaired. The arrival sensor was erratic and was replaced. Production was immediately improved and the well stabilized. The lease operator was instructed on monitoring and maintenance of the system.

Well #3 was a single zone vertical well in Winkler Co, TX. Production had fallen off and the plunger was failing to run consistently. A new plunger was installed and the well was closely monitored and adjusted for a few days. Better settings were established and the lease operator was instructed on proper monitoring and programing of the electronic controller settings.

SUMMARY

When confronted on how to address the early stages of liquid loading in flowing wells many operators do not consider plunger lift, but instead go straight to rod, submersible or hydraulic pump and more recently gas lift. However, it is relatively easy to bring production back up in these early stages utilizing plunger lift. For wells that are being swabbed off or shut-in for pressure buildup to surge fluid off, production rates are often up and down so much that they only average about half the well's potential. With minimal expense plunger lift can restore these rates, even if for an interim period of time. The bottom line is that it is a "cheap try" and the system can be completely salvaged and easily moved to another well. Also, as previously cited, the well does not have to be killed to install the system, which can disrupt the natural flow of the reservoir which sometimes cannot be restored to previous rates.

Rodding a well up or selecting one of the other pump alternatives will typically cost as much as ten times the amount it would to convert to plunger lift and the well will also have to be killed to install these pumps. Plunger lift is such a low cost alternative it is hard to justify the decision not to try it. Most often the response is that engineers or field people are not familiar with the technology or they believe that at some point the well have to be rod pumped anyway. Additionally, these forms of artificial lift will require some form of outside energy (electricity/natural gas) to drive the system. Plunger lift is the only option that requires no additional expense to bring in an outside energy source.

Existing plunger lift wells that are not operated properly will often have production characteristics similar to wells in the early stages of liquid loading. The up and down production patterns are typical when field personnel struggle to operate the system efficiently. Common operational factors affecting production include:

1. Holding excess pressure on the system to maintain plunger cycles
2. Making incorrect plunger choices for the well conditions
3. Poor downhole analysis for the placement of tubing or down hole tools
4. Poor evaluation of downstream factors such as separators, chokes, dumps, flowlines
5. Improper programing of electronic controllers and pilot or regulator settings

All of these wells demonstrate that there are plenty of opportunities in the Permian Basin to realize substantial increases in net operating income with a minimal amount of expense, if industry personnel only knew what to do. The number one obstacle is the lack of knowledge and how to apply it. Below are nine wells in this study that showed a combined net operating increase of almost $1,000,000 per year.

Plunger Lift Well Data

	OIL	GAS	WTR	GLR	BHP	SN (FT)	REQ BHP	REQ GAS	COUNTY
Flowing Wells									
WELL #1	12	125	2	8.93	725	9,200	920	52	Crane
WELL #2	4	90	0	22.50	1200	10,000	1000	16	Midland
WELL #3	2	70	1	23.33	800	11,800	1,180	14	Lea

Rod Pumped Wells									
WELL #1	2	18	1	6.00	725	6,850	685	8	Regan
WELL #2	6	51	3	5.67	900	7,900	790	29	Sterling
WELL #3	15	100	10	4.00	2445	9,220	922	92	Howard

Plunger Lift Wells									
WELL #1	7	45	8	3.00	640	7,965	795	48	Regan
WELL #2	40	200	3	4.65	850	9,620	960	165	Ector
WELL #3	22	270	15	7.30	1100	9,730	970	144	Winkler

Required BHP: Static Reservoir of 100#/1000' SN Depth

Required GLR: .4 MCF/BBL/1000' SN Depth

Plunger Lift Results

	START AVG OIL (BBL/D)	END OIL (BBL/D)	START AVG GAS (MCFD)	END GAS (MCFD)	EXPENSE (Dollars)	PAYOUT (Days)	12 Mo Net Income (NOI)
Flowing Wells							
WELL #1	12	18	125	200	$8,770	21	$191,625
WELL #2	4	8	90	130	$9,675	33	$116,800
WELL #3	2	5	70	145	$14,900	46	$136,665
Rod Pumped Wells							
WELL #1	2	4	18	22	$14,850	132	$52,880
WELL #2	6	8	51	65	$15,475	109	$63,830
WELL #3	15	20	100	120	$17,650	57	$125,150
Plunger Lift Wells							
WELL #1	7	10	45	65	$5,600	27	$76,650
WELL #2	40	45	200	220	$3,750	12	$113,150
WELL #3	22	26	270	300	$2,300	9	$94,900
						TOTAL:	$971,650

Note: Economics based on $3/MCF and $50/BBL & $1,000/Mo Avg. Rod Pump Expense