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Technically Speaking



A Comparison of the Energy Efficiency of Various Types of Artificial Lift Systems

by Rick Tennessen *division manager*

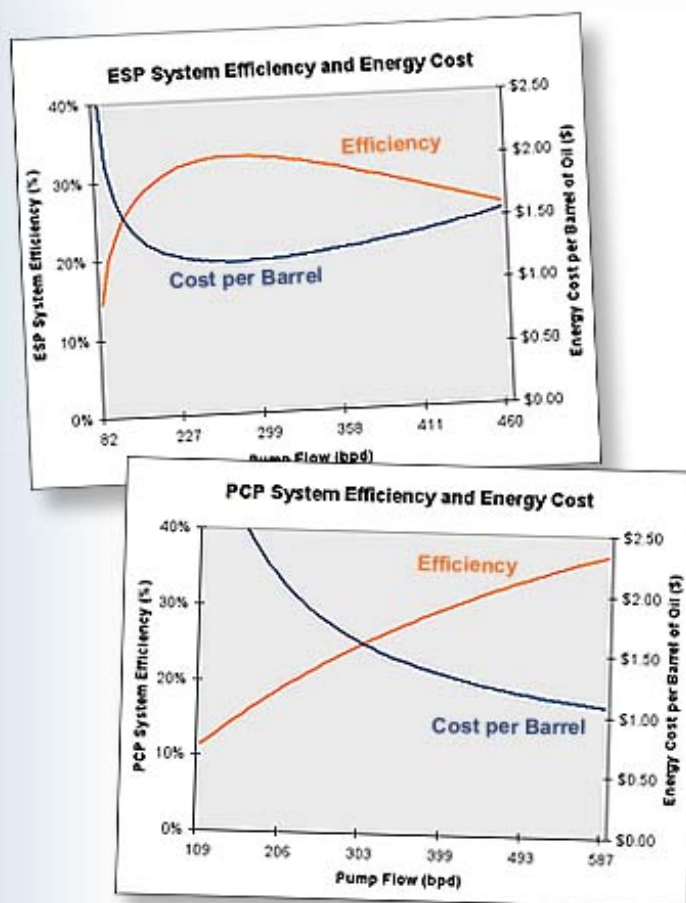
In the past, little emphasis was given to the relative energy efficiency of the various forms of artificial lift since each served separate pumping requirements. The introduction of large progressing cavity pumps (PCPs) has enabled the use of PCPs as alternatives to electric submersible pumps (ESPs) in many instances. Improved control methods have allowed rod pumps to compete with ESPs and PCPs in a number of applications. The overlap of potential artificial lift methods is also high in coal-bed methane production, where several different types of pumping systems are commonly used for dewatering coal seams.

The following comparison between beam, Rotaflex, progressing cavity, and electric submersible pumps is intended to give a qualitative sense of the relative energy efficiency of those pumping systems. Of necessity, the analysis was based on a 5,000-foot-deep well that might be a typical candidate for all four types of lift. A typical utility rate of \$0.06 per kWh and 90% water cut were assumed to help emphasize the economic impact that the selection of an artificial lift system makes on an operator's utility bill. The results are shown in the table.

Artificial Lift Comparison Summary

Pumping System	Pumping Speed (spm, rpm)	Production Rate (bpd)	Input Power (kW)	Lift Power (kW)	Energy Efficiency (%)	Cost per Barrel (\$)
Sucker Rod	3.0	108	10.1	2.97	29.4	1.34
	6.0	227	13.3	6.23	46.8	0.85
	9.0	362	20.8	9.94	47.9	0.88
	12	500	31.4	13.7	43.8	0.90
	15	637	47.1	17.5	37.1	1.07
Rotaflex	1.0	110	4.33	3.02	69.8	0.57
	2.0	222	8.75	6.10	69.7	0.57
	3.0	338	14.3	9.28	65.0	0.61

	4.0	461	20.3	12.7	62.4	0.63
	5.0	586	26.9	16.1	59.8	0.66
Electric	2,355	82	15.5	2.24	14.5	2.73
Submersible	2,643	227	19.8	6.27	31.5	1.26
	2,930	299	25.2	8.21	32.5	1.22
	3,216	358	31.9	9.85	30.8	1.28
	3,500	411	39.9	11.3	28.3	1.40
	3,783	460	49.4	12.7	25.6	1.55
Progressing	175	109	26.1	2.98	11.4	3.42
Cavity	200	206	29.5	5.62	19.1	2.06
	225	303	33.0	8.30	25.1	1.57
	250	399	36.6	11.0	30.0	1.32
	275	493	40.3	13.7	33.9	1.17
	300	587	44.0	16.4	37.2	1.08



System efficiency and energy costs versus flow for PCP and ESP systems.

There are a number of general conclusions that one might draw from this comparison. Rotaflex units have the greatest energy efficiency due to their long-stroking design. Energy savings for those units, however, may be cancelled by high capital costs relative to other systems. By comparison, ESP energy efficiency is relatively low and falls off dramatically outside of its intended operating range. Sucker rod pumps also lose efficiency at high and low stroking rates, but not as dramatically as ESPs. PCP

efficiency tends to increase in proportion to pumping speed. All pumping systems lose efficiency at low volumes due to leakage effects.

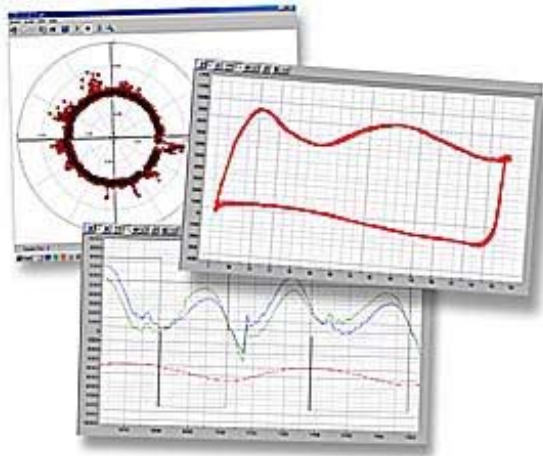
Unico has developed tools for assessing energy issues with artificial lifts that can help you make better decisions regarding the life-cycle costs of an installation. If you would like a detailed analysis, please [contact us](#).

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Product Watch

DriveLink™ Graphical Enhancements Help Users Visualize Well Performance

DriveLink™, Unico's drive-monitoring software for personal computers, has recently been enhanced to provide graphical displays of well performance. The software, which allows a user to setup and monitor up to 99 drives from a



Windows-based PC, is typically used to capture well production information, reset control functions, archive setup data, and display operating parameters.

Newly added enhancements include a chart-recorder-type plot that can be used to display rod-pump gearbox torque as a function of time, a circle chart commonly used for displaying motor torque in ESP applications, and an X-Y mode that can display rod-pump load and position in the familiar dynagraph format for analysis.

 [Contact us](#) to learn more about DriveLink™.

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Feature Focus

Software Upgrade Benefits Existing Pump-Jack Drives



A software upgrade has been developed for existing pump-jack controls that provides many of the advantages of our latest pump-jack drive systems with the simple change of a chip.

Over the years, thousands of Unico variable-speed drives have been installed on pump jacks, many under the tradename *Northlander*™. The earliest units were limited to single-speed operation. Dual-speed control was added a number of years ago to improve well production using independent upstroke and downstroke speed settings. Both types of control required the operator to manually select the appropriate speed to maximize production while avoiding fluid pound and bridle separation problems.

Our latest generation pump-jack systems automate this process by selecting the ideal pumping speed based upon pump fillage. The new control, which incorporates many other improvements as well, requires

use of the latest 40 MHz control module. However, a software upgrade is now available that provides older pump-jack systems with many of the enhancements of the new platform with a simple firmware change. [Contact us](#) for information on obtaining the upgrade if the features below would benefit your operation.

Class I Beam Pump Drive Upgrade Features

- Designed specifically for Class I beam pumps
- Operates without load cells and position sensors
- Assists in counter-balance selection
- Continuously computes pump fill
- Provides manual single- and dual-speed operation
- Automatically optimizes speed using pump fill
- Allows variable-speed or start/stop pump-off control
- Provides continuous readout of crank angle
- Prevents damaging downstroke bridle separation
- Saves energy by optimizing pump fill
- Constant-power control allows increased sheave ratios
- Provides a serial communication channel for remote data access
- Includes both RTU and ANSI II communication protocols

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What's Coming Up

In Future Issues...

Look for the following articles in upcoming issues of *Oil & Gas Automation Solutions*:

- Integral dynamic braking option included in new 1105 series drives
- Using harmonic filters to satisfy utility power quality regulations
- Software option allows use of Palm Pilots for monitoring and archiving well parameters
- 1110 series drives allow operation of artificial lift pumps from single-phase power sources
- Rotaflex maximum pumping capacity increased 33% using novel speed control

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