Permanent Magnetic Motors Lower Energy Costs

By Dan Wowchuk, National Oilwell Varco

Alternative driveheads help progressive cavity pumping systems deliver better performance.

Electric and hydraulic driveheads have been traditional solutions to power progressing cavity pump (PCP) systems. However, permanent magnetic motors (PMM) are quickly setting the standard for reliable, safe, affordable and flexible operation.

The PMM PCP top drive delivers full-rated and continuous torque from 30 to 450 rpm. In addition to a 92.9 percent efficiency that some PMM models deliver from utility to rod string, some also provide a 97.4 percent motor efficiency that reduces energy consumption (see Image 1).

Because electric motors do not have the operating efficiency or full-rated torque throughout their operating speed range, any major changes in speed may also require shifts in the gear or sheave ratio between the motor and the pump. A PMM drivehead, on the other hand, is designed

Image 1. PMMs provide reliable, safe, affordable and flexible operation. *Article images courtesy of National Oilwell Varco*

and manufactured specifically for PCP top drive applications. Because it uses a PMM topology, it is also an ideal selection for low-speed and high-torque applications.

Long-Term Costs

Affordability over time is a the principal benefit of some PMM PCP top drives. Although manufacturing a PMM requires an additional one-time investment to create the permanent magnetic field in the rotor, the investment typically pays for itself in less than one year. It eliminates the cost of continuously using electricity to create the magnetic field on the rotor, which is required when using a conventional, asynchronous motor.

Conventional top drives traditionally have a 75 to 80 percent operating efficiency across a limited speed range. However, some PMM PCP top drives can deliver a 92.9 percent system efficiency. This increase in system efficiency continually reduces operating costs, which also serves to offset the slightly higher purchase cost. Extensive testing and use by major producers in severe conditions in Canada have proved that these driveheads can withstand harsh conditions across long periods of time.

Savings from the increase in overall efficiency that a PMM provides can considerably affect the bottom line. For example, when a PMM provides a 15 percent electrical energy reduction and the initial base power consumed is 555,000 kilowatt hours (kWh), the PMM reduces the annual power usage by 83,250 kWh. This power reduction equates to $9,900 in annual savings based on power costs of 12 cents/kWh (see Table 1, page 42).

Even if the PMM provided the lowest end of observed energy consumption with a reduction of 10 percent, the annual power savings would be $6,660. Total annual energy savings in specific applications depend on the overall power consumption and the cost of power in the operating region.

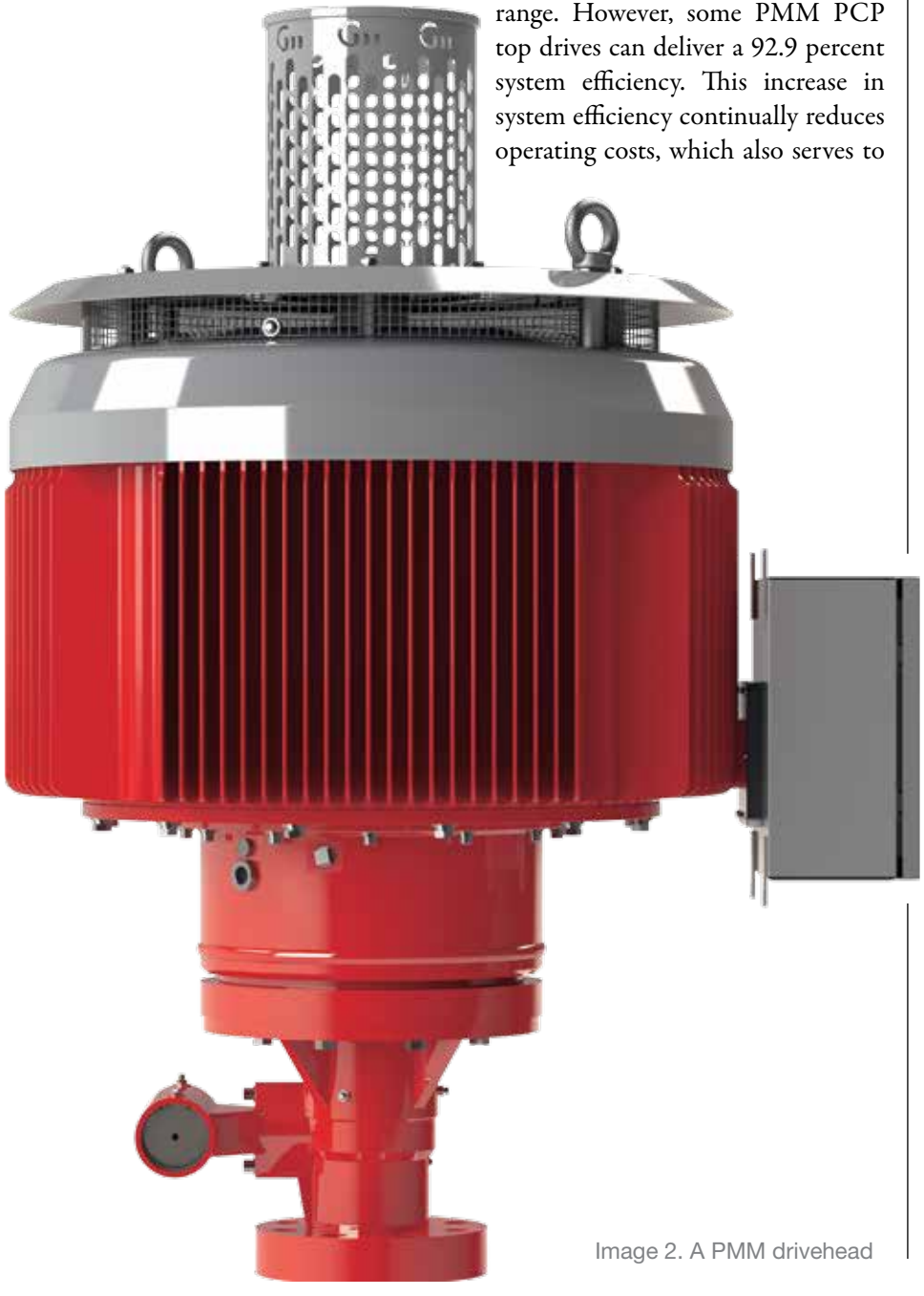

Image 2. A PMM drivehead

Safety Advantages

In addition to providing an economic advantage, the PMM PCP top drive also is a safer alternative. Conventional PCP driveheads are equipped with many external rotating parts—including belts, gears and sheaves—that present a potential safety hazard to personnel working on the equipment.

Since the PMM PCP top drive has only a single rotating external part, which is fully guarded, it is a safer option.

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The PMM design's simplicity almost eliminates the need for maintenance, except oil for changes. This reduced maintenance proves especially important in more severe environments in which dust, heat and humidity create more frequent upkeep needs.

To enhance the drivehead's safety, the variable frequency drive (VFD) includes an integrated fail-safe electronic resistive brake that eliminates uncontrolled backspin. Backspin could lead to surface equipment damage, backed-off rod strings, and safety hazards to personnel working on or near the surface equipment.

The PMM's rounded, balanced motor leads to significantly safer lifting because it eliminates the overhanging mass of the motor on a conventional PCP top drive. This feature also makes installation easier than changing conventional top drives on retrofits or for installation on new wells.

Flexibility & Other Features

Contributing to its flexibility is the simplicity of changing the VFD parameters. The PMM PCP top drive's full rpm range does not require manpower-intensive and time-consuming well shutdowns to allow for sheave, belt or gearbox changes. VFD parameters can be changed with the press of a button, making it easier to remotely monitor and control applications.

Its higher system efficiency allows the PMM to deliver greater production volume without increasing energy consumption. Because of the increased efficiency that these driveheads deliver, the PMM is among the more environmentally friendly PCP top drive solutions. The PMM also has a reduced noise output of only 68 decibels at a distance of 10 feet, making conversation possible when standing nearby.

Two types of PMM driveheads have rated torques of 750 foot-pounds (ft-lb) and 1,000 ft-lb, respectively. These PMMs also deliver exceptionally high starting torque along with rated torque efficiently across their entire operating range.

Additional options that are available for some top drives include:

- A 77,000-pound thrust bearing for extremely heavy-duty operations
- Jungle-hardened VFD cabinets for harsh environmental conditions
- Alternate motor winding options for non-standard speed and torque applications
- PCP optimization and control software

Conclusion

The flexibility of PMM PCP top drives can improve efficiency, installation and safety. They also offer better life-cycle affordability when compared to other options.

Initial base power consumed (kWh)	PMM electrical energy reduction	Power reduction (kWh)	Power price (per kWh)	Annual power savings
555,000	10 percent	55,500	$0.12	$6,660
555,000	15 percent	83,250	$0.12	$9,990
555,000	20 percent	111,000	$0.12	$13,320

Table 1. PMM electrical energy reduction provides annual power savings. These assumptions are for a 100-horsepower-equivalent top drive with an 85 percent load factor.

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