Contribution to energy-saving by use of mechanical seals in agricultural pumps

N. C. Tiwari' and Abhay Keny

Agricultural production is the backbone of Indian economy. Today, the demand for energy in agriculture sector is on the rise. The gap between demand and supply of energy is increasing year after year. Scenario of power distribution in the country is not very encouraging. Many parts of the country are still waiting for electrification. The quality and availability of power are not satisfactory. Practices like overloading of transformers, derating of equipments, illegal connections, etc. are making the situation further worse.

To meet this ever-increasing demand of energy and improve the supply condition, we have to either generate additional power, which requires huge investments and a long gestation period (5 to 7 years), or utilise the available energy efficiently by avoiding all kinds of waste and plugging the drains.

This paper highlights one of the ways to improve energy efficiency in agriculture pumping – a big and untapped potential sector.

Why so much noise about agriculture pumping?

Over the last decade, the consumption of energy in agricultural sector has increased substantially. This increase in energy consumption has necessitated the need for better utilisation. At present, over 30% of the total energy consumption in the country is accounted for by agricultureal pumping systems. Over 15 million electric pumping systems are today irrigating the farms in the country. Studies show that majority of the pumpsets (almost 80%) are operating at a very low system efficiency and waste precious energy as well as power. Every year, around 800,000 pumpsets are added to this family.

Average power consumption by agriculture pumping systems	: 4 kW
Average operating hours per year (10 hours per day and 200 days a year)	: 2000
No. of pumping systems operating in the field	: 15,000,000
Power consumed by these systems	: 60,000,000 kW
	: 60,000 MW
Annual energy consumption by these systems	: 120 billion kWh

Obviously, huge energy is being consumed in agricultural sector and there is potential for huge saving by improving the efficiency of these systems. Even a small improvement in efficiency can lead to a huge saving.

Energy –saving through use of mechanical seal pumps:

There are various ways of improving energy efficiency of agriculture pumping systems. One of them is to go for mechanical seal pumps instead of gland-packed pumps.

Mechanical seals and gland packings are used shaft sealing purpose. Prior to development of mechanical seals, gland-packed pumps were used for domestic sectors also. As awareness about energy efficiency increased amongst domestic users after 1980, mechanical seal pumps have replaced the gland-packed pumps. Today, all the pumps used for domestic sector necessarily have mechanical seals for shaft sealing and the availability of mechanical seals has improved drastically.

Use of mechanical seals offers the following advantages:

- Mechanical seals offer much less friction to the shaft as compared to gland packing. Hence, better efficiency can be achieved.
- Mechanical seals offer zero leakage along the shaft. Leakage loss through gland packing and problem of air entry at high suction lifts is eliminated.
- Mechanical seals offer longer sealing life and hence eliminate frequent tightening and replacement.
- Mechanical seal makes a pump lighter in weight and reduces overall length due to elimination of gland packing.

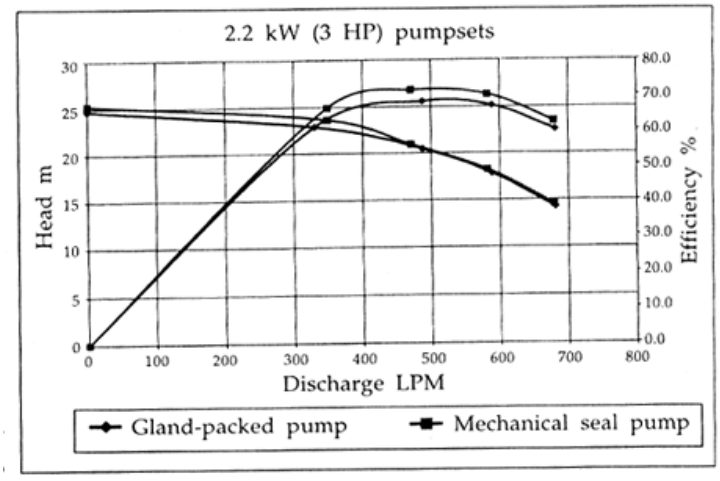
- Maintenance cost of a mechanical seal is the lowest as there is no shaft wear or shaft sleeve wear.
- Replacing a mechanical seal is easy, provided there are trained mechanics at village level.
- Mechanical seals keep the floor clean and avoid contamination of pumped water with leakage from gland.
- Bearing life of monosets using mecahanical seals is greatly enhanced as there is less possibility of bearings getting affected with water drips from stuffing box area.

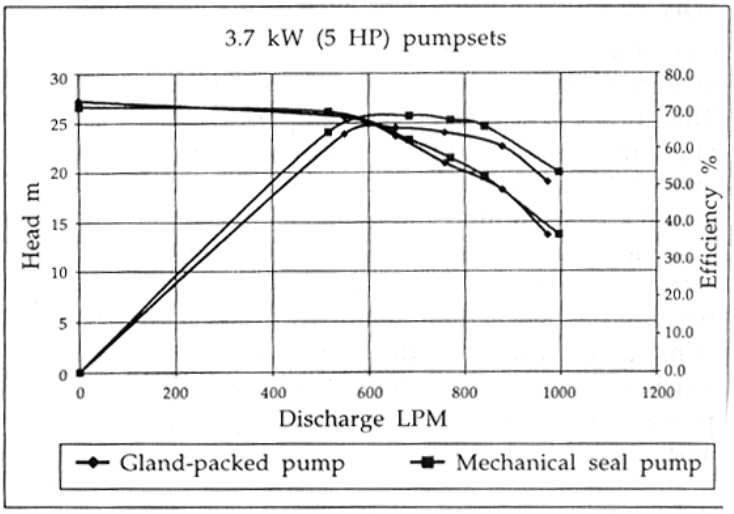
However, agricultural sector still uses glandpacked pumps due to low awreness about energy efficiency as the power is available at low cost or no cost. These pumps are used due to the following perceived advantages:

- Easy availability of gland packing. Even if specified gland packings are not available, other alternatives like coir ripe, etc. are used.
- Apparent cost of recharging the gland packing is less and also the replacement does not require trained mechanic.
- Gland packing can withstand wrong usage for longer duration as compared to mechanical seals. One of the wrong usages is pump priming using cow dung mixed water to arrest foot valve leakage in priming, which also carries sand particles and results in premature failure of mechanical seal in the field.

A study was conducted on two ratings of pumpsets, which are mainly used for agricultural application to identify the extent of energy saving by using mechanical seal for agriculture pumps.

For this study, two sets of one 3 hp pump and one 5 hp pump with duty-point head around 20 m were selected. Same hydraulic components (impeller and delivery casing) and motors were used for mechanical seal and gland-packed versions. Two different brackets were used for accommodating gland packing and mechanical seal. All the four pumps were tested on the same set-up. Every care was taken to eliminate other sources of variation.





From these test results, it can be observed that 3.3 percentage points (4.8%) better efficiency is achieved in case of 2.2 kW mechanical seal pumpset. Similarly, 3.5 percentage points (5.3%) better efficiency is achieved in case of 3.7 kW mechanical seal pumpset.

Potential for energy savings:

Based on an average improvement of 4.5% in efficiency, potential for saving by using mechanical seal pumps instead of gland-packed pumps can be estimated. The savings can be calcualted as follows:

Average power consumed by agriculture pumping system	: 4 kW
With 4.5% improvement in efficiency by using mechanical seal pumps, reduction in average power consumption	: 3.82 kW
Average operating hours per year(considering 10 hrs per day and 200 days a year)	: 2000
No. of pumping systems operating in the field	: 15,000,000
Power consumed by improved systems	: 57,300,000 kW : 57,300 MW
Annual energy consumption by improved systems	: 115 billion kWh
Thus, saving in annual energy consumption as a result of using mechanical seal pumps	: 5 billion kWh
Annual energy saving in Rs. (considering Rs. 4 per unit)	: Rs. 2000 crores.

At the same time, it will also result in reduction in connected load demand by 2700 MW, which will reduce load on transformers and improve quality of power supply. Generation, transmission and distribution of this much amount of new power will require over Rs. 12,150 crores.

This saving in connected load can also be utilised in energising of additional pumpsets without any additional investment in power generation.

Recommendations:

- There is immediate need to ensure that new pumping systems installed are efficient. Preference should be given to mechanical seal pumpsets.
- To encourage customers for installing mechanical seal pumps, preference in connection can be given
- To encourage manufacturers, incentives should be provided in the form of tax benefits, subsidy, preference in purchases, etc.
- Widespread awareness programmes should be conducted through advertisements, live demonstrations. etc.
- The following wrong practices should be stopped without delay. Manufacturers encouraging such practices should be debarred:

- Derating of pumpsets – putting lower ‘kW’ nameplate on higher ‘kW’ pumpsets.
- Use of capacitor bank – to operate pump on two phases.
- ISI mark for part of the equipment (for example, only motor in case of monobloc pumpset) to mislead and customers.
- Using ISI mark on name plate ‘for reference only’.

Conclusion:

Today, the country is starving for energy, hence, every possible effort should be made to ensure optimum utilisation of available energy. Looking to the potential of savings in agricultural sector, which can be achieved by using mechanical seal pumps, it is recommended to give preference to such pumps. These pumps will not only save precious energy, but also ensure longer life of pumpsets without maintenance.

Reference Book:

Indian Pumps
Newsletter of the Indian Pump Manufacturers Association,
June 2005