International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 05 | May -2020 ISSN: 2582-3930

Energy Efficient Motors

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Abstract

In the future, crises of the energy will increase due to environmental problem and limited sources. The electric motors consume a significant amount of electricity in the industrial and in the tertiary sector of the India. Because of its simplicity and robustness the three phase squirrel cage induction motor is the prime mover of the modern industry. The electric motor manufacturers are seeking methods for improving the motor efficiencies, which resulted in a new generation of electric motors that are known as energy efficient motors.This paper deals with energy conservation by installing energy efficient motor (EEM) instead of standard efficiency motor. One case study of industry Gopala polyplast limited, Ahmedabad, Gujarat. This transition becomes a necessity as a direct result of limitation in energy sources and escalating energy prices. In the end of this analysis there are different practical cases in where EEM is compared with standard motor and rewound motor, in all these cases energy savings can be achieved and the simple payback is less of five years. The energy consumption of electric motors is broken into two categories. Direct energy consumption which is the energy consumed while performing work and indirect consumption the fixed energy consumed regardless of the operational state. So, it is very interesting the implementation of EEM in the industry.

Introduction

Over half of all electrical energy consumed is used by electric motors. Energy Efficient Motors Full Seminar. Improving the efficiency of electric motors and the equipment they drive can save energy and Energy Efficient Motors are the best solution to solve energy crisis NEMA (National Electrical Manufacturers Association) set standards for energy efficient motors and named them as premium efficiency motors. As efficiency depends on losses, reducing them itself improves efficiency. Improved design specifications help to improve the efficiency. Comparison between the energy efficient motors and standard motors indicate the annual energy saved and thereby cost savings. reduce operating costs. Energy efficiency should be a major consideration when we purchase a motor, as well as the more common considerations.

MANUFACTURING RANGE :

Efficiency Level 1

⇒ 0.37 kW to 160 kW

⇒ Frame sizes : 71 to 315 for TEFC 80 to 315 for Flame proof

⇒ The entire range is available in IEC frames sizes (metric range) and also in NEMA frames

CONFORM TO FOLLOWING STANDARDS :

⇒ IEEMA : 19-2000

⇒ IS 12615

⇒ IS 325-1996 & IEC 60034

⇒ NEMA EPACT EFFICIENCY VALUES (for NEMA motors) IEEMA 19-2000 standard covers kW ratings only up to 160kW. However we are offering energy efficient motors up to 450 kW.

Oversizing of standard motors

Using a 20 HP motor on a system which requires only 10 HP, for example, will give good results as far as running the system is concerned, but will consume more electric power than a 10 HP motor and will cause the power factor of the electric system in the plant to become poorer, especially during periods when the motor is idling. Idling current of a 20 HP motor is about half the full load current of a 10 HP motor, so a great deal of power is wasted during periods in the cycle when the motor is idling.

Undersizing of standard motors

Using a 20 HP motor on a system which requires 25 HP for peaks is quite possible, but during overload periods the line current of such a motor may be about twice the line current of a 25 HP motor. Again, there may be a high waste of power during peak times in the cycle. But the smaller motor may save considerable power during periods it is idling or working at less than full rating.

Rewinding of a standard motor

Electric motors are relatively simple mechanical devices; Alternator rewinding is the rewinding of the stator. Rajamane Hegde provides comprehensive services covering all types of low- and high-voltage motors including Electrical Motor Rewinding. Our network of global service facilities the corporate as their service partner in Asian Country, as well as our in-house coil

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Volume: 04 Issue: 05 | May -2020 ISSN: 2582-3930

manufacturing and test capabilities, guarantee a fast turnaround.

This is a complete motor renewal and is completed at our workshop and we have the resources to perform rewinding and repairs to ALL types of Electrical Motor Rewinding for a wide range of industries and equipment including Pumps, Mining, Lifts and elevators, Cranes, Transformers etc.

Efficiency of energy efficient motor :- Energy efficient motors use less electricity, run cooler, and often last longer than NEMA (National Electrical Manufacturers Association) B motors of the same size.

To effectively evaluate the benefits of high efficiency electric motors, we must define "efficiency". For an electric motor, efficiency is the ratio of mechanical power delivered by the motor (output) to the electrical power supplied to the motor (input).

Efficiency = (Mechanical Power Output / Electrical Power Input) x 100%

Thus, a motor that is 85 percent efficient converts 85 percent of the electrical energy input into mechanical energy. The remaining 15 percent of the electrical energy is dissipated as heat, evidenced by a rise in motor temperature. Energy efficient electric motors utilize improved motor design and high quality materials to reduce motor losses, therefore improving motor efficiency. The improved design results in less heat dissipation and reduced noise output.

Motor rating		11 kW	4 kW	7.5 kW
% efficiency at Full load	EEM STM	84 76	87 84	89.5 87
% efficiency at Half load	EEM STM	84 74	87 83	89.5 85
P.F. at full load	EEM STM	0.75 0.70	0.82 0.78	0.91 0.84

Design of energy efficient motor to reduce the losses

Energy-efficient motors reduce losses because of their better design, materials, and manufacturing. These motors are 2 to 8% more efficient than standard ones. Lengthening the core and using lower- electrical-loss steel, thinner stator laminations, and more copper in the windings reduce electrical losses.

Core loss :- core losses are further divided into hysteresis and eddy current losses. Eddy current losses are minimized by using lamination on core. Since by laminating the core, area decreases and hence resistance increases, which results in decrease in eddy currents. Hysteresis losses are minimized by using high grade silicon steel. The core losses depend upon frequency of the supply voltage.

Copper loss :- Copper loss is the term often given to heat produced by electrical currents in the conductors of transformer windings, or other electrical devices. Copper losses are an undesirable transfer of energy, as are core losses, which result from induced currents in adjacent components.

Friction and windage losses :- Mechanical losses. These include friction in the bearings and a term called windage. (wind (like the weather) - age) Windage is due to air turbulance and shear as the rotor and stator move past each other. Stray losses.

Stray loss :- Stray load losses are one of the most irritating parameter for designers of machine and transformer. These are basically the losses which are caused by variation in load but their values cannot be determined accurately at any point of time. Eddy currents in armature conductors.

Other design aspects :- Air gap between stator and rotor is optimised to reduce the magnetising current and associated losses. This results into improved p.f.

Class F or H type insulation is provided which can withstand very high temperature. This results into cooler motor operation and requires less maintenance.

EEM may be provided in drip proof totally enclosed, fan cooled, explosion proof type enclosure.

Features of energy efficient motors

Number of efficiency standards for motors have been adopted and proposed over the years. These standards recommend motors to exceed their efficiency to some specific value which varies with the motor size, motor speed, enclosure type etc.

National Electrical Manufacturer's Association (NEMA) in 1989 , published a standard that list the nominal and minimum efficiency for a motor. Motor efficiency must exceed the minimum efficiency mentioned in standards in order to be designed as an energy efficient motor.

Benefits of energy efficient motors

Improved efficiency is available from 60 % to 100 % load. The eff curve is almost flat resulting in higher energy savings as in most of the cases the motor is not always fully loaded .

The special design features also result in lower operating temperatures which enhance the life of motor and reduce the maintenance costs.

These motors have inherently low noise and vibration and help in conservation of environment . Crompton Greaves energy efficient motors offer an additional feature which no other manufacturer offers. These motors are with highest power factor in the industry due the special exclusive designs available with Crompton Greaves.

The higher power factor reduces the currents in the cables supplying power to motor and this reduces cable loss, improving the system efficiency sometimes by even 2 %.

Sometimes this allows even a lower cable size saving tremendously on capital costs. Saving is also made by reducing capacitors required to improve power factor.

Conclusion

Higher efficiency motors (HEMs or EEMs) are preferred than that of standard efficiency motors, because increased efficiency saves significant amount of energy consumed and therefore saves energy bill, costs incurred over maintenance of the standard motor . However EEMs may not always lead to lower power consumption.Sometimes there would be an increase in energy consumption rather than a decrease due to the smaller slip in selecting a suitable motor. So proper selection of high efficiency motors must be made according to the type of application and energy required. One should be careful in choosing proper rating, always avoiding over-sized motors.

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