

## Non Implemented Case Study– Energy Conservation Measure

<b>Measure</b>
Operation of under loaded motors in star mode
<b>Equipment</b>
Fans
<b>Industry / Sector</b>
Textile
<b>Year of Implementation</b>
1998 Implemented but failed
<b>Cost Benefit Analysis</b>
⊖ Type of Measure: Long term measure
⊖ Annual Energy Savings: 1920 kWh
⊖ Actual cost savings: Rs. 8440 lakh
⊖ Actual investment : Rs.25000
⊖ Payback: 3 years
<b>Implementation Highlights</b>
<ul style="list-style-type: none"> <li>☞ Very simple measure and can be easily implemented with out any external expertise</li> <li>☞ Plant has implemented the measure but the measure has failed due to increased load on the motor during the winter.</li> <li>☞ Plant has resorted to original delta mode.</li> <li>☞ After considering the load increase during winter it was suggested to install auto star delta controller.</li> <li>☞ Even after suggesting the retrofit to take care of increased load beyond star operation the plant has not implemented the measure due to <ul style="list-style-type: none"> <li>⊖ High investment</li> <li>⊖ High payback period</li> </ul> </li> </ul>

### Summary

Star mode operation of the under loaded motors (which are loaded below 45 % of the rated capacity) results in improved operating efficiency of the motor and power factor by reducing the operating voltage by 73 times.

**Background**

One of the leading textile units was having re-circulation fan for the process requirements. The energy audit study was carried out during May 1998.

During the study the motor (rated motor is 18 kW) was measured and monitored for the loading and other electrical parameters. The details were:

Parameter	Value
Voltage, V	426
Current, A	17.8
Power factor, pf	0.55
Frequency, Hz	48.5
Demand, kVA	13.13
Power, kW	7.22
% loading on kW	40%

**Proposal:**

In view of under loading of the motor, it was suggested to operate the motor in star mode. The plant personnel immediately implemented the measure by converting the delta connection to star mode. The motor electrical parameters after star mode conversion are:

Parameter	Value	Improvement
Voltage, V	426	-
Current, A	12.0	-
Power factor, pf	0.77	0.77
Frequency, Hz	48.5	-
Demand, kVA	8.85	4.28
Power, kW	6.82	0.40

The motor was continued to operate in star mode. During the winter, motor got burnt. After the detailed investigation it was found that the motor failure was due to increased load on the motor. The major factors for increased loading are reduction in operating temperature of the re-circulation air during the winter and improved frequency (49.4 Hz).

In view of increased load during the winter it was suggested to install auto delta star converter, which converts the motor connection either in star or delta mode based on the load on the motor.

**Techno-economics:**

Power savings	: 0.40 kW
Possible operating hours in star mode	: 4800 h
Annual energy savings	: 1920 kWh
Annual cost savings (@ Rs.4.4 per kWh)	: Rs. 8440/-
Investment required	: Rs 25000
Payback period	: 3 years

**Principle**

Motors, which operated at loads below 40-45% of the rated capacity, an easiest and inexpensive energy conservation measure is operating the motor in star mode. A change from the standard delta operation to star mode operation involves re-configuring the wiring of the three phases of power input.

Operating in the star mode leads to a voltage reduction of  $\frac{1}{\sqrt{3}}$  per phase. Motor output falls to one-third value in the delta mode, but the performance characteristics as a function of load remain unchanged. Thus, full load operation in star mode gives higher efficiency and power factor than partial load operation in delta mode. However, motor operation in star mode is possible only for applications where the torque to speed requirement also reduces with the reduced load.

For loads, where there will be variation in load installation of auto delta – star converter can be installed.

The electronic ballast or choke (solid state choke) does not require starters or capacitors to be used with it. It consumes only 7 W when compared to 15 W of power in conventional choke. More over the efficiency of the lighting improves by 10%. The power factor is improved.

The electronic choke offers a rapid start to the system, which lights in less than one second. Stroboscopic effect, other wise known as flickering effect is more pronounced in conventional choke which are operated at the mains frequency.

The life of the tube is also increases as compared to a tube used with conventional choke.