

ENERGY SAVING in Under-Loaded Motors in Textile Mills

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The textile spinning mill is 24 hour 360 days round the clock running segment and Electricity Input is the main energy bill for the mill. Hence Electricity saving at 1 unit per hour equals 24 units per day for them, and any ECON measure, tiny, micro or small size is welcomed by the mill. We have to monitor and target every unit of Electricity KWH used in our industry.

BEE Mantra is Monitoring to Target the Energy / Electricity Reduction.

1 KW of Electricity saving / hour in industry equals to Rs.50,000/- saving per Annum.

This paper suggests the retrofit to carding cylinder under-loaded motor gives around 15 units per day saving, and Rs.30,000/- saving in one year for Rs.10,000/- invested now. This is the First Year Return of Energy conservation measure in this motor and it goes on. Whatever we implement to reduce energy loss in motors, it amounts to decrease the Units per Kg of yarn. **First we have to conduct initial Motor loading survey to assess the loading of motors as over-sized, rightly-sized or under-sized to confirm the motor is rightly loaded.**

EXISTING ENERGY LOSSES IN CARDING CYLINDER MOTORS:-

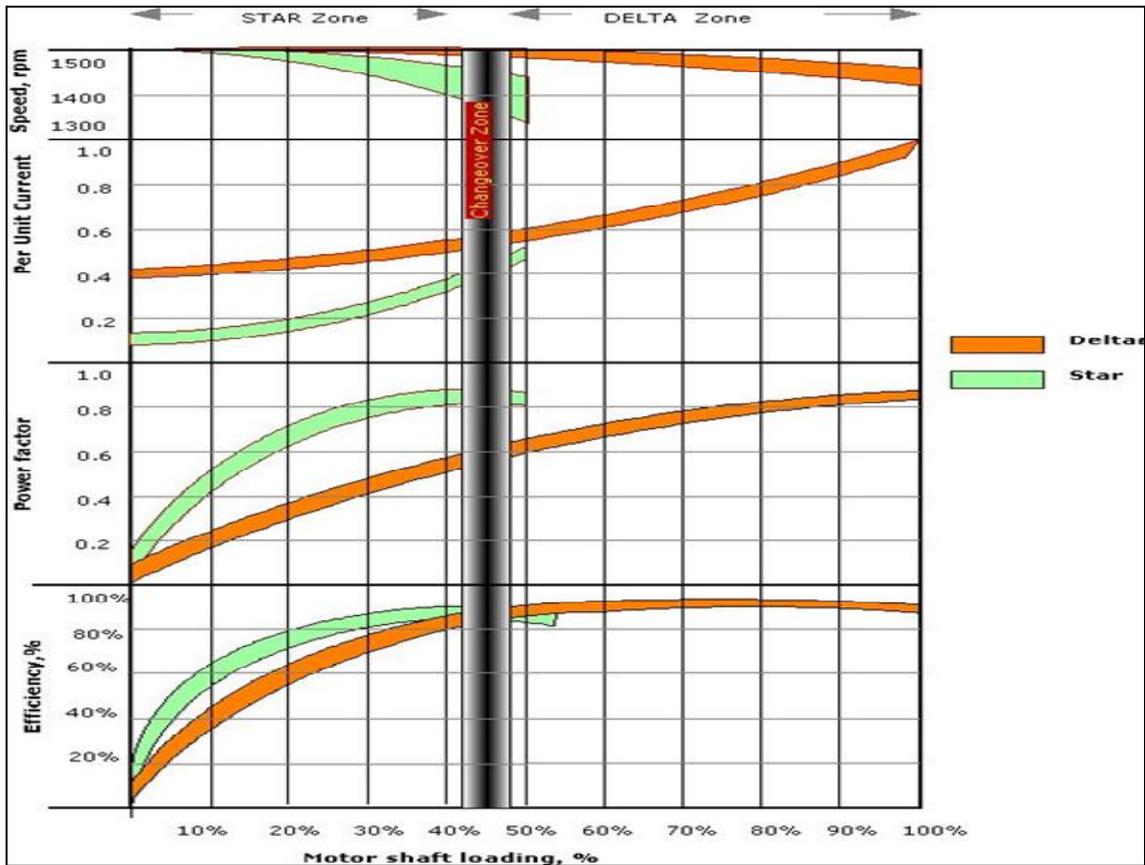
1. The textile spinning mill has many numbers of Carding machines of different brands, and machines are getting updated now for higher productivity & lower power consumption, aiming for higher productivity.
2. **“Well Carded is Half Spun” is the trend followed now by many mills in their Spin Plan.** They are allotting in the spin plan to match each card to each ring frame production. So the mills understand now, that the carding machine has to be run at slower cylinder speed to improve the overall carding & spinning quality of yarn.
3. Typical case study of carding cylinder motor in any textile mill is that cylinder is a heavy rotating mass to start with and run by its motor. **Hence all Carding machine OEMs oversized their motor to say 5.5 / 7.5 / 9.3 KW rating to give robust starting torque to the motor to rotate the cylinder.**
4. All our decade-old carding cylinder motors are conventional motors and having standard efficiency norms and they have peak efficiently at around 75 % band and are IE 1 versions as per latest IE norms globally.
5. Standard motor has a Efficiency Droop, below its 50 % loading when run on Delta mode. So the carding motor running at around 40 % loading now faces **the Droop Efficiency loss when running at 2.5 to 3 KW that is at around 40 % loading of motor shaft rated 5.5KW at the Standard motor Full Rated efficiency of 85 %.**
6. Previously the mills, wrongly applied the idea of Star Loading the motor, manually changed the motor terminals to Star connection, permanently ran the motor always in Start mode. **This short cut exercise made the motor hotter initially and within few days motor got overloaded and burnt.** The reason is that the cylinder sides are choked with Fluff. So instead of running in Delta, since the motor was already in Star connection, the motor failed due to wrong running in Star when load is above 50 %. **This means Manual Star moding the motor, is not the correct solution, but Automatic Delta to Star is the low cost & Cost-Effective solution.**

HOW TO IMPROVE THE LOADING EFFICIENCY OF UNDER-LOADED MOTORS?

Descriptions	Carding (TC-03)		Carding (LC300A V3)		Description	Before	After
	Before	After	Before	After		Without Power Saver	(With Power Saver)
Machine Type	TC-03		(LC300A V3)		LC 333 carding machine		
Name of Motor	Cylinder Motor	Cylinder Motor	Cylinder Motor	Cylinder Motor	Name of Motor	Cylinder Motor	Cylinder Motor
Motor rated KW	7.5 KW	7.5 KW	5.5 KW	5.5 KW	Motor rated KW	9.3	9.3
Avg. Volts	408.4	408.6	402.5	402.3	Avg. Volts	404	409
Avg. Amps	9.9	7.9	7.85	6.2	Avg. Amps	7.88	5.01
Avg. KVA	6.94	5.57	4.85	4.12	Avg. KW	3.67	3.19
Total Units	106.72	92	13.4	10.9	Avg. KVA	5.5	3.54
Units per Hour	4.64	3.9	3.35	2.9	Avg. PF	0.67	0.90
Units per Day	106.72	92	80.4	68.4	Units per Hour	3.67	3.19
Saving Units / Day		14.72		12	Units per Day	88.08	76.56
					Saving %		13.08
					Saving Units / Day		11.52

I & II image – Carding machine cylinder motors rated 5.5, 7.5, 9.3 KW gives around 15 % KWH savings.

Here the low cost solution is to retrofit Automatic Delta to Star convertor to the control circuit of carding cylinder motor. This allows the motor to run the motor on Star mode, automatically and gives 10 to 15 % on the motor running KW. Moreover, this reduces the KVA demand from motor end too.



III image - BEE guideline to operate the 'Less 40 % loaded motors' on Automatic star zone during running condition. Carding machine cylinder motor consumes only one third of that motor rated KW during running condition

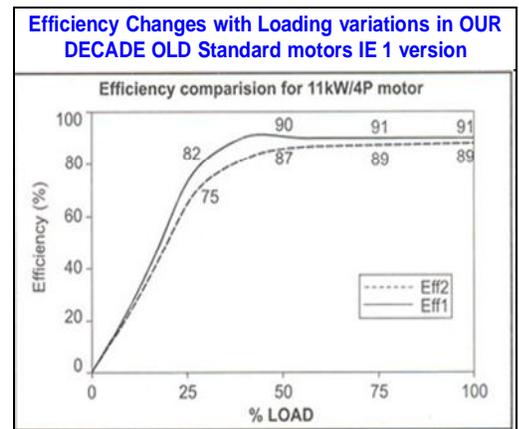
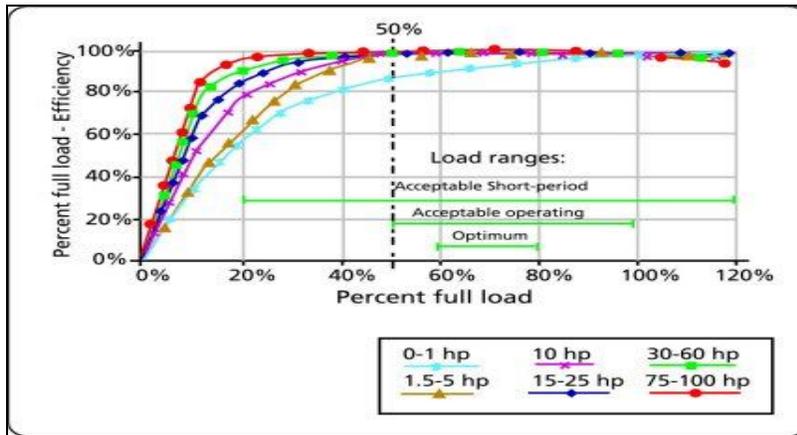
1. Above BEE diagram shows the efficiency, power factor, speed and current vs. motor shaft load characteristics in both Delta and Star connections. 'In Delta-Connection', the line voltage is impressed on each motor phase winding. Whereas in 'star connection', line voltage divided by Sq.Root 3 is impressed on each phase winding.
2. The vertical dark band (40 to 45 % loads) is the 'Changeover' region, which differentiates possible.
3. Delta operating zone (right hand side) and Star operating zone (left hand side). Observing the efficiency curves, it is clear that at light loads (30% or less); operation of motor in Star connection can save energy, as the efficiency is significantly better. It should be noted that, at light loads, change over to Star connection results in drastic drop in current.

Description DK 803 card	Before in Delta (Without Power Saver)	After in Star (With Power Saver)
Running 16s count / 516 rpm		
Name of Motor	Cylinder Motor	Cylinder Motor
Motor rated KW	7.5 KW	7.5 KW
Avg. Volts	405	408
Avg. Amps	9.4	5.97
Avg. KW	4.03	3.59
Avg. KVA	6.6	4.31
Avg. PF	0.61	0.85
Units per Hour	4.03	3.59
Units per Day	96.7	86.1
Saving Units / Day		10.6
Saving units in %		11

COUNT:	30sVL	CARDING : DK800
DOFF SPEED	110	CARDING MACHINE NO.24
LENTH	5000	MOTOR: CYLINDER MOTOR
DESCRIPTION	NORMAL (W/O ENERGY SAVER)	WITH ENERGY SAVER
KW	3.99	3.62
AMPS	7.43	5.91
KVA		
PROD	21KG	21 KG
KWH INITIAL READING	6101.9	6099.3
KWH FINAL READING	6105.1	6101.9
UNITS	3.24	2.62
UKG	0.154	0.125
STOPPAGE / BREAKS	NIL	NIL
DOFF TIME	45 MINTS	42 MINTS
SAVING UNITS/KG		0.030
PER DAY PRODUCTION IN KGS		600
ENERGY SAVER MODE CONSUMED POWER		74.73
NORMAL MODE CONSUMED POWER		92.45
POWER SAVING PER DAY / machine		18
ENERGY SAVING %		19

IV & V image – For same given production, the power saving varies from motor to motor based on its Derating.

4. If a motor is oversized and continuously loaded below 30% of its rated shaft load, the motor can be run on Start in Star- Delta mode and run using the Delta to Star Change over Converter to the Star.
5. If the motor is normally loaded below 30% but has a high starting torque requirement, then the motor can be started with a suitable starter and, after overcoming the starting inertia, be automatically switched from Delta to Star, using timer control or current sensing.
6. However, if the changeover is very frequent the contactors would get worn out and the savings achieved may get neutralised by the cost of frequent contactor replacements.
7. There are two options available to this constantly-underloaded motor which is having high initial torque during the Start with and run at under loading only. One is this Automatic Delta to Star convertor retrofit and other one is the costly option of going for VFD to this motor.
8. But VFD is not rightly suitable for carding cylinder motor due long duration of starting higher current. Since the motor is always constantly loaded, then this Automatic Delstar will give the energy savings in running this under-loaded motor.



VI image – 1 to 10 HP motor Eff 1 Std. motors show heavy drop in efficiency values below 40 % loading.

VII image – 11 KW / 4 pole motor the old Eff1 / Eff2 motors (New version IE 1 / IE 2 motors) From 2018, I E 1 motors are banned by the Gazette, but each mill is having hundreds of IE 1 motors & operated at poor loading.

Benefits of Automatic DELSTAR:-

1. In the electrical distribution of mill, this Auto Delstar Retrofit to your existing motor, reduces the KVA demand from the motor to the Incoming side. Normally the carding machine reads only around 0.60 PF, and this demands more KVA from the load.
2. This carding machine panel contains both electric switch gear components and the electronic harmonic prone components; hence the capacitor can't be fixed to each carding machine panel, as this will aggravate the THD levels at the Incoming.
3. By retrofitting this Auto Delstar to this cylinder motor circuit, the above problems get solved partly. Previously the PF measured was 0.50 and now after the retrofit, the PF goes upto 0.90. The cylinder motor is the only heavy rated motor in the machine panel. This is only pulling the PF down and hence carding SSB PF is around 0.5 only.
4. By retrofitting this gadget in all the carding machines, automatically, the carding SSB PF goes upto 0.90 PF, thus reducing the KVA demand from the carding section side.
5. You must be aware that you have a batch of say 10 carding machines and that SSBs record only PF 0.5 due to this poor loading, and because of this, you are forced to put Heavy Capacitor banks at the incoming carding SSB and at the MV panel in the Power house.
6. Since it is Harmonic multiplied now due to this addition of capacitor at the incoming of non-linear load, you have to put additional over-sized Passive and Active Harmonic Filters in the Power house.
7. First Improve the Power factor of the under-loaded motors at the load ends, as this will Load End Compensate the PF lagging loads, will reduce the Line-losses, Reduce the voltage Drops existing now, and reduces the capacitor requirements in the overall Electrical Distribution system of the mill.

8. Condition monitoring the carding machine, and its cylinder motor, we are assuming the cylinder load is constant. But actually, it is not so. Since the sides of the cylinder are loaded unevenly with cotton fluff material in the course of running in few weeks, the cylinder motor power goes up and automatically lands into Delta rating by this convertor. In case you had connected this machine in Star mode manually, then this heavily loaded motor at Star mode, will kill the motor instantaneously.
9. This gadget being automatic, this can be made user-friendly by setting to give alarm audio / visual inside the dept. **This visual alarm from Delstar will alert the user that his carding cylinder motor running in Delta mode, needs timely servicing by the mill crew, so as to bring down its load.**

Description	With out CSC	With CSC
9.3 KW rated motor. 100s Count, cylinder speed 380 m/ min.		
Unit consumption/day	119.38	99.14
Volts	415	416
Amps	13.08	9.84
KW	5.24	4.85
KVA	8.81	6.79
PF	0.61	0.703
No. of Laps running	2	2
No. of breaks	Nil	Nil
Units / Hour	5.080	4.160
Unit Savings per day	NA	20.24
Units % saving		18%

VIII image – case study shows Delstar instantaneous readings trended readings in KWH savings.

IX image – UNEP Knowledge Sharing Program on Energy Efficiency Opportunities in Motors.

MORE APPLICATIONS OF DELSTAR:-

1. **This Partly loaded motor or under-loaded motor is not only there at the carding cylinder motor only.** This under-loaded motors are there in Ring frames used for Fine counts of yarn DOFF stages which run for more than 10 hours, out of which say 4 hours can be run on Star Mode Automatically by the Delstar.
2. This Delstar finds its applications in your mill's other motors like carding cylinder, ring frame (running for Fine counts of yarn), AC plant motors, Waste collection motors etc. This being a low-cost retrofit, and gives instant results immediately on hooking up this to the existing motor. Though higher options are available like the VFD and closed loop VFD, EE motor replacement etc for the above load patterns and applications.
3. This Auto Delstar is not only retrofitted in textile mills, **but in other industries as well in their material handling equipment motors that are steadily run under-loaded after Start & running for more hours per day.**

CONCLUSION:-

Machine OEM designed and provided Factor of Safety in Loading Operations, and conveniently oversized the motor, **considering the safety aspects only.** The industry must take up this Motor Load Survey exercise as first priority now. Today, Draw a line to isolate the Rightly sized motor to machine as per the instantaneous KW, KVA figures and cumulative KWH & KVAH values. **The Low Hanging Fruits are your decade old, old efficiency Standard under-loaded motors where Part Load Efficiency of your Motors is very less compared to its Rated Efficiency.** Here Reducing Primary voltage Input to your Under-loaded motor from 415 to 230 Volts (using the Star Delta Start and in Run Mode) is the option available to you and let us make use of the same, TODAY.

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