

# VISUALIZE VISIBLE RPM LOSSES IN BELTS & PULLEYS in your Textile MILLS

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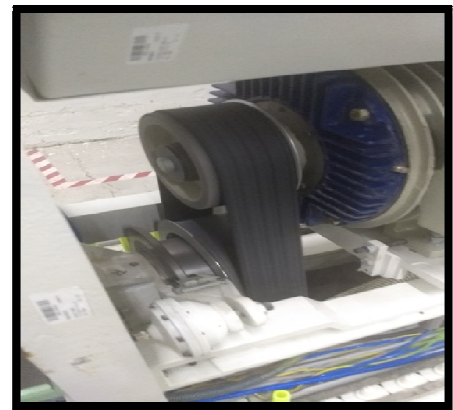
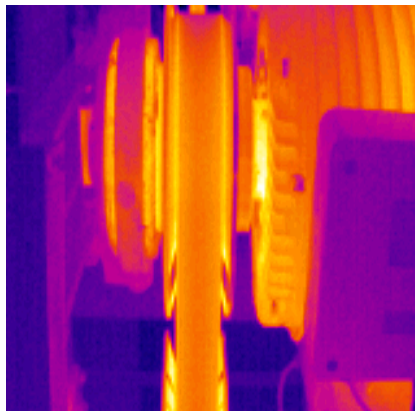
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Textile spinning mills are visualizing now, the energy loss in belt transmission upto 5 % in the aspects of power and productivity. Today buy a Non-Contact Tacho for few thousand Rupees and measure your Motor and Tin roller speeds in your short and long ring frames. With respect to the dimensions and the Speed Ratio, you will find few tens of RPM are losing in belts. This loss gets multiplied in few hundreds of RPM in spindle speeds. Drop in RPM means drop in production. Please monitor the RPM loss from your motor to tin roller bearing and then to your thousands of spindles to increase your yarn KG.

If your belts are Actively Gripping the pulley, then you are maximizing your Belt Transmission Efficiency. If your belts are only Passively Touching the pulley, then your belts & pulley consume More Power and Less Belt Transmission Efficiency now. The industry must visualize TODAY, the visible loss in their belts and pulleys. If you change your V belt today to Raw Edged Cogged REC belt, this transmits power without loss, compared to the V belt to deliver near the rated RPM, Revolutions per Minute and hence it gives you more productivity. Simultaneously if you optimize the 'motor & load's pulley to suit to the same output as load RPM, then it is power saving for you. Please concentrate on your slippage from motor to machine now. The Slip between the Cup & Lip in the energy flow is there always, but in some cases we find now, the Cup is Slipped in between! And Slip is reported above 10 % when slip during installation was recorded as only 2 %, few years back and not checked by your Tacho routinely.

If you want both power- saving & more productivity, then reduce the pulley weight and optimize its drive to match to the running load, under-number the belts from say 3 V belts to 2 REC belts / 2 V belts to 1 REC belt (this is subject of many factors) for the same given load. So focus on belt & pulley change TODAY (and not only the belts only as a routine change), and anticipate more productivity at less power consumption. Kindly Monitor and Record the 'Before & After' Power Readings for the power saving, and RPM change for productivity increase. This exercise will indicate you, how much you had lost in belt transmission in each machine, till date.

## PRODUCTIVITY LOSS IN BELTS & PULLEYS IN RING FRAMES:-



I image shows short ring frame runs with loose belts on the pulley and not gripping, hence losing the RPM in belt transmission.

II image shows in the Long ring frame, the heated belt, pulley and hotter motor Drive-end bearings, all Hot Spots show Loss.

III image – OEM's Latest machines have Timing belt along with reduced pulley sizes for power saving and no RPM loss now.

1. The short ring frames are losing production due to these loose V belt pulleys. Because of the looseness of belts and heavy pulley, the mill is losing ring frame productivity. Zero cost is resize the pulley, reduce its possible over-weight, put REC belts which can grip better, the motor & machine pulley during wedge-in and wedge-out.
2. Take the cue from long frame, many years before, the machine OEM went for standard sizing of 300 & 235 mm for motor and tin-roller pulley. Now the machine is fitted with VFD retrofit by the OEMs have re-sized the same to 220 & 220 mm motor & machine pulley so as to reduce the energy linkage losses which happened in between before. Once the starting of machine is SOFT now, the power carrying capacity of belts need not be over-sized as well the pulleys can be shorter sized, thus reducing the loss in transmission power. Now, the latest ring frame OEMs have switched over to Timing belts.

- Here energy savings is achieved by reducing the pulley size and weight, improving the angle of contact of belt in pulley, reducing the friction & windage losses in motor. **More productivity by Less Loss of RPM in between, over the wide range of loading by using the Timing belts that sit on the mating toothed-drive sprockets in the pulley drive.**
- The mills can implement today, the above same exercise in very low cost, by matched REC belt itself, resizing the pulley as 1 : 1 and reducing the size & less weight of pulley (compared to V belt or even timing belt) and the REC belts to achieve energy savings in this swap. **Also the RPM transmission is more in this exercise compared to your existing V belts, thus increasing ring frame production as well, hence “units less and Kg more” is achievable by the mill in each ring frame, thus improving the overall UKG parameters of each ring frame.**
- The mill needs to understand that their existing & running V belts in the short frames are either loose & weak to transmit power or over-strong to self-consume power more than to transmit power to tin-roller. So Optimize your belt grip on both the pulley for the full DOFF cycle. **Having generated so much KW from motor, please DO NOT waste the power in between and ALLOW the power to be transmitted to the tinroller & spindles. The Allowable transmission losses in practice is only around 2 % as per norms and our findings indicate this belt transmission losses goes upto 10 % in some mills and this is not at all acceptable.**

#### EXISTING VEE BELT TRANSMISSION PRACTICES:-

- The motor is coupled to the machine by V belts, either one or in multiples say 2,3 & more, to suit to the demands.
- The V belts are designed for motor at full load rating and 7 out of 10 cases, over belting is designed.**
- The motor and machine pulley are heavy mass when designed and this adds more to tare load consumption of motor + belt + pulley upto the load, thus increasing unproductive load on the motor power.
- Because of over-belting, the pulley sizes, belt width and the number of belts go up to increase power demand to motor.
- Motor designer of IE 2 and above versions, are reducing the motor cooling fan size so as to reduce the no-load motor power, but machine designer and the user increase the power demand in between by strong heavy belts and multiples of belts, matching heavy pulley at motor & load, and silently ignore the KW demand that has increased to his motor now.**
- The industry is in the habit of allowing the belt to tear during running and then only change at the eleventh hour.** Instead of 4 matched belts, the user changes only one or conveniently tries to run with the balance belts between machine & motor.
- Even while changing, the industry is viewing the belt as a OTC (over the counter) commodity and buys from nearby retailer and somehow manage to run the machine, so as to solve the problem for that day.**

**Motor drive transmission efficiency :-  
Visible Losses seen in Belt Losses from motor to load**

*Table 3.4: Losses in V Belts*

Sr. no.	Motor HP	Losses %
1	2	8-15
2	3	7-13
3	4	6-12
4	6	5.5-10
5	8	5-9
6	10	4.5-8.2
7	20	3.5-7
8	30	3.2-6
9	40	3-5.5
10	60	2.8-5
11	80	2.5-4.5
12	100	2.5-4.5

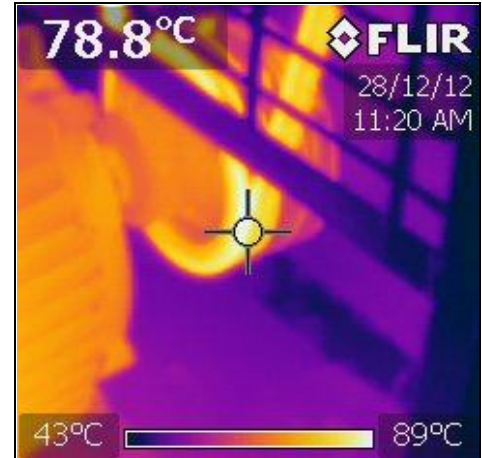
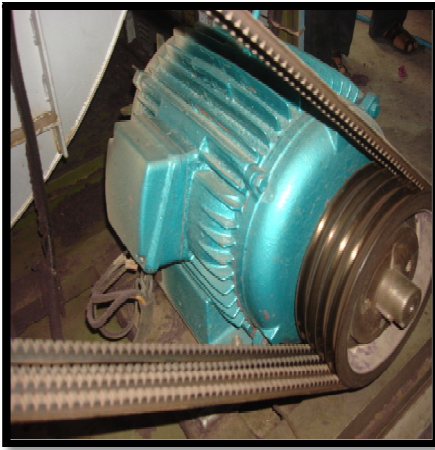
Details	V Belt drive - 4 Drives SPC	Cog belt Drive - 3 Drives - XPB	Cog Belt drive - 2 Drives - XPB
Motor HP	75	75	75
<b>Motor KW</b>	<b>66</b>	<b>66</b>	<b>66</b>
Motor Pulley Dia	258	245	245
Machine Pulley Dia	425	406	406
Actual RPM	898	890	888
<b>Actual KW</b>	<b>38.27</b>	<b>34.67</b>	<b>33.96</b>
Kw savings with Cog belt drives		3.6	4.31
<b>Savings attained in %</b>		<b>9.4</b>	<b>12.4</b>
<b>KIt Investment cost</b>		<b>21746</b>	<b>19600</b>
<b>Expected savings /Year</b>		<b>192207</b>	<b>230115</b>
<b>Payback in Months</b>		<b>1.4</b>	<b>1.2</b>

IV image :- BEE Table indicating the losses happening due to V belts and its variation based on the Motor HP.  
V image:- Case study of 55 KW centrifugal blower in waste collection centrifugal blower system in a textile mill in South India.

- The blower was running with 4 V belts before, and the same is swapped with REC belts of less pulley size, but the same speed ratio. The V belts had slippage before, and now cogged belts the slippage is reduced, weight of belt and pulley is reduced.
- Now this 55 KW motor is consuming only around 33 KW instead of 38 KW and later they are planning to go for VFD with closed loop control sensing the Pascal pressure from the main suction plenum after the Primary & Secondary filters from the motor shaft, to achieve more savings. Here, mill achieved Rs.2.3 Lakhs saving in First year after spending only Rs.20,000/-.**
- Though the RPM change is less here, this mill achieved savings by optimizing their motor & machine pulley drive sizes.
- This is a typical case study and this power savings will be possible in this centrifugal application only.** This saving varies on the load like either like centrifugal / axial flow blower, centrifugal / screw type compressors or pumps etc.
- This saving varies depending on the nature of rotation in axial / tangential load like blower, pump, and compressor application. **The savings will be different for shock loading, pulsating, grinding, agitating, reciprocating working application etc.** Say for example, 10 HP motor losses vary from 4 to 8 %. So the Loss band is 4 to 8 % implies that the losses are there in V belts and in

pulley drives as well. If loss is from belt only, say it is 4 %. If loss is due Belt +Pulley drive, say it is 8 %, this is what we inferred from our case studies. So it is not only the change from V belts to Cogged belts, but also the pulley drive needs to be optimized to the running load.

## HOW TO ASSESS THE EXISTING V BELT LOSSES?



VI image – Cogged Belts and Drives rightly changed for this motor drive system and Energy savings achieved.

VII image Belt Tension must be in such a way that when pressed, it must not exceed the belt thickness here.

VIII image shows the thermal imaging of worn-out pulley due to belt and alignment issues raises temperature to 89 °C.

1. Today, with your Infra red Thermal Imager, scan and screen the hundreds of belt driven motors in your industry. You focus on the motor & machine Drive End bearings, the motor & machine pulleys, and belts end to end.
2. Assuming the ambient of 40°C, the relative temperature increase must not increase above 10°C above the Ambient, when measured at belts and pulleys. Any relative temperature deviation shows the nature of abnormality in the alignment. After screening, you can concentrate on the hot spots like belts & pulleys. This is apart from bearing checking on motors.
3. Measure the motor & machine speeds by non-contact Tachometer, for the normal running load, the dia of motor & machine pulley, calculate the speed ratio and check for slippage losses in each belt transmission. This costs few Thousands only.
4. Also, measure the motor running load, its rated KW, and the motor running frequency in Hz.
5. Visually check for cracked or worn-out belts, belt tension, alignment and the pulley for heavy wear & tear.
6. This Thermal Image of belt & pulley will show how much your KW input to motor is unwantedly heating up the belts & pulley drives. You will also find rubber burnt smell and screeching when machine is started and these are the signs of wear-out now.
7. A good belt / alignment / installation does not require routine / periodical regular tensioning like monthly, etc. Are you?
8. Some mills are habituated to regular tensioning of belts once in 15 / 30 / 45 days. This shows you have lost the grip in belt transmission / alignment etc right from the installation date. Please correct atleast now and not to loose any more RPM.

## WHY SHOULD YOU REPLACE WITH COGGED BELT & PULLEY TODAY?

1. Your existing motor is always not running to the designed full power ratings.
2. The V belts are not used as matched set and say one or two belts only in that belt set actively transmit the power.
3. You have changed your motor starting from Harsh DOL, Star Delta starting to smooth VFD starting now and so now your belt & pulley also needs to under-sized to withstand only slow ramp of VFD starting current.
4. Discuss about the weak transmission points happening in your V belts now with the machine OEM.
5. The origin of In-efficiency due to over-design of belt & pulley drive transmission starts from the machine OEM only.
6. The efficiency of the mechanical power transmission depends on grip between pulley & belt, further depends on the co-efficient of friction and tensile strength of the belt transmission.
7. We the Energy Auditors, suggested to the industry till date, to replace with cogged belts only on same pulley so as to instantly achieve energy savings by this Swap. After replacement, this reduced the transmission losses by say 3 % in terms of RPM and hence increased the power demand from load shaft.
8. The user does not analyze the overall productivity from the machine is improved, but blames that the power demand increased from machine and not satisfied with the exercise done, from V belts to cogged belts.
9. You the industry need to be aware that your pulley (also due to this cyclic belt movement under harsh conditions) needs to be replaced around 5 years duration, based on the loading nature and thermal imager inputs on pulley.



10. Now we always demand the industry after our energy audit, to replace belts, and optimize power in their pulley & drive. Here, we have to look into the design aspects of what parameter is wanted in each machine either Pascal, RPM or parameters required for the material movement from this motor & belts system.

#### **BENEFITS OF COGGED BELTS & PULLEY OVER V BELTS:-**

1. The cogged belts by design, is having 30 % power carrying capacity for the same V belt weight now.
2. The cogged belts run cooler, run say, 50 % more longer hours, and occupy less space in pulley.
3. The narrow & cogged belts operate higher speed ratios using smaller diameter pulleys.
4. Hence this needs the existing pulley to be replaced with say 20 % around, less weight pulley.
5. Kindly study the above 4 FINE POINTERS, this will catalyze you to change to cogged belt immediately, Today.
6. After thermal imaging and measuring the slippage losses, we the Energy Auditors now suggest to the user, to replace both belts & pulley from V belt to cogged belt now.
7. Citing the above factors, let us first re-size the pulley, discuss with the belt & machine OEM to achieve the same RPM or the desired RPM after reduced slip, possible now due to this cogged belt.
8. Kindly take this as Energy conservation proposal on the running machine and you will be surprised to see now that your machine runs with maybe 2 cogged belts instead of 4 V belts before; And the pulley weight has come down by say 50 % due to above change. Ultimately resulting in more than double the expected savings of likely 10 % instead of 5 % due to excessive wear & tear, slippage existed in the belt transmission before. This will cost your industry Few Thousand Rupees only.
9. The case study on 45 KW blower motor shows motor pulley got reduced from 18 Kg to 10 Kg weight. The machine pulley got reduced from 55 Kg to 25 Kg weight. This is how power savings space-saving and less weight in transmission yields. Any way blower is a different load application. This cant' be compared to exactly to the ring frame application. But still gap remains.
10. The industry is now looking at ways and means of energy saving in their motor driven systems. You are planning to change your motors from IE 1 to IE 2 and IE 3 motors with VFD compatible versions to improve your motor efficiency levels by few percentage points. But instead of replacing the motor only, you can FIRST FOCUS TODAY on the motor as a system as 'Motor + Belt & Pulley transmission' to deliver the power, without any slip in between, upto the load machine's shaft.
11. Your industry can go for Timing / Synchronous Belts as this gives Maximized % in belt transmission efficiency over range of loading, if you want to prioritize the production ONLY from your machine. But this is costly alternative compared to V belt and hence we suggest going in for cogged belts due to the additional factors of Correction Power Rating, Speed Ratio, Belt length Correction Factor, and Arc of Contact Correction Factor. These factors aid in optimizing the pulley drive for cogged belts.

#### **CONCLUSION:-**

When you view your running machine's belt transmission, the running belt must look STANDSTILL. This is the visual symptom of healthy power transmission from motor to machine, by belt. Actively gripping belts look like Standstill when machine is running. Passively touching belts vibrate more to prompt the losses. If you see wobulations in your belts, this shows the belt transmission efficiency is losing and energy losses due to slippage, mis-alignment of belts, poor matching of belts to drive, hotter Drive-end bearings.

Energy Auditing involves about optimizing the Design parameters to suit to the running conditions and this is a classic case of material conservation in optimizing the 'pulley & belt change' for the same given output from the machine shaft at the given running condition, in turn this will lead to power saving too. We the Energy Auditors have to be the focal point between the Machine OEM and the user industry, and maximize machine efficiency and this is WIN-WIN situation for All of US. Consult the Belt Specialist, Machine OEM and bring them to your ECON Table to achieve Energy Savings at one Stroke.

You will be shocked to know your loss in productivity due to the worn-out rattling belts & pulley till yesterday. Today once you have implemented the Belts & Pulley exercise, you will find a relief on Still Motion of your belts running in machine. Tomorrow it will be delight to see your Reduced Electricity consumption from this motor and your Productivity from this Machine has gone up Marginally More. Kindly share your Swap exercise case study NOW and Today for the benefit of others, as you are aware that your Motor generated so much KW and this power must not be lost in transit to your Machine. And 1 KW loss to you now & here, in your industry is equal to 8000 units loss per year i.e.Rs.50,000/- Annum loss to your Organization.

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