Allow motor to breathe out to maintain health in textile mills

Ring frame motors do not maintain sustained efficiency over years, and hotter motors inside a mill is a symptom of mill inefficiency, says **Ashok Sethuraman**, who advocates allowing motors to breathe out openly in order to keep spinning mills healthy.

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◆ Textile is the only industry segment wherein the individual equipment, motor, the prime mover is enclosed under a hood, and in other industry segments the motor works comfortably in the open. In tropical countries like India the motor works better at ambient conditions unlike in the Western countries. In other industry segments, they keep the motor in ambient surrounding and allow the motor to vent out its internal losses, which appear as heat. Mainly, the long frame motor and pneumafill motor are hotter at half the loading level and hence the efficiency gets reduced gradually by 3 to 5% due to prolonged and harsh ambient conditions.

◆ Why are we concentrating on ring frame motor? It is because more than half the mill power consumption is accounted for by ring frame only. The mills having KVAH, KWH meter recording in each ring frame and in the SSB level have understood the need for this "Frame to frame relative condition monitoring". In some cases, the power consumption differs by 10% even in adjacent frames running at the same speed and production levels. For that matter, any power deviation above 5% between the adjacent ring frames needs to be a focused area in future. This focus point will be the short-cut to energy savings.

Motor – when it consumes more; then becomes a consumable

◆ Where your motor efficiency stands is the efficiency of the motor when it is tested under the hot running conditions. This indicates the real efficiency practically at the partly-loaded condition after running for years.

◆ Thanks to increasing inverter drives in a mill, the motors are hotter due to negative torque by the 5th harmonics and this harmonic generation must be curbed at the source of generation then and there. If this harmonics propagate to other machines like a contagious virus, then the losses are much more. So, first the harmonics at the frame or SSB itself must be arrested. This has to be the first step to KVA demand in each machine and later to be corrected at the powerhouse to fully make use of the sanctioned demand

Fan out the motor fins- - Cheap & best way for sustained efficiency

◆ EE motor OEMs have given more fins now compared to old motors as this is the easy way to dissipate the heat and improve its working. The symptom of loss comes out as heat and is fanned out of fins by throwing away the heat all around the motor. But what one find, when the motor hood in long frame is opened, is the fluff coating on motors practically. It is like person wearing a sweater and running under sunshine on a hot sunny day!

◆ Here is an incident from an industry, where a good running motor, after routine service and painting, was put back to service. In a few days it failed due to over-coating of paint that acted as thermal insulation on motor and retained the heat. Like-wise if one focus on the fluff deposit, motor's active ventilation and bearings lubrication, then one can make the motors more healthy & efficient. To circumvent the problem the OEMs give TEFC or TENV motor and here too this motor can perform better only when a cross flow of fresh surrounding ambient air across the

fins all around the motor frame is available.

◆ Just because the motor insulation spec is Class H temperature limiting to class B levels, etc one cannot wait for the motor fins to be heated up to 80°C to take up routine maintenance and in some cases motor even boils! The higher the temperature, more the power losses as waste output. First the cause of overheating is to be checked and waste output to be reduced and this will automatically enhance useful output to production.

◆ The loss method of calculating boiler efficiency as an analogy, indicates any equipment with a skin temperature of 20°C above ambient, is losing more. So a healthy running motor cannot have more than 20°C above ambient as fin temperature, the same measured by the infra-red gun or by thermal imaging. Higher than 60°C on skin does not mean motor must not be run. It is to infer that it is running unhealthy and loss is shown as heat symptom.

◆ Hence to cool the long frame horizontally-finned motors, now the fluff air washing the motor from the top does not serve the purpose at all and the motor fan running is a waste to duct out the fluff air from pneumafil fan and divert the same to the trench. Separately, fresh air can be provided from the side cover of hood opposite to fan cowl through Netlon filtered hood cover with chute provision inside so as to be sucked by ring frame motor fan, making it cooler and efficient.

◆ This practice is being now adopted by the latest Autoconer OEM by providing mesh filter on hood cover so that the motor fan inside facing the filter sucks the ambient air from outside and blows all around its motor fins.

Motor breathes shallow or deep now?

◆ The above images show that the heat retention is uneven on the motor skin, the top skin showing less heat and bottom skin part showing more heat. This is due to uneven air ventilation across the surrounding skin and this affects motor efficiency over years.

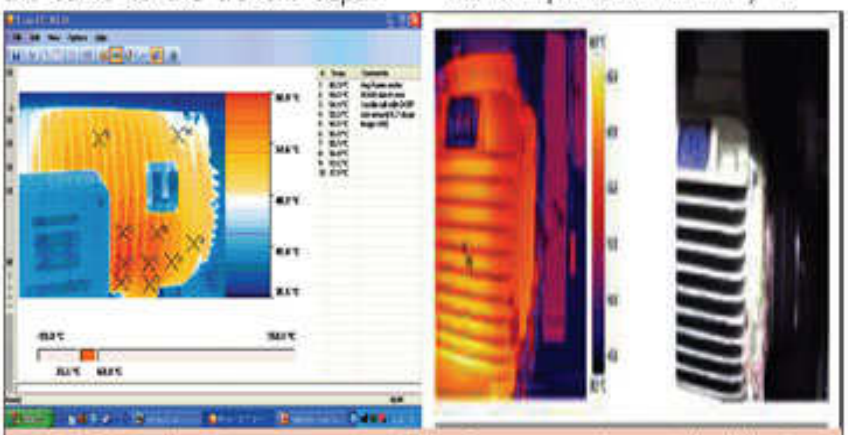
◆ The thin hot air pushed out by the pneumafil motor along with micro dust and fluff after the filter has less cooling potential on the main motor. Moreover, the fluff gets deposited on the main motor fins, etc. The normal skin temperature of any efficient running motor at optimum load is around 50°C, ie, that is 10°C above the ambient. But the motor skin temperature normally is around 60°C plus and this does not get reduced by the pneumafil air which is hot, stale, with dry RH, mixed with static heat from the material. In fact the localised heat on the fins is forced to stay there always. The bottom portion of the motor is still hotter due to poor circulation of the above hot air. The motor is not allowed to radiate and dissipate the heat outside.

◆ That is why it is found that find the inside temperature at the motor hood is around 5°C more than the ambient practically in many cases. Hence the motor for the given power input, gives only lower output due to combined effect of hotter and thinner air. The primary working of pneumafil motor is to suck the fluff with air and push it into the trench. To achieve two solutions with one impeller, it will be all the more better approach to separate motor cooling and fluff air exhausting.

◆ So, now many users and OEMs are thinking of over-motoring the ring frame main motor as a viable alternative. Now-a-days, the motor OEMs also offer their motors for testing at ring frames at an optimum loading of around 50% only.

◆ Hence the motor is derated and details of de-rating of motor given by ABB are shown in the Table.

The proposed modification at the vertical finned ring frame motor: The pneumafil motor instead of running with impeller at one end, is proposed to run the same motor with both side impellers. (Now it runs with one side impeller only) Let the existing impeller do the same work of sucking the fluff and air and push out through the pneumafil trench separately without passing through the main motor.



TESTO Thermal Imaging of two types of Ring Frame motors in a textile mill – Courtesy R N Agencies, Coimbatore.

Ambient temperature, ° C	30	40	45	50	55	60	70	80
Permitted output, % of rated output	107	100	96,5	93	90	86,5	79	70

Height above sea level, m	1000	1500	2000	2500	3000	3500	4000
Permitted output, % of rated output	100	96	92	88	84	80	76

◆ The new impeller to be fitted on the non-drive end will suck the air from top/side of the panel and force the air through the vertical circular fins from top and at bottom. This helps to reduce the motor skin temperature. V-type filters are provided on the top or side of the machine panel to supply air to the pneumafil motor housing.

◆ This addition of non-drive end impeller does not need a separate prime mover motor. But this will consume in addition, say a few hundred watts and the same motor of size 5.5 KW can take up this load. Again this is offset by the reduction in power due to the chute diverter duct to be fixed on pneumafill air discharge to trench.

◆ What is observed in many mills is that ring frame main motors are hot, but pneumafil motors hotter. Many of the mills have changed this pneumafil motor to inverter duty type and putting the inverter in automatic closed loop suction pressure control. So active and fresh air ventilation becomes mandatory for the same so as to avoid burnout later.

◆ Brief pre-cooling & post-cooling of main motor in-between: Doff cycle helps to expel the heat out of motor, but now it is retained in motor. Additionally to improve the overall system efficiency and performance, one can add a time delay to pick up and drop out timer one minute for the pneumafil motor contactor. This helps to keep the main motor fan out its heat prior to starting and post stopping cycle. One have to provide built-in comfort to 24 X 7 motors so as to avoid accelerated ageing and sustain its energy efficiency for many years.

◆ This retrofit exercise can be done in few hours and the cost will be less than Rs 10 K and more important after the above exercise is that the both main and pneumafil motors' efficiency can be sustained for many more years of usage.

Industry to focus on energy losses now

◆ During the correct transfer of energy in the running equipment; If the same is perfect & smooth accepting unavoidable losses, then the productive output is more and the wasted output is less. During the incorrect transfer of energy - In the running equipment is done with more avoidable losses, then productive output reduces, and waste output increases and gets dissipated in the form of heat, light, sound, which is a sign of visible loss in equipment operating parameters and inferred through our Energy Audit.

◆ Likewise the efficient motors are to be tested yearly after commissioning in each ring frame to confirm the motor is able to maintain the sustained efficiency right from the commissioning month. Any new EE motor will definitely outperform the old existing motor during trial and commissioning month. What the mill has to ensure is that the same % over-performance is achieved since commissioning is maintained even after one year and it has to be repeated annually for the mill sustenance.

◆ The mill manager can question that this was not the problem before and the ring frame performed well all along. Before we ran sub 15 K speeds and now we are gradually increasing to above 20,000 speeds. So to take the best out of the ring frame, the present trend may be correct but equally bring the machine to achieve a sustained efficiency at higher speeds. The same can be done only first by condition monitoring with respect to frame, with respect to time for given textile parameters.

◆ Considering the flexibility of operation and automation needs, now the ring frame motors need to be operated by inverters from now on. When one is taking care of the harmonics dumping to incoming side by the inverter, one have not taken care of the load side of inverter, that is the motor, till date. The motor becomes hotter due to inverter spikes, non-linear quasi sine wave, inability to dissipate the heat outside and lack of high temperature lubrication. So steps have to be taken to arrest through load choke retrofit, switch over to high temperature greasing on motor bearings and implement active ventilation process.