The US west puts its foot down on the road to recovery

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Rotor thermal stress can lead to a pulper’s unscheduled downtime. Here, Baldor’s senior principal engineer Mike Kozlowski explains why it’s vital that proper rotor construction and material is specified.

COPPER BAR ROTOR MOTOR DESIGN FOR PULPER APPLICATIONS

In tissue mills, process reliability is absolutely crucial to the bottom line. Due to the batch nature of the stock pulping process, pulpers typically will start three to four times per hour, sometimes more. Frequent starting of the motor causes rotor thermal stress and can contribute to pulper’s unscheduled downtime. For these reasons, it is critical that proper rotor construction and material be specified.

CAUSE OF THERMAL STRESSES

In order to save energy, the pulper is often shut down when not being used. If the induction motor has a direct online (DOL) start, inrush currents which range from five to seven times full load current will produce rapid heating effects in the rotor. There are two stress producing mechanisms of rotor heating that occur during starting which produce radial and axial forces. These issues must be addressed during the design of the rotor to ensure long motor life.

What is not a common known fact is that during motor starting, the rate of temperature rise in the rotor’s end rings can be as high as 20 degrees Celsius per second. This creates radial expansions of the end ring material relative to the rotor steel laminations. Axial forces also occur due to the expansion of the rotor bars embedded in the rotor laminations.

Both of these stresses combine to produce concentration points on the rotor bar/end ring material which can cause material fatigue resulting in rotor failure.

'Rotor bar extensions are optimised to reduce bar radial forces.'

Figure 1. Black pen marks on the far left of this motor highlight the burn patterns where the end ring has separated from the rotor bar joints.

Figure 2. The use of copper bars and end rings can accommodate cyclic fatigue stress of frequent starting of the pulper application.
joints. Figure 1 highlights this phenomenon. The black marks indicate burn patterns where the end ring has separated from the rotor bar joints. This motor had a cast rotor and was used in a high number of start applications.

**WHY ARE COPPER BAR ROTORS BETTER?**

Copper bar rotors are an improvement over cast aluminium rotor motor in pulper applications for two reasons. Firstly, there is better control of the material being used to construct the rotor. The use of copper also eliminates the possibility of voids which can occur during the casting process of an aluminium rotor. The use of copper bars and end rings (Figure 2) also allows the use of a unique “floating cage” copper bar rotor design, which can accommodate cyclic fatigue stresses associated with frequent starting of the pulper application. These rotors use a controlled clearance between rotor bars and laminations, and are manufactured with a precisely controlled process resulting in a bar rotor that is free to expand axially while remaining tight enough to prevent high stresses. The rotor cage is axially secured at the bar midpoint by inserting equally spaced pins in the centre of the rotor. The rotor employs two endplates to keep the rotor core under uniformly controlled pressure. The rotor end rings are non-slotted and incorporate a smooth machined radial groove that maximises the joint contact area and reduces brazing stresses. Rotor bar extensions are optimised to reduce bar radial forces. These features lower stresses in the bar to end ring joint encountered during starting, thus resulting in longer life.

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