Steel vs. Glass Banding Evaluation

Rotating equipment generates centripetal forces which are proportional to the rotating mass and radius and increase with the square of the rotating speed. At high speeds the forces can be significant even for relatively small masses. Initially, steel banding was utilized to provide additional strength to resist the centripetal loads based on its availability, known mechanical properties and the lack of alternative materials. Although steel banding was readily available and had excellent material properties, a failure of the insulating pad could result in arcing, failure of the band and catastrophic consequential damage to the machine.

During the 1950's with advancement in material sciences and manufacturing processes the concept of employing non-conductive banding was developed. Suitability of an alternative was dependent upon the mechanical properties at both low and high temperatures, resistance to creep, thermal expansion and aging characteristics of the alternative material. Glass banding, developed by several Original Equipment Manufacturers (OEM's) typically utilized non-woven, parallel, glass fiber yarn, impregnated with a polyester or epoxy resin. The glass banding is formed by applying several layers of glass tape under sufficient tension such that neither the pre-load stress in the tape, nor the stresses resulting at operating speed exceed the strength of the material. Following application of the glass tape, the applied resin is cured by heating resulting in a structure which is extremely strong and has an excellent strength to weight ration.

Conversion of banding from Steel to non-conductive glass banding is frequently considered during refurbishment of rotating machines. The key issues to be considered are the space limitations and whether the support for the Banding is adequate. The analysis requires calculation of the Number of Turns Required (NG) and the retained tension in the band (FG) based on an applied preload which exceeds the centripetal force at the machine Over Speed Condition by 10% and consideration of the tension lost for Cold Banding Application on Rigid Structures. Inherent in the analysis is understanding of the modulus, thermal coefficient of expansion and density for the proposed banding material. The analysis also assumes no radial deflection of the of coil supports due to the application of the banding. Adjustments to the banding structure may be necessary based on the specific machine geometry, construction and application. Typically the resulting thickness of the glass banding material is consistent with the thickness of steel banding, however the clearance available must be verified at the conclusion of the proposed retrofit.

The methodology for assessing Banding arrangements has been performed by EME on dozens of machines and is well understood. Glass Banding is generally an excellent alternative to Steel Banding, however for very high temperature applications Steel Banding remains the preferred material of choice. The application process for either banding material is critical to ensure that the desired pre-load is achieved and that the modeled material properties are maintained during normal speed.

In some cases it is not possible to convert a machine from Steel Banding to Glass Banding, due primarily to the machines geometry or application; small radial clearances or very high speed and/or very high operating temperatures. In these cases the Steel Banding can be analyzed for suitability and the key parameters; required pre-load, Number of Turns Required, Retained Tension (also requires consideration of the effects from the insulating pads) will be considered. As with the Glass Banding analysis, these parameters will be evaluated in the context of the maximum Over-Speed condition and loss of tension for Cold Banding on a Rigid Structure and the analogous material properties for the specific steel to be used need to be known.