A VEXTEC CASE STUDY:

Improving Industrial Manufacturing by Eliminating Premature Manufacturing Line Failures

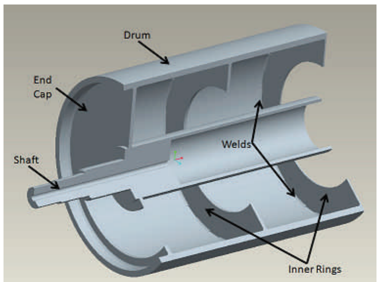

Figure 1: Half symmetry cutaway schematic showing the major components that make up the forming roller assembly.

OVERVIEW

All industrial equipment is designed to operate safely within a certain range of conditions, and in a perfect world, would be operated within its predetermined limits. But often, the designed-for conditions and actual operating conditions are worlds apart, with predictable results: premature failure, unanticipated downtime, unplanned maintenance, productivity losses, unexpected repair and replacement costs, and lost revenue. Such was the case with an industrial manufacturing company that was turning out products for the construction industry using a series heavy rollers operating at pressures above designated operating limits. VEXTEC was asked to determine the root causes of failure, and to identify and evaluate possible corrective actions.

VEXTEC Virtual Life Management ™ (VLM) technology predicts the durability of manufactured products aggregating all the various data sets that describe the product and its behavior. Traditional design analysis today accounts for some of these data, for instance, by looking at the stress imparted on a component. However, stress data alone, is not enough to predict durability which is a function of the materials reaction to that stress. By relating all the data that describes the product in one computationally robust platform, VEXTEC VLM simulators give engineers the ability to see how material processing variation, design changes, or changes in the operating conditions affect component durability, even before the component is manufactured.

THE PROBLEM

The industrial manufacturing company was producing a rolled product for the construction industry. In this process, a material was manufactured over a series of rollers, then finally compressed and cut using breast and forming rollers (Figure 1). The breast roller provided the upward pressure on the forming roller which spun on a shaft that was supported by journal bearings. These two rollers were routinely operated above the designed pressure rating, which was necessary to meet final product design specifications. However, this increased pressure caused the forming roller to fail prematurely. The forming roller developed cracks in the welds at various interior joints, and also in the shaft, which taken together, were compromising the structural integrity of the roller, ultimately resulting in unacceptably premature failure.

THE SOLUTION

Using VLM technology, VEXTEC created a Virtual Twin™ Simulator of the forming roller and predicted the probability of failure over time based on changes in operating conditions and the resulting stresses. By using a structural FEA model to determine the local stress states during operation and a material simulation to determine the resistance capacity of the steel component and the welds, the Virtual Twin Simulator correctly predicted cracks in the structural components of the forming roller, which correlated with the actual roller degradation that was occurring.

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THE RESULTS

The Virtual Twin Simulator pinpointed that the interior welds are critical to the forming roller's structural integrity and when those failed, breakdown in other structural parts quickly followed. The Virtual Twin Simulator was repeatedly exercised to quantify the operational cost-benefit of changing welding methods, redesigning interior buttress supports, and re-designing the shaft as a means for improving durability.

VEXTEC Virtual Life Management simulations combine the effects of operating conditions, geometry and inherent material variability to predict component durability by simulating all the product data's inter-related effects. In this case, VLM processed the forming roller components as an assembly of millions of individual material grains, each varying in strength (intrinsic to the material) and absorbing different microscopic loads (depending on micro-structure configuration and applied loads). VLM technology, and the Virtual Twin simulation that was used in this case, evaluated this variability by conducting millions of simulations at the individual grain level to deliver an accurate prediction of the component's expected durability (Figure 2).

VEXTEC provided the manufacturer with a cost-benefit roadmap to enhance manufacturing throughput by extending roller life. Some relatively simple roller modifications were identified that will eliminate weld and shaft failures altogether and double overall roller life. The Virtual Twin was used to determine the root causes of failure, and identified and evaluated possible corrective actions, providing the client with a clear understanding of the performance versus cost tradeoffs of the possible corrective actions in less than 60 days.

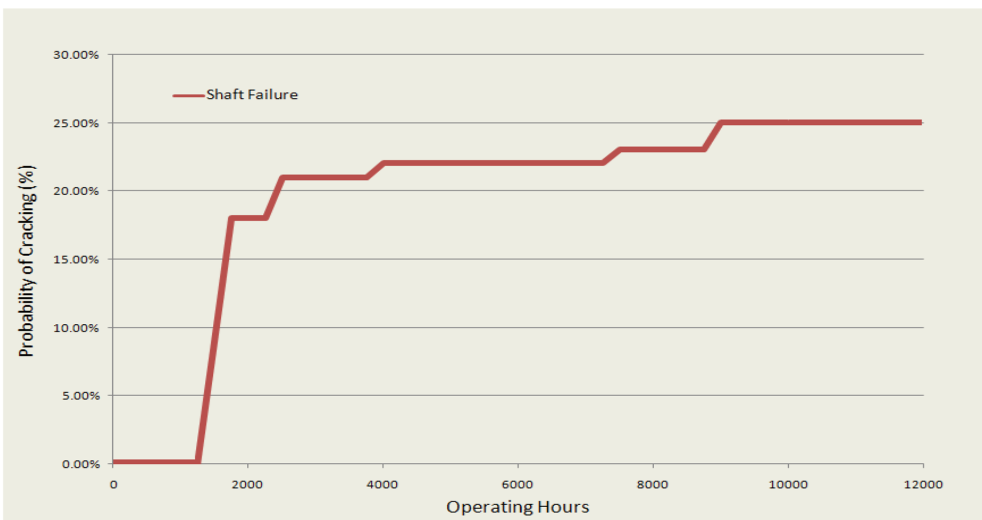

Figure 2: The Virtual Twin simulator was used to extend the originally predicted 25% probability of shaft failure at 8,000 hours of operation to 0% at 12,000 hours of operation.

ABOUT VEXTEC

VEXTEC accurately, efficiently and economically predicts the performance, durability and true lifetime cost of a single component or an entire fleet—before they're ever built. Founded in 2000, VEXTEC has pioneered and patented innovations that create a computational framework that forms the foundation of its Virtual Life Management (VLM) technology. Forward thinking manufacturing companies in aerospace, heavy equipment, automotive, electronics, energy and medical implants are benefiting from VEXTEC's unique ability to predict product life cycle reliability and failure, and most importantly, their financial consequences. To learn more, visit www.vextec.com.