Fatigue Failure Analysis of Vibrating Screen Spring by Means of Finite Element Simulation: A Case Study

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ABSTRACT

Vibrating screens are often used in the mining industry to separate mineral particles by size. In many designs, spring arrays are used to provide the system with the necessary stiffness for screens to vibrate in a controlled manner. Naturally, these springs are subjected to varying loading cycles, which can cause their premature fatigue failure. This behavior has been studied by means of finite element analysis and compared with data obtained from a real case scenario, in which a helical spring failed.

The 3D computational model was developed using the geometric characteristics and material properties of a fractured spring, as well as the loading characteristics of a specific vibrating screen. The meshing and the simulation tasks were performed in the general purpose software ANSYS Mechanical. Given the nature of the helical springs and the high-cycle loading conditions, for the fatigue analysis it was determined that a stress-life approach with constant amplitude and non-proportional loading best fit the investigated phenomenon. In solving the non-proportional loading case, stress values of two static scenarios were required to determine the upper and lower limits. Then, to perform the fatigue calculations a solution combination was used. In addition, in order to correct the effect of mean stress and calculate the stresses component respectively the Goodman and Von Mises theories were employed.

Simulation results showed that spring would present failure below the second turn of the coil when working with the full nominal load during nearly forty million cycles. These results strongly agreed with the data extracted from a vibrating screen where fractured spring had been working. Fatigue analysis also predicted that the nominal load should be reduced to 90% in order for the spring to meet the minimum life requirements before failure occur.

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