

An Investigation of Johnston Vertical Pump Vibration Problem, 2005

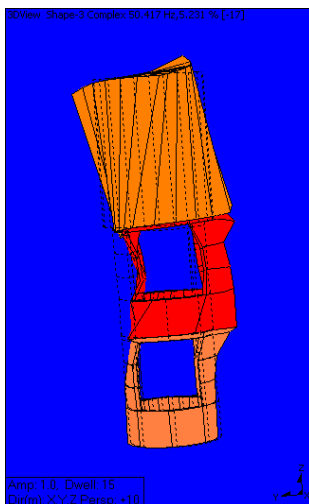
The frequent failures of the Johnston vertical pump were investigated. Based on the Modal analysis performed and Finite Element Analysis, it is concluded that the root cause of the Johnston Vertical Pump problem is a structural resonance problem.

During the operating condition, the forces generated by the motor, rotating at 3000 rpm (50 Hz) is transmitted to the thrust pot and discharge head section. These phenomena was clearly shown from ODS analysis animation at the running speed; while the vertical pump which is operating in this region is suffering from excessive bending movement that caused the mechanical seal, bush etc. to wear.

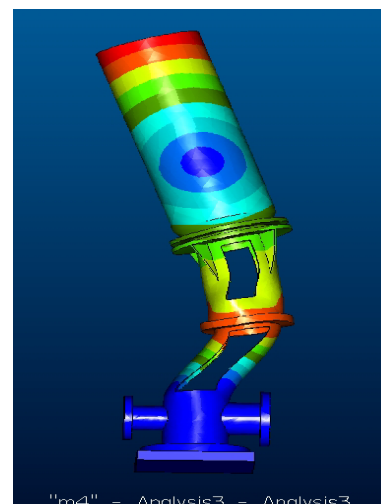
From Modal analysis and FEA, the vertical pump was having its 2nd bending mode at 50.4Hz; 'on-spot' to the running speed of 50 Hz, hence, hitting its structural resonance. The animation clearly showed that the structural movements by this 2nd bending mode was having its anti-node at the thrust pot – discharge head interface assembly that would eventually caused the mechanical seal and other components to wear and leading to the frequent failure of the vertical pump.

Based from the analyses results, the dynamic design criterion was established as follows; a dynamic design criterion was established that would shift the 2nd bending mode of Vertical Pump away from the running speed up to above 70Hz frequency while ensuring that the twisting mode at lower frequency will not enter into the operating region.

Therefore, the modification is aimed to stiffen the thrust pot – discharge head support structure. Structural Dynamic Modification (SDM) was performed by adding stiffener to the existing thrust pot and discharge head. Performing the proposed SDM has shifted the 2nd bending mode of the pump at to 81.4Hz.



Mode shapes @ 50.4Hz



FEA Mode shape@ 51.9Hz