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Empirical investigation of acoustic emission signals for valve failure identification by using statistical method

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Abstract
This study proposed to employ acoustic emission (AE) signal to detect valve abnormalities in reciprocating compressor. The AE signals obtained are post-processed by using wavelet packet transform (WPT) to decompose the signals into different frequency ranges. To examine valve problems, root-mean-square (R.M.S) values of signals computed at each frequency and time segments are compared among three different valve conditions. The analysis of variance (ANOVA) test is conducted to investigate the effect of different valve conditions on the R.M.S value at its corresponding time and frequency segments. Finally, a post-hoc test named Tukey comparison test is performed to identify time-frequency segments best representing the valve condition. It is believed that valve problems can be identified effectively by monitoring the R.M.S values at these segments.

Key words: Acoustic emission, valve failure, reciprocating compressor, wavelet packet transform, statistical method

1. Introduction

The competitive environment today requires machines to have maximum reliability and product throughput while minimizing its operating cost for profit maximization. To ensure the machine to work at its optimum efficiency, condition monitoring techniques are utilized to monitor the physical condition of machine. In the petrochemical industry, valve failure is always the major cause of sudden shut down for reciprocating compressor [1]. Non-destructive diagnostic techniques namely the vibration, acoustic emission (AE), crankshaft instantaneous speed [2, 3] measurement are always preferred due to its ease of installation and flexibility in giving minimum interference to the operating condition.

Previous studies showed that acoustic emission (AE) technique can provide earlier detection of fault condition in rotating machines, especially at lower speed, when the energy generated from the defect is difficult to be detected by using conventional vibration technique [4]. This is because AE technique measures the transient elastic waves generated when a material undergoes deformation, micro fracture, bubble collapse, friction, and impact

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