

VIBRATION ANALYSIS OF CENTRIFUGAL PUMPS FOR CONDITION MONITORING

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ABSTRACT

A centrifugal pump is the primary equipment in a clean water distribution system that requires reliable operating conditions to ensure service continuity. One of the most widely used approaches for evaluating the operating condition of centrifugal pumps is vibration-based condition monitoring, as it enables the detection of mechanical faults without interrupting the operating process. This study aims to analyze the vibration characteristics of centrifugal pumps, evaluate their operating conditions based on the ISO 10816-3 standard, and develop maintenance recommendations based on condition monitoring results. A quantitative research method was employed through direct measurements on three centrifugal pump units at PDAM Tirta Dumai Bersemai using a vibration meter. Vibration measurements were conducted at the Drive End (DE) and Non-Drive End (NDE) in the vertical, horizontal, and axial directions over a five-day observation period. The collected data were analyzed according to the ISO 10816-3 standard and supported by One-Way ANOVA statistical analysis. The results showed that the average vibration values were 1.972 mm/s for Pump 1, 1.342 mm/s for Pump 2, and 0.970 mm/s for Pump 3. The One-Way ANOVA results indicated a statistically significant difference in the average vibration values among the three pumps ($p\text{-value} = 0.01747 < 0.05$). Based on the ISO 10816-3 evaluation, all pumps were classified as operating within acceptable limits. The findings demonstrate that vibration analysis can be effectively applied as the basis for condition monitoring to evaluate pump operating conditions and support the development of appropriate maintenance recommendations.

Keywords: *Vibration analysis, condition monitoring, centrifugal pump, ISO 10816-3, One-Way ANOVA.*

ANALISIS GETARAN PADA POMPA SENTRIFUGAL UNTUK *CONDITION MONITORING*

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ABSTRAK

Pompa sentrifugal merupakan peralatan utama dalam sistem distribusi air bersih yang memerlukan kondisi operasi yang andal agar kontinuitas pelayanan tetap terjaga. Salah satu pendekatan yang banyak digunakan untuk mengevaluasi kondisi operasi pompa adalah *condition monitoring* berbasis analisis getaran, karena mampu mendeteksi indikasi gangguan mekanis tanpa menghentikan proses operasi. Penelitian ini bertujuan menganalisis karakteristik getaran pada pompa sentrifugal, mengevaluasi kondisi operasi pompa berdasarkan standar ISO 10816-3, serta menyusun rekomendasi tindakan pemeliharaan berdasarkan hasil *condition monitoring*. Penelitian menggunakan metode kuantitatif dengan pengukuran langsung pada tiga unit pompa sentrifugal di PDAM Tirta Dumai Bersemai menggunakan *vibration meter*. Pengukuran dilakukan pada sisi *Drive End* (DE) dan *Non Drive End* (NDE) dengan arah vertikal, horizontal, dan aksial selama lima hari pengamatan. Data dianalisis berdasarkan standar ISO 10816-3 dan didukung analisis statistik One-Way ANOVA. Hasil penelitian menunjukkan nilai rata-rata getaran Pompa 1 sebesar 1,972 mm/s, Pompa 2 sebesar 1,342 mm/s, dan Pompa 3 sebesar 0,970 mm/s. Hasil ANOVA menunjukkan terdapat perbedaan rata-rata nilai getaran yang signifikan antar pompa ($p\text{-value} = 0,01747 < 0,05$). Berdasarkan evaluasi ISO 10816-3, seluruh pompa masih berada dalam kondisi layak beroperasi. Hasil penelitian menunjukkan bahwa analisis getaran dapat digunakan sebagai dasar penerapan *condition monitoring* dalam mengevaluasi kondisi operasi pompa serta mendukung penyusunan rekomendasi pemeliharaan.

Kata kunci: Analisis getaran, *condition monitoring*, pompa sentrifugal, ISO 10816-3, One-Way ANOVA.