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PdMsolutions
Machinery Condition Report
for
Chemical Company
27-29 April, 2004
Washington, New Jersey

Report Date:
3 May, 2004

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His Phone Number

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1.0 Introduction

VibrAlign, Inc has been commissioned to evaluate predictive maintenance vibration data. Vibration data is collected quarterly by company personnel and transmitted to VibrAlign for analysis. Data for this report was collected from 27-29 April, 2004.

For this report there is 1 machine which requires scheduled action. It is the P-201C Oxide Unloading Pump which requires motor bearing replacement. There are 2 machines which should be “watched”. These are A-407 Reactor and P-202A Oxide Unloading pump. Amplitudes are increasing on the Reactor and it should be monitored for change. Additional information is contained in Sections 3 and 4 of this report.

2.0 Data Collection and Interpretation

The instrumentation package used to collect data contained in this report consists of a DLI Engineering DCA-31 portable vibration data collector fitted with a tri-axial vibration sensor. Vibration measurements are made by temporarily attaching the tri-axial sensor to small bronze mounting pads that have been attached to the machinery at selected monitoring locations. These are typically located at or near bearing caps. Vibration measurements are made automatically over two frequency ranges, often at 10 times and 100 times the rotational rate of the machine being tested. As the data is collected, it is stored in the memory of the DCA-31 data collector.

When the data collector is returned to VibrAlign, Inc, it is connected to a computer and the data is unloaded into a ExpertALERT diagnostic database. This database contains specific information about the mechanical configuration of the machinery in your plant. The DLI Engineering ExpertALERT software contains an expert system that has been set up to identify which of your machines have abnormally high vibration, and to assist in the diagnose and severity of equipment faults. After being processed by the expert system all data is reviewed and edited as necessary by a certified category III or higher vibration analyst before being included in this report.

Vibration amplitudes in this report are expressed in engineering units of velocity inches/second. This is noted on the plots as IPS 0-peak. Velocity units are utilized for most PdM measurements because they are representative of equipment fatigue. In some instances data is expressed in other units such as displacement (mils Pk-PK) or in acceleration units of G's (0-Pk). Displacement is used for some low frequency measurements and for data collected from shaft proximity probes. Acceleration information is used in high frequency applications, such as the evaluation of gear mesh in high speed gearboxes.

During data evaluation, collected data is passed through an expert diagnostic template. This template contains information regarding machinery construction as well as discreet fault frequencies for the specific component. As part of this template the data is evaluated relative to the average response characteristics of that specific machine or a group of like machines performing the same function.

When a deviation is measured which exceeds the average response plus one standard deviation it is flagged by the system for further evaluation. When viewing the analyst discussion for selected machines in Section 3.0 of this report, the numbers in parentheses () indicate the amount by which the current vibration level exceeded this statistically derived value. Statistically, this means that 20 out of 24 identical machines will not exceed the level, or roughly 16 percent will exceed the average alarm level and will require more detailed engineering analysis.

For data contained in this report, vibration frequencies are identified as multiples (orders) of the shaft rotating speed. Hence, the running speed of a machine would be expressed as 1X with multiples being expressed as 2X, 3X, etc. In some instances such as pump vane passing specific fault codes are assigned to in identifying key fault frequency components and assist in the analysis of the component. As an example, if a Pump has 6 vanes on the impeller, the frequency of the vibration spectral peak would occur at the vane passing rate of 6XP. However on the plot it would be identified as PV for pump vanes.

The following table summarizes some of the common designators utilized to identify specific components and faults.

| Machinery Code | Refers to | Machinery Code | Refers to |
|----------------|----------------------|----------------|----------------------|
| M | Motor | MB | Motor Rotor Bars |
| F | Fan | FB | Fan Blades |
| P | Pump | PV | Pump Vanes |
| T | Turbine | G1 | Gear Mesh 1 |
| D | Diesel | FT | Fundamental Train |
| G | Generator | BS | Ball Spin |
| N | Spindle, Misc. Shaft | BPO | Ball Pass Outer Race |
| BR | Belt Rotation | BPI | Ball Pass Inner Race |

3.0 Summary of Results

- 1) P-201C Oxide Unloading Pump: Replace motor Bearings. Indicated pump bearing degradation is being induced to pump from the motor.
- 2) A-407 Reactor: Collected data continues to show that amplitude levels are increasing. It appears due to a gear mesh or bearing problem associated with the Low Speed Shaft of gearbox. However bearing information and gear tooth count are currently not available for confirmation of fault. This machine should be watched closely.

4.0 Data and Discussion

4.1) P-201C Oxide Unloading Pump

Report generated on: 5/3/2004 03:04 PM

Acquired: 4/28/2004 08:10 AM 1xM = 3563 RPM 1xP = 3313 RPM Averages: 3

Maximum level: 0.0882 (+0.0826) in/s at 24.1xM on 1T in high range

RECOMMENDATIONS:

IMPORTANT: REPLACE MOTOR BEARINGS

DESIRABLE: MONITOR PUMP BEARINGS FOR INCREASED VIBRATION

DIAGNOSES:

SERIOUS MOTOR FREE END BEARING LOOSENESS

| | | | |
|--------|-----------|-------------|--------------------|
| 0.0442 | (+0.0392) | in/s at 9xM | on 1A in low range |
| 0.0313 | (+0.0293) | in/s at 8xM | on 1T in low range |
| 0.0313 | (+0.0278) | in/s at 9xM | on 1T in low range |
| 0.0198 | (+0.0173) | in/s at 6xM | on 1T in low range |
| 0.0125 | (+0.0097) | in/s at 6xM | on 1A in low range |
| 0.0099 | (+0.0081) | in/s at 8xM | on 1A in low range |
| 0.0099 | (+0.0083) | in/s at 5xM | on 1T in low range |
| 0.0088 | (+0.0053) | in/s at 6xM | on 1R in low range |
| 0.0088 | (+0.0053) | in/s at 9xM | on 1R in low range |
| 0.0088 | (+0.0078) | in/s at 7xM | on 1T in low range |
| 0.0079 | (+0.0072) | in/s at 7xM | on 1A in low range |
| 0.0062 | (+0.0034) | in/s at 4xM | on 1T in low range |
| 0.0062 | (+0.0053) | in/s at 5xM | on 1R in low range |
| 0.0056 | (+0.0045) | in/s at 8xM | on 1R in low range |
| 0.0056 | (+0.0048) | in/s at 5xM | on 1A in low range |

SERIOUS MOTOR FREE END BEARING WEAR

| | | | |
|--------|-----------|------------------|---------------------|
| 0.0625 | (+0.0616) | in/s at 14.4xM | on 1R in high range |
| 0.0442 | (+0.0417) | in/s at 14.4xM | on 1T in high range |
| 0.0351 | (+0.0335) | in/s at 14.5xM | on 1A in high range |
| 0.0313 | (+0.0285) | in/s at 38.1xM | on 1A in high range |
| 0.0028 | (+0.0014) | in/s noise floor | on 1T in high range |
| 0.002 | (+0.0009) | in/s noise floor | on 1R in high range |
| 0.0018 | (+0.0005) | in/s noise floor | on 1A in high range |

SERIOUS MOTOR DRIVE END BEARING WEAR

| | | | |
|--------|-----------|------------------|---------------------|
| 0.0176 | (+0.0172) | in/s at 4.28xM | on 2R in low range |
| 0.0157 | (+0.0153) | in/s at 6.33xM | on 2T in low range |
| 0.014 | (+0.012) | in/s at 2.14xM | on 2A in low range |
| 0.0125 | (+0.012) | in/s at 6.33xM | on 2A in low range |
| 0.0111 | (+0.0097) | in/s at 99.4xM | on 2R in high range |
| 0.0088 | (+0.0018) | in/s at 28.4xM | on 2A in high range |
| 0.007 | (+0.0063) | in/s at 20.3xM | on 2A in high range |
| 0.0018 | (+0.001) | in/s noise floor | on 2R in high range |
| 0.0016 | (+0.001) | in/s noise floor | on 2T in high range |
| 0.0014 | (+0.0007) | in/s noise floor | on 2A in high range |

MODERATE PUMP BALL BEARING WEAR

| | | | |
|--------|-----------|----------------|--------------------|
| 0.0125 | (+0.0107) | in/s at 5.04xP | on 3R in low range |
| 0.0125 | (+0.0105) | in/s at 4.19xP | on 3R in low range |
| 0.0088 | (+0.0078) | in/s at 6.27xP | on 3T in low range |
| 0.0079 | (+0.0066) | in/s at 4.19xP | on 3A in low range |
| 0.0062 | (+0.0046) | in/s at 5.04xP | on 3A in low range |

POSITION LEGEND:

POSITION 1 IS: MOTOR, BEARING 1

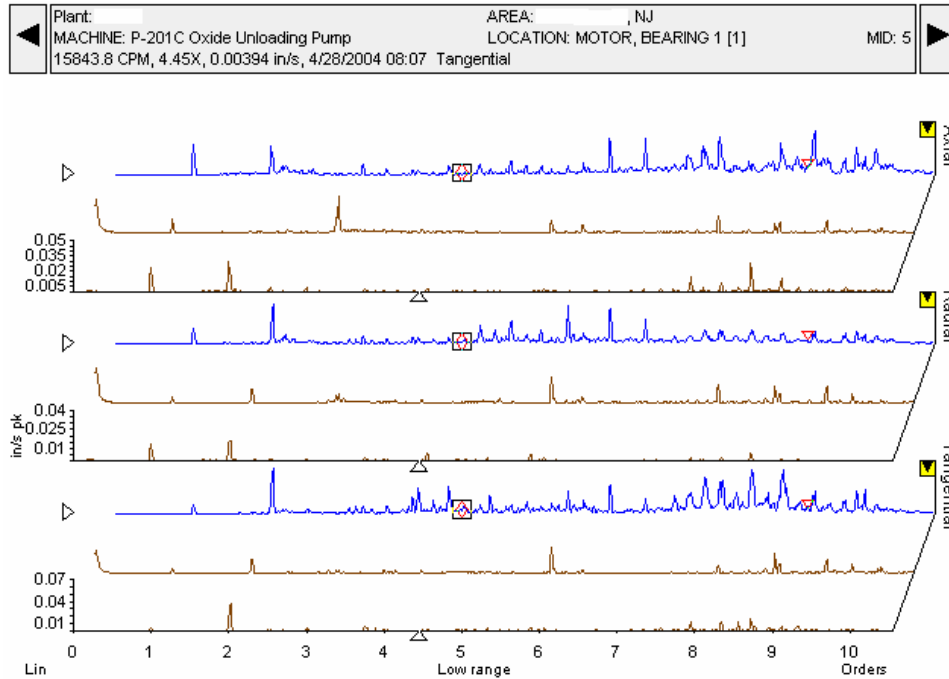
POSITION 2 IS: MOTOR, BEARING 2

POSITION 3 IS: PUMP, BEARING 3

OVERALL LEVEL READINGS

OK: 0.44 in/s at 1A Alarm level: 0.00 in/s
 OK: 0.31 in/s at 1R Alarm level: 0.00 in/s
 OK: 0.51 in/s at 1T Alarm level: 0.00 in/s
 OK: 0.14 in/s at 2A Alarm level: 0.00 in/s
 OK: 0.21 in/s at 2R Alarm level: 0.00 in/s
 OK: 0.22 in/s at 2T Alarm level: 0.00 in/s
 OK: 0.07 in/s at 3A Alarm level: 0.00 in/s
 OK: 0.10 in/s at 3R Alarm level: 0.00 in/s
 OK: 0.09 in/s at 3T Alarm level: 0.00 in/s

Analyst Comments: Pump bearing indications appear to be coming from the motor fault. Motor bearing should be replaced.



4.2) A407 Reactor

Report generated on: 5/3/2004 06:07 PM

Acquired: 4/27/2004 02:47 PM 1xM = 1377 RPM 1xN = 151 RPM Averages: 2

Figure of Merit = 216.

Maximum level: 2.4871 (+2.3472) in/s at 8.17xM on 1R in low range

RECOMMENDATIONS:

DESIRABLE: MONITOR ALL MOTOR BEARINGS FOR INCREASED VIBRATION

DESIRABLE: ALIGN MOTOR TO GEARBOX.

DESIRABLE: MONITOR DRIVE GEARS FOR INCREASED VIBRATION

DIAGNOSES:

MODERATE INDICATION OF POSSIBLE MOTOR FREE END BEARING WEAR

0.1569 (+0.1073) in/s at 20.5xM on 1R in high range

0.0279 (+0.0268) in/s at 93.2xM on 1T in high range

0.0111 (+0.0086) in/s at 77.2xM on 1T in high range

MODERATE MOTOR TO GEARBOX ANGULAR MISALIGNMENT

0.1976 (+0.148) in/s at 1xM on 2A in low range

0.099 (+0.0639) in/s at 1xM on 3A in low range

0.0394 (+0.0172) in/s at 1xM on 3R in low range

MODERATE SECOND GEAR MESH PROBLEM OR WEAR

0.0625 (+0.0129) in/s at 12xI on 3A in low range

| | |
|-------------------------------|---------------------|
| 0.0557 (+0.0381) in/s at 12xI | on 3T in low range |
| 0.0313 (+0.0234) in/s at 24xI | on 3A in high range |
| 0.0176 (+0.0088) in/s at 12xI | on 3R in low range |
| 0.0157 (+0.0046) in/s at 24xI | on 3R in high range |

SLIGHT MOTOR ROTATIONAL RATE VIBRATION

| | |
|------------------------------|--------------------|
| 0.3942 (+0.1966) in/s at 1xM | on 1T in low range |
| 0.3513 (+0.2114) in/s at 1xM | on 1R in low range |
| 0.2217 (+0.1866) in/s at 1xM | on 1A in low range |
| 0.1976 (+0.148) in/s at 1xM | on 2A in low range |
| 0.0701 (-0.041) in/s at 1xM | on 2T in low range |
| 0.0176 (-0.0266) in/s at 1xM | on 2R in low range |

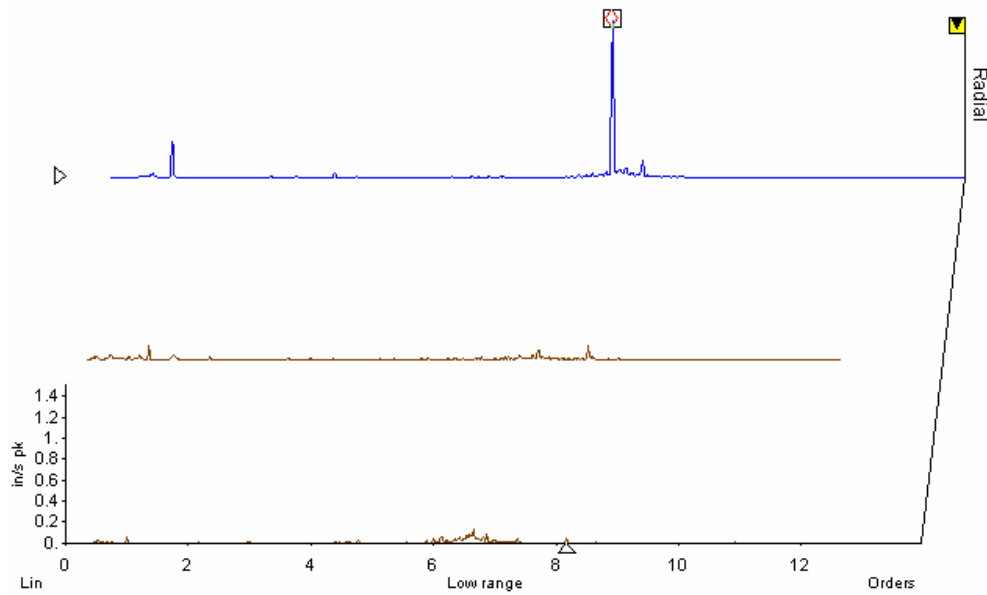
POSITION LEGEND:

POSITION 1 IS: MOTOR, BEARING 1
POSITION 2 IS: MOTOR, BEARING 2
POSITION 3 IS: GEARBOX, BEARING 3
POSITION 4 IS: SPINDLES, BEARING 4

OVERALL LEVEL READINGS

OK: 1.63 in/s at 1A Alarm level: 0.00 in/s
OK: 3.13 in/s at 1R Alarm level: 0.00 in/s
OK: 0.74 in/s at 1T Alarm level: 0.00 in/s
OK: 0.27 in/s at 2A Alarm level: 0.00 in/s
OK: 0.20 in/s at 2R Alarm level: 0.00 in/s
OK: 0.27 in/s at 2T Alarm level: 0.00 in/s
OK: 0.23 in/s at 3A Alarm level: 0.00 in/s
OK: 0.11 in/s at 3R Alarm level: 0.00 in/s
OK: 0.14 in/s at 3T Alarm level: 0.00 in/s
OK: 0.14 in/s at 4A Alarm level: 0.00 in/s
OK: 0.11 in/s at 4R Alarm level: 0.00 in/s
OK: 0.12 in/s at 4T Alarm level: 0.00 in/s

Analyst Comments: Vibration levels continue to increase. The increase is most notable on the Motor Non Drive End. It appears that the response is being induced from the Gearbox and is most likely due to the gear mesh frequency of the low speed shafting. The speed that the unit was tested at was less than the previously collected data; as a result the response measured could possibly be due to the excitation of a system resonance at the lower speeds. In any event amplitude levels are excessive and actions should be taken to reduce the high levels in the overhang. Further testing would be required to confirm resonant response. Additional information is required to fully access the exact cause of the fault. At present no bearing or gear information is available. It would be helpful if Motor, Gear and Output shaft bearing information was available. Also to confirm Gear Mesh activity the number of teeth on each of the gears is required. Response at 8.18X running speed has increased at all measured locations.



4.3) P-202C Oxide Unloading Pump

Acquired: 4/29/2004 08:39 AM 1xM = 3600 RPM 1xP = 3326 RPM Averages: 1

Figure of Merit = 701.

Maximum level: 114 (+59) VdB [1T] at 1.60xM

RECOMMENDATIONS:

- DESIRABLE: MONITOR PUMP BEARINGS FOR INCREASED VIBRATION
- DESIRABLE: REPLACE MOTOR BEARINGS
- DESIRABLE: REPLACE COUPLING ROLLING CONTACT BEARINGS

DIAGNOSES:

MODERATE MOTOR FREE END BEARING WEAR

| |
|-------------------------------|
| 104 (+37) VdB [1T] at 4.80xM |
| 97 (+31) VdB [1T] at 10.70xM |
| 95 (+31) VdB [1T] at 13.70xM |
| 89 (+27) VdB [1A] at 0.50xM |
| 67 (+ 6) VdB [1T] noise floor |
| 62 (+ 1) VdB [1A] noise floor |

MODERATE PUMP BALL BEARING WEAR

| |
|------------------------------|
| 104 (+41) VdB [3T] at 5.20xP |
| 97 (+33) VdB [3T] at 11.50xP |
| 95 (+38) VdB [3T] at 14.80xP |

MODERATE COUPLING ROLLING CONTACT BEARING WEAR

| |
|-------------------------------|
| 104 (+41) VdB [3T] at 5.20xP |
| 97 (+33) VdB [3T] at 11.50xP |
| 95 (+38) VdB [3T] at 14.80xP |
| 57 (+ 5) VdB [3T] noise floor |
| 55 (+ 3) VdB [3R] noise floor |

MODERATE MOTOR DRIVE END BEARING WEAR

| | | | | | |
|-----|-------|-----|------|-------------|---------|
| 105 | (+48) | VdB | [2T] | at | 4.80xM |
| 98 | (+30) | VdB | [2T] | at | 10.70xM |
| 95 | (+44) | VdB | [2T] | at | 13.70xM |
| 88 | (+25) | VdB | [2A] | at | 0.50xM |
| 81 | (+14) | VdB | [2R] | at | 0.50xM |
| 66 | (+ 4) | VdB | [2T] | noise floor | |

POSITION LEGEND:

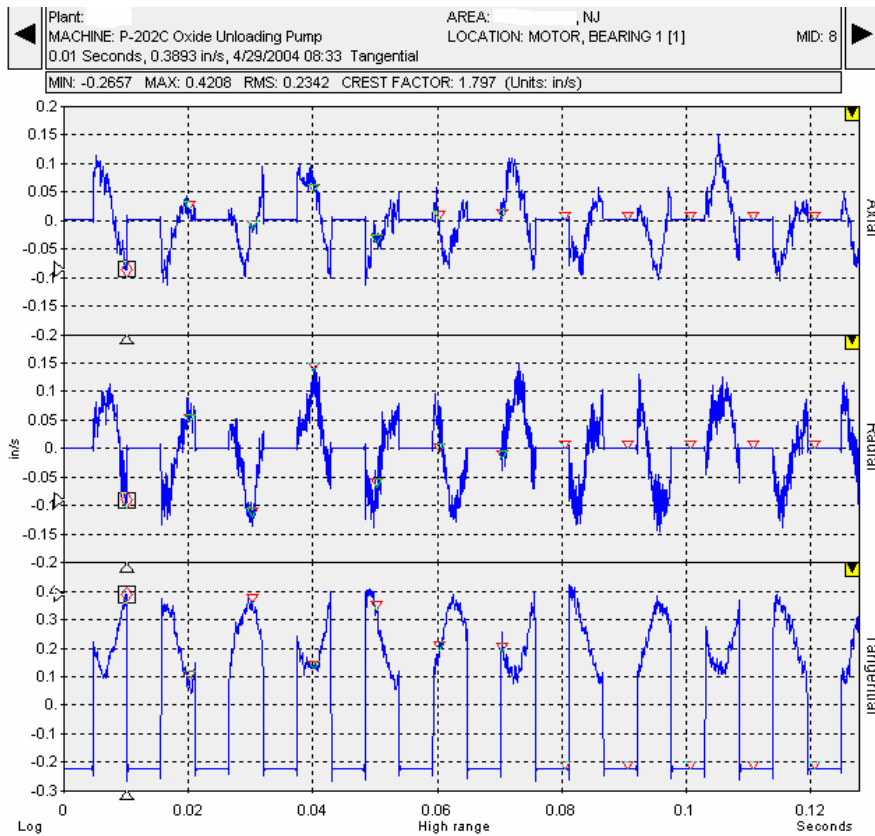
POSITION 1 IS: MOTOR, BEARING 1
 POSITION 2 IS: MOTOR, BEARING 2
 POSITION 3 IS: PUMP, BEARING 3

OVERALL LEVEL READINGS

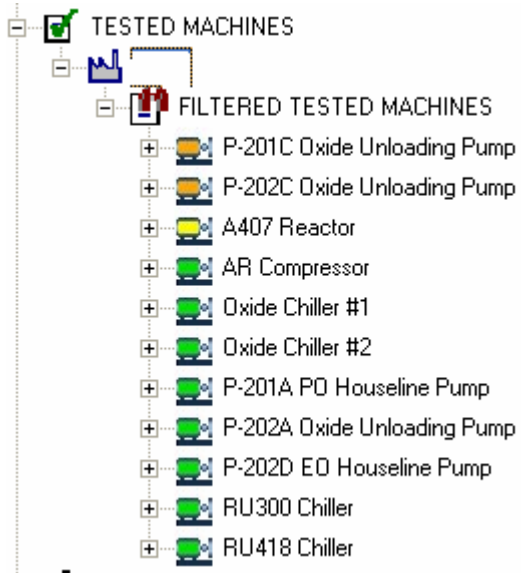
OK: 0.11 in/s at 1A Alarm level: 0.00 in/s
 OK: 0.14 in/s at 1R Alarm level: 0.00 in/s
 OK: 0.39 in/s at 1T Alarm level: 0.00 in/s
 OK: 0.10 in/s at 2A Alarm level: 0.00 in/s
 OK: 0.10 in/s at 2R Alarm level: 0.00 in/s
 OK: 0.42 in/s at 2T Alarm level: 0.00 in/s
 OK: 0.06 in/s at 3A Alarm level: 0.00 in/s
 OK: 0.06 in/s at 3R Alarm level: 0.00 in/s
 OK: 0.27 in/s at 3T Alarm level: 0.00 in/s

ANALYST NOTES

Measured response appears to be due to data collection problem. This is based on observation of time waveform which shows overlapping gated timing response at all measured locations. It is very unlikely to be a machine problem.



5.0 Tested Machine List



6.0 Untested Machine List

No Machines left untested