MONITOR

A Publication of Condition Monitoring Society of India

Regd. No. 45061/2003 | Volume 7, No. 2 | June 2010

From President's Desk...

Good News for all Condition Monitoring People!

Going by Frost & Sullivan Report (2008) on "World Condition Monitoring Equipment & Global Market", one should say the future of Condition Monitoring is very bright! The report is a very informative document which analyses worldwide market for machinery condition monitoring equipment in millions of US $. The major product segments analysed are vibration machinery, thermography, lub. oil analysis and corrosion monitoring equipment. The report covers 147 companies across US, Canada, Japan, Europe, Asia -Pacific, Latin America and rest of world. Annual forecasts are provided for each region and product segment period of 2000 through 2015. Increasing awareness and acceptance of condition monitoring technologies and means to maximize asset health and performance is contributing to the continued growth of the World Condition Monitoring equipment and services markets. Advancement in the technology has also contributed to the steady decline in condition monitoring equipment prices. Wireless communications is fast becoming the norm and recent advances in wireless technology have enabled remote condition monitoring of critical machines much more easier. An additional driver for the market is the growing trend towards automation of maintenance function in organization by integrating condition monitoring information with Plant Asset Management (PAM) systems and Computerized Maintenance Management Systems (CMMS). This is expected to develop alliances with CMMS solution provider. Many more aspects are discussed in this report which needs attentions of all players in Condition Monitoring.

Main Features of this Issue

Practicing Oil Analysis: A Case Study

The clinker hammer crusher is one of the important equipment in cement production and is used for the crushing of clinker, the main product of cement kilns, into smaller parts for the preparation of grinding. At CEMEX Egypt, the bearings used in the clinker crusher are spherical roller bearings. These bearings are lubricated with a lithium complex thickened grease with a synthetic base oil designed for high-temperature applications.

At the CEMEX plant, bearing failures can lead to a halt in cement production. To maintain continuous operation, it is critical for the bearings to operate smoothly. As part of the predictive maintenance program, vibration analysis is used to monitor the condition of the crusher. A grease sample to analyze wear debris was taken at the first shutdown of the clinker crusher as part of a new program to monitor the performance of equipment. Vibration monitoring of the out board bearing in the third clinker line at a speed of 360 RPM provided no warning signals. During the next scheduled shutdown, the bearing was opened and a sample of grease was taken. Wear debris analysis was performed on the grease sample to find the cause of the bearing failure that occurred.

Wear debris analysis was carried out on used greases by extracting magnetic particles from the sample using a magnet. Microscopic analysis of the sample identified numerous small and large spherical particles. Research has shown that spherical wear debris can reveal the severity of rolling contact fatigue wear. Because large spherical particles (50 microns) are the product of high metal-to metal contact and high frictional temperature, their presence is considered a supporting symptom for assessing the wear severity levels.

Wear particles were considered to be a critical alarm indicating the need to change the bearing before a forced outage occurs. During shutdown, the crusher's outboard bearing was replaced. To check for potential defects, the bearing was opened and visually inspected. A close look of the outer race of the defective bearing showed signs of severe wearing.

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Practicing Oil Analysis: A Case Study

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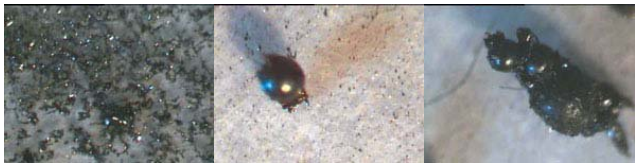

This case study illustrates the efficiency of condition monitoring based on the detection of debris in grease, which can be a resourceful tool in controlling machine condition and should integrate diagnostic devices.

Defective Bearing Shows Signs of Severe Wear

Reference:

Ahmed Safwat, Cemex Egypt, "Wear Debris Analysis". Practicing Oil Analysis Magazine. November 2006.

TENTATIVE GUIDE TO VIBRATION LIMITS FOR MACHINE TOOLS

Amplitudes of machine tool vibration must be relatively low in order to maintain dimensional tolerances and to provide acceptable surface finish of machined workpieces.

The vibration limits tabulated below are based on the experience of manufacturers and were selected as typical of those required on machine tools in order to achieve these objectives.

These limits should be used as a guide only – modern machines may need even tighter limits for stringent machining specifications.

It should be mentioned that vibration limits are in displacement units, as the primary concern for machine tool vibration is the relative motion between the workpiece and the cutting edge. This relative motion is compared to the specified surface finish and dimensional tolerances, which are also expressed in terms of displacement units.

When critical machinery with a heavy penalty for process downtime is involved, the decision to correct a condition of vibration is often a very difficult one to make. Therefore, when establishing acceptable levels of machinery condition, experience and factors such as safety, labor costs, downtime costs and the machine's criticality should be considered. It is thus reiterated that standards should only be an indicator of machine condition and not a basis for shutting down the machine. What is of extreme importance is that vibrations of machines should be recorded and trended diligently.

Type of Machine	**Tolerance Range (mils)**
Grinders	
Thread grinder	0.01–0.06
Profile or contour grinder	0.03–0.08
Cylindrical grinder	0.03–0.10
Surface grinder (vertical reading)	0.03–0.20
Gardener or besly type	0.05–0.20
Centerless	0.04–0.10
Boring machine	0.06–0.10
Lathe	0.20–01.0

Reference: Practical Machinery Vibration Analysis and Predictive Maintenance, Elsever Publications

Product news

The Efector Octavis VKV is a self-contained vibration monitor with built-in switching output and a transmitter function. Attached to almost any machine, the VKV monitors the overall condition of equipment by analysing the severity of the vibration. Knowing how to set up such a unit is made easier by reference to the ISO standard 10816. This standard establishes the general conditions and procedures for the measurement and evaluation of vibration using measurements made on the non-rotating parts of machines, primarily with regard to securing reliable long-term operation. Coverage of machine types in the standard ranges from reciprocating pumps to industrial machines, steam turbines and generators.

In use, the Efector Octavis VKV is firmly attached to the machine, then the rms (vibration in mm/s or even inches/s) is set on the first ring, followed by the time delay on the second ring. Once the setting is in and locked, the task is complete and the VKV will monitor the plant unattended.

Small and easily set-up, the Efector Octavis VKV reduces the need for specialist knowledge or expensive outsourcing. The output will switch if the preset vibration velocity is reached, or the additional 4-20mA signal can display a value or be monitored centrally.

For more information, visit www.ifm.com

THREE PHASE INDUCTION MOTOR ANALYSIS

Over 47% of electric motor failures occur due to electrical faults. Ten percent are due to rotor faults, the rest are due to stator winding faults. Contrary to popular belief, insulation to ground faults (insulation resistance) account for the least number of initial faults. The primary causes, such as insulation (thermal) breakdown, contamination, moisture incursion, transients, and mechanical stress, first result in a breakdown of insulation between conductors within the same coil, between coils in the same phase or between coils of separate phases. These winding 'shorts' may, but not always, end up as an insulation resistance fault when the winding actually fails. Detection of changes between conductors provides a greater chance of early repair or replace action before equipment actually stops operating (failure), reducing unscheduled downtime costs.

The anatomy of a winding fault between conductors is:

Stage 1: The insulation between conductors is stressed, causing a change to the resistive and capacitive values of the insulation at the fault point. High temperatures and similar reactive faults result in carbonization of the insulation (dielectric) at that point. Carbonization may also occur due to tracking across the insulation system.

Stage 2: The point of fault becomes more resistive. A mutual inductance occurs between the 'good' portion of the winding (and other current carrying components of the system) and the shorting turns. I^2R losses increase at the point of the fault due to the increase in current within the shorting turns, increasing the temperature at that point and causing the insulation system to carbonize quickly. The motor may start tripping at this point, although it may be able to run after a short cooling period.

Stage 3: Insulation breaks down and the energy within the point of the short can cause an explosive rupture in the insulation system and vaporization of the windings.

Through a series of readings that include simple resistance, inductance, impedance, phase angle and current/frequency response, these faults can be detected in the first stage of failure. The rate of fault between the stages will depend upon the motor voltage, size of fault and severity of fault. In the present operating environment, most corrective measures are applied in the second or third stage, in which the equipment is having a financial impact on production, or the mission of the equipment. High voltage test equipment will detect some stage 1 issues, however, once detected, will cause a rapid move towards stage 3. Current signature analysis will only detect faults that are progressing from stage 2 to stage 3.

Rotor fault detection has become more popular at the turn of the 21st Century. This is the result of two issues: 1) Marketing and papers presented by manufacturers of equipment who rely on mutual inductance measurements; and, 2) Marketing and papers presented by manufacturers of current signature analysis equipment, who are limited to rotor and air gap fault detection. In both cases, these technologies can only detect, within strict limits, the later stages of winding faults.

The types of faults common to electric motor rotors are:

Air gap (Rotor Eccentricity): Which is normally not a progressive failure, unless there is looseness in the rotor, or a fault within either the motor shaft or bearings has become severe. Looseness, bearings and motor shaft issues can be detected faster, and safer, using vibration analysis techniques. Manufacturing and repair air gap issues can be detected with static winding circuit analysis during acceptance testing or at the manufacturer/repair shop prior to time lost installing the equipment. This type of acceptance testing is used to determine if the air gap has been set properly (+/- 10% of average air gap reading taken at either end of the rotor during installation).[9]

Casting Voids and Rotor Bar Connections: Which may progress to 'broken rotor bar' faults over time. There are always casting voids in cast aluminum rotors, variations in the aluminum alloy and variations in the joints of copper alloy bars that will effect inductance. The faults can be detected by taking a series of readings as the shaft is rotated 360 degrees. These readings can be graphed as a waveform and viewed for faults by looking at the position of inductance and/or impedance changes of the waveform. A small change on the incline or slope of the waveform indicates a small, usually non-intrusive defect, while a significant change at the peak of the waveform indicate severe rotor faults. Severe faults will interfere with the operating characteristics of the motor.

Broken Rotor Bars: Are progressive faults that normally occur due to incorrect operation of the electric motor. As an electric motor is started, heat builds up in the rotor due to high currents and high frequency, requiring a cool-down period. In other cases, a rotor may be stalled, causing high currents and high rotor frequencies. The expansion rate of the copper alloys (or aluminum) and the rotor materials are different, putting mechanical stress on the bars themselves. Under extreme stress, the rotor bars may crack, reducing the ability of the motor to produce torque. As rotor bars fracture, the surrounding rotor bars carry additional current, causing a further increase in rotor bar temperatures and possibility that additional cracks will occur.

Source : Extract from "Theory of Static Winding Circuit Analysis", by Howard W. Penrose, Ph.D.

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Condition Monitoring Society of India(C M S I)

CMSI Members in News

Sri N.S. Naidu, Scientist 'F', NSTL, Visakhapatnam was unanimously elected as Vice President, Acoustical Society of India (ASI). CMSI wishes him best of luck in his future endeavors.

Dr. M.R.S. Satyanarayana, HOD, Mechanical Engg. Department, GITAM University, Visakhapatnam has been appointed as Vice-Principal of Engineering College. CMSI wishes him best of luck in his future endeavors.

CMSI Welcomes New Members!!

Life Members:

Sri. K. V. Raghavendra Rao
Sri. V. Ramakrishna
Sri. D. Ramesh Babu
Dr. Syed Kamaluddin

Editorial Board

Dr. V. Bhujanga Rao

Prof. Dr. M. Ananda Rao

Sri K.V.V.S.S. Murty

Sri T. Venkata Ratnam

CONDITION MONITORING AROUND THE GLOBE...

Courses, Conferences, Workshops

2nd International Conference on Mechanical, Industrial, and Manufacturing Technologies (MIMT 2011)

Date : **26-28 Feb 2011**
Venue : **Singapore**
Paper Submission : **Oct 10, 2010**
For Further Details : www.iacsit.org/mimt/

International Conference on Vibration Engineering & Technology of Machinery (VETOMAC-VI 2010)

Date : **December 13 - 15, 2010**
Venue : **IIT, Delhi**
Registration : **Before 15 September 2010**
For Further Details : http://web.iitd.ac.in/vetomac

🕮 Reference Books 🕮

Rotating Machinery Vibration: From Analysis to Troubleshooting by **Maurice L. Adams, Jr.**
This book includes comprehensive descriptions of vibration symptoms for rotor unbalance, dynamic instability, rotor-stator rubs, misalignment, loose parts, cracked shafts, and rub-induced thermal bows. It is an essential reference for mechanical, chemical, design, manufacturing, materials, aerospace, and reliability engineers. Particularly useful as a reference for specialists in vibration, rotating machinery, and turbomachinery, it also makes an ideal text for upper-level undergraduate and graduate students in these disciplines.
Publisher: CRC Press; 2 edition (December 23, 2009)
ISBN-10: 1439807175

BOOK POST

If undelivered please return to:

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All feed back, comments and contributions to the news letter are most Welcome.

- Editor