

On-line Machine Diagnosis System[†]

1. Introduction

This on-line machine diagnosis system is widely used in various industries as a tool for monitored maintenance (predictive maintenance) in production sites and has achieved significant positive results.

This report introduces the new technologies, features, and application technologies combined with other technologies of the latest version of the on-line machine diagnosis system that is made available by the JFE Group.

2. Overview of the System

This system was developed as a commercial product using the machine diagnosis technology developed by the JFE Steel as the basis for visualization and quantization of the machines while they are operating.

Using the sensors, installed in on-site machines, such as vibration pick-up sensors and measurement units that are connected to a network, the system automatically measures bearing vibrations and various process signals and automatically accumulates data, checks the presence or absence of abnormalities, and analyzes the causes of the abnormalities that have occurred.

The data that has been accumulated and checked can be displayed and verified from dedicated on-line terminals or application terminals.

3. New Technology and Application Technologies of the System

3.1 New Technologies and Features of the System

(1) Distributed Network System

The system uses an Ethernet based LAN (local area network), which is a world standard technology, for the connections between the measurement units that are installed in the site. The LAN wiring cost was kept to a minimum by utilizing the existing plant network infrastructure facilities and sharing lines with other systems.

The system supports various commercial network

devices (optical LAN, wireless LAN, ADSL, and so on), thereby achieving high expandability.

(2) Web Remote Access

By using a Web browser, the system enables users to check diagnostic data in remote mode without installing special software in existing personal computers as application terminals.

By using the e-mail report function at the occurrence of an alarm, the user can check the occurrence of an alarm using the mail software.

(3) Real Time Measurement

By installing a 1 s parallel measurement function for checking vibrations, vibration behaviors can be measured and stored in real time while the machines are operating.

This function enables the user to examine the details of machine vibration characteristics of rolling machines and machine tools during rolling or cutting. Such information can be used as quality control index data and post-examination data for detecting the causes of failures at the occurrence of unforeseen accidents.

(4) Sharing Data with Maintenance Information

The inspection diagnosis system manages variations of the machine conditions with the code-number structure that is integrated with the maintenance management system. When the system determines that machine should be managed with care, the system outputs a recommended inspection date automatically. This function expedites the generation of diagnostic results and ensures subsequent maintenance actions.

This function enables sharing of data collected by the portable vibration measurement system with the data collected on-line and integrated management of data such as maintenance details.

(5) Automatic Vibration Diagnosis

This system incorporates a series of diagnostic functions from simple diagnostic evaluation to automatic precision evaluation using frequency analysis in the standard software.

The well-developed analysis support functions (zooming, harmonic, sideband, and so on) have strengthening enabled precise diagnosis of complicated machines in more detail.

(6) Software in English and Korean Versions

In addition to the Japanese version software for data

[†] Originally published in *JFE GIHO* No. 11 (Apr. 2006), p. 62–64

display terminals, English and Korean versions are also available and these versions can be used to monitor the maintenance of overseas production factories.

3.2 Utilization Technology of the System

(1) Abnormal Machine Diagnosis Analysis Service

The on-line machine diagnosis system manages variations of machine conditions and displays alarms by detecting values outside of the threshold values and any sudden deterioration. The system also activates precision diagnosis and displays assumed causes of abnormalities with corresponding certainty factors. However, since analysis of any abnormality caused by complicated factors requires advanced know-how, by using the Web, a diagnosis expert can analyze the waveforms, and report to the customer on the assumed causes and recommend the appropriate actions to be taken.

(2) Utilization Example

(a) Example of abnormality analysis of a press transfer machine

Figure 1 shows an example of abnormality analysis of a press transfer machine. Deterioration of the ball screws of a press transfer machine was detected by trend monitoring of the variation, the parts were replaced, and the event was used to initiate maintenance.

(b) Example of detection of electrical corrosion

Figure 2 shows an example of the detection of electrical corrosion. The cause of the bearing abnormality was clarified by precision diagnosis.

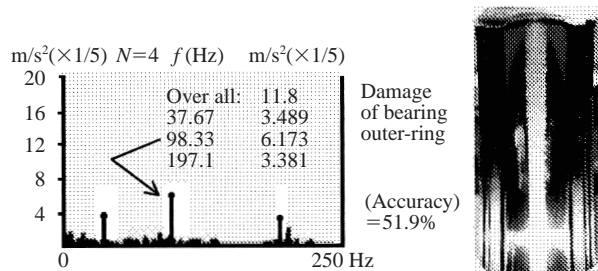


Fig.2 Fast Fourier transform (FFT) of motor equipment

4. Examples of System Application

4.1 Application to Automobile Press Plants

Press machines used in the automobile industry are employed under harsh conditions where bodies and small components around engines are forged at high speed. When any machine abnormality occurs, lot defects in large quantities can occur as the consequence. Press operation is performed at high speed, 2 s per cycle, so that the measurement of vibrations in a short time is required using timing signals avoiding the press head bottom dead center that entails a strong impact. The system has achieved significant results in monitoring of abnormalities in overloaded machines through monitoring of the slide metal temperatures, lubrication oil pressure of the slide metal, servo motor current for reciprocating operation, and flywheel shaft displacement.

4.2 Application to Paper Manufacturing Plants

Various measures are taken for the drier part of a paper machine line since high-speed operation in a high-temperature environment involves significant fire danger.

In particular, the monitoring of conditions of the bearing sections in a drier part is very important in terms of fire prevention. However, inspection of bearing vibrations by an inspector is very difficult since the bearing section is located within a high-temperature, high-humidity environment.

By installing the on-line machine diagnosis system using heatproof vibration pick-ups in such an environment, significantly positive results can be achieved in the prevention of sudden failures and fires.

4.3 Application to Chemical Plants

Rotary machines such as pumps and fans in chemical plants are often located in dangerous areas since they handle volatile chemical substances such as gases and liquids. In this case, sensors that are installed in the sites, such as vibration pick-ups, must have explosion-proof certification according to the degree of the com-

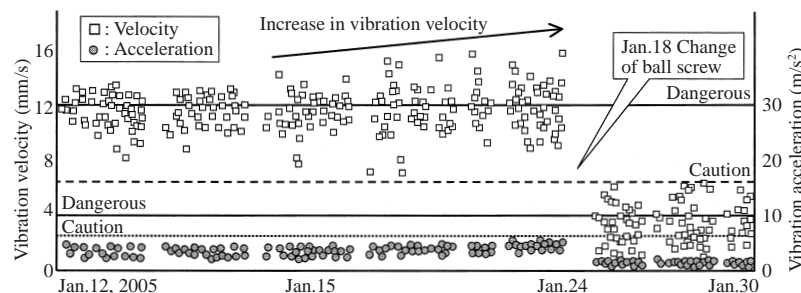


Fig. 1 Trend data of press equipment

bustion danger.

Rotary machines are often installed over a wide area and inspection is labor-intensive.

In such an environment, by installing this on-line machine diagnosis system using intrinsically safe, explosion-proof vibration pick-ups, significantly positive results can be achieved in the prevention of sudden failures and improvement of inspection efficiency.

5. Production Introduction

5.1 Vibration Diagnosis Emphasis System “CMS-6100”

System “CMS-6100” was developed by enhancing the advanced analysis function in vibration diagnosis such as real time monitoring functions and analysis support functions (Fig. 3).

5.2 Maintenance Information Data Sharing System “SM2003”

“SM2003” is a comprehensive management system that shares data with portable vibration measurement systems and centrally manages data with maintenance information such as the maintenance management system (Fig. 4).

6. Conclusion

This system is installed in a variety of businesses and facilities and has been highly evaluated for its excellent performance. We will continuously make comprehensive efforts as the JFE Group to satisfy customer requirements.

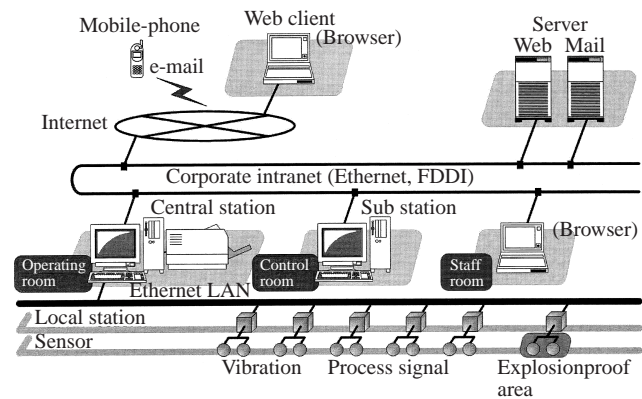


Fig. 3 CMS-6100 System configuration

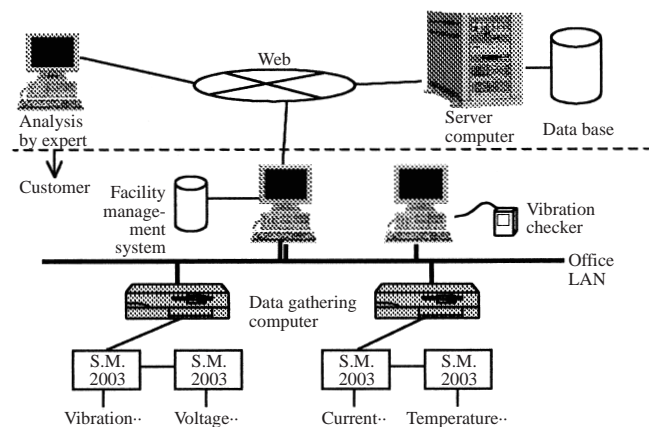


Fig. 4 SM2003 System configuration

For Further Information, Please Contact to:

Tokyo Office Sales Sec., Measuring & Diagnosis Div.,
JFE Advantech
Phone: (81) 3-3662-5341
Sales Room, Control Sales Div., Head Office, JFE Mechanical
Phone: (81) 3-3864-3849