Fit for the future with intelligent condition monitoring

Ratingen, Germany, 18.2.2016

Team of experts realise condition-oriented maintenance strategy on a large scale for the production of specialist papers

Whether it is in the form of sales receipts, bank statements, entrance tickets or tickets of any type, thermal paper is everywhere. The paper gets its special characteristics from a special coating known in the trade as a "coat". Around 300 tons of thermal paper goes through Coating Machine 3 at Mitsubishi HiTec Paper Europe GmbH in Bielefeld, Germany (MPEB) every day. The four-storey machine has a maximum operating speed of up to 1730 metres per minute and has held the world record for curtain coating technology since 2007. Coating Machine 3 has 26 fan units, each consisting of a supply and exhaust air fan. These ensure the contactless drying of the coated paper. Since the start of 2014, 26 FAG SmartCheck sensors from Schaeffler have been monitoring those fans for deviating vibrations by carrying out vibration measurements. An FAG SmartController based on a Mitsubishi Electric PLC from the MELSEC L-series operates as a bidirectional gateway between the customer controller and sensors. As a result of using the monitoring system, unscheduled machine shutdowns are avoided which ultimately enables production to be optimised and total operating costs to be reduced.

Paper finishing – a high-tech business
Mitsubishi HiTec Paper Europe GmbH is part of the international Mitsubishi Paper Mills Group and has two sites in Bielefeld (MPEB) and Flensburg (MPEF). Around 450 employees work at the historic site in North Rhine-Westphalia covering an area of more than 418,000 square metres which has a production capacity of 150,000 tons per annum. The portfolio includes special coated papers for a wide range of applications and printing technologies such as e.g. thermal, inkjet, carbonless or label paper. The base paper is produced in-house, enabling papers and the functional coat to be optimally matched.

Jürgen Heitland, Head of Electronics and Measurement and Control Technology (EMSR) at MPEB, explains: "On Coating Machine 3, we finish the raw paper with a pre-coat and a top coat to give it its thermal characteristics. In order to guarantee the perfect coating, the paper which can be up to 2.9 metres wide must be dried without contact. That critical task is carried out by a total of 13 hot air drying hoods, each with two large radial fans for supply and exhaust air." The supply air fans blow the hot air at a temperature of up to 250 degrees Celsius into the drying hoods. In the process, the surface of the thermal paper must not be heated above 68 degrees Celsius otherwise, based on the operating principle of the thermal printer, an undesirable discolouration will occur. The larger supply air fans have a diameter of just over one metre and weigh around 100 kilograms while the exhaust air fans are slightly smaller and lighter. With a fan weighing up to 100 kilograms rotating at a speed of 1500 rpm, this results in an imbalance over time that can cause direct damage to the bearing. If that imbalance is not detected and rectified in time, the result will be a production shortfall or, if one of the first four hot air drying hoods is affected, production will come to a standstill.
In mid-2013, when an imbalance in Coating Machine 3 was not detected in time, it resulted in the complete failure of a fan. Besides the bearing, attachment parts were also heavily damaged. This resulted in a short system shutdown which led to a reduction in the rate of production. The Head of EMSR looks back at the incident: "That fan failure was the catalyst for our decision to look for a way to switch from time-based to condition-oriented maintenance. We wanted to be able to detect imbalances or damage to roller bearings early before they became apparent through noise or an increase in temperature. Because as soon as the temperature rises in the bearing, then it is usually already too late for a scheduled component replacement. At that point, action must be taken – and fast. Yet as a rule, replacement parts are not immediately available, meaning that the failure of the fan goes on for even longer. Such unscheduled shutdowns are always costly."

Arkadius Schostak, Service Manager at Werthenbach who was responsible for the development and implementation of the solution, explains: "The early warning system with the FAG SmartCheck enables us to predict the actual failure of a component up to several months in advance, leaving us enough time to order replacement parts and to accurately schedule a system shutdown for maintenance and repairs. As a result, machine availability and process reliability have improved."

A meeting of expert minds

Werthenbach has been collaborating with Schaeffler in the field of roller bearings for decades. As an authorised premium partner, the company has realised several projects on condition monitoring with the help of the
roller bearing specialist and its service experts. "We have used the FAG SmartCheck for other customers too but the size of this project at MPEB really was something special", says Arkadius Schostak. Werthenbach has also been working with MPEB for decades so that the service team are familiar with and understand the customer's requirements.

The collaborative relationship between Schaeffler and Mitsubishi Electric Europe began in 2010 during the product development process for the FAG SmartCheck. Today, Schaeffler is a Mitsubishi Electric e-F@ctory Alliance partner. Christoph Behler, Senior Business Development Manager, Factory Automation – European Business Group at Mitsubishi Electric, explains: "At the time, Schaeffler was looking for a way to connect the intelligent vibration sensor to customer systems and databases via an equally intelligent controller. The controllers in our MELSEC L-series are able to communicate with all common field bus systems and at the control and sensor level via an Ethernet based connection. The SLMP protocol (Seamless Message Protocol) running between sensor and controller is based on Ethernet TCP/IP and therefore permits system access via an integrated web browser in the sensor at the same time as well as bidirectional data communication with the controller."

It was six months after the discovery of the problem when the solution was finally put into operation. First of all, Werthenbach produced a complete set of documentation and then data was collected and evaluated based on an offline vibration measurement carried out on all the fans. Once again, Schaeffler compiled recommended measures and drew up an action plan based on the results. All the information was used to formulate a proposed solution. After an in-depth examination by the engineers from MPEB, Werthenbach was awarded the contract and the system was put into operation after approximately six weeks. Installation was carried out by Werthenbach while configuration and activation were
taken care of by Schaeffler. With support from Mitsubishi Electric Europe, the configuration of network communication, i.e. the actual integration of the comprehensive monitoring solution in the customer system, only took a matter of hours.

**Specific customer requirements**

The technical department at MPEB had specific requirements for an online monitoring solution. One of the main criteria was to keep cabling to an absolute minimum in order to achieve maximum cost efficiency. The use of Power-over-Ethernet (PoE) meant that the number of cables could be reduced by two thirds. Thomas Schmitz, Service Manager Condition Monitoring at Schaeffler, explains: "The retrospective process of laying cables is often complicated, particularly when upgrading an existing machine, and all the more so in the case of Coating Machine 3 which has multiple levels. Thanks to PoE, a single cable is all that is required instead of individual communication, voltage and additional signal cables. Besides enabling the bidirectional exchange of data, the cable powers the whole system and provides a Power-over-Ethernet network connection. All signals are assigned to recipients by the FAG SmartController. Minimal programming was required in the process."

Another challenge presented itself in the form of the automated processing of speeds without affecting the performance of the customer controller. The FAG SmartController rose to that challenge: as an intelligent gateway between the customer controller and sensors, it enables bidirectional communication and is connected to the FAG SmartChecks as well as the customer controller via the Ethernet cable by means of PoE switches. It transmits vibration data and status information from those sensors to the customer controller where the data can then be displayed in a SCADA system. The SmartController also distributes individual variable speed-related information from the customer controller
to the individual sensors.

The solution is freely expandable which means that in the future, it will be possible for the whole four-storey machine to be monitored by a unified system, enabling the behaviour of all the rotating parts if the speed is increased to be precisely recorded. In theory, the system can be accessed from any workstation at the plant with the corresponding programs while the Werthenbach service team can also make full use of remote assistance via a VPN connection. The hardware required for establishing a WLAN connection is also available so that in the future, it will be possible to gain access via mobile terminals at any time from any location at the site.

**FAG SmartCheck – small, but powerful!**

The purpose of condition monitoring is to indicate when limit values will be exceeded in good time. FAG SmartCheck systems have a status indicator with a traffic light function for that purpose. If the status changes from green to yellow into preliminary-alarm status, a predefined limit value has been exceeded. However, the machine can still continue to operate for the time being. A red alarm indicates an urgent need for action and means main-alarm. The operating personnel can access each individual sensor via an integrated web server and display detailed information. If required, Werthenbach can transmit that information to the specialists from Schaeffler who will not only identify the problem but also draw up a written recommended action plan. As the system can issue an initial warning via the yellow preliminary alarm up to three months in advance, that leaves sufficient time to schedule a system shutdown and order replacement parts, thus avoiding bearing damage in the process.

Besides purely monitoring bearings, the monitoring solution enables a whole process to be monitored. Thomas Schmitz explains: "Each FAG
SmartCheck system monitors a fan unit for unacceptable vibrations and the two pedestal bearings and the fan impeller each have their own vibration pattern. Based on the data history, trend curves can be produced and used as a basis for drawing conclusions regarding the condition of the machine and processes. So it is often even possible to identify when and most importantly why a problem first arose so that it can then finally be rectified. Based on meaningful data, MPEB is able to track the long-term behaviour of the units despite constantly changing production conditions and to carry out targeted structural improvements."

**Successful pilot project**

The monitoring system proved its worth just a few months after commissioning when it detected anomalies in two exhaust air flotation driers. The Werthenbach service team recorded data and carried out an initial analysis. The experts from Schaeffler went one step further and compiled the results, along with a recommended action plan, in the form of a written report. The reason for the anomalies was an unacceptably high imbalance combined with damage to an outer ring bearing. Both problems were successfully resolved in good time by carrying out scheduled maintenance, long before the imbalance would have become audible or perceptible or damage would even have been caused to adjacent components. Both costly and tedious troubleshooting and high follow-up costs were avoided as a result.

The aim is for MPEB’s own technical and operating personnel to build up their knowledge of the monitoring system so that they will then be able to look after the system themselves. Werthenbach will assist its customer throughout this learning process by carrying out such tasks as the remote analysis of data. Initial staff training has also been scheduled.

Due to the good results of the pilot project, Mitsubishi HiTec Paper
Europe decided to install the FAG SmartCheck on the coating machine at its Flensburg site too. 22 systems now monitor the vibrations of eleven supply and exhaust air fans there. "The system has been successfully installed! We are in the process of drawing up corresponding proposals on a similar scale for two further interested parties", says Arkadius Schostak. "This type of solution is suitable for use with any type of process technology where continuous operations lead to vibrations such as electric motors, pumps, compressors or gearboxes, for example."

Jürgen Heitland finishes by saying: "Condition monitoring with the FAG SmartCheck has enabled us to take a decisive step towards Industry 4.0. The FAG SmartController is the key part of the whole system as it enables us to transmit information from the sensor at field level via the control system level and the MES for use in the ERP system as well as to implement higher-level data directly at field level."

**Image captions:**

**Picture 1:** The condition monitoring solution monitors 26 fan units, each consisting of a supply and exhaust air fan. The hot air drying hoods ensure the contactless drying of the coated thermal paper.

[Source: Mitsubishi HiTec Paper Europe GmbH]
The futuristic-looking Coating Machine 3 built in 2001 is the result of a design study carried out by the machine manufacturer.

[Source: Mitsubishi HiTec Paper Europe GmbH]
The four-storey machine has a maximum operating speed of up to 1730 metres per minute and has held the world record for curtain coating technology since 2007.

[Source: Mitsubishi HiTec Paper Europe GmbH]
**Picture 4:** 26 fan units, each consisting of a supply and exhaust air fan, ensure the contactless drying of the coated paper on Coating Machine 3. The photograph shows the supply air fan level.

[Source: Mitsubishi Electric Europe B.V.]

**Picture 5:** A fan unit consists of a motor, belt, shaft and fan. The FAG SmartCheck sits on the shaft bearing and the belt pulleys and fan impeller are interconnected.

[Source: Mitsubishi Electric Europe B.V.]
Picture 6: The FAG SmartController is housed in a control cabinet along with the PoE components in the vicinity of the fan units.

[Source: Mitsubishi Electric Europe B.V.]
Picture 7: An FAG SmartController in the form of a Mitsubishi Electric PLC from the MELSEC L-series operates as a bidirectional gateway between the customer controller and sensors in the condition monitoring system.
[Source: Mitsubishi Electric Europe B.V.]

Picture 8: Mechanical engineer Alexander Schröder of Mitsubishi HiTec Paper Europe GmbH inspects an exhaust air fan. The status display on the FAG SmartCheck indicates a change in the state of the unit on side. Further maintenance measures can be initiated based on that information.
[Source: Mitsubishi Electric Europe B.V.]
A SCADA system displays the vibration data and status information from the sensors in real time. The units are situated at a distance of approximately 100 metres from the control station and are installed at different levels.

[Source: Mitsubishi Electric Europe B.V.]
Mitsubishi HiTec Paper Europe GmbH is part of the international Mitsubishi Paper Mills Group and has two sites in Bielefeld and Flensburg. The portfolio includes special coated papers for a wide range of applications and printing technologies, e.g. thermal, inkjet, carbonless or label paper.

[Source: Mitsubishi HiTec Paper Europe GmbH]

**Picture 10:** Mitsubishi HiTec Paper Europe GmbH is part of the international Mitsubishi Paper Mills Group and has two sites in Bielefeld and Flensburg. The portfolio includes special coated papers for a wide range of applications and printing technologies, e.g. thermal, inkjet, carbonless or label paper.

[Source: Mitsubishi HiTec Paper Europe GmbH]

**Picture 11:** Around 450 employees work at the Mitsubishi HiTec Paper Europe GmbH site in Bielefeld which covers an area of more than
418,000 square metres. It has a production capacity of 150,000 tons per annum.

[Source: Mitsubishi HiTec Paper Europe GmbH]

**Picture 12:** From left to right: Arkadius Schostak, Service Manager, Carl Werthenbach Konstruktionstelle GmbH & Co. KG; Thomas Schmitz, Service Manager Condition Monitoring, Schaeffler Technologies AG & Co. KG; Jürgen Heitland, Head of Electronics and Measurement and Control Technology (EMSR), Mitsubishi HiTec Paper Europe GmbH; Alexander Schröder, Mechanical Engineer, Mitsubishi HiTec Paper Europe GmbH; Christoph Behler, Senior Business Development Manager, Factory Automation – European Business Group, Mitsubishi Electric Europe B.V.

[Source: Mitsubishi Electric Europe B.V.]
ADDITIONAL TEXT

**Picture 13:** Around 300 tons of thermal paper goes through Coating Machine 3 at Mitsubishi HiTec Paper Europe GmbH every day.
[Source: Mitsubishi Electric Europe B.V.]

**Picture 14:** A roll of thermal paper from Coating Machine 3 weighs more than nine tons (9108 kg).
[Source: Mitsubishi Electric Europe B.V.]
First released in Germany in 2015

Note to Editor: if you would like the text in another language please contact Philip Howe at DMA Europa – philip@dmaeuropa.com.

About Mitsubishi HiTec Paper Europe GmbH
Mitsubishi HiTec Paper Europe GmbH, one of the world's leading manufacturers of speciality papers, combines the know-how of a top-class paper manufacturer with unique technology. With support from ongoing product development, consistent market orientation, a global distribution network and the latest logistics facilities, innovation and progress are guaranteed. As a subsidiary of Mitsubishi Paper Mills in Japan and a member of the Mitsubishi Group, Mitsubishi HiTec Paper Europe GmbH benefits not only from an excellent international distribution network but also from collaboration in the fields of research and development, service and logistics. At the same time, the company has retained the flexibility of a medium-sized business – for the benefit of its customers.

Further information:
www.mitsubishi-paper.com
www.mitsubishi-paper.com/ueberuns_europe_start.html

About Carl Werthenbach Konstruktionsteile GmbH & Co. KG
"Competence that moves" is the guiding principle of the Werthenbach Group. In 1932, Carl Werthenbach set up on his own as an agent for Nüral Kolben and laid the foundations for today's Werthenbach Group with headquarters in Bielefeld. The company continually expanded its range by adding new product groups, offices and distribution centres in order to keep pace with market requirements. Over the years, three main areas have emerged in the distribution structure:
automotive and engine parts, industrial products and industrial hydraulics. Since 2007, Werthenbach's range of services has included a dedicated service team.

Further information:
www.werthenbach.de

About Schaeffler Industrial Aftermarket
Schaeffler Industrial Aftermarket (IAM) takes care of the replacement parts and service business with end customers and distribution partners in all major industrial sectors. With innovative solutions, products and services in the field of roller and slide bearings as well as through the consistent application of the total cost of ownership (TCO) philosophy, IAM reduces maintenance and operating costs, increases machine availability and helps to make our customers more competitive. With more than 82,000 employees at 170 sites and a turnover of around 12.1 billion euros (FY 2014), the Schaeffler Group is a leading global integrated automotive and industrial supplier.

Further information:
www.schaeffler.de/aftermarket

About Mitsubishi Electric
With over 90 years of experience in providing reliable, high-quality products to both corporate clients and general consumers all over the world, Mitsubishi Electric Corporation is a recognized world leader in the manufacture, marketing and sales of electrical and electronic equipment used in information processing and communications, space development and satellite communications, consumer electronics, industrial technology, as well as in products for the energy sector, water and waste water, transportation and building equipment. With around 124,000 employees the company recorded consolidated group sales of 39.3 billion US Dollar* in the fiscal year ended March 31, 2014. Our sales offices, research & development centres and manufacturing plants are located in over 30 countries.
Mitsubishi Electric Europe B.V., Factory Automation European Business Group (FA-EBG) has its European headquarters in Ratingen near Dusseldorf, Germany. It is a part of Mitsubishi Electric Europe B.V., a wholly owned subsidiary of Mitsubishi Electric Corporation, Japan. The role of FA-EBG is to manage sales, service and support across its network of local branches and distributors throughout the EMEA region.

*Exchange rate 103 Yen = 1 US Dollar, Stand 31.3.2014 (Source: Tokyo Foreign Exchange Market)*

Further Information:
Website: eu3a.mitsubishielectric.com/fa
YouTube: http://www.youtube.com/user/MitsubishiFAEU
Twitter: https://twitter.com/MitsubishiFAEU

Press contact:
Mitsubishi Electric Europe B.V.
Factory Automation European Business Group
Monika Torkel
Marketing Communications Coordinator
Gothaer Str. 8
40880 Ratingen, Germany
Tel.: +49 (0)2102 486-2150
Fax: +49 (0)2102 486-7170
Monika.Torkel@meg.mee.com

PR agency:
DMA Europa Ltd.
Mr. Roland Renshaw
Europa Building, Arthur Drive, Hoo Farm Industrial Estate, Kidderminster, Worcestershire, UK
Tel.: +44 (0)1562 751436
Fax: +44 (0)1562 748315
roland@dmaeuropa.com
www.dmaeuropa.com