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Research Report

2024 March JAPAN TAPPI JOURNAL
Vol.78, No.3 Abstracts

Digitization Made Innovative Operation Management -The need to digitize time-series information-

Yusuke Nishida
Honeywell Cyber and Connected Industrial, Honeywell Japan Ltd.

Plant operations require management of operational constraints, reference values, detection and correction of deviations from those constraints and reference values. To solve the management challenges faced by companies, more advanced and proactive condition awareness is required. Our operations management software, Operations Monitoring, is an application that systematically monitors plant operations data and summarizes deviations from standards, helping to ensure that plant operations are always within the "best" operating envelope. The software conforms to the "Integrity Operating Window" defined in industry standard guidelines established to ensure that process equipment critical to plant operations is better and safer managed, and is used for worker safety, prevention of environmental contamination due to chemical releases, and management of equipment critical damages. The "Integrity Operating Window" is also applied for worker safety, prevention of environmental pollution from chemical emissions, and management of equipment malfunctions. The "integrity operating window" translates directly to "integrity of the operating area," and refers to the control of the integrity of the operating conditions within a defined boundary value. Boundary values in a manufacturing site may include, first, environmental safety boundaries that affect the public, and second, design limits of equipment assets that may lead to equipment damage. The Operations Monitoring software allows managers to define these boundaries centrally for the process data under consideration. The Operations Monitoring software allows managers to define these boundary values centrally on the process data to visually evaluate the operation status, detect events that deviate from the boundaries, and make improvements. In addition, the software enables the workers and management to examine the data using a common index.

Recent Generator Online Insulation Diagnosis

Makoto Takanezawa
Toshiba Energy Systems & Solutions Corporation

Generators installed in power plants and factories are important power supply equipment. To ensure stable operation over a long period of time, it is necessary to monitor the operating conditions and perform maintenance on a regular basis. With the introduction of renewable energy in recent years, thermal power plants have come to play the role of a regulating power source, which is different from conventional operations, requiring enhanced monitoring of the entire power plant. To meet this need, Toshiba has developed a new power plant monitoring and diagnosis system that incorporates an IoT application for power generation equipment diagnosis into the CPS(Cyber Physical System)-based IoT platform "TOSHIBA SPINEX for Energy". This system monitors equipment operation in real time to detect signs of failures that may lead to outages and formulates optimal maintenance plans to improve equipment operation rates. In the event of a breakdown, the system provides information on the cause of the breakdown and countermeasures to support early restoration. This monitoring and diagnosis system can also be applied to power generation equipment in factories.

The insulation of stator coils in generators deteriorates over long periods of operation, which can lead to ground fault accidents. The accident results in an unplanned shutdown of the generator, and a long period of time is required to repair the ground-faulted stator coils. To avoid long-term unplanned shutdowns of generators, it is important to conduct insulation diagnosis and ascertain the state of insulation deterioration. Conventionally, insulation diagnosis of stator coils has been conducted with the generator stopped, and off-line insulation diagnosis, which comprehensively diagnoses the insulation condition based on multiple test results, has been used. In the future, online insulation diagnosis, which enables monitoring of insulation condition trends during operation, is expected to become the mainstream.

Toshiba has developed an on-line insulation diagnosis system that can be installed in "TOSHIBA SPINEX for Energy" as an IoT application for diagnosis and that uses a non-contact sensor installed outside the generator. This paper introduces its features.

Automated plant operation using AI that imitates manual operation

Kazuto Asamura
Yokogawa Digital Corporation

"AI plant operation support solution" realizesautomatic operation using AI model that learns human operations from plant data and manual operation history. The AI model automatically relearns frequently based on the accumulated manual operation history. By the automatic relearning, the AI was able to output appropriate operations depending on the situation, such as production volume and equipment deterioration over time.By introducing this solution to a chemical plant, we succeeded in automating manual operations that are difficult to automate with existing control technology, reducing the workload of plant operators.

Realization of smart factory in Tissue processing equipment

Shinya Takai
Kani Mill, Daio Engineering Corporation

Daio Engineering Co., Ltd. is an engineering company of the Daio Paper Group. The Kani Maintenance Department, to which I belong, is responsible for maintaining the processing equipment at Daio Paper Co., Ltd.'s Kani Mill.

Daio Paper Co., Ltd.'s Kani Mill is located in Kani City, Gifu Prefecture, and is the Daio Paper Group's second-largest production base after the Mishima Mill, producing the largest amount of Elleair brand tissue and toilet paper in the group. It's a factory.

This paper introduces the transformation of equipment into smart factories to process household paper products such as tissues and toilet paper into final products. We hope that you will find this case study useful as a reference.

A Small Scale Advanced Control Solution to Utilize Sensors and Analyzers

Nozomu Wada
Voith Turbo Co., Ltd. BTG Japan, Process Solutions

The current state of automation in Japanese paper mills assumes that today's automation technologies have already implemented IoT infrastructures such as DCS and OPC.

On the other hand, there are still many factories, especially in small and medium-sized enterprises, where the operator changes the SP (SV) for each loop while operating it by PID controller-based control. Even if one decides to consider advanced automation technology, the huge cost and manpower required to design and implement a small-scale DCS, PLC control, or OPC system from scratch can be a major hurdle.

Therefore, the author believes that a new solution is needed to improve and spread automation technology throughout the paper industry, one that provides predictive model control such as APC, but also has the low cost and manpower requirements of a conventional PID controller.

In this paper, a novel standalone control system package currently on going as a new project which provides prediction model-based control, however more simplified and easier to implement is introduced.

Case study : Degitalization of raw material yard
-Degital data utilization and visualizaiton by BI × IoT Technology-

Taichi Kitamura
MITANI SANGYO Co., Ltd.

The cost of recovered paper continues to rise due to recent fuel price hikes, which have increased collection and transportation costs. Whereas the rapid increase in demand for recovered paper in Southeast Asia, making it necessary to manage recovered paper inventories to avoid wastage.

Against the backdrop of the above, in this initiative, we together Rengo Co., Ltd. Fukui Division Kanazu Mill (hereinafter "Kanazu Mill") collect data through the Internet of Things (IoT), and use the collected data and Business Intelligence (BI) to digitalize the recovered paper yard (hereinafter "yard"). The goal was to achieve first-in, first-out (FIFO), which further enhances the recyclability of recovered paper through the digitalization of the yard.

To solve the problem, there were challenges in integrating two types of data with different structures, sensor data (unstructured data) and recovered paper inventory data (structured data), but we were able to solve them with the cooperation of the Kanazu Mill.

The introduction of BI increased the visibility of the structured data, clarified the traceability of raw materials, and made it possible to instantly trace which lot of recovered paper was at risk in the event of an emergency. In addition, the ability to visually grasp the condition of recovered paper has prevented the retention of deteriorated recovered paper, and the appropriate delivery of raw materials has improved the yield rate of products, leading to an improvement in product quality.

DX brought by Control AI
-Winner of the Prime Minister's Award-

Makoto Shimizu
Executive Officer, DX Consulting Division, Yokogawa Digital Corporation.

The Japanese manufacturing industry has long led the world with its high-quality products and advanced technological capabilities. However, in recent years it has been forced to respond to rapid changes in the external environment and intensifying international competitiveness. At the same time, with the development of digitalization and AI technology, a wide variety of AI exists, and under the banner of DX, a wide variety of AI is being applied to manufacturing sites. Nevertheless, it is rare to hear of any major success stories in the manufacturing industry.

In this paper, we describe the most promising AI that can create a differentiating factor for Japanese manufacturers to become internationally competitive, and describe a successful case of autonomous control of a chemical plant using control AI, which won the Prime Minister's Award, the highest award of the 52nd Japan Industrial Technology Awards sponsored by the Nikkan-Kogyo-

Characteristics of CNF-reinforced PA6for PBF 3D printers

Ryota Inoue, Takashi Date
Nippon Paper Industries Co., Ltd

Cellulose is the most abundant, renewable, and environmentally friendly bio-based polymer, which is available from non-edible biomass sources such as wood, grass, and agricultural residues. Cellulose is attracting much attention as a reinforcing material for resin that can replace glass fibers and glass beads. Composites of resin and cellulose nanofibers (CNFs) have been prepared for many attempts in the injection molding field, but only few tries in the 3D printing industry. Therefore, we have produced CNF-reinforced composites in demonstration facility, and verified the application of CNF-reinforced composites to powder bed fusion (PBF) 3D printers. In this research, we prepared a 5wt% CNF compounded PA6 (CNF5%/PA6) powder by compounding of modified pulp fibers and PA6 pellets and followed by cryogenic powdering. The obtained CNF5%/PA6 powder was then molded to prepared test pieces by a PBF 3D printer, and the mechanical properties of the pieces were evaluated. As a result, the tensile strength and modulus of the CNF5%/PA6 test pieces were 60MPa and 2.6GPa, and the bending strength and modulus were 95MPa and 2.7GPa, respectively. These values of the CNF5%/PA6 test pieces were similar to or better than mechanical properties of 20% glass bead-reinforced PA6 composites composite (GB20%/PA6). Moreover, the CNF5%/PA6 3D model samples were almost 10% lighter than GB20%/PA6 because of characteristics of the lower density of CNFs than that of GB. Therefore, the CNF5%/PA6 powder is expected to be an important candidate as the raw material for the PBF type 3D printers.