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INProcess

A Newsletter from the Computer Integrated Food Manufacturing Center and Pilot Plant at Purdue University

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CIFMC automates still retort

The Computer Integrated Food Manufacturing Center has recently automated a still batch retort using the Foundation Fieldbus technology. Foundation Fieldbus is a relatively new communication standard for the process industries. It employs intelligent sensors and field devices to implement such advanced process automation features as truly distributed control schemes, asset management programs and electronic record keeping.

The retort is a 1962 Berlin-Chapman Model D-2002A non-agitating batch sterilizer designed for steam or water processing. An attached heat-exchanger system is required to conduct the water cook.

The retort is equipped with Foundation Fieldbus sensors and valve actuators from various manufacturers including Rosemount, SMAR International and Endress+Hauser. The control program runs in the Fisher-Rosemount's Delta V automation system. In addition to its unsurpassed continuous control capabilities, the Delta V system offers a truly batch-oriented software package that allowed the CIFM center to write, debug and validate the retort sequence program in just one week.

The retort now operates in fully automatic or manual mode using recipes incorporated in the software program or created on the fly. The system provides a detailed report for each batch with electronic records created in full compliance with FDA 21 CFR Part 11 "Electronic Records and Signatures" regulation.

The next short-term goal of the CIFM center is to create a flexible and informative human-machine interface for the retort. The interface will be created using the Delta V Operate HMI software based on the Visual Basic for Applications (VBA) technology.

The CIFM center also wants to implement ASi (Actuator-Sensor interface) technology for digital communications for discrete devices on drain and vent valves.

The scientific research involving the Berlin-Chapman retort will attempt to discover how new digital standards in combination with intelligent sensors can benefit food manufacturers in terms of production flexibility, easing control system validation, and ensuring compliance with electronic record keeping regulations. The retort will also be used for heat penetration and heat distribution studies including finite element modeling research projects.

For more information about the Delta V automation system please visit http://www.easydeltav.com.

For more information about Foundation Fieldbus please check the Fieldbus Foundation website at http://www.fieldbus.org.

For more information about the Asi communication standard please visit http://www.as-interface.com.

CIFMC partners with JCS Controls, Inc.

The CIFM center at Purdue University and JCS Controls, Inc., a process engineering firm located in Rochester N.Y., has recently reached an agreement to establish a long-term partnership for conducting applied research in the area of food process automation.

JCS Controls, Inc. is an engineering company specializing in process and control system design and implementation, primarily within the food, beverage and pharmaceuticals industries. The company offers expertise in implementing advanced control in aseptic processing, batch processing and in-line blending.

As a part of the agreement, JCS Controls, Inc. will upgrade the CIFMC programmable logic controllers (PLC's) to the state-of-the-art ControlLogix automation system from Rockwell Automation. The system will be incorporated in the tightly integrated control infrastructure within the CIFM center and the Pilot Plant at Purdue University.

For more information please visit the JCS Controls, Inc. website at http://www.jcs.com.

Director presents at IUFoST conference in Korea

Dr. Timothy A. Haley, CIFMC Director recently gave a presentation at the 11-th World Congress of Food Science and Technology entitled "The Role of Fieldbus and Intelligent Sensors in Smart Food Manufacturing". The congress was organized by the International Union of Food Science and Technology (IUFoST).

Recent developments in control networks now allow multiple sensors and final control elements to communicate digitally over a single cable. However, the benefits of digital fieldbus go much further than reduced wiring and installation costs.

Compared to 4-20 mA analog signal transmission, digital communication facilitates the transmission of multiple process variables between field devices and control systems for enhanced process automation capability.

When used with intelligent sensors, fieldbus allows the migration of logic and control functions from remote control systems, where the intelligence has traditionally resided, to devices in the field.

Unlike analog based field devices, intelligent fieldbus instruments can report diagnostic information on a real-time basis. The diagnostics capability of intelligent sensors combined with digital fieldbus networks make it possible to monitor and record such conditions as valve wear and transmitter status. Such capability enables maintenance to be done on an as needed basis rather than during scheduled shutdowns.

Dr. Haley's presentation detailed the installation, operation and maintenance of fieldbus and intelligent field devices in food manufacturing applications. The ability of this technology to improve product quality and manufacturing productivity was also discussed.

While in Korea, Dr. Timothy Haley was invited to visit the Nong Shim Instant Noodle factory in Kumi City, approximately a 3-hour drive from Seoul.

The Nong Shim plant is fully computer integrated. All aspects of manufacturing, from utilities management to plant floor automation to manufacturing planning and execution are automated and integrated.

The manufacturing process is completely automated from raw material to finished product warehouse storage and requires only 6 people to monitor and control the entire noodle production.

The plant is designed to produce approximately 300 single serve packages of instant noodles per minute. Dr. Haley was invited to the factory to discuss the benefits of digital fieldbus with Nong Shim engineers who designed the facility.

Currently, the facility is using Siemens PLCs with Profibus for only a few pressure sensors and motor controllers in the raw material batching operation. However, plans are underway to expand the use of digital fieldbus networks to more field devices

and to access additional information from field devices for preventive maintenance purposes and asset management.

Magnetic Resonance Sensor Evaluation

The CIFMC is currently conducting tests to evaluate the performance of a D2150 Magnetic Resonance Sensor manufactured by Magnetic Instrumentation, Inc. of Indianapolis, Indiana. The purpose of testing is to determine whether the sensor can provide an accurate in-line measurement of the moisture content of process cheese during manufacturing.

Laboratory tests have indicated that the spin-spin relaxation (T2) values are well correlated with moisture content when off-line measurements are made on samples placed in tubes and inserted into the sensor cavity.

The evaluation project will determine whether the measurements of T2 made in-line are also well correlated with moisture content. Another question to be answered is whether T2 values can be measured as the material is moving or whether it is necessary to temporarily stop the flow while a measurement is being made.

The sensor is installed in a closed-loop processing system with a tubular heat exchanger and a positive displacement pump. The cheese sauce temperature is regulated by a heat exchanger set to determine the effect of temperature on the sensor reading. The moisture content of the cheese spread is being varied by addition of tap water. The project will continue for approximately 2-6 months.

Please visit the Magnetic Instrumentation Inc. website at: http://www.maginst.com. For more information about this project please contact Dr. Richard L. Stroshine at (765) 494-1192 or strosh@ecn.purdue.edu

Non-glass ISFET pH Sensor Evaluation

The CIFM center is currently evaluating the performance of an inline ISFET CPS 401 pH/Redox probe manufactured by Endress+Hauser (U.S. office located in Greenwood, IN).

To date, the pH of food products cannot be measured in-line owing to the safety concerns surrounding the use of glass electrodes directly in the process stream. Although non-glass pH probes based on ISFET technology are commercially available for inline use, these probes are sensitive to the extreme pH conditions encountered during normal CIP operations. In particular, exposure to high concentrated solutions of high pH (when using alkali cleaning agents) significantly reduces the useful life of pH sensors based on ISFET technology.

Recently Endress+Hauser has developed the ISFET CPS 401 pH sensor that can be retracted during CIP operations. The sensor itself can be automatically cleaned while it is retracted.

The purpose of the testing is to compare the new ISFET probe with traditional inline glass pH sensor as well as an offline laboratory pH meter. The ISFET sensor will be tested on various food products in offline and in-line modes to determine long-term accuracy and precision, minimal calibration intervals and cleanability.

For more information about the CPS 401 ISFET probe please visit the Endress+Hauser website at: http://www.endress.com or contact Marc Buttman at (317) 535-1493.

If you would like to conduct short-term or long-term evaluation of your equipment in our Pilot Plant and receive a comprehensive report including detailed statistical analysis, please contact CIFMC manager Sasha Ilyukhin at (765) 496-7224 or send an e-mail to: ilyukhin@foodsci.purdue.edu All test results are kept confidential.

Aseptic Processing and Packaging Workshop

The eighteenth annual Aseptic Processing and Packaging workshop was held by the Food Science department at Purdue University on May 14-17, 2001. Courses included topics in microbiology, chemistry, engineering, package engineering, regulatory and advances in aseptic processing.

The annual workshop consists of approximately 60% lecture and 40% laboratory sessions. It is taught at the college level. The workshop program is intended for engineers, microbiologists, product developers, QC/QA, managers, sales, equipment designers, operators and others who want to learn more about aseptic processing.

This year we had 37 attendees, 30 from industry and 7 graduate students. Companies represented

included Campbell Soup, Con Agra-Dairy, Precision Foods, Ross Laboratories, H.J. Heinz, Tetra Pak, General Mills, Florida Natural, Quaker Oats, FMC-Fran Rica, Southern Gardens and Kraft Foods.

The workshop has evolved over the years and has become very popular. By popular demand, we now offer the exclusive workshops. Exclusive workshops allow us to customize the course specifically to a company's process and product. The Food Science Department conducts 4-6 workshops per year at company sites. With our involvement in bulk storage of orange juice, the Department faculty members have made many trips to Florida.

Next year's Aseptic workshop will be held on May 13-16, 2002. For more information about hosting an Aseptic workshop for your company please contact Steve Smith, Processing Specialist - Purdue Food Science/1160 Food Science Building/West Lafayette, IN 47907-1160. Phone: (765) 494-7706. E-Mail: smithrs@purdue.edu.

New Equipment

- **Tetra Pak ultrafiltration module**

The food science pilot plant recently purchased a Tetra Pak ceramic ultrafiltration module. The Food Science Department will be using this module to concentrate proteins in milk products for class demonstrations.

The UF cartridge contains 7 membralox membranes 1020 mm long with channels 4 mm in diameter. The pore size is 50 nm. The module is capable of filtering down to 10,000 Dalton or atomic mass units (AMU). The UF cartridge is capable of being sterilized and can be easily cleaned. It is also capable of handling high temperatures and pressures.

Ball Formula Goes Online

As part of the vPRO/SciMedia Information Technology Project, the CIFMC is creating JAVA applets that can be used to model and evaluate the thermal sterilization of foods. Recently, two JAVA applets that implement the Ball Formula Method were completed and will be available on-line for a short time.

In 1923, C. Olin Ball published the first well-defined mathematical method for establishing thermal processes for canned foods. The 'Ball Formula Method' has since become the most widely used method in the US for evaluating the sterility value achieved in canned foods during thermal processing.

One of the JAVA applets uses Ball's original formula method to calculate the process time required to meet specified F-value requirements. The other JAVA applet uses the Ball Formula Method to calculate the F-value that results from a specified process time. The applets are for research and educational purposes.

Additional applets will be posted to our website as they become available. Since Ball's original contribution, there have been many extensions and alternate models suggested. We will soon release JAVA applets of many of these alternate models. In addition, our plans include the development of other processing models for dynamic simulation of food process equipment such as retorts, spray dryers, drum dryers, evaporators, etc.

Our entire suite of vPRO/SciMedia products is available offline in customized versions for specific needs. Please contact us if you are interested in custom software solutions for food engineering applications.

To access the Ball Formula Method calculation applets, please go to the CIFMC website at http://cifmc.foodsci.purdue.edu and then click on "Resources/Ball Formula Online".

If you would like more information on custom JAVA software for your particular food engineering applications, please contact Tim Haley at (765) 494-9093 or send e-mail to: TimHaley@Purdue.edu