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Computer-based monitor/control system offers versatile process research tool

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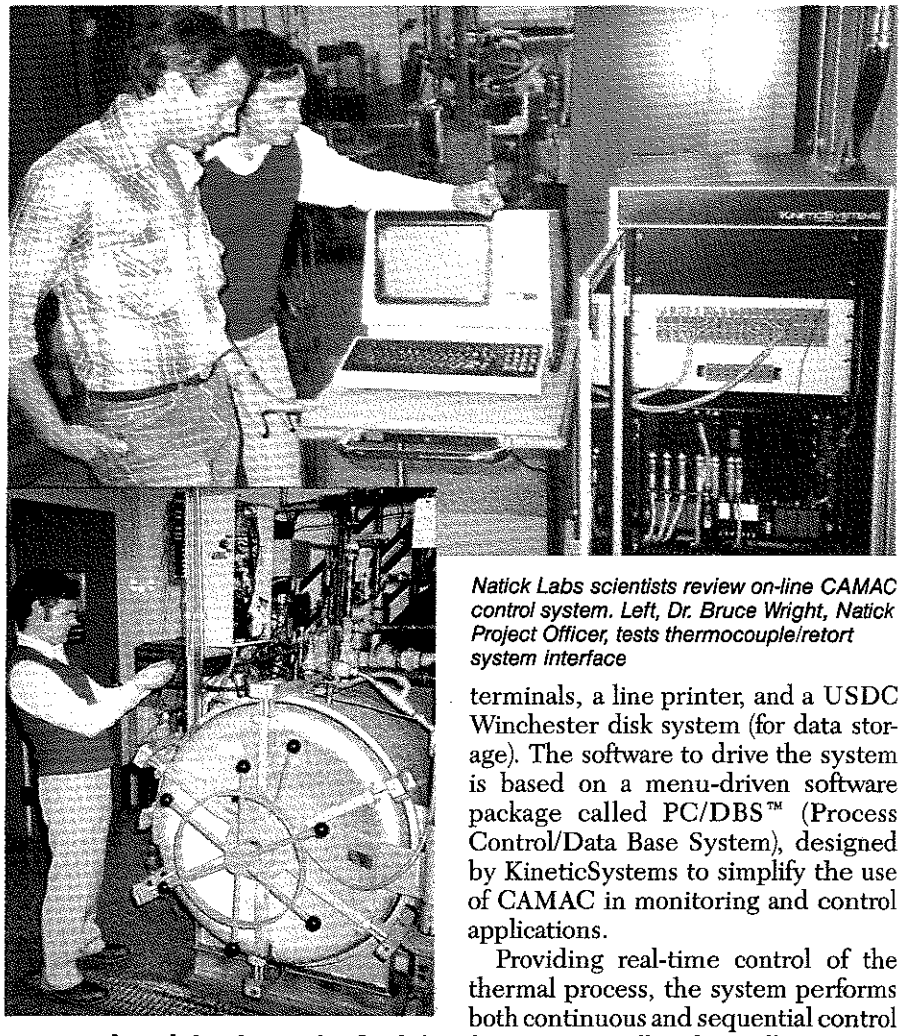
A Computer Automated Measurement and Control (CAMAC:IEEE Std 583) system has been adopted recently by food and process development researchers at the U.S. Army Natick R&D Center, Natick, MA, for food retort processing, freezer monitoring, microwave vacuum drying, and extrusion processing. Several separate military food concept research projects, including individual retort pouch and multiple-serving tray-pack processing, are or will be utilizing pilot and production-scale equipment in the Natick Food Engineering Laboratory to develop acceptable foods meeting special military specifications.



Natick Labs scientists review on-line CAMAC control system. Left, Dr. Bruce Wright, Natick Project Officer, tests thermocouple/retort system interface

Complex research needs

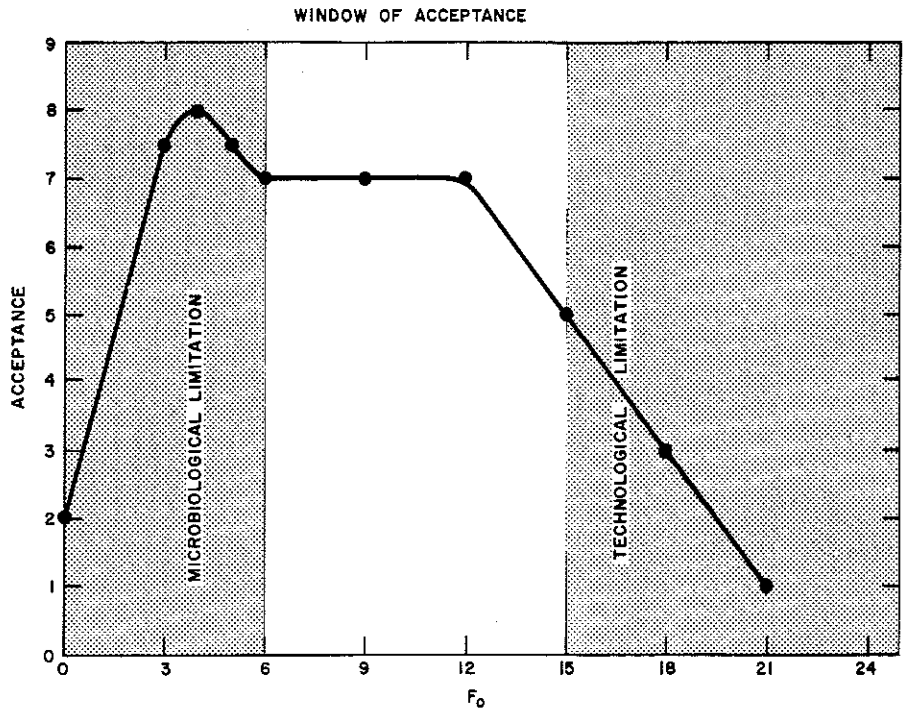
Project management was faced with the problem of developing optimum processes with a variety of equipment having many critical control variables (i.e., temperature, pressure, time, microbial lethality values, etc), within the constraints of economy-minded research budgets. Manufacturers of the varied process equipment offered individual machine control (often computer-based) devices. However, Natick desired a single versatile control system for economies of cost, efficient data acquisition and information management, common programming language and documentation, multi-interfacing capabilities, and flexibility.

Based on these criteria, military researchers acquired the CAMAC system, which is being applied to several food development programs including a planned 3-year project on automated thermoprocessing procedures. For all programs, several primary parameters were identified: on-line collection of data; real-time process control; versatile adaptation to currently existing food processing and computer systems; and modular design for flexibility in purchase, installation, and service.

Retort process control

The first research application by Natick R&D Center is in the control and optimization of thermostabilization processes for its Tray Pack ration development program. The modular CAMAC system was installed by KineticSystems to monitor and control an existing batch-type Reid retort modified for automated operation. It is connected to a DEC LSI-11-based microcomputer system with two display terminals, a line printer, and a USDC Winchester disk system (for data storage). The software to drive the system is based on a menu-driven software package called PC/DBS™ (Process Control/Data Base System), designed by KineticSystems to simplify the use of CAMAC in monitoring and control applications.

Providing real-time control of the thermal process, the system performs both continuous and sequential control functions as well as data collection and storage. During a process run, the system regulates the temperature, pressure, and water level inside the retort through the manipulation of steam, air, water, vent, and drain valves. Data can be visually displayed on the CRT screens or can be stored for future evaluation. The control system utilizes a "crate" or housing, which contains modules for acquiring data and manipulating control valves. Out of a possible 48 inputs, 16 are being used for thermocouples in product trays that can be scanned every 5 seconds in order to graph a time-



"Window of Acceptance" model diagram for evaluation of optimum process/sensory factors

temperature profile or accumulated lethality curve on an appropriate time scale.

Confidence in the control of retort processing is extremely important to assure product safety and prevent overprocessing, which causes both product quality degradation and costly loss of processing capacity. Other benefits would include reduction of potential process deviations and avoidance of excessive process safety factors. Many processors of Tray Pack products also utilize the batch system of retorting, which has potential for significant variation in processing.

"Variation" might be reflected in different sensory, chemical, or shear characteristics of the finished food products resulting from some overcooking or uneven cooking. This variation, in turn, is often critically affected by lack of precise control of the lethality resulting from the retort heating or even cooling cycle times. A crucial factor here is determining the heat distribution, the "hot" and "cold" spots in products and in the retort during processing. Equally important to a safe overall thermosterilization is the prediction of cooling time lethality based on accurate data from multiple, previous runs on different products.

"Window of Acceptance" concept

One basic concept being evaluated by the Natick research group is the determination of optimum retort processes that achieve the minimum safe heat process together with the maximum sensory acceptance of the foods. Military foods must be made safe and processed for long shelf life at ambient storage temperatures without compromising nutritional content and product sensory acceptance. Consequently, every individual heat processed item should receive a sterilization value (F_o) above the microbiological lower limit and below the technological upper limit, corresponding to the F_o at which the acceptance drops to 5 on a 9-point hedonic scale (see diagram).

The program of applying this automated control system and coupling it with a determination of the technological upper limit for representative foods could result in reduced processing times, which would enhance product quality. The information obtained on procedures for achieving a higher degree of food thermoprocessing control than is currently possible will be provided to food processors, consumers, and regulatory agencies. END

Additional information on the CAMAC (IEEE-583) standard and process monitoring and control systems is available from KineticSystems Corporation, 11 Maryknoll Drive, Lockport, Il 60441.