

PLANT-WIDE AUTOMATION OF PALM OIL MILLS

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Laboratory-scale and pilot-scale studies on a new process for continuous sterilization demonstrated its technical and economic viability and a commercial-scale system was subsequently built in the MPOB Palm Oil Mill Technology Centre (POMTEC) in Labu (*Figure 1*). In the new process, the closed-knit arrangement of the spikelets in bunches is first disrupted using a double-roll crusher. The bunches are then heated using live steam at low pressure to facilitate continuous processing.

The continuous sterilization process provides the impetus for new paradigms in the design and operation of palm



Figure 1. Fully automated continuous sterilization system.

oil mills. The use of technology that is simple and uncomplicated ensures that the system is competitively priced. It eliminates the use of sterilizer cages, rail tracks, overhead cranes, tippers, transfer carriages and tractors and thereby facilitates the design and construction of mills having significantly smaller footprints than conventional mills.

A NEW PARADIGM FOR AUTOMATION OF MILLS

A significant advantage of continuous sterilization over batch sterilization is that it renders the palm oil milling process a continuous operation from start to finish, making it cost-effective to automate the bunch handling operations. A plant-wide control system can now be used to facilitate overall monitoring and control of the mill from a control room. The four most important functions of this control system are described in the next section.

Real-Time Process Monitoring

All the important information pertaining to the status of equipment and processes can be monitored by the control system using animated process graphic and text displays. Real-time monitoring permits much more comprehensive and in-depth assessment of equipment and process performance and process dynamics than is possible manually.

Automatic Control

Control loops can be used for all the critical process variables. Although control loops can be used to ensure that process parameters such as temperature and level are maintained at desired values, the added complexity and the cost of implementing such control loops can only be justified if there are benefits. Until process analysis studies are able to confirm the benefits of automatic control, remote monitoring from the control room and periodic adjustments by field operators will be considered sufficient.

Centralized Motor Control

To promote greater automation and to facilitate monitoring and control of the mill from a control room, the plant-wide control system can be used to monitor the on/off/trip status of all motors. The system can also monitor the load on all equipment in the mill and provide alarms when the load is abnormally high.

The system can be used to start-up and shutdown sections of the mill and to perform emergency shutdown if there is an abnormal condition.

Inverters can be used for the more critical motors to facilitate changing the retention time and/or throughput from the control room.

Visual Surveillance

A CCTV system can be used to monitor operations that need to be closely monitored but cannot yet be completely automated and to beef up security surveillance in the palm oil mill.

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SYSTEM OVERVIEW

The plant-wide control system described below has recently been installed in POMTEC. Automation to the scale undertaken in this project has never been previously attempted in palm oil mills. The new control system (Figures 2 and 3) makes it possible to operate the palm oil mill, including the boiler (Figure 4), using two control room operators and a maximum of eight field operators. Communication between the control room operators and the field operators is achieved using walkie-talkies.

SCADA System Hardware

By using a supervisory control and data acquisition (SCADA) system consisting of a network of personal computers (PCs) and programmable logic controllers (PLCs) (Figure 5), the new plant-wide control system provides a cost-effective and comprehensive solution to the automation requirements of palm oil mills. The system enables you to manage the process as a complete system, with control over the inter-relationships of various sub-systems to improve the overall performance.

The PLC system comprises one unit main control panel complete with a master programmable logic controller and remote control panels complete with remote PLCs and touch-screen colour graphic user interfaces (Figure 6) as sub-systems to enable the field operators to execute some of the monitoring and control functions without having to communicate with the control room operators.



Figure 2. Control room.



Figure 3. Plant-wide control system.



Figure 4. Fully automated boiler.

HMI/SCADA Software

The HMI/SCADA (human-machine interface/supervisory control and data acquisition) software supports communication with all the popular types of PLCs available in the market. The software also includes features that facilitate process graphic displays, historical data analysis, statistical process control and formatting of printed reports. Figures 7 to 11 provide samples of display screens provided by the SCADA system installed in POMTEC.

Centralized Motor Control

Monitoring of the motor load (Figure 9) and the running hours of the equipment is useful for trouble-shooting purposes and for scheduling the maintenance of the machinery to minimize the mill downtime. The alarm provided by the system (Figure 10) when the load exceeds some preset value permits maintenance personnel to anticipate problems and take corrective action to improve operational efficiency and avert costly disruptions and incidents.

In the case of the continuous sterilization plant, the control system is also able to automatically shut down the plant if the load is abnormally high. The system has also been successfully applied for automatic start-up and shutdown of the plant (Figure 7). Such control capabilities are greatly appreciated by the users and can be easily extended to the rest of the mill.

Closed Circuit Television (CCTV) System

Surveillance systems can nowadays be easily integrated into computer networks using either network cameras or network video servers. The CCTV system used in POMTEC (Figures 12 and 13) is designed to facilitate visual monitoring using computers connected to the same network as the SCADA system. Users are able to gather information at all critical points of the palm oil milling process and view it in real-time from any point in the network. The system also enhances security personnel's ability to provide round-the-clock security surveillance.

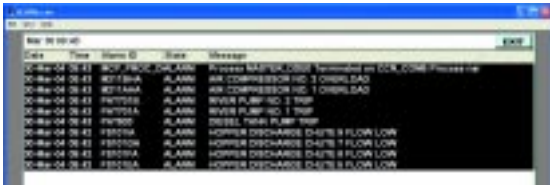


Figure 10. Alarm summary.



Figure 11. Process summary.



Figure 12. Closed circuit television (CCTV) system.



Figure 13. Closed circuit television (CCTV) system

The CCTV system has been found to be useful in a number of ways:

- dedicated cameras providing close-up views are useful for continuous monitoring of the critical points of the production process;
- pan, tilt and zoom (PTZ) cameras are useful for providing an overview of the entire plant;
- the ability of cameras (both dedicated and PTZ) to provide close-up view of problems is useful for trouble-

shooting and rectifying problems from remote locations;

- operators are likely to be more productive if they perceive that management is watching them;
- historical records kept by the CCTV system are useful for verifying claims of operator negligence and sabotage; and
- when alarms are provided by the SCADA system, users can use the CCTV system to obtain more information on the nature of the problem. Experienced operators can figure out what is happening based on the inputs provided by the SCADA and CCTV systems. Potentially dangerous and costly breakdowns can be discovered and rectified at an early stage, saving the company substantial amounts of money.

WHY MILLS SHOULD AUTOMATE

- Compelling issues such as labour shortages, more stringent regulations, increasing environmental concerns and escalating production costs.
- Significant advances in automation technology in recent years, spurred on by hardware and software developments in information and communication technology (ICT).
- Continuous sterilization makes palm oil mill automation cost-effective.

BENEFITS

- Increase in operator productivity leading to reduction in the number of operators.
- Improved monitoring of milling processes and equipment by operators.
- Reduction in mill downtime and improvements in mill utilization.
- Improvements in steam management and reduction in black smoke emission from boiler stacks.
- Improvements in programming the scheduled maintenance of equipment due to real-time tracking of performance.
- More consistent process performance (reduced variability).
- Reduction in the losses of oil and kernel from milling processes.
- Improvements in the quality of the finished products.
- Provision of a more conducive work environment for operators.

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