AUTOMATED KILN CONTROLLERS, ARE THEY NECESSARY?

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The topic for discussion is "Automated Kiln Controllers, Are They Necessary?". I will attempt to address this subject by using the following outline in my presentation:

(1) Types of controllers.
(2) Similarities and differences between the types of controllers.
(3) Factors influencing kiln drying performance.
(4) Pre-requisites to success in automated kiln drying;
  a) A controllable kiln drying process.
  b) Controlled upstream and downstream processes;
  c) Trained personnel.

For many years kiln operators have been using manual recorder/controller systems to dry easy as well as difficult species with relatively good results. However, semi-automatic kiln control systems have helped to reduce operator workload and error, and are readily implemented with either pneumatic controls or more precise electronics. These systems appear to have a distinct advantage over the other in such a simple application.

Why have automated systems become such useful devices in today's drying operations? The recent availability of rugged and reliable industrialized micro/-mini-computers created the opportunity to automate the control of moisture content. This advance has taken two distinct directions:

(a) Straight forward automation of the original U.S. FPL moisture content based schedules using in-kiln moisture content sensors. Enhancement using EMC wafer helped to eliminate the troublesome wet-bulb sensor, with further extension to monitor and control the moisture gradient and internal air velocity distribution.

    Their added cost and complexity is usually justified by the reduction in the risk of loss due to operator error, and more stringent control of kiln conditions. Automatic shut-down and remote monitoring seem to be the features most appreciated benefits by the operators.

(b) The use of inferred load moisture content from wet-bulb and dry-bulb temperature or other measured parameters using proprietary algorithms of varying complexity. This eliminates the need for direct moisture content sensing with in-kiln probes, reducing initial and operating cost, but increases the risk of loss due to undetected kiln system malfunction. The proprietary schedules used are another unknown as they lack the decades of experience behind moisture content based schedules.

SIMILARITIES AND DIFFERENCES (MANUAL, SEMI-AUTOMATED, AND AUTOMATED CONTROLLERS)

In the manual and semi-automated controller, the dry-bulb and wet-bulb temperatures are measured by sensors actuated by vapor/gas. The vapor/gas pressure in the sensor operates a flapper in a pneumatic circuit comparing the sensed temperature to a manual set point or cam schedule.

This differential actuates heaters, spray valves and vents to achieve the desired kiln schedule. In these vapor pressure instruments, the elevation of the bulb in relation to the recording instrument affects the readings. The sensors are therefore must be mounted level with the recorder.

Automatic controllers generally utilize platinum resistance temperature detectors (RTDs). Cables from these elements can be used in any convenient location. The distance between the instrument and the bulb has less impact on the accuracy of the readings and intervening conditions between the bulb and instrument present no problems in automated systems. However, high quality hardware, good installation and wiring practices, and careful maintenance are still necessary to prevent electromagnetic interference and signal degradation.

Functional components appear to be easy to replace and calibrate in automated controllers whereas with manual or semi-automated controllers this is a difficult process. In some cases the entire controller has to be sent back to the manufacturer for repairs.

The response to temperature changes is slow in manual and semi-automated controllers owing to the large mass of their bulbs, whereas in automated controllers which utilize resistance bulbs response is faster.

Reversal of the fan during the drying schedule requires switching between sensors in the appropriate air passages to capture a correct inlet reading. This can be difficult with vapor tension sensors. Most automated controllers utilize multiple temperature sensors to measure the temperature distribution of the incoming and outgoing air. This allows better monitoring of kiln conditions and an average reading is said to improve the accuracy of the measurements of the dry-bulb temperature.

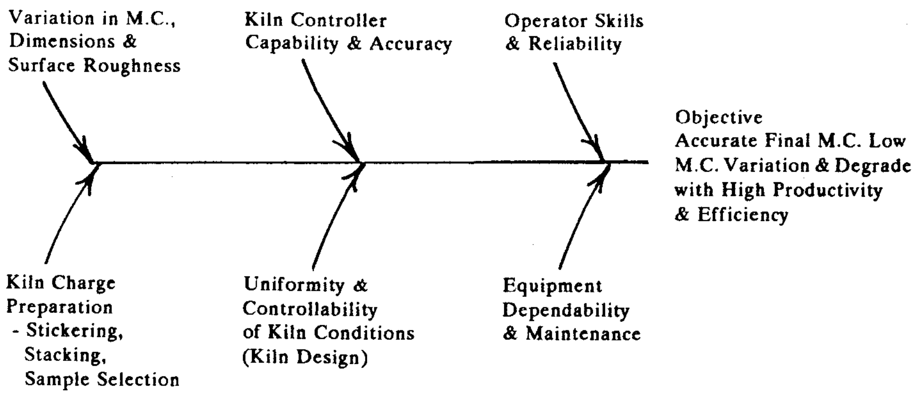
Some automated controllers monitor the EMC of the kiln load by electronically measuring the moisture content of a cellulose wafer which responds quickly to the air conditions the kiln. For the semi-automated and manual controllers, the EMC and relative humidity is measured by feeding the wick of the wet-bulb with a constant supply of water. Careful attention must be paid to the mounting procedure of the wet-bulb as there must be an air space between the bulb and the feed water tank to prevent inaccurate readings.

Another method adopted in judging the EMC and moisture content of the kiln charge is to measure the temperature drop across the load. In some cases, this value is used in conjunction with other variables (eg. opening and shutting of the vents) to calculate the final moisture content and to shut down the kiln.

FACTORS INFLUENCING KILN DRYING PERFORMANCE

Table 1 shows the impact of factors influencing grade outturn and final moisture content of the product. The trade-off between quality and cost can only be improved by addressing all of the above factors.

Table 1. Influences on kiln performance.



Much of the future advance of kiln controls by analogy to automated process control elsewhere, will be in enhancements of ancillary functions such as circulation fan sequencing, reversal and speed control, monitoring and annunciation of control system and kiln failures, burner sequencing and flame monitoring, steam allocation, local load records, and tracking for inventory management including prediction of time to completion.

Other advances will be in greater user friendliness, in the areas of remote distributed control and monitoring, improved "situation awareness" with enhanced display, access to greater variety of schedules, with "help" routines to ease and improve schedule selection and modification to suit specific load characteristics.

Integration into the total sawmill automation and computer control with the data collection, analysis, and broader process control (eg. green moisture sorting) needed to exploit it, will be the next major challenge.