

## MICROPROCESSOR-BASED KILN CONTROL SYSTEM FROM LIGNOMAT USA, LTD.

Uli Heimerdinger  
Lignomat USA, Ltd.  
Portland, Oregon

Two years ago the engineers at Lignomat USA, Ltd. decided to develop a Microprocessor Kiln Controller for the United States dry kiln market. The system had to be easily adaptable to existing kilns or had to be used on new kilns.

Main considerations during the development were:

- 1) Ease of operation (no special knowledge or training in computers required)
- 2) Safe to operate
- 3) Follow as much as possible the existing procedures in kiln drying as predominant in the U.S.
- 4) Use the capabilities of a microprocessor to its full potential and let it perform additional tasks besides "just running the dry kiln." Additional fields of great importance are:
  - considerations in electrical energy consumption
  - optimization of steam distribution
  - provide administrative information to management

The goal was to create a system which will be a strong tool for the kiln operator to let him do his job more efficiently and which will pay for itself by decreasing drying time and utility cost, and by doing so, increase yearly throughput at a kiln installation by maintaining and improving existing quality standards in kiln drying.

The most significant differences between existing Foxboro or Moore type instruments are as follows.

- 1) Use of probe system to measure the moisture content in wood continuously from inside a dry kiln to run MC schedules automatically and,
- 2) Use of wafers to measure the EMC directly from inside the kiln, without measuring the wet bulb temperature.

Having the required "safety of operation" in mind, it was decided in the beginning to go with a "modular system." This means that a stand-alone controller, which can operate the dry kiln without a microprocessor, will have the capability to communicate with a microprocessor if it is desired to fully automate the drying process. Should it be decided or become necessary to run the system without microprocessor (i.e., a failure occurred in the computer system) a full back-up is immediately available to run the kiln with the LSA in the semi-automatic mode. The modules developed for that purpose are the semiautomatic controller LSA 1 (1 temperature zone) and LSA 2 (2 temperature zones) and the microprocessor MP 8.

While one LSA unit is required for every kiln, each MP 8 can operate up to 8 kilns, or talk to 8 LSAs at a time.

## FEATURES OF THE LSAX

The semi-automatic controller LSAX is a microprocessor-based kiln controller which accomplishes the following tasks.

- Measure and display Dry Bulb Temperature (in Celsius or Fahrenheit)
- Measure and display EMC
- Measure and display MC (up to 8 Probe Stations) and average mc
- Set and display Reversing Time
- Set and regulate Dry Bulb Temperature (one or two zone control)
- Set and regulate EMC
- Communicate with MP 8
- Perform plausibility and safety checks and report errors

All circuits in the LSA are digital which assures long calibration stability of all measuring and regulating circuits. Since the whole system is only as good as the LSA measures and regulates temperature, EMC and moisture content, a great effort has been made to use only high grade electronic components and the latest technological advancements in the design of this unit.

The direct and continuous measuring of MC from inside the kiln allows to run MC controlled schedules without weighing sample boards which are taken from the kiln. The necessary adjustments of dry bulb temperature and EMC is done on a continuous basis by the MP 8 or manually (without MP 8) at a rate as the drying wood and the applied schedule determine, this being the main reason for saving drying time as an end result.

The successful use of moisture probes inside a dry kiln has been a result of Lignomat's 20 years of research, experience and special know-how in measuring moisture content in wood. Temperature and species compensation for all MC readings are performed by software, which allows entering up to 20 different calibration curves, in essence a calibration curve for every species being used at a customer's site. This guarantees a great degree of accuracy in the measuring of MC.

A software-controlled PID regulating algorithms assures that all the desired values for temperature and EMC are maintained very precisely. The system can be set to work with pneumatic or electric actuators in an either ON-OFF or MODULATING mode.

## OPERATION WITH LSA

When a kiln is operated with the LSA alone, the kiln operator sets his desired values of temperature and EMC at the front panel. These values have to be changed manually when the moisture content of the lumber, measured at up to 8 locations distributed throughout the kiln and indicated at the front panel, has changed and different settings according to the used schedule are required. The regulating system will then maintain these desired values for temperature and EMC in the kiln automatically. Of course, each kiln to be controlled needs its own LSA.

## OPERATION WITH MP 8 CONNECTED TO LSAs

When a kiln is equipped with the LSA connected to the microprocessor MP 8, the kiln operator enters the drying schedule at the beginning of the drying cycle and the MP 8 selects the proper settings for EMC and temperature according to the entered time controlled or moisture controlled schedule. See more information about operation below.

### FEATURES OF MP 8

The microprocessor MP 8, which works in combination with the LSA, has the following features:

- Can accept up to 20 different drying schedules
- Schedules can be either time controlled or MC controlled
- MC and time controlled schedules can be linked together
- Runs kilns automatic according to selected schedule and progress of drying process
- Accepts schedule to change air velocity when operated with variable speed controller
- Distributes steam flow according to preset priority list in case of limited steam supply
- Provides immediate information of status of all kilns in kiln operation, including information of what is loaded in each kiln
- Accessing remote kiln operations from one central location
- Can transmit data to IBM-PC or compatible computer for further data processing, i.e., storing of drying histories and schedules for schedule optimization or displaying availability of lumber quantities of given specifications
- Print out of drying histories at end of drying cycle or at request
- Password protection of selected information about drying operation

### OPERATION OF MP 8

The MP 8 can operate up to 8 kilns equipped with an LSA. The easy-to-follow, menu-driven operating system guides the operator through the different screens which allow him to accomplish the tasks necessary to run a kiln operation.

Screen 1: Create, modify or delete schedule.

Allows to enter, modify or delete up to 20 different drying schedules, either moisture content to time based, in standard American notation. Temperatures can be entered in Celsius or Fahrenheit. Each schedule is stored in the schedule library.

Screen 2: Start or stop kiln.

Before start-up the kiln operator can call up any drying schedule from the library and enter additional information about the kiln to be started. After all parameters are checked, the

kiln can be started from the CRT unit. At any time the kiln can be stopped from that screen.

Screen 3: Individual kiln status.

This screen is updated every 15 seconds and shows information about the individual kiln. It displays desired and actual values for actual and desired EMC and temperature as well as the momentary operating phase which is highlighted on the screen. The selection of the active probes which represent the average moisture content is also selected from this screen.

Screen 4: Overall kiln status.

A brief of the status of each kiln connected to the MP 8 is given on this screen. In addition to that, exact information can be entered on a "scratch pad," which can be accessed from that screen, of what is actually loaded in that kiln, i.e., package sizes, grade, species and thickness. This information can then be transmitted to an IBM-PC or compatible computer once or twice a day to compile this information into a lumber availability list or graph which shows the weekly availability of user specified lumber from the kiln operation.

Screen 5: Schedule library.

Shows a list of all previously defined and stored schedules. Before start-up the operator can select the schedule to be used for a specific dry kiln.

Screen 6: Create, modify or delete rate schedule.

Allows to define over a 24-hour period up to 6 different time segments during which the fanspeed is reduced by a specified ratio. This is helpful to avoid high demand charges during start-up times of additional equipment at the plant or to prevent high electricity cost during peak rate hours.

Screen 7: Utilities.

Being used to assign passwords, set date and time of day and to initiate printer options.

Once a kiln is ready to be started the operator selects the schedule sequence (one or several schedules, either time controlled or MC controlled, linked together) under which this charge has to run. Typically, a schedule sequence to dry green 4/4 Red Oak would start out with a time controlled schedule for the first few days and would then call up a MC controlled schedule. At the end, for equalizing, conditioning and cooling the corresponding time controlled schedules for these three phases would be called. Once the schedule for cooling has timed out, the kiln will shut itself down.

During the different drying phases, the MP 8 takes all the readings of the connected kilns every 15 seconds and checks if all of them are plausible. If not, immediate corrections are being made or actions like shutting off the fans in case of

overttemperature are carried out. Occasionally the operator has to check the readouts of the MC probes and has to select those which are the most representative for the kiln charge at that time. The average moisture content is calculated out of these "active" probes. The complete drying cycle is otherwise controlled automatically from beginning to finish by the MP 8.

Today about 100 dry kilns throughout the U.S. are controlled by this kind of a system. This success has been mainly achieved because Lignomat USA, Ltd. created a system which is, because of its ease of operation and the fact that we are looking at the complete drying environment, an appreciated tool of many kiln operators to make them more effective and their job a little easier. Savings in drying time and ease of operation are the main monetary incentives to install a system like this and on certain instances we have seen pay back periods of less than six months.