Dry Kiln Automation

By E. M. WENGERT

In the 1950's and early 1960's, many of us probably felt that the design and operation of steam-heated dry kilns were quite stable. In the past few years, however, we have seen many changes—high temperature drying for softwoods and hardwoods, widespread usage of direct-fired kilns, and new schedules we would not have dared to use in the past.

Now it seems possible that the era is passing in which the kiln operator has to enter the hot, steamy kiln periodically for samples he needs to calculate moisture content of the charge and to set recorders. Kiln automation—the automatic determination of the moisture content of the lumber in the kiln and automatic changing of the kiln conditions—is very promising.

Modern kiln design probably started in the early 1900's with H. D. Tiemann's "water spray" kiln. In 1923, Rolf Thelen of the FPL patented the reversible, single-line shaft, internal-fan kiln. This is the model on which modern kiln design is based, except that today we use overhead fans, pneumatic controllers, and usually one fan per shaft.

Automation probably began with the "Kilnboy", introduced in the late 1930's. The recent investigations and advances at the Forest Products Laboratory were initiated at the urging of Raymond C. Rietz, one of the nation's outstanding dry kiln experts and a long-time member of the Laboratory staff.

Mr. Wengert is Technologist on the staff of the Forest Products Laboratory, Forest Service U. S. Department of Agriculture, at Madison, Wis.

Our approach to kiln automation consists of two parts: (1) weighing automatically and continuously, a part of the kiln load (which is equivalent to treating part of the load as one big sample board) and then determining automatically and continuously the moisture content based on the weight; and (2) changing automatically the kiln conditions on the basis of the automatically calculated moisture content.

Of course, when drying softwoods,

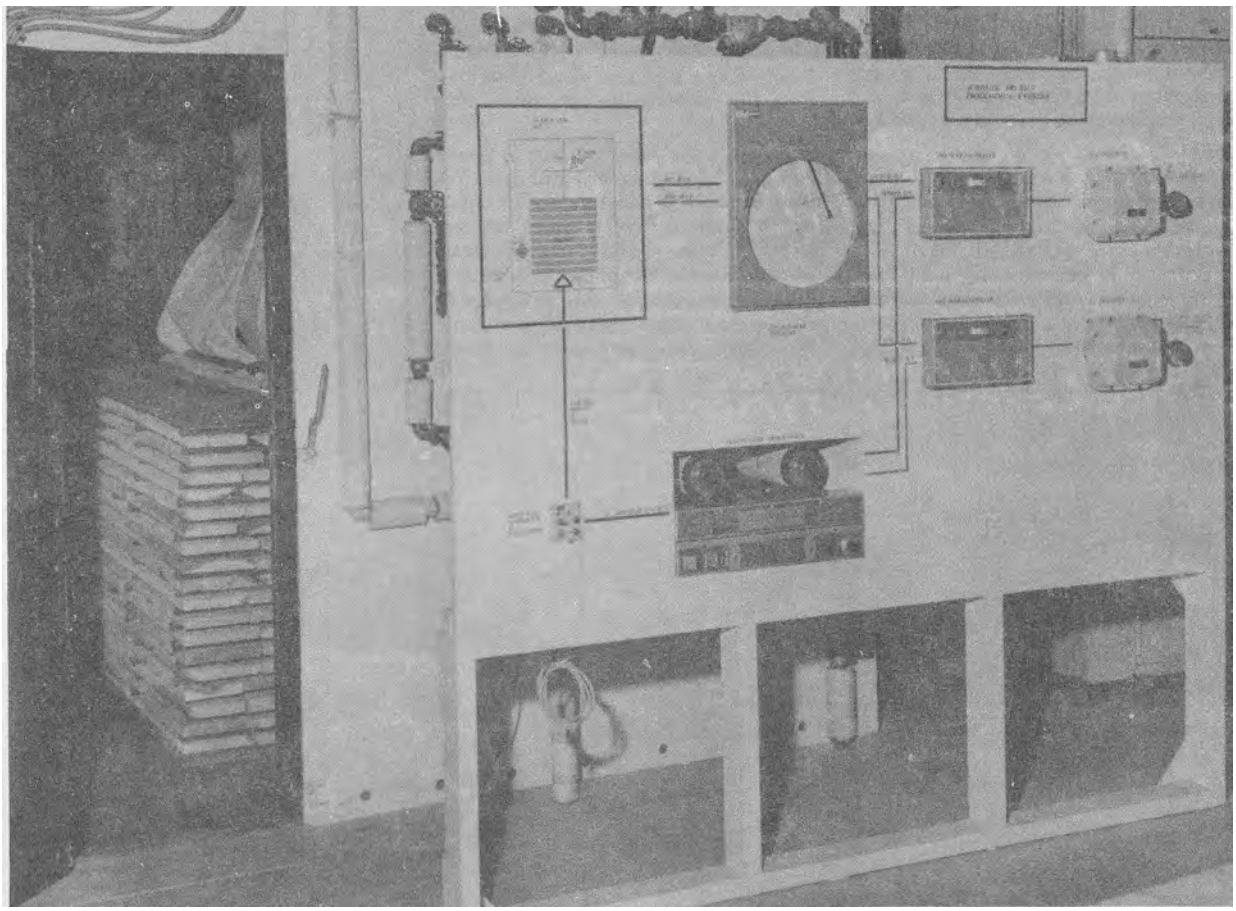

FIGURE 1.—Overall view of the automatic *kiln with* the moisture content *computer on* the *left;* recorder, upper center; *programmer, lower center;* dry-bulb controller and *pneumatic converter, upper* right; wet-bulb controller *and* converter, lower right.

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samples are seldom used—the schedule changes are made on a time basis. In this case, automation consists only of one part—changing automatically kiln conditions on the basis of time.

Technically Feasible

There is little question about the technical feasibility of kiln automation—there are at least three automatic kilns of various sizes that today can dry hardwoods or softwoods (Figure 1). The major question is "How much does it cost?"

We estimate that the equipment costs for automation of a well-equipped hardwood kiln are between $5,000 and $6,000. Installation costs will vary, but can be kept rather low if the kiln operator can run the wires between the load cell and programmer, recorder and controller, and so, forth, thereby avoiding some of the installation costs.

The benefits from automation can range from very great to very small; it depends on the individual operation. If the average kiln load takes four days, it wouldn't be of much benefit to shorten the time to 3½ days if the crew isn't available to unload and reload the kiln. However, if the average time of eight days can be shortened to seven, or 4½ to four, the benefits of automation could be large.

Automation may simplify the training of new kiln operators. The kiln schedule for a given species and thickness, once assembled and drawn as a graph, is permanently available in its original form for use on the next load or on a load next year. The kiln operator is then primarily responsible for the operation of the automatic equipment and for initial and final moisture content determinations.

Through automation the operator is relieved of the responsibility of daily moisture content calculations and tedious schedule formulation. In most cases, he could miss a day or two of work without any loss in dry kiln productivity. He can also determine moisture contents in kilns operating at high temperatures or high humidities, or in direct-fired kilns in which the interior atmosphere is unfit to breathe.

In short, automation is similar to hiring a virtually errorless, 24-hour-, a-day kiln operator (that doesn't require many fringe benefits) to assist the present operator.

As a result of having this 24-hour-a-day operator, we can use some new schedules—that is, rather than having several large temperature steps in the schedule, we can have many small steps, because we have an operator present to make changes at any time. In fact, instead of steps, the schedule can be smooth (Figure 2). (Incidentally, this smooth schedule was also used in Tiemann's water-spray kiln and other kilns before the pneumatic controller was introduced.)

Because the kiln operator is present around the clock and because the schedule is accelerated by making it smooth, drying times can be expected to be shorter. In work done at the Forest Products Laboratory on small loads, the time savings for drying oak were about 18 per cent. We expect these savings to be about the same for other hardwood species and for some softwoods.

We expect that industrial experience with automated kilns in the next few years will indicate whether automation is here to stay, **almost** 40 years after it was first tried.

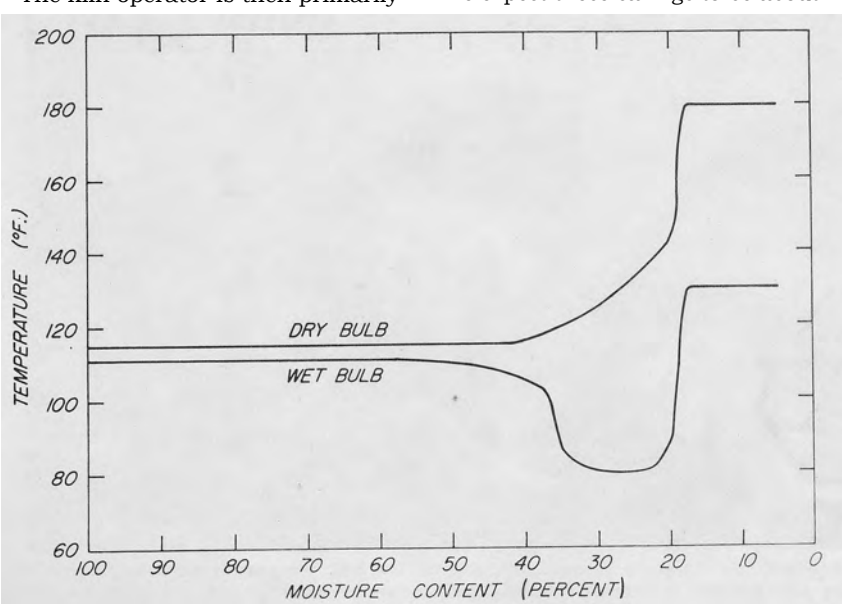

FIGURE *2.—Smoothly changing kiln schedule.*