# CASE STUDIES FOR DRY KILN OPERATIONS

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Steam Engineering Inc. has worked with lumber drying clients across the country to improve the capacity, efficiency, and reliability of their boiler, and steam drying operations. This presentation discusses three techniques that we have used successfully to improve the operation of dry kiln steam systems. Most of our clients are using at least one of these techniques and several are using all three.

We have been working with companies that want a quality product but are working diligently to dry lumber faster to increase the capacity of the facility. Our improvement designs include; high temperature boiler feed water, steam load management, and systems without steam traps.

### High Temperature Feedwater

When a dry kiln steam system utilizes steam at a pressure of 100 psig or greater a lot of the energy in the steam remains in the hot condensate being discharged from dry kiln steam traps. The energy is usually lost as flash steam from the vent on the condensate receiver as shown in this picture.

If this waste energy can be used to heat boiler feed water to an elevated temperature, less fuel will need to be burned to convert the hotter feed water to saturated steam.

In case study number one, a North Texas dry kiln operation runs the boiler at a pressure of 165 psig, the dry kilns at a pressure of 125 psig, and the deaerator most often operates at a pressure of 50 psig. The boiler feed water is at a temperature of 298°F instead of 220°F.

The results are that the facility used the efficiency improvement to generate 11% more steam while burning the same amount of fuel, they reduced plant makeup water from 12,000 gallons per day to 2,000 gallons per day, and they reduced the amount of chemical treatment by 75%.

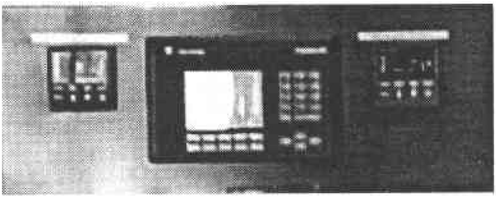
### Operating Considerations

- This improvement does put back pressure on the steam traps, and the traps had to be sized for a 75 psig pressure differential instead of a 125 psig differential.

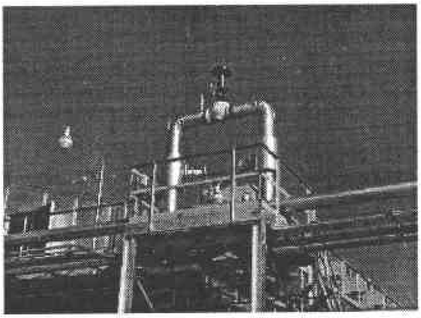
- The return condensate line from the dry kilns to the boiler room high pressure deaerator had to be increased in size to accommodate the mixed flow of condensate and low pressure flash steam.

● The deaerator is able to degasify the condensate and make up water at the elevated pressure. The basic principal of deaeration is that the water must be at boiling temperature for the pressure of the vessel and for this reason we can deaerate at 5 psig, 50 psig, or even at a vacuum.

**Steam Load Management**

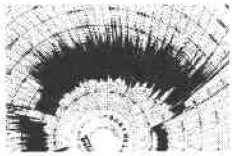


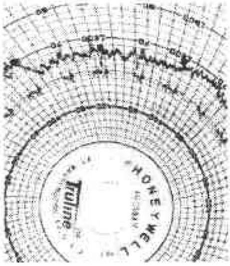
The Steam Engineering steam load management system is very different from the systems built by dry kiln and dry kiln control manufacturers. Dry kiln manufacturers often have a system that prioritizes dry kilns and even individual steam control valves within a dry kiln.



The Steam Engineering design utilizes an electronically controlled pressure reducing station with two inputs to accomplish the desired result. We try and operate the boiler at its highest practical pressure, frequently 150 psig to 175 psig and then we reduce the steam pressure at the dry kilns to 100 psig to 125 psig. This gives us a reservoir of higher pressure steam that dampens the impact of cycling individual dry kiln control valves. The potential impact of this control system on steam flow is demonstrated in the before and after steam flow charts.

In case study number two, an Eastern Washington dry kiln operation utilizes a boiler pressure of 180 psig and a dry kiln pressure of 120 psig. We use two single loop electronic controllers and condition the output of the controls through a low select relay. The first control is used to maintain dry kiln pressure at 120 psig, and the second control is used to maintain the boiler at a minimum pressure of 160 psig. Each of the controls also utilizes the output rate function of the control. Example: when a cold kiln is placed in operation the dry kiln header pressure will decline and our steam load management system opens the pressure reducing valve to the kilns slowly. The result is that the kiln steam pressure may decline to 80 psig and then slowly recover to its set point of 120 psig. The temporarily reduced dry kiln steam pressure will not impact the schedule of the hot dry kilns and the cold kiln will be placed in service without spiking the boiler steam flow. The second control is used to reduce the dry kiln steam load if the boiler is challenged to maintain minimum pressure. If the boiler pressure begins to fall the output to the reducing station is reduced to throttle the flow of steam to the kilns until the boiler can recover. This is again done to keep from over firing the boiler in an effort to quickly recover from an upset condition.





The charts above demonstrate the advantage of this steam load management system.

- The quality of steam was improved, the steam leaving the boiler was drier.

- The condensate vent loss was reduced because the kilns are operating at 120 psig instead of 150 psig, and this saves energy, boiler makeup water, and chemical treatment.

- The boiler firing rate changes are much smoother and this was very important in reducing air emission excursions, (spikes in the CO emissions from the boiler).

- The back pressure control that keeps the boiler from over firing can also be used as a master governor by setting a high output limit in the control. This was an important feature in convincing the air emission authority that the boiler would not be over fired.

## Operating a Steam Dry Kiln Without Steam Traps

Steam traps are used to insure that the steam supplied to a dry kiln is condensed and to insure that as the condensate is formed it is discharged from the dry kiln coil. All steam traps have an orifice that is operated on and off, or modulated to discharge condensate but shut off to keep from wasting steam. Steam Engineering has installed several high temperature feed water systems on dry kiln operations and these installations lend themselves to a dry kiln condensate system that utilize a simple orifice in place of the steam traps. If the orifice wastes some steam at low steam loads, the steam is not really a waste if it is being used to heat feed water to an elevated temperature.

Case study number three involves a two dry kiln operation in South Carolina. This client is using a high temperature feed water system, the steam load management improvement, and they operate the dry kilns without steam traps. They operate the boiler at 160 psig, the dry kilns at 120 psig, the deaerator most often operates at 45 psig, and they do not use any steam traps in the dry kilns. The facility enjoys the following results:

- They have eliminated the cost of steam traps.

- They have eliminated the repair cost of steam traps.

- They are not troubled by the fact that some steam traps do not do a very good job of venting non-condensable gas from the steam coil. An orifice is never off, and because it is always full open it does a good job of venting any air or gas that would accumulate in the steam coils

They also realized the following system wide improvements.

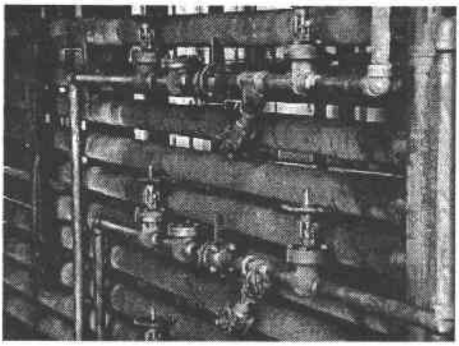
- They are able to limit boiler output to 23,000-lbs/hr steam flow.

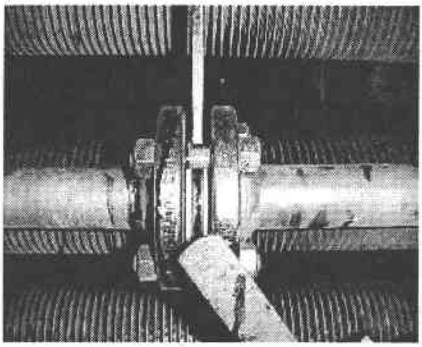
- They reduced dry kiln heat up time from 8 hours to 4 hours.

- They do not suffer spikes in steam flow to the dry kilns.

- They are able to put the second dry kiln in service whenever it is ready to start.

The photo at the left shows valves, strainer, and orifice after the steam coils. The photo at the right shown the flange holding the removable orifice plate.





Making steam systems as good as they can be.