Engineering Guidelines

by INDUSTRIAL STEAM

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Engineering Guidelines

are offered by

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to assist in the application, sizing and selection of deaeration and feed water conditioning systems.

If you have questions on any of the topics discussed or about the information provided, please contact one of our people in our sales or engineering groups for assistance.

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Modulated Feedwater Control vs On-off Pump Control

Modulating the feedwater to the boiler is the most important part of the boiler feedwater system. Modulating the feedwater flow to the boiler has so many advantages over on-off feedwater addition, it is difficult to visualize any other system. Boilers with modulating firing controls are quite common. Why would you modulate the boiler firing rate, but control the feedwater with an on-off level switch?

Modulating feedwater control offers several benefits.

ELIMINATES PUMP PROBLEMS

Experience shows that a larger number of the systems with on-off pump controls have problems with the boiler feed pumps. It is easier for on-off pump operation to result in the pump running outside of the allowable NPSH range. This results in pump cavitation and increased pump maintenance costs.

INCREASES BOILER EFFICIENCY

With on-off feedwater addition, the pump is sized for two or three times the boiler evaporation rate. The pump must be oversized to allow it to catch up when the boiler calls for feedwatert. When the pump starts it literally overloads the boiler with “cooler” water. If your boiler had a window and you could actually see the effect of this surging quench, you would be amazed. What you would see is a boiler happily steaming away until the pump starts and this colder surge collapses the bubbles and disrupts the natural thermal circulation. The result is a slight loss in pressure which signals the firing control to add more fuel resulting in wasteful cyclical firing. When compared to the smooth operation of a modulating system, one can imagine the effect this constant cycling has on the fuel consumption. On-off pumping systems remind me of a car trying to average 50 mph by going 100 mph for an hour then stopping for an hour.

STABILIZES DEAERATOR OPERATION AND EFFLUENT QUALITY

Did you ever stop to consider what on-off pump control does to deaerator performance? Suppose you have a 400 hp boiler and 400 hp deaerator. Your on-off pump selection would be roughly three times 400 hp or equivalent to 1200 hp. The deaerator is rated at only 400 hp so in effect your deaerator operates at 1200 hp one-third of the time and zero load for two-thirds of the time. This unbalanced cyclical loading ruins the quality of the feedwater because it drives your level and pressure controls crazy.

USES EFFICIENT, LOW WEAR CENTRIFUGAL PUMP

At this time, it might be well to compare turbine type pump to multi-stage centrifugal pump.

The ***turbine type pump***, which is generally the type of pump used for on-off systems, is considered to be a low capacity, high head pump. They rely on close tolerances and consequently have very high wear rates. They are inexpensive. They are also inefficient . Their lower initial cost is rapidly overshadowed by high repair costs and wasted energy.

On the other hand, the centrifugal pump is more efficient, has a longer life cycle and experiences fewer repairs.

The main difference in operation is the turbine type pump has a very steep curve making it unsuitable for modulating operation. The centrifugal pum has a fairly flat curve which offers a steady inlet pressure to the feedwater regulating valve thus making it ideal for modulation.

PUMP SIZE CAN BE REDUCED

With modulating feedwater, it is not necessary to drastically oversize the boiler feed pumps since the boiler input matches boiler steam output. Modulating valves function as an engineered restriction in the feed line thus preventing the pump from overloading, and allowing the selection of smaller, more efficient, lower horsepower pumps. With a slight overcapacity for surge loads a pump can be selected for 125% to 150% of the boiler(s) rated output.

MANY SYSTEM VARIATIONS AVAILABLE

As part of this engineering information sheet we have included a suggested specification and a drawing for a modulating system which automatically starts the boiler feed pump when the feedwater valve is just opening on the boiler and continues to operate until water is no longer required.

On multiple boilers, we automatically start the pump when any one of the boilers needs water. This system has the advantage of eliminating the need for a recirculating orifice since the pump is never allowed to operate against a closed valve or dead end situation.

There are many variations to the above system. One is where we furnish two (2) P/E switches, the second switch set to operate a second or lag pump should any one of the feedwater valves go to a full open position. This allows the selection of a lead pump for light boiler loads and then automatically starts a second pump for heavy loads. Or perhaps using a pump more closely sized to actual operating conditions with built-in surge capability.

Another variation is utilizing a flow switch in the discharge manifold which signals a selected lag pump to pick up the volume whenever the flow exceeds a single pump capacity. This type of system is particularly useful on jobs that have varying capacities due to variable process requirements, summer/ winter heating loads, etc. With this system three pumps are used in lieu of two larger pumps. With electrical horsepower figuring at $300 to $400 per year per horsepower, using smaller pumps and/or eliminating wasteful recirculating orifices is very cost effective.

A third variation includes a pressure switch on the discharge manifold to automatically start a second or lag pump should the lead pump fail. An alarm can also be added to this system.

A fourth system would stage the feedwater pumps using a flow controller.

Using modulating feedwater control is far superior to on-off pump control. Modulating feedwater control doesn't' slug the boiler, allows the deaerator to operate with in it's capacity and requires smaller pumps which use less electricity.