Richard hourigan, inc.
Responding to the needs of industry since 1973.

THE NEED FOR AUTOMATED BOILER BLOWDOWN CONTROL

INTRODUCTION:

Water, when used for industrial use, contains many dissolved minerals and gases which can cause undesirable effects on industrial equipment. These undesirable effects in the generation of steam can result in corrosion, scale deposition, and lack of the effective use of purchased fuel BTUs. When steam is generated in a boiler without proper treatment or control all three of these can occur. The result will be higher operating costs and lower equipment life expectancy. An effective Boiler Water Treatment Program will make the boiler water more manageable for the production of steam. This can not be done by the use of chemicals and pretreatment equipment alone. It requires that the chemicals added to the boiler system and the blowdown schedules both be proportional to the equipment load. To do this it is necessary to automate the chemical feed and the blowdown control. This paper will address the need for automated blowdown control only.

WATER CHARACTERISTICS:

Pure water is a highly effective insulator. That is to say that it will not conduct electricity. What allows water to conduct electricity is the dissolved mineral content. The higher the quantity of dissolved minerals, the greater the amount of the electricity which it will conduct.

Some minerals, notably calcium and magnesium, exhibit a characteristic known as reverse solubility. Whereas most minerals become more soluble as water is heated; calcium and magnesium become less soluble and tend to form scales on the hottest parts of the systems. Since they are highly effective at insulating heat transfer; these scales result in loss of fuel BTUs up the boiler stack which greatly reduces boiler efficiency. It is best to address this problem by the use of a water softener to remove calcium and magnesium before they enter the boiler.

MINERAL CONCENTRATION:

As steam is generated, water is evaporated in its pure form leaving practically all of the dissolved minerals behind (though not the dissolved gasses). Steam (and the condensate which forms once it has released its energy to heat other equipment) is essentially distilled water. Thus the remaining boiler water contains the minerals which are left behind by the evaporating steam.

As these minerals concentrate in the boiler, they too begin to cause problems and must be removed. Problems noted are the carry over of boiler water into the steam causing wet steam which has a lower overall BTU content and thus requires the generation of even more steam to provide the desired heating. This results in the loss of additional fuel. The additional water in the steam must be removed by the steam traps which can be seriously over worked and damaged, thus shortening their life. Finally it is possible for the wet steam to leave behind mineral deposits that insulate the steam side of heat

exchangers preventing efficient heat transfer.

The fact that water increases its conductance of electricity as the mineral content increases allows us to devise equipment that can monitor the mineral content of the boiler by monitoring the water's ability to conduct electricity. With this equipment we can allow the boiler water to reach high conductivity levels to conserve water, chemical, and fuel. While at the same time we can prevent the conductivity (i.e. mineral content) from becoming so high that it causes the types of problems noted in the previous paragraph.

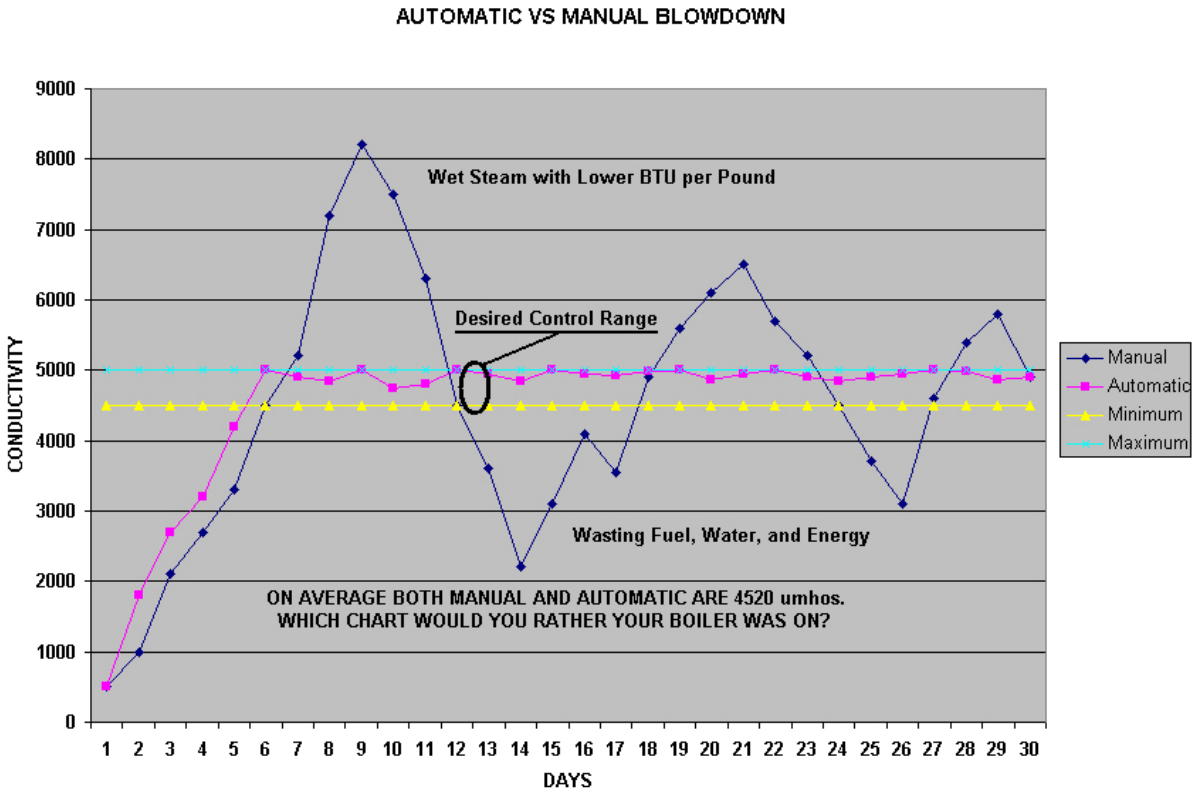
EXAMPLE:

If we determine that the maximum effective operating range is between 4500 μmhos and 5000 μmhos, then we can set the controller to control blowdown at that range (as shown below). Below 4500 μmhos we are wasting water, chemical, and fuel. While above 5000 μmhos we are risking the generation of wet steam.

If we produce steam at 15 psig, the boiler water and steam temperature will be 252 degrees Fahrenheit. The BTU content of the dry steam will be 1164.7 BTUs per pound while that of the boiler water will be 220.6 BTU per pound. If the steam were 10% boiler water then the resultant BTU per pound would be 1070. If the steam were 20% boiler water then the resultant BTU per pound would be 975. At 10% boiler water in the steam you would need to generate 8.85% more steam to generate the same heat while at 20% you would have to generate 19.4% more steam.

For a 15 psig boiler with 100% make up whose mineral content is 18 times make up, each 1000 pounds of steam would result in 59 pounds of blowdown. That same boiler being over blown to the point that its mineral content is only 9 times make up would result in 125 pounds of blowdown for each 1000 pounds of steam generated. Thus a waste of 66 pounds (~ 8 gallons) of water, a requirement for 2.1 times as much chemical, and a loss of 13,042 BTUs per 1000 pounds of steam generated assuming a make up temperature of 55 degrees Fahrenheit.

This is the case for automatic blowdown control.


AUTOMATIC VS MANUAL BLOWDOWN
CONDUCTIVITY
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Wet Steam with Lower BTU per Pound
Desired Control Range
Wasting Fuel, Water, and Energy
ON AVERAGE BOTH MANUAL AND AUTOMATIC ARE 4520 umhos.
WHICH CHART WOULD YOU RATHER YOUR BOILER WAS ON?
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
DAYS
Manual
Automatic
Minimum
Maximum