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Understanding Boiler Water Treatment

Constituents present in surface water and ground water sources, including dissolved solids and suspended solids, can result in significant operating costs in industrial processes. Removing these constituents will result in cost savings. When considering an investment in water treatment equipment, it's important to recognize and quantify each source of value creation. In industrial applications, these sources typically fall under the broad categories of:

Energy Reductions
Water Volume Reductions
Chemical Treatment Cost Reductions
Reductions in Downtime/Maintenance Costs
Improvements in Product Quality

The design of a suitable water treatment system (and resulting investment cost) depends primarily on the characteristics of the incoming water supply and on the finished water requirements. Any water treatment system must deliver - at a minimum - a reliable water supply that meets the water volume requirements and the finished water specification. Improvements in water quality beyond the minimum specification can add attractive cost-savings payback.

(mg/l)	Make-Up Water		Water Chemistry in Boiler	
	Raw Water	*RO Permeate*	*Raw Water @ 10 cycles*	*RO Permeate @ 50 Cycles*
K	10.0	0.28	43.7	5.4
Na	30.0	0.56	131.1	10.8
Mg	20.0	0.14	87.4	2.7
Ca	50.0	0.93	218.5	17.9
Ba	0.1	0.00	0.4	0.0
HCO_3	240.0	4.69	1048.8	90.2
Cl	11.0	0.12	48.1	2.3
F	0.0	0.00	0.0	0.0
SO_4	70.0	0.43	305.9	8.3
SiO_2	10.0	0.31	43.7	6.0
TDS	**441.3**	**7.46**	**1928.6**	**143.5**

In terms of creating value toward generating an attractive ROI, the RO permeate in the above example is responsible for several significant cost-saving changes in boiler operation. The solids within the boiler have been significantly reduced, even at 50 cycles of concentration, allowing for corresponding reductions in the amount of boiler treatment levels required to treat these solids. In addition, the blowdown volume has been reduced from 22.2 gpm to 4.1 gpm, reducing the amount of treatment chemicals that are released from the boiler. Taken together, the lower level of solids within the boiler and the reduced blowdown rate will typically result in chemical treatment savings of 80-90%. The reduction in volume of high-temperature blowdown also results in significant energy savings. In addition, the "cleaner" water within the boiler will show a much lower tendency to form scale, resulting in improved heat transfer efficiency.

The concentration of solids allowable in the boiler water is dependent on the operating pressure of the boiler. As a general guideline, The American Boiler Manufacturing Association publishes the following table:

Boiler Pressure - psi	Total Solids - ppm
0-300	3500
301-450	3000
451-600	2500
601-750	2000
751-900	1500
901-1000	1250
1001-1500	1000

Using these guidelines, the most cost-effective water treatment system for a low pressure boiler may be softening, while a high pressure boiler using the same raw water source may require softening, double-pass RO, and EDI to provide adequate water quality.

Impurities in water add significantly to the cost of effectively operating a boiler. As steam is lost and make-up water is added to the boiler, the concentration of impurities in the water "cycles up," quickly moving beyond the concentration at which they can be adequately treated by chemicals. To prevent this, high-solids water must be bled from the boiler ("blowdown") to maintain a reasonable level of solids in the boiler water. Unfortunately, blowdown - in addition to releasing high solids - also releases money that has been invested in the water. Specifically, the heat energy that brought the water up to temperature and the chemicals required to treat the water are lost during the blowdown process.

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