Meredith College Goes “Green”

History of Bon Aqua

Environmental Water Treatment

Meredith College

Raleigh, NC

New 'physical water treatment' program saves 5 million gallons of water per year at Meredith College in Raleigh, NC.

Tom Sherry – Director of Operations at Meredith College in Raleigh, NC needed better control over the existing water treatment program protecting Meredith's 2600 tons of open loop cooling tower system and 3 – 300 hp steam boilers. Several traditional water treatment options were presented.

After significant research and site visits a decision was made to choose the non-chemical Bon Aqua program.

The Bon Aqua water treatment program was chosen because it eliminates all corrosion and inorganic scale control chemicals, reduces biological chemical demand, reduces system water consumption and because it creates a scale free environment - saves energy.

There were local establishments with similar sizes HVAC equipment that had been successfully applying the technology for over 10 years.

The Bon Aqua water treatment program supplies a steam-condensate, or an open loop water cooling process with flux density greater than 22,400 gauss, which in turn causes an electric current to be generated in the flowing water. According to physics, this creates a "Faraday's Generator" with the flowing water being the armature and the steel pipe being the field coil. An impressed current from a negative ground source supplies an infinite flow of electrons to the metal pipe and into the flowing water. Proper application of the Bon Aqua technology will cathodically protect the entire open loop water system.

In December of 2003 a partnership was formed. Consistent effort by Ron Johnson (Maintenance Manager) and Tony Alston (HVAC Technician) in managing the HVAC equipment and applying the concepts of the Bon Aqua program has:

- Eliminated over 95% of the water treatment chemicals used at Meredith
- Reduced water consumption by more than 5 – million gallons per year
- Kept the heat exchange equipment scale and corrosion free - saving energy
- Eliminated the discharge of toxic chemicals to the sewer – environmentally friendly

The steam boilers were opened for inspection after a year of Bon Aqua water treatment and were clean. Chiller - condensers have been opened and the tube bundles were scale free.

Tony Alston learned the art of chemical water treatment in the Navy and has done an exceptional job managing the Bon Aqua program. Tony said; "the Bon Aqua program worked well and is as near a perfect water treatment system possible". "The Bon Aqua Program has done everything they said it would do".

Tom Sherry agrees. "This has been a good program for Meredith". Their HVAC equipment is protected from scale and corrosion. Re-occurring chemical costs have been eliminated freeing that money up for other projects. A safer working environment has been created for their employees that normally handle water treatment chemicals. Meredith not only saves millions of gallons of water per year but also no longer discharges used water treatment chemicals to the sewer.

Tom Sherry

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Bon Aqua Analysis of Meredith College Savings

The procedure used to collect information for our proposal, which included a return on investment projection, encompassed a site survey to determine the sizes of the equipment to be treated, measurements of the outside diameters of the inlet lines to each condenser, return lines to towers, and make-up water lines. The figures used for the ROI were actual numbers supplied by the facilities director (at that time, Aramark's Ron Johnson) of the KWH rate, cost per 1000 gallons of the water and sewer, and annual chemical costs. The quantity and HP of the cooling tower fans and pumps were also factored into our calculations.

These numbers were entered into our ROI computation worksheet, which is based on industry standard formularies of the Cooling Tower Institute in conjunction with the manufacturers of HVAC equipment. It is their method of determining water and power volumes, and efficiency expectations.

Industry guidelines state that 50% of the water entering the system is lost to evaporation and 50% is lost to bleed. Bon Aqua uses a far more conservative ratio (2/3 to evaporation, 1/3 to bleed) to ascertain the bleed water volume. Our savings are predicated on minimizing those bleed water volumes by keeping the deleterious TDS/CND in solution longer, which in turn, increases the cycles of concentration in the system, thereby minimizing the demand for new city water make-up.

1. The ROI used Meredith's 3000 chiller tons operating 2000 evaporative hours a year. (Standard averages run from 2640 to 4320 evaporative hours annually)
2. The 2003 cost per 1000 gallons of water and sewer was $3.10.
3. Water savings are based on increasing the cycles of concentration, which at the time of the Bon Aqua installation were at 2.5 COCs. By the end of the first year, the COCs had increased to 6.8, which translates to a 5 million gallon savings as noted by Tom Sherry in a report on Meredith's website in 2005.
4. 2003 combined annual chemical costs used in the ROI were $30,000 (Actual-$37,000).
5. The power volumes were arrived at by converting the horsepower of the tower fans and pumps to kilowatts, added to the chiller KW, and then multiplied by 2000 operating hours and lastly, multiplied by the 2003 rate of $.045/kwh to arrive at the cost.
6. The 5% power savings is the minimal amount that should be saved by keeping the system free of scale.
7. The total annual projected savings in 2003/2004 was $57,221.
8. Extrapolated over 8 years totals $457,768 based on '03 dollars.

Because of the many variables in a steam boiler system (types of fuel, full-fire vs. half-fire, annual hours of operation, etc.) we cannot provide an accurate ROI on the steam boiler systems. However, in order to accurately depict the complete job cost, we factored the total chemical expenditure, as well as the Bon Aqua boiler treatment costs in the ROI numbers.

To support this analysis, attached is the return on investment worksheet, the cooling system highlights, and the future considerations from the Meredith History package.

Meredith Savings Synopsis

	2003 Costs	2012 Costs	Projected Savings 2003/2004	Actual Savings 2012
Water/Sewer (per 1000 gallons)	$3.10	$7.98	$16,573.00	$42,661.00
KWH Rate	$.045	$.079	$10,648.00	$18,693.00
Chemical Costs	w/o price escalation		$30,000.00	$37,000.00
Annual Savings			$57,221.00	$98,354.00 @ 2012
Return on Investment			**1.29 Years**	**7 Months**
Cycles of Concentration	2.5 ('03)	6.8 ('04)	Gallons Saved	5 Million (1st Year)
Current COCs 9.0				
Extrapolated 8 years using 2003/2004 projected savings = $457,768.00				

Equipment Treated Under This Project	**Cost @ 2003**
600 ton Marley tower system with 600 ton York condenser	
Two 1200 ton BAC towers with two 1200 ton Trane condensers	$58,600.00
350 HP Keeler Water Tube Boiler	
350 HP Burnham Fire Tube Boiler	
200 HP Burnham Fire Tube Boiler	$15,141.00
Project Total	**$73,801.00**

Apr, 2012

General Highlights:

1. Program installation was completed during the last week of December 2003. No equipment down time was required to properly install the Bon Aqua equipment.

2. Operator training began immediately and was continued until Meredith personnel were comfortable with the program and its operating parameters.

3. Bon Aqua personnel were available to answer questions and trouble shoot operation concerns when asked.

4. $37,000.00 of cost was eliminated from the Meredith College 2004 chemical water treatment budget.

5. Daily maintenance of the water treatment chemicals and application equipment was eliminated.

6. Water treatment chemical handling, storage and their associated costs were eliminated with the exception of bromine tablets for biological control in the cooling tower water loops.

7. Bon Aqua assisted in establishing a more cost effective program to handle bromine and neutralizing amine for the condensate system.

8. Steam boiler and cooling system operating personnel found the Bon Aqua water treatment program easy to master and maintain.

Compiled by: R. Houdlette Jan. 14, 2005

Boiler Highlights:

1. All boiler water treatment chemical addition was discontinued immediately upon installation.

2. Boiler operation continued through the 2004-heating season without interruption.

3. Boiler water appearance went from a brownish – rust color to a clear liquid.

4. Boiler blow-down frequency was decreased through the course of the heating season and boiler conductivity was controlled and maintained (more) with top blow down verses bottom blow down.

5. All boilers met the conductivity target limits established at the Bon Aqua program start-up.

6. All boilers were opened for inspection during the summer months and each boiler was clean and in good condition. The state boiler inspector suggested that boiler #3 (Burnham fire tube) was the cleanest boiler in the state. See attached Picture.

7. No boiler water treatment chemicals were used during the 2004-heating season.

8. A small amount of chemical (less than $400 in 2004) for pH control of the condensate loop was added during the latter part of the summer months. It was determined that condensate pH at the remote receivers was (and is) being lowered by 3 – 4 pH points by the introduction of air handler condensate water to the boiler condensate water system. A solution to this problem will be addressed during January, 2005.

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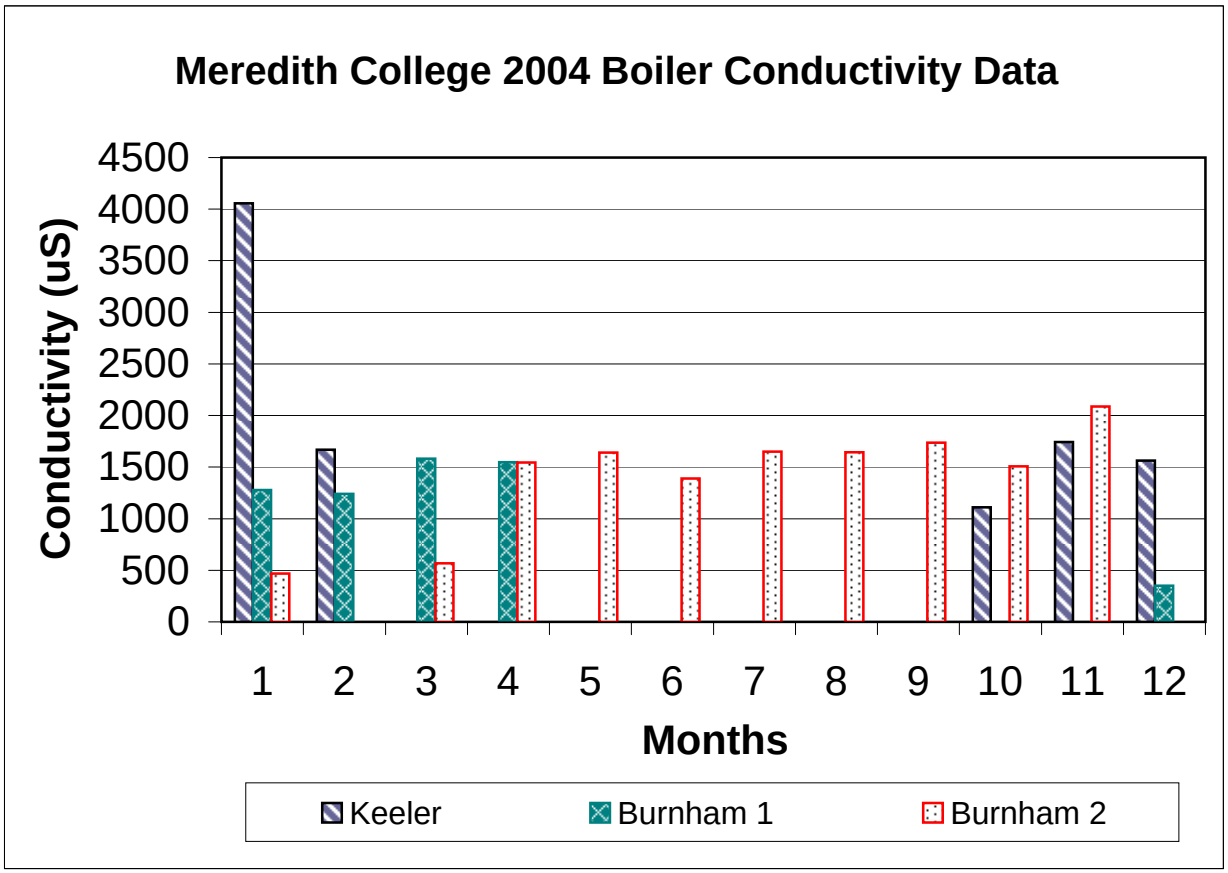
Meredith College 2004 Boiler Data

2004	Keeler		Burnham 1		Burnham 2		Condensate	
	pH	Cond (µs)	pH	Cond (µs)	pH	Cond (µs)	pH	Cond (µs)
AVG →	11.0	2027	11.0	1200	10.9	1424	7.6	36
Month								
1	11.0	4055	11.2	1279	10.1	467	7.9	35
2	11.0	1667	11.1	1241			7.8	22
3			11.1	1583	10.6	566	7.4	21
4			11.1	1547	11.0	1543	7.4	28
5					11.0	1642	7.5	34
6					10.8	1390	7.3	29
7					10.9	1651	7.0	33
8					10.8	1645	7.1	47
9					10.9	1736	7.3	44
10	10.8	1110			11.1	1507	8.4	52
11	10.8	1743			11.3	2088	8.1	44
12	11.2	1562	10.6	350			8.2	47



Meredith Boiler #3 (Burnham 2 – 300 hp) December 2004 - one year after Bon Aqua Water Treatment initiated. ABB scratched into pipe in early December – 2003. Boiler tubes had some scale on all the tubes and now there is none.

Cooling System Highlights:

1. All three chillers and cooling towers performed without interruption throughout the cooling season in 2004.

2. All three towers remained scale and algae free throughout 2004.

3. Turbidity of the cooling tower pan water was reduced significantly.

4. Cooling tower cycles of concentration increased from a 2003 average of 2.5 cycles to a 2004 average of 6.8 cycles. This equates to greater than 75% reduction in tower bleed water and more than 4.5 million gallons of bleed water saved by Meredith College in 2004 verses 2003. See the attached graph that compares 2003 cycles with 2004 cycles of concentration. By September of 2007 the cycles of concentration had increased to 9 cycles.

5. All three chillers met the condenser inlet and outlet conductivity criteria established at the start of the Bon Aqua program.

6. Total bromine requirement for 2004 was less than $300.00

7. Condensers will be opened for inspection during the latter part of the first quarter of 2005.

8. Non-destructive Eddy current tests will be performed at pre-determined intervals to document the interior condition of the condenser tube bundles.

Compiled by: R. Houdlette Jan. 14, 2005

Meredith College Performance Data

2004 Bon Aqua System Results

Data	Bleed Water Gal.	Cost	Chemical	Total
*2003 Costs	5,808,816	$18,007.33	$37,400.00	$55,407.33
*2004 Costs	1,281,946	$3,974.03	$300.00	$4,274.03
2004 Savings	4,526,870	$14,033.30	$37,100.00	$51,133.30
2004 % Reduction	77.93%	77.93%	99.20%	85.68%

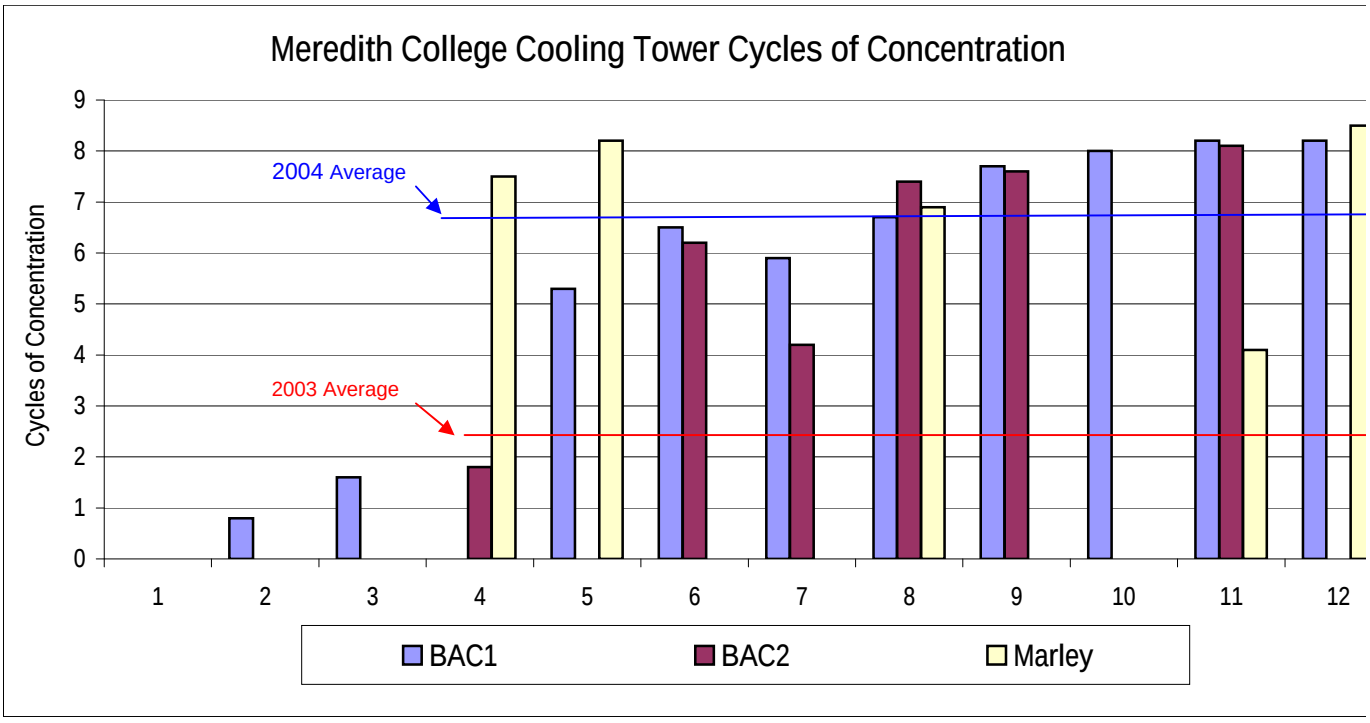
*Client water & Sewer rate = $3.10 per 1000 Gallons

*Client Chemical Costs for Boilers and Cooling

*Client chemical cost for biocide only

Estimated annual savings at $50,600

Meredith College 2004 Cooling Loops Data Summary					
Annual Average Result	Tower		Chiller		
Description	pH	Cycles	Δ ^{0}F	Cond In µs	Cond Out µs
Cooling Loop #1	BAC 1		Trane 1		
Data	8.2	7.1	6.4	1284	1285
Cooling Loop #2	BAC 2		Trane 2		
Data	8.4	6.7	7.8	1580	1584
Cooling Loop #3	Marley		York		
Data	8.4	7.0	7.7	1597	1599
Make up Cond µs	195				



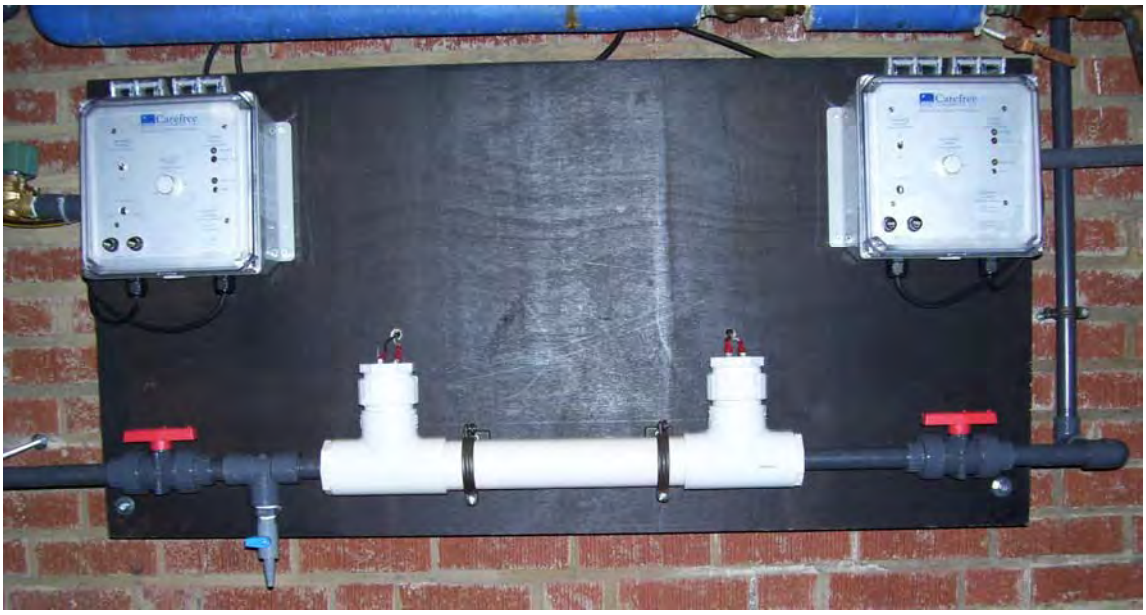
Future Considerations:

- Convert 100% of boiler blow down and cooling tower bleed from the sanitary sewer to a storm sewer source. This action can be taken, as there is no water treatment chemicals associated with the wastewater streams. Potential savings for Meredith College will be the elimination of sewer charges for about 3 million gallons of water per year.

- Target 'condenser in' conductivity of 1900 uS to 2100 uS to average 8 – 10 cycles of concentration.

- Install a meter on the tower water make up line and tower bleed- down line in order to determine and capture the water and sewer (cost) lost through evaporation and bleed down.

- An electrolytic ionizer was installed in April, 2009 to replace the Bromine that was being used for the control of bacteria. This action makes Meredith officially chemical free. The ionizer is low maintenance and only requires that the anode be replaced every two years at a nominal cost.



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