

System Science vs. Chemical Sales

WHAT EVERYONE NEEDS TO KNOW – BUT DOES NOT – ABOUT HVAC WATERSIDE MANAGEMENT

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The Purpose Of Water Monitoring & Treatment

The entire purpose of water analysis and chemical treatment in HVAC systems is to *maximize the efficiency and longevity of the heat-transfer surfaces*. This means maintaining the wetted surface in a clean condition, whether it is the exterior of tubes in a steam boiler -- bathed in boiling water -- or the interior of condenser coils -- bathed in chilled tower water. These surfaces are to be consistently kept free of corrosion, scaling and fouling.

The Problem With The Status Quo

Much of what passes for waterside protection in HVAC systems is neither properly-engineered nor science-based. You may have become accustomed to paying thousands of dollars a year for water treatment, while continuing to experience water-induced failures. But prevention is neither expensive nor difficult, and failures are certainly not inevitable.

You Have The Right To

- Experience no tube, pipe or boiler failures.
- Know whether system chemistries meet objective standards.
- Demand that corrosion rates be less than 0.1 mil per year.
- Pay no more than \$30 per year per system for treatment chemicals.
- Expect systems to last as long as the buildings they serve.

Most of what is offered to you are sales-based treatment programs. That is not to say that the chemicals sold are ineffective, or that the company reps are dishonest. But in a sales-based system, the vendor's principle reward comes from selling as much product as possible, rather than from ensuring that the systems receive consistent, long-term protection.

Hallmarks Of A Chemical Sales Program: Promotes Company Products

- Encourages Expense – Features proprietary treatment blends and sophisticated brand-name equipment.
- Products Over Process – Emphasis is on the features and benefits of a product line.
- Poor Transparency – Test results are not routinely compared to chemistry safe zones.
- Little Proof Of Performance – Corrosion monitoring is viewed as an upgrade, rather than as a basic necessity.
- Lack Of Professional Oversight – System chemistries are supervised by a sales representative.

Hallmarks of An Engineered Monitoring Program: Promotes Effective Process

- Encourages Savings – Features undiluted chemicals and reliable, low-cost technologies.
- Process Without Product – Emphasis is on effective management using non-proprietary methods and materials.
- Complete Transparency – Test results are always compared to chemistry safe zones.
- Proof Of Performance – Corrosion monitoring is always performed, full-time, whether system is on- or off-line.
- Professional Oversight – System chemistries are supervised by a water chemist or chemical engineer.

Solving The Problem By Setting Standards

Here are 10 questions to ask when interviewing and evaluating those who seek to oversee your HVAC chemistries in exchange for a chunk of your budget. Justifications for each criterion are provided. Keep in mind that a comprehensive protective program need not cost over \$1 a day per system, which includes the cost of sample analysis, corrosion monitoring, treatment chemicals and feed devices.

Questions	Good	Fair	Poor
1) How often is water analysis performed?	cooling towers: monthly hot/cold loops: quarterly steam boilers: monthly		
2) Are corrosion rates measured?	yes, at no charge	yes, for a charge	no
2a) Are rates measured while systems are on- and off-line?	yes, year-round	on-line only	no
2b) What is the maximum corrosion rate tolerated?	0.1 mpy	0.5 mpy	no guarantee
3) Is off-line or lay-up chemical protection included?	yes		no
4) Who oversees system chemistries?	chemist or engineer		sales person
5) Is treatment added as-needed or on a time-schedule?	as needed		time schedule
6) Are "all-in-one" or "one-drum" products used?	no		yes
7) What percent active ingredient are the treatment chemicals?	> 95%	30-50%	< 30%
8) How much does it cost to treat 1000 gallons of system fluid?	< \$5		> \$20
9) Are non-chemical devices used?	no		yes
10) Is sodium nitrite used?	no	sometimes	yes

1) Analysis should be performed *each quarter* during system operation for heated and chilled hydronic loops, since these systems take on little or no make-up, and therefore have relatively stable chemistries. Analysis should be performed *each month* during operation for steam boilers and cooling towers, because they operate under high temperature and pressure (steam boilers), or are open to the environment (cooling towers), and therefore have relatively dynamic chemistries. Certain steam boiler and cooling tower chemistries should also be reported every week, by in-house staff. Test kits, training and log sheets should be provided for this purpose.

2) The primary purpose of water treatment is to prevent corrosion, and to a lesser extent, scaling and fouling. If corrosion rates are not measured, neither you nor the vendor has direct evidence of the efficacy of the protective program. Also, corrosion rates can be many times higher when systems are off-line or out-of-service, so in order to be representative, corrosion rates should be measured year-round.

3) System protection is not complete if systems are ignored when they are off-line or out-of-service. Lay-up treatment and procedures should be an integral part of all protective programs.

4) Those who profit from the sale of water treatment are not a reliable sources of objective water treatment advice. You are looking for a *heat-transfer efficiency manager*, an individual whose professional responsibility and primary interest is the lifelong well-being of your systems. You are not looking for the “best” line of products. Seek a chemist, an engineer or a scientific professional who subscribes to the *NSPE Engineers’ Creed*, and will function as your trusted partner and ally.

5) Chemical treatment serves its purpose when used to achieve protective ranges, or safe zones (see table below). With the exception of biocide feeding in cooling towers, if chemical is fed on a time-schedule, it is not being fed in response to demand (as indicated by test results). This serves the vendor’s purposes, not yours.

Chemistry Parameter	Cooling Tower	Hydronic Loop	Steam Boiler	Condensate
conductivity, $\mu\text{mhos/cm}$	< 7000	~ local tap water	< 7000	< 50
freeze point, $^{\circ}\text{F}$		< winter lows		
nitrite, ppm		700 - 1200		
opacity / color	clear / colorless	clear / colored	clear / colorless	clear / colorless
pH	8 - 9	9 - 10	10 - 12	8 - 9
phosphate, ppm	2 - 20	10 - 20	30 - 50	
phosphonate, ppm	6 - 10			
sulfite, ppm		30 - 50	30 - 50	
total alkalinity, ppm			< 700	

6) “All-in-one” or “one-drum” products sound like a good idea, but they are designed for the convenience of the vendor. Feeding all chemicals when only one is needed results in overfeeding the other chemicals, which wastes resources and raises your costs.

7) Most liquid blends are priced at over \$20 a gallon, and contain roughly \$2-worth of active ingredients. Check your chemical labels; most will quote ~20% active ingredients and ~80% inert ingredients (water). This makes them a great value for the seller, and a poor one for the buyer. Even undiluted “solid blend” treatments, which are marketed as a break-through (because the user is no longer forced to pay for water), offer little cost advantage over liquid blends. Most are priced at over \$150 a gallon, but contain less than \$10-worth of active ingredients. You may need a \$500 unit at each location to dissolve the block before it can be fed.

Water Treatment Product	Price They Pay For Actives	Price You Pay*	Cost To Treat 1000 Gallons
Liquid Blend, 1 gallon	\$2.65	\$25-\$65	\$25-\$65
Solid Blend, 1 gallon	\$7.95	\$150-\$250	\$30-\$50

*Quoted from Cannon Water Technology Incorporated, Solid Blend Technologies Incorporated and KML Incorporated.

8) Beware of terms like “high-powered” or “concentrate”. Ask approximately how much it costs to treat 1000 gallons of tap water for the system type of your choice (steam boiler, hydronic loop, cooling tower), and compare that figure to the table below. If they can’t tell you, you don’t want them caring for your equipment. Water treatment chemicals are not inherently expensive; they average about \$1 a pound in their original, powdered form.

Undiluted Active Ingredient	Function	Price Per Pound**	Cost To Treat 1000 Gallons
acetate (EDTA)	inhibits scale	\$0.63	\$2.52
dipotassium phosphate	buffers pH, inhibits corrosion	\$1.80	\$1.12
phosphonate (HEDP)	inhibits scale, inhibits corrosion	\$1.69	\$0.14
quaternary ammonium	biocide	\$0.89	\$0.05
sodium hydroxide	builds alkalinity	\$0.44	\$0.44
sodium sulfite	scavenges oxygen	\$0.55	\$0.48
sodium nitrite	inhibits corrosion	\$0.68	\$3.80

**Quoted from Univar USA, an international distributor of thousands of unadulterated chemicals. Most chemicals can be purchased in 50# bags.

9) Magnetic fields, radio frequencies and molecular re-alignment do not prevent corrosion, scaling or fouling. Check vendor claims at <http://www.chem1.com/CQ/>

10) Sodium nitrite, mixed with sodium borate, is a standard offering among chemical sales companies. Though nitrite is a good corrosion inhibitor, it is a poor choice for closed loops for a number of reasons. First, nitrite is an environmental toxin. Second, it is aggressive to copper and brass. Third, at levels above target concentrations, it hardens rubber gaskets and forms abrasive crystals at evaporation sites, wearing seals and valves. At levels below target concentrations, it accelerates corrosion rates, making it worse than having no treatment. Fourth, nitrite is a ready source of food for the microbes that cause fouling.