



**Zeta Corporation's Complete Guide to  
Water Treatment in Evaporative Cooling  
Systems.**

2045 N. Forbes Blvd. • Suite 102 • Tucson, AZ 85745 • USA  
TEL 520.903.9904 • 888.785.9660 • FAX 520.903.9910  
EMAIL [info@zetacorp.com](mailto:info@zetacorp.com) • INTERNET <http://www.zetacorp.com>

**Introduction**

This is a three part paper. The first part covers the objectives that any evaporative cooling water program should meet. The second part addresses how the Zeta Rod System meets these objectives, and the third part is a table in which a comparison is made between the Zeta Rod System and a conventional Chemical Treatment Program.

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2045 N. Forbes Blvd. • Suite 102 • Tucson, AZ 85745 • USA  
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## **Part A:**

Description of an evaporative cooling  
system water treatment program.

## Cooling Tower Water Treatment Program

This document covers the basic principles of water treatment for a cooling tower, as well as some information associated with the operation and maintenance of the cooling tower. Some of the information here has been extracted from:

*“Chemical Treatment of Cooling Water in Industrial Plants, Basic Principles and Technology”*, Timothy Keister, ProChemTech International, Brockway PA.

*“The Chemical Treatment of Cooling Water 2<sup>nd</sup> Edition”* James W. McCoy, Chemical Publishing Co. New York, NY.

*“Water Treatment for HVAC and Potable Water Systems”*, Richard T Blake, McGraw-Hill Co. New York, NY

*“Legionellae Control in Health Care Facilities: A Guide for Minimizing Risk”*, Matthew R. Freije, HC Information Resources, Fallbrook CA. 1996.

Any discussion of cooling water treatment must begin with an objective statement of what is expected from the cooling water system. In manufacturing plants, the cooling water system must provide reliable production equipment cooling with maximum heat transfer efficiency. The following four basic requirements are derived from this objective.

- 1) **Minimize problems from corrosion, scale, deposition, and biofouling to obtain maximum efficiency.**
- 2) **Implementation and control must be "do-able" with a minimum input of labor and money.**
- 3) **Cost effective as possible considering the total water system capital and operating costs.**
- 4) **Must be environmentally acceptable.**

These four requirements form the basis for the following discussion of cooling water control and treatment.

## Operation of the Cooling Tower & Water Conservation.

### Cycles of Concentration.

Cycles of concentration determine how much is the water being recycled in an evaporative cooling system (cooling tower or evaporative condenser); or the number of times that the dissolved salts in the fresh **makeup water (MU)** are concentrated by evaporation from the cooling system. It can be measured in several ways, but the three most common are:

1. **By Conductivity or Total Dissolved Solids (TDS):** The cycles of concentration are equal to the ratio of the conductivity (or TDS) in the recirculating water (**RW**) to the conductivity of the make up water.

$$C = \text{TDS}(\text{RW}) / \text{TDS}(\text{MU})$$

Conductivity meters or TDS meters are used. TDS is measured in parts per million (ppm) and conductivity in micro or milli siemens (roughly 1ppm = 2 us).

2. **By Volumetric Water flows:** Cycles of concentration can be measured as the ratio of make up water (**MU**) to blow down water (**BD**). In systems equipped with cumulative water meters on the make up and the blow down, the cycles can be calculated as the amount of water added to the tower (by make up) divided by the amount of water purged from the tower (through blow down).

$$C = (\text{MU}) / (\text{BD})$$

3. **By highly soluble ions.** When towers run at high cycles, some of the ions that are measured with conductivity meters and TDS meters go from solution into suspension (they precipitate). When this happens, the cycles measured by conductivity or TDS do not reflect the true cycles of the tower. There are certain ions that are much more soluble (they do not precipitate) and thus the cycles can be measured as the ratio of those ions in the circulating water to their concentration in the make up water. The most commonly used ion is chlorides. However, in towers where sodium hypochloride (or other chlorinated compounds) is used as a biocide, this can affect the level of chlorides in the recirculating line.

The goal of operating the tower at higher cycles is to lower both the makeup and blowdown requirements, cutting the cost of fresh water and sewage disposal. With corrosive waters, increasing the cycles so that the water is rendered less corrosive is a "cheap" means to improve control of corrosion. Typically, the most economical cycles to operate at is in the range of 3 to 6.

### Setting and Controlling the Cycles of Concentration

1. **By Conductivity or TDS with Conductivity or TDS Controllers:** This is probably the most utilized method now a days. What you do is you place a conductivity probe in the recirculating line of the cooling tower. The probe is connected to a Conductivity

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TEL 520.903.9904 • 888.785.9660 • FAX 520.903.9910  
EMAIL [info@zetacorp.com](mailto:info@zetacorp.com) • INTERNET <http://www.zetacorp.com>

controller; which is connected to a solenoid valve in the bleed line. If the conductivity of the make up water is quite stable then you just set the controller to open the solenoid valve at the given cycles that you desire to maintain (chemical programs typically operate between 2.5 and 3.5 cycles, zeta programs typically operate between 4 and 6 cycles). Once a month is recommended to check the conductivity of the make up (and adjust the setpoint in the controller if needed) and the calibration of the probe (and calibrate as needed). For locations in which the conductivity of the make up water fluctuates constantly, there are some controllers that can take two conductivity reading inputs (one from the recirculating line, and one from the make up water line) and determine a given ratio and adjust the setpoint to the solenoid valve given the conductivity of the make up water.

2. Manually: There are still many places in which the towers are operated either with a constant blow down, or in which plant personnel opens the blow down valve for some time on a daily basis. This is a much cheaper method, but it provides little to no control to the tower. (NOT RECOMMENDED).

### **Issues concerned with cooling water treatment.**

#### **SCALING**

Deposition of scale is a chemical precipitation process where dissolved salts in the cooling water go from being in solution, to being in suspension due to their solubility limits being exceeded. The most common scale formers, calcium salts, exhibit reverse solubility in that they become less soluble as the temperature of the water increases and/or as the pH of the water increases. This property causes scale formation in the most sensitive area, the heat transfer surfaces of production equipment.

Since the thermal conductivity of scale is substantially less than metal, heat removal from the equipment is reduced and production speeds must be lowered to compensate. In extreme cases, enough material precipitates to physically block the cooling water passages, resulting in the effected equipment being removed from production for either chemical (acid) or mechanical cleaning.

Scale can be controlled, or eliminated, by application of one, or more, proven techniques. Typical measures taken to control scale start by controlling cycles; followed with chemical scale inhibitor treatment, pH adjustment by acid addition, or softening of cooling water system makeup

#### **Scale Monitoring**

This can be achieved primarily by two different techniques: by analyzing the scaling potential of the water, or by physically looking for scaling signs.

Scaling potential of the water can be evaluated by the Langelier's Saturation Index (LSI) which is a calculation that utilizes the levels of calcium, alkalinity, pH, dissolved solids,

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and temperature in the cooling water. The LIS indicates the tendency of water to form a calcium scale or promote corrosion. Thus, a positive LSI number indicates a scale forming water, while a negative LSI number indicates a scale dissolving, or corrosive, water. It is important to notice that the LSI analysis indicates only a “potential” for scaling or corrosion. It does not mean that in waters with positive LSI there is scaling taking place. The LSI method is used with chemical programs because when salts exceed their solubility limits (positive LSI’s) scaling is likely to occur. This does not indicate that scaling is taking place, instead that bulk precipitation of the salts from the solution is likely. In order to check if scaling is taking place then it is necessary to conduct physical tests.

Physical tests can be done by closely observing certain operating parameters in the cooling system. For cooling tower-chiller applications the condenser approach is a good indication of scaling (although it could be some other form of fouling) taking place in the condenser tubes. In plate and frame type of heat exchangers a decrease in the dT or dP across the unit is also an indicator of fouling of the unit. In evaporative condensers an increase in the discharge pressure of the refrigerant is related to scaling of the tube bundle. These methods will detect potential fouling in the key elements of a cooling system: the heat exchangers. However, the source of the fouling could be other than scaling. In order to monitor for scaling, without having to open a condenser and looking inside the tubes, a scaling monitoring device can be used. These systems typically consist of a pre-weighed heating element that is set to operate at a temperature similar than that of the surface temperature of the heat exchanger. The unit is then installed in the condenser water supply line for a given period of time, after which the unit is removed and inspected for scale deposits. The unit can be weighed and the amount of scale calculated, or the unit can be visually inspected. Due to the easy access to the tube bundle of evaporative condensers it is relatively easy to do visual inspections in these units for scale formation.

## **CORROSION**

Water, while an excellent transporter of heat and quite inexpensive, is also an excellent ionic type solvent which will dissolve more, or less, of just about all known materials. Given this chemical fact, the chemistry of all cooling water treatment programs must begin by addressing corrosion, which is basically an electrochemical oxidation process which results in destruction of the basic metals from which most cooling systems are constructed.

Many factors effect the uncontrolled corrosion rates which could be expected in a given cooling water system. Such items as the presence of dissolved gases, chloride and sulfate levels, pH, alkalinity, scaling tendency, and protective ions such as phosphate and nitrate; must all be taken into consideration along with such engineering factors as water temperatures, presence of galvanic couples, and water velocity in the design of corrosion control chemistry.

## Corrosion Monitoring

The most common way of monitoring for corrosion is accomplished by inserting corrosion-test coupons in the cooling water loop. This corrosion-test method has been described by the National Association of Corrosion Engineers and is consistent with the ASTM Standard "Corrosivity Testing of Industrial Cooling Water (Coupon Test Method).

The method consists of exposing a test coupon in the recirculating water system for a given period of time. The corrosion rate is then calculated on the basis of the weight loss of the test coupon, the coupon's surface area, and the exposure time; corrosion rate is expressed in mils penetration per year (mpy). The pre-weighed coupon is placed in the recirculating water loop for 30-60 days.

Electronic corrosion rate meters have been developed to the point where they are fairly accurate and quite valuable in many cases. Their major problems are that they are substantially more costly than corrosion coupons and do not give long term rate data.

A third method to evaluate corrosion is by measuring the concentration of total iron in the recirculating water: 0.1-0.2 ppm is normal; 0.5-1.0 is excessive; >1ppm is cause for alarm.

The elimination of corrosion is an unattainable goal; for practical purposes one attempts to keep wastage at some acceptable level. Any description of degrees of Corrosivity in terms of penetration inevitably produces a scale that is difficult to defend: what is acceptable in one unit may be catastrophic in another. It probably can be agreed in a general way that the classification of corrosion rates shown in the following tables has some validity. The numbers on the tables refer to results of coupon tests.

Qualitative Classification of Corrosion Rates (McCoy)		
Corrosion Rates (mpy)		
Description	Carbon Steel	Copper Alloy
Negligible	<1-2	<0.1
Mild	2-5	0.15-0.2
Moderate	5-10	0.2-0.35
Severe	>10	0.5-1

Qualitative Classification of Corrosion Rates (Blake)		
Corrosion Rates (mpy)		
Description	Carbon Steel	Copper Alloy *
Excellent	0-2	0-1
Good	2-5	1-2
Fair	5-8	2-3
Poor	8-10	3-4
Intolerable	>10	>4

- For Standard 16-gauge copper condenser tubing.

## BIOFOULING

Open recirculating-water systems are continually exposed to the ambient air and contaminants therein. One category of contaminants consists of those microorganisms, which will grow in water under favorable circumstances. These organisms may be slime forming bacteria, fungi, or algae; they are present in the atmosphere, attached to dust and dirt particles, and are swept into the recirculating water system with the air motion. Microorganisms may be controlled by substances capable of killing them (biocides) with minimum damage to the material of construction of the system. Some of the most common biocides currently used are chlorine or bromine based products.

The two main problems associated with biocides are related to their direct effect and environmental regulations.

Once bacteria enter a recirculating water system they will begin to adhere onto the surfaces of the system and form colonies in the form of biofilms. Biofilms are a complex

2045 N. Forbes Blvd. • Suite 102 • Tucson, AZ 85745 • USA  
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matrix of different types of bacteria protected by an exo-polysaccharide (EPS) generated by slime forming bacteria. The EPS gives biofilm that slimy texture; it has several functions, amongst some of them providing a protective layer to the bacteria, and as a means to channel nutrients and waste between bacteria colonies. Bacteria growth takes place within the biofilm and not while they are in their pelagic (free-floating) stage. Here is where the biocides are rendered inefficient. Biocides are designed to kill bacteria, and not to prevent the formation or remove existing biofilms. Because biocides cannot kill all the bacteria when biofilms are present, the bacteria population is constantly showing rapid growths despite the continuous use of biocides, or the frequent biocide shocks applied to the system. There is another critical problem with biofilms, and that is that they are the place where harmful bacteria reside and multiply. Bacteria such as *legionella pneumophila* and other pathogens that can cause respiratory diseases are not slime-forming bacteria, instead they require the presence of a biofilm to find a place where to establish their colonies. Biofilms are also the cause for microbially induced corrosion (MIC) which causes severe pitting damage in the system. Iron reducing bacteria and sulfur reducing bacteria can colonize the lower areas of the biofilm where an anaerobic environment is created. These bacteria will feed from the carbon in the steel, and generate hydrogen sulfide as a by-product which in turn converts into sulfuric acid in the presence of water. Finally, it has been documented that bacteria have the capability of mutating into different strains that are resistant to biocides.

The other problem with biocides is associated with environmental regulations. New regulations are being issued constantly with regards to the amount of biocide that plants are allowed to discharge in their blowdown water. Not only the amount, but the types of biocides that can be used are being targeted by these regulations, some places have additional waste water processing charges based on the types and amounts of chemicals being discharged in the water.

### **Monitoring biofouling and bacteria.**

Test methods are available for monitoring the recirculating water for bacteria. These methods include test strips or dipsticks that are used to obtain a total bacterial count. Tests made periodically during operation of the system will provide a history that will indicate whether there is an increase in the bacterial count during any particular season. These tests are also used to determine the effectiveness of a biocide program and to indicate when treatment should be changed or altered.

When it comes to deciding what is the allowable limit of bacteria to have in a recirculating water system, there are different opinions. McCoy indicates that viable plate counts less than 10,000 colony forming units per milliliter (cfu/ml) are seldom obtained, even immediately after treatment with biocide due to the constant inoculation of the system. Counts of 100,000 – 500,000 cfu/ml ( $1 \times 10^5$  –  $5 \times 10^5$ ) indicate a biologically clean system; and when counts exceed  $1 \times 10^6$  a biocide shock is required.

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Freije indicate that the bacteria counts on the test are an indication of the general cleanliness of a cooling tower, but they do not indicate legionella levels. Monthly dip slide tests are recommended to ensure that the total bacteria counts remain under  $5 \times 10^5$  cfu/ml.

## **SLUDGE**

Deposits of mud, dirt and foreign suspended matter washed out of the atmosphere (sludge) into open recirculating-water systems can be as troublesome as scale and they must be controlled to ensure efficient operation of heat transfer equipment.

The amount of sludge accumulated in a cooling system varies from location to location, and it is related to the environment in which the cooling tower is found. Visual inspections of the basin of the cooling tower will allow the plant personnel to determine or quantify the amount of sludge build-up in the system and determine the frequency in which the tower will have to be cleaned. It is recommended to do at least an annual cleaning of the tower's basin, there are locations that require more frequent cleanings. Some plants have installed sidestream filtration units to constantly remove sludge forming matter from the system, this is done in locations with high sludge forming rates.

## **SUMMARY**

As it was mentioned before, the goal of a cooling water treatment system is to allow the equipment to operate at optimum conditions by preventing the buildup of scale corrosion and biofouling while reducing water consumption and complying with environmental regulations.

There are many different ways to treat a system, but it is up to the customer to select the approach that will maximize the return of its investment.

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## **Part B:**

# The Zeta Rod<sup>®</sup>: Application to Open Recirculating Water Cooling Systems.

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EMAIL [info@zetacorp.com](mailto:info@zetacorp.com) • INTERNET <http://www.zetacorp.com>

## **Application of Zeta Rod<sup>®</sup> Systems to Open Recirculating-water Cooling Systems.**

This document contains a brief description of a Zeta Rod System, how it operates, and how it protects an open recirculating-water cooling system (cooling tower, or evaporative condenser).

### **The Zeta Rod: A true capacitor.**

The Zeta Rod is installed directly into the fluid, which it treats, either directly into the pipe, or into the basin of the cooling tower. Its flexibility and ease of installation make it possible to install without having to shut-off the recirculating water, or with minimum disruption of the operation.

Once the electrodes have been installed, connected to the power supply, and the system energized, the Zeta Rod becomes part of a capacitor in the pipe or tank into which it has been inserted. The power supply provides a 30-35kV DC potential to the electrode. The interior coating of the electrode becomes the positively charged plate, the ceramic and the particles in the water act as the dielectric, and the properly grounded pipe or vessel becomes the grounded plate of the capacitor.

Because it is a true capacitor, this means that there is no current flowing across the ceramic body of the electrode and into the water. As a matter of fact, the only time when there is any measurable current flowing from the power supply to the electrode (it stops at the electrode, it does not flow into the water) is when the power supply is turned on. This lasts until the electrodes have been charged, and it typically lasts less than one second. Even during that instant when there is current flowing from the power supply to the electrode, the maximum current output of the power supply is set at 600 $\mu$ A (just over half a milliamp). The power supplies meet UL, CSA, CE and FCC standards, which ensure that they present no risk to the operators, and that they cause no interference with any instrumentation in the system or the vicinity. For this same reason, the operating cost of a Zeta Rod System is negligible. A fully charged and operational Zeta Rod System will consume less than 10 watts of energy per day.

The materials of construction of the Zeta Rod System make it long-lasting equipment. It is estimated that the useful life of a Zeta Rod System is 20 years or more. The oldest Zeta Rod Systems installed on the field have been operating for over 10 years without any problems.

Since the electrode is not a sacrificial anode or cathode, it does not require to be replaced at any time. This makes the maintenance requirements for the Zeta Rod practically inexistent. The only daily requirement is to ensure that the power supplies are connected, turned on, and that the status indicating LED's are indicating proper operation.

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### **Method of operation**

Once the Zeta Rod System has been energized, it creates a high voltage electrostatic field between the two plates of the capacitor. The effect of this field is detected in the colloidal particles present in the water. The net effect of the Zeta Rod is an increase in the density of the surface charge of the particles in the water, which in turn creates a stable dispersion effect.

The field generated by the Zeta Rod is not limited to the space surrounding the electrode; instead it expands both upstream and downstream into the pipe, or in the entire basin area if installed into the basin. The benefit of this is that a Zeta treated system does not require the water to be flowing in order to be treated.

### **Effect on a cooling tower**

#### **Scaling & Corrosion**

As water evaporates in a cooling tower the minerals in the water are left behind increasing their concentration. As the concentration of these salts increases, they reach their solubility limits and begin to precipitate, that is, they go from being in solution to being in suspension.

Cooling towers treated with Zeta Rod Systems can operate at relatively high cycles of concentration without any risk. Zeta treated towers are usually set to operate between 4 and 6 cycles of concentration. At those cycles, the buffer capacity of the water makes the pH reach equilibrium between 8.9 and 9.0. Under those conditions, the water will be under a highly positive Langelier's Saturation Index (LSI). A positive LSI is indicative of no corrosion and high potential scaling, but because the Zeta Rod effect is upon particles, it is then when it becomes most effective. As the ions of the salts in the water go from solution to suspension, they create tiny colloidal particles, and it is then when the Zeta Rod creates a stable dispersion amongst them.

At a positive LSI and pH level of 8.9 to 9.0 corrosion rates for mild steel and copper alloys is minimal. Zeta treated towers usually show corrosion rates well under the acceptable industry levels of 5 mpy for mild steel and 0.2 mpy for Copper alloys. Even though the Zeta Rod is not a corrosion inhibitor it allows the tower to operate under conditions where corrosion is not a concern.

#### **Biofouling**

Although the Zeta Rod is not a biocide its most characteristic effect is biofouling control. The Zeta Rod does not kill bacteria, however, it addresses the problem at the source: the biofilm. The effect of the Zeta Rod is such that it eliminates existing biofilms and prevents the formation of new biofilms. In a system with no biofilms present on the surfaces, bacteria have no place where to grow and reproduce. Zeta treated towers

typically exhibit bacteria counts in the order of  $1 \times 10^3$  to  $1 \times 10^4$  which is well below the acceptable level of  $5 \times 10^5$  without the use of any biocides.

### **Sludge**

The Zeta Rod cannot do anything about airborne particles being washed into the tower. It is these particles that create sludge deposits in the system. However, most of the sludge deposits that create problems use biofilms as a substrate onto which adhere to. Since the Zeta Rod eliminates biofilms, the sludge accumulation will only take place in low flow areas such as the basin of the tower. It is still necessary to do at least an annual cleaning of the basin of the tower to eliminate slud

## **Part C:**

# Comparison between Zeta Rod and Chemicals for Open Recirculating Water Cooling Systems.

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TEL 520.903.9904 • 888.785.9660 • FAX 520.903.9910  
EMAIL [info@zetacorp.com](mailto:info@zetacorp.com) • INTERNET <http://www.zetacorp.com>

## **Comparison of Zeta Rod treatment system with Chemical treatment system for cooling water.**

The following table contains a brief summary of the primary differences between a Zeta Rod treatment system and a chemical treatment program. Given the variety of chemical products, programs, brands, and technologies, it is impossible to include all the varieties of chemical treatment programs in one table, however, some of the primary and basic concepts are covered in this document. The variety and complexity of the chemical treatment programs come with a wide variety of price ranges as well.

In order to gain better understanding of the table, it is important to first list the primary goals and objectives of a cooling water treatment program. There are four main objectives to achieve in such a program, those are:

- Water conservation
- Scale Control
- Corrosion Control
- Biofouling Control.

Maintaining a balance in all those four parameters is the key of a well-managed treatment program. With that in mind one can look at how a Zeta Rod system and a chemical program address those points:

Comparison of Cooling Water Treatment Programs: Zeta Rod and Chemicals		
ISSUE	Zeta Rod System	Chemical Program
Water Conservation	Zeta treated towers typically operate between 4 and 6 cycles of concentration. Depending on water quality higher cycles can be maintained.	Typically towers treated with chemical programs operate between 2.5 and 3.5 cycles. When acid is used, towers can be operated as high as 5 cycles.
Scale Control	<p>The Zeta Rod prevents scaling by two main mechanisms:</p> <ol style="list-style-type: none"> <li>1. Creating a stable dispersion amongst colloidal particles, and</li> <li>2. By preventing the formation of biofilms on the surfaces of towers and heat exchangers.</li> </ol>	<p>In order to prevent scaling several options are available, these include but are not limited to:</p> <ol style="list-style-type: none"> <li>1. The use of chemical dispersants which chemically alter the surface charge of colloidal particles to prevent their deposition</li> <li>2. The use of acid in order to maintain a low pH, and in that way keep an LSI of close to zero</li> <li>3. Maintaining low cycles of concentration with one or both methods described above.</li> </ol>
Corrosion Control	<p>In a Zeta treated system running at high cycles the pH of the water will stabilize between 8.9 and 9.0 due to its buffer capacity. At this pH the tower operates at a positive LSI, or in a non-corrosive environment.</p> <p>By removing existing biofilms and preventing new ones from developing the Zeta Rod eliminates the potential for microbially induced corrosion (mic).</p>	<p>A wide variety of corrosion inhibitors are available in the market. Their main function is to create a passive layer on the surface of the pipes and thus prevent corrosion from taking place. There are three main types of inhibitors:</p> <ol style="list-style-type: none"> <li>1. Anodic inhibitors (chromate, nitrite, sulfonate)</li> <li>2. Cathodic inhibitors (zinc, polyphosphonate, orthophosphate)</li> <li>3. General (tolyltriazole, benzotriazole)</li> </ol>

<p>Biofouling Control</p>	<p>Although not fully understood, several theories attempt to explain the effect that the Zeta Rod has on biofilms and bacteria:</p> <ol style="list-style-type: none"> <li>1- Due to reduced surface tension as an effect of the Zeta Rod, super-hydration of biofilms takes place. In essence the biofilms take in more water than they can actually hold and the shear forces of turbulent flow enhance their removal.</li> <li>2- The Zeta Rod creates an environment that bacteria find adverse; this makes the bacteria enter into a biostasis mode.</li> </ol> <p>Bacteria reproduction takes place within biofilms. By preventing biofilms from forming bacteria counts are maintained at very low levels. Zeta treated towers typically exhibit bacteria counts in the <math>10^2</math> to <math>10^3</math> level.</p>	<p>Biocides are the most common form of biofouling control used with chemical treatment programs. There are a great variety of biocides available. Oxidizing biocides and halogen based biocides are the most commonly used, some examples include:</p> <p>Chlorine gas, sodium hypochloride, chlorine dioxide, bromine, ozone, hydrogen peroxide, UV.</p> <p>UV and ozone have been labeled by some as “non-chemical biocides”.</p> <p>There are several problems with biocides, some include:</p> <p>Bacteria develop resistance to them, and it is recommended to rotate between different types.</p> <p>Biocides focus on the symptoms of the problem, that is killing the bacteria, and not in the root of the problem, which is eliminating biofilms.</p> <p>Some chemical biocides have been developed, however, they have not been proven to be all that efficient due to the different resistances exhibit by different types of bacteria.</p>
<p>Health &amp; Safety</p>	<p>The Zeta Rod meets with UL, CSA, CE and FCC standards, which ensure the safety of the operators, as well as certifies that it creates no interference with any instrumentation.</p> <p>The Zeta Rod system is now certified to meet the NSF part 61 standard which clears it for potable water applications.</p>	<p>Different chemicals have different toxicity levels, or hazardous properties. The MSDS of each chemical used should be thoroughly inspected to know of proper handling and disposing procedures.</p> <p>Today more and more regulations are being passed that prohibit the use of certain chemical products,</p>

	<p>Despite the high voltage generated, the power supplies have a built in detector that will shut the power supply down in case of a short. The power supplies are also current limited to a maximum output of 600<math>\mu</math>A.</p> <p>Since the Zeta Rod does not add or remove anything from the fluid that is being treated, there are no concerns with toxic substances, their handling, or their disposal.</p>	<p>and or limit the discharge levels allowed.</p> <p>Different requirements as far as storing, handling and disposing of chemicals are required by states, and by cities. Some go as far as requiring to file an inventory of the amount of chemicals being stored, and to report any incidence of chemical spills.</p>
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This table provides just some of the main guidelines and characteristics of the Zeta water treatment program and a typical chemical treatment program. It is not intended to cover every chemical product, program or treatment method available in the market. The chemical industry is an active industry and new products are being developed on a daily basis.