# TRIANGULAR WAVE TECHNOLOGIES, INC. (TWT®) CHEMICAL-FREE FLUID CONDITIONING & TREATMENT for the HVAC INDUSTRY

Technologically Advanced Products, Systems and Methods for Water & Fluid Management Providing Comprehensive End-To-End Solutions



Encrusted Heat Exchangers

Eliminates deposits in pipes, heat exchangers and related equipment.

Triangular Wave Technologies, Inc. is the Leader in Chemical-Free HVAC Fluid Conditioning & Treatment Systems. Using It's Patented Triangular Wave Deposit Control Technology, TWT<sup>®</sup> Effectively Meets The Needs Of Any Application. Enhancing Water Quality, Improving HVAC Operating Efficiency and Equipment Life Cycle

HARD WATER PROBLEMS SOLVED EASILY! • CONSERVE WATER • SAVE ENERGY • INCREASE COOLING EFFICIENCY



# **TWT® PATENTED DEPOSIT CONTROL TECHNOLOGY**

# Versatile Fluid Management System To Effectively Meet The Needs Of Any Application

- Control Scale Deposits/Bacteria Corrosion/ Algae/Colloids In All Fluid Based Systems
- Improve Operating Efficiency And Life Cycle Of Equipment

The TWT Deposit Control System is an advanced method for controlling scale and bio-fouling. It is applicable with once through and recirculating HVAC, Cooling Towers, Heat Exchangers, Boilers, Chillers, Spray Systems, Pumps, Induction Furnaces, and Process Cooling Systems, as well as agricultural, industrial processing, wastewater, and other fluid based systems.

The electronic deposit control technology uses a signal coil that is wrapped around a pipe in the plumbing system being treated. The signal coil produces an extremely small time-varying magnetic field inside the pipe. The resulting induced, oscillating electric field provides the necessary molecular agitation for chemical-free scale prevention and removal.

- Polarity changes from positive to negative many thousands of times per second.
- Frequency varies, the range of frequencies is wide enough to affect the water and the materials in the water.
- Amplitude varies, this means that the water molecules and the materials in the water are being subjected to a wide range of field forces.

The entire Triangular Wave Signal is repeated 30 times each second. When the current reaches the solenoid, a constantly changing electro-magnetic field is formed. That field induces a constantly changing voltage in the fluid. This process ensures proper fluid treatment results and increased operational efficiency. The Triangular Wave

Deposit Control System uses a Current Source as the drive circuit to the pipe solenoid. A Current Source is the most reliable and strongest conditioning signal over a wide frequency range. Most waters have qualities that vary over time. Higher total dissolved solid concentration will cause greater impedance in the system. The TWT system, with a Current Source generator is able to sense the increased impedance and maintain the strong conditioning.

- One time cost vs. recurring monthly chemicals = better profit margin
- Labor costs for maintaining the systems will be reduced
- Costs to replace corroded parts like heat exchanger tube bundles, etc. will be reduced.
- Less downtime for equipment repairs an maintenance=increased production
- Increased heat transfer from non-scaled tube surfaces=significant energy savings

When the TWT systems are properly installed the effects of the Triangularwave Technology Treatment Last Downstream Enhancing water quality, and improve operating efficiency and life cycle of equipment. Triangularwave Technologies systems use technologically advanced methods to restore and maintain a clean, corrosion-free delivery system in an environmentally safe and chemical- free manner...The result is clean pipes, tubing and equipment with no bio-film and reduced bacterial contamination.

The build up of scale deposits is a common and costly industrial problem. The higher costs of maintaining and cleaning fluid-fed equipment can be attributed to the continuous cleaning of scaled surfaces or to the increased energy and operating costs due to the poor conductivity of the fluid pipe. For example, with every 1/4" of scale, 40% more energy will be needed to heat the water. Moreover, scale deposits narrow the inner diameter of piping, increasing the amount of energy required to pump the water through the system.

#### Why does scale occur?:

The source of scaling problems lies in hard water which contains excess ions such as calcium and magnesium. Because of the inverse solubility laws, these mineral ions precipitate as hard water is heated, resulting in the deposition of scales on heat transfer surfaces.



#### How TWT Deposit Controller and Reaction Chamber System Work:

Using modern integrated circuitry and signal processing techniques, the patented TWT Deposit Control Technology works by producing a complex frequency-modulated waveform. This creates a deionizing effect, induced by physical means, which increases the solubility of the minerals, and colloids in the liquid and changes the shape, size and texture of the calcium carbonate crystals. By this reaction, the minerals, colloids and crystals lose their adhesive properties and remain in suspension in the liquid.Pre-existing scale is taken back into solution and removed in the same way. The effects are immediate and long lasting down stream.



Triangularwave (TWT®) Generator Surpasses Other Wave Form Generators

#### **TWT Operating Principals:**

The TWT System utilizes a principal of molecular agitation to neutralize the dissolved calcium that causes hardness and lime scaling. Molecular agitation uses resonant energy forces, which develop on charged particles moving through an electrical impulse induction field, to change the molecular surface energy states of dissolved minerals. Dissolved mineral surface energy states, a quantum function, determine the subsequent precipitated crystalline structures created. In this case, the doubly positive ionic calcium is treated so that neutral aragonite crystal instead of lime scale crystal precipitation results.

The signal from the TWT system circuitry flows to a solenoid coil (reaction chamber) wound around the pipe being treated. This coil develops the frequency modulated electrical impulse induction field that immediately neutralizes the hardness, or functionally "softens" the water. The field penetrates the piping to its center, with the modulation component acting on the passing water and dissolved mineral molecules.

### TWT® THE COMPETITIVE EDGE!

How to find additional technical information about TWT<sup>®</sup> Deposit Control Technology. Go on the home page of the TWT web site and click on "About the Technology" there you will find additional Installation & Technical Guidelines

# Current Source Generators Out Perform Voltage Source Generators Microprocessor-driven deposit control, Ionization, disinfection, purification for commercial and industrial environments.

Triangularwave Technologies, Inc. products and systems provide technologically advanced methods for water and fluid management that are both efficient and cost-effective. Components and subsystems chosen from across the range of treatment methods can be combined in different configurations to provide custom solutions specific to any industry, site or application.

TWT systems work to consistently deliver high quality water, reduce scale and bio-fouling in plumbing systems, and to increase efficiency of both once-through and re-circulating HVAC, process cooling, agriculture, industrial processing, wastewater and other fluid based systems. Each product line offers a variety of both standalone and comprehensive treatment solutions for end-to-end fluid management, for all types of applications.

# Salt and chemical-free water conditioning for any application

#### PREVENTS SCALE BUILD-UP

 Scale particles in the water receive an enhanced surface charge that causes them to repel each other and from the walls of the equipment

#### **ELIMINATES TOXIC CHEMICALS**

- No recurring chemical expense
- · No handling and storage of hazardous chemicals on site
- No chemical discharge

#### **REDUCES CORROSION**

- Reduces bio-corrosion by preventing the formation of biogrowth on vessel surfaces where bacteria can attack the metal
- With higher concentration ratios and TDS, the pH will be higher and there will be much less tendency for corrosion
- · Prolongs life cycle of equipment
- Increased cycles of concentration in cooling systems=*significant water savings*

#### **CONTROLS ALGAE AND BACTERIA**

- Bacteria and algae must attach to something before they can feed and reproduce. The Triangularwave System keeps the bacteria, algae, and their food dispersed in the water, off of surfaces, and away from their biofilm breeding ground
- · Eventually the bio-film is eliminated and bacteria die
- Improve the operating efficiency and life cycle of process infrastructure and equipment

#### SHORT PAYBACK PERIOD

- The combined reduction of water, chemical and energy costs is enough to pay for the Triangularwave System in as little as 9 to 18 months.
- With the Triangularwave Treatment, the systems can run at higher concentration ratios, meaning the amount of water removed as blowdown and the corresponding sewer charges are greatly reduced. TWT treatment equipment is a reusable investment and retains its value – if you move your facility or reengineer your plumbing system, TWT equipment moves with you.
- With no chemicals being added, the requirements for pre-treatment of blow down are eliminated

- One time cost vs. recurring monthly chemical=better profit margin
- Labor costs for maintaining the systems will be reduced
- Labor costs to clean the vessel surfaces will be reduced
- Costs to replace corroded parts like heat exchanger tube bundles, etc. will be reduced.
- Less downtime for equipment repairs an maintenance= increased production
- The Triangularwave System requires little or no maintenance
- There is little electrical current flow through the electro magnetic system
- Reduces energy costs use through improved heat transfer efficiency
- Increased heat transfer from non-scaled tube surfaces= significant energy savings
- Easy interface with facility management hardware and software systems for centralized management

### Benefits for HVAC Cooling & Heating Applications

The constant battle of monitoring cooling and heating systems will become a thing of the past. Balancing the water chemistry on a daily or weekly basis is not necessary with the Triangularwave System. Cleaning of the systems will be much easier, involving a pressure wash one or two times per year, rather than extensive manual brushing and acid washing. When water systems are clean and free of deposits, heat transfer is at its most efficient. Scale and biofilm are great insulators, that are eliminated. Also scale buildup in pipes creates increased roughness and reduced flow area. Clean pipes mean less energy is needed to drive the pumps.

Energy costs may be reduced by up to 30%. Many municipal sewer agencies penalize and charge fees to users, because their blowdown contains hazardous chemicals, which the agencies must treat. Without chemicals in the blowdown, those fees can be avoided.

Unpolluted discharge from blowdown and bleed=environmental compliance. The workplace is safer, because the staff is not handling toxic chemicals. Cooling and heating systems are large investments that need to be protected. The Triangularwave System reduces corrosion, deposits, and harmful chemicals, all of which allow the equipment to meet or exceed life cycle expectations. Recent studies by manufacturers of cooling systems indicate that systems that should last 20 years or more are lasting an average of 8Ï to 12 years.

### TWT<sup>\*</sup> Saves: Chemicals, Water, Energy, Labor, Time & Materials.

Let TWT custom design a system to meet your specific application, system integration, and/or retro-fit needs.

# POINT-OF-ENTRY (P.O.E.) POINT-OF-USE (P.O.U.)

Filtration • TWT Deposit Control Technology • Disinfection Purification End-to-End Treatment & Conditioning (Multi-Process)

TWT,Inc. offers a full range of products & systems designed to address HVAC water treatment problems end-to-end. Versatile, scalable products & systems can be deployed in different configurations to fit your industry specific flow requirements and other treatment needs.

# **Filtration Systems:**

Filters are designed to trap various kinds of debris, dirt and organic particles that will otherwise enter your equipment and/or plumbing system, restrict your water flow and create a breeding ground for bacteria. Filtration is the first line of defense for commercial, industrial facilities, where the source of water may be ponds, wells, streams or other water sources that



High pressure, High capacity filters



Stainless Steel Filter Housings

have high exposure to contamination from air borne pollutants, surface runoff, agricultural or industrial waste or similar dangers. The first step in achieving clean water is to install a filtration device that effectively removes particulate matter and similar debris.

Filtration is an important step in water treatment, especially for water intended for human consumption. Filtration systems provide a bacterio static environment and are designed to

remove, volatile organic chemicals, hydrogen sulfide and sulfur, herbicides, pesticides, chemical fertilizer residues, trihalomethanes and many other pollutants. The filtration units utilized in TWT systems are comprised of several media that remove harmful chemicals, metals, and toxins from the water as it passes through these layers. The TWT Filter media can utilize a sediment filter, dual

media filter, granular activated carbon filter, extruded carbon activated block filter, Silica, DE, or other filter media upon request. TWT filter system/ media can be configured to trap particles of various micronic sizes.

### Iron Removal Systems (no chemical injection required)

Effects of iron and manganese in water– When exposed to air, dissolved iron or manganese reacts with oxygen and is converted by



Separation, a viable alternative

oxidation to a colored, solid material that settles out of the water. Iron changes to white, then yellow and finally to a reddish-

brown color. Manganese forms a black residue. High concentrations of these sediments cause reddish-brown or black stains in and on facility fixtures. Another result of iron and manganese in water is the presence of harmless bacteria in soil, shallow groundwater supplies and some surface water that secrete large amounts of red-brown (iron) or black-brown (manganese) slime that stain bathroom fixtures. The iron removal filter system is designed to effectively eliminate rust from your water supply economically and thoroughly. TWT offers several systems designed to treat and meet your GPM/GPD requirements.



# **TWT<sup>®</sup> Deposit Control**

#### TWT<sup>®</sup> Patented Deposit Control Technology

The basic component in the TWT systems is the deposit controller. It is comprised of a microprocessor, solenoid coil wrap and/or a reaction chamber. The microprocessor is a patented controller that functions like a computer to relay a continuous electrical power supply to the solenoid coil and/or reaction

chamber. The reaction chamber is plumbed into the main water in-take line and/or just before each piece of vital processing equipment, and provides a factory wrapped wire coil forming a solenoid. The solenoid conveys the Triangularwave signal at the appropriate power level (as



allowed by the model chosen) to the water passing through the chamber. This signal constantly changes the polarity, frequency, and amplitude of the current entering the water. This Triangularwave treatment produces several benefits. It increases the capability of the water to hydrate scale ions and other colloidal particles. In effect, the surface charge of the hydrogen molecules is enhanced and the water is made "wetter". This "hydrated" water can dissolve unwanted particles, suspend them in solution, and allow them to be easily filtered out or flushed from the system. Accordingly, the mineral

and biological particles that cause scale, deposits, and corrosion are dissolved and

Continued next page



TWT Industrial Stainless Steel reaction Chamber

washed away. This means that the breeding environments for bacteria, such as bio-film and corrosion, are eliminated. The agitation created in the reaction chamber also disrupts the conditions essential for the normal reproduction of bacteria and they die, thus allowing them to be harmlessly flushed out of the system.

If left untreated, scale build-up inside the reaction chamber and on the quartz sleeve containing the UV lamps may rapidly diminish the UV disinfection effectiveness by reducing the amount of UV light which is absorbed into the water stream. The TWT Deposit Control System will further condition the filtered water stream so as to prevent this scale-build-up inside the UV reaction chamber, helping to maintain maximum UV life cycle and penetration into the water stream.

# Ozone disinfection/purification another viable treatment alternative.

# Ultra-Violet:Disinfection/Purification

The UV disinfection technology used in the system to provide safe water, free of disease-causing pathogens. As water passes through the UV chamber UV light will attack and render harmless any bacterial, viral or spore contamination present in the treated water. "High intensity UV light destroys these contaminates with a 99.9% kill rate" The output

water is thus disinfected and offers exceptionally high quality. Ultraviolet is a means of killing or rendering harmless microorganisms in a dedicated environment. These microorganisms can range from bacteria and viruses to algae and protozoa. UV disinfection is used in air and water purification,



sewage treatment, protection of food and beverages, and many other disinfection and sterilization applications. A major advantage of UV treatment is that it is capable of disinfecting water faster than chlorine without cumbersome retention tanks and harmful chemicals. UV treatment systems are also extremely cost efficient!





TWT offers several systems designed to treat and meet your GPM/GPD requirements.

#### **Ionization:**

# Bacteria, algae, fungus control in HVAC, Pools, Spas Environments.

#### **IonGuard Purification System-**

The lonGuard Purification System is an electrolytic copper / silver ion generator. The system units contain specially cast

copper/silver alloy electrodes. These electrodes are mounted in a housing designed for easy access (HVAC & Pool Environments). The IonGuard Purification System purifies water through a process called ionization. This process utilizes a low voltage direct current (DC) to place pre-



cise and minute amounts of copper and silver ions into water systems. Copper ions kill algae and silver ions kill bacteria (integrate with TWT deposit control technology for enhanced results).

### Point-Of-Entry Treatment Systems: Factory Assembled & Mounted Fluid Management System

#### These fluid management systems are compact, selfcontained, mounted unit for the treatment of water.

Applies all the needed elements for maximum fluid protection, management, and peace of mind in one simple packaged solution. Technologically advanced method for water &



fluid management. Filtration, TWT® Microprocessor Deposit Controller, Reaction Chamber, and UV Disinfection / Purification units are combined to provide a start-to-finish answer to simplified prevention, treatment and management of water line contamination dangers. TWT<sup>®</sup> solutions are scalable to fit the gpm's and water conditions you need. TWT All-In-One integrated water treatment systems are ruggedly con-



structed for exceptional performance. These systems are ideally suited for Wells, Factories, Hospitals, Restaurants, Schools and anywhere the need for cleaner water to use and drink are required. The rugged self-contained design of these systems ensure that the system will enjoy a long and reliable lifecycle when properly cared for.

# TWT<sup>®</sup> COOLING TOWER/CONDENSER/CHILLER APPLICATION & INSTALLATION GUIDELINES









Note:The TWT® Deposit Control System does not interrupt the cooling tower operations.

Unique, Scalable Systems For Every Need TWT<sup>®</sup> Deposit Control Products & Systems can be deployed in different modular configurations, scaling to fit your specific needs. 6

#### Configuring for extreme hard water conditions (TDS) Example:

An industrial plant with 2" piping and a moderate to high Total Dissolved Solids (TDS) level could be treated with the expected TWT-5C8- 402 (2") Deposit Controller and the appropriate 2" Reaction Chamber, Copper Pipe Signal Enhancer or on-site solenoid wrap.If that site, however, had a very high TDS level, the 2" pipe would best be treated by a 3", 4", or even 6" TWT Deposit Controller combined with the appropriate 2" Reaction Chamber, Copper Pipe Signal Enhancer or on-site solenoid wrap, depending upon the severity of the TDS level. In other words, for unusual situations, application of TWT products can be scaled up to meet those needs.

Note:

When upgrading controller, the reaction chamber, copper pipe signal enhancer or on-site wrap coil dimensions must continue to match the actual pipe size, not the controller upgrade.

In effect, a clean, corrosion-free delivery system is restored and maintained in an environmentally safe and chemical-free manner. The result is clean pipes and tubing with no biofilm and reduced bacterial contamination

The TWT Deposit Control System will keep the IonGuard System electrodes free of scale and other deposits for more effective results. At the same time, the Deposit Control System will continue eliminating scale and biofilm deposits throughout the entire fluid based system.

### IonGuard Disinfection/Purification:

The lonGuard Purification System purifies water through a process called ionization. This process utilizes a low voltage direct current [DC] to place precise and minute amounts of copper and silver ions into water systems. Copper ions kill algae

and silver ions kill bacteria. The lonGuard Purification System is an electrolytic copper/silver ion generator. The system units contain specially cast copper/silver alloy electrodes. These electrodes are mounted in a housing designed for easy access (HVAC & Pool Environments).



Electrodes

### **PROTECTION FOR NEW EQUIPMENT**

Provides new equipment with the ability to enhance it's features and benefits

#### TREATMENT FOR EXISTING EQUIPMENT

Retrofit existing equipment to improve its operating efficiency and life cycle

# HOT WATER HEATER/BOILER APPLICATION GUIDELINES

# **Application Examples: TWT® Reaction Chamber**

To use in conjunction with the TWT Deposit Control Systems when required, *Triangularwave Technologies Deposit Controller & Reaction Chambers* 

Triangularwave Technologies, Inc. has developed a line of factory-wrapped wire coil Reaction Chambers to address magnetic pipe environments. Typically, wire coil cannot be installed on any magnetic pipe, such as steel, galvanized steel, ductile iron, or cast iron. When the coil is applied to a magnetic material, the pipe becomes a shield and prevents the wave energy from entering the fluid path. The TWT Reaction Chambers provide an easily installed section of non-magnetic pipe to provide the proper pipe material for the Deposit Control System to work as designed.

The TWT Reaction Chambers are fully sealed, protecting their layers of factor wrapped coil. The PVC, Stainless Steel and the Industrial Reaction Chamber systems are designed and manufactured to meet the highest quality specifications.



The TWT Copper Pipe Signal Enhancer (For copper pipes only)



Schematic rendering of the TWT-CSE-0227 hookup

#### Copper pipes, although acceptable, are one of the more difficult of materials to work with. To overcome this difficulty...

Triangularwave Technologies has designed its Copper Pipe Signal Enhancer. This unit is placed between the controller and the copper pipe solenoid. The function of the signal enhancer is to provide a proper impedance match and to ensure maximum energy transfer between the controller and the solenoid, which ensures enhanced treatment of the fluid. The Copper Pipe Signal Enhancer must be used in all copper pipe applications to maximize the performance, and provide a boost to your application. (Teflon wire recommended for hot water applications) The copper signal enhancer is a passive signal / impedance matching circuit. This device provides a power boost to the conditioning signal in copper pipes.

#### Points Of Use & Treatment For Hot Water Systems







Hot Water Heater/Boiler and/or Steam Generator



# **TWT®CONDITIONING / TREATMENT PRODUCTS & ACCESSORIES:** TUBE & PIPE APPLICATION GUIDELINES

### HVAC/POOL & SPA APPLICATION, INSTALLATION, CURRENT SOURCE AND OPTIONAL EQUIPMENT GUIDELINES

#### Triangularwave (TWT®) Deposit Control Technology Products & Accessories

Tube & Pipe Sizes (Inches) In Diameter	TWT® Deposit Controller	TWT® Industrial Reaction Chamber	TWT <sup>®</sup> Copper Pipe Signal Enhancer (For copper pipes only)
1 "	TWT 5C8-401	IRC-01–PVC ISRC-01-St/St	TWT-CSE-0227
1 1/2"	TWT 5C8-401	IRC-1.5–PVC ISRC-1.5-St/St	TWT-CSE-0227
2"	TWT 5C8-402	IRC-02–PVC ISRC-02-St/St	TWT-CSE-0227
3"	TWT 5C8-403	IRC-03–PVC ISRC-03-St/St	TWT-CSE-0229
4"	TWT 5C8-404	IRC-04–PVC ISRC-04-St/St	TWT-CSE-0229
6"	TWT-5C8-406	IRC-06–PVC ISRC-06-St/St	TWT-CSE-0229



8

For information on larger pipe size application contact your distributor and/or TWT, Inc.

#### Triangularwave Technology lonGuard Ionization (see pg 5 for Ionization) & Purification **Products & Accessories**

Tube & Pipe Sizes (Inches) In Diameter	lonGuard lonization Controller	Electrode Installation kit	Replacement Electrodes
Up to 11/2" or less	s TWT-5C8-277–.05 amp	TWT-IDK-0265115	TWT-RE-0245 (3")
Up to 2" or less	TWT-5C8-278–1.25 amp	TWT-IDK-0265122	TWT-RE-0255 (3")
Up to 3" or less	TWT-5C8-278–1.25 amp	TWT-IDK-0265123	TWT-RE-0262 (6")
Up to 4" or less	TWT-5C8-278-1.25 amp	TWT-IDK-0265124	TWT-RE-0262 (6")
Up to 6" or less	TWT-5C8-279-2 amp	TWT-IDK-0265126	TWT-RE-0262 (6")

IonGuard Disinfection, Purification and TWT<sup>®</sup> Deposit Control Technology All-In-One package Unit

Up to 11/2" or less TWTDCI-5C8-377-.05 amp TWT-IDK-0265115 TWT-RE-0245 (3") Up to 2" or less TWTDCI-5C8-278-1.25 amp TWT-IDK-0265122 TWT-RE-0255 (3") Up to 3" or less TWTDCI-5C8-278-2 amp TWT-IDK-0265123 TWT-RE-0262 (6")









All-In-One Controller

Electrodes Installation Kit See TWT Reaction Chamber as above

#### **TWT® SYSTEM NOTES**

- Optional: TWT® Side Stream ByPass systems for larger pipe size, volume application and treatment requirements
- Current Source Requirements: Must specify with P.O. 110/20 VAC-220/30 VAC or other

Electrodes

- TWT provides full support before, during and after all installations
- Products, Systems, Ultra Violet Disinfection, Purification and Technical Information: In order to ensure the greatest level of performance and satisfaction in your work with the TWT products & systems, we recommend that you contact our engineering staff, who will be pleased to work closely with you to determine the optimal application and installation for your industry specific needs.
- · Additional product and technical information can be found on our website

Email: info@triangularwave.com • triwaveinc@aol.com • Websites: www.triangularwave.com • www.twtwatertreatment.com



**IonGuard Ionization Disinfection** & Purification