

CHEMICAL-FREE FLUID MANAGEMENT SOLUTIONS FOR THE IRRIGATION & AGRICULTURAL INDUSTRIES

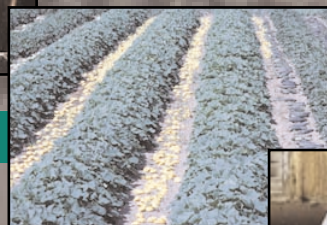
TWT Water Treatment Systems For The Control of Scale Deposits

• Bio-film • Algae • Colloids In All Water Feed Lines & Irrigation Equipment

Cows are “Fussy” – The More Water They Drink, The More Milk They Produce



Crops Absorb Water & Nutrients Faster (increase crop yield)



Enhance Watering & Cooling System (improve hog raising operations)



Prevents Clogging of Drip & Irrigation Emitters (improves wetting efficiency)



Improves Operating Efficiency of Medicators, Bell Nipple Waterers & Feed Lines (safeguard your poultry and yield)



HARD WATER PROBLEMS SOLVED EASILY!

Your Simple and Safe Solution! Enhance water quality, and improve operating efficiency and equipment life cycle.

TWT systems use state-of-the-art technology to restore and maintain a clean, corrosion-free delivery system in an environmentally safe and chemical-free manner...The result is clean pipes, tubing, medicators, emitters and water feed lines with reduced biofilm and bacterial contamination.



CLEANER WATER IS HEALTHIER WATER!

85 Chestnut Ridge Rd. • Montvale, NJ 07645 USA • Tel: 201-573-0030 • Fax: 201-573-8710



**TRIANGULAR WAVE
TECHNOLOGIES, INC.**
FLUID MANAGEMENT SOLUTIONS
www.triangularwave.com

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AGRICULTURAL AND IRRIGATION WATER TREATMENT

The North American farming community faces many operating challenges on a day to day basis, among them variable costs and revenues for a broad range of supplies, equipment, and processes, including fertilizers, water, energy, farm machinery, storage, labor for cultivation and harvesting, and market selling prices. Farming expertise keeps the farm on an even keel, but intelligent and responsible use of new and available technology often gives an owner an edge that would otherwise be unreachable. Sometimes it can even mean the difference between staying in or going out of business.

An area of challenge that frequently remains unaddressed is that of water quality and its impact on farming operations, both crop and livestock. According to the U.S. Geological Survey, 85% of the U.S. suffers from hard water and its effects. Chances are, your farm is part of the 85%... Triangular Wave Technologies, Inc. manufactures fluid man-

agement products and solutions designed to enhance your operating conditions, taking the negatives of poor water quality and turning them into an improved bottom line and profit margin for your farm.

TWT has pioneered the advanced design of fluid management products to meet the needs of residential, commercial, and industrial applications. TWT manufacturing expertise is reflected in our efficient engineering design team. Our technical test department constantly strives to meet the ever changing requirements of the fluid management environment. Our unique capabilities and design expertise have successfully solved a wide variety of problems for a wide variety of customers. Under the direction of a manufacturing supervisor and group leaders, our state-of-the-art products are designed and assembled to meet our precise quality control standards, and to support the needs of the agricultural sector to the highest levels.

Dairy Farms/Water Quality Problems:

Stock water

Deposit control and better taste for hard water used for cow watering. Dairy cows need between 15 and 35 gallons per head per day for drinking and barn needs; many cows are "fussy" about the water they drink. The more water they drink the more milk they produce. Deposit control means that waterers do not scale up and leak, and that the lines are clean.

Clean-up Water

Treated water usually requires less chemical additives. Iron in the water is bound up with the scale minerals and taken out of the "chemistry"; the result is easier clean-up using fewer chemicals to remediate the iron effects. Field experience has shown that water supplies with E. coli contamination showed a zero count after treatment by the Triangular Wave System. Further testing is underway to verify these results. TWT Deposit Control Systems work continuously to keep your water feed lines clear, clean, and well maintained, significantly reducing biofilm and resulting bacteria, and providing easy flow access to the water supply for your livestock.



Aquaculture

To survive, grow, and reproduce, fish require quality water. Water quality variables that are of extreme importance to a successful aquaculture operation include temperature, pH, dissolved oxygen, carbon dioxide, alkalinity, and ammonia. To the extent that these variables either maintain or diverge from their optimum levels is a large measure of the success or failure in harvesting quality fish, and so a careful balance must be maintained at all times.

Carbon Dioxide, pH, and Alkalinity: according to the Department of Animal Ecology at Iowa State University, at night, respiration by bacteria, plants, and animals results in oxygen consumption and carbon dioxide production; during sunlight, respiration continues, but algae uses CO₂ for photosynthesis. In productive ponds, especially those with low alkalinity, the daytime pH may reach 10, which can be lethal to young fish.

Calcium Carbonate is used to help control nitrates, and pH in the water. Useful for those purposes, it does, however, greatly increase the probability of scale and biofilm conditions, which affect heat exchange (temperature control) and bacteria levels. Ammonia results from the breakdown of fish feed and wastes; chronic exposure to certain forms can be toxic to warm water species. Dissolved oxygen is a most critical factor. More fish die from low dissolved oxygen levels than from any other factor, according to the Aquaculture Network Information Center.

AGRICULTURAL AND IRRIGATION WATER DEPOSIT CONTROL

Aquaculture continued

Temperature, another broadly critical factor, controls the solubility of gases in water, the reaction rate of chemicals, the toxicity of ammonia, and of chemotherapeutic to fish. TWT Deposit Control Systems tackle these problems efficiently and without chemicals. Our Triangular Wave System reduces or prevents the occurrence of scale and biofilm formation from calcium carbonate, reduces or prevents the occurrence of scale and biofilm formation from fish and food wastes, in turn reducing the occurrence of ammonia, as well as bacteria conditions. Allows hard water to be "wetter", i.e., allows for greater hydration of the water - less hydrogen bonding to oxygen molecules allows optimum and consistent heat exchange and operating efficiency by keeping piping, pumps, heaters, boilers, and tanks free of scale build-up and the resulting reduced heat exchange levels and increased energy consumption.

Visit the TWT website home page and click on Ultraviolet Disinfection Systems for additional information beneficial to the aquaculture industry.

Hog Raising Operations

Animal Waterers

Deposit reduction and/or control in the water nozzles and valves, which can stick opened or closed, either wasting water or preventing the hogs from obtaining the water they need.

Pen Cooling Misterns

Deposit control in the water nozzles, allowing proper misting and dispersion.

Water Wall Curtain Cooling System

The temperature in hog facilities is very important. If the animals get too hot they suffocate. To help control cost of operation and lower air conditioning costs, a water wall curtain is used. This is a system that uses a heavy plastic panel (plastic curtain) like in cold storage warehouses. This water wall has a header applying streams of recycled water to the wall. The water collects in a trough at the bottom. As the water streams down the wall curtain, the water cools air that is coming through the slits in the curtain. This does two things: it cleans the air and drops the air temperature. Triangular Wave system would prevent scale deposits on the header nozzles and on the wall curtain itself.

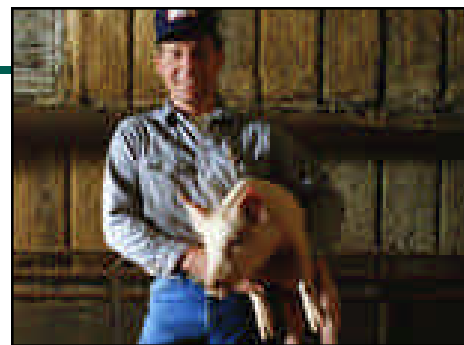
Waste Management

Waste management is a huge cost and a large, constant problem. Water is used to flush the floor and pen areas. The waste is directed to troughs and eventually to pits where it is lagooned for liquid application to fields. Triangular Wave Systems can prevent clogging of pipe lines, pumps, sensors, etc.

Hog Watering System

Many of the health problems of the hogs stem from the water chemistry. Triangular Wave Systems offer deposit control and better taste. Hogs will drink more, improving their health & viability, increasing the herd, and improving the end quality.

Visit the TWT website home page and click on Ultraviolet Disinfection Systems for additional information beneficial to the hog raising industry.



Crop farms/Triangular Wave Systems Benefits:

Irrigation System

Deposit control in spray nozzles, pipes, pumps, and valves.

Soil Moisture

Reduced surface tension allows greater moisture penetration into the soil. Salts in the water are flushed beyond the root zone.

Spray Equipment

Deposit control in spray applicators of fertilizer and pesticides.

Rolling Stock

Control scale deposits in the cooling systems and radiators of tractors, trucks, and generators.



AGRICULTURAL AND IRRIGATION WATER CONDITIONING

Poultry Farms

Bird Waterers

Treatment and deposit control in water lines and on bell-nipple waterers.
Reduced leakage at valve, leading to drier and more easily handled manure.

Medicators

Deposit control in medication ports in watering systems.

Purification System

Reduction and/or elimination of chlorine (makes the birds hyperactive and panicky) by using the Triangular Wave Deposit Control System with the Triangular Wave IonGuard Purification System; TWT provides a complete, non-chemical solution.



Turkey Farm Reduces Harmful Biological Build-ups with Triangular Wave System

Miller Turkey Farm:

10,000 Bird Facility • 6,000 Gallons of Water Per Day • 50 Grains of Water Hardness

The Miller Turkey Farm raises approximately 10,000 turkeys during each growing cycle. A growing cycle is 17 weeks from the time they receive the turkey chicks. Maintaining the turkey's optimum health and growth results in the Millers maximizing their operation. Profits were being lost when a certain percentage of the birds would not survive until the end of the 17 week cycle, and others would not reach their full weight.

Hard water was one problem that the Millers knew was costing them turkeys and, ultimately, dollars. The deposits from their water source would quickly leave scale build up on the bell nipple waterers and coat them with a thick white crust; restricting drinking water for the turkeys. The deposits also clogged the medicators that are used for disease prevention. Even with regular cleaning, the restricted flow in the systems took its toll on the turkeys; as they received inadequate water and medication

The scale also was a breeding ground for bacterial growth, which increased the chances of infection and other unhealthy situations. A strong ammonia odor from the barns was evidence of waste and bacteria. Mr. Miller estimates that their annual loss was about 10 percent of their turkeys. Much of the loss can be attributed to the scale and bacteria problems caused by the hard water.

In 1996, a Triangular Wave System was installed on the main water supply line to the farm. The scale build-ups on the bell nipple watering system began to disappear, and cleaning became unnecessary. In addition, the strong ammonia odor on the farm was greatly reduced. As evidence of the positive effect of the Triangular Wave System, the mortality rate of the turkeys dropped by half. Furthermore, the turkeys at maturity are heavier and healthier. ***The Triangular Wave System eliminated the severe scale problem, and that means, the Millers sells more turkeys, and heavier turkeys.***

TWT installations have eliminated the scale and biofilm, as well as the need for the sodium and chlorine treatment of the water.

The methods employed resulted in the following benefits:

- ***Saves salt and other chemical additive costs***
- ***Saves equipment maintenance costs***
- ***Saves chemical handling costs***
- ***Saves electricity costs***
- ***Produces healthier products***
- ***Reduces mortality rates***
- ***Produces higher profit margin***
- ***Improves food conversion rates***



AGRICULTURAL AND IRRIGATION WATER CONDITIONING

Shank's Inc./Chicken farm egg laying facility

- 250,000 Bird Facility • 9,600 Gallons of Water Per Day**
- 21 Grains of Water Hardness**

The Shank's Hen House egg laying operation has been run by the Shank family for many years. Roy Shank is the present owner. During most of those years, they had problems with the water supply, which is very hard. Their initial treatment included a large filter and a water softener. On a typical day of operation, workers would walk among the cages to remove culls and replace nipple waterers which had become encrusted with scale. Each worker would carry a pocketful of waterers. The entire process took several hours per day. Then they would be ready for the day's work of crating and stacking the eggs.

When Mr. Shank was first introduced to the Triangular Wave Deposit Control System in 1998, he wanted to replace the water softener, save the entire backwash water, and not have to buy and store salt. He was quite concerned that without the softener they would be right back where they had been before the softener was installed. They installed the TWT Deposit Control System to replace the water softener and also to protect the ultraviolet disinfection systems in use from scale buildup on the quartz tubes in those UV units (buildup on the quartz sleeves reduces the ability of the UV to be effective). They were cautious and reduced the water softener usage gradually over a 30-day period, decreasing its cycles every week until it was totally bypassed. The TWT system has performed beyond all expectations.

- They have not used any salt.**
- They have not experienced any problems with the nipple waterers.**
- The plumbing system and UV disinfection systems have operated flawlessly since installation of the TWT system.**
- They have reduced the time spent walking among the cages to minutes instead of hours.**
- They have increased the size of their flock from 245,000 birds to 325,000 birds with no extra help.**



Triangular Wave Deposit Control System treats water before the water enters the UV disinfection units, keeping quartz sleeves clean

Mr. Shank recently told a group of visitors that... "without the TWT Deposit Control System I would not be able to stay in business, and that is not an exaggeration."

Other Successful Applications of the TWT Deposit Control Systems

Problem: Heavy mortality due to bio-film and scaling conditions of the water which caused the waterers to plug, resulting in dehydration and death.

Sought: A means of treatment without the use of chemicals or high maintenance equipment to clean the plumbing schematic and manage the bio-film.

A chicken farm located in central Pennsylvania, has a population of 225,000 egg layers. The grower wanted to eliminate the high cost and maintenance of a water softener system. He also was very leery of any equipment which would revert his water system problems to its prior history of very high mortality causing total plumbing replacement. A TWT Deposit Control System was installed prior to softener. The softener was reduced in use 25% per week for one month to wean the water system. After one month the entire system was totally conditioned by the Deposit Controller only. This farm was experiencing a manganese problem, causing waterer fouling and also had a bio-film presence. They installed a TWT Deposit Control System to remediate the conditions. The grower was advised to "pig" the service lines with sponges to help remove the accumulation of scum and manganese deposits after the unit was energized for a period of two days.

Results: This was accomplished and the manganese problem is now under control and the waterers are all functioning properly, and the manpower necessary to walk the lanes replacing slow or stopped waterers was eliminated. The cost of salt resulted in an annual savings in excess of \$1,000.00 which also eliminated storage and the manpower used to load and unload bags of salt. The maintenance of the softener was eliminated. The manhours saved allowed the grower to expand his operation by 80,000 birds without an increase in manpower. The grower has also stated that without the Deposit Controller he would not have been able to afford the expansion!

AGRICULTURAL AND IRRIGATION WATER SOLUTIONS

Hydroponics

Quality Water

This is an industry of soil-less production of vegetables and flowers in a controlled environment (usually a greenhouse). Troughs, tubes, poly trays, tanks, float beds, or poly socks are used as the growing frames. The frames are filled with perlite, gravel, rock wool, vermiculite, sand or other inert media for rooting. The chemically enriched water to feed the plants is administered through spray nozzles, pipes, drip tubes, flooding, continuous low flow, or timer controlled cycles of the above. Triangular Wave systems control deposits on all of the water equipment.

Calcium Carbonate Scale Control

To balance the pH, the facility will use calcium carbonate to raise the pH to the desired 7.0 to 7.5. The calcium carbonate is sacrificial. The calcium carbonate is fed into the tanks, and that in turn causes problems downstream with pumps and aerators. The Triangular Wave system controls scale formation from calcium carbonate and lime, and maintains and improves operating efficiency, keeping energy consumption down.

Bacteria Control

Triangular Wave Systems control bacteria by killing portions of it and keeping the rest suspended in the water and off the walls of pipes and plants. Bacteria control is a huge factor in hydroponics. The cost of starts and loss of production time is significant. When disease occurs, plants must be removed from production. New plants are not installed, so that area of the house is lost. When planting new stock, it takes months to get up to production. The operators want the life span of the plants to be as long as possible.

More Efficient Root Zone Uptake

Triangular Wave systems decrease surface tension and increase the solubility of nutrients in the water. Roots are tubes that absorb nutrients and water; Triangular Wave treatment promotes this process. Further, TWT untreated water will form on the roots. Triangular Wave systems will control root scale. Systems will control root scale (untreated water that forms on roots).

Irrigation

The **Triangular Wave System** has proven its worth in preventing clogging of Drip and Spray Irrigation emitters. The unique ability of the Triangular Wave System to maintain clean surfaces applies to biological deposits (slime and algae), as well as scale deposits. With the Triangular Wave System there is no need for the injection of acids and strong biocides like chlorine to keep irrigation piping and emitters free of deposit buildup.



Soil Wetting and Penetration

Some soils will not readily absorb water. Often a chemical wetting agent or surfactant is added to the water at considerable cost to improve the speed and depth of penetration of the water into the soil. Parks, golf courses, and the grounds of office parks are not cultivated and, in arid climates, a buildup of sodium in the root zone can adversely affect the health of the plants. Low frequency magnetic fields have been proven to alter the molecular state of water. Studies at Texas A&M University revealed an enhancement in fruit (i.e., squash) weight by more than 24%.*

The Triangular Wave System has been shown effective for improving wetting efficiency, reducing sodium concentration in the root zone, and maintaining the free flow of irrigation water through pumps, piping and emitter systems.

- Eliminates scale deposit on irrigation piping and emitters, reduces maintenance
- Improves wetting efficiency
- Eliminates biological deposits (slime and algae)
- Reduces the necessity for chemical additives (surfactants)
- Crops absorb calcium-free water molecules faster

* Waternet.com

BENEFITS OF THE PATENTED TRIANGULAR WAVE SYSTEMS

TWT Deposit Control Systems reduce or eliminate the need for chemical treatment of fluids and chemical cleaning of heat exchanger tube bundles and water pipes.

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 bio-growth 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 Triangular Wave System keeps the bacteria, algae, and their food dispersed in the water, off of surfaces, and away from their biofilm breeding ground
- Eventually the biofilm will die, too

SHORT PAYBACK PERIOD

- The combined reduction of water, chemical and energy costs is enough to pay for the Triangular Wave System in as little as 9 to 18 months
- With the Triangular Wave 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
- With no chemicals being added, the requirements for pretreatment 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 and maintenance=
increased production
- The Triangular Wave System requires little or no maintenance
- There is little electrical current flow through the electromagnetic 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

OTHER BENEFITS

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 Triangular Wave 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 Triangular Wave 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 8 to 12 years.

ENERGY SAVINGS MECHANISM

The primary energy savings result from a decrease in energy consumption in heating or cooling applications. This savings is associated with the prevention or removal of scale build-up on a heat exchange surface where even a thin film (1/32" or 0.8 mm) can increase energy consumption by nearly 10%. Examples of savings resulting from the removal of calcium-magnesium scales are shown in **table below**. A secondary energy savings can be attributed to reducing the pump load, or system pressure, required to move the water through scale-free, unrestricted piping.

Scale Thickness (inches)	Increase Energy Consumption (%)
1/32	8.5
1/16	12.4
1/8	25.0
1/4	40.0

Example Increase in Energy Consumption as a Function of Scale Thickness*

* See Federal Technology Alerts/Non-Chemical Technologies for Scale and Hardness Control (http://www.pnl.gov/fta/11_non.htm)

TWT treatment equipment is a reusable investment and retains its value – if you move your facility or re-engineer your plumbing system, TWT equipment moves with you.

IMPROVE THE QUALITY & TASTE OF WATER

Agriculture is one of the nine vital "Industries of the Future" designated by The US EPA Office of Industrial Technologies. According to the OIT, these nine industries necessarily use large amounts of heat and energy* to physically or chemically transform materials. Collectively, they supply 90% of the materials vital to our economy, produce \$1 trillion in annual shipments, directly employ over 3 million people, and indirectly provide an additional 12 million jobs at all skill levels.

***To learn more about energy, water and cost savings using TWT fluid management systems, visit the TWT website@www.triangularwave.com**
TWT Deposit Control Systems and comprehensive integrated treatment solutions provide the agricultural and food processing sectors with undeniable benefits and significant return on investment in a cost-effective and environmentally responsible manner.

TWT Versatile Fluid Conditioning & Treatment Systems Effectively Meet The Needs Of Any Application
TWT Systems Can Be Custom Designed To Meet Your Specific Needs



Conserve Water and Save Energy