

Water and the Superior Water Conditioner



ADVANTAGES OF USING SUPERIOR® NON-CHEMICAL WATER TREATMENT PRODUCTS:

There are three major concerns for all users of water for the purpose of thermal transfer:

- ENERGY SAVINGS
- WATER CONSERVATION
- POLLUTION PREVENTION

Superior Water Conditioners® meet all three criteria for effective water treatment for control of lime/scale and corrosion for thermal transfer efficiency.

The Battelle Report titled “Non-Chemical Technologies for Scale and Hardness Control”, sponsored by the Department of Energy and published in 1998, confirms that the elimination of chemicals is only part of the savings realized by the non-chemical process. It indicates a payback of less than one year and an adjusted internal rate return greater than 50%. Non-chemical water treatment technologies were calculated and determined life-cycle cost-effective (at one or more Federal sites) in terms of installation cost, net present value, and energy savings.

Frequently overlooked (or ignored) costs associated with chemical water treatment (besides the chemicals) are:

- Freight for 55-gallon drums
- Labor to unload from truck
- Storage for 55-gallon drums
- Labor to hook up new drum
- Cost to dispose of empty drum
- Chemical feed pumps: repair parts, labor, and electricity
- Conductivity meter: repair parts and labor
- Solenoid valve: repair parts and labor
- Water testing kits
- Water testing chemicals with freight
- Labor to test water in boiler(s), cooling tower(s), evaporative condensers(s), etc.
- Labor to readjust chemical dosage
- Heat transfer loss due to scale
- Corrosion of equipment
- Acidizing
- Estimated cost for reporting (new laws requiring monthly reports on hazardous materials stored, used and disposed of)
- High bleed rates in water to control TDS in cooling towers and evaporative condensers
- High blow-down rates in water to control TDS in steam boilers
- Heat loss in boiler blow-down water

It is well known in the chemical industry that a 55-gallon drum of chemicals contains as much as 50-53 gallons of water.

Some industries are being charged by the hazardous waste hauling companies up to three times the acquisition cost of the chemicals to haul the hazardous material away as it is discharged after its use throughout the plant. When these costs are combined with the previously noted ancillary costs of chemical treatment, **the life cycle cost of chemical water treatment balloons to a staggering factor of seven (7) times the original acquisition cost of the treatment chemicals!!!**

It is also a common practice to acidize steam boilers, cooling towers, evaporative condensers, chillers and other equipment to remove excessive scale even though chemicals are being used to supposedly prevent this build-up in the first place. Not only does this add to the pollution problem, but, it also is dangerous material to handle and has the potential cost to human health, e.g. burns, loss of sight, respiratory ailments, and even death.

Blow down of the boilers and bleed-off for cooling towers can be reduced considerably after installing a properly sized and designed magnetic water conditioner. However, it may be helpful to maintain the same blow down or bleed-off rate as before until all the scale is removed if the boiler or cooling tower is badly scaled at the time of installation.

An interesting article was featured in an issue of Maintenance Technology magazine (copy enclosed). It points out, in very broad terms, how water treatment chemical sales people simply skirt the issue of price by avoiding it. A strong point is made about how much a customer “may be paying for ‘unpriced services’, such as testing, lab services, on-site monitoring, analytical equipment, reagents, supplies, and so forth.”

TYPICAL PRODUCT PAYBACK

Superior® believes that the time is right for the Government to take a good look at these products because of the numerous benefits with no ill side effects. The Superior Water Conditioner® system has proven time and time again that it will pay for itself by the elimination of chemical costs alone. Payback is accelerated when all of the aforementioned costs are factored into the analysis!

The typical payback for heating and cooling systems is;

| Equipment | Use | Payback Average |
|-----------|-------------------|-----------------|
| Boilers | Process steam | 6-9 months |
| Boilers | Process hot water | 8-12 months |
| Boilers | Steam heating | *15-18 months |
| Boilers | Hot water heating | 24-36 months |

*The payback varies considerably due to the quality of the water, once-through or returned-as-condensate recirculating systems as well as the effectiveness and cost of the previous chemical treatment.

| Equipment | Use | Payback Average |
|----------------|-----------------|-----------------|
| Cooling Towers | Process cooling | 10-12 months |
| Cooling Towers | Comfort cooling | *1-2 seasons |

*Payback depends on which months of the year it is used

Plus proven:

- “Saving of energy” by reducing scale on heat transfer surfaces
- “Conservation of water” by less blow down and bleed-off
- “True pollution prevention” up front—not at the end of the pipe
- “Reduction of injury and cost” due to the elimination of hazardous waste
- “Better corrosion control”, outperforms other corrosion inhibitors

The Superior Water Conditioner® technology will help industry meet the environmental requirements of EPA, DNR, DOE and other state and federal regulatory agencies.

MAGNETIC FLUID CONDITIONING

ABSTRACT

The water treatment industry is on the verge of exploding into one of the greatest opportunities of all time. The American people are crying out for the discontinuation of the use of chemicals in an effort to protect the earth. Companies are now turning to magnetic water treatment to help solve this problem.

Magnetic water treatment takes a different approach to solving the same problem that chemical treatment attempts to solve, namely the problems caused by hard, or mineral-bearing water when it is used as industrial process water in cooling towers and heating systems. Chemical treatment attempts to eliminate these problems by changing the behavior of the dissolved minerals through chemical reactions and interactions. Magnetic treatment approaches the elimination of these problems by changing the behavior of the problem causing minerals rather than by changing the chemistry of the water.

The magnetic field through which the water passes causes the water molecules to uniformly line up end to end as the net charges are all equalized. This in turn does not allow the hard minerals, generally Calcium Carbonate or Magnesium Carbonate, measured as CaCO_3 , to form scale inside of the pipes and on heat transfer surfaces. The minerals are then able to settle out as sludge in the sump of cooling towers, bellies of boilers, etc.

This paper will describe the process of magnetic fluid conditioning its uses, and its environmental aspects.

INTRODUCTION

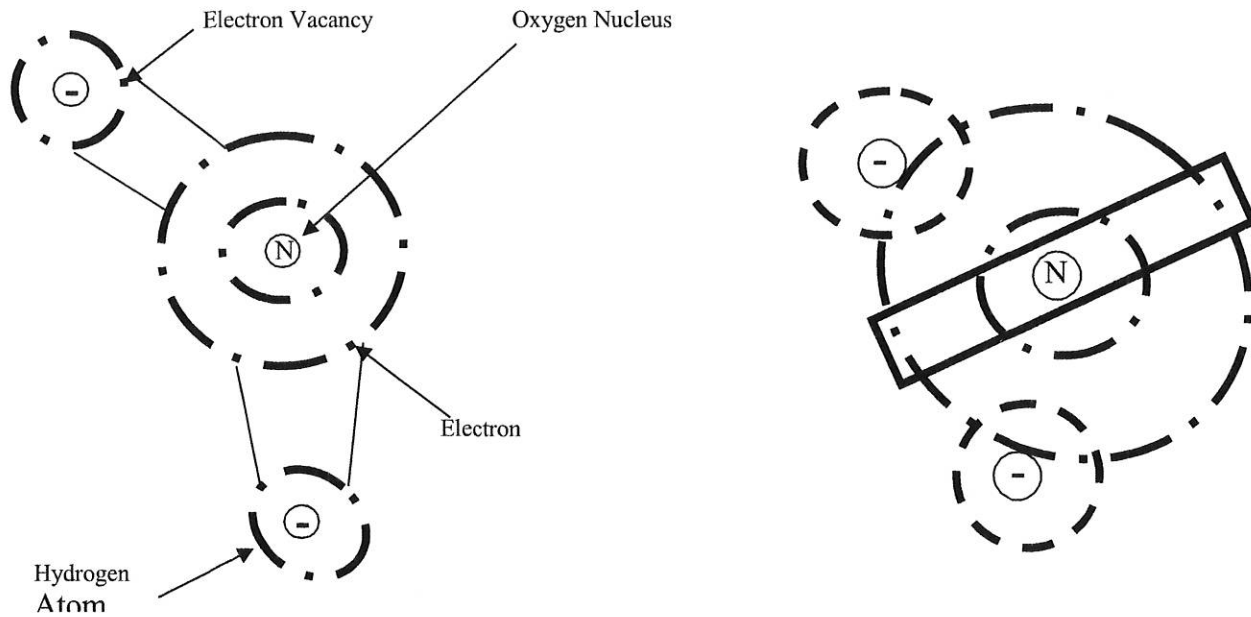
Naturally occurring suspended particles in water are one of the primary causes of scaling in water or stem lines. Scale forms when these particles crystallize, cling to the walls of pipes and attract other crystals. The clogging of pipes can cause down time, corrosion, and greatly reduced flow. Improvements of water treatment have become one of the major problems in industrial applications, power production, and water supply. The increased demands, coupled with today's escalating prices of energy, establish a need for an effective water treatment process. The magnetic fluid conditioning provides substantial savings in both time and money, while keeping environmental pollution within attainable limits.

CHEMICAL PROPERTIES OF WATER

Evaluating liquids experimentally had theoretically involves a field of study still in its infancy. The liquid phase of a substance is comprised of molecules held together by intermolecular attractions.

A molecule of water is expressed as H_2O . The hydrogen and oxygen atoms share electrons, which form a chemical bond (Figure 1).

Wells, 1962



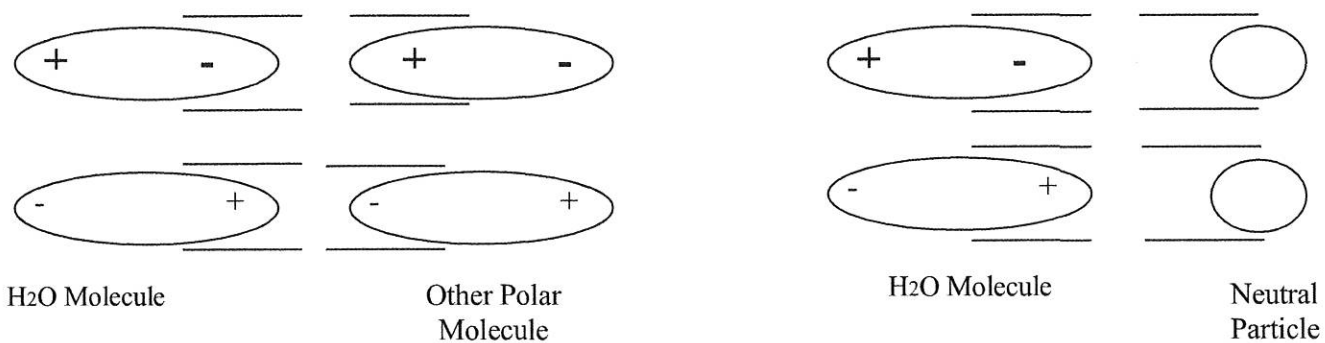
Water molecule shown as a polar molecule or a molecule with a dipole moment

Figure 1

The molecule possesses a positive charge on one end and a negative charge on the other end, causing it to act like a bar magnet. This gives to the term “dipole moment” of a molecule. This dipole moment results when two charges $+Q$ and $-Q$ are separated by a distance d , and constitutes an electric dipole of magnitude Qd . This dipole moment or polar molecule is responsible for one of the most distinctive properties of water, its solubility.

Water has been called the universal solvent because it can dissolve almost inorganic and many organic substances. The negative or positive portion of the water molecule attracts the opposite portion of other polar particles (Figure 2). As a substance dissolves in water, its particles break away from one another and cling instead to individual molecules.

Kaptein, 1977



Opposite charges mutually attract each other.

Neutral particles are attracted by either positive or negative charges.

Figure 2

The presence of a polar molecule in the vicinity of another molecule has the effect of polarizing the second molecule. This induced dipole can then interact with the dipole moment of the first molecule, and the two molecules are attracted together.

Non-polar molecules may acquire a dipole moment when they are exposed to magnetic fields. Under the influence of a magnetic field, their electron distribution becomes distorted and the centers of positive and negative are separated. The magnitude of the induced moment is proportional to the strength of the field.

MAGNETIC FIELD

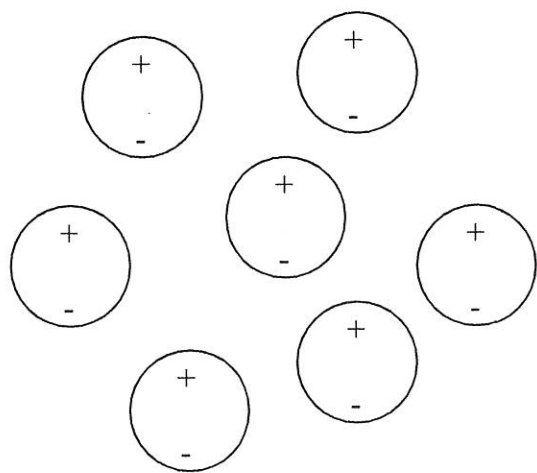
A magnetic field can be produced by aligning the positives and the negatives to opposite ends of any magnetic material. The material used will determine the gauss and the flux density of the magnet when the magnetic metal has been fully saturated.

Modern multi-pole, multi-field bar magnets increase the flux density and utilize the magnetic lines more effectively than a two pole magnet. These magnets do not require any energy to maintain themselves. However, flux changes may result from metallurgical changes, temperature, time, or adverse fields. Proper stabilization will eliminate or reduce these effects.

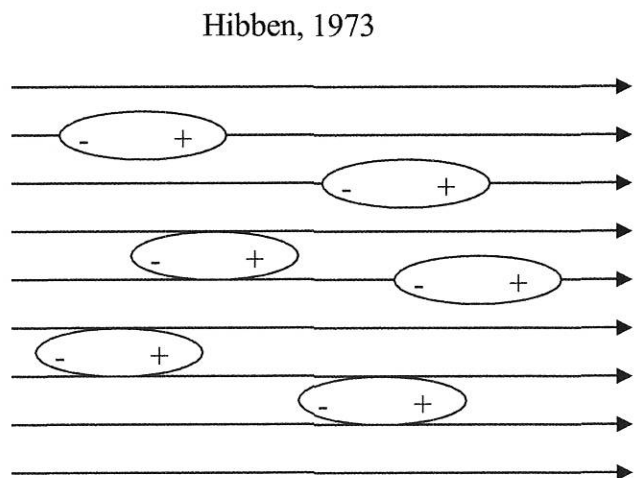
EFFECT OF A MAGNETIC FIELD

The molecule of a substance may be classified as either polar or non-polar. A non-polar molecule is one in which the center of gravity of the positive nuclei and the electrons coincide, while a polar molecule is one in which they do not. Symmetrical molecules like H_2 , N_2 , and O_2 are non-polar while molecules like H_2O and N_2O are polar.

Under the influence of a magnetic field, the charges of a non-polar molecule become displaced (Figure 3). These molecules are said to become polarized by the magnetic field and are called induced dipoles. Restoring force then pulls the molecules together. The charges separate until the restoring force is equal and opposite to the force exerted on the charges by the field.



Arrangement of non-polar molecules in the absence of a magnetic field.



Arrangement of non-polar molecules under the influence of a magnetic field.

Figure 3

Polar molecules are oriented at random when no magnetic field is provided. When under the influence of a magnetic field, the dipoles point toward the direction of the field (Figure 4).

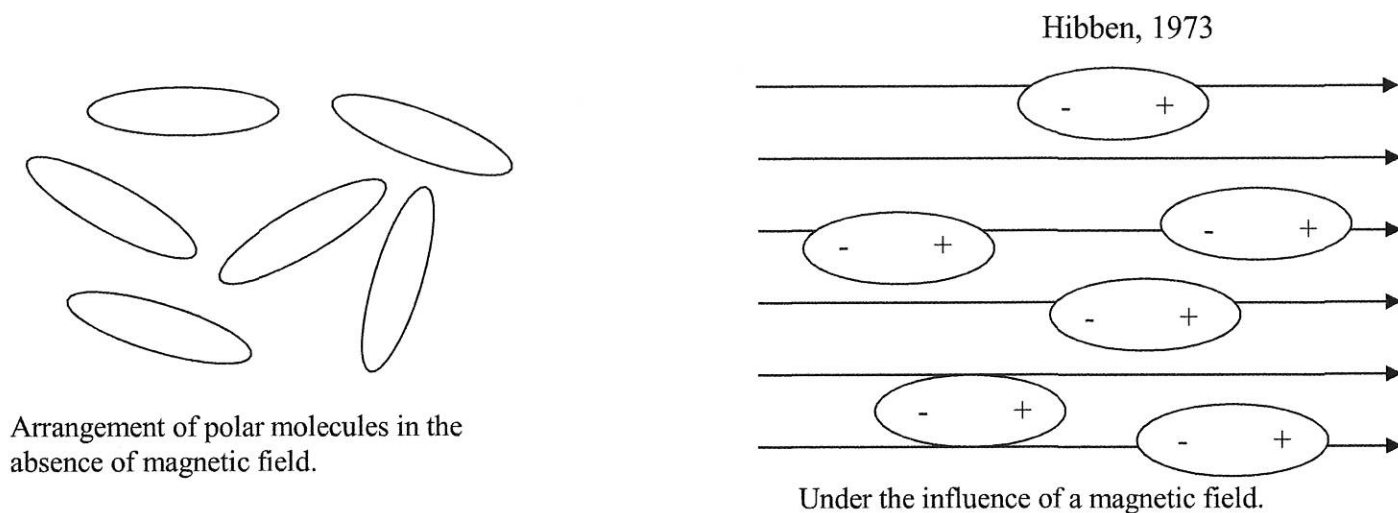


Figure 4 Polar Displacement

When water is passed through magnetic field, the following conditions must be met in order to achieve the desired effects:

1. The path of the water must be perpendicular to the magnetic lines of force.
2. The water should first cut the south magnetic lines and exit the magnetic chamber through the single north pole flux path.
3. The water must be under pressure and moving with the least amount of turbulence possible, just before and after being exposed to the magnetic field.

THEORY OF MAGNETIC FLUID CONDITIONING

The only fact generally agreed upon is a magnetic field reduces the kinetics of crystallization processes and the freedom of movement of charged particles. This limitation of the motion of particles results in an increase in the number of collisions and formation of crystallization centers. Magnetic treatment is effective only if the liquid is passed between the poles of a magnet having a sufficiently strong field and magnetic gradient, providing the temperature of the liquid is not too high.

Through years of research the basic phenomenon follows five scientific concepts:

1. Matter is composed of atoms containing outer valence electrons.
2. Minerals generally form ionic bonds, which are arranged into an ionic lattice structure.
3. These ions are held in place by the balance of both attractive and repulsive electrostatic forces.
4. Immediately prior to precipitation of any inorganic substance, these ions form liquid crystals.
5. A magnetic field resulting from an electrode will exert a force on an electron moving perpendicular to it. Therefore, an electrode will dislocate the ionic lattice by displacing the electrons from their normal state and inhibit the formation of solid crystals.

SCALE

Water hardness is the total of calcium carbonate (CaCO_3) and magnesium carbonate (MgCO_3) and is measured as CaCO_3 . It has been known that these two salts are responsible for much of the scale since they precipitate out of water more readily than other minerals. These precipitates are held in aqueous suspension and, when subjected to the normal temperature and pressure changes, accelerate the clustering of the suspended molecules. When the cluster achieves a size larger than that, which can be maintained in suspension, the scaling process is initiated. In a pipe or tubing, the fluid velocity is greater in the center than close to the wall. The natural tendency is for scale deposits to form where the velocity of the fluid is lower. Therefore, scale forms on the walls of pipes and lower velocity surfaces of heat exchangers.

The scale deposited in pipes and heat transfer surfaces of equipment results in reduced heat transfer (Figure 5)

Gobert, 1981

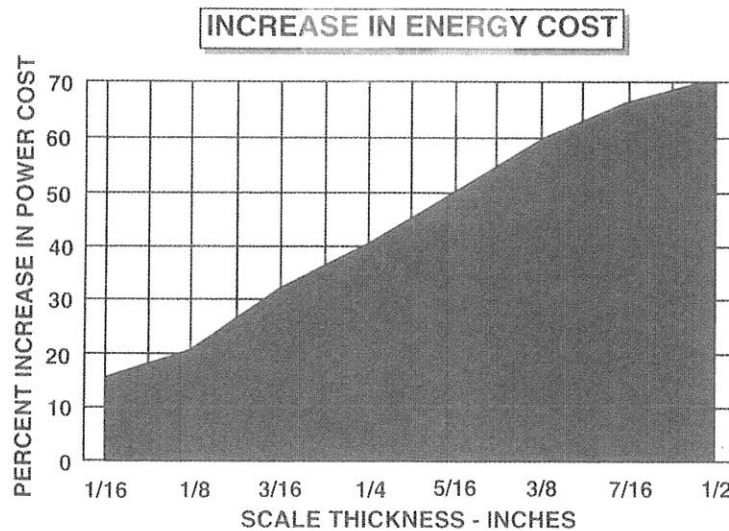


Figure 5 Scale vs. Heat Transfer

The Magnetic Fluid Conditioner, MFC, is able to change the characteristics of CaCO_3 . Instead of forming a regular crystalline structure, smaller crystals are formed throughout the volume of water. These crystals do not adhere to the surface but will drop to a low point in a boiler, where they can be easily blown down or they are carried on through a system and returned to cooling towers or detention basins where the crystals settle out as a sludge. The velocity of the water flow through the system keeps the solid material suspended until it is able to settle out. Any scale, which is present in the system when treatment begins will be gradually removed and drop to a low point in the system.

When dealing with an open system where water is cooled by evaporation, a concentration of the mineral content is inevitable, as fresh mineral-bearing water is added to make up for the evaporated losses. When the water becomes supersaturated with minerals, scale begins to form within the solution and drop to a low point rather building up on heat transfer surfaces of the equipment. Thus, the end result of the water treatment is the system continues to perform efficiently while the expense and pollution of chemicals are eliminated.

USES

The MFC can be used to prevent build-up in steam boilers, cooling towers, air conditioning units, industrial heat exchangers, piping systems, high pressure hot water sprayers, water jackets, cooling systems, and any other device in which fluid is passed through pipes.

When a MFC is used for descaling it must be remembered that the descaling process can be a slow cycle. The unit's effectiveness is measured by the minimum maintenance required, while producing only a slight pressure drop, and requires no chemicals. Therefore, there are no adverse environmental effects, the unit has an indefinite service life, and may be easily integrated into existing installations.

CONCLUSION

Magnetic water conditioners, a non-chemical method for treating water, are used all around the world today, with reduction in treatment cost. Marked reduction in scale formation in steam boilers has been verified in practice and confirmed in laboratories. The mechanics by which magnetic treatment affects the properties of water system is still being discussed and is somewhat controversial (especially throughout the chemical industry). However, the question of whether or not it works has long been put to rest.

The fact is, magnetic treatment does work and when applied properly, it is a very cost effective method of fluid treatment for the prevention of scale build-up in residential, commercial, and industrial water-using applications.

REFERENCES

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WATER

Water is truly an amazing substance and yet it is so common that we seldom are aware of its vital role in the life process.

Water is one, if not the only natural resource that is genuinely replenishing. There is no more or less water today than when the earth was formed. It is evaporated, condensed, recirculated, and reused over and over again.

Water is a universal solvent, and dissolves almost any substance it touches. The ocean's water continually evaporates as vapor into the atmosphere, condensing into rain or snow. As the precipitation falls, it picks up carbon dioxide, dust and other elements in the air and by the time it reaches the ground is a diluted carbonic acid solution. Upon reaching the ground, the water dissolves other minerals, primarily calcium.

Hard water and soft water are terms that have no exact meaning because water considered hard in one region might be considered soft in another. Hardness is usually associated with what happens when soap is used. Soap does not clean as efficiently in hard water and leaves an insoluble residue. In addition, hard water causes scale in water heaters, boilers, and pipes and reduces their capacity and heat-transfer efficiency. While there are no distinct definitions for hard or soft water, the following chart provides a general guideline that is used by the Water Quality Association.

Grains per Gallon

| | |
|-----------|-----------------|
| 0-1 | Soft |
| 1.1-3.5 | Slightly Hard |
| 3.6-7 | Moderately Hard |
| 7.1-10.5 | Hard |
| Over 10.5 | Very Hard |

Though water is replenishing, it can become polluted by wastes or contaminated by chemical additives. Many chemicals find their way to the aquifer making man's job much more difficult in reprocessing the water for potable and irrigation purposes.

Water is a very complex substance and much has yet to be learned about it. The Superior Water Conditioner® (a non-chemical process), while not a cure for all water related problems, can be the solution for controlling lime/scale and corrosion build-up and in many cases can eliminate the need for water softening equipment, depending on the problems to be solved.

PROBLEMS CREATED BY WATER

Generally speaking, there are two major problems created by the use of water:

SCALE

Dissolved minerals in the water form a hard scale in pipes and equipment under various conditions – temperature changes in the water, movement, change in pressure and time. The formation of scale hampers the heat transfer efficiency of equipment by insulating coils or tubes, requiring more fuel to heat or cool the water.

Many minerals, primarily calcium and magnesium, form scale. The Superior Water Conditioner® is an effective treatment for prevention or limiting scale build-up created by calcium or magnesium deposits.

INCRERASED ENERGY COSY DUE TO HARD SCALE BUILD-UP

| BOILERS | | COOLING TOWERS | |
|-----------------|------------------------|-----------------------|------------------------|
| BUILD-UP | ADDITIONAL FUEL | BUILD-UP | ADDITIONAL FUEL |
| 1/32" | 8% | .018" | 11% |
| 1/16" | 15% | .030" | 20% |
| 1/8" | 20% | .038" | 32% |
| 1/4" | 39% | .050" | 41% |
| 3/8" | 55% | .060" | 52% |
| 1/2" | 70% | .080" | 70% |
| | | .088" | 82% |

(Above data from the University of Illinois and the Bureau of Standards.)

CORROSION

Corrosion is the dissolving and deterioration of metal, which can destroy a water heater and plumbing in a very short time. Correcting the problem is not easy because there are many causes of corrosion and the exact cause must be determined before corrective action can be taken.

Superior helps fight corrosion by depositing a thin protective film of aragonite tale on the pipe surface. This keeps free oxygen and carbon dioxide from attacking the pipes.

The following are contributing factors to corrosion:

- A. Free oxygen and carbon dioxide are two of the major contributors to corrosion and can normally be controlled by the Superior Water Conditioner®.
- B. Low pH (acidic) waters are quite prevalent. Superior® does not uniformly change the pH of water and may have problems protecting against corrosion when water has a pH level below 7.
- C. Electrolysis (action of dissimilar metals) and abnormal electrical interference can cause deterioration of the metals. In most cases, Superior® will help reduce this type of corrosion, but may not eliminate it entirely.

WATER TESTING

It is often necessary to test the water to determine the proper water treatment to use. When considering a Superior® installation, it is important to determine calcium and magnesium content as total hardness, silica, pH, and total dissolved solids (TDS).

Water tests can be conducted on-site, using a portable water test meter, or a sample can be taken and sent to a laboratory for analysis. As part of Superior Manufacturing's sales support program, we offer analysis of water samples, or you can purchase a portable water test meter for your own use.

HOW THE SUPERIOR WATER CONDITIONER® WORKS

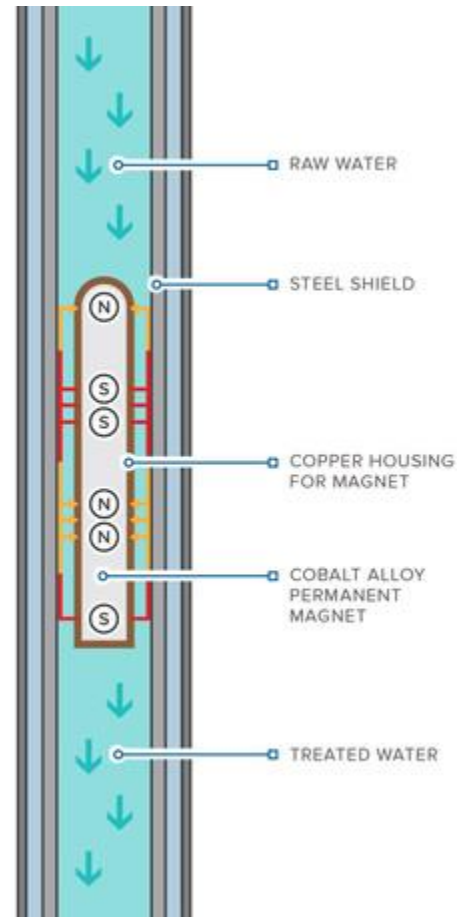
The operation of the Superior Water Conditioner® is simple. Water runs through the conditioner, in at one end, and out at the other. Nothing is added and nothing is taken away, so water purity remains the same.

The Superior Water Conditioner's® magnetic treatment affects the scaling environment of the water, changing the ability of calcium and magnesium to form a hard scale build-up. The precipitated minerals in the water settle out as a soft powder or drainable mud that can be removed through proper maintenance.

Though the composition of the water remains the same, when subjected to magnetic treatment the minerals precipitate out of solution in an "aragonite talc" form rather than the normal hard crystalline structure (calcite). This can be compared with water's solid state; in the form of ice, it is HARD, and in the form of snow, it is SOFT.

The Superior Water Conditioner® can effectively treat water up to 132 grains of hardness. The Superior Water Conditioner® works most effectively at 180°F but loses only 3% of its efficiency at 32°F or 475°F. So for all practical purposes, the Superior Water Conditioner's® temperature range is from 32°F up to 475°F.

The Superior Water Conditioner® is one of the most effective devices in use today to control lime scale and corrosion build-up in industrial, commercial, and residential applications.



A SIMPLE EXPLANATION OF THE SUPERIOR WATER CONDITIONER®

You do not have to be a chemist or a physicist to sell Superior Water Conditioners®.

The Superior Water Conditioner® magnetically changes the water borne minerals' ability to form hard brittle scale build-up and corrosion.

Our unit contains a unique multi-field permanent magnet. As water flows around the PERMACORE®, the minerals that cause lime/scale are suspended. The suspended minerals eventually settle to the bottom of the system and can be easily removed through blow-down, or they will just pass on through the plumbing system.

The Superior Water Conditioner® will also remove pre-existing lime/scale. A fine aragonite talc, a byproduct of the minerals, will then coat the pipes, thus preventing corrosion.

Advantages

- ◆ Easily installed
- ◆ No additional expense after initial purchase
- ◆ Cost-effective, user-friendly, and environmentally- safe
- ◆ Energy efficiency is increased due to less time to heat or cool
- ◆ Prolongs life of equipment and pipes due to prevention of scale and corrosion
- ◆ Very low maintenance (periodic cleaning may be required in some applications)
- ◆ Eliminates the need for chemical treatment and down-time normally required for lime/scale control
- ◆ 10 year warranty against defects in materials and workmanship

SUPERIOR'S NON-CHEMICAL INDUSTRIAL WATER TREATMENT

The Cost- Effective, User-Friendly, & Environmentally-Safe Alternative

The Superior Water Conditioner[®], manufactured by Superior Manufacturing Corporation, Fort Wayne, Indiana, U.S.A., controls lime/scale build-up and corrosion in pipes and water-using equipment without the use of chemicals, saving valuable time, money and energy. Water borne minerals, when in their natural state, are usually in a soluble state. However, when coming into contact with a heat transfer surface, the minerals precipitate out of solution, form scale, causing maintenance problems in water-using equipment. Other physical changes in the water, such as turbulence, friction, pressure change, and evaporation will also cause these dissolved minerals to precipitate out of solution. Furthermore, oxygen can become trapped under the scale and cause pitting on pipes and on the metallic heat transfer surfaces of water-using equipment.

The Superior Water Conditioner[®] is an in-line unit that alters the natural characteristics of hard water minerals, making it difficult for them to bond together and form a hard brittle scale. Instead, they remain in a suspended state throughout the heat transfer process and will flow right on through the system. In some cases, they will settle to the low point of a system and can be easily removed by blow down or draining.

The treatment process allows the minerals to precipitate out of solution in a soft suspended state called aragonite, which will attach itself to all wetted surfaces, creating a microscopic coating, protecting metal from the harmful effects of free oxygen and other aggressive properties in the water. Water-using equipment will operate with improved efficiency, and maintenance or periodic replacement due to calcium/magnesium scaling and corrosion becomes almost non-existent.

The Superiorized[®] water will also gradually reduce the existing lime/scale deposits by breaking down the accumulation, allowing it to settle and purge during the blow down. The system has been successfully used in the residential, commercial and industrial marketplace around the world since 1964. Units are sized according to maximum flow rate and are available for systems with requirements ranging from 1 gallon per hour to in excess of 50,000 gallons per minute.

LIMITATIONS ON THE USE OF THE SUPERIOR WATER CONDITIONER®

The Superior Water Conditioner® is not a cure-all and must not be represented as such. It is designed to control scale and corrosion, and other applications should be viewed with caution as the conditioner may or may not correct the problem.

In these other applications, The Superior Water Conditioner® may do the complete job, in others it may only do a partial job, and still, in others may not do anything at all. Therefore, such applications must be placed in a category of limitations and the prospect should be made fully aware of all facts beforehand. In that way the customer may be completely satisfied with a partial job.

Superior Manufacturing must be consulted prior to any limited application installations. Some of the most common applications in the limited category are:

- 1) **Discoloration** – Rust stains and other deposits on sinks, urinals, toilets, and other vitreous and porcelain enamelware are usually not affected by Superiorizing® the water. There are many reports from customers that the stains were completely removed after the Superior® unit was installed, which can happen especially if the surface is smooth underneath the deposit. There are many factors involved, and removing stains caused by tannic acid or iron is *not* one of Superior's® claims. If stains are removed, there is no extra charge for the additional benefit. (Note: Manually cleaning the rust off *is* made easier when Superiorized® water is used.)
- 2) **Clarity** – The Superior Water Conditioner® is not a filter and cannot clarify the water like a filter. It may clarify the water to some degree if suspended minerals are allowed to settle out and then drained from the system. The conditioner may also help if cloudiness is due to air in the water, due to its ability to reduce the water's surface tension.
- 3) **White Spots** – There are many installations where white spots and discoloration on glassware and metal surfaces are cleaned up when using the conditioner. However, the quantity and kind of minerals in the water and the type of detergent used will have a bearing on whether these spots will clear up entirely with the conditioner.
- 4) **Extreme Steam Pressure** – Be very cautious on any steam boiler application having a working steam pressure in excess of 185 psi. The Superior Water Conditioner® is not designed to operate on steam pressures exceeding 185 psi. Special heavy duty units are available for almost all applications; however, it is a good policy to avoid such installations.
- 5) **Algae** – Algae is an aquatic plant without roots. It subsists on impurities in the water, sun, impurities in the air, and metals found in the equipment. Sterilization is perhaps the most effecting method for controlling algae.

Only when algae is feeding on the minerals and chemical additives in the water will the Superior Water Conditioner® offer some relief from the problem. When the suspended solids and other impurities settle out and are removed through blow-down or bleed-off, the algae has less on which to feed, thereby slowing its growth.

6) **Bottle Washing Equipment**

- a) Alkali and other chemicals are injected into the soak tank of the bottle washer to cleanse and sterilize the bottles. The resulting scale in the soak tank is a chemical scale, not a mineral scale. The Superior Water Conditioner® will have little, or no effect on this type of chemical scale. Therefore, do not try to treat the soak tank unless the customer has been advised of the difficulty.
- b) The rinse waters on a bottle washer have spray heads, which become clogged with scale. The spray heads can usually be kept clean with the Superior Water Conditioner®, depending upon the kind and amount of chemicals injected into the rinse waters. If the spray heads are Superiorized®, it is possible that conditions in the soak tank may also improve. The entire bottle washer should be thoroughly cleaned before the Superior Water Conditioner® is installed.
- c) A better application for the Superior Water Conditioner® on a bottle washer is removing milk stone (gray film) from the inside of the bottles. This gray film continues to become denser until the bottles have to be discarded for new ones, representing quite an expense to the customer. However, this application should be handled in the same limited category as the white spots.
- d) Make sure water is drained daily from the system or devise a method for circulating water so the Superior Water Conditioner® is continually treating it.

7) **Flash Steam Generators**

- a) Small tubular coils inside a flash steam generator are very difficult to keep clean. Water flows through the inside of the coils and steam is produced in a very short time, i.e. 90 seconds. The blow-downs are primarily a team blow-down, which has little effect on removing the settled minerals inside the coils.
- b) In addition to the regular blow-downs, an operating procedure must be established for thoroughly backwashing the coils with water for an adequate length of time to completely change all the water in the system. This should be done while the generator is shut down and as often as possible. A continuous bleed-off should also be installed.
- c) Even if the above operating procedures are strictly adhered to, it is impossible to definitely state what kind of job the Superior Water Conditioner® will do on limited applications. It will not keep the generator clean indefinitely. However, it will lengthen the periods between acid washes and this could represent considerable savings to the customer, justifying the cost of the Superior Water Conditioner® installation.
- d) On installations where the Superior® Distributor cannot engineer the blow-down schematic him/herself, Superior Manufacturing will provide instructions on how to properly backwash the coil if complete information and a diagram of the plumbing is supplied.

8) **Instantaneous (rapid recovery) Water Heaters** – The heating element in rapid recovery water heaters produces such a tremendous amount of heat, the water touching the element actually evaporates, leaving an air space around the element.

If the heating element is not kept wet, mineral deposits will sometimes coat the surface. Usually the coating will soften and fall to the bottom of the heater when the heating element is not energized, therefore allowing the Superiorized® water to come in direct contact with, and softening up the scale. A Superior® unit will always help reduce the scale potential problem, but this is not the best application.

The instantaneous water heater should be flushed out and drained routinely in order to remove the suspended solids.

9) **Electric Interference** – The largest single cause of magnetic failure for Superior® is due to electrical interference, i.e. high voltage lines, transformers, large electric motors, relays, etc. The Superior Water

Conditioner® should always be installed at least 48" from any 3 phase motors, controls, and wiring to insure against electrical interference.

10) **Silica** – Silica can combine with calcium to form a hard scale or silica can form a scale of its own. The Superior Water Conditioner® can effectively eliminate silica/calcium silicate scales when the silica content is less than 10% of that of calcium, i.e. 20 ppm of silica and 200 or more of calcium. If the SiO₂ is more than 10% of the Ca content, a silica based scale can build up. However, (depending on temperature, concentration, etc.) silica will form at a slower rate if the water has been Superiorized®.

11) **Iron** – If iron is present in the water, recommend that an iron treatment system be installed prior to the Superior Water Conditioner®. This will prevent ferric films from coating the Permacore® and causing the Superior® system to eventually malfunction.

Where iron treatment is not used, recommend that the unit be removed and inspected after 30 days. If there is a build-up, the unit must be cleaned regularly or an iron treatment system installed to protect the Superior Water Conditioner® from any ferrous iron in the water.

Suspended ferrous iron particulate should be removed by either media filtration, centrifugal separation, or magnetic straining.

11) **High Sulfates – Low Alkalinity**

It has come to our attention that, on the West Coast, there can be a problem when the sulfates are higher than the alkalinity. We have not had this problem in the Midwest or the eastern part of the country, but it is important to note that parts of California, Colorado, New Mexico, Arizona, Utah, Montana and Wyoming have had some problems.

Installing an Ion Exchange unit with a hardness by-pass, allowing 3-5 grains of hardness to mix with the softened water will prevent scaling, and the 3-5 grains of CaCO₃ will be sufficient to generate enough aragonite talc from the Superiorized® water for protection against corrosion, thus preventing the problem described above.

Even if a filming amine or oxygen scavenger, plus a water softener are used in conjunction with the Superior Water Conditioner®, it can still be cost effective in most cases.

If we can eliminate only one chemical, there is that much less pollution, and the cost of continually adding the treatments to the heating vessels is reduced.

Water has been considered the most complex and complicated substance on earth.

It is the universal solvent, and for that reason, the water analysis will vary from location to location. Even wells drilled just a few feet apart can be drastically different.

Earthquakes can, and do change the water quality, even from the same well. Drilling a well may be the cause of another well to have a change by perhaps drilling down through two aquifers which connect the two together.

Dynamiting in stone quarries can also change the flow patterns of the underground water source.

Superior® did not experience any problems during the first 25 years in business, with over 250,000 installations (provided they were installed within the working limitations of the unit and the system was properly maintained).

Most chemical salesmen will not take on the boiler responsibility when the water hardness is over 5 grains per gallon unless a water softener is also installed.

The purpose of the Superior Water Conditioner® is to reduce or eliminate chemicals, not replace filters, softeners, etc. In most cases, Superiorized® water will eliminate all chemicals used for the control of scale and corrosion in HVAC equipment and other water-using vessels.

Please do not oversell by insinuating that the Superior Water Conditioner® will provide benefits that it is not engineered or designed to give. **Honesty is always the best policy!**

Thank you for adhering to these very important guidelines. If any application is in question, please contact Superior Manufacturing at (800) 348-0999 or info@superiorwaterconditioners.com.

DISCHARGE IN GALLONS PER MINUTE

This chart is based on water flow if valves are wide open. If valves are only partially opened, water discharge will be less than indicated on the chart.

For example, a 1" pipe at 60# pressure will discharge 47.06 gallons/minute when the valve is wide open.

| P.S.I. | DIAMETER OF PIPE IN INCHES | | | | | | | | | | | | |
|---------------|-----------------------------------|------------|----------|--------------|--------------|----------|--------------|----------|----------|----------|----------|-----------|-----------|
| | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 4 | 6 | 8 | 10 | 12 |
| 20 | 4.74 | 12.85 | 26.67 | 45.54 | 72 | 147 | 253 | 397 | 794 | 2139 | 4089 | 6774 | 11146 |
| 30 | 5.75 | 15.82 | 33.79 | 56.97 | 90 | 181 | 310 | 488 | 975 | 2619 | 5011 | 8406 | 13656 |
| 40 | 6.66 | 18.63 | 38.14 | 66.42 | 104 | 209 | 362 | 562 | 1125 | 3030 | 5792 | 9708 | 15768 |
| 50 | 7.43 | 20.83 | 42.70 | 74.28 | 116 | 234 | 405 | 633 | 1258 | 3388 | 6474 | 10854 | 17664 |
| 60 | 8.35 | 22.98 | 47.06 | 81.30 | 127 | 257 | 443 | 688 | 1350 | 3843 | 7098 | 11886 | 19794 |
| 70 | 9.04 | 25.17 | 50.83 | 87.84 | 137 | 278 | 479 | 745 | 1492 | 4017 | 7662 | 12846 | 20916 |
| 80 | 9.68 | 26.61 | 54.34 | 93.90 | 150 | 297 | 514 | 798 | 1590 | 4294 | 8166 | 13728 | 22368 |
| 90 | 10.35 | 28.22 | 57.64 | 99.66 | 156 | 315 | 543 | 847 | 1692 | 4537 | 8706 | 14568 | 23712 |
| 100 | 10.88 | 29.75 | 60.81 | 105.66 | 164 | 332 | 574 | 893 | 1784 | 4801 | 9174 | 15348 | 24008 |
| 110 | 11.28 | 31.95 | 63.72 | 110.16 | 172 | 348 | 601 | 937 | 1884 | 5045 | 9396 | 15876 | 26232 |
| 120 | 11.92 | 32.59 | 66.54 | 115.02 | 180 | 364 | 628 | 978 | 1958 | 5330 | 10068 | 16818 | 27774 |
| 130 | 12.41 | 34.66 | 69.24 | 119.76 | 187 | 380 | 654 | 1008 | 2037 | 5485 | 10476 | 17706 | 28518 |
| 140 | 12.87 | 35.20 | 71.88 | 124.26 | 195 | 394 | 679 | 1056 | 2115 | 5692 | 10890 | 18102 | 29634 |
| 150 | 13.71 | 36.45 | 74.40 | 128.64 | 202 | 408 | 703 | 1096 | 2189 | 5892 | 11274 | 18786 | 30676 |
| 160 | 13.96 | 37.63 | 76.86 | 132.84 | 208 | 421 | 727 | 1132 | 2266 | 6084 | 11616 | 19466 | 31680 |
| 170 | 14.23 | 38.89 | 79.38 | 136.92 | 214 | 434 | 750 | 1174 | 2336 | 6150 | 12006 | 20082 | 32658 |
| 180 | 14.64 | 40.02 | 81.54 | 140.88 | 221 | 447 | 772 | 1201 | 2404 | 6456 | 12330 | 20658 | 33654 |
| 190 | 15.04 | 41.95 | 83.70 | 114.78 | 230 | 459 | 793 | 1234 | 2469 | 6576 | 12690 | 21228 | 34578 |
| 200 | 15.17 | 42.25 | 85.92 | 148.50 | 233 | 471 | 813 | 1270 | 2533 | 6804 | 13020 | 21774 | 35064 |

PRESSURE DROP FOR SUPERIOR WATER CONDITIONER® (STANDARD MODELS)

(When installed in an application with the model's maximum designed flow rate)

| <u>MODEL NUMBER</u> | <u>MAXIMUM FLOW</u> | <u>PRESSURE DROP</u> | <u>FEET OF WATER</u> |
|----------------------------|----------------------------|-----------------------------|-----------------------------|
| C-5 | 3 GPH | 0.25 PSI | 0.58 |
| C-10 | 6 GPH | 0.28 PSI | 0.65 |
| C-25 | 15 GPH | 0.19 PSI | 0.44 |
| C-50 | 30 GPH | 0.22 PSI | 0.51 |
| C-75 | 45 GPH | 0.21 PSI | 0.48 |
| C-100 | 1 GPM | 0.20 PSI | 0.46 |
| C-200 | 2 GPM | 0.24 PSI | 0.55 |
| RT-500 | 4 GPM | 0.35 PSI | 0.81 |
| RT-750 | 8 GPM | 0.29 PSI | 0.67 |
| RT-1000 | 15 GPM | 0.33 PSI | 0.76 |
| SF-1250 | 30 GPM | 0.37 PSI | 0.85 |
| SF-1500 | 50 GPM | 0.50 PSI | 1.15 |
| SF-2000 | 75 GPM | 0.33 PSI | 0.76 |
| SF-2500 | 110 GPM | 0.26 PSI | 0.60 |
| SF-3000 | 175 GPM | 0.19 PSI | 0.44 |
| SF-4000 | 250 GPM | 0.08 PSI | 0.18 |
| SF-5000 | 350 GPM | 1.05 PSI | 2.42 |
| SF-6000 | 500 GPM | 1.10 PSI | 2.53 |
| SF-8000 | 700 GPM | 1.05 PSI | 2.42 |
| SF-10000 | 850 GPM | 1.10 PSI | 2.53 |
| SF-12000 | 1100 GPM | 1.10 PSI | 2.53 |
| SF-14000 | 1400 GPM | 1.50 PSI | 2.53 |
| SF-16000 | 1800 GPM | 1.60 PSI | 3.68 |
| SF-18000 | 2600 GPM | 1.30 PSI | 2.99 |
| SF-20000 | 3100 GPM | 1.30 PSI | 2.99 |
| SF-24000 | 4000 GPM | 1.40 PSI | 3.22 |
| ACV-2 | 80 GPM | 0.33 PSI | 0.76 |
| ACV-2.5 | 120 GPM | 0.26 PSI | 0.60 |
| ACV-3 | 180 GPM | 0.19 PSI | 0.44 |
| ACV-4 | 300 GPM | 0.08 PSI | 0.18 |
| ACV-5 | 500 GPM | 0.85 PSI | 1.95 |
| ACV-6 | 650 GPM | 0.90 PSI | 2.07 |
| ACV-8 | 900 GPM | 0.85 PSI | 1.95 |
| ACV-10 | 1200 GPM | 0.90 PSI | 2.07 |
| ACV-12 | 1400 GPM | 0.90 PSI | 2.07 |
| ACV-14 | 3000 GPM | 1.15 PSI | 2.65 |
| ACV-16 | 3800 GPM | 1.20 PSI | 2.76 |
| ACV-18 | 5000 GPM | 1.00 PSI | 2.30 |
| ACV-20 | 6400 GPM | 1.00 PSI | 2.30 |
| ACV-24 | 8000 GPM | 1.10 PSI | 2.53 |

TECHNICAL DATA FOR USE WITH SUPERIOR® INSTALLATIONS

One cubic foot of water = 7.481 gallons

One gallon of water weighs 8.335 pounds

Induced draft towers, evaporative condensers, or economizers typically circulate 3 GPM of water per ton

Natural draft towers typically circulate 4-5 GPM of water per ton

Evaporation rate is approximately 2% of circulating water GPM flow

Bleed-off rate + approx. 2% evaporation + drift (approx. 0.1 to 0.2%) = raw water make-up GPM requirement

Maximum evaporation in boilers is .07 GPM / 4.2 GPH per horsepower

35 lbs. of steam at 212°F evaporating per hour is equivalent to 1 boiler horsepower

33,475 BTU/hr. = 1 boiler horsepower

.07 GPM x HP of boiler = constant speed pump capacity in GPM

.07 GPM x HP x 3 = approximate off and on boiler pump capacity in GPM (always check if possible)

Old type (not package) boilers have 10-12 sq. ft. of heating surface per horsepower

Package type boilers have 3-5 sq. ft. of heating surface per boiler horsepower

Fire tube boilers (old type) can be pulled up to 150% of rated HP; package boilers up to 130% of rated HP

Water tube boilers (old type) can be pulled up to 200% of rated HP; package boiler up to 150% of rated HP

WATER SURFACE TENSION TEST

Water Surface Tension – The ability of small objects with densities greater than the density of a liquid to float on the surface of a liquid due to property of the liquid known as surface tension or resistance of the liquid surface being broken. This surface tension may be explained by reference to intermolecular attraction. A molecule of liquid below the surface, (A-Fig. 1), within the body of the liquid is attracted by equal forces in all directions from the neighboring molecules. A molecule of liquid adjacent to the surface of the liquid, (B-Fig. 1), is attracted toward the body of the liquid below, but experiences negligible forces from the space above the molecule. These unequal attractive forces produce tension in the liquid at the liquid surface resistance to the surface being broken.

EQUIPMENT USED

- 1 Model RT-500 Superior Water Conditioner®
- 2 Beakers
- 1 Dropper
- Red Food Coloring

PROCEDURE

1. A sample of Fort Wayne city water was collected in beaker one. See figure 2.
2. One drop of red food coloring was dropped into this beaker of untreated water.
3. Upon hitting the water surface, the red food coloring spread rapidly, almost as if it “flashed” across the water surface.
4. After this noticeable initial “flashing”, the drop of food coloring filtered down through the water.
5. A sample of Fort Wayne city water was collected and poured through the RT-500 Superior Water Conditioner® into the second beaker. See figure 3.
6. One drop of red food coloring was dropped into this beaker of Superiorized® water.
7. Upon hitting the water surface the drop of food coloring remained intact without the noticeable “flashing” and filtered on down through the water.
8. Steps 5 through 7 were followed for a sample of Fort Wayne city water poured through the RT-500 Superior Water Conditioner®. No change was observed from that occurring in steps 5 through 7.

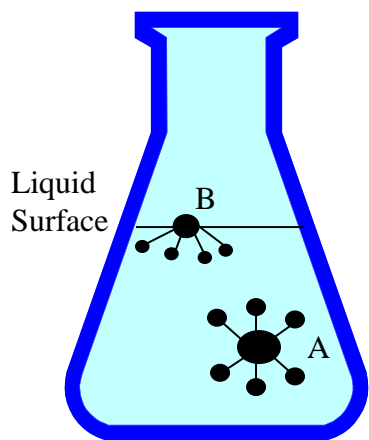


Figure 1

Notice “flashing”
of the food
coloring across the
surface.

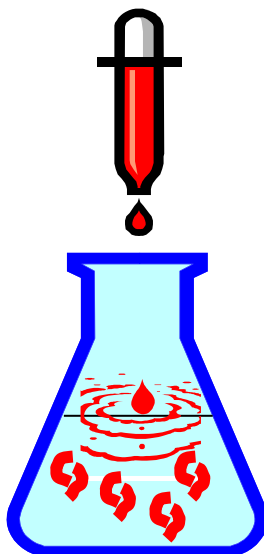


Figure 2, Untreated Water

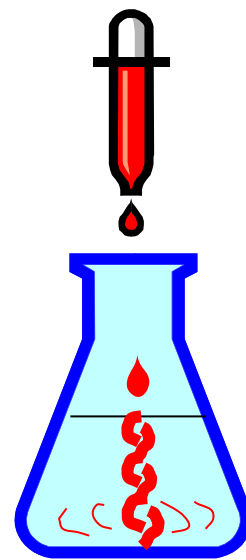


Figure 3, Superiorized® Water

CONCLUSIONS

1. It appears that the untreated offered greater resistance to penetration of the water surface by the drop of food coloring than the Superior Water Conditioner® water. This greater resistance prevented the drop of food coloring from penetrating the water surface as rapidly as in the Superior Water Conditioner®.
2. This resistance to penetration offered by the water surface is known as surface tension. Surface tension may also be thought of as the penetrating ability of liquid. Liquids possessing smaller values of surface tension can more easily penetrate surfaces or material than liquids possessing larger values of surface tension.

NOTE: Water that has a high resistance (surface tension) will provide more dramatic results than water with a low original surface tension. Also, in cases where water has been chlorinated, this could alter the results of the test.

Superior Water Conditioner® Applications (Partial List)

RESIDENTIAL USE

Main Line
Water Heaters (tank and tankless)
Swimming Pools
Dishwashers
Coffee Makers
Ice Makers
Hot Water and Steam Heating Boilers
Solar Applications
Heat Pumps
Open Loop Geothermal Systems
Humidifiers
Shower Heads
Reverse Osmosis
Evaporative Cooling Systems

COMMERCIAL USE

Main Line
Water Heaters
Boilers (hot water or steam for building heat)
Cooling Towers (for comfort cooling)
Mist Cooling Systems
Restaurants – Coffee Makers, Ice Machines,
Dishwashers, Steam Equipment, etc.
Breweries
Vending machines
Drinking Fountains
Distillers
Laundry Facilities
Computer Room Humidifiers
Laboratories
Decorative Water Fountains

INDUSTRIAL USE

Main Line
Cooling Towers (process cooling)
Steam Boilers (process steam)
Steam Generators (process steam)
Vending machines
Drinking Fountains
Electric Furnaces
Heat Pumps
Heat Exchangers
Desalination

AGRICULTURAL USE

Irrigation (drip, spray, flood, etc.)
Fertilizer, Herbicide/Pesticide Sprayers
Greenhouses
Dairies
Livestock Water Feeders
Poultry Water Cups

MEDICAL USE

Autoclave/Sterilization Equipment
Distillers
Water Syringe (Dental)
Cuspidor (Dental)
X-ray Film Rinse
Laboratories
Embalming Equipment