Improving Heat Exchanger Functionality with Quantum Mechanics Technology (QMT) Using the NAWT Collar

Many Facility Managers & Engineers consider Heat Exchangers to be the Industry's Low Hanging Fruit. A great place to convert "Energy Waste" to "Energy Savings"

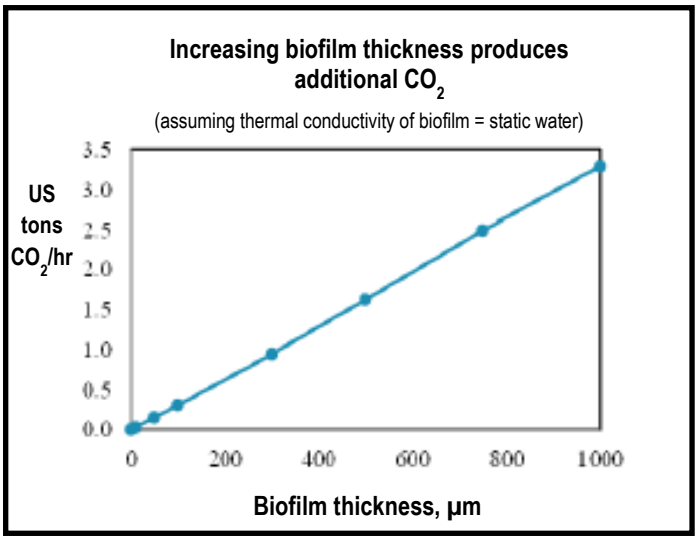
A heat exchanger is a device that is used to transfer heat between a process and a cooling fluid during an industrial application. The term **"thermal management"** best describes the heat exchanger function. Relatively simplistic in design, an HE's operational condition can significantly impact the day-to-day energy consumption of an industrial process and its carbon footprint. Phenomena such as biological fouling (aka, biofilms), calcium carbonate deposits (aka, scaling) and corrosion, cause heat exchangers to increase GHG emissions and energy expenditures.

Heat exchangers are basic devices found in large numbers in all industries, including mining, chemical production, petroleum refining, metallurgical, power generation and large commercial facilities (educational, multi-unit dwellings, manufacturing, warehousing, etc.) Typically rugged, they are over designed to compensate for potential inefficiencies to minimize excessive downtime or diminished functionality. Exchanger parameters to be considered for optimum function are exchanger size, plate surface area and importantly, cooling water flow characteristics. Unfortunately, even though sufficient design margins are anticipated, certain conditions, such as cooling water fouling (as seen in figure1), can result in increased energy draw and thus excessive GHG. The results of this degrading functionality are expressed through reduced heat transference and increased back pressure within the cooling water system.

For a heat exchanger to function efficiently, it requires clean heat transfer surfaces and unimpeded cooling water flow. Fouling occurs when contaminants within the cooling water adhere and solidify on heat transfer surfaces and in flow spaces. This condition begins immediately after a clean heat exchanger is brought online. Although not immediately apparent, as formations increase in density or dimension, there is an ever-decreasing function expressed by the exchanger. Each exchanger requires a specified cooling water volume, speed, and pressure to ensure heat extraction. This is not achieved if there is impeded flow space or misdirection away from heat transfer surfaces.

Obstructions reduce flow volume which causes increased back pressure across the exchanger. Furthermore, on heat transfer surfaces, the biofilms and scaling function as thermal insulators, reducing the transfer of heat from one fluid to another. Sensors will demand greater water flow from the cooling water pump as a response to a temperature and pressure rise. To compensate, the pump increases water output necessitating increased amperage draw. This increased energy is typically from a source that uses fossil fuel combustion for electrical energy production, ergo the need for more fossil fuels, and their negative impact on our environment. Even a small, incremental rise in pump demand due to foul formation can often translate to measurable increases in GHG generation (see Graph). There is an ever-increasing decline in

function (and corresponding increase in energy draw) that continues until an acute condition, such as total malfunction, requires an emergency disassembly. Unfortunately, due to the importance of a heat exchanger within a process system, they are not readily taken offline to clean, and are typically tolerated until and when an issue arises.



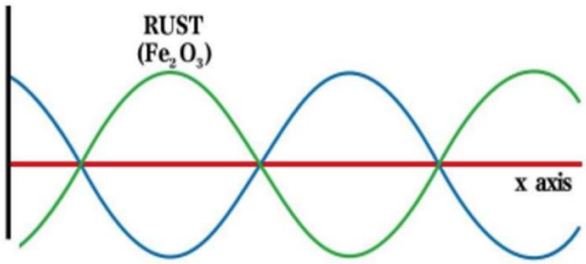
The above graph is from one of the many papers that have indicated the relationship between heat exchanger fouling and its environmental impact [3,4]. The paper concluded the following: *"...the presence of unwanted deposits on heat transfer surfaces in power station steam condensers can increase the discharge of greenhouse gases. The extent of the increase is of course dependent upon the thickness of the deposit. The loss of heat recovery and the additional energy for pumping represent a loss of thermal efficiency. When fuel combustion supplies energy, additional greenhouse gas emission will result."*

Technical Edification of Quantum Mechanics used to Improve Heat Exchanger Functionality:

A NAWT Collar water treatment device uses quantum technology, an emerging, yet proven technology, to keep heat exchangers and other industrial equipment operating at peak efficiency. The NAWT Collar uses specially modulated ultra-fine waves, stably stored on a silicon-aluminum material by utilizing laser injection technology. The NAWT Collar continuously emits pre-recorded ultra-fine vibration waves, interfering with the material waves of various substances (biofilms, iron oxide, calcium carbonate et al.) that results in a coordinated resonance reaction. This in turn causes physical changes by eliminating forming, bonding and sedimentation. The microscopic appearance of the substances will exist in the form of particles which will be flushed away by the circulating water. They will not accumulate on the heat exchanger plates or tubing. Any fouling or bonding that does exist will be broken down and flushed out as suspended solids or in solution.

The NAWT Collar water treatment products use quantum mechanics technology. This technology is the latest generation of environmentally friendly water treatment. It uses specially modulated electromagnetic waves to interact with a dielectric material made of a special alloy composed of silicon and aluminum. It stably stores ultra-fine vibration waves on the dielectric material by utilizing laser injection technology. The dielectric material will continuously emit pre-recorded ultra-fine vibration waves, changing the material waves of various substances in the medium. This will result in a coordinated resonance reaction, causing physical changes, thereby changing existence (no formation on the walls of the pipes, no bonding, and no sedimentation). The macroscopic appearance is calcium carbonate and iron oxide, which exist in the form of particles. These flow away with the circulating water without accumulating on the pipe wall. Organic matter such as bacteria and algae will die in the shock wave environment, achieving the function of inhibiting bacteria and algae.

Example Number 1: Interference Effects on Rust

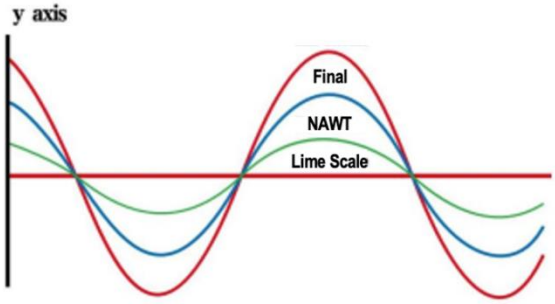


The green wave is the matter wave of rust molecules

The blue wave is the oscillating wave of NAWT Collar

The red line is the result of the final superposition of green and blue waves, changing the physical properties of rust

Example Number 2: Superimposed Effects on Lime Scale



The green wave is the matter wave of the lime scale

The blue wave is the oscillating wave of the NAWT Collar

The red wave is the superposition of blue wave and green wave, indicating that the material wave of the lime scale has changed under the action of the oscillating wave. The result is changes in the physical properties of lime scale.

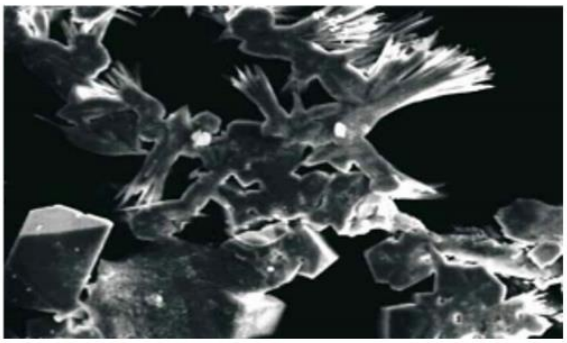
Mechanism of Action

Scale Inhibition & Removal

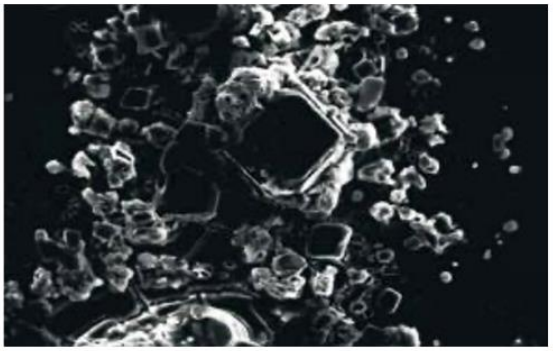
There are a large number of soluble salts in the circulating water system, mainly $Ca(HCO_3)2$. As water temperature and other conditions change, unstable calcium bicarbonate decomposes into the inorganic compound calcium carbonate (CaCO3), which is extremely insoluble in water. A single calcium carbonate molecule which has a weak charge polarity on a microscopic level, and is easily affected by water or other charged substances, will aggregate and grow into flaky or even massive mixed crystal structures on the pipe wall or heat exchanger plate.

These mixed crystals are arranged in a staggered pattern to form an extremely strong scale layer that requires the use of chemical acids or high-energy physical impact to peel it off. Under the influence of a NAWT Collar, single or small clusters of calcium carbonate molecular crystals in the aqueous solution are disrupted by the cooperative resonance effect of ultra-fine vibration waves. The microstructure of calcium carbonate crystals changes from a needle-like structure that is easily cross-bonded to a spherical or small granular structure, with a smoother appearance. That is, scale appears as loose small particles that no longer adhere to the inner wall of equipment or pipes. It settles in the form of soft floc at the bottom of the container in still water, and is eventually carried away by the water flow.

When the calcium ion concentration reaches 400 mg/L and the pH value exceeds 11, it still shows good anti-scaling effect.



Lime deposits in untreated water.
Magnification: 250x



Lime deposits in water treated with OMT Collar.
Magnification: 250x

Corrosion Prevention & Inhibition

During the operation of the industrial circulation cooling process, there is a layer of metal oxide on the surface of the equipment and pipes.

The ultra-fine vibration waves generated by products using quantum mechanics technology can react on iron atoms on the metal surface and oxygen atoms in the water. This causes the iron atoms and oxygen atoms to be directionally combined to form a Fe3O4 film that acts on the inner wall of the pipeline; thereby isolating the erosion of corrosion factors. This oxide film is denser and has better corrosion inhibition performance when subjected to high-chlorine corrosive water.

Bacteria & Algae

The NAWT Collar continuously releases ultra-fine vibration waves similar to biological signals into the water. After the water environment is affected, it destroys biofilms, the nutritional source of bacteria and algae, making them unable to survive. At the same time, under the action of ultra-fine vibration waves, bacteria and other pathogen fragments are disintegrated. The biofilm loses viscosity, is dispersed in the water, and finally discharged through the sewage system.

BENEFITS OF NAWT COLLAR IN HEAT EXCHANGERS

> NO MAINTENANCE REQUIRED

Other types of mechanical systems used to mitigate biofouling & scaling in heat exchangers require additional equipment -- equipment that requires maintenance, ergo additional costs. The NAWT Collar requires no maintenance. The human element is removed. Install it & forget it!

> NO ENERGY SOURCE REQUIRED

Nanobubbles, UV, and Magnets require a power source. This increases electricity costs and increases installation costs.

>NO CHEMICALS NEEDED

The NAWT Collar eliminates the costs of procuring, handling, and disposing of chemicals (and their containers), and special handling equipment. It keeps the chemicals out of the environment. The Collar removes *100%* of biofilms – something chemicals *cannot* do!

> EASY, NON - INVASIVE INSTALLATION

NO cutting pipes, NO installing flanges, NO welding. Only two bolts that need tightening with only one tool, an Allen wrench. NO lost production and NO downtime for equipment.

Depending on size, it should not take longer than 30 minutes to install. No special skills required. NO footprint needed -- it installs on the OD of an existing pipe.

> ADVANCED SOLID-STATE TECHNOLOGY

Activated upon installation. Useful life of over 10 years. Not affected by ambient conditions. Heat, cold, water spray, high humidity, high temperature, VOC's, will not affect performance.

> EXTENDS LIFE OF SERVICE EQUIPMENT

Inhibits & removes scale so cooling water flows unimpeded. NO increase in pump motor speed or amperage draw. Keeps valves fully operational and cuts corrosion in piping systems.

> SAVES ENERGY

NO energy source is required. NO increased energy required to overcome flow impediments. Reduces system operating cost.

For decades, industry has borne the financial expense and challenges presented by heat exchanger fouling because of the difficulty of remediation or prevention. It was understood that there was a fiscal impact of maintenance, repair, excessive energy, and loss of process which could reach .25% of an industrialized country's GNP due to fouling [5]. These challenges were tolerated since the results of these inefficiencies were only felt by the facility. It was the advent of climate change and an understanding that each malfunctioning heat exchanger offers a compounding impact on environmental global events. It is now universally accepted that there is a need to reduce GHG expression from industrial process systems by utilizing a sustained method to prevent fouling in heat exchangers.

About the Author

Robert B. Bender BS, MBA, MPTD has been introducing emerging technologies to corporate America for over half a century. His clients include Ford Motor Company, General Motors, Anheuser-Busch, National Grid, Brookhaven National Labs, Department of Environmental Protection - New York City, US Steel, Bethlehem Steel, Lever Brothers, AMTRAK, Long Island Railroad et.al. Mr. Bender's creative problem-solving skills at all corporate levels have resulted in much lower costs for the maintenance, operating and procurement corporate functions. He has made it his life's quest to remove toxic chemicals from the environment. Mr. Bender sits on the executive boards for DPCC, LIMBA, and AFE (Association for Facilities Engineering), and is President of the Long Island, NY Chapter of AFE since 2007.

Acknowledgments:

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5. Müller Steinhagen H, Malayeri MR, Watkinson AP (2005) Fouling of Heat Exchangers-New Approaches to Solve an Old Problem. Heat Transfer Engineering 26: 1-4.
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