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MAXWELL..

A revolutionary cooling solution for the challenges of a warming planet

Insynch Energy Services

Agent, Installer and Distributor
Maxwell Heat Transfer Fluids for Increased Energy Efficiency

All Enquiries: info@insynchenergy.co.uk

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Value Proposition

The Problem

- Energy requirements for cooling applications are growing exponentially and demand for air-conditioning is projected to triple by 2050
- Current hydronic cooling and heating systems use conventional fluids, such as water and glycol almost exclusively for heat transfer
- Improving thermal conductivity is key to increasing heat transfer and reducing energy consumption and carbon emissions
- Other energy conservation measures involve costly upgrades or disruptive system shutdowns

The Solution – Maxwell™

- Maxwell™ is a patented, innovative nanofluid additive for improving heat transfer
- **Proven 15% + increase** in thermal energy transfer, reducing energy costs and carbon emissions
- **Applicable to any closed loop hydronic system** (Chillers, Heat Pumps, Energy Recovery Units)
- Simple drop-in additive at **only 2% of total system fluid volume.**
- **Delivers immediate results** - does not require any special retrofitting of existing systems
- **Useful life of 10+ years** w/ minimal maintenance
- Depending on the application and utilization rates of equipment, **typical payback in 1 to 3 years**

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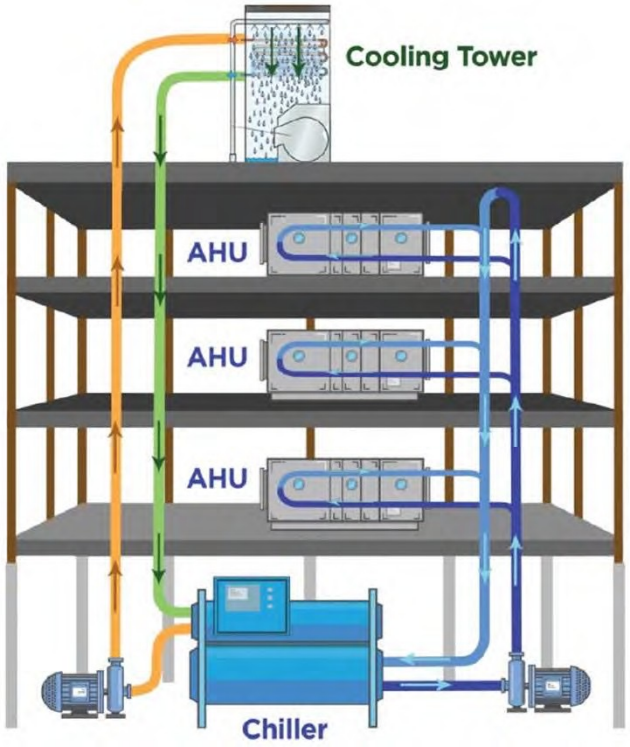
How Maxwell™ Works in a Typical Chilled Water System



- Water (or a water/glycol mix) is circulated from the chiller in a closed evaporator loop (blue) to air handling units (AHU). Maxwell™ can also be used in a closed condenser circuit with a closed cooling tower.
- Maxwell™ increases the transfer of heat in the chiller evaporation cycle, reducing compressor "lift" or work
- Maxwell™ also increases thermal energy transfer in the AHU coils, satisfying room setpoints more quickly, requiring less chilled water and reducing pump energy

Maxwell™ - Applications and Industries

Applications

- **Heat Pumps:** Maxwell™ increases the heat transfer from the outside air or condenser fluid to the system fluid through the coil. The increase in heat transfer reduces compressor lift or work by 15%+.
- **Chillers:** Maxwell ™ when added to a system's base fluid increases heat transfer in the evaporator by 15%+, reducing compressor lift and electrical energy consumption. Maxwell™ can also be used in a closed condenser circuit with a closed cooling tower.
- **Energy Recovery Systems:** Maxwell™ when added to the runaround loop increases heat transfer at the exhaust fan recovery coil, and air handler pre-heat/cool coil, by 15%+. This reduces demand for chilled and hot water and can often allow the fluid pump to run on lower flow rate / power.
- **Pumps, Fans and Terminal Units:** Maxwell™ increases thermal energy transfer throughout the hydronic system. Fan coil and air handling units, system pumps and supply fans can operate on lower power without compromising comfort.

Typical Industries

Commercial buildings
Residential buildings
Data centers
Healthcare
Manufacturing - process cooling
Food & Beverage - process cooling

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Industry Partners

- Energy recovery units (ERU) for air handlers and exhaust fans in two research buildings. Active trial site since March 2020.

UNIVERSITÀ DEL SALENTO

- **University of Salento, Italy:** Air-to-water heat pumps serving an office building. Active trial site since January 2020.

Johnson & Johnson

- **Johnson & Johnson, Irving, Texas:** Two chillers serving multiple air handling units in a manufacturing facility. Active trial site since October 2021.

aramco

- **Saudi Aramco, Dhahran, Saudi Arabia:** Two chillers serving individual fan coil units cooling in a mid-rise mixed-use building at Aramco's manufacturing and research campus. Active trial site since September 2021.

(*) These companies and institutions are participating with pilot installations in Europe and the U.S

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Business Opportunity

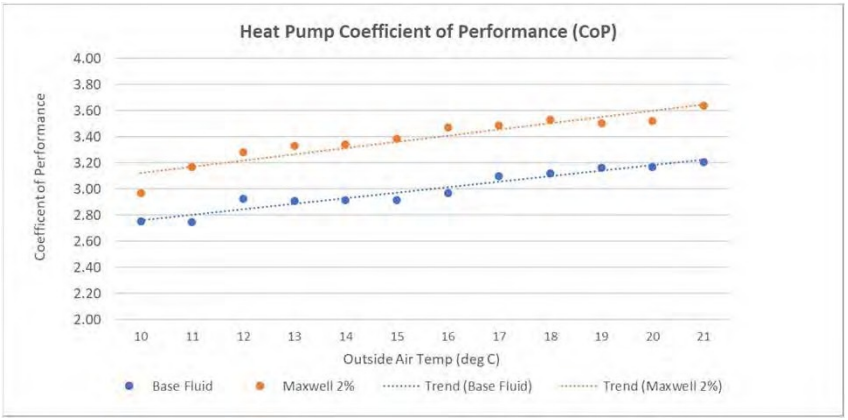
- We believe this is an opportunity for our industry partners to become adopters of the **next generation heat transfer fluid** with minimal cost and with limited risk
- Maxwell™ **increases the efficiency of heat transfer throughout mechanical systems by 15% or more**, lowering energy consumption and reducing carbon emissions and enhancing system operating capacities.
- **Payback periods are generally 1 to 3 years**, depending on system utilization and energy rates
- Maxwell™ can **extend HVAC equipment useful life** and reduce maintenance costs due to reduced compressor run times
- Maxwell ™ is an additive to water or water/glycol thermal systems at only a 2% by volume concentration
- **Maxwell™ is proven to be safe** for installation, operation, removal and disposal and with no negative impact on equipment or the environment
- Based on suitability and timing, HTMS will provide industry partners with both our product, installation services and performance monitoring at no cost to host sites. In addition, a comprehensive performance report will be furnished at the end of the test period (generally three months).

Performance Results - Heat Pump

UNIVERSITY OF SALENTO - Office Building, Lecce, Italy

- Single air-to-water rooftop heat pump serves individual fan coils throughout a 10,000 square foot office building.
- Maxwell™ was added to the fluid loop to improve the heat pump's Coefficient of Performance (COP) and its Energy Efficiency, which directly correlates to a reduction in energy consumption.
- Maxwell™ also increased heat transfer at the zone fan coil units allowing thermostats to reach setpoints more quickly.

PERFORMANCE RESULTS



The above chart shows the COP of the Heat Pump with the base fluid pre-Maxwell (blue) and after Maxwell was added (orange).

COP increase of 15.05 %

Energy Efficiency increase of 12.10 %.

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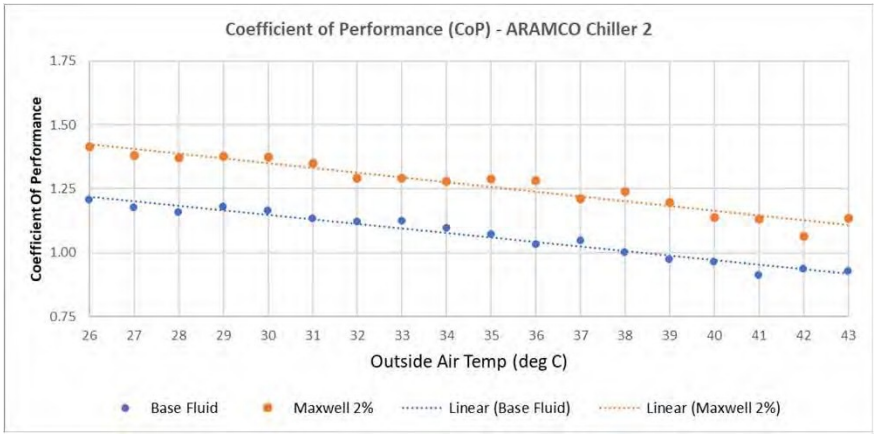
Performance Results - Chiller

ARAMCO – Mixed-Use Building 1900, Dharan, Saudi Arabia

- Twin Carrier air-cooled chillers serve individual fan coil units throughout a 10,000 sq foot mixed-use building.
- Maxwell™ was added to the fluid loop to improve the chiller's Coefficient of Performance (COP) and the system's Energy Efficiency (EE) which directly correlates to a reduction in energy consumption.
- Maxwell™ also increased the heat transfer rate in the fan coil units allowing thermostats to reach setpoints more quickly.

PERFORMANCE RESULTS



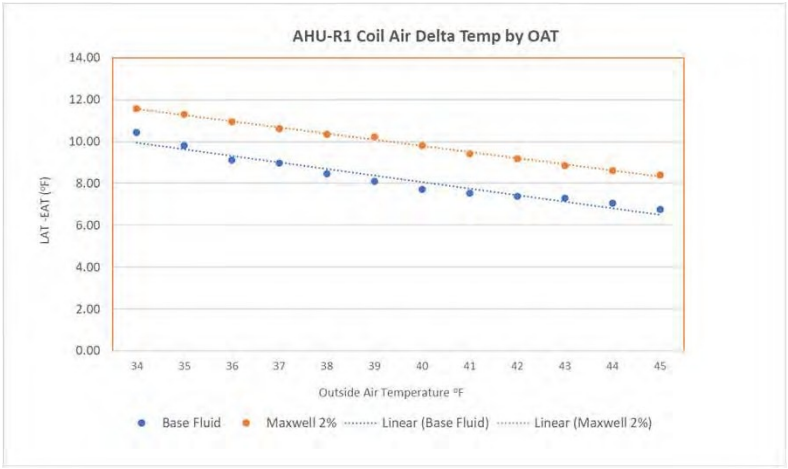
The above chart shows the COP of a single Chiller with the base fluid pre- Maxwell (blue) and after Maxwell was added (orange). This includes the system's circulating pump.

COP increase of 16.20%
Energy Efficiency increase of 13.16%.

Performance Results - Energy Recovery Unit

- Two energy recovery units and multiple air handling units provide 100% outside air to several laboratories, operating 24/7/365 in two separate buildings.
- Maxwell™ was added to the runaround loop to increase heat transfer at the recovery coils at the exhaust fans and air handling units. The improvement in heat transfer allowed for a lower fluid flow rate, reducing both the circulating pump power and annual electrical energy consumption by 10%.

PERFORMANCE RESULTS



The above chart shows the difference between leaving and entering air temperatures (LAT – EAT) across the supply air preheat coil during the baseline period (blue) compared to the increased temperature differential (orange) achieved after Maxwell was installed in the runaround loop fluid.

Increase in fluid to air heat transfer of 21.5%

Reduction in pumping power by 10.2%

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MAXWELL™ | Appendix

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Typical Properties of Maxwell™

- Maxwell™ is a patented engineered suspension of submicron aluminum oxide (Al_2O_3) particles in a base fluid, either water (W) or water with propylene glycol (PG)
- Maxwell™ is proven safe for all typical components and materials in mechanical systems. See appendix for corrosion tests

Maxwell™ (@2% of system volume)	
Composition (by weight)	
Performance additives	9%
Water	91%
Colour	White
Odour	Odourless
pH	10
Density @20(°C) (kg/m^3)	1058
Operating Range (°C)	0 to 180
Freeze Point (°C)	0
Burst Point (°C)	0
Boiling Point (°C)	100
Flash Point (°C)	na

**Typical properties for Maxwell™, not to be construed as specifications. Complete product specifications are available on request.*

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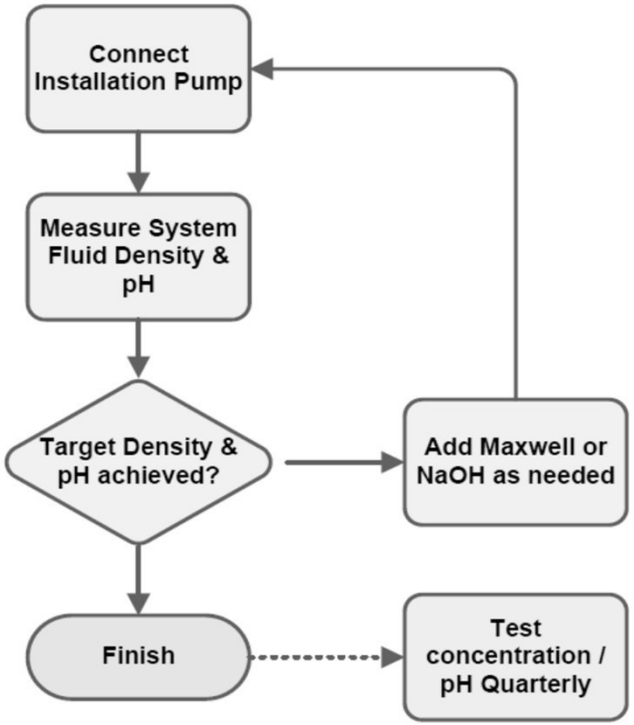
Key Technical Data for Maxwell™

The table below shows the Saturation Properties of Maxwell™ at various temperatures compared to Water.

	[illegible]				[illegible]			
Temp.	***Therm. Cond.***	***Specific Heat***	***Density***	***Viscosity***	***Therm. Cond.***	***Specific Heat***	***Density***	***Viscosity***
oc	W/mK	kj/kg K	kg/m ^{3}	mPa-s	W/mK	kj/kg K	kg/m ^{3}	mPa-s
10	0.637	4.09	1061	1.32	0.580	4.19	1000	1.31
20	0.648	4.08	1058	1.05	0.598	4.18	998	0.98
40	0.679	4.07	1050	0.71	0.630	4.18	992	0.62
65	0.718	4.08	1038	0.46	0.659	4.19	980	0.43

Maxwell™ Installation Process

- The installation process starts with the testing of the existing system's base fluid (i.e. water / glycol), inspection of pumps and pump seals and a general review of system design and operating set-up.
- Once the tests and inspections are completed and any operating or mechanical issues resolved, the installation process is accomplished by pumping Maxwell™ (in concentrate) directly into the hydronic system. Regular samples of fluid density and pH are taken during the pumping process until the target levels of 2% Maxwell (by volume) concentration and pH of 10-10.5 are achieved.
- System installations of 5,000 gallon or less can be completed in one 8 hour day.
- Generally no system shut down is required for an installation.
- Separate tanks are used to receive fluid displacement (estimated at 13-15% of total system fluid).



(*) Please refer to the Operating Guide for full details on installation

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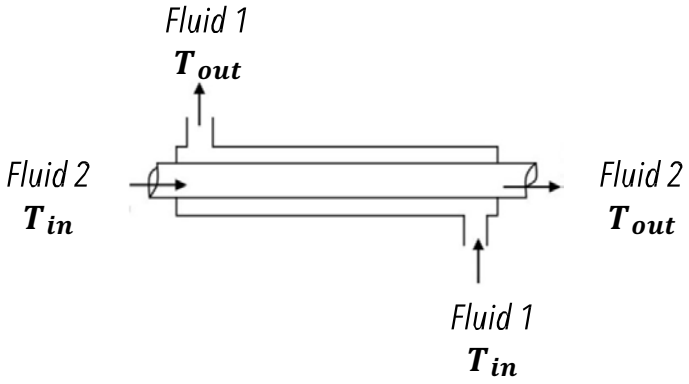
Technology | General Heat Transfer Equation for Thermal Systems

$$Q[kW] = hA(T_s - T_f) = [mc_p(T_{out} - T_{in})]_1 = [mc_p(T_{out} - T_{in})]_2$$



Counter-flow heat exchanger schematic

where:

Q [kW] = heat transfer

h = convective heat transfer co-efficient, proportional to thermal conductivity

A = surface area of the heat exchanger

Ts = average surface temperature of the heat exchanger walls

Tf = average fluid temperature within the heat exchanger

 = mass flow rate

Cp = specific heat capacity

1 & 2 = fluid 1 and 2 respectively

By increasing the heat transfer coefficient (h) and mass flow rates ( ), Maxwell™ decreases the temperature differences ($T_s - T_f$ and $(T_{out} - T_{in})$ for fluids in the heat exchange process.

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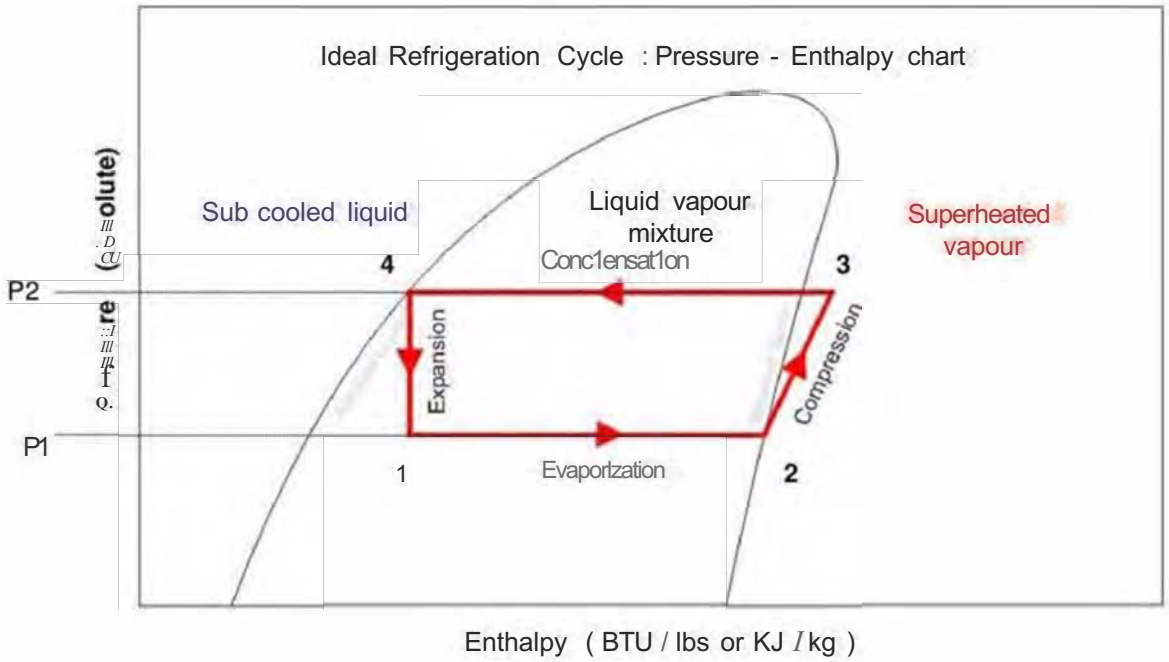
Technology I Heat transfer in Chillers and Heat Pumps

The use of Maxwell™ in a system's base fluid reduces the approach temperatures during the heat exchange phases corresponding to transformations 1 - 2 and 3 - 4 (for a heat pump} shown below, resulting in a reduced pressure differential P2 - P1. Reduced pressure differential decreases compressor runs times and related energy consumption and equipment maintenance.



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Corrosion Test Results

- Maxwell™ has been tested using ASTM guidelines for the metals and synthetic materials that are commonly used in heat transfer systems.
- Maxwell ™ is evenly dispersed in the system fluid, does not cause corrosion, clogging, or abrasion, and has minimal effect on viscosity with its low concentration.
- Maxwell ™ has been installed in hydronic systems with continuous operation for thousands of hours and with no detrimental effect on pumps or associated equipment.

Metal	D.I. Water	MAXWELL 2020® W
Solder	3.10	0.01
Aluminum	13.2	0.01
Copper	0.08	0.01
Brass	0.22	0.01
Greycast Iron	21.1	0.02
Carbon Steel	9.69	0.01

*Based on corrosion tests ASTM D1384, in mils per year (mpy).

Synthetic	D.I. Water	MAXWELL 2020® W
EPDM	0.0000061	0.0000057
VMQ	0.0000037	0.0000033
FKM	0.0000020	0.0000019
AEM	0.0000312	0.0000241
CR	0.0000125	0.0000104
HNBR	0.0000015	0.0000015

*Based on corrosion tests ASTM D471, in mils per year (mpy).

For more information

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