Liquid **Innovation**

Special Feature

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MicroHeat Technologies

Australian owned technology developer MicroHeat Technologies, has created a new and innovative type of instantaneous water heater. The Continuous Flow Electric Water Heater (CFEWH) directly energises 'conductive' fluids (such as water or glycol) by making the fluid a 'connecting wire' between energised plates. This means the desired fluid can be heated in a controlled, energy-efficient and instantaneous manner, without the need for overheated elements, or the risk of boiling dry.

Rapid heating of substances is desirable in a range of fields, including residential and commercial buildings, automotive, marine, aeronautical and aerospace applications.

MicroHeat
Hot water just got smarter

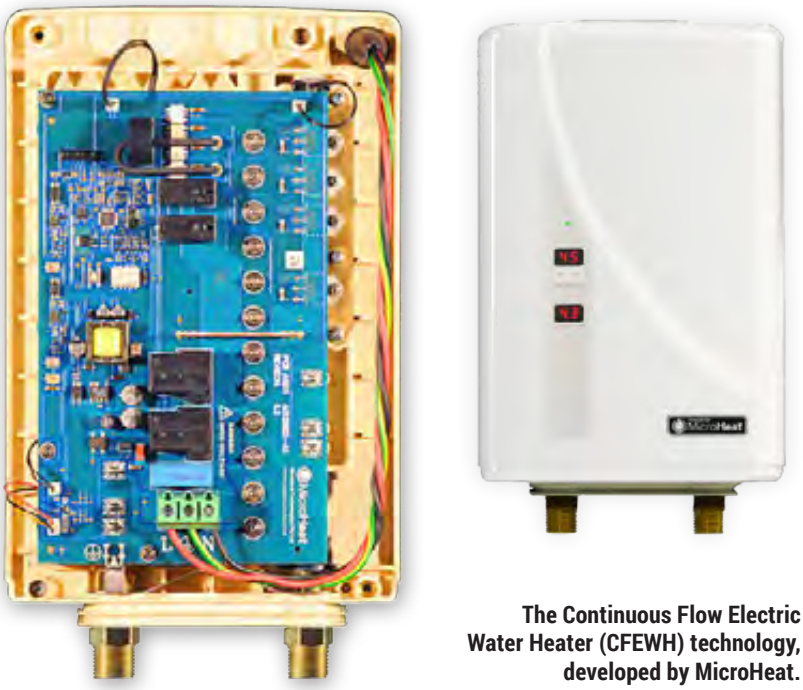
Setting the Scene

In Australia, water heating products are the second largest users of energy out of all household appliances, using 23% of household energy, according to the Australian Bureau of Statistics (ABS), 2010. Energy consumed for water heating is the second largest source of household greenhouse emissions in Australia, emitting 24% of greenhouse gases in the average Australian household.

Another ABS study (2007) showed that in Perth, Western Australia, half (50%) of the water heating systems in households were storage systems and half (48%) were instantaneous systems.

Storage water heaters have the advantage of heating using energy (gas, electricity or other) at a relatively slow rate, storing the heat for later use. Storage water heater systems are generally considered to be energy inefficient as they operate on the principle of storing and heating water to a predetermined temperature greater than the temperature required for usage. Over time, the water inside the tank cools down, and thermal energy is lost, activating the heating system to heat the water back up. Ultimately, a consumer may not require hot water for some considerable period of time.

Instantaneous, or tankless water heaters, conquer many of the disadvantages experienced with storage systems, through heating water on demand. There is no storage of water. Instant hot water systems currently use natural gas, LPG or electricity as the energy source. Gaseous water heaters are common due to the lower cost and high availability of the fuel, especially for commercial and residential buildings. However, with gas prices predicted to rise, and a growing concern for the environmental effect of such a fuel, electrical instant water heaters are moving into the spotlight.



The Continuous Flow Electric Water Heater (CFEWH) technology, developed by MicroHeat.

The predominant technology incorporated into electrical instantaneous hot water systems, includes “hot wire” or “bare element” technology. The hot wire or bare element instantaneous hot water system have the wire, or heating element located inside a tube of a relatively small diameter, a voltage is applied to the wire and the water passing through the tube is heated by coming into contact with the heated wire, element until the temperature of the water reaches the desired, predetermined temperature setting.

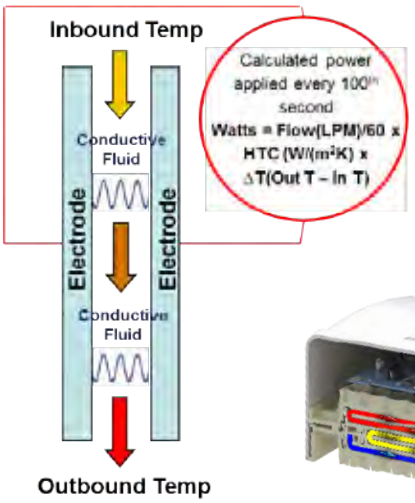
While this type of system avoids the energy inefficiencies involved with the storage of hot water, being a thermal transfer (heat exchange) technology it suffers a number of other disadvantages. In particular, the wire is heated to temperatures much greater than that of the surrounding water. Not only is this energy inefficient, but hot areas of the wire will scale. Scaling has the potential to deposit crystals of dissolved salts naturally present in varying concentrations in water, such as calcium carbonate and calcium sulphate, on the wire. The wire becomes “caked” and thus reduces the efficiency of thermal transfer from the wire. Since the tube housing the wire is generally small in diameter, the caking can also reduce the flow of water through the tube.

Safety Concerns

As mentioned, all instantaneous water heaters,that are either gas or electrically powered, use traditional Heat Exchange Technologies, where heat exchange temperature can vary in temperature anywhere between 300°C to more than 600°C, which is well above the temperature of the water being heated. This raises the issue of user safety.

Scalding is a serious concern with traditional water heaters because of this necessity to have the heat exchanger/heating elements

operate at such high temperatures. As research from the American Society of Plumbing Engineers shows, human skin burns more quickly at high temperature, in less than 5 seconds at 60 °C; older people and children often receive serious scalds due to disabilities or slow reaction times. Scalding from water heaters is particularly prevalent in environments that cater for the elderly and the very young. Scalding can occur when using hand washing showering or bathroom facilities found in health or hospitality workplaces, where water can be delivered far above the recognized applicable water temperature.



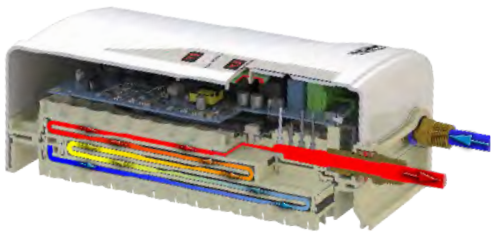


Figure 1. The incoming cold fluid flows through a set of robust, inert electrode plates. The technology exploits the electrically conductive properties of fluid (e.g. water, glycol), allowing the fluid to be "directly energised" and thus heating it to the desired temperature.

A common solution is to install a tempering or thermostatic mixing valve on the outlet of the water heater. This additional component mixes enough cold water with the hot water from the heater to keep the outgoing water temperature fixed. AS/NZS 3500.4 Section 1.9 deals specifically with this concern.

Creating a Safe, Efficient & Controlled Water Heater

The disadvantages with instantaneous water heating systems, as well as the gap in the water heating market for an efficient electrical instant system, provides the opportunity for a controlled, efficient and safe water heater to be developed.

The solution lies in technology that uses electrical power to directly energise a fluid, by using the fluid as the 'connecting wire' between electrically energised electrodes. This heating technology exploits the electrically conductive properties of fluids that allow the fluid to be directly energised. Directly energising a fluid electrically causes the fluid to heat up – this is "Direct Energy Transfer" – heating of the fluid without the use of a heat exchange (heating elements), rather passing energy directly to the fluid using a set of robust, inert electrodes.

Directly energising 'conductive' fluids (e.g. water, glycol) in a controllable manner provides an energy-efficient and highly effective means of fluid heating. The diagram in Figure 1 provides a simple representation of how the technology works.

The technology, labelled as a Continuous Flow Electric Water Heater (CFEWH) accurately calculates the exact amount of electrical energy that needs to be supplied to heat the water, by emulating the Thermal Heat Equation. Sensing devices monitored by a microprocessor every 100th of a second, controls the temperature to within one degree to avoid energy and water waste and ensure controlled and safe heating. This applies to all low and high flow CFEWH product configurations.

Using Electrodes to transfer the energy into the water stream, means that the electrical energy is applied directly to the water which will heat up as a result – no heat transfer is required. This technology results in the electrodes being the same temperature as the water being heated and hence does not cause them to scale or to suffer stress corrosion that heat exchangers (electric heating elements - either bare or sheathed) do today.

There is no heating element burn out with the MicroHeat technology; which is a common failure in water heaters that use heating elements. This occurs, when there is no or insufficient water in the system. Additionally, traditional water heaters using heat exchange technology suffer thermal inertia, or sluggish response to changes in the amount of energy being applied. This will occur where the heating element temperature required is much hotter than the water being heated, or much colder than the water temperature required resulting in further temperature instability.

This new electrode technology also lends itself to new ways to design and manufacture water heaters. The electrodes, which will always be at the same temperature as the water, eliminate the need

A space and weight efficient fluid heater prototype. Designed for heating water or glycol circuits for automotive, marine and aerospace applications.

for thermal shields - the high temperature plastics and metal casings that are required in water heaters that use traditional electric heating element technologies.

The CFEWH product has a compact footprint that does not generate heat, ensures 99.9% energy transfer efficiency, and accommodates a quick and easy installation at the hot water point of use. Almost zero energy (typically half a Watt) is used in standby mode when heated water is not needed.

The CFEWH product ranges are supplied to consumer, commercial and industrial markets for delivery of heated water for human consumption, across all hot water uses. This includes residential buildings/units, commercial builds as well as for boosting existing, remotely installed hot water services.

Further Applications

Rapid heating of substances is desirable in a range of fields, including automotive, marine, aeronautical and aerospace. For instance battery performance in cold climates is an ongoing concern for hybrid electric vehicles. It is therefore necessary to warm up the batteries in hybrid vehicles in order to achieve acceptable power and energy performance from the batteries. In an especially cold environment, both the battery and the hybrid vehicle's engine are cold. To avoid sluggish engine performance, it is desirable to preheat the engine block. In other situations it is the air in a compartment of the vehicle which requires heating for the comfort of passengers.

A heater core or heat exchange system is typically used in heating fluids or gases. As an example, heated engine coolant, heated by a vehicle's engine, is passed through a heat exchanger of a heater core installed in the vehicle. Air is forced past the heat exchanger by a fan and receives heat from the heat exchanger that is heated by the engine coolant. The heated air is then directed into the passenger compartment for the comfort of occupants, or may be directed to the windscreen for demisting or de-icing.

MicroHeat Technologies is preparing to target global vehicle makers across all drive segments from combustion, hybrid and electric vehicles with a ground-breaking water and glycol fluid heater module, that does not need heated engine coolant and can provide instantaneous heat at 99.9% energy efficiency in a device not much bigger than a mobile phone.

Apart from its thermal efficiency and low weight, the MicroHeat heater is much more compact than conventional heater modules, the compactness is due to the advantages of using the direct energy transfer method and the conductive fluid over the existing well established, heat exchange technologies. The MicroHeat heater does not use heat exchange technology, which all but eliminates the dangerous probability of heating unit burn out.

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