Heat Transfer Fluids

Arteco builds on a heritage of technology, creativity and expertise to develop and market its products in various applications to enable **controlled heating or cooling** in industrial production processes and applications. Arteco introduced state-of-the-art long-life corrosion technology in the industry meeting specific customer needs.

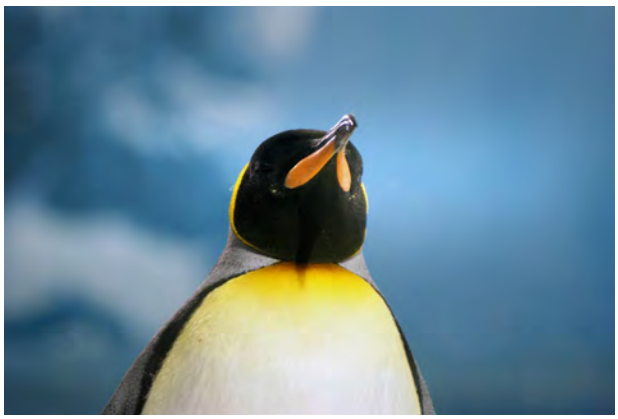
Based on the individual characteristics of the different products in our product range, the **heat transfer fluids** (HTF) can be used to its full potential in certain applications.

There are many applications that require **heating or cooling**, ranging from low-temperature applications such as ice rinks, flushing fluid in industrial installations and various applications in the pharmaceutical, food & beverage industry where consumer safety requires the use of an MPG-based fluid.

Heat Transfer Fluids Applications Guide

The most common applications for our products are listed in this document. Please do not hesitate to contact your local sales area manager for advice for any application that is not mentioned.

- Ice rinks & sports applications
  e.g. football stadion ground heating
- Gas liquefaction
- Ground freezing
- Leak detection
- Solar heating systems
- Reactor heating & cooling
- Air conditioning & water-based heating systems
- Heat pump systems
- Indirect coolings systems / Secondary refrigeration
- Indirect contact freezing
- Industrial cooling



Applications are limited only by our imagination

Ice rinks & sports applications

Ice skating, hockey and indoor skiing thanks to heat transfer fluids

Ice skating, hockey and indoor skiing are growing in popularity, with disciplines including figure skating and speed skating to name a few. Around Christmas, towns set up their temporary ice rinks. Although these temporary ice rinks are set up outdoors, the surrounding temperature is not cold enough to guarantee continuous freezing.

Ice rinks are a typical example of **secondary cooling**. The primary refrigerant does not cool the ice directly. Instead *cold is transported via the heat transfer fluid* in the secondary loop. This fluid is pumped through a network of pipes underneath the ice and guarantees cooling. The process of ice formation is very complex. Many different layers of ice, some thinner than 1mm, form the final skating surface. When an ice surface is built, chillers cool the heat transfer fluid which is pumped through the pipes. These pipes are commonly made from steel, aluminium or plastic. Deionised water is sprayed onto this network of pipes, and the water starts to freeze when it comes into contact with the cold pipes.

Other sports facilities that want to **prevent snow and ice**, for example very large football stadiums use *a network of pipes filled with heat transfer fluid*. This prevents the cold from damaging the grass.

References:
- Olympic Icering Sochi (Russia)
- Icering Heerenveen (The Netherlands)
- Bobsleigh Piste La Plagne (France)
- Leppävirta Ice Skating Rink(Finland)

Recommended product:
- 35-40% Zitrec® M
- Zitrec® L
- Freezium™ -15°C

Gas liquefaction

Turning a gas into a liquid state

Most gases can be turned into a liquid state by **cooling them down at atmospheric pressure**. However, some gases require pressurization as well. This gas liquefaction requires the **removal of latent heat** in a condenser using a heat transfer medium.

Typical examples:
Liquefaction of gases may be used for storage (e.g. LPG), transportation, refrigeration, air conditioning or cryosurgery (e.g. liquid nitrogen) purposes. Also Hydrogen fuel stations as upcoming trend.

Recommended product:
- Freezium™ -60°C

Ground freezing

Using heat transfer fluids to stabilise the ground

Ground freezing is not a new technology. A cold medium is circulated through a suitable pipe system, which **cools the soil** and thus **converts the in-situ water to ice**. Brines are mostly used as a cold medium. Our recommended product is not as corrosive or difficult to handle as $CaCl_2$.

Benefits of ground freezing:
- Can be applied in **all types of soil and groundwater conditions**, such as running sand, gravel, etc. It allows working in each of these soils.
- Most effective **as an earth support system** where groundwater is a concern and where either pumping or cutting off the water flow cannot be readily achieved using other methods.
- Can be used for either temporary containment or as a long-term barrier.
- Can be **removed easily** and completely, simply by allowing the ground to thaw naturally, without long-term effects on the subsurface environment.
- Allows frozen soil barriers to be **easily monitored** in many ways, just by including temperature and pressure sensors.

References:
- construction & mining projects
- groundwater control
- excavation support in underground construction industry

Recommended product:
- Freezium™ -60°C

Leak detection

Reliable detection of the smallest leak

When a liquid is leaking from a pipe, tank or other receptacle, leak detectors make this visible. They are primarily used when visual detection is not possible or difficult, for example underground tanks.

Heat transfer fluids can be **used in double-walled tanks** to keep the contents of the tank at a certain temperature or to protect them from freezing. Leakage from underground storage tanks, or even from above ground tanks, may result in contamination of the soil or groundwater.

Due to the fact that heat transfer fluids are **electrically conductive**, they can be used as a **leak detection fluid** in combination with leak detection equipment.

Typical examples:
- Storage tanks (under & above ground)

Recommended product:
- Zitrec® L
- Zitrec® M
- Freezium™

Solar heating systems
Heat storage on sunny days

Solar energy is available abundantly and cheaply. What's more, it's environmentally friendly. This energy can be used either to heat buildings or water, or to generate electricity.

In the 1970s, the push for **renewable energy** was driven by oil shortages and price increases. Today, the push for renewable energy sources is driven by renewed concern for the **environment**. Solar energy is the prototype of an environmentally friendly energy source. It consumes none of our precious energy sources, does not contribute to air, water or noise pollution and does not pose a health hazard. Solar energy does not leave harmful waste products in the environment. Solar energy cannot be embargoed or controlled by any nation, nor will it run out until the sun dies.

The challenge facing solar heating is **heat storage**. Solar heating systems must have some way of storing the heat collected on sunny days. This heat may be stored either in a tank as a hot liquid (direct system in which the actual water to be used is heated and stored) or transferred through the heat exchanger in the hot water boiler.

For heating applications, a **heat transfer fluid is pumped through a solar collector**, where the fluid is heated up. The heat transfer fluid is then pumped either to areas where it delivers its heat to heat up rooms, or is sent through water storage tanks where it warms up water for domestic use. The fluids most commonly used are based on *water and propylene glycol and ethylene glycol*. When selecting a heat transfer fluid, the following criteria should be considered:

- Base fluid choice
- Coefficient of expansion
- Viscosity
- Thermal capacity
- Freeze point
- Boiling point
- Flash point
- Corrosivity
- Thermal stability

Typical examples:
- Solar room heating: houses are warmed up by means of solar energy
- Solar water heating: e.g. hot domestic water

Recommended product:
- 35-40% Zitrec® L

Reactor heating & cooling
Managing temperatures varying from -30°C to +150°C

In the chemical industry, many processes require either cooling or heating. **The temperature** range of applications can widely vary.

In most cases, the heat transfer fluid will only be used at one temperature. However, in some applications the same fluid is used at different steps of the process and **at different temperatures** (e.g. reaction processes where cooling is needed during the exothermic reaction and followed by heating to remove water during a crystallization step).

Typical examples:
- nuclear & petrochemical plants, naphta crackers, ...

Recommended product:
- Zitrec® M
- Zitrec® L
- Zitrec® F
- Freezium™

Air conditioning & Hot water heating systems
Ensuring comfortable temperatures in buildings

The use of **heat transfer liquids** instead of inhibited water is linked with energy savings during shutdown. Many hot water systems are used to heat buildings that do not require permanent heating. When a proper HTF is used, the entire system or parts of the system can be turned off, even when outside temperatures are below zero. Meanwhile, the system is ready to be started at any time. The mixture of a heat transfer fluid **guarantees freeze protection** and **corrosion protection**.

2 basic functions of the fluid:
- Guranteed freeze protection
- Corrosion protection

For moderate climates such as Western Europe, freeze protection down to -20°C is generally sufficiant to protect the installation, even if the pipes are installed in the external walls. The use of our HTFs in **floor heating systems** has proven to be as succesful as an **antrifreeze or corrosion inhibitor**, even when plastic pipes such as those made from PE are used.

Typical examples:
Schools, churches, holiday homes

Recommended product:
- 20-35% Zitrec® M
- Zitrec® L
- Freezium™

Heat pump systems
Reversing the natural heat flow direction

Heat flows naturally from a higher to a lower temperature. Heat pumps, however, are able to **reverse this flow in the other direction**. To do so, a relatively small amount of external energy, usually electricity, is required. In heat pumps, the heat transfer fluid is used as the **heat transfer medium for the external circuits**.

The mixture of heat transfer fluid and water **transfers heat from the internal circuit to the heat pump**.
Heat pumps transfer heat from natural heat sources in the surrounding areas such as air, ground or water, or from man-made heat sources such as industrial or domestic waste, **to a building or an industrial application**. Heat pumps can also be used for cooling. In this case, heat is transferred in the opposite direction, from the application that is cooled to surrounding areas at a higher temperature. Since heat pumps consume less primary energy compared to a conventional heating system, they have a positive effect in terms of reducing gas emissions that are harmful for the environment.

- *Industrial heat pumps:*
  Space heating, process water heating and cooling, drying process, evaporation and distillation processes.
- *Ground source heat pump:*
  For example closed-loop systems where the heat transfer fluid circulates through pipes installed beneath the ground level. During the winter, the fluid collects heat from the earth and carries it through the system into the building. In summertime, the system reverses to cool the building by extracting heat from the building through the system into the ground. This process can heat up water for free in the summer and delivers substantial hot water savings in wintertime.
- *'Clean' heating*:
  Residential heating by heat pumps is supported by the governments of some countries as a step towards greater energy efficiency and reducing polluting conventional heating such as local oil or coal burners.

Recommended product:
- 35-40% Zitrec® L
- Freezium™ -15°C or -25°C

Indirect cooling systems / Secondary refrigeration
Transferring cold and protection against corrosion

The difference between direct cooling systems and indirect cooling systems, also known as **secondary refrigeration**, resides in the **physical separation** between the primary circuit, where the cold is generated, and the secondary system, where cooling takes place. The cold generated in the primary circuit is transported by the heat transfer fluid to the place where the products need to be cooled. Temperatures for this application can **vary from -40 °C to 40 °C**. In indirect refrigerant systems, heat transfer fluids have two basic functions:

- To **transfer the cold**: the coolant in indirect cooling systems must remain fluid at all prevailing temperatures in the system, and the viscosity should preferably be as low as possible.
- To **protect the system against corrosion**: compared to other applications, corrosion protection at low temperatures requires a different set of inhibitors and a different protection mechanism. Our Zitrec® products are designed to offer maximum protection under all conditions.

Benefits of indirect refrigerant systems:

- Minimal amount of refrigerant
- Reduced risk of leakage of the primary refrigerant
- Reduced system size
- Less severe demands on piping and pumps
- Fewer legally mandatory maintenance and checking operations for smaller primary cooling circuits
- Simpler to modify, which makes it extremely attractive for production processes requiring flexibility
- Transporting refrigerant over a long distance is avoided, as the secondary fluid can easily be carried away from the system and cooled at a convenient distance.

Typical examples:
- Fresh & frozen displays in supermarkets<
- Logistic services
- Deep freeze units
- Ice cream machines

Recommended product:
- Zitrec® M
- Zitrec® L
- Zitrec® F
- Freezium™

Indirect contact freezing

The gentle method of food preservation

Freezing food is probably the gentlest method of food preservation. Freezing prevents food from spoiling by inhibiting micro-organic and enzymatic action, and has few adverse effects on taste, texture, nutritive value or colour.

Most **foods are frozen** as result of an **indirect contact freezing process**. During this process, the product and a heat transfer fluid are separated by means of an interface or barrier between the cooling medium and the product. This interface may be a metal plate or the product packaging material, which prevents direct contact between the product and the cooling medium.

Typical examples:

- breweries, wine producers, dairies, bakeries

Recommended product:

- 45-65% Zitrec® F

Industrial cooling

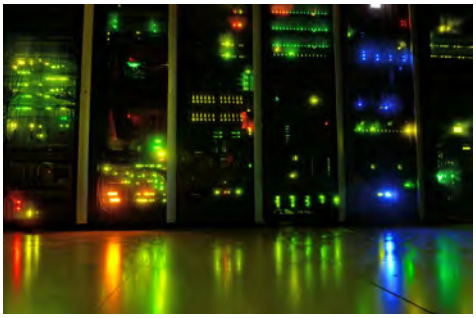
Process cooling in large scale

Heat transfer fluids are the ideal solution to cool processes and machinery in large scale. Some examples:

Plastics industry (process cooling in injection moulding systems, extrusion systems and blow moulding machines): Heat transfer fluids enable to cool down to a temperature of -50°C. This means that significantly lower temperatures can be generated for mould cooling, enabling significantly shorted cooling times and increased production.

Metal & steel industry: Regardless if you want to reduce the temperature of finished metal products or require reliable cooling for tool machines, laser systems and cutting systems, heat transfer fluids help to reach the required process temperatures.

IT and computer centers: Small, medium and large server rooms require cooling outputs of tens to thousands of kilowatts. Using precision air conditioning units with water and glycol circuits have proven its worth here. Heat transfer fluids are used as a heat transfer medium and prevent the outdoor cooler freezing at winter temperatures.



Recommended product:

- Zitrec® M
- Zitrec® L
- Zitrec® I
- Zitrec® F
- Freezium™