Alfa Laval in brief

Alfa Laval is a leading global provider of specialized products and engineering solutions.

Our equipment, systems and services are dedicated to helping customers to optimize the performance of their processes. Time and time again.

We help our customers to heat, cool, separate and transport products such as oil, water, chemicals, beverages, foodstuff, starch and pharmaceuticals.

Our worldwide organization works closely with customers in more than 100 countries to help them stay ahead.

How to contact Alfa Laval

Contact details for all countries are continually updated on our website. Please visit **www.alfalaval.com** for more information.

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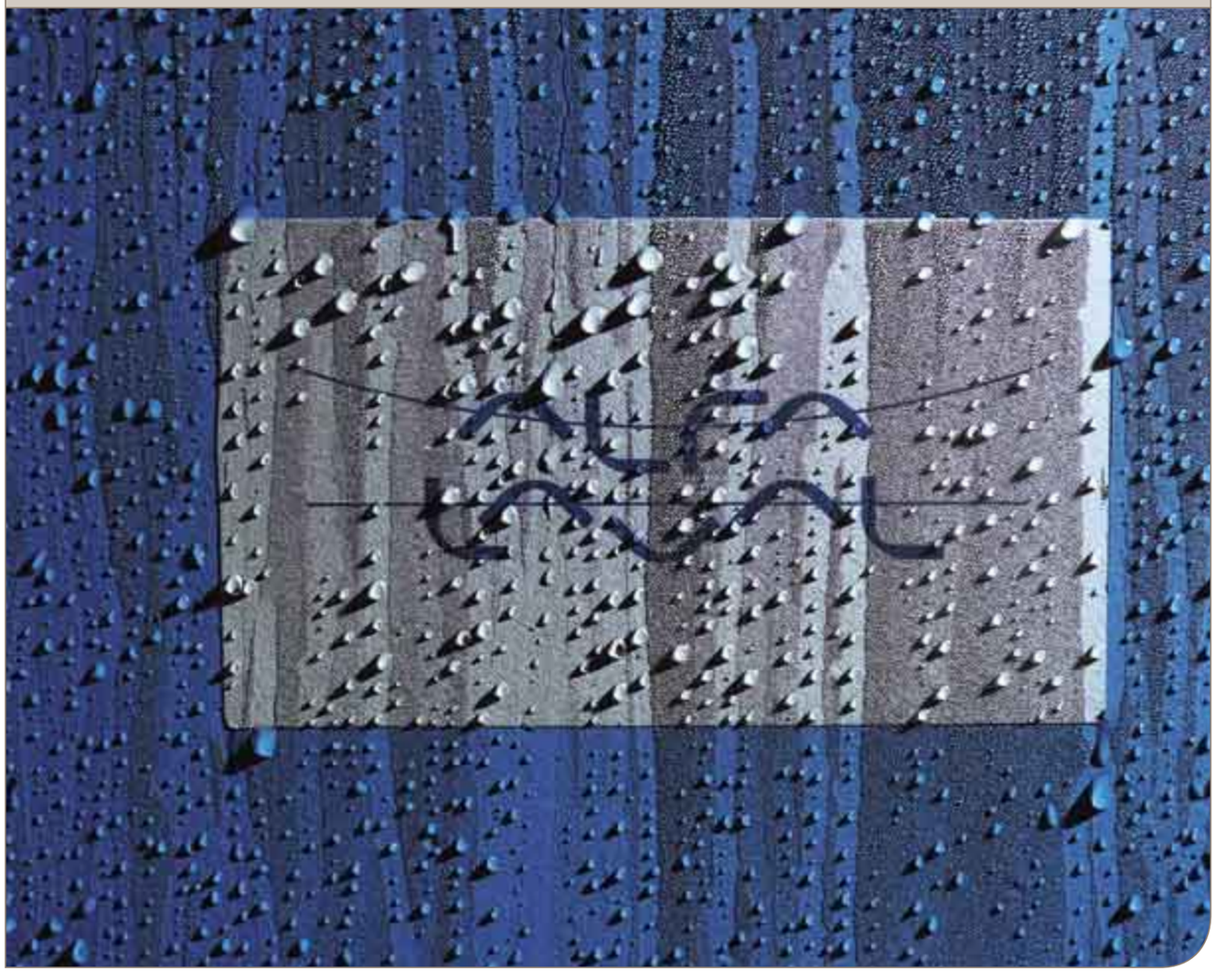
Cooling Applications

Knowledge, Experience and Products for Optimized HVAC Systems



Welcome to the Cool World of Alfa Laval!

Planning of a cooling application is influenced by many physical factors including the cooling source and the size and nature of the space or media to be cooled. Other important considerations include restrictions imposed by legislation or local regulations, architectural limitations and cost-effective installation and implementation.

Successful planning is a question of close cooperation between the owner, the consultant and the contractor. Together, you must address a large number of complex questions, and the best way to get the right answers is to involve an experienced expert at an early stage. Alfa Laval customers always benefit from our first-hand experience from thousands of projects in different countries and climates all over the world. Another big advantage is our worldwide organization for service and support.

In today's upgraded HVAC systems, heating and cooling are becoming increasingly integrated. We at Alfa Laval will be able to provide you with the advice you need to obtain a truly energy-optimized system. Why, for example, let the sewage water go down the drain without first using its energy content – for instance to produce cold and heat in a heat pump. Or why not use the waste heat from industries, hospitals etc to do the same job.

Alfa Laval provides high-quality knowledge, experience and components for a large number of cooling applications. In this brochure you will find a number of examples that we hope will give you a good picture of the potential of our products and expertise in your operation.

Alfa Laval has a full range of heat exchangers catering for every cooling need.

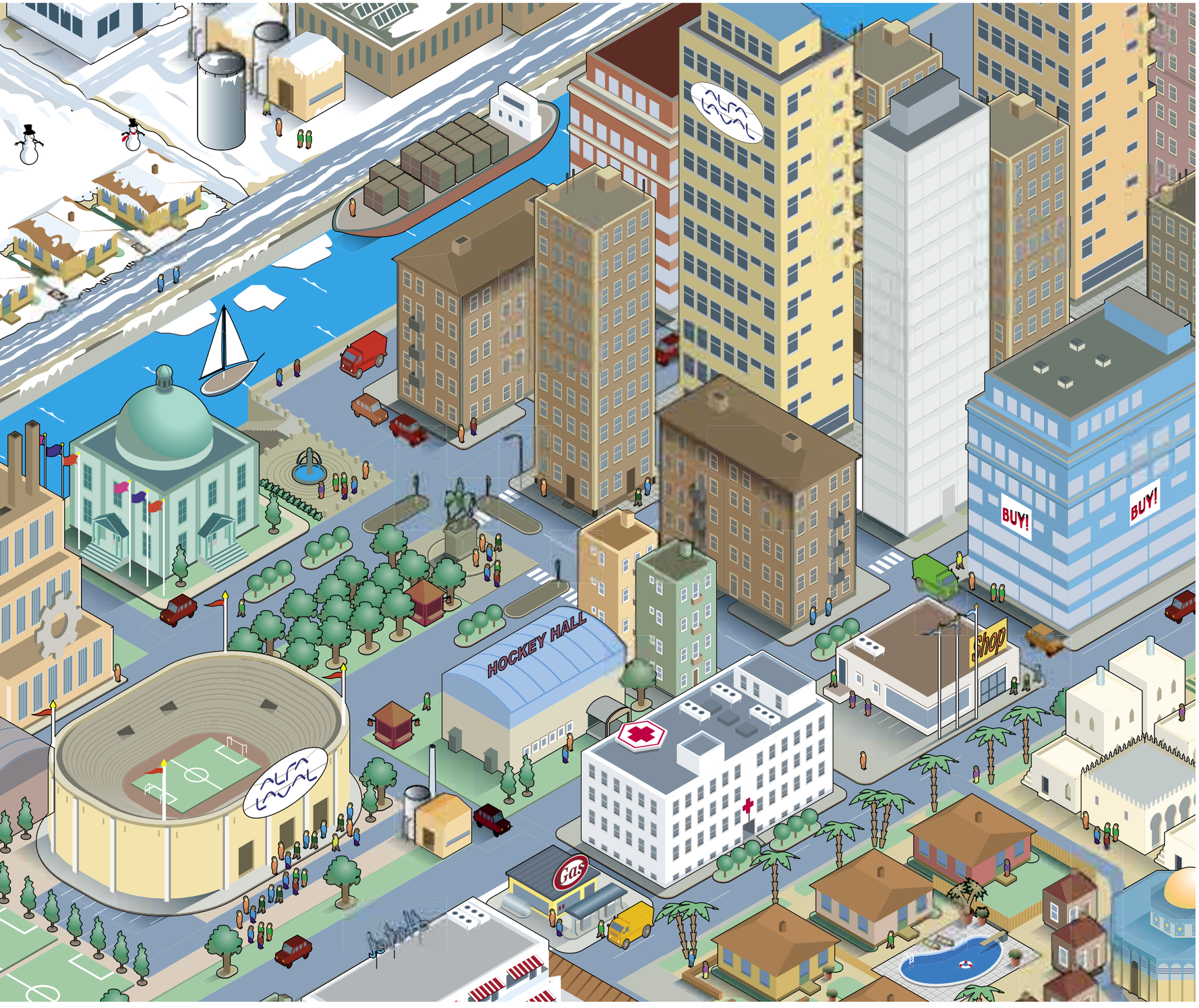
By choosing world market leader Alfa Laval you will get heat exchangers and other products with superior design and energy efficient, environmentally sound and reliable operation, plus minimum maintenance. You can also be sure of the lowest possible total cost of ownership supported by the highest standards of service and support for the lifetime of your plant, regardless of where in the world you are located. Below you find some Alfa Laval advantages:

Superior plate design
Alfa Laval's intensive product development has resulted in the well-engineered heat exchanger plate patterns that enable our "close approach". Only Alfa Laval can give you down to 0,5°C/<0,9°F temperature approach between two circuits. The optimized corrugation of the plates not only increases the heat/cold transfer; it also means minimized fouling as the patterns create a highly turbulent flow. The plates can be tailor-made in various geometrical patterns, making it possible to meet every customer's duty and pressure drop requirements.

Performance certificate
All Alfa Laval components and solutions are accompanied by a performance certificate, which outlines the performance specifications in detail. If, against all odds, these specifications should not be met, an Alfa Laval engineer will immediately be dispatched to ensure that the component/system is fine-tuned and up to par.

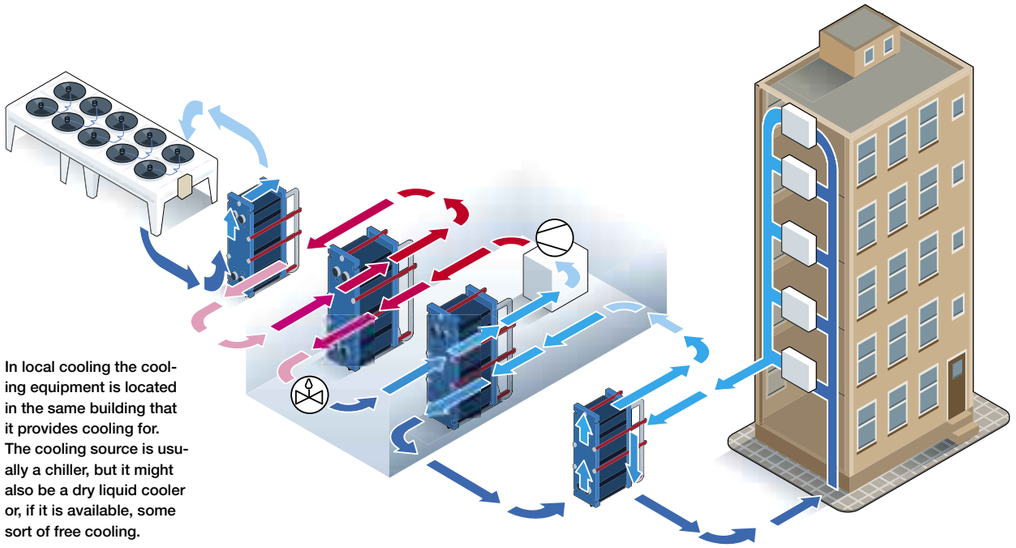
Optimizing software
In order to make the most of our customers' cooling applications, Alfa Laval provides and runs software for design and functionality testing, early simulations and estimates of maintenance costs – even test setups. One example is our new OLA (Optimization Liquid Air) software that calculates a liquid cooler–heat exchanger solution that lets you optimize your cooling application with regard to season. To ensure our customers maximum uptime we also offer on-site training, education and detailed manuals.

Worldwide presence
Alfa Laval's worldwide network means that our customers are close to one of our authorized regional distributors, at all times and in any geographical location. Our representatives will provide installation guidelines with full price details. Alfa Laval's customers can also depend on our full service concept – we will support, service and recondition all their components and systems.



Applications Index

Local and District Cooling



In local cooling the cooling equipment is located in the same building that it provides cooling for. The cooling source is usually a chiller, but it might also be a dry liquid cooler or, if it is available, some sort of free cooling.

Local cooling

Local cooling is the most common cooling system globally. The local cooling system provides cooling for a single building, for example a hotel, conference center, sport center, hospital, or an office block. The chiller plant and the storage facility are located inside each building, the cooling source usually being a chiller. Depending on availability some sort of free cooling might be used, alone or in combination with the chiller. The cold from the source water is transferred to the building's internal cooling system in a plate heat exchanger (PHE).

OLA (Optimization Liquid Air), Alfa Laval's new special software, will let you calculate an optimized combination of two heat exchangers, for example a dry liquid cooler and a PHE.

This optimized package will make your system work at just the right capacity. A fine-tuned system will run smoother and minimize maintenance. It will also enable you to choose the most economical cooling source solution for each season, for example free cooling in the wintertime.

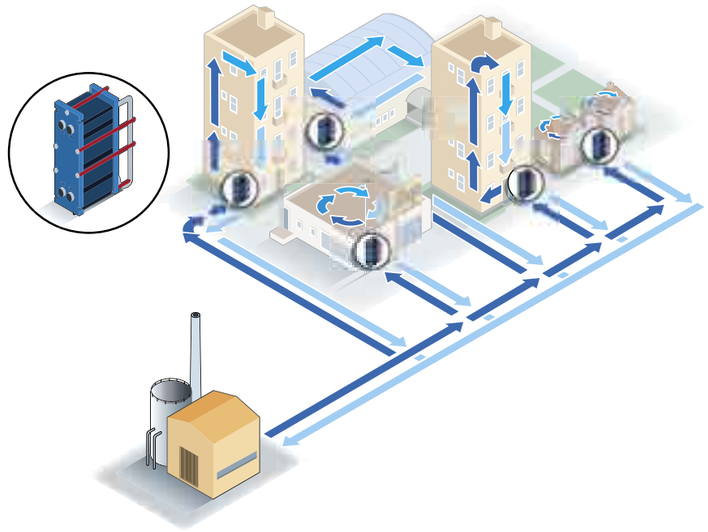
Another PHE application is installing PHEs at different stories in tall buildings to solve the cooling system pressure problems. These PHEs act as pressure interceptors, transferring the cold between the separate zones, and also protect air handling units and other equipment from excessive pressure.

District cooling

The concept of district cooling is becoming more and more widespread all over the world. The idea, as for district heating, is to use one central source instead of local systems for each building. This will create both economic and environmental benefits.

The district cooling system offers operating flexibility, since each building can use as much or as little cooling as needed, without worrying about chiller size or capacity. The installation will be very comfortable and convenient for the customer, with the possibility of having the same supplier for electricity, heat and cooling. The installation of a district cooling system is greatly facilitated if it is combined with an existing district heating system, or one constructed at the same time, since the costs can be split between the two systems.

One of the benefits for the customer is the saving of space at the location as there is no chiller. The investment cost will also be less than when having to invest in a chiller. There will be no need to replace chiller, cooling towers or pumps due to wear or CFC/HCFC phase-out, as the CFC/HCFC handling problem will be taken care of. With centrally produced comfort cooling there will be no noise or vibrations. Maintenance and running costs will be lower, and a better level of equipment redundancy and round-the-clock expert management, which individual buildings cannot match, will be achieved.



In district cooling one central source is used for several buildings. A district cooling system has both economic and environmental advantages, especially if it is combined with district heating in an optimized system.

Direct–indirect cooling systems

In cooling systems the distribution can be either direct or indirect. If direct, the cooling water goes directly into the internal piping system of a building. In an indirect system, a heat exchanger separates the internal from the external system. Today this is the most common system, and the indirect system provides several benefits.

Leakage will be easier to detect and, if it does occur, create minimum damage. There is no risk of one system contaminating another. In a district cooling system the responsibility line will be clearer, and the regulation and sales are easier to monitor with clear borders. With separate circuits the customers may experience fewer fluctuations and disturbances, should the central system expand or need maintenance.

In an indirect system the heat exchanger will also decrease the static pressure, thus working as a pressure interceptor. Sounds from valves can be eliminated when the pressure in the pipes is decreased. In the indirect system solution the dimensions of the consumer's internal system will be smaller, and thus cheaper.

Installing Alfa Laval PHEs in an indirect cooling system means there will be minimum energy loss throughout the system. Alfa Laval's "close approach" enables temperature exchange approaches of no more than 0,5°C/<0,9°F.

Pressure interceptor

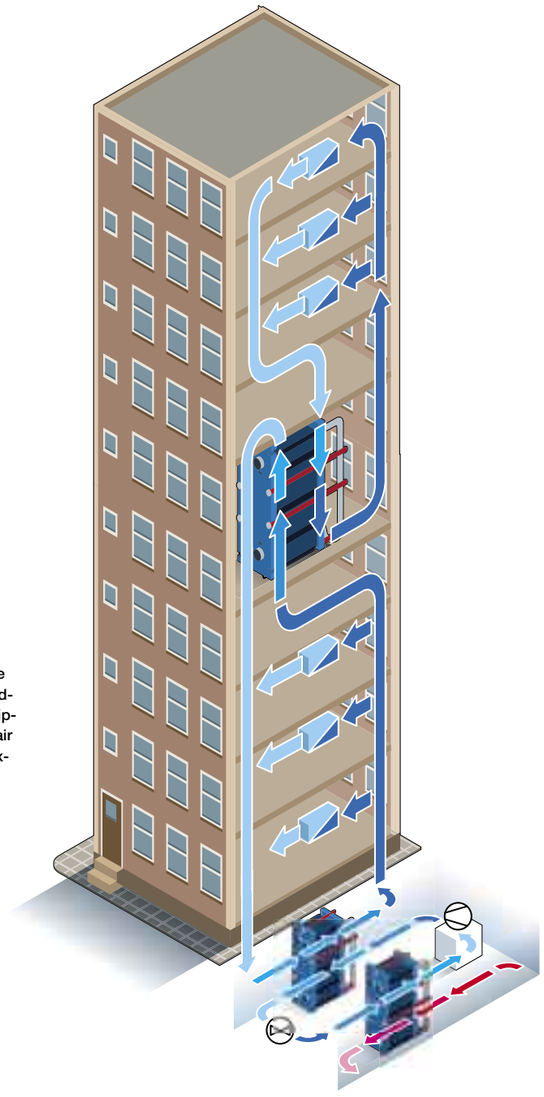
In skyscrapers, the static head creates a pressure that may exceed what the chiller condenser or room air conditioners can handle. A PHE will then split the circuit in order to keep the pressure at an acceptable level. It is possible to put PHEs on different levels throughout the building, thus limiting the pressure and the corresponding requirements on, for example, pumps, piping and valves.

Depending on the size of a skyscraper there might be many PHEs acting as pressure interceptors. It is very important that cold is not wasted in the cooling system. Alfa Laval's "close approach" when it comes to energy efficiency means that the PHEs will transfer practically all cold to the top of the building with minimum loss.

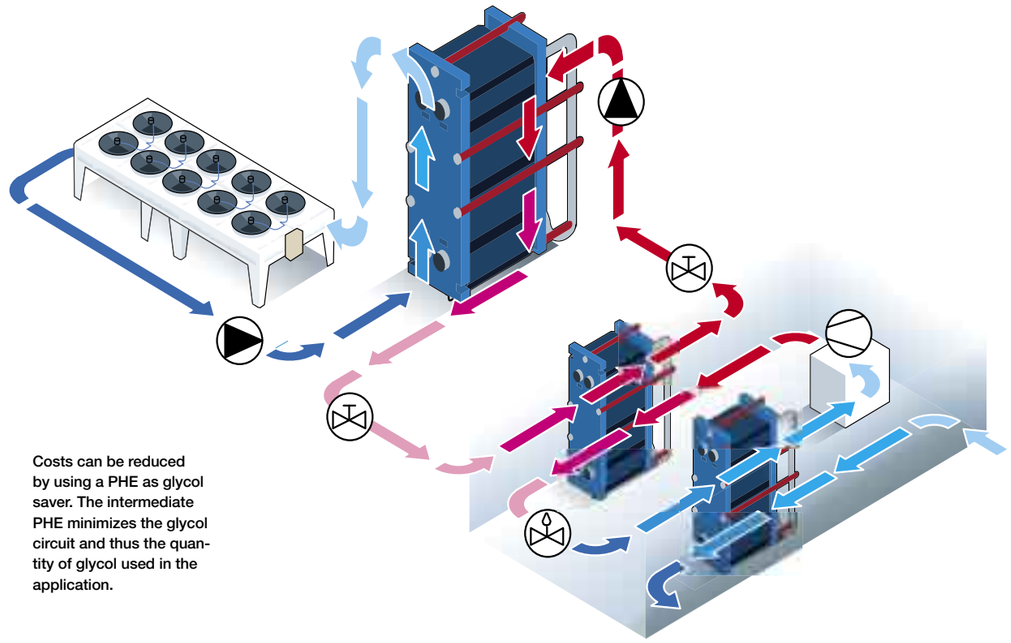
Advantages of PHEs as pressure interceptors

The entire chilled water system will be designed for low pressure, for example 10 bar (150 psig). This means cost savings in the chiller as well as in the selection of air handling units and other system equipment. Instead of having many chillers in a building, PHEs can be placed on several floors as pressure interceptors. This has a positive effect on building design:

- They are very compact and only require normal floor height, i.e. <3 m/10 ft, and only a third of the floor space of a chiller with identical capacity. This makes them easy to fit in, even in buildings with limited space.
- They do not cause any vibrations or noise. This will save money for the owner as the rest of the floor can be rented out without the tenants being disturbed.
- They do not normally need any maintenance attention, apart from a planned maintenance consisting of a gasket replacement approximately every 10–12 years.



PHEs used as pressure interceptors in tall buildings protect other equipment like chillers and air condition units from excessive pressure. It is a compact, low-noise, no-worries solution.



Costs can be reduced by using a PHE as glycol saver. The intermediate PHE minimizes the glycol circuit and thus the quantity of glycol used in the application.

Glycol saving

Glycol is used in systems with outside piping when there is a risk of the ambient temperature dropping below 0°C/32°F. Another cooling application where a PHE can be installed is as a glycol saver.

The sketch above shows an example where a dry liquid cooler is used instead of a cooling tower. In order to avoid the risk of bacteria in the cooling tower water, this is increasingly required by law in many countries.

In cases where the dry liquid cooled condenser is situated far away from the chiller and glycol is used, the amount of glycol that has to be added to the system is high and so is the cost. An intermediate PHE will minimize the glycol circuit, thus acting as a glycol saver and cutting expenses.

Cooling Sources

Cooling tower

Today water qualities are deteriorating because of different kinds of pollution. This increases the risk of chiller shutdowns due to operation problems of the condenser. The condenser is subject to attacks from either chlorides that will cause corrosion or impurities or biological activities in the water that will cause fouling. As the expectations of trouble-free cooling operations have increased, it has become more and more interesting to look at alternative solutions where these problems can be avoided.

One solution is an indirect system using a heat exchanger in combination with the open cooling tower. The advantages of this are:

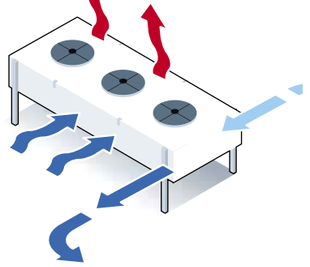
- Low system cost: Cost calculations show that the payback period of the heat exchanger is very short.
- Material savings on condenser: Less expensive materials can be used.
- With an intermediate heat exchanger, chillers as well as cooling towers can be run at an optimal temperature.
- An intermediate heat exchanger means that the use of water treatment chemicals, for example chromates used for the cooling tower water, can be minimized.
- Less maintenance of condenser.

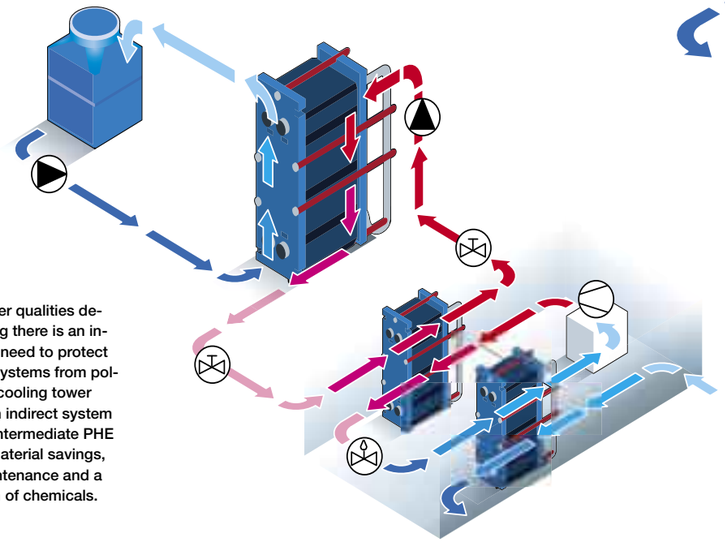
Dry liquid cooler

Dry liquid coolers are an energy-saving cooling source option and an alternative to cooling towers in smaller, indirect cooling systems, up to approximately 1 MW. Dry liquid coolers or other closed-circuit coolers must also be used where cooling water is in short supply or nonexistent, or where legislation renders the use of sufficiently large quantities of water impossible. They are also a source of free cooling during the cold season.

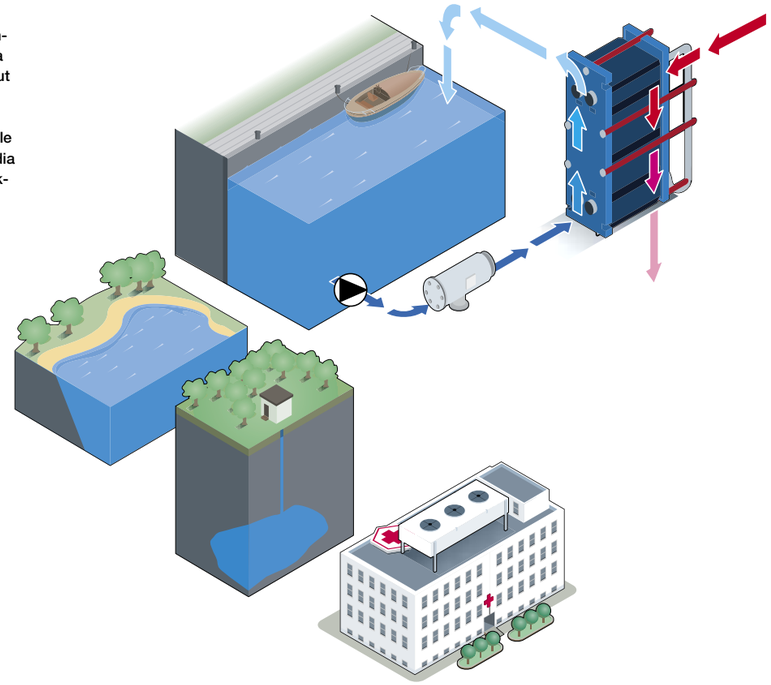
Alfa Laval offers a wide range of robust, heavy-duty dry liquid coolers for the cooling of water, water mixtures, brine and several kinds of oil. The high cooling efficiency combined with high fan efficiency has made it possible for us to construct very compact coolers. Different models are available for both blowing and sucking air across the coil, and there are many customizing options, so we will be able to supply the right cooler for your system.

For smaller or medium-sized cooling applications a dry liquid cooler is an energy-saving option that might be a source of free cooling when the temperature drops. Alfa Laval offers a wide range of high-quality dry liquid coolers.





With water qualities deteriorating there is an increasing need to protect cooling systems from pollution in cooling tower water. An indirect system with an intermediate PHE means material savings, less maintenance and a minimum of chemicals.



Free cooling has many economical and environmental advantages. Alfa Laval's knowledge about for example corrosive media has resulted in products that can handle aggressive cooling media like seawater and brackish water.

Free cooling

Free cooling combines an environment-friendly alternative for producing cold with economical benefits. Cooling applications relying on free cooling have been installed with good results in many countries around the world.

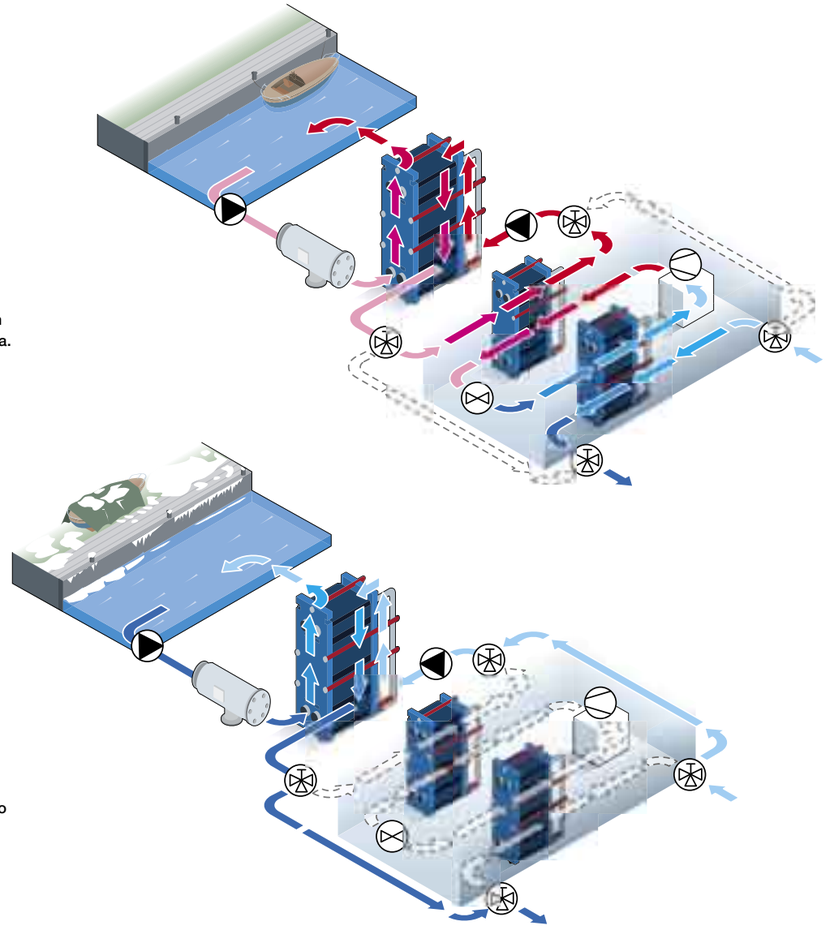
When utilizing free cooling as cooling source in an application, the use of ecologically harmful refrigerants can be reduced. Free cooling is also a way to cut down on electricity costs – in some cases the cut might exceed 75 percent, resulting in great savings. Reduction in electricity consumption also has environment-friendly effects, as electricity power production often involves air pollution.

Free cooling is used mainly for air conditioning and process cooling. It can cover the cooling requirements during the period when the free cooling source has lower temperature than the cold water, for example during winter. In spring and autumn a combination of free cooling and chiller-produced cold is used. In the summertime the chiller supplies the total cooling requirement. Suitable free cooling sources are water from for example rivers, lakes, (deep) oceans or ground water, ice and snow storage, or air.

Products for free cooling

Alfa Laval's continuous research and development strategy means we are able to supply products for any cooling application, regardless of cooling media and cooling source. This makes it possible to utilize aggressive cooling media such as seawater, brackish water, or water from rivers and wells. By installing a PHE, the chilled water (loop) can be totally isolated from sensitive equipment like air conditioners, thereby eliminating corrosion, scaling and constant maintenance. In seawater and fresh water applications, installation of a filter for protecting the PHE is recommended. A cooling system using free cooling in combination with a PHE will also require less space, creating an extremely compact solution.

But Alfa Laval is more than outstanding products and optimized systems. Based on our vast experience we are always able to provide quality solutions.



Chiller bypass system (summer). The chilled water is isolated from the other cooling equipment. This minimizes costly maintenance and the system can use even aggressive cooling media.

Chiller bypass system (winter). The chiller temperature can be cut off during the cold season. A large amount of electricity can be saved and the chiller will not have to operate at low and inefficient capacity.

Chiller bypass

Traditionally the chiller in an air conditioning system runs continuously during the entire cooling season, even when full capacity is not required. Previously, the only alternative to constant chiller operation has been a chiller bypass system using a strainer. This strainer removes impurities, but at the same time it requires costly maintenance, chlorination and other chemical treatment.

By installing a PHE – and sometimes a filter to protect it – in the chiller bypass system, corrosion, scaling and constant maintenance can practically be eliminated. Another advantage is that this system can use any type of cooling, such as a cooling tower or free cooling with river or well water, even seawater or brackish water, without ruining sensitive equipment like air conditioners.

As soon as the bulb drops below the required condenser temperature (min. 1°C/1,8°F), the PHE makes it possible to cut off chiller temperature. This means that a large amount of electricity can be saved during the cold season. It also means that the chiller will not have to operate at a low and inefficient capacity, and that chiller maintenance can be efficiently scheduled during this period. Total investment costs are generally paid back in six months to three years, depending on local conditions.

Ice accumulator/storage

An ice accumulator/storage is a tank where ice can be accumulated during one period, stored and then thawed and used during another. There are two main reasons for using an ice accumulator/storage:

- Where the cooling effect demand varies during the day a smaller chiller can be used. As a result the initial cost of cooling equipment can be reduced considerably.
- Energy can be purchased during the night or off-peak hours. In many countries this means that it can be obtained at a lower price.

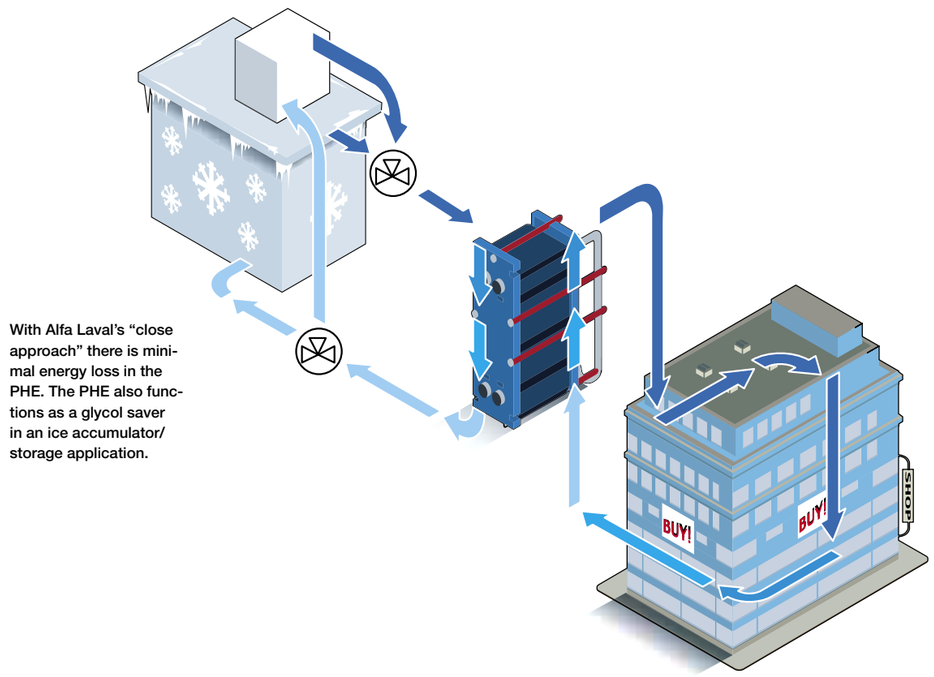
Since it has been shown that payback periods for ice accumulators will be as low as two years, it is an increasingly worthwhile investment. There are two main applications for ice accumulators: air conditioning and industry. Especially in industry, the cooling demand is often variable, for example in a dairy where the milk will be brought in in the morning.

Types of ice accumulators

There are two main types of ice accumulator systems:

- Systems with internal melting consist of a polyethylene tank containing coils of the same material. The container is filled with water. When ice is accumulated, a –5°C/41°F glycol solution is run through the coil. The water will gradually freeze into ice, first around the coils and then further and further out in the tank. When the extra cooling capacity is required, the glycol solution in the coils will be led through the system and returned to the tank at a higher temperature. The ice accumulated in the tank will then melt, and the glycol solution will be recooled until all the ice is consumed.

- In systems with external melting the tank is made of steel or concrete. Here too are coils with glycol or a CFC/HCFC coolant, and ice is accumulated to a thickness of 35 mm/1,4 inches around each coil. The rest of the tank will be filled with water. When there is a need for cooling energy, ice water is pumped out from the bottom of the tank to the system. When it returns to the ice accumulator it will be forced to circulate around the ice. In this system, the ice water that is pumped into the system will always retain the same temperature.



With Alfa Laval's "close approach" there is minimal energy loss in the PHE. The PHE also functions as a glycol saver in an ice accumulator/storage application.

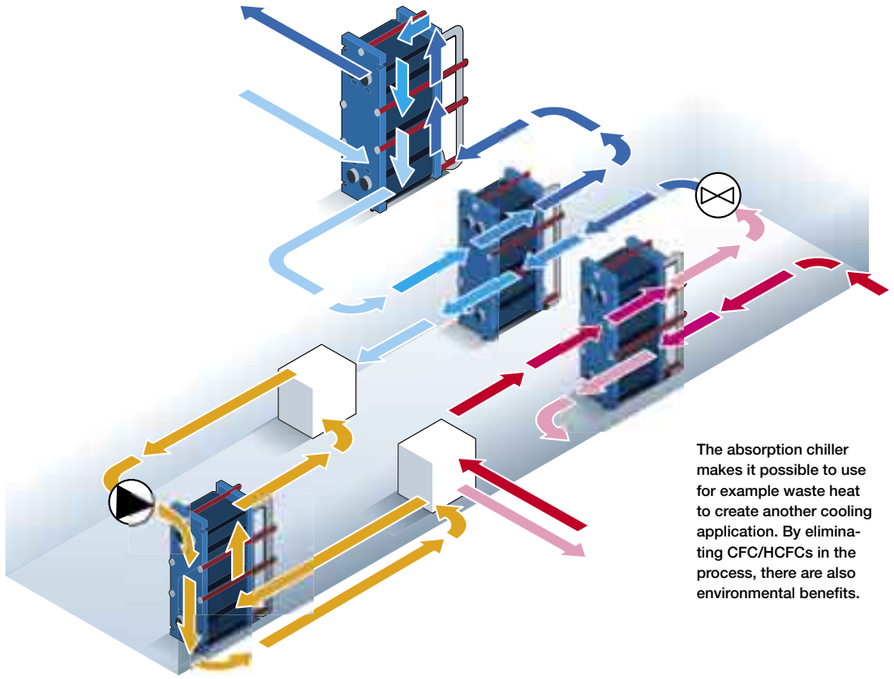
Other Applications

Absorption chiller

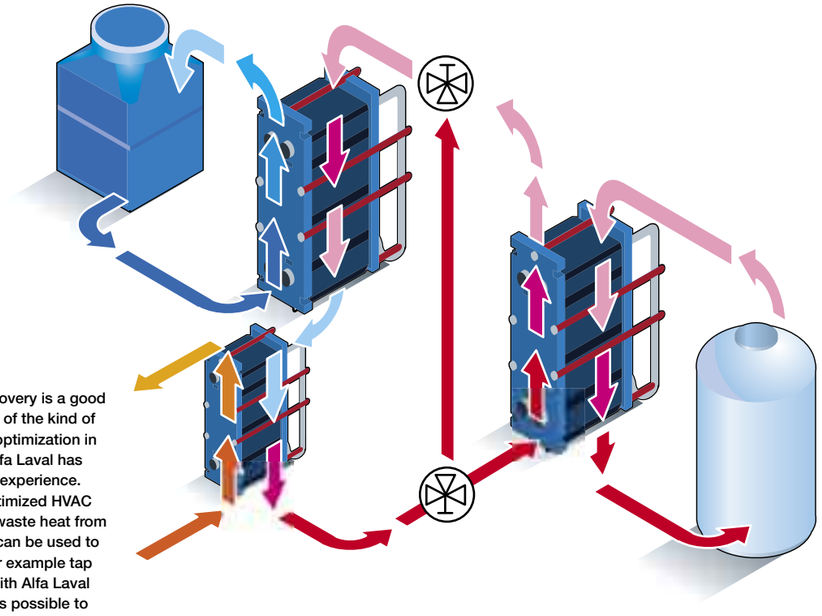
If district heat or waste heat is available, for example from waste disposal, there is another possibility for comfort cooling with the absorption chiller. This is an example of the kind of system optimization Alfa Laval excels in. We have the knowledge and just the right equipment for providing solutions with both economical and environmental benefits.

In this application the CFC/HCFCs influencing the ozone are exchanged to for example water and lithium bromide, both environment-friendly.

In the evaporator the refrigerant (water) takes up heat/energy from the connected system, thus cooling the air conditioning circuit in a heat exchanger. The refrigerant enters the absorber as low-pressure vapor, where the liquid solvent (lithium bromide) absorbs it. The pump increases the pressure and the mixture continues to the interchanger where it is preheated in for example a PHE. Using the district heat, the refrigerant is boiled off from the solvent in the regenerator. The high-pressure vapor is sent to the condenser, where heat is emitted during the refrigerant's condensation.



The absorption chiller makes it possible to use for example waste heat to create another cooling application. By eliminating CFC/HCFCs in the process, there are also environmental benefits.



Heat recovery is a good example of the kind of system optimization in which Alfa Laval has years of experience. In an optimized HVAC system waste heat from cooling can be used to warm for example tap water. With Alfa Laval PHEs it is possible to recover up to 95 percent of energy that would normally be wasted.

Heat recovery

In an optimized HVAC system, cooling and heating are integrated and waste heat and cold will be re-utilized in the system. Heat recovery is one often-neglected area where PHEs can be profitably used.

There are large potential savings as soon as there is a demand for hot tap water or other types of heating at the same time as the cooling system is running. Some types of buildings where this may be the case are hospitals and hotels, or different production facilities, for example in the chemical, pharmaceutical and beverage industries.

Alfa Laval has many years' experience from both cooling and heating applications and from customizing this kind of optimized system.

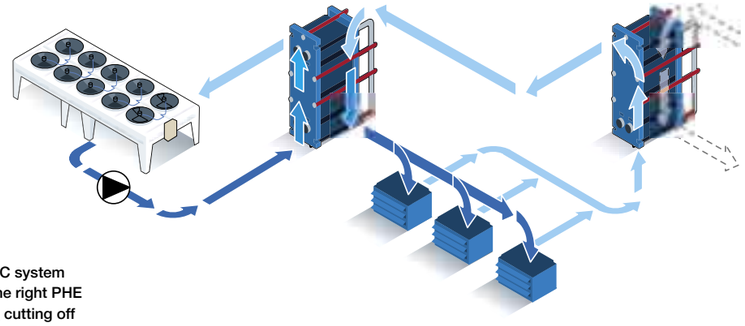
The heat recovery PHE will be installed between the condenser and the cooling tower, recouping part of the energy that would otherwise be let out in the air. While recovering heat for pre-heating of tap water, for example, the cooling need decreases on the condenser side. Thus the savings will not only be the energy recovered in the heating system, but also the energy not wasted in the cooling system. Due to the extreme efficiency of the PHE it is possible to recover up to 95 percent of the energy that would otherwise be wasted. This is often more than enough to offset the capital and operating costs of the PHE. In this case the PHE may well be of the double-wall type, with double walls between the condenser circuit and the tap water, to give extra protection against contamination.

Reversible air conditioning system

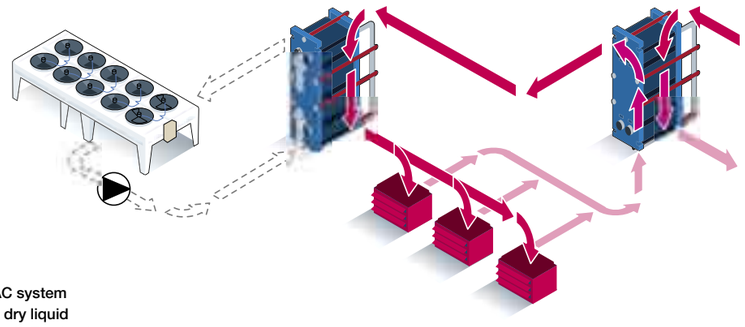
Another system where heating and cooling is integrated is the reversible air conditioning system. In this particular type of condenser cooling system there are separate small cooling units in each room of, for example, an office building. These chillers can be used as both chillers and heat pumps, depending on the season and the climate. They are all connected to a main pipe that carries water through the system. This pipe is connected both to the cooling source and to the heat source of the building.

During the summer, the heat source is cut off and the water will flow directly through the PHE on the heat source side. The water of the main pipe will cool the condensers of the room units and transport the excess energy to the cooling source via the PHE on the cooling source side.

During the winter, the cooling source is cut off and the water will flow through the PHE on the cooling source side with no change of temperature. Instead the heat source will now be in operation, and the water will be heated when passing the PHE on the heat source side. The room units will now be reversed, so that the hot water will go into the evaporators and transfer the heat to the rooms. The room units are now heat pumps.



Reversible AC system (summer). The right PHE is bypassed, cutting off the heat source. The room units are used as chillers.



Reversible AC system (winter). The dry liquid cooler is cut off. The heat source is in operation and the room units are used as heat pumps.

The PHE separates the computer room loop from the rest of the cooling system. This way the effects of a leakage in the sensitive area can be minimized. The temperature in the room can also be better controlled.

Protection of sensitive sections

Our modern society has increasingly come to depend on electronics, computers and telecom solutions. It is of the utmost importance that vital systems and sensitive sections within for example hospitals, the IT and telecom sectors, the biotechnology and pharmaceutical industries are thoroughly protected.

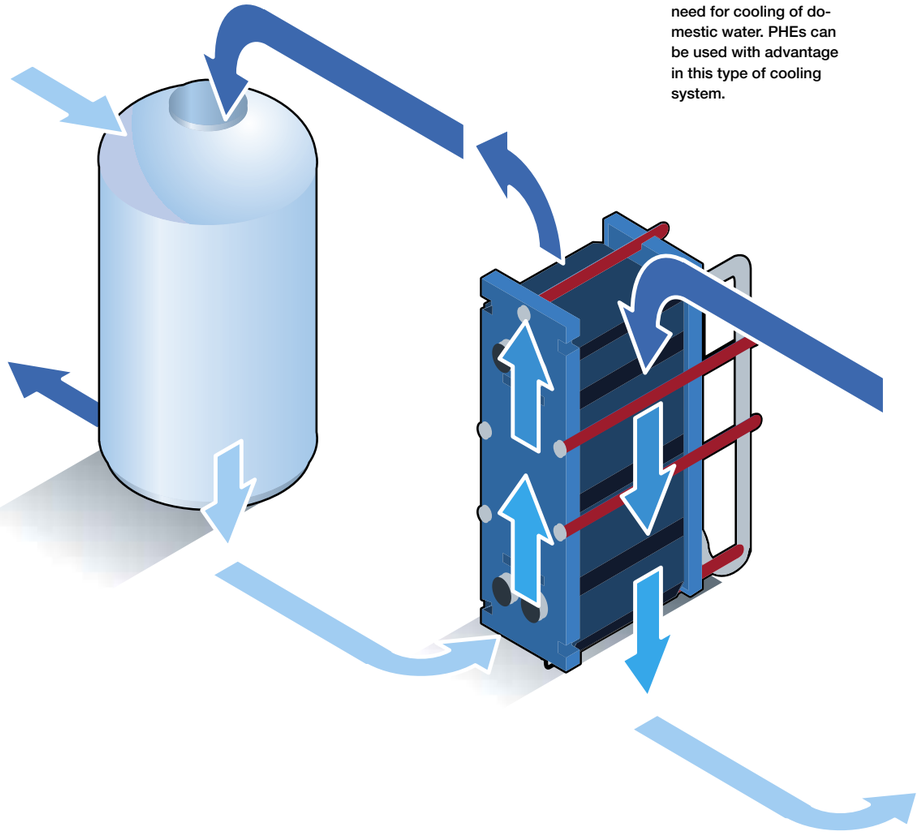
There are two reasons for using a separate loop through the air handlers of a computer room, for example. If there is leakage into the room from the water system, the water volume that could cause damage is reduced by installing a PHE that separates the two systems from each other. The temperature level of the circulating water can also be better controlled and kept at a higher level, in order to avoid condensation problems.

With the energy efficiency of Alfa Laval's PHEs there will be minimal energy loss using an extra loop in the system. Our "close approach" enables temperature exchange approaches of no more than 0,5°C/<0,9°F.

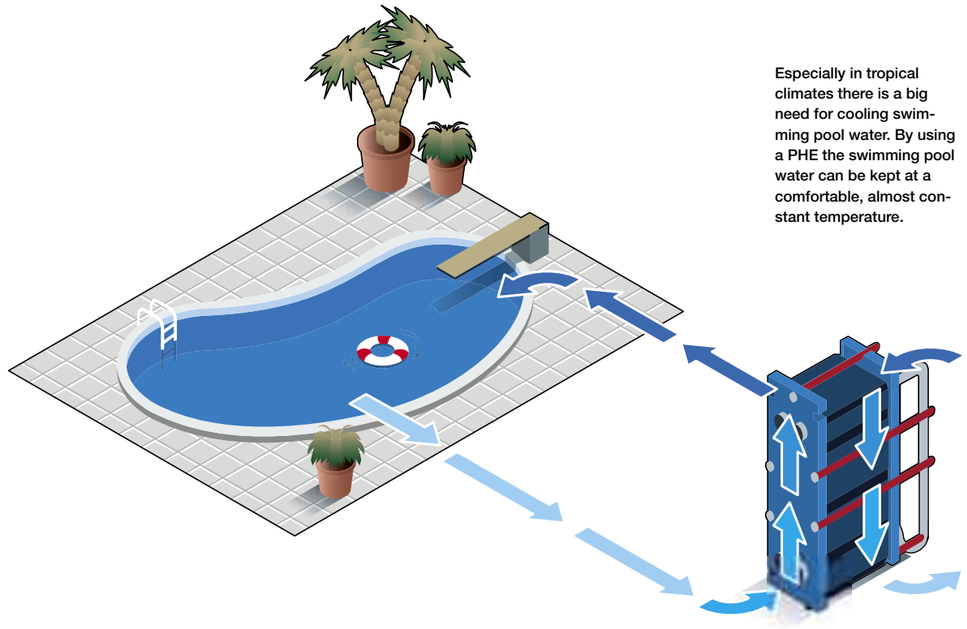
Tap water cooling

In hot geographical regions, where the atmospheric temperatures are in the range of 40–45°C/104–113°F, cooling plays a vital role in an individual's daily life. With such an atmospheric temperature one can automatically imagine the water supply temperature to be in the range of 35°C/95°F. This gives rise to the need for domestic cooling.

This is achieved by having domestic water flowing through one side of the heat exchanger. The other medium flowing through the heat exchanger is chilled water.



In regions with extremely hot atmospheric temperatures there is an increased need for cooling of domestic water. PHEs can be used with advantage in this type of cooling system.



Especially in tropical climates there is a big need for cooling swimming pool water. By using a PHE the swimming pool water can be kept at a comfortable, almost constant temperature.

Swimming pool cooling

PHEs can be used to maintain a nearly constant temperature in swimming pools all year round. In hot geographical regions where the atmospheric temperatures are in the range of 40–45°C/104–113°F, there is a need to cool the incoming water temperature (~40°C/104°F) to more suitable pool temperatures (~26°C/79°F).

The swimming pool water is one of the media that flows through the heat exchanger. Chilled water is used as the other medium.