DigiPlex

Air-to-Air cooling

The next generation of data centre solutions

Our Air-to-Air awarding winning system capitalises on the cool, moist atmospheric conditions of the Nordics to deliver "free cooling". The system gives important energy savings that result in sustainability and economic benefits, delivering high levels of cooling with exceptionally low power consumption.

Proven technology

The DigiPlex Air-to-Air (A2A) modular data centre has been developed to deliver high levels of cooling with exceptionally low power consumption. Developed in-house by our experts in partnership with air treatment specialist Munters and with help from modular frame manufacturer Gardner DC Solutions, this state-of-the-art modular prefabricated solution incorporates indirect evaporative cooling technology which can be combined with a hypoxic fire prevention system, if desired, to provide an advanced, sustainable and efficient data centre solution.

Award winning solution

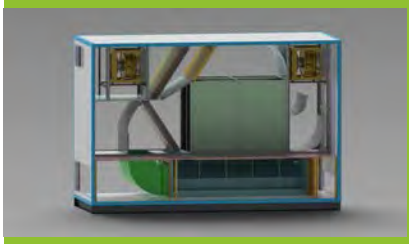
This innovative, modular solution came about as part of an innovatve concept DigiPlex developed for three matched freestanding module-types: a white space module, an electrical switchroom module, and an air treatment module known as an Air Treatment Pod (ATP). The ATP module has been developed onwards to be the cooling capacity ”heart” of our most recent air-cooled data centres in Fet and Stockholm.

Modular plant construction makes the Air-to-Air solution easily scalable. Many multiple ATP modules (capable of up to 230kW each) have been deployed, once the building shell and basic infrastructure are in place, cooling units can be procured and installed as the IT load increases. Minimum build so far deployed is approx. 400kW with three ATPs (two duty, one standby) to provide the necessary cooling. This configuration provides N+1 redundancy across the white space and three ATP modules gives flexibility to choose maximum free cooling, minimum CAPEX and increased load density.

Modular ATP was part of the innovative concept which won DigiPlex an award for Future Thinking and Design Concepts in 2012. Whilst the concept has not yet been deployed in it’s entirety, the innovative design of the ATP, which is the key to the modular data centre’s exceptionally low power consumption, has now been deployed large scale at two of DigiPlex data centres. Each pod incorporates a highly efficient indirect evaporative cooling system, derived from Munters’ tried and tested evaporative cooling technology, that has been widely deployed in both the USA and Australia. The big advantage of this system is that it uses the evaporation of water as the principle source of cooling energy, rather than the more traditional, energy intensive, mechanical cooling and refrigeration solution based on chillers, CRAC units and their associated pipework and pumps.

At the heart of the evaporative cooling system is a heat exchanger. Here heat is exchanged between two air streams: cool outside air and warm indoor return air without them mixing. The cool outside air enters at the base of the evaporator compartment; it is drawn up over a series of ribbed, polymer, tubes that form the heat-exchanger, removing heat from them before being discharged back outside. In the second airstream, warm indoor air is drawn into the heat exchanger from the white space hot plenum.

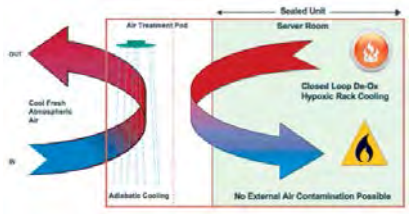
The air enters the unit at 35°C. It then passes through the polymer heat-exchange tubes, where heat is removed, cooling it to 24°C +/-2°C. This cooled air is then supplied back to the white space cold aisle, through the raised floor void. The evaporative cooling system operates in three modes to remove heat from the heat exchanger in the most energy efficient manner. In its simplest mode the unit is run in dry mode without supplementary cooling. It will do this when the dry bulb temperature of the outside air is cool enough to remove sufficient heat from the heat exchange tubes to cool the temperature of the indoor air to its set point. If the outdoor dry bulb temperature is not low enough, the unit will switch to its second mode of energy saving operation as an indirect evaporative air cooler. In this mode of operation the heat exchanger elements are wetted with a film of water to introduce adiabatic and evaporative cooling effects, to cool the white space air further. To optimise the evaporator’s performance and to save on fan energy, the volume of outside air can be varied to match the heat load. The indirect evaporative cooler enables the DigiPlex ATP to work at any location around the world.



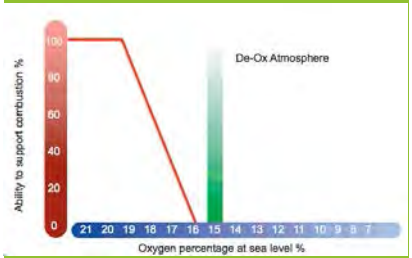
AirTreatment Pod (ATP) concept

A2A module layout

Multi stack modules



Simplified A2A process



Indirect heat exchange supports hypoxic fire supression technology deployed at Fet data centre

Its precise operational efficiency, however, will be dependent on local ambient conditions. Ambient wet bulb temperature is the determining factor in the unit's mode of operation. Wet bulb temperature governs the point at which evaporation of water can take place. Where the external/ambient wet bulb temperature is only 1°C or 2°C below the dry bulb temperature it will feel humid and the effect of evaporative cooling will be reduced. However, even in these conditions the indirect evaporative cooler will still provide cooling because the configuration of the evaporative cooler means that even if the outside air enters the unit saturated and at a low temperature, evaporative cooling will still occur because the air is heated as it passes over the heat exchanger, raising its dry bulb temperature and enabling it to hold more moisture.

The unit also includes a direct expansion (DX) unit, the 3rd mode of operation, to provide a small amount of additional cooling to top up the evaporative cooling effect for days when outside air temperature and humidity is exceptionally high. Heat from the DX unit is rejected into the evaporator exhaust air stream, avoiding the need for an additional plant outside the facility.

In cool Northern European climates run-time for the DX unit will be minimal. Research by consultants Cundall Johnston and Partners LLP predicts that for a typical year at London Heathrow, DX cooling will be required for less than 50 hours. In Madrid the DX unit is predicted to run for less than 300 hours. Even in hot, humid environments with the DX unit running, the Air-to-Air modular data centre will show significant running cost savings over a refrigerant-cooled data centre.

To enable the unit to work cost effectively anywhere in the world, the amount of water and electricity consumed in the ATP can be manipulated by raising or reducing the point at which evaporative cooling is activated. In locations such as Northern Europe, where water is plentiful and cheap and energy is relatively expensive, the unit is set to maximise the benefits from evaporative cooling. By contrast, in locations where water is relatively expensive and energy plentiful, as in the Middle East for example, the unit is set up to maximise the use of the DX unit to minimise the water use in the evaporative cooler.

Using an evaporative cooling solution enables the energy efficiency of the DigiPlex Air-to-Air modular data centre cooling solution to be significantly better than that of a traditional solution. Power usage effectiveness (PUE) is a measure of how effectively a data centre uses power. PUE is the ratio of the power used by the building divided by the power used by the white space alone. On a conventional data centre the PUE ratio can be as high as 2, whereas the energy efficient cooling system used in the ATP will help the Air-to-Air modular data centre to deliver an overall PUE ratio of less than 1.17 and PPUE of 1.06. In other words less than 10% of the energy used by the data processing units is used to keep them cool.

The ATP comes with dual power supplies (A and B). An additional benefit of the Air-to-Air modular date centre is that a smaller power supply is needed for the site than for a chilled water equivalent. This is due to the fact that the mechanical (DX) cooling only needs to be sized to load lop the exceptional days, normally less than 20kW in a 200kW ATP. This reduces the utility costs of getting power to site and it makes more sites viable. In addition, transformer and generator ratings can be reduced along with switchgear and cable sizes. This will have obvious cost benefits as well as easing the construction process. Alternatively, more IT space can be allocated for a given power supply to a site.

In addition to a minimal electrical consumption, the ATP also has low water consumption. Water is recirculated in the evaporator; it is sprayed at low pressure from rotating nozzles at the top of the unit onto the polymer heat exchanger tubes, wetting them; the water dripping from the tubes is then collected in a sump at the base of the unit and returned to the sprays. The unit will automatically refresh the sump water when it becomes dirty with dust and pollen picked up from the airstream or when the calcium content of the water reaches a set point.

ATP as deployed

N+1 ATP deployment

Two water supplies serve the evaporator: one is connected to the mains the other to a tank containing harvested site rainwater. Unlike misting systems, this robust solution does not need a cleaned or sterilized water supply. Instead, the unit's environmental impact is minimised by using harvested rainwater as evaporative cooler's primary water supply. To ensure the unit always has two water supplies available, if levels in the rainwater tank fall to a minimum reserve level, the unit will switch to run on mains water.

In addition to the environmental sustainability benefits of using rainwater, water is a renewable energy as it is never consumed (except in some chemical processes). Evaporative cooling does not change the water molecule – it only changes the energy level of the orbital electrons for a short period of time before the electrons fall into a lower energy orbit and revert back to a liquid water molecule.

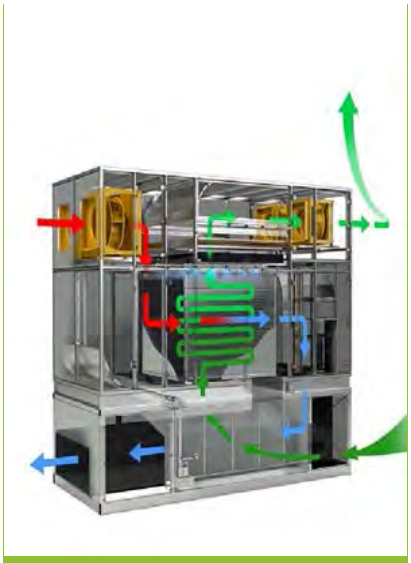
The evaporator unit has the benefit of being self-cleaning and relatively maintenance free. The polymer heat exchange tubes and stainless steel housing containing them provides excellent corrosion resistance, even in the harshest of environments. The heat exchanger tubes are manufactured with small ribs to increase the surface area and create air turbulence to improve heat transfer; this turbulence has an additional benefit in that it causes the polymer tubes to vibrate gently, which helps ensure any deposits that accumulate on them during evaporation are dislodged keeping them clean. Munters has also carried out extensive research to prove that there is no risk of Legionella bacteria forming in the evaporator.

A major advantage of using indirect evaporative cooling technology is that it enables the data centre white space to be sealed and positively pressurised. As a result, the Air-to-Air modular data centre is not subject to external pollutants or contaminants.

A dedicated control system has been developed to ensure the ATP units operate at optimum efficiency. The unit's performance, under a wide variety of conditions, has been verified under test in Munters' environmental chamber. The controls feature an algorithm to balance the data centre heat load with the ambient wet bulb temperature to ensure the evaporative cooler runs at optimum efficiency. Evaporative cooling is a variable as a function of ambient conditions, so the control strategy will ensure a constant supply temperature by varying the amount of outside air passing across the heat exchanger tube in response to variations in the cooling load. In addition to optimising the performance of an individual ATP, the controls have been configured to enable an entire installation to be run at the optimum performance.

To ensure every Air-to-Air module is of consistent high quality and to help speed construction, the data centre modules are built off-site. The modules are available in widths of 2.4m or 2.9m, to enable them to be easily transported by road. The white space module is 12m long, the ATP modules 6m long.

All the cooling equipment and controls are factory installed to enable the DigiPlex Air-to-Air modular data centre to provide a ready-made, scalable, sustainable and economic data centre solution that can be tailored to match customer demands for an above ground data centre anywhere in the world.



Internal arrangement of ATP as deployed

For the way in which the Air-to-Air unit is optimally controlled

Future Thinking & Design Concepts