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SYSKON_4.0 AND THE KONVEKTA-CONTROLLER

syskon_4.0

A milestone in energy recovery

New mathematical approaches facilitate very much higher computing speeds. This makes it possible for us to extend the system boundaries by optimizing energy saving measures for ventilation and air conditioning technology. Energy recovery systems can now be viewed as an integral component of building technology as a whole. Their influence on the different maintenance groups and on construction plans can be taken into account.

OPTIMIZATION AND REGULATION OF A HIGH EFFICIENCY CIRCULATORY NETWORK ERS

Syskon_4.0 and Konvekta-Controller:

« A high efficiency circulatory network energy recovery system (ERS) must not only have the ideal dimensions, it also needs to be optimized to achieve maximum performance. »

OPTIMAL FUNCTIONING OF A HIGH EFFICIENCY CIRCULATORY NETWORK ERS

A high efficiency energy recovery system (ERS) not only reduces the annual energy consumption associated with heating, cooling and dehumidification of the ambient outside air, but also decreases peak heating and cooling demand, helping to minimize any central plant investment requirements.

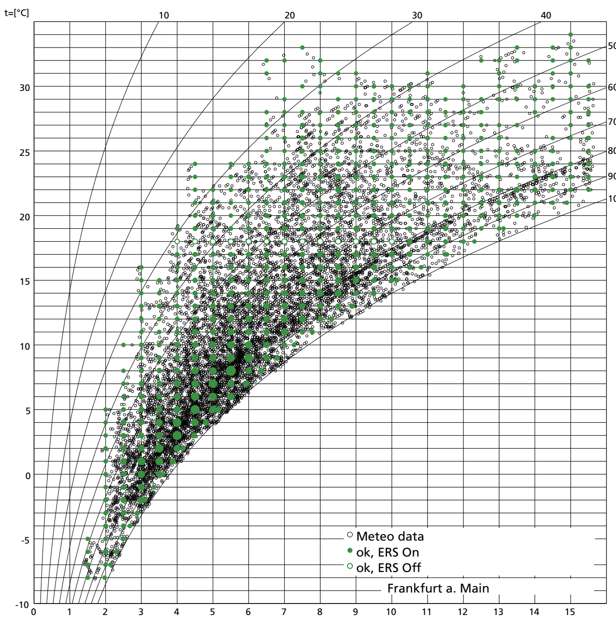
Proper design and selection of an ERS is a critical element in maximizing energy recovery efficiency and economic benefit.
The ERS design should take into account system performance at all potential operating conditions. Syskon_4.0, was specifically developed to facilitate the design and selection of ERS components (including coils, pumps and valves) necessary to achieve maximum performance.

An optimized ERS design commonly provides 70-90 percent of the make-up air heating requirement, resulting in much lower monthly and annual utility expense in addition to less $C0_2$ emissions.

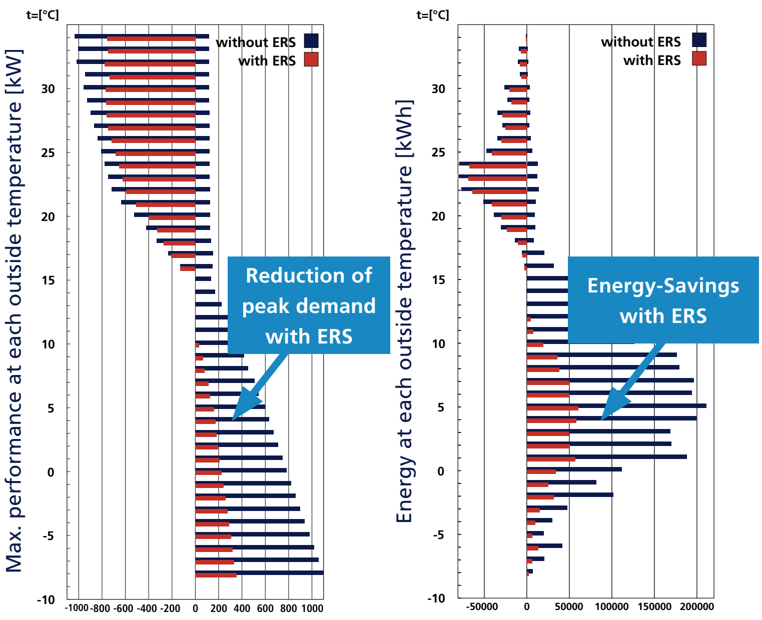
Once the ERS design has been optimized, and the ERS installation completed, the next consideration is the actual day to day operation of the ERS. An important factor in the operation of the ERS, is a user interface which provides facilities maintenance personnel with an easy to use performance and diagnostic tool, such that any performance anomalies can be quickly identified and corrected resulting in failure free operation over the life of the system.

Optimization and Performance monitoring

The Konvekta-Controller delivers best in class energy performance at all operating conditions, by continuously monitoring and adjusting each operating variable, and immediately alerting the operating personnel of any performance anomalies.



Optimization of the ERS across the entire operating spectrum, from minimum to maximum external conditions



ERS delivers savings at peak demand levels (at peak performance) and also optimizes energy requirements for heating, cooling and dehumidification of the ambient air.

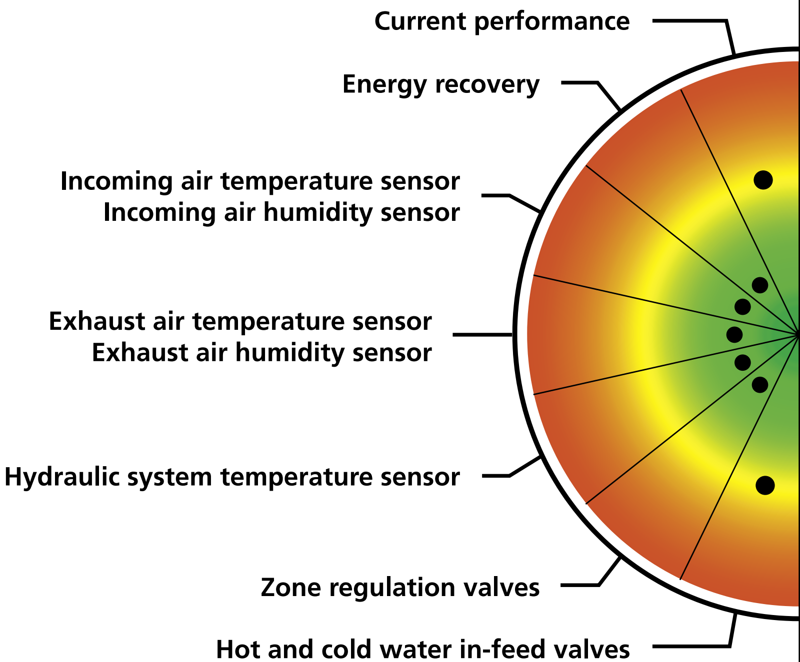
THE KONVEKTA-CONTROLLER

Functional monitoring and Regulation means optimal performance

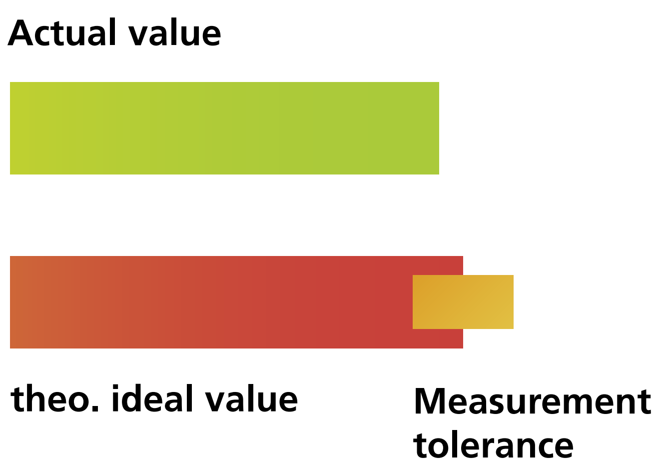
The Konvekta-Controller monitors and regulates the ERS, including any plate heat exchangers fed by central heating or cooling plant systems. Feedback from temperature, humidity and airflow sensors allow the Konvekta-Controller to analyze actual system performance in comparison to a simulated optimal performance value. The Konvekta-Controller also uses pump, valve and coil characteristics as part of the active simulation process.

Any discrepancy between the ideal and the actual values will result in an automatic user notification, such that any corrective action necessary to restore the system to peak efficiency can be initiated.

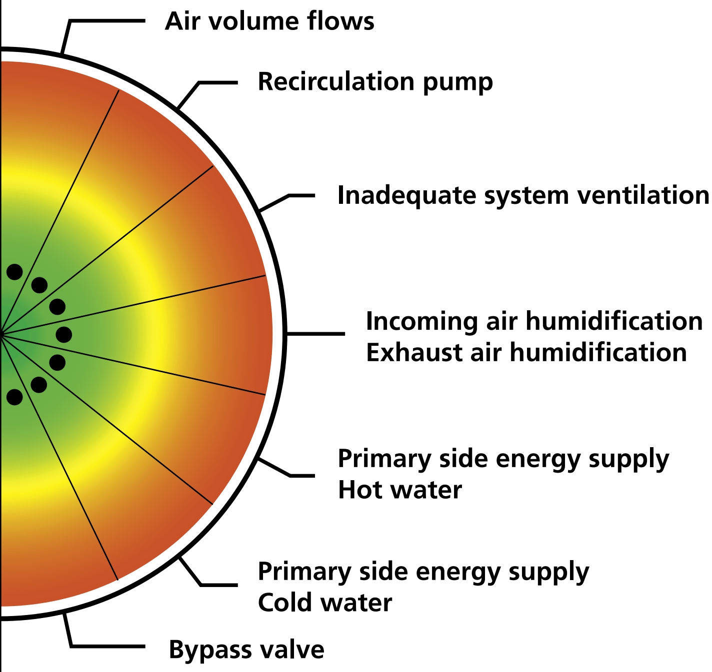
The simple comparison of a setpoint prescribed by the building automation system to the actual controlled variable feeback (e.g. the reading of the discharge air temperature) is not generally an effective means for maximizing efficiency. Where this approach has been used, the building automation system would automatically compensate using another source of heating or cooling, as necessary to achieve the discharge air setpoint, and the malfunction or reduced performance would typically go undetected.



Reporting and analysis of a deviation



Comparison between the computed ideal values for essential system data under the currently registered operating conditions and the effectively achieved actual values.



Technological Advancement

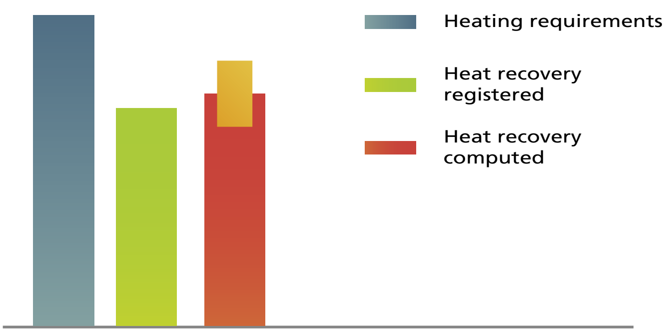
Prior generations of ERS did not allow for the effective tracking and verification of actual energy efficiency savings. Fortunately, with the application of recent technological advancements, facilities professionals now have the ability to easily visualize real-time performance data.

Current technology is able to go beyond an ability to optimize the design of the ERS, providing a new level of confidence that the ERS is performing optimally at all operating points, and the ERS manufacturer has been able to deliver the savings promised or guaranteed. This is a much higher level of assurance than the simple verification of performance at a single operating point.

An additional benefit of the available technology includes the ability of the ERS manufacturer to perform the ongoing commissioning and fault detection necessary for the achievement of optimized performance, throughout the initial year of operation and beyond. Real-time monitoring also helps to identify and eliminate any operational anomalies throughout the start-up and warranty periods.

A guarantee and validation process generates the documentation necessary to report any performance shortfalls, while providing a basis for the assessment of any financial penalties, should the ERS fail to achieve the prescribed energy savings results.

Energy data

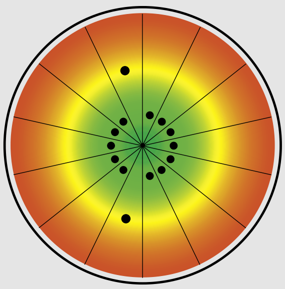


Example: comparison of the computed ideal values for energy and heat recovery, under the operating conditions registered, with the effectively achieved energy recovery levels.

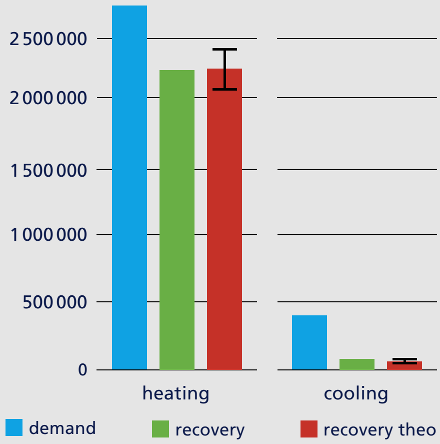
KONVEKTA-CONTROLLER VISUALIZATION

The transparent graphic representation of the most important system data makes it easy for customers to monitor performance.

actual state



energy sums actual year

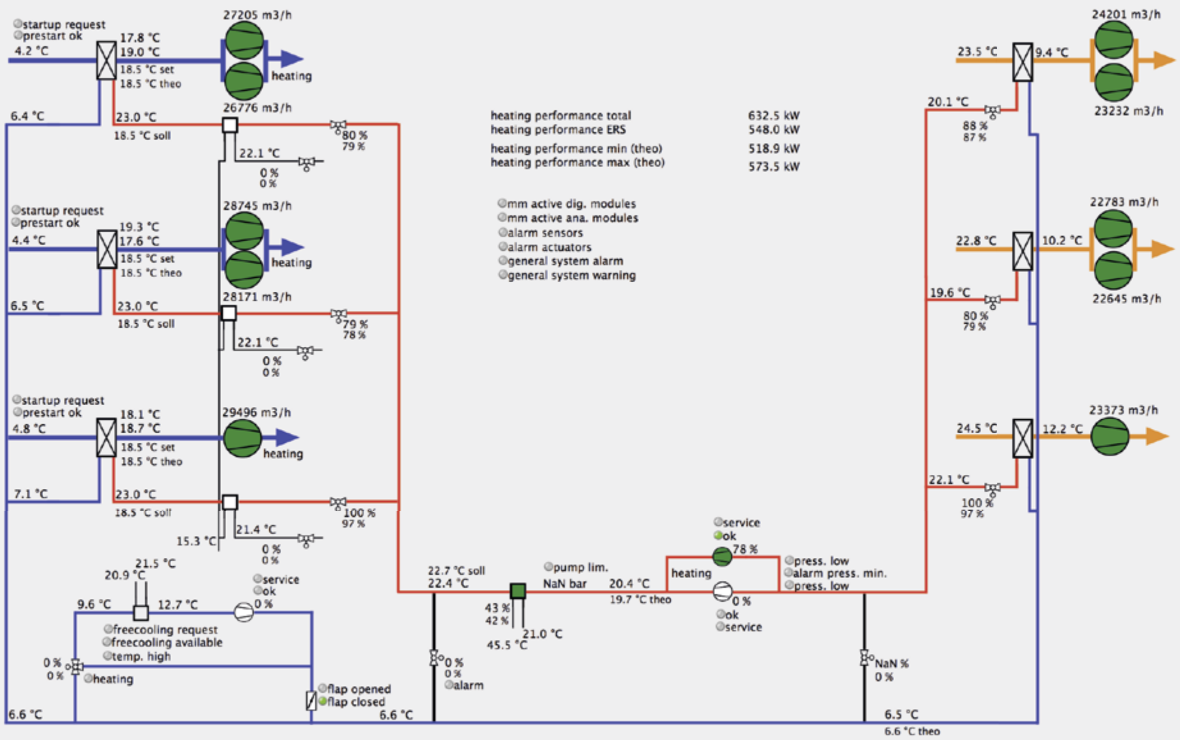


amounts over lifecycle

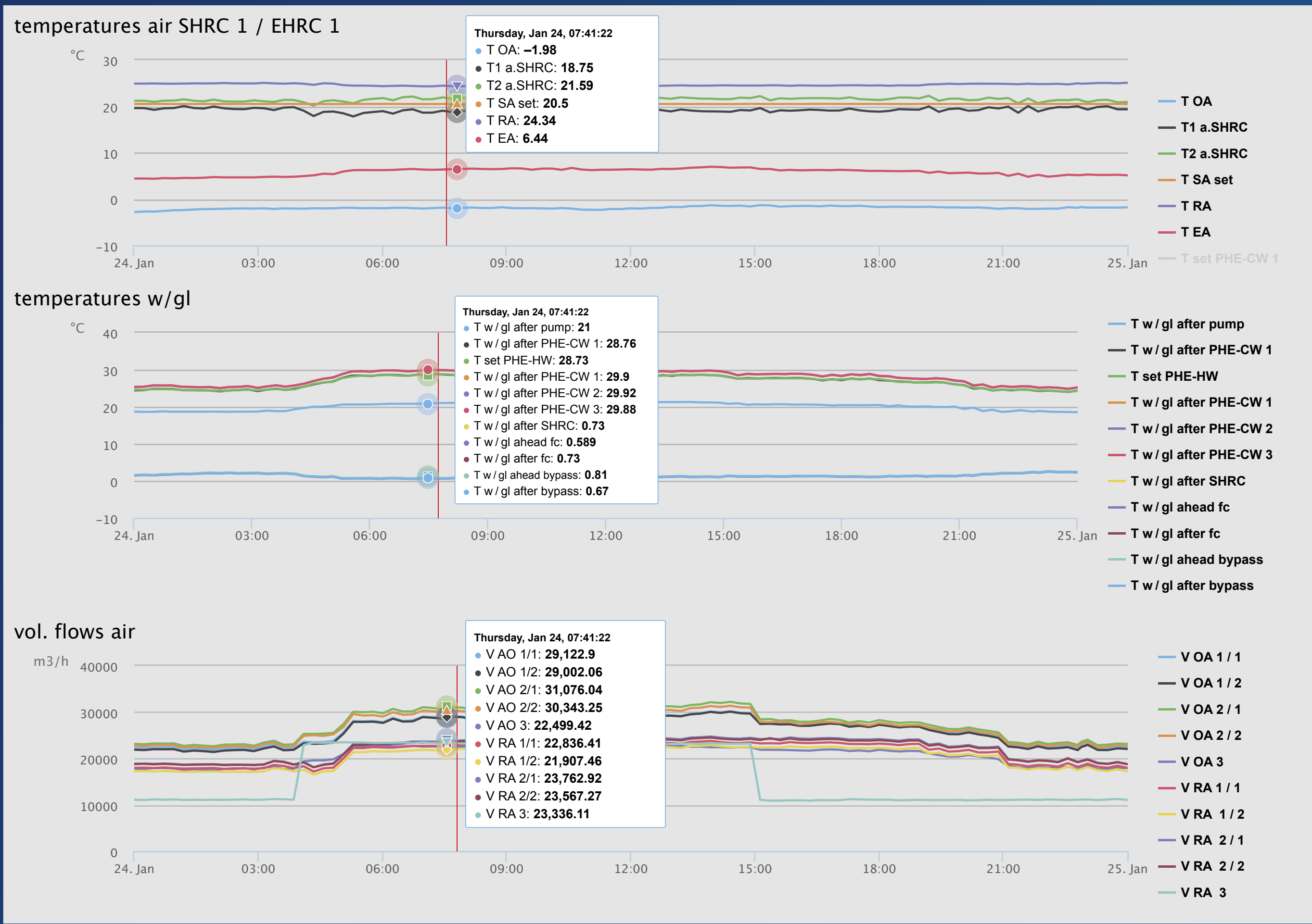
system in operation since: January 2018

total saved heating energy (kWh))	2255914
total saved cooling energy (kWh)	77048
total saved CO_2 (kg)	836837

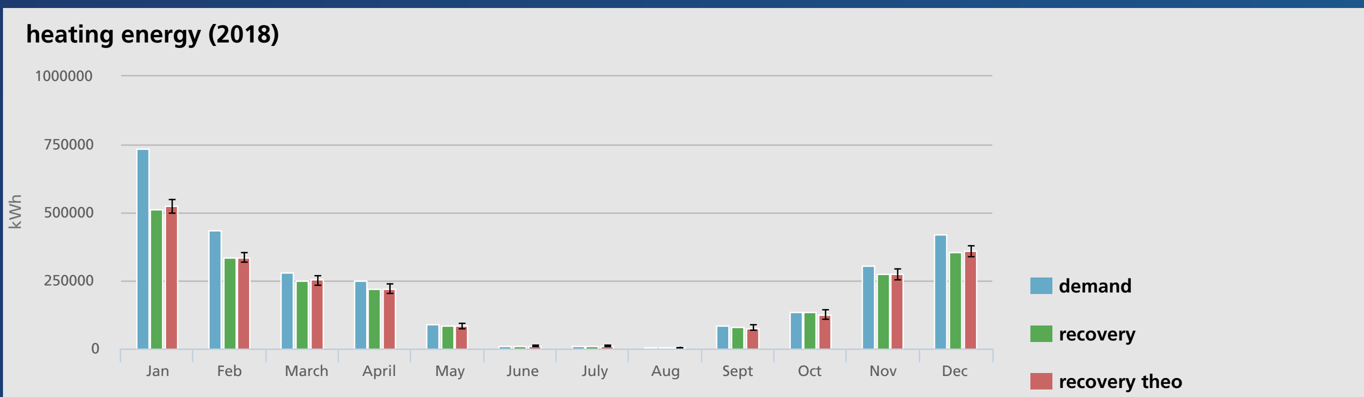
The Konvekta-Controller conducts ongoing simulation of the operation of the system, and compares the theoretically determined values with the effectively achieved ones. In case of any deviation of the effective values from the target values, an automatic notification will be given along with the analytical results.



The Konvekta-Controller supports static control of the data currently supplied by the ERS at any time.



The Konvekta-Controller supports the checking and analysis of dynamic performance.

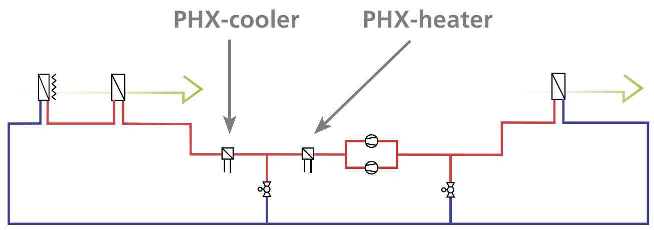


heating energy (2018) / (kWh)	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	total
demand	737081	433719	280690	249644	90008	9560	11244	4496	83575	137051	306034	419171	2762273
recovery	519115	337247	250386	218942	86554	9560	11180	4427	82347	132515	276931	356710	2255914
recovery theo	523057	336401	253304	220752	84741	9126	10572	3691	77058	126657	274103	359955	2279477
recovery theo range (max)	549239	353695	269601	235471	94021	11156	12657	4843	87931	142569	294972	378655	2434810
recovery theo range (min)	496852	317439	231094	201444	73688	7344	8469	2737	65007	109322	251215	337718	2102329

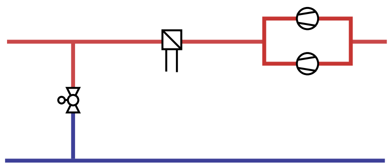
The energy requirements and energy recovery levels for heating of the ambient air can thus be compared for every month throughout the year.

SPECIAL FEATURES OF THE DIFFERENT ERS SYSTEMS

Syskon_4.0 facilitates the optimization of different system configurations, taking into account the significant influential variables. The Konvekta-Controller makes it possible to convert the ideal performance characteristics, as determined by Syskon_4.0, into actual performance results. The following diagrams are examples of typical system configurations which can be effectively optimized with the use of the syskon_4.0 and Konvekta-Controller:



Heating and cooling via plate heat exchangers to the hydraulic system of the ERS



Bypass switching to prevent a too low temperature of water or glycol when fed into the ERS air cooling system

Multifunctional ERS systems

Heating and cooling of the outdoor air is supplemented by means of plate heat exchangers, which are integrated into the ERS hydraulic system. The facility's heating and cooling plants supply energy to the heat exhangers as needed to increase or decrease the temperature of heat recovery fluid.

In the case of a multifunctional ERS system with integrated heat exchangers, the temperature transfer efficiency of the energy recovery coils is reduced when the heat exchangers are active, which can effect the sizing of the coils.

The benefit associated with this design option, is the ability of using the heat recovery coil for all ambient outdoor heating and/or cooling function eliminating the total number of coils installed in the air stream, and reducing the overall fan energy requirements.

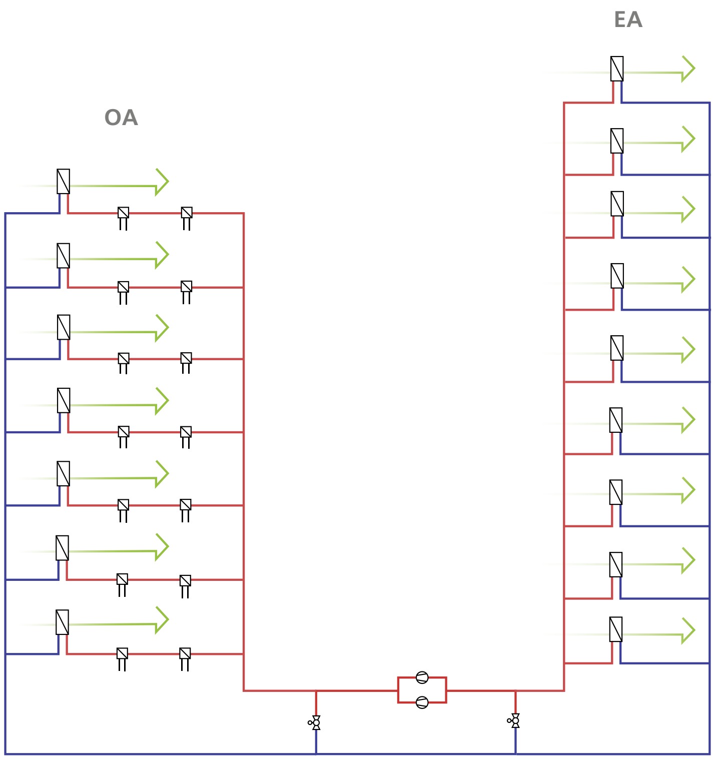
Freezing / ice formation threshold

Any ERS has a freezing threshold, based on specific operating conditions. If outside air temperatures fall below freezing, measures must be in place to ensure that any condensation occuring at the exhaust air coil does not freeze – in other words, the pipe surface temperature of the ERS coils must not be less than 0° C. With a run around energy recovery system, performance stays constant even below the freezing threshold, i.e. the heat recovery level is reduced. Frost prevention results in reduced heat recovery levels when temperatures drift below the threshold where frosting can occur.

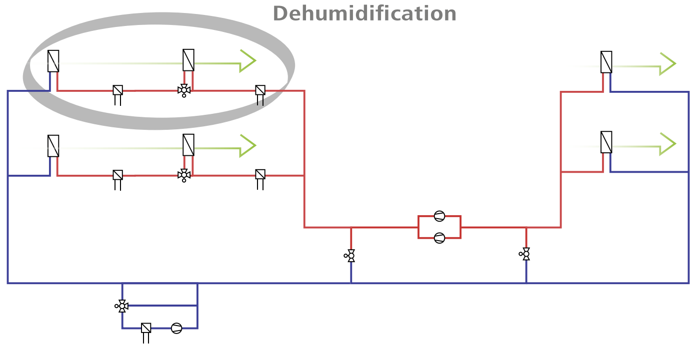
This reduced performance below the freezing / ice formation threshold must be taken into account when designing an ERS.

Consequently, measuring heat recovery efficiency at low ambient temperatures does not yield a clear picture of overall performance.

Network system



Network system with 7 supply and 9 exhaust zones all combined to one hydraulic system



Dehumidification for better conditioning of outside air

Combined systems

Multiple ERS coils in the supply airstream are connected to multiple ERS coils in the exhaust airstream via a common hydraulic system.

The energy contained in the exhaust air is available to be transferred to the incoming ambient air, based on the discharge air setpoints necessary to effectively condition the areas served by the supply or make-up air handling units.

The Konvekta-Controller is able to perform a continuous simulation, calculating the ideal fluid volume required to be delivered to each of the supply and exhaust coils, then control the pump and coil valves to achieve the optimized rate of flow through each coil.

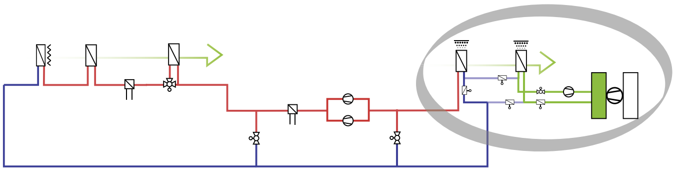
The net result of this approach is the effective distribution of available energy and a maximum amount of energy transfered from exhaust to supply.

Cooling and dehumidification of make-up air

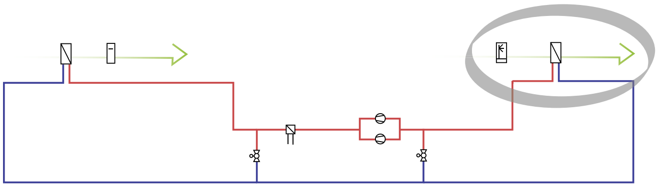
The application of a high efficiency ERS, to make-up air applications requiring dehumidification, can result in substantially lower peak cooling requirements. In the event the ERS peak benefits are taken into account when designing the central plant systems, capital costs savings can be realized due to smaller central plant equipment necessary to support the actual cooling peak demand. In the event the ERS peak cooling savings are not taken into consideration during the design of the cooling plant systems, the application of the high efficiency ERS option will none the less result in increased redundancy or capacity at peak operating conditions.

In this example, during summer months, the energy needed for reheating is recovered from either the exhaust air or the outside ambient air, while in the winter months, both supply air energy recovery coils are utilized to heat the outside ambient air as needed to achieve the discharge air setpoint, maximizing the coil surface area available for the heating function during this period.

The Konvekta-Controller will evaluate multiple options to determine the optimal energy solution, including the bypass of the exhaust coils to conserve pumping energy, in the event exhaust energy does not contribute to maximum energy conservation.



Recooling of the cooling unit via the ERS



Increased performance by adiabatic cooling

Recooling of the cooling unit by means of the ERS

Advantage of Recooling via the ERS:

- External coolers can be reduced in size or completely eliminated
- No additional sound emissions
- Structural measures for external coolers will not be required - this reduces costs

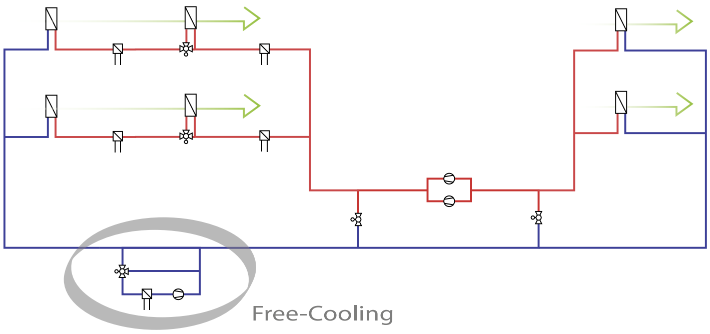
In winter both parts of the ERS exchanger in the exhaust air are activated in series, and used for energy recovery. When the remote chiller is in operation, the upstream exchanger is used for precooling of the ambient air, while the downstream exchanger is used for the recooling of the remote chiller. The ERS exchanger used for recooling purposes comes with a sprinkler system. This sprays the fins with water. Thanks to the extensive surface of the fins, and the combined transfer of heat and mass, these sprinkler recooling units achieve a high degree of efficiency.

The additional fan or pump energy required to support the recooling components is included in the design analysis and any guaranteed energy savings calculations.

This approach is often the best possible solution, in terms of both overall investment costs and energy requirements.

Adiabatic exhaust air dehumidification

Adiabatic humidification of the exhaust air makes it possible to reduce cooling requirements for the cooling and recooling systems. With lower heat loads, it is often possible to dispense cooling and recooling altogether and still achieve an acceptable room temperature.



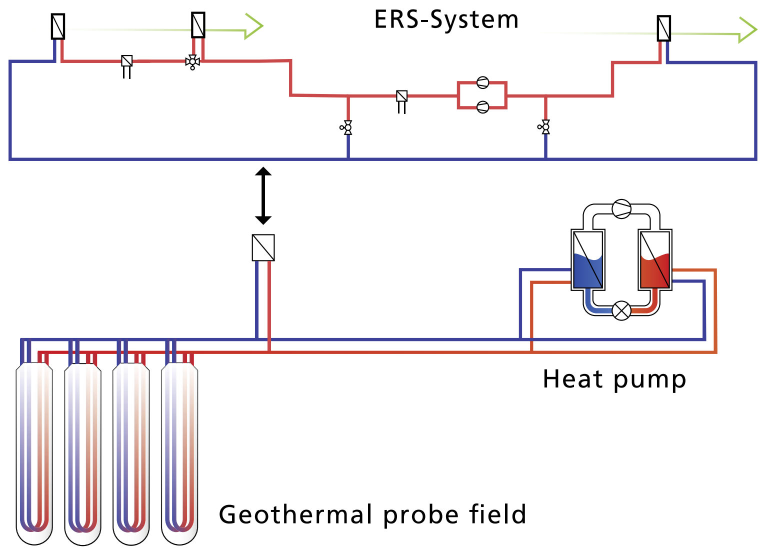
Free cooling via the ERS

Free cooling

When a system emits waste heat at low external temperatures (e.g. from circulating air cooling equipment in server rooms, cooling ceilings etc.), it can be fed into the piping system of the ERS. This achieves the following benefits:

- Additional source of heat for heating of the ambient air in winter
- The cooling system and recooling units can be switched off at external temperatures of 10 to 15° C, so saving electrical energy.

IMPACT ON OTHER TRADE



Example: Reversible heat pump / cooling unit with earth heat probes

In order to achieve a consistent performance level throughout the year, the temperature of the ground needs to remain constant. It is essential to prevent the earth from freezing around the earth heat probes. This necessitates a balance between the heat extracted from the earth in winter and the heat rejected to the earth in summer. In this context, both the energy flow associated with the earth itself, and the energy flow associated with the reversible heat pump and cooling unit need to be taken into account.

Syskon_4.0 is able to compute the energy recovery of an ERS with a high degree of accuracy, creating an ideal basis for the determination of energy quantities obtained from the earth probes for the purpose of heating the outdoor air in winter, and the energy rejected to the earth to accomplish cooling and dehumidification during the summer months. Analysis using Syskon_4.0 enables the planners to determine if design adjustments are needed to achieve an energy balance within the earth.

If during the planning stage, Syskon_4.0 indicates the balance of the energy flows in winter and summer is uneven, the planning team must introduce measures to reduce the imbalance. (For compliance with the relevant standards and directives, see SIA [Swiss Society of Engineers and Architects] Guideline 384/6).

A cost-effective option that can often be utilized is to connect a renewable energy source such as a charging station to a high effi ciency ERS. The result is warm outside ambient air in the summer being used to heat the water or glycol medium supplying the earth heat probes. An additional benefit of this option is that it makes pre-cooling of the outside air possible.
A similar strategy can be applied in winter, to cool the earth in the vicinity of the earth heat probes.

The charging station of an ERS circulatory network entails few investment costs, and the need for additional electrical energy is minimal.

The charging station thus supports the sustainable operation of a reversible heat pump or cooling unit with a high coefficient of performance, and raises the operating safety level of the entire combined system of earth heat probes and heat pumps.

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