Technical Information Crossflow Heat Exchangers

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Freezing in heat exchangers

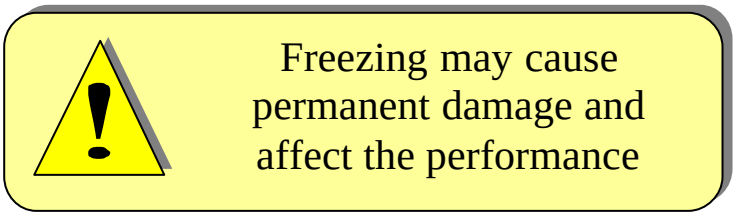
Freezing

Freezing will occur if the exhaust air is cooled down to the condensation temperature so that condensation takes place and the condensing water then comes into contact with a plate surface that has a temperature below 0°C.

The condensing temperature of the exhaust air depends on the temperature and relative humidity of the air when it enters the heat exchanger. Air containing a lot of water will have a high condensing temperature.

In a cross flow heat exchanger the temperature distribution of the exiting air is uneven, and there will be one “warm” and one “cold” corner of the exchanger.

If freezing occurs it will start in the cold corner and the exhaust air flow will then gradually decrease because of the blocking of the exhaust channel. If nothing is done this can continue until the exhaust side is completely blocked. The ice (or snow) will normally not damage the exchanger, only affect operation.



Since the heat exchanger plate will have a temperature that is in between the exhaust air temperature and the supply air temperature on each side of the plate, freezing will not start when the outside air temperature is 0°C but at a lower outside air temperature. As a rough rule of thumb, for freezing to take place the temperature of the supply air must in most cases be below approximately -8°C

(equal supply and exhaust air flows) and the exhaust air must also contain enough water so that condensation will start. The selection software Heatex Select will give an indication of at which outdoor temperature freezing in the heat exchanger may start to take place.

Preventing of freezing

One of the most common ways to prevent freezing is by totally by-passing the cold supply air when it is below a certain temperature (for example -5°C). Another way is to by-pass only part of the cold air stream, just enough so that freezing does not start. By mechanically blocking part of the heat exchanger the flow in the cold corner can be reduced and thus prevent freezing.
Another common way is to use a heater to heat the supply air before it is entering the heat exchanger.

It should be noted that a higher efficiency of the exchanger will increase the amount of condensing water and will also lower the temperatures in the exchanger and thus the freezing will start earlier compared to a heat exchanger with lower efficiency. Therefore it is not always the case that more energy can be recovered with an exchanger with high efficiency than with one with a lower efficiency if the average over a whole year is taken into account.