Frost protection and snow melting

Functions in LCC4

In LCC4 there are a few functions available for frost protection and snow melting in the heating system of the greenhouse.

Snow melting

When snow falls it is normal to use the heating system to melt the snow so no risk of damaging the building will appear due to high weight of the snow on the roof. Naturally this procedure will cause a high energy loss.

Calculation of energy loss

Phase shift from solid to liquid demands a particular enthalpy to loosen the water molecules from each other. This energy must be taken in account when calculating energy balance.

Example:

Greenhouse floor area: 3 000 m^2
Persistent snowfall intensity: 12 mm snow/h
Snow density: 60 kg/m^3
Power demand: 61,2 W/m^2
Total power demand: 184 kW

Note that this energy is just what it takes to melt the snow. It is obvious that not all power from the heating system reaches the snow. There are huge losses, especially when the greenhouse is closed for the winter; that is there is no culture in there so the air temperature is set low.

Energy screen needs to be opened, floor, benches and other parts in the construction needs to be heated before the air is warmed.

The solution

As everybody knows it is common to use special heating tubes positioned above the screen near the roof cover and/or underneath the gutters. Hereby the power loss is reduced strongly.

LCC4

LCC4 has a special function to control these "snow melting tubes". A special heat valve is assigned to be used for snow melting purposes.

The menu "snow melting" is found under *Heating/Settings/9/Snow melting*. Se fig 1 below.

- Function selector. *Off/On/Aut*.
  - *Off* means that the function is completely shut off. But even if this function is shut off, the circulation pump for the snow melting tubes can still be active. The circulation pump functions are described below.
  - *On* means that the function is running even if the conditions does not demand it.
  - *Aut* means that snow melting is activated by outdoor conditions; that is that snow fall is detected. Snow is detected when outdoor temperature is below a setting and

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precipitation is detected by the rain sensor.

Snow melting

Function selector	Off
Function selector, valve	Stop
Minimum flow temperature	0.0 °C
Maximum flow temperature	70.0 °C
Flow temp. by snow	60.0 °C
Stop delay	00:00:01
Pause factor	1.0
Step factor	1.0

Readings

Flow temp. demand	0.0 °C
Flow temp.	99.0 °C
Circulation pump output	0
Snow	0

Fig 1

Snow detection

Outdoor temperature for snow	1.0 °C
Delay for snow start	00:01:00
Max off delay	00:30:00
Snow detection delay factor	1

Fig 2

The *Snow detection* menu is found under *Local service/Compartment setup/6/Snow detection*. See fig 2 above.

- ▪ Outdoor temperature for snow
  - Setting of outdoor temperature to detect snow. The temperature is read from the weather station. When the weather station communicates precipitation and the outdoor temperature is below the setting, precipitation is considered to be *snow*.
- ▪ Delay for snow start
  - When outdoor temperature falls below the setting above, a delay is used before the system communicates that it is snowing.
- ▪ Max off delay
  - When snowfall has ceased the snow melting will continue during this time setting.
- ▪ Snow detection delay factor
  - A compartment local setting to make it easy to change delay for certain compartments.
- Function selection, valve
  - o This function selector sets the overall function of the heat valve.
    - ▪ Close
      - Closes the valve manually
    - ▪ Aut
      - The valve is controlled automatically
    - ▪ Open
      - The valve is fully opened manually

- Stop
  - The valve is stopped in current position
- Minimum flow temperature
  - Setting of the flow temperature that is used when no snow is detected.
- Maximum flow temperature
  - Setting of the highest flow temperature that is used even if the snow melting setting of flow temp is higher.
- Flow temp. by snow
  - Setting of the flow temp used when snow is detected.
- Stop delay
  - When snow detection has ceased the flow demand remains during this time setting.
- Pause factor
  - The heat valve is run by a "cradle type" exponential controller. If the reaction time of the fluid temperature is long, the pause factor may be increased.
- Step factor
  - The heat valve is run by a "cradle type" exponential controller that will make an open/close pulse longer the higher value. Step factor x 40 sek = maximum step length. A DGT heat WV2 valve has a running time on 5 minutes. In this case a 0 – 40 seconds step length is optimal. A faster valve should be set to a lower value.
- Flow temp demand
  - Reading of the current flow temp demand
- Flow temp
  - Reading of the current flow temp
- Circulation pump output
  - Reading of the current state of the cirk pump. 1 = running, 0 = Stopped.
- Snow
  - Reading if snow is detected. 1 = Snow, 0 = No snow.

Circulation pump

Frost protection	On
Frost protection start	1.0 °C
Frost protection hysteresis	0.5 °C

Fig 3

The settings for the snow melting circulation pump is found under *Heating/Service/1/Heating setup/Frost protection*. See fig 3.

- Frost protection
  - On means that the function is activated and the pump runs when outdoor conditions says so.
- Frost protection start
  - Setting of outdoor temperature read from the weather station that will start the circ pump.
- Frost protection hysteresis
  - When outdoor temperature is lower than *Frost protection start* setting –Hysteresis the pump will run. The pump will stop when outdoor temperature is higher than Frost protection start + Hysteresis. In the example on Fig 3 the pump will start when outdoor temperature goes under 0,5°C and stop when outdoor temperature goes over 1,5°C.

Extended use of Frost protection.

The frost protection function is convenient to use when keeping freeze free in the greenhouse at winter when no crop is present and you want to avoid that the heat tubes freezes.

In these conditions it can happen that the pump does not start when the demand for higher flow temp occurs to avoid freezing. Normally the pumps only starts when a heat demand is detected. Heat demand is present when the flow temp demand is higher than the air temp demand. When running in low temperatures in the greenhouse air, +0.5 - +2.0°C, e.g. the hysteresis, normally on +/- 0.5° can make a malfunction. To avoid this it is possible to start the pumps in relation till outdoor temperature instead. A skilled technician from CM Teknik can make the necessary minor changes in the installation to make it work. The frost protection output in the *Expansion* is simply connected to the pump outputs via diods.

To make frost protection safer it is recommended to use the return flow instead as the outgoing flow for the flow temperature sensor. Place a second flow sensor on the return tube and connect to a switching contact with a *winter* and a *normal* setting. When using return flow sensor, the controller works suboptimal, so it is not recommended to use it when having crops in the greenhouse.

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