RO Plant: Using the LCD Screen

The plant can be controlled via the LCD screen.

The up and down arrows scroll through the different pages of the display.

The state of the plant can be understood by observing the second line of the second page. The second line alternates between displaying the time spent in the current state, a description of the current state, and a message explaining any faults.

Certain pages allow the modification of parameters. Press both the F1 and F3 buttons together to move to edit mode. In edit mode, press the up and down buttons to change the parameter's value. Once the desired value is shown, press the enter key (immediately left of the up button) to set the new value.

The plant will process product until a certain concentration factor has been obtained. For example, if you wish for a two-fold concentration of the product, set the concentration factor to 2.00. If the plant stops because the desired concentration has been reached, it will display a message indicating this.

The last display page specifies the control algorithm. The original algorithm was designed for the use of all eight membranes, however if the alternative pipework is installed such that only one membrane is used, then the control algorithm needs to be changed. The original (8-membrane) algorithm is specified by setting the control algorithm to zero. The single-membrane algorithm is specified by setting the control algorithm to one.

Original Control Algorithm (#0)

When eight membranes are installed, the permeate flow is able to be reliably measured by FT03. The control algorithm has three important process variables: the differential pressure along the membranes (DP12), the proportion of flow through the permeate line compared to the retentate flow (R13), and the proportion of flow through the bypass line compared to the permeate line (R21).

The setpoints associated with the process variables are DPC12SP01, R21SP01, and RC13SP01. These need to be set before the production process is started.

Single-Membrane Control Algorithm (#1)

When a single membrane is installed, the permeate flow measurement via FT03 is not reliable. This control algorithm has three important process variables: the differential pressure along the membranes (DP12), the proportion of flow through the bypass line compared to the retentate flow (R23), and the desired pressure (PT01).

The setpoints associated with the process variables are DPC12SP01, RC23sp, and PC01sp. DPC12SP01 needs to be set before the production process is started, however RC23sp and PC01sp should be set during processing.

The operator should observe the flow of the permeate. If an increase in permeate flow is desired, the pressure setpoint PC01sp should be increased. However, it is important not to increase this value too quickly. Moving the value by one bar is acceptable. Once the value is changed, the operator should observe R23 to ensure that the system is stable before further increasing the operating pressure.

1. Press the Production button. The plant does a number of checks, then fills the pipework will product and starts up the pumps. When the plant has reached the “Step 06: Production” state (as displayed on the second line of the second screen) it is starting to produce permeate. The plant begins operating at a low pressure with the bypass line fully open. The target operating pressure (PC01sp) is set at this low pressure.
2. Increase the target operating pressure from where it is (at the start this might be around 3.5 to 5.5 bar) by about 1 bar (that is, an increase of 100 on the LCD). To do this press the up or down arrows below the LCD until you see PC01sp. Press the F1 and F3 buttons simultaneously to enter edit mode. Press the up arrow to increase the target pressure. Press the return button to set the target pressure.
3. Observe the value for PT01 on the LCD. The plant should fairly quickly attain the desired operating pressure. Wait until the desired pressure has been attained is stable.
4. Observe the value for RC23sp. It will be set to 10000, which equates to a target of 100% of flow through the bypass. This is clearly a physically impossible target, but it guarantees that the machine will be putting as much flow through the bypass as possible. This is a stable state.
5. Observe the value for RC23. This is the percentage (multiplied by 100) of flow actually going through the bypass. At the start this will be around 7.5 to 9.5%.
6. Round down RC23 and set RC23sp to this value. This will mean the plant is now targetting what it is currently achieving in terms of flow through the bypass. CV01 will start to close, however given the plant is currently achieving the desired bypass flow percentage, the signal is very weak for where CV01 should sit.
7. Increase the target operating pressure by increasing PC01sp by 1 bar (a value of 100 on the LCD). You will hear the speed of PP01 increase. You can observe PT01 to see the target pressure is being sought. At the same time, CV01 will be seeking to control the bypass flow.

Wait until both PT01 and RC23 are (approximately) at their specified targets and are stable. This may take several minutes.

8. Observe that CV01 is not at either end of its range (that is, it is not near 0%, nor near 100%). This is important because if CV01 is near either extreme then the system will not be able to control the proportion of flow through the bypass. (It is important that there is flow through the bypass, otherwise the retentate in the pipework may become so devoid of its permeate that the viscosity changes to the point that it can no longer be pumped.) If CV01 is too near 0%, it cannot open enough; reduce the target bypass percentage (reduce RC23sp by say 0.5 percentage points, or 50 on the LCD display). If CV01 is too near 100%, it cannot close enough to achieve the target bypass flow; increase the target bypass percentage (increase RC23sp by say 0.5 percentage points, or 50 on the LCD display).
9. Observe the speed of pump PP01 (P01SPD). If the pump speed is too near 100%, it cannot run fast enough achieve both the target pressure and the target bypass rate. Assuming you really do wish to run at the current target pressure, the only option is to decrease the target bypass percentage (decrease RC23sp by say 0.5 percentage points, or 50 on the LCD display).
10. If you have made a change to the target bypass percentage in either steps 8 or 9, wait until the values of PT01 and RC23 are (approximately) at their specified targets and are stable. This may take several minutes.
11. If permeate flow is insufficient you will need to increase the target operating pressure. Return to step 7.

Desired Concentration

The desired concentration is displayed as the factor that the volume will be reduced by, thus if the display reads 2.00, the plant will stop when the current volume in the machine is about half of the initial volume.

When in edit mode, the display will read the same, but without the decimal point, thus a factor of 2.00 will be displayed as 200.

PC01sp

The pressure setpoint PC01sp displays in bar, but without the decimal point. Thus 800 should be read as 8.00 bar.