MED-WET

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PRIMA
IN THE MEDITERRANEAN AREA

SLECI

Operation and Maintenance Manual

November 2023

Project

Improving MEDiterranean irrigation and Water supply for smallholder farmers by providing

Efficient, low-cost and nature-based Technologies and practices Project (MED-WET)

Deliverable Leader

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Dissemination Level

MedWet partner countries

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MED-WET

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1. Introduction

"SLECI" technology (Self-regulating, Low Energy, Clay based Irrigation) is a self-regulating subsurface irrigation technique that uses the actual suction force of the surrounding soil for regulation of the system's water release. Its concept, production and installation are simple and thus adaptable to rural environments saving on water and energy. Water is transported via clay tubes which have a higher suction tension than the applied hydraulic pressure, so the surface of the clay tubes stays damp.

The SLECI is a simple, clay-based, self-regulating invention that can increase crop production while saving on water and energy.

2. Components of the SLECI System

The Kit for each pilot contains the number of items appropriate to the irrigation plan for the field. It is designed for Water supply by water tank or pressure water.

2.1 VCA Vertical Control Assembly VCA

- Water meter (Wm)
- Float valve (FV; pressure reducer)
- UV-C filter (optional)
- Inlet valve
- Pipe mains DN16mm
- Mounting pole
- Mounting plate for VCA

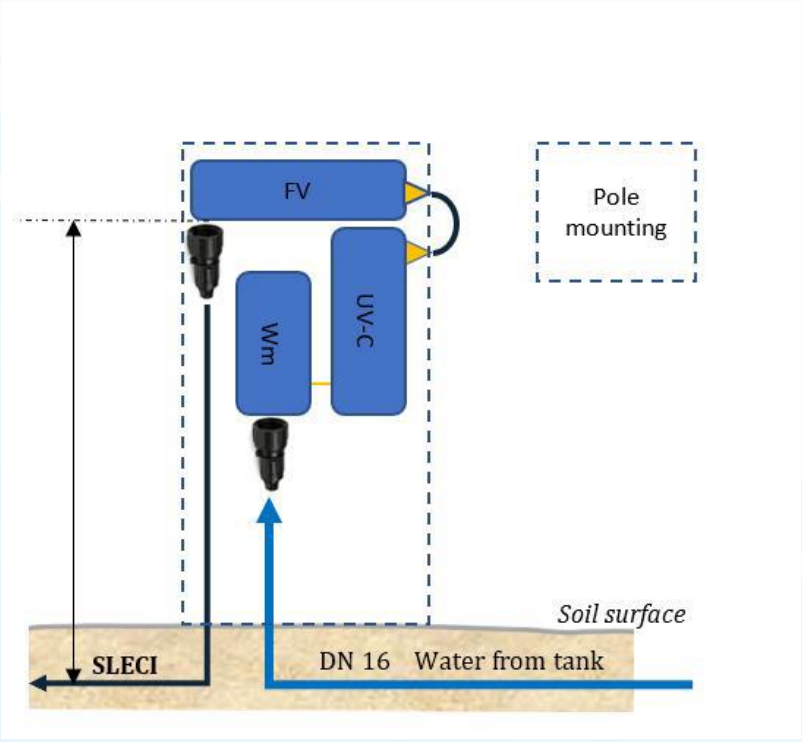


Figure 2: Vertical Control assembly VCA consisting of Float Valve FV, water meter Wm, ultra-violet filter UV-C, mounting Pole.

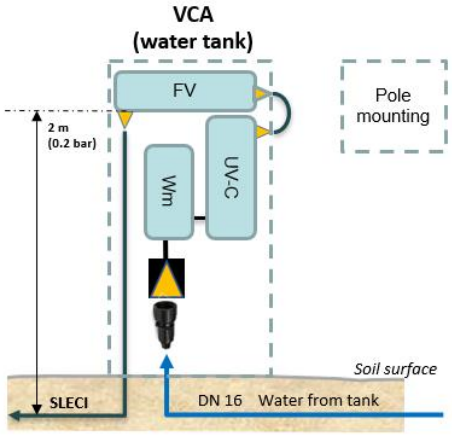
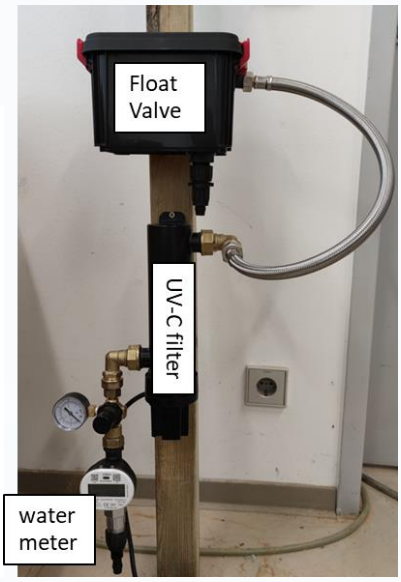
2.2 PE-hose and connectors for Sleci drippers.

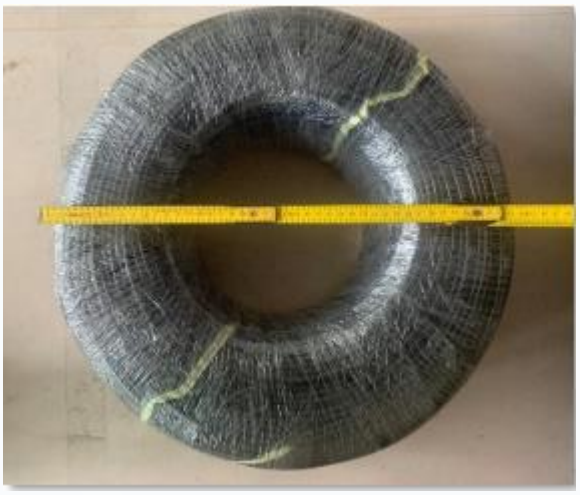
- Mains line 16mm
- T – barbs 16-16-16mm
- Elbows 16mm
- PE- hose 6mm
- T-barbs 6-6-6mm
- Connector 6-6mm

- Cable ties/ endcaps for end closing DN 16mm, DN 6mm hoses
- Digital manometer

optional

- T- barbs 16-6-16mm
- End cap 6mm

No.	Part	Sketch/Photo
A	Vertical Control Assembly (VCA) Including • water meter • Float valve • UV-C filter • inlet valve With compression fittings • to DN 16 pressure water • to DN 16 SLECI main line	  • designed for a pressure supply connection of more than 0.4 bar • maximum pressure connection: 3.5 bar • optional UV-C filter can be included • *not included: water tank, DN 16 / 20 hoses, mounting pole*

B	PE-hose 6 x 4 mm connectable for SLECI elements	
C	SLECI elements Type A: branch-line (branch line connection to main lines) Type B: in-a-row (emitters connected in series)	 
D	Connectors SLECI connectable tube size: • 6 x 4 mm • DN 16 mm *connection of the main line to SLECI lines*	 t-barb 6-6-6mm  T-barb 16-6-16 mm  straight-way 6-6 mm
E	Connectors main line connectable tube size: • DN 16 mm	 
F	Endcaps connectable tube size: • 6 x 4 mm	

G	Cable ties/ Endcaps	a) End closing DN 16 hoses or 6 mm hoses b) Fastening VCA to the vertical pole  
H	Mounting device for the VCA	Fastening Float Valve (FV) 
I	Digital manometer	

3. Preface

The SLECI system consists of only a few partly preassembled elements which have to be completed on the field by plastic hoses (16 mm and 6 mm) of the appropriate length.

3.1 Variants of the SLECI System

Sleci system type A, type B

- Type A: branch line (vertical or horizontal subsurface)
- Type B: in-a-row (horizontal subsurface lines)

Irrigation water supply

- by pressure water
- by a (overhead) water tank

Pressure control

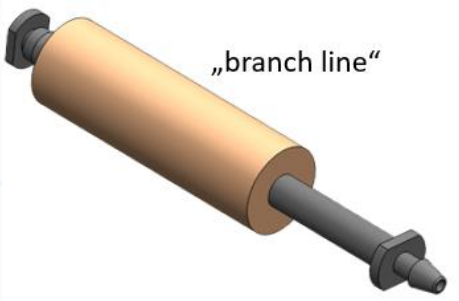
- float valve: only for pressure ≥ 0.4 bar
- float valve mounting at the appropriate height

embedded SLECI

- directly in soil
- a sand interphase

3.1.1 Side View Type A

For type A, SLECI elements are branch lines predominantly in a vertical orientation to the surface. Also horizontal laying schematics (subsurface) of branch lines may be appropriate.



The type of SLECI elements type A is “branch line“ (with an endcap at the end). SLECI elements may be composed of 1 or 2 clay emitters (SLECI-element) in line.

SLECI elements are connected to a 6 mm line to the main line (6 mm or DN 16/20) for water supply.

In case of a DN 16/20 main line, in a field without gradient very long SLECI lines can be realized.

In case of 6 mm main lines, the maximum length of the SLECI line has to be limited depending on the water release of the single SLECI element, the slope of the terrain and the applied pressure. The main line may be positioned directly on top of the soil surface or in an appropriate height, if field work is thereby simplified. Main lines may also be positioned in an appropriate height for field work or subsurface in a trench.

Normally type A is considered for vertical application. Therefore, the preparation of the field requires a bore hole of 6 – 8 cm diameter for installation of the SLECI-element. The following Fig. 3-1a and 3-1c show schematically the SLECI irrigation system Type A containing all elements.

Pressure Water Supply

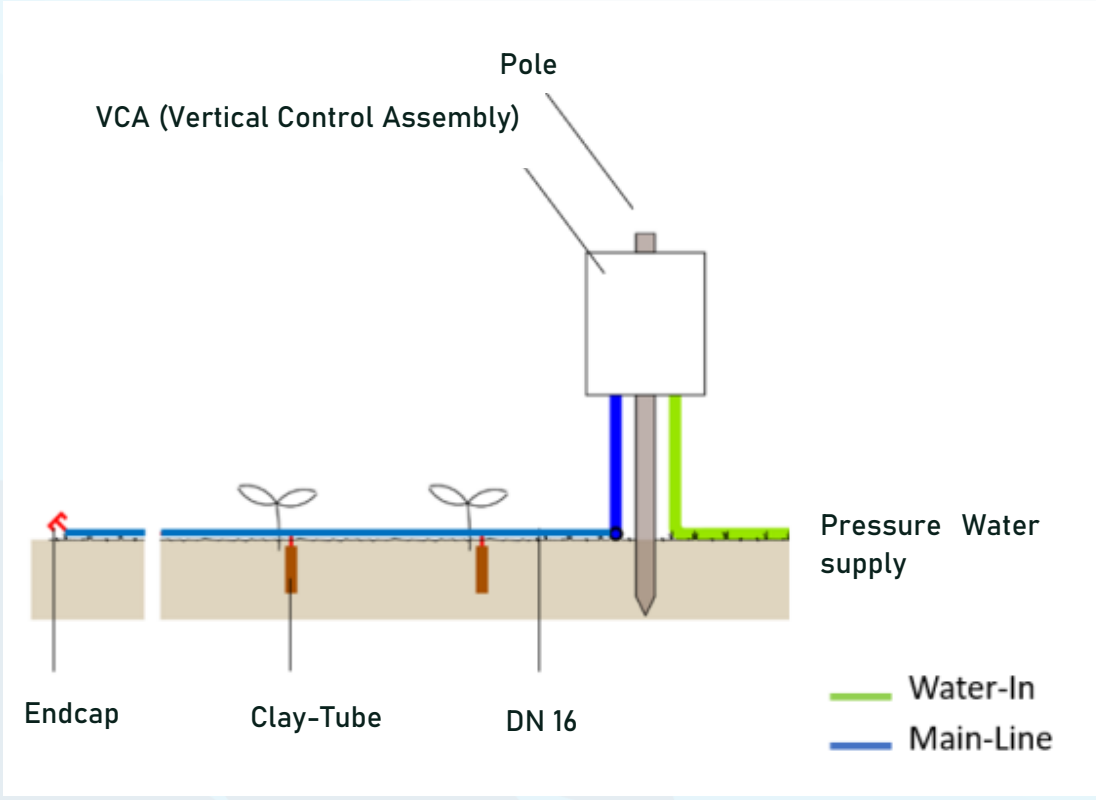


Figure 3-1a: SLECI system Type A / water supply by pressure water schematically

The main line is connected to a VCA (vertical controll assemply), that controlles the hydraulic pressure of the SLECI line and contains a water meter. If necessary also a UV-C filter is part of the VCA.

Water Tank Supply

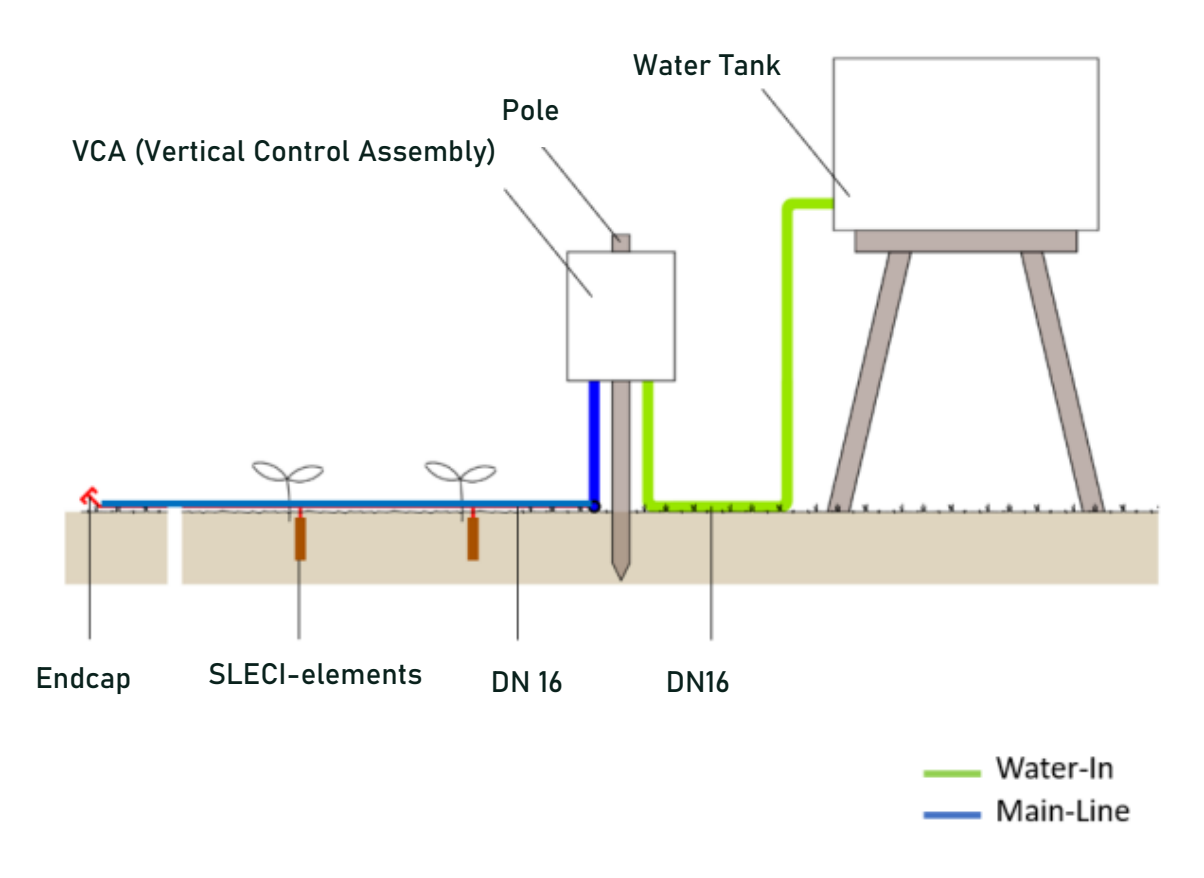


Figure 3-1b: SLECI system Type A / water supply by a water tank schematically

The SLECI main line is connected to a VCA (vertical control assembly), that controls the hydraulic pressure of the SLECI line. If necessary, also a UV-C filter is part of the VCA.

Positioning in soil and sand bed

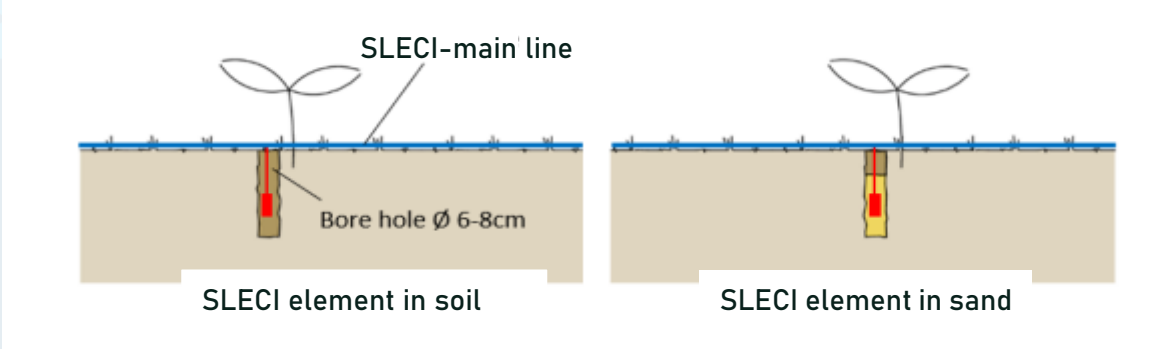


Figure 3-1c: SLECI system type A side view; Figure 3-1b: SLECI system type A side view; SLECI elements embedded in soil (left) or in a sand bed (right)

The following figures show the top views of installed SLECI elements type A in different situations:

- Fig. 3-1d: Installation for new plantings
- Fig. 3-1e: Installation for older plantings

The figures also demonstrate the variables in:

- number of SLECI elements per crop
- embedding the SLECI elements in soil or in a sand bed
- main line: 6 mm hose or 16 mm tube

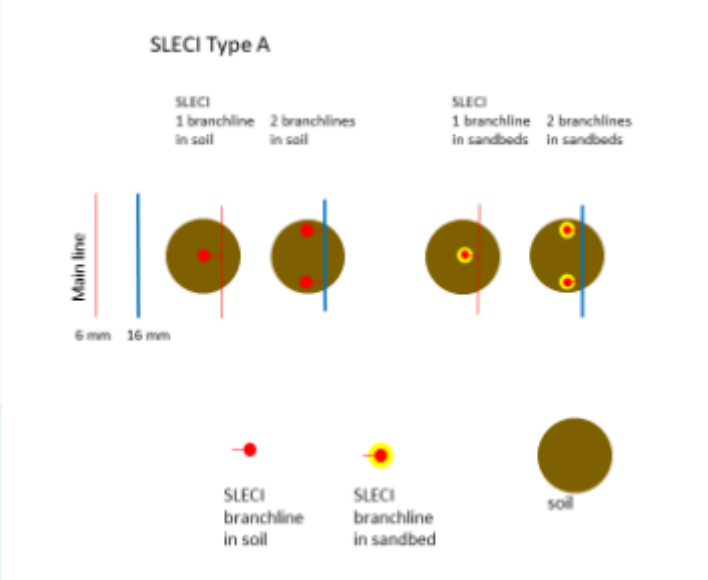


Figure 3-1d: SLECI system Type A variants for new planted crops

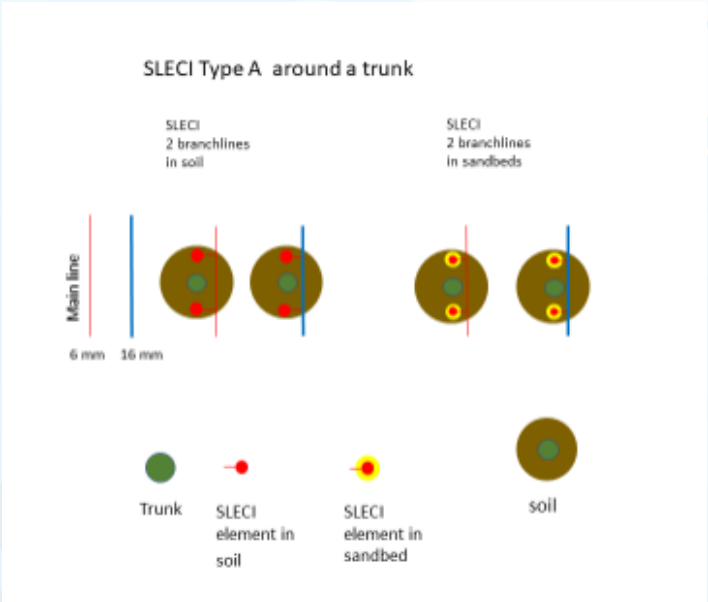
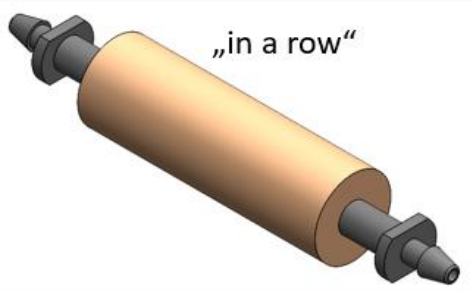


Figure 3-1e: SLECI system Type A variants for older crops

3.1.2 Side view Type B

The following Fig. 3-2a and 3-2c show schematically the SLECI irrigation system Type B containing all elements.



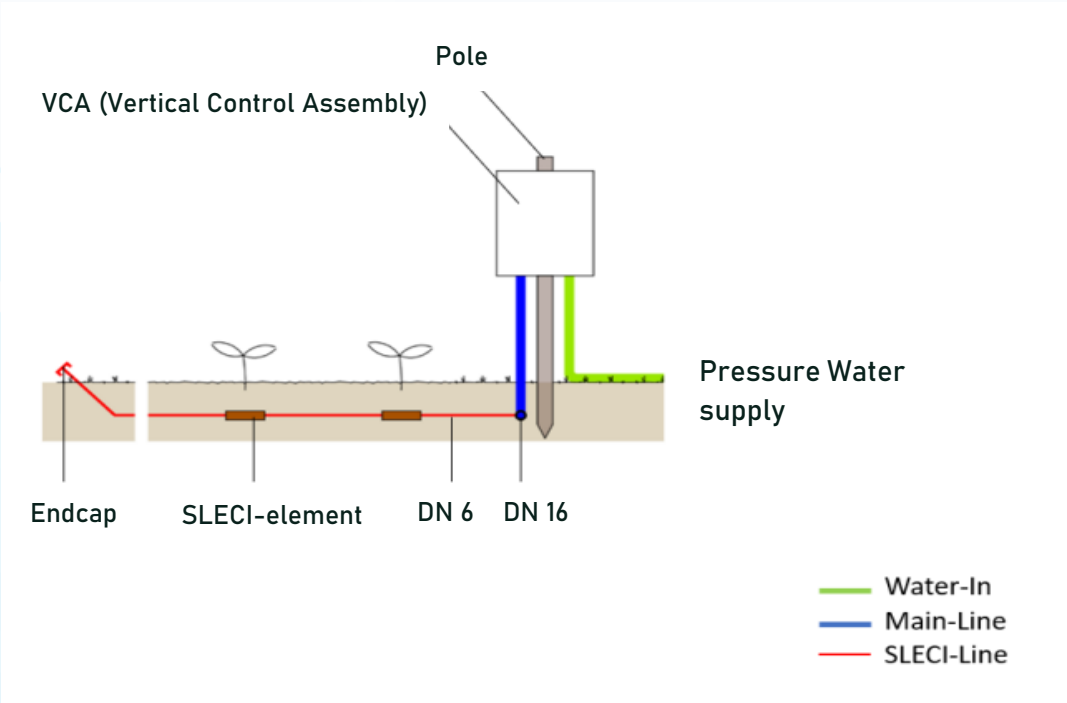


Figure 3-2a: SLECI system Type B / water supply by pressure water schematically

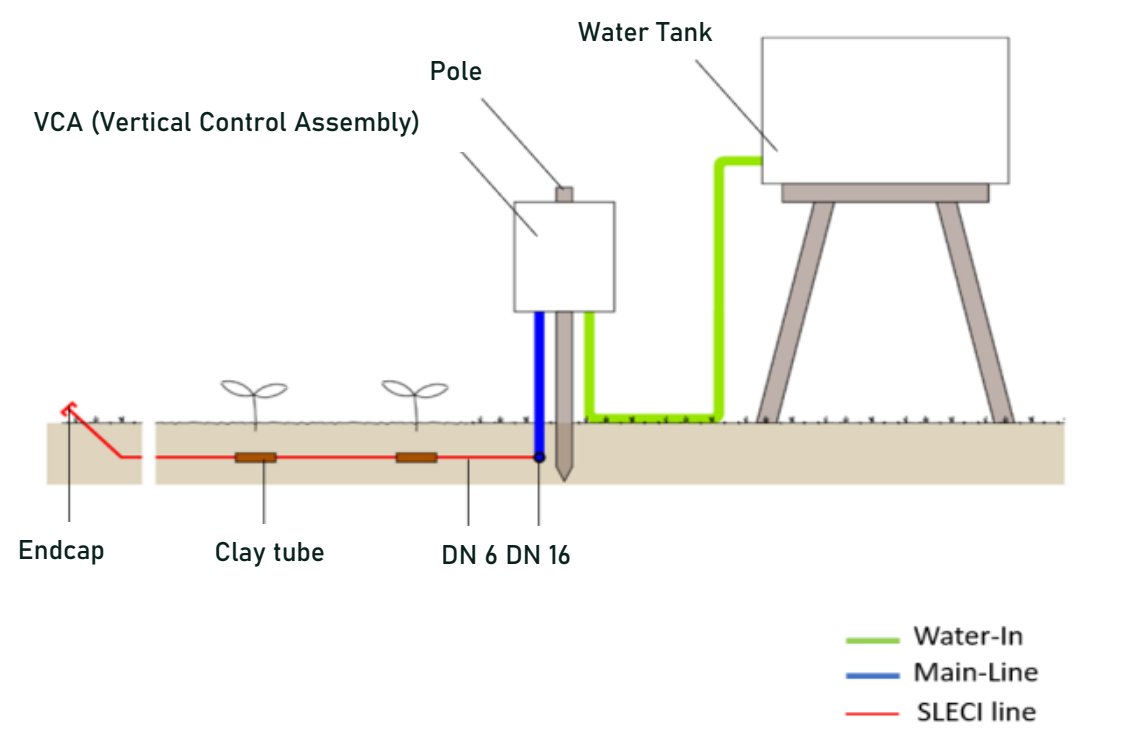


Figure 3-2b: SLECI system Type B / water supply by water tank schematically

Note:

The water tank (to be mounted on a stand in an appropriate hight), bottom of tank or water outlet from tank is not part of the SLECI system.

The SLECI main line is connected to a VCA (vertical control assembly), that controls the hydraulic pressure of the SLECI line.

Positioning in soil and sand bed

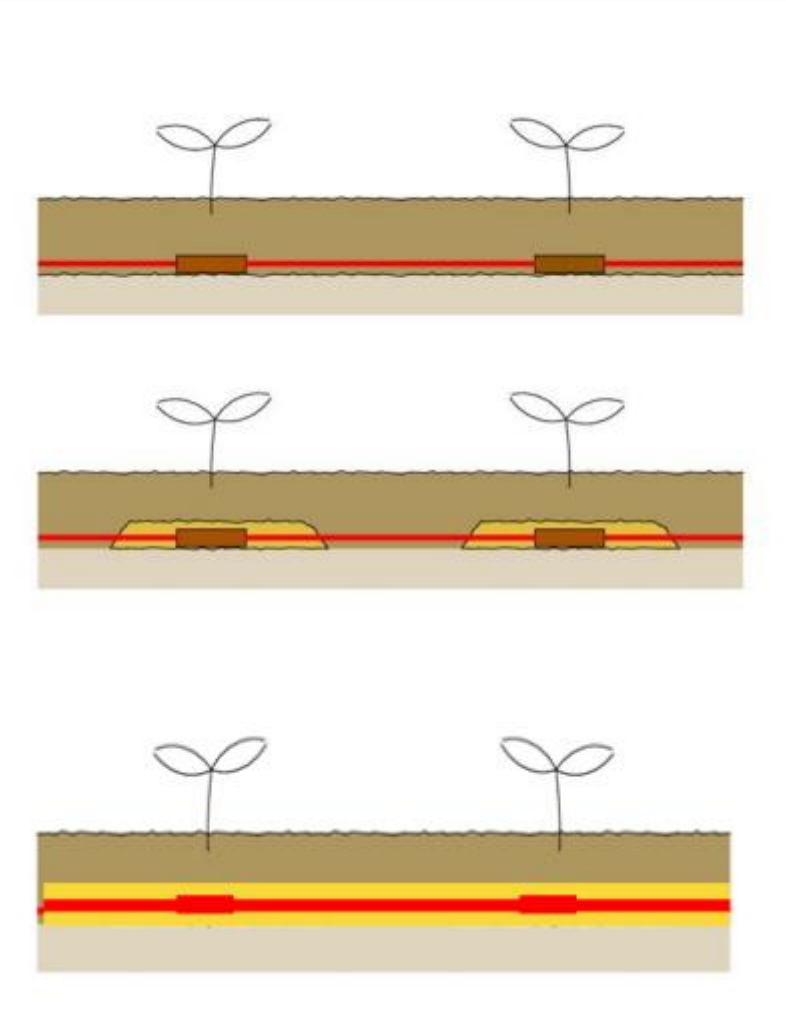


Figure 3-2c: SLECI line (side view);
Top: SLECI elements embedded in soil
Middle: SLECI elements embedded in a sand bed
Bottom: SLECI line embedded in a sand bed

The following figures show the top views of installed SLECI elements type B in different situations:

- Fig. 3-2d: Installation for new plantings
- Fig. 3-2e: Installation for older plantings

The figures also demonstrate the variables in

- number of SLECI elements per crop
- embedding the SLECI elements in soil or in a sand bed

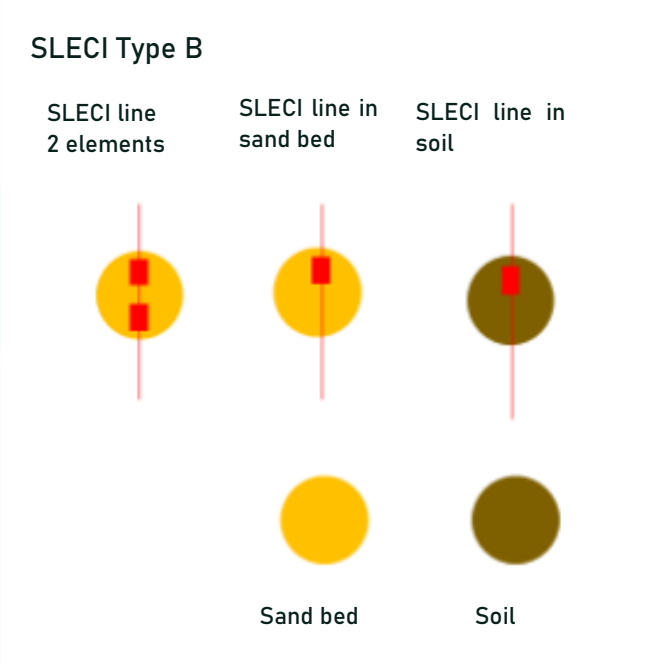


Figure 3-2d: SLECI system Type B variant from new planted crops

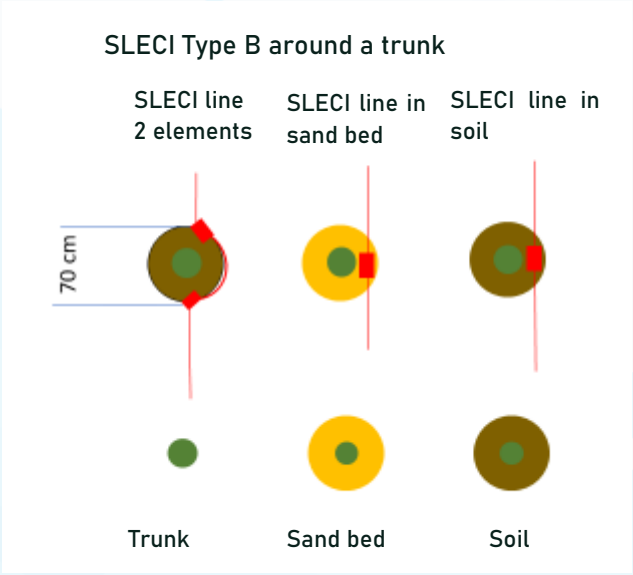


Figure 3-2e: SLECI system Type B variant from new planted crops

3.2 Prefiltering of irrigation water

Irrigation water for SLECI must be filtered in order to protect them from blocking. Solid particles therefore must be removed from the irrigation water by:

- a sand filter
- a mesh filter 50 microns
- a mesh filter 1 microns

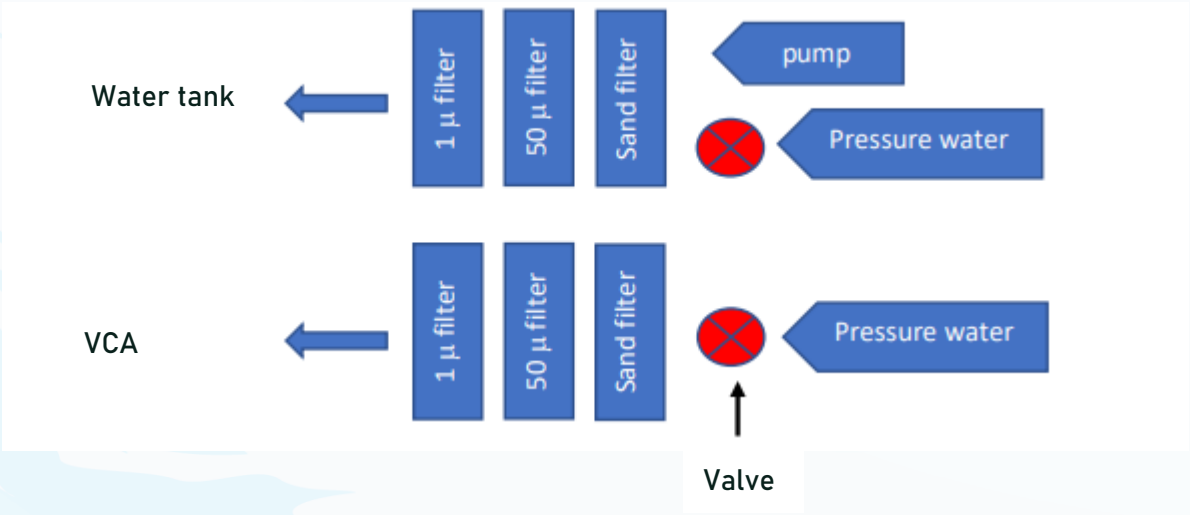


Figure 3-3: Prefiltering of the irrigation water

Note: Prefilters for the irrigation water (all items shown in Fig.3-3) are not part of the SLECI system but are strictly recommended.

In case, the irrigation water could be polluted by algae growth, as part of the VCA a UV-C filter is recommended additionally. The UV-C filter must be positioned so it is only burdened by the pressure of 0.4 bar (behind the float valve rep. the pressure valve).

Note: The UV-C filter is designed for pressure < 0.5 bar.

3.3 SLECI elements

The core of the systems is the SLECI element consisting of a clay cylinder adapted to the individual conditions (type of crops and type of soil) and a preassembled connector to 6 mm hose (Fig. 3-4 a-b).

Figure 3-4a: SLECI-element with connectors to 6 mm hoses (branch-line) for Type A

Figure 3-4b: SLECI-element with connectors to 6 mm hoses (double ended) for Type B

3.4 SLECI line

The SLECI line is completed with PE-hoses with the appropriate length between the clay tube elements in the appropriate number. This fully assembled combination of clay tube elements with hoses in between is called "SLECI line" (Fig. 3-5a). The SLECI line must be built up in the field. The SLECI-Line can also be equipped with an end cap (Fig. 3-5b)

The SLECI line must be buried in the recommended depth with the clay tubes positioned close to the plant roots.

Figure 3-5a: SLECI line (part of it):

clay tube elements with 6 mm hoses of the appropriate length on both sides

Figure 3-5b: SLECI line with endcap (alternative cable tie)

3.5 Main irrigation line

The starting side of the SLECI line will be connected to a main irrigation line DN 16/20 mm by preassembled t-barbs (16 mm in line, 6 mm perpendicular, see Fig. 3-6a). The end of each SLECI line will be closed by an endcap (see Fig. 3-6b).

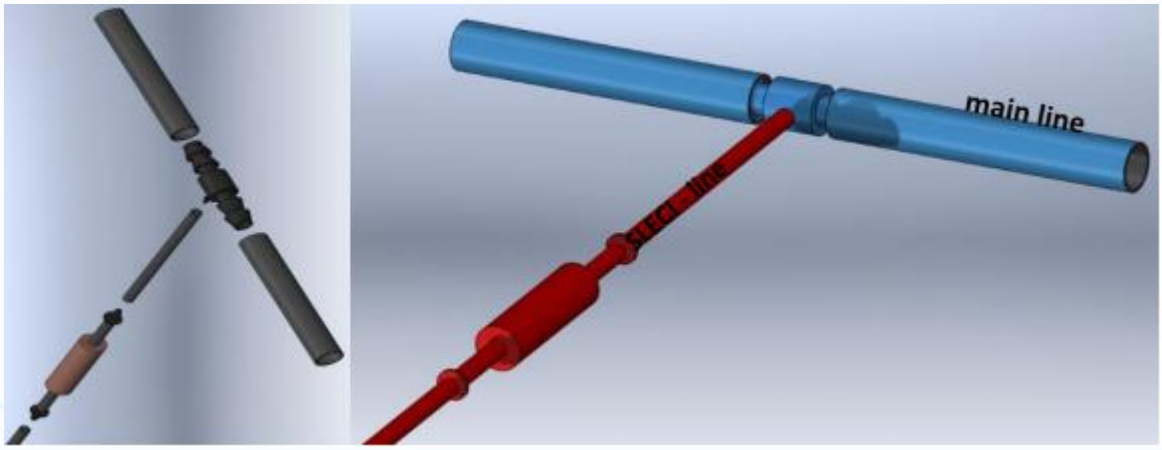


Figure 3-6a: Connection of SLECI lines to the main irrigation line by t-barbs

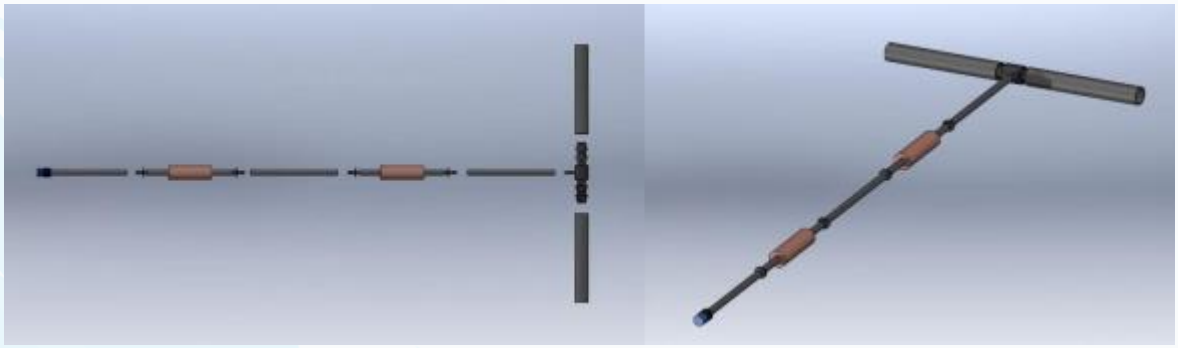


Figure 3-6b: Connection of SLECI lines with endcap to the main irrigation line by t – barbs

The starting side of the main line will be connected to a "vertical control assembly (VCA)", the other end of the main line at the opposite side to the VCA is closed (e.g. by cable tie).

3.6 Vertical Control Assembly (VCA)

3.6.1 Water supply by water tank

The VCA is the interface between irrigation water supply line and the main irrigation line. It contains a digital water meter (Wm), a Float valve (FV) (that must be adjusted in the appropriate hight above average depth level of the SLECI line) and optionally a UV-C filter (in case of algae pollution of the irrigation water) (Fig. 3-7a).

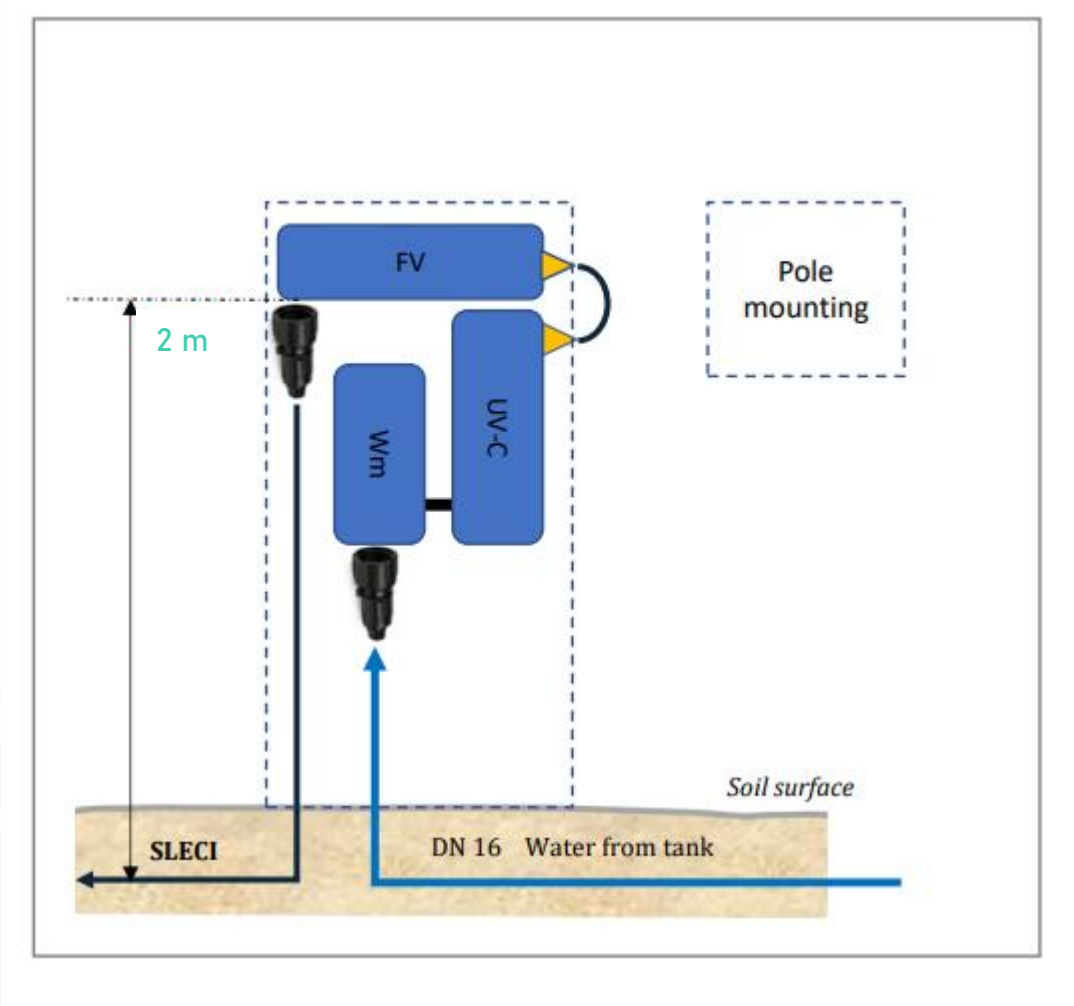


Figure 3-7a: VCA schematics for water supply by water tank

Irrigation Water Supply

The inlet of the VCA has to be connected on the field to the irrigation water supply unit; a water line connected to a water tank.

Position of the water tank:

Distance to VCA Bottom level of the water tank: > 0.2 m higher than float valve level

Position of the Float Valve (FV):

The height of the Float Valve (FV) should be fixed at a distance of 2 m from the SLECI line. In the event that the tank is already fixed at a height of 2 m, the float valve can be dispensed with.

UV-C filter is recommended in the case that irrigation water is pump from an open reservoir (river, open fountain, lake…)

The pre-pressure on the SLECI emitters should not be higher than 0.4 bar. If you are not sure, please use the Float Valve.

3.6.2 Water supply by pressure water > 3.0 bar

The VCA is the interface between irrigation water supply line and the main irrigation line. It contains a digital water meter (Wm), a Float valve (FV) (that has to be adjusted in height to 0,4 bar) and optionally a UV-C filter (in case of algae pollution of the irrigation water). In case of algae filtration a pressure valve regulator (PV) is additionally installed to regulate the pressure avoiding the overloading of the UVC-filter. (Fig. 3.7b)

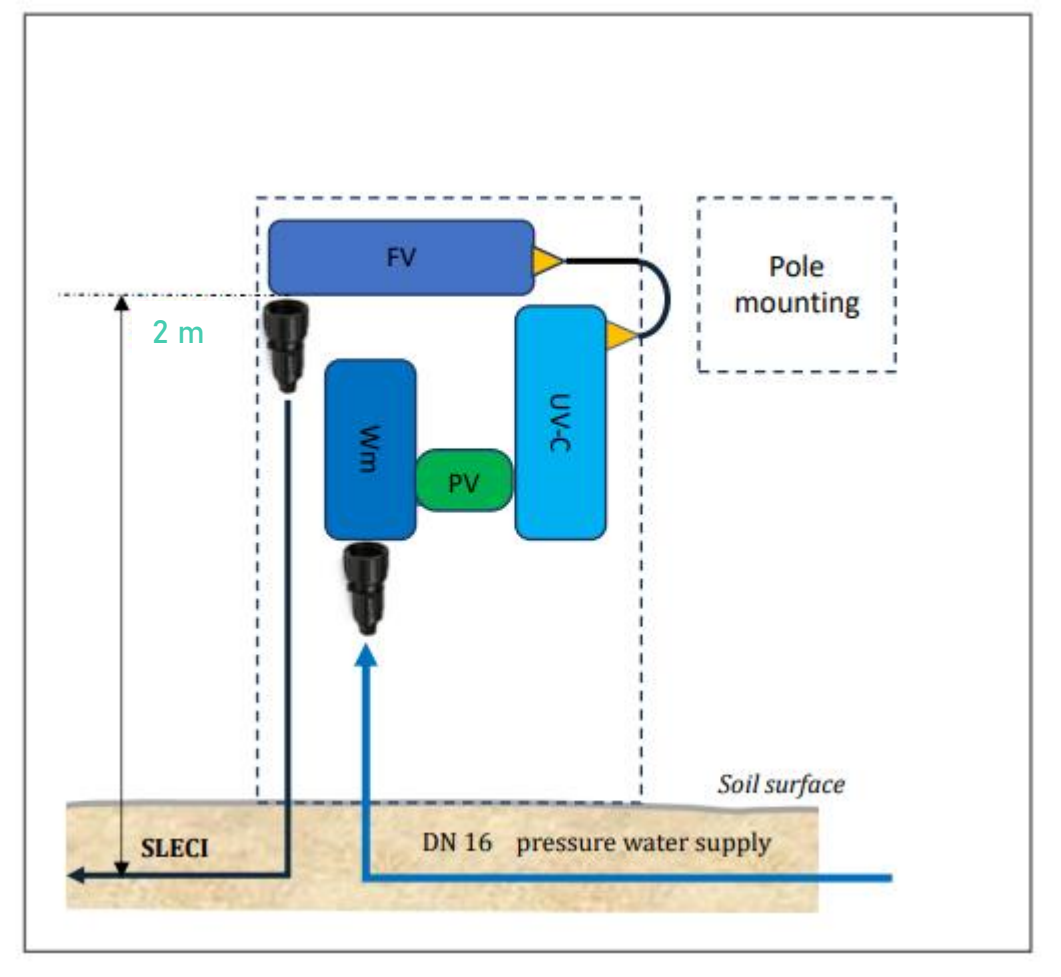


Figure 3-7b: VCA schematics for water supply by pressure water

Figure 3-7c: VCA for water supply by pressure water: Photo (version with pressure water bypass to a next section downstream)

Irrigation Water supply

The inlet of the VCA has to be connected on the field to the irrigation water supply unit, a water line connected to the water pressure line.

Position of the Float Valve (FV):

The height of the Float Valve (FV) should be fixed at a distance of 2 m from the SLECI line.

UV-C filter is recommended in the case that irrigation water is pump from an open reservoir (river, open fountain, lake, …)

Note:

Pressure of the waterline must be on constantly. Otherwise, the entire system (incl. the pressure valve of the VCA) will not be able to work accurately.

3.7 VCA attachment to the pole

The VCA should be attached to the vertical pole in that way, that the outlet of the VCA is positioned at the end of the trench for the main line.

The pole is not part of the SLECI system. It must be fixed in the soil and has the appropriate height above surface for mounting of the VCA, especially the float valve in the appropriate level. There is a mounting device for the attachment of the VCA as part of the shipped items.

4. Testing of the SLECI system and repair where necessary

4.1 Connection of the VCA to the water supply line

Use the preassembled compression fitting for the connection of a DN 16 water supply line or use the ¾“ thread (OT) for assembling the water supply line.

Ventilation of the lines:

1. Open the endcap of the first main line.
2. Open the main valve for water supply at the VCA.
3. Wait, until water is running through the end of the first main line.
4. Close the endcap of the first main line.
5. Repeat these steps until all SLECI lines and main lines are vented.

4.2 Test and repair procedure

4.2.1 Type A (branch lines)

1. Check for clogged SLECI elements and for connections, that are not waterproof.
2. Watch for building up moisture around every SLECI single clay tube.

3. In case of missing moisture:
   Replace the identified SLECI elements by a spare part.

4. Watch for connections, that are not waterproof.
5. Replace the identified connection by a spare part.

If a repair is required:

1. Close the main valve at the VCA.
2. Replace the connections, which are not waterproof by a spare part.
3. Replace the SLECI element, that is clogged by a spare part.
4. Open the main valve.

4.2.2 Type B (subsurface SLECI lines)

1. Check for clogged SLECI elements.

2. Walk along the SLECI line in order to identify clogged SELCI elements.

3. In the case, a SLECI element is clogged, there is no seepage of the SLECI elements downstream the clogged element. In this case, replace the clogged element with a spare part, and repeat the procedure.

4. Check connections of SLECI elements, that are not waterproof.

5. Walk along the main line and the SLECI lines in order to identify connections, that are not waterproof.
6. In case of the demand of a repair:
    a. Close the main valve at the VCA
    b. Replace the SLECI elements or connectors, which have to be changed by a spare part.
    c. Open the main valve.

4.3 Operation of the irrigation system

For water supply by water tank:

1. The tank is filled with water, and the valve of the tank outlet is closed.
2. Open the outlet valve of the tank.
3. Open the main valve (inlet) of the VCA.

4. Remove the endcap from 1 SLECI line and wait for water outlet.
   The SLECI line is thereby vented.
5. Close that SLECI line with the endcap.
6. Proceed in the same way with the other SLECI lines.

For water supply by pressure water:

1. Adjust the pressure valve of the VCA to nearly "0" bar (turn left!)
2. Remove the endcap from 1 SLECI line and wait for water outlet.
3. Open the valve of the pressure line carefully:
4. Watch the manometer at the VCA when carefully open the pressure (turn right), so the pressure on the SLECI side does not exceed 0,4 bar. This is important, because the UV-C unit is built for a maximum pressure of <= 0.5 bar. If the pressure exceeds 1 bar, the unit will break!!

5. Watch the open end of the SLECI line for water outlet.
6. The SLECI line is thereby vented. Adjust the pressure valve of the VCA to nearly "0" bar (turn left!)
7. Close that SLECI line with the endcap.
8. Adjust the pressure valve again to 0,4 bar.
9. Proceed in the same way with the other SLECI lines.

5. Maintenance of the irrigation line

5.1 Water Level in the water tank

If the water level in the tank has fallen to significantly less than 50%, the tank has to be refilled. procedure:

1. Close the main valve of the VCA.
2. Fill up the surplus water.
3. Open the main valve of the VCA.
4. Remove the end cap and check the water flow.
5. Replace the end cap.

5.2 Measurement of water consumption by ultrasonic water meter

(NFC-connective) See Appendix “Reading the W1 data memory with the Axioma Android APP”

From time to time check the water consumption per day and compare with the “normal” values in the past.

In case the water consumption is noticeable too high, check for leakages in the SLECI system (see Appendix “trouble shooting”)

In case the water consumption is noticeable too low, check for clogging of SLECI elements in the SLECI system (type B only: see Appendix “trouble shooting”.

5.3 Pressure control

From time to time, check the pressure at the entrance of the SLECI line (not necessary for float valves) and adjust the pressure valve to 0.2 bar (or the lower recommended pressure calculated for longer SLECI lines in case of a slope in the terrain).

From time to time, check the pressure at the end of the SLECI line (type B only with 6 mm hoses) for clogging (see Appendix “trouble shooting”)

6. Appendix “Trouble shooting”

6.1 UV-C Filter does not work

Caution: The UV-C light filter must be placed so that it does not sink into the water. Don’t use the device in the water and don’t use under water!

Please check out the SAFETY INDICATIONS of the UV-C lamp for a correct handling!

Indication of proper operation:

Figure 6-1a: UV-C filter in operation

There is a blue LED light, that indicates proper operation of the UV-C filter. In case, the blue light does not appear (Fig. 6-1a-b):

Figure 6-1b: UV-C filter not in operation

1. Check the AC connection to the UV-C

2. Change the lamp:

Disconnect the UV-C from the AV

Caution when opening the case: UV- light is very harmful for the eyes!

Open the housing by screwing the lamp socket counterclockwise about 20 degrees pull out the lamp socket (see photo below)

3. There is 1 replacement lamp as part of the SLECI kit shipped by IPT!!

In order to change the lamp, disconnect the internal housing (1 screw to pull) and disconnect the glass tube from the socket. After replacing the lamp, go through every step-in reverse direction!

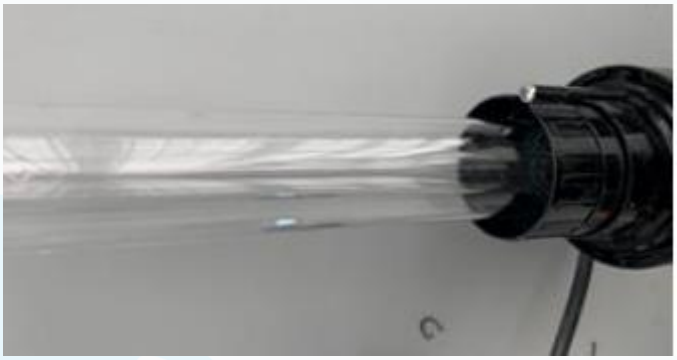


Figure 6-1c: UV-C lamp case demounted from the main case

6.2 SLECI tubes show no moisture (type B: subsurface)

Check the water pressure at the end of the SLECI line by exchanging the end cap with the digital pressure gauge (part of shipped items). There is a power switch (left) to push for a few seconds in order to start operation of the manometer. In case the manometer doesn't work, change batteries (rear side).

Note:

During the first weeks[1], the water discharge of the SLECI elements tends to reach the equilibrium between water discharge of the elements and water saturation of the surrounding soil. During that time, a higher water release by the SLECI elements leads to a pressure drop to the end of the SLECI line especially using a pressure valve.

It is therefore recommended, to check the pressure at the end of the SLECI lines, when water discharge has stabilized (watch water meter !!!)

[1] Duration depending on the soil- and SLECI elements- characteristic

6.3 Clogged SLECI elements in a SLECI line type B with 6 mm hoses

During operation (trenches already refilled):

Identification of a clogged single SLECI element needs partial excavation of the affected SLECI line:

- Excavate the soil from the top down to the position of the SLECI element.
  In the case, there is no moisture in the vicinity of the SLECI element it means that this element does not work. Start checking in the following way:

  1. Excavation in the middle of the SLECI line near a SLECI element.
     If there is humidity: 2. Excavation in the 3. Quarter
     If there is no humidity: 3. Excavation in the 1. Quarter

  2. Repeat by searching in the same way (dividing the remaining length of the SLECI line, where the clogging should be by 2 every time.

Following this procedure, the total number of excavation procedures will be low (mathematically its LOG 2 of the number of SLECI elements per line). Example:

- If the number of SLECI elements in 1 line is 128 (this is 2^7), the number of needed excavations will be 7 at most.

6.4 Clogged SLECI elements in a SLECI line type A

During operation (trenches already refilled):
Identification of a clogged single SLECI element is not possible without partly excavation of the branch lines:

1. Excavate to the depth of the SLECI element in order to identify humid soil.
2. If there is no humidity: excavate and replace the clogged SLECI element.

7. Appendix “Reading the W1 data memory“

Steps:

1. Install AXIOMA Android App (app-debug.apk) on your android phone *(Note: The App is not available for iOS).*
2. Start the App

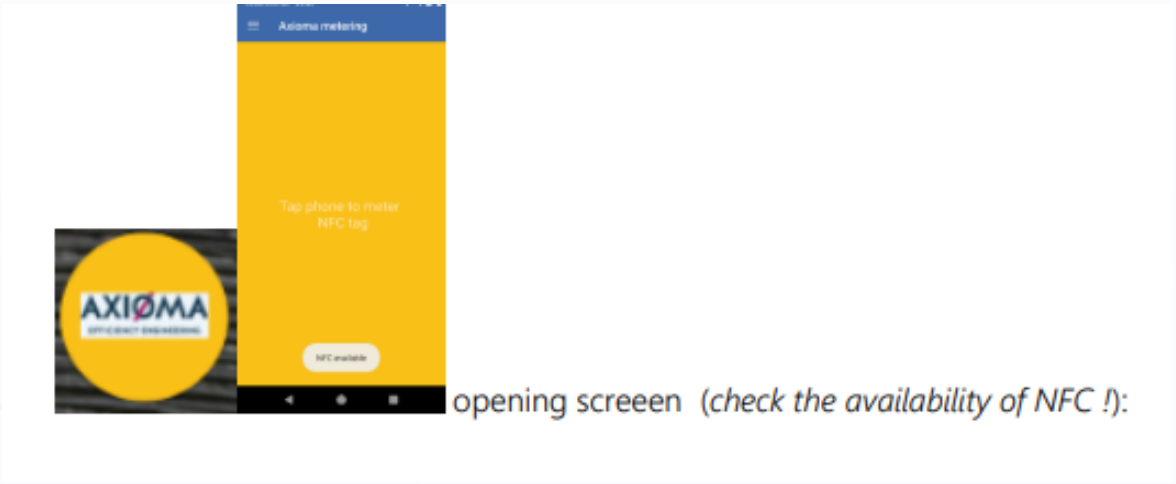


Figure 7-1a: opening screen of Axioma App

3. Tap your android phone (bottom side onto the surface of the water meter) to the NFC of the water meter. Search for the proper position (depends on the individual localisation of NFC-sensor inside your phone). If the connection is successful, the readout starts:

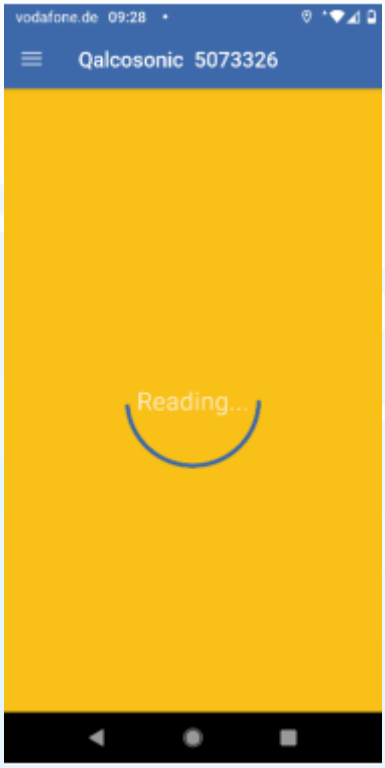


Figure 7-1b: reading process after successful connection to the water meter

4. After successful readout, the following screen appears:

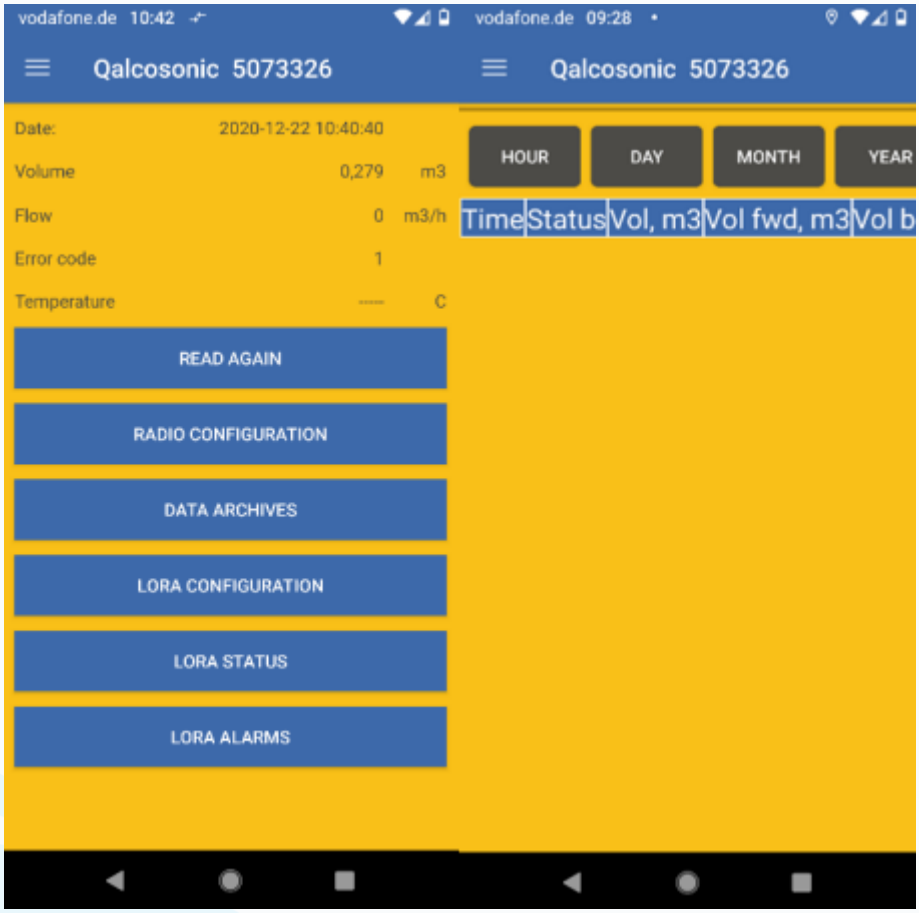


Figure 7-1c: User interface with various options to choose

5. In order to read out the data memory of the meter, the menu item "DATA ARCHIVES" must be selected.

6. On the following screen you select the readout of the day values (selection):

   - hour (max. 1.460 values – ca. 60 days)
   - day (max. 1.130 values – ca. 3 years)
   - month (max. 36 values)
   - year (max. 16 values)

   After selection, the smartphone must be placed again on the W1 to activate the NFC connection.

7. Search for the proper position (depends on the individual localisation of NFC-sensor inside your phone). If the connection is successful, the readout starts:

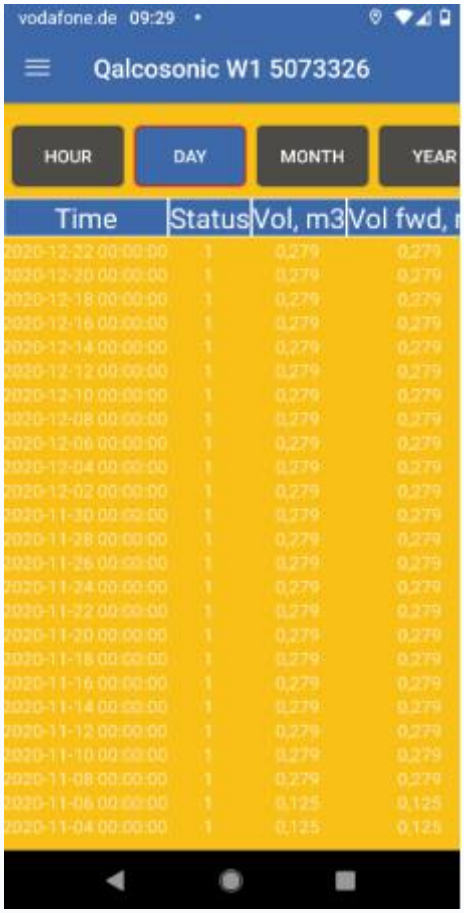


Figure 7-1d: example for a successful readout

Note:

The data archive will be filled up with every day / hour. There is no possibility to empty the data archive. So: If you want to read out only the data of the last 7 days for example, wait until 7 data lines appear. The last data is the first to appear!

Another example:

If you like to read out the hourly data of the last 24 hours, wait until the screen has filled up with data (1st 24 lines). Afterwards, disconnect the phone and go to the next step (“Send “).

8. The read values can be exported via "Send"
   (Swipe TOP line to left. The sign “send“ appears on the very right)

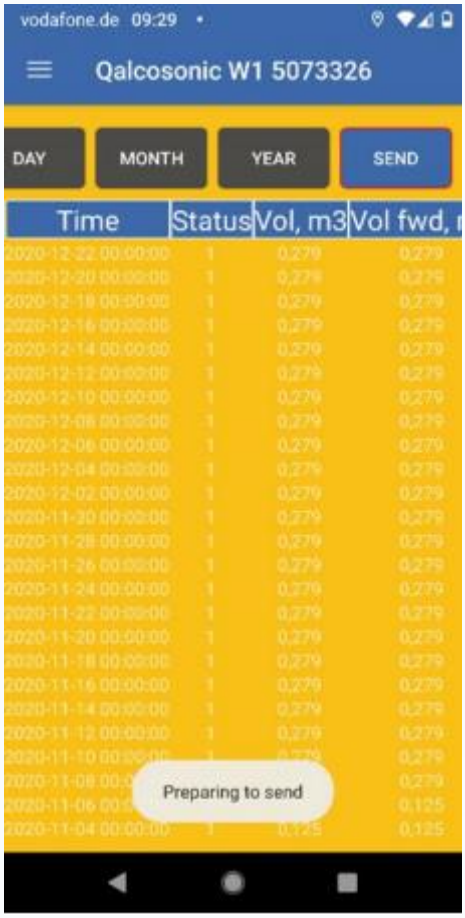


Figure 7-1e: Saving/ Exporting the data via "send" button

9. A csv file is created and stored in the directory: My files > internal storage > Android > Data >com.axioma.qalcosonic.configurator >files > Download

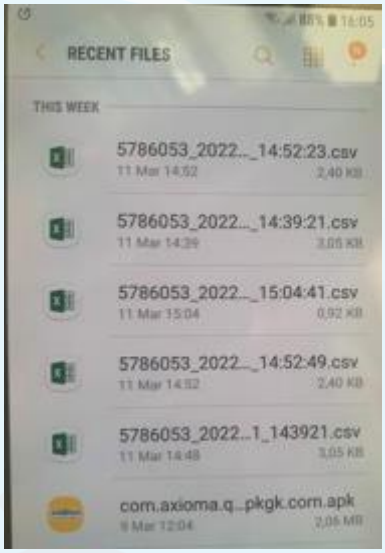


Figure 7-1f: Storage location of the csv files

10. The contained data can easily be imported into Excel

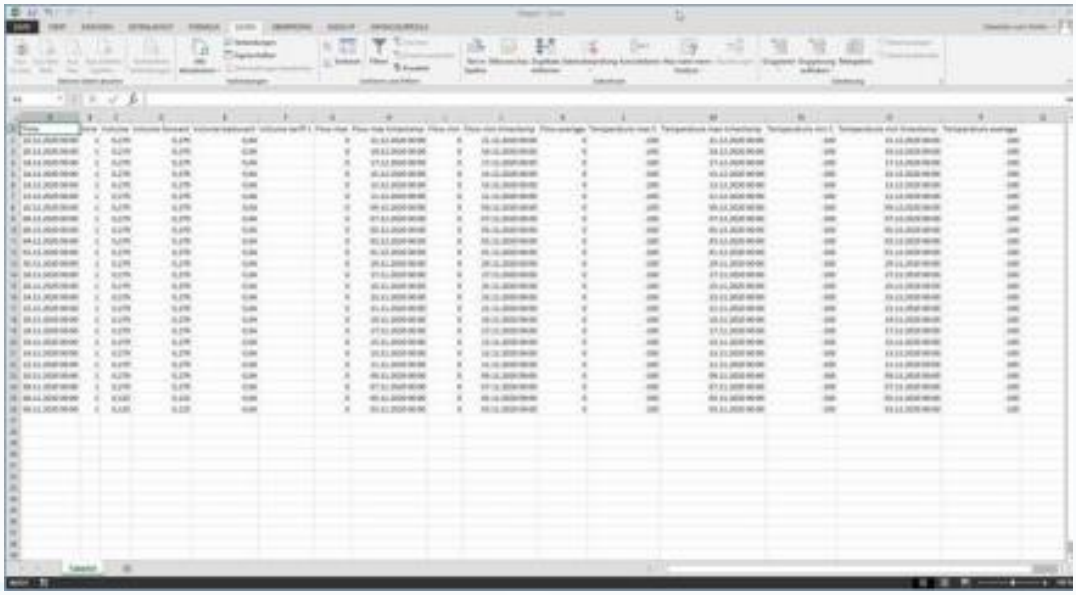


Figure 7-1h: Imported data in Excel

8. Appendix “Terms and summary”

Terms

SLECI system

Type A:

branch lines with a SLECI element connected to a main line (6mm or 16 mm hose)

Type B:

subsurface SLECI lines connected to a main line (6 mm or 16 mm)

SLECI element: 1 or 2 SLECI clay tubes in a line (dead end or double sided)

SLECI line all SLECI elements in a line connected by a hose

Main line

Type A: along the row

Type B: perpendicular to the SLECI lines

VCA	Vertical Control Assembly containing at least a pressure valve or float valve and optional a water meter, a main valve and/or a UV-C filter
PV	pressure valve to be adjusted to 0.2 bar[2]
FV	float valve to be positioned in a height of 2 m (0.2 bar)[3]

[2] for longer SLECI lines in terrain with slope a lower pressure can be recommended
[3] for longer SLECI lines in terrain with slope a lower height can be recommended

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