

### 2.3.2.6 Installation of irrigation systems

Every living wall system must have a complete irrigation and drainage system. The irrigation system starts in the machine room, with water preparation, filtration, pumping, pressure regulation and controls for accurate irrigation of the living wall. With larger living wall systems, the machine room may be separate room, while in smaller systems it may be a compartment in a gutter. Whatever its size, the machine room needs to be easily accessible and care must be taken that it cannot be flooded by excess water.

#### a) Water filter

The water filter prevents clogging of the drip emitters. The filter mesh must be 300 microns. For dirty or underground water, sand filters are recommended. Filters must be cleaned periodically, or you can use self cleaning filters.

#### b) Pump

The pump station consists of a suction basket with a mesh filter, suction pipe, pump, pressure regulator with a pressure gauge, fine 300  $\mu\text{m}$  mesh and water distributor with magnet valves which distribute water to different parts of the living wall.



Mini pump for self standing green wall and wall green tapestry



Medium sized pumping station with solenoids, filter and two fertigation tanks and air compressor integrated in a gutter below the green wall



Medium sized pump station with reverse osmosis filter for soft water



Medium sized pump station with two fertigation tanks, reverse osmosis filter for soft water, two water storage compartment and two pumps



Small fertigation and irrigation station for dosing six different fertilizers, activators, acids etc.

Figure 1: Pumping

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For equal water distribution, a water flow calculation must be done taking into account the number of drip emitters and their capacity, and the size of the cross-section of the pipe. Pressure drop and cavitation should also be considered: every 10 meters of height is one Bar pressure drop plus resistance of the fittings. Pressure on the drip emitters will vary according to the type used; pressure compensating drip emitters will always deliver the same amount of water.

### c) Drip emitters

Drip emitters are placed above the panel, pot, container or trough. There is a wide range of drip emitters with different capacities at different pressures, such as pressure compensating emitters, hand regulated emitters, and so on. If the emitters get clogged they can be cleaned by using an acidifying fertilizer like PeKacid. Take care to flush the acid with clean water in order to dilute it in the substrate. Living wall systems with gutters and cascade irrigation systems have only a pipe connection to the gutter and no emitters.

#### d) Controls

The control system is the brains of the irrigation system. Basic control systems function like a clock switch: they switch on the pump or magnet valves at a certain time for a certain period. Better quality control systems have multi-station programmes with multi-starting times, different watering times, percentage adjustment, rain sensors, moisture sensors and double solenoid valve operation. The most modern control systems use the Internet of Things, with many sensors placed around the living wall to measure solar radiation, humidity, wind speed and direction, moisture, soil and air temperature, CO<sub>2</sub>, photosynthesis and active radiation. Software compares the data from the sensors with needs of the plants and the weather forecast, controls the irrigation, fertigation, lighting, and heating accordingly, and provides information to the service team.

#### e) Pipes

Different materials are used for irrigation piping. In the machine room it is most convenient to work with PVC (polyvinyl chloride) pipes which can be glued together. PE (polyethylene) pipes are also suitable, but require more space because of the fittings for each thread. Black iron and galvanized pipes are not suitable because of corrosion caused by fertilizers and acids. Galvanised pipes can also release Zinc which can harm the plants. Solenoid valves are also made of PE or PP (polypropylene) with rubber seals. Piping from the solenoid to the living wall is normally done with PE, PA (polyamide) or PVC pipes. For very tall living walls, where the pressure is higher than 10 Bars, special high pressure or multilayer pipes are used.

#### f) Sensors

Moisture sensors make it easy to achieve the correct level of irrigation. Most moisture sensors work on the dielectric capacity between two poles, the anode and the cathode. Sensors made of copper can be damaged by corrosion very quickly, while those laminated with precious metals like gold or silver have a longer life. Alternatively, a two spike sensor with stainless steel electrodes can be used. The principle is the same. The most accurate moisture sensor is a frequency domain reflectometer (FDR) with a frequency of between 10 to 500 MHz, which is not affected by the salinity caused by fertilizer. This probe must be calibrated in dry soil and saturated soil.

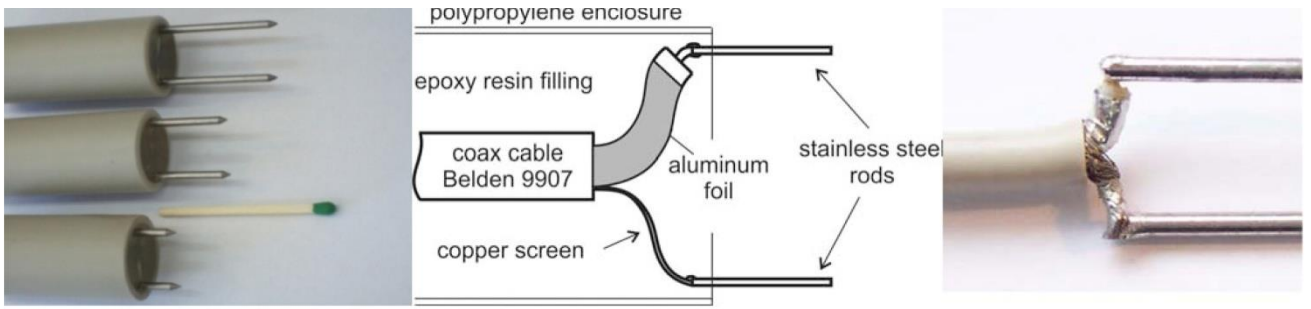


Figure 2: Two wire stainless steel rod FDR probes (left), the scheme of internal details (middle) and the interface between coaxial and parallel waveguides

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