



ECOMAWARU

ECO-sustainable MAnagement of WAter and wastewater in RUral communities

D4.4 – A4.4 **Technical Report on Systems as installed**

30th June 2011

Technical Report on Systems as installed

ACTION 4.4: Installation and field testing

The aim of this deliverable is to report the detailed description of the installation and of the field testing of two phytodepuration systems: photobioreactor and pond.

The photobioreactor has been installed nearby the wastewater treatment plant of San Pietro Vara, hamlet of the municipality of Varese Ligure. This site was selected because of the available area for the photobioreactor installation (**Action 4.1: Sites selection for micro phytodepuration systems installations**).

In the meantime a photovoltaic system for energy recovery was built up in the selected area by the Varese Ligure municipality, such as shown in Fig. 1_a and Fig. 1_b. Therefore a new photobioreactor location was due to be chosen. The dry sludge storage area, which was planned to move, has been chosen such as final photobioreactor location (Fig. 2).



Fig. 1_a: available area for the photobioreactor installation before the system solar panel building up



Fig. 1_b: the photovoltaic system for energy recovery built up in the selected area for the photobioreactor installation



Fig. 2: sludge storage area chosen such as final photobioreactor location

While waiting the availability of the above mentioned area, it has been chosen to install a first module of the phytodepuration system nearby the footbridge near the oxidation tank of the wastewater treatment plant of San Pietro Vara (Fig. 3 and Fig. 4).



Fig. 3: arrangement area of the first module of the photobioreactor



Fig.4: first module of the photobioreactor

The first module of the photobioreactor is composed by: twelve horizontal tubes in Plexiglas (internal diameter 4.10 cm, length 200 cm, thickness 2 mm, internal section 13.20 cm², total volume 31.68 cm³) and a recycling vessel in fibreglass (width 53 cm, depth 53 cm, height 70 cm).

The tubes are positioned in horizontal way and the arrangement of the first module of the photobioreactor (tubes, recycling vessel, pump housing and multiparametric probe housing) is shown in Figure 5.

The multiparameter probe (BeC Electronics sensor SA8145.101) has been installed inside the upper tube in the multiparametric probe housing of the photobioreactor (Fig. 5), in order to properly measure pH, temperature and oxygen dissolved. Previously the probe has been calibrated in laboratory.

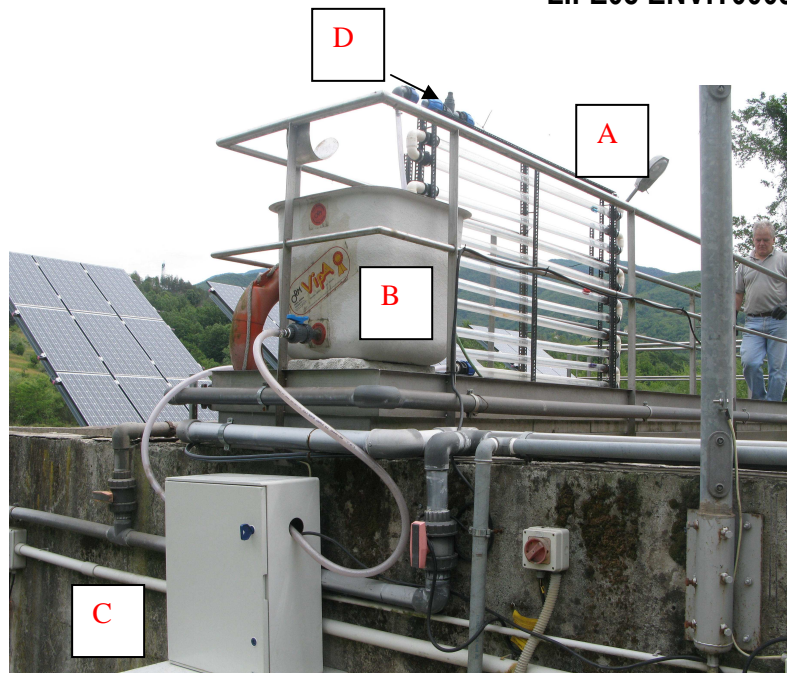


Fig.5: first module of the photobioreactor parts (A tubes, B recycling vessel, C pump housing, D multiparametric probe housing)

The tubes are connected together by PVC coupling sleeves: the upper and the lower tubes of the photobioreactor are connected with the recycling vessel.

The circulation of the wastewater in the photobioreactor is operated by a centrifugal pump (IWAKI Mo-40RM magnet pump 65 W, 2600-3200 rpm, maximum head of 45 m and maximum flow rate of 52 l/min).

The plant was filled with the outflow from the wastewater treatment plant and with an algal inoculum taken from the batch culture in Dichep laboratory.

The process is discontinuous: the plant is weekly discharged of about 30 % of the liquid volume. This blowdown is discharged in the denitrification tank of the wastewater treatment plant of San Pietro Vara, whereas the photobioreactor is reintegrated (30 %) with the effluent from the wastewater treatment plant. Periodically some samples are collected and analyzed in Dichep laboratory.

About the pond, its optimal location has been individualized in Pezze (Fig.6), it has been chosen with the methods described in the specifications and in the specifications up-date (Action 2).

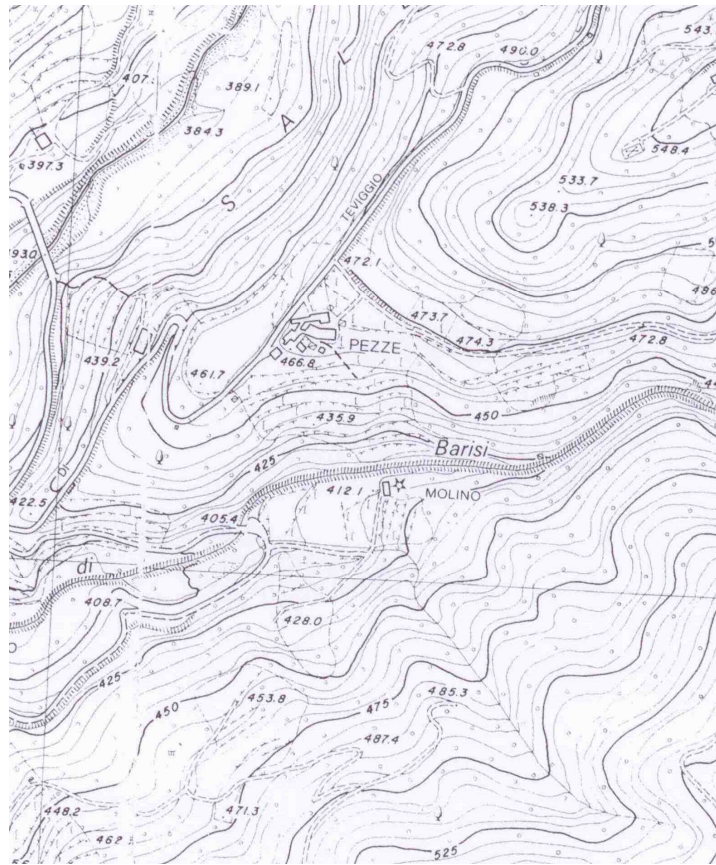


Fig.6: Pezze map

This area (50 m²) is available and it has been located at a distance of about 150 m from the scattered houses (max 10 inhabitants), that will be connect to the phytodepuration system.

The system is composed by an Imhoff tank, a pond system and a recycling system (Fig.7).

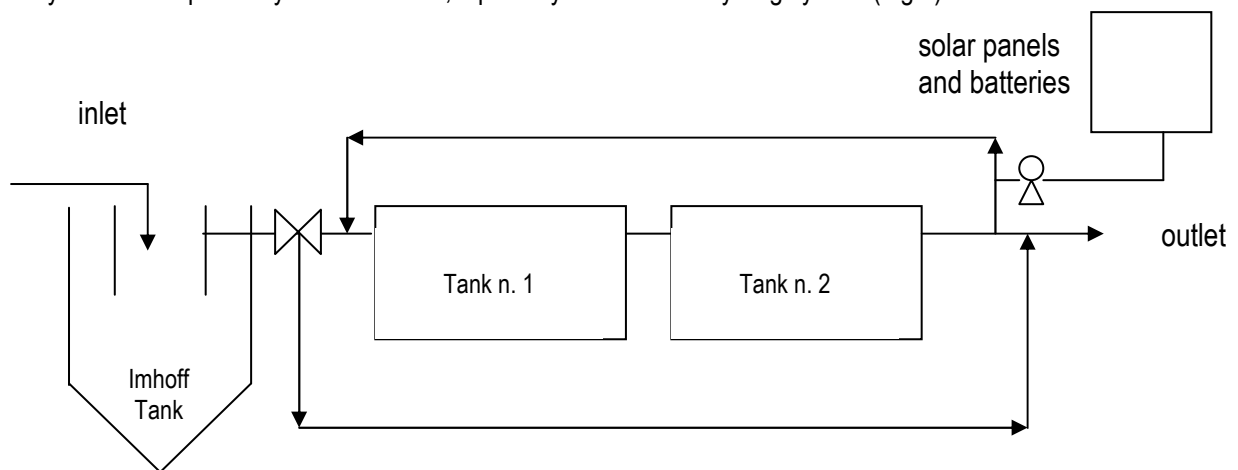


Fig.7: lay out of the phytodepuration system

The pond system is composed by two rectangular tanks in PRFV. The tanks sizes are: width 1 m, length 4.2 m, gross height 0.5 m, gross capacity 2100 l, their level bottom are connected together by PRFV pipes and PVC connection sleeve (diameter 6.3 cm) put in the bottom of the tank (Fig. 8).

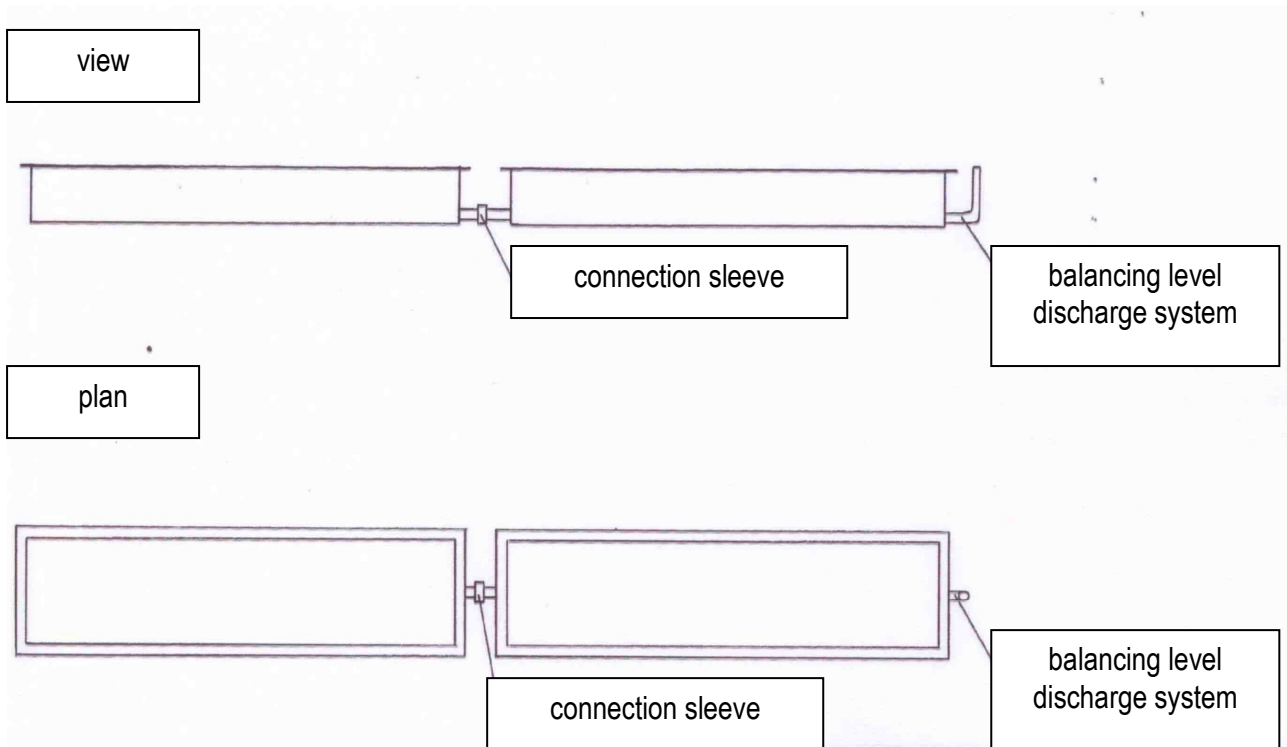


Fig.8: view and plan tanks

The recycling system is composed by: a direct current pump (BLASTER 65863 24 V – 4.5 A, flow 13.2 l/min or 0.792 m³/h), a system of two parallel solar panels (PHOTON-SOLAR 220 Wp, length 990 mm and height 1600 mm for one panel) to supply the energy to the pump, a charge controller (PROSTAR 15 system voltage 24 V), two batteries in serial order (HAWKER-VARTA 12TP110, positive tubular plates 140 Ah, endurance 20 h with final voltage 21.6 V for two batteries). The solar panels system is placed on a cement slab with length of 220 cm and width of 160 cm.

The effluent comes from the Imhoff tank to the pond system by force of gravity, the discharge system is a balancing level type and the effluent is discharged by force of gravity in the river. The technical characteristics of the phytodepuration system are shown in the following tables (Tab. 1 and Tab. 2).

Tanks	
width	1 m
length	4.2 m
tanks area	9 m ²
gross height	0.5 m
gross capacity	2100 l
detection time	3 d
diameter pipe fittings	6.3 cm

Tab. 1: technical characteristics of the tanks

Solar panels	
length	990 mm
height	1600 mm
system voltage	220 Wp
Pump	
sizes	203x127x118 mm
system voltage	24 V
flow	3.5 GPM – 13.2 l/min
amp max	4.5 A
block pressure	45 PSI – 3.1 bar
Batteries	
amp max	140 Ah
endurance	20 h

Tab. 2: technical characteristics of the recycling system

At this moment the available area has been levelled (Fig. 9), the two tanks and the recycling system have been purchased. Whereas the hydraulic connections, which are between the scattered houses and the phytodepuration system, and the cement slab realization (220 x 160 cm) will be yet done. These civil works will be done by September 2011.



Fig.9: the levelled area available to the phytodepuration system installation

The testing of the photobioreactor has been done in S. Pietro Vara, the testing expected hydraulics and mechanics check i.e. inflow rate, outflow rate and the seal of tubes connection. As for the multiparameter probes (BeC Electronics sensor SA8145.101), that have been installed inside the phytodepuration systems, have been calibrated in laboratory.

As for storm water, the present deliverable has the goal of reporting the detailed description of the monitoring stations in terms of sampling equipments and sensors installed within the pilot sites selected through the on-site SURVEY (performed within the Municipal territory in the course of Action 4.1 – “*Sites selection for micro phytodepuration systems installation*”) in order to acquire quality and quantity data of storm water runoff. In particular, two monitoring stations were installed at the Municipal waste depot located in Baghino within Municipality of Varese Ligure. The area is employed to handle and storage recyclable and non-recyclable urban waste; the site consists of two different aprons respectively dedicated to the storage of different waste typologies.

Each sampling station is equipped with a flow-meter to obtain continuous flow rate measurements. As for quality aspects, each gauge station is equipped with an automatic sampler (12 glass bottles with a capacity of 950 ml. each) to collect runoff water samples which are subsequently analysed at the chemical laboratory of DICHEP as for the chemical-physical parameters reported in the “Technical Report on system Specification” Deliverable (D2). Furthermore the monitoring stations are equipped with a rain gauge to acquire in-situ rainfall data.

In the following section, a detailed description of the monitoring stations as installed is provided.

MUNICIPAL WASTE DEPOT

The selected pilot site is the MUNICIPAL WASTE DEPOT located in Baghino within the Municipality of Varese Ligure. The area is employed to handle and storage recyclable and non-recyclable urban waste; the site consists of two different aprons respectively dedicated to the storage of different waste typologies as illustrated in Fig. 10, 11 and 12. The instrumented catchment is the asphalt apron illustrated in Fig. 10. The area has an extension of about 230 m² and the drainage system consists of circular pipelines (D = 160 mm) and a rectilinear sequence of 3 inlets. The drainage system is equipped with a treatment system. In particular, the treatment system consists of an on-line tank with a capacity of 1500 litres directly discharging into a small stream tributary of the Vara River (see Fig. 13 and 14).

The selected location for the installation of the monitoring stations is the branch of the drainage network next to the storm water tank. The monitoring stations of storm water runoff are installed upstream and downstream the existing treatment system, in order to analyse both treated and untreated storm water runoff quality. A tipping-bucket rain gauge (with a bucket capacity equal to 0.2 mm) has been installed on the rooftop of the office and connected directly to the automatic sampler (Fig. 15). Note that, before installation, the rain gauge has been properly calibrated by DICAT according to the WMO guidelines (see Deliverable U2).

Because of the dimensions of the drainage network, the first gauge station is installed downstream just before the inlet in the tank. The pipe is equipped with the flow-meter consisting in an area-velocity sensor and with the intake suction line of the automatic sampler (Fig. 16 and 17). In order to provide a minimum level, a small triangular weir (H= 0.025 m) was installed in the terminal section of the channel thus permitting to properly measure level and to produce the submergence of the intake suction line. The triangular weir was calibrated in the DICAT laboratory in order to obtain the experimental stage-discharge curve (see Deliverable U2). Hereinafter the monitoring station, above described and illustrated in Fig. 15, 16 and 17, is named VARESE IN.

The second gauge station, that measure the outflow from the tank, is equipped with the intake suction line (Fig. 18), the area-velocity sensor (Fig. 19) and the triangular weir located at the outlet section of the tank. For measuring outflow rates, the experimental discharge curve calibrated in laboratory is applied. In particular the area-velocity sensor has been installed inside the tank in order to properly measure the water level above the triangular weir. Furthermore a small rectangular weir (H= 0.04 m) is installed in the terminal section of the pipe thus permitting to produce the submergence of the intake suction line (Fig. 20). Hereinafter the monitoring station, above described and illustrated in Fig. 18, 19 and 20, is named VARESE OUT.

The automatic samplers corresponding to the stations VARESE IN and VARESE OUT are placed into the office that is located in the first apron of the Municipal Waste Depot just in front of the storm water tank (see Fig. 21). Finally, a workstation has been placed into the office, connected to the automatic samplers in order to retrieve data and modify the auto-sampler operational rules (see Fig. 20). Since both the workstation and the automatic sampler need to be supplied with electricity, they have been connected to an electric device to avoid voltage drop. The function of controlling and activating the sampling phase is based on both rainfall intensity and water level threshold values, respectively equal to 2.4 mm/h and 0.03 m.

VARESE IN and VARESE OUT gauge station were activated on June 20th 2011. A first phase of testing has been carried on for about three months.



Fig. 10: municipal waste Depot: general view of the monitored area



Fig. 11: particular of the special waste stored on the site monitored area



Fig. 12: particular of the special waste stored on the site monitored area



Fig. 13: particular of the existing treatment system



Fig. 14: particular of the existing drainage network



Fig. 15: particular of the area-velocity probe and the intake suction device for the monitoring station” Varese IN”



Fig. 16: installation of the intake suction line for the monitoring station” Varese IN”



Fig. 17: particular of the triangular weir for the continuous measure of the flow into the storm water tank



Fig. 18: installation of the intake suction line into for the monitoring station” Varese OUT”

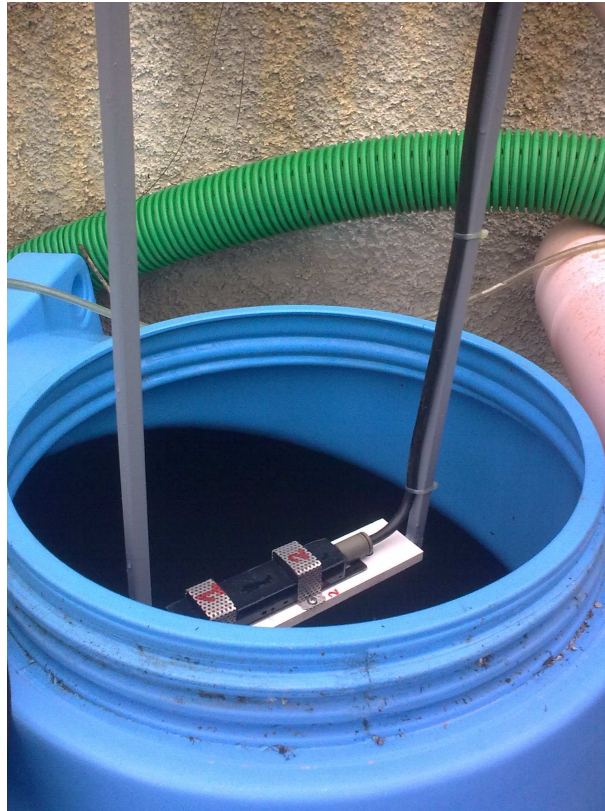


Fig. 19: installation of the area velocity probe inside the tank for the measure of the level



Fig. 20: particular of the rectangular weir for the submergence of the intake probe



Fig. 21: view of the acquisition system and the automatic samplers