

Pilot evaluation in Poland

Second pilot

Krynica Zdrój commune

Słotwiny and Tylicz pilots

Institute of Technology and Life Sciences in Poland

Prof. Andrzej Eymontt
M. Sc. Eng. Magdalena Gugąła
Techn. Michał Kuźniar

Riga 14th March, 2018

Krynica Zdrój commune, Słotwiny and Tylicz pilots

Location



Population: 16 843

Area: 145,3 km²

Population density:

116,1 ppl/km²

Krynica Zdrój City

Population: 10 907

Area: 39,68 km²

Rural area population: 5 936

Rural area population density:

56,2 ppl/km²

arable land 39%, forest land 55%

Pilot evaluation in Poland

Krynica Zdrój commune, Słotwiny and Tylicz pilots

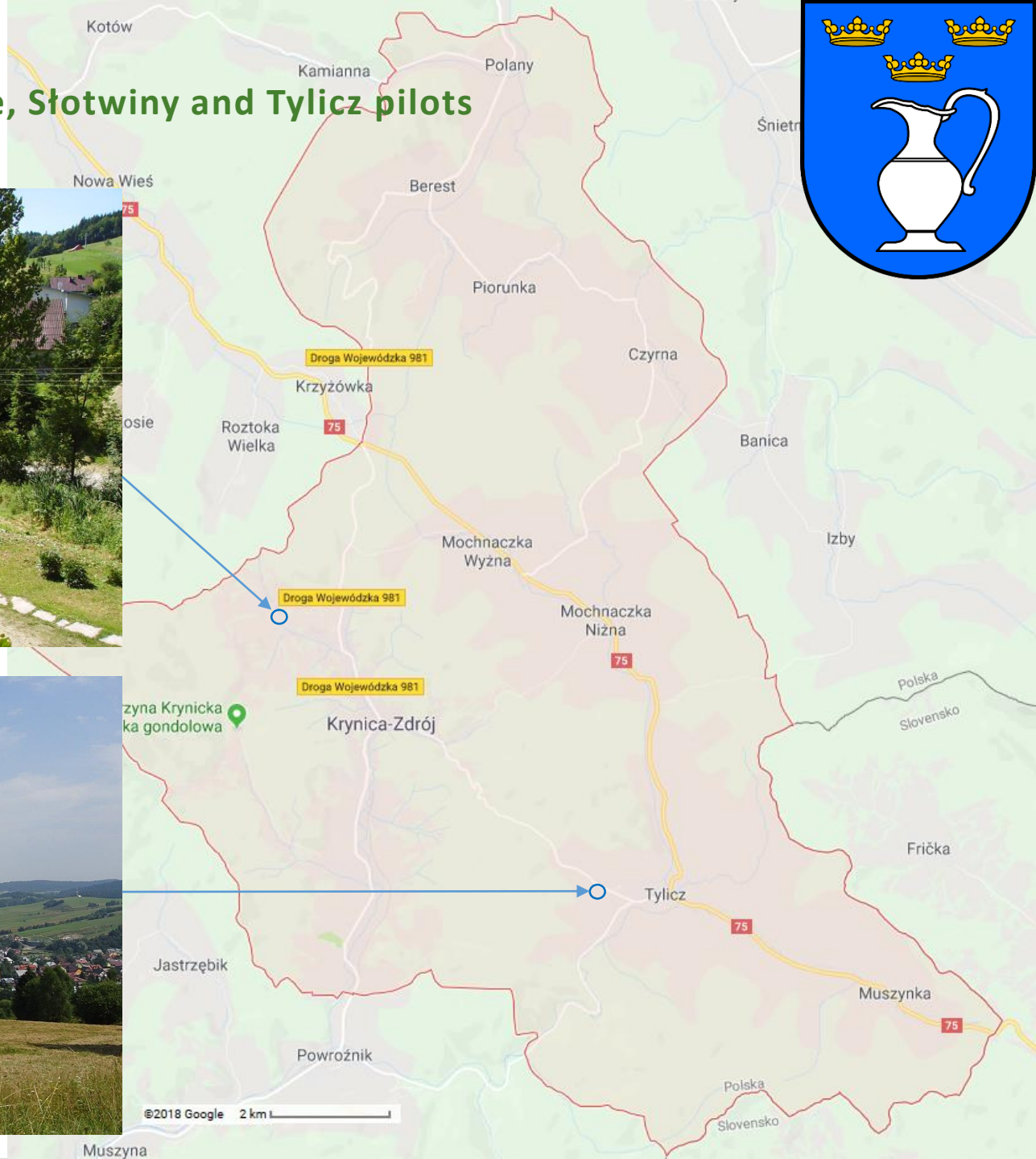
Location



Słotwiny



Tylicz



©2018 Google 2 km

Krynica Zdrój commune, Słotwiny and Tylicz installations

Short pilot description

Słotwiny



1

Small domestic waste water treatment plant for agro touristic activity (single household).

Technology:

tree chamber sedimentation tank,
vertical flow trickling filter,
slope soil plant filter bed,
infiltration ditch.

Tylicz



2

„Educational and presentation trail”
of pilot treatment technologies.

Technology:

sedimentation tank,
vertical flow trickling filter,
slope soil plant filter beds,
water ditches (water eyes, ponds),
grassy soil areas for final sorption and infiltration.

Krynica Zdrój commune, Słotwiny and Tylicz pilots

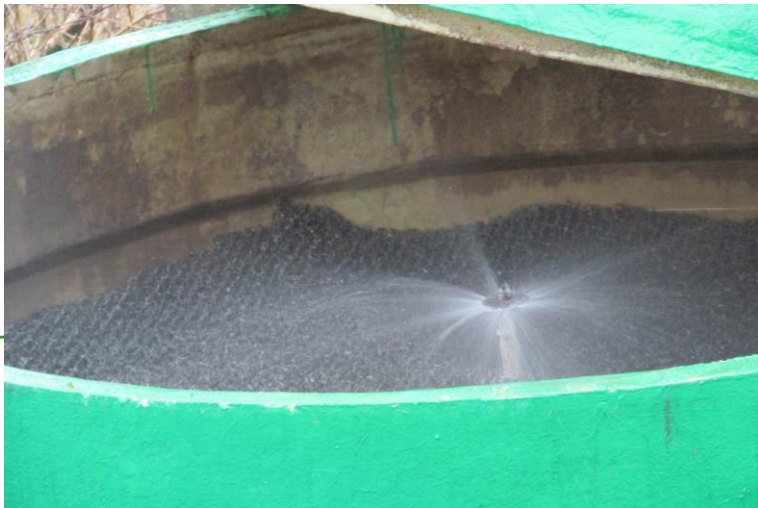
1 Technology description

Słotwiny



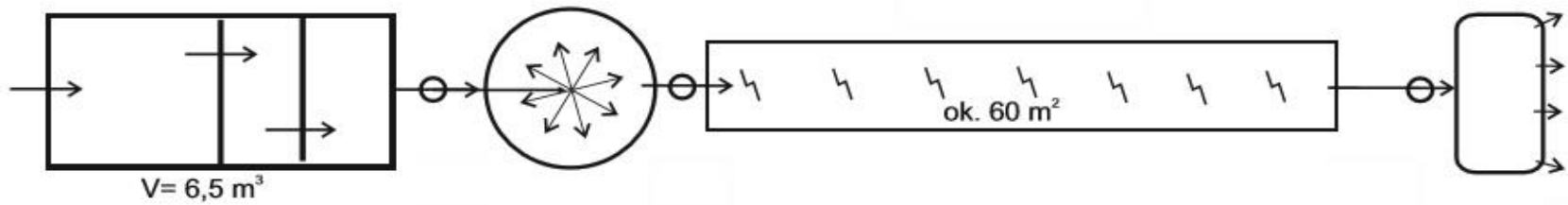
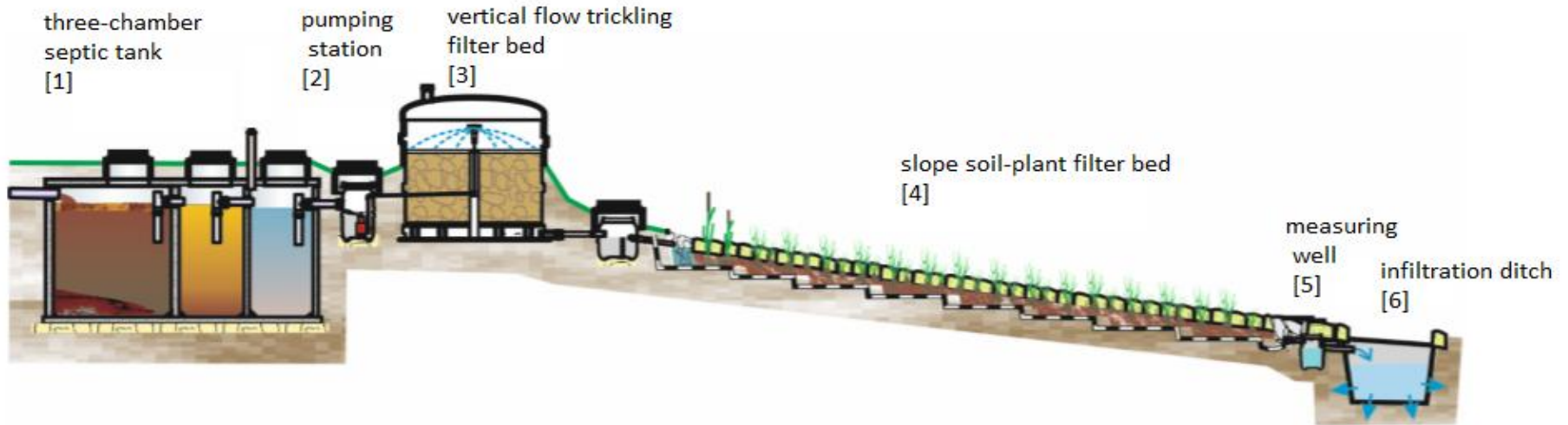
Small domestic waste water treatment plant for agro touristic activity (single household).

Technology:
tree chamber sedimentation tank,
vertical flow trickling filter,
slope soil plant filter bed,
infiltration ditch.



Krynica Zdrój commune, Słotwiny and Tylicz pilots

1 Technology description Słotwiny



Stream →

Krynica Zdrój commune, Słotwiny and Tylicz pilots

1 Technology description Słotwiny

Pre-treatment takes place in a three-chamber septic tank [1], where the sedimentation of suspended solids and anaerobic biochemical decomposition of organic matter occurs, which results in organic nitrogen ammonification and sulfur compounds formation.

Then the wastewater is pumped through the pumping station [2] to the trickling vertical filter [3], which is filled with light expanded clay aggregates sprayed with wastewater. That's where an intensive biochemical aerobic decomposition of organic wastewater pollutants (BOD_5 , COD) and advanced nitrification of ammonium ions takes place.

Tertiary treatment occurs in the horizontal flow slope soil-plant bed [4], which is a strip isolated from the ground. On this stage following processes occur: physical filtration of remaining suspensions, mineralization of residues of organic matter (BOD_5 , COD), nitrification and denitrification of nitrogen compounds as well as physical and chemical sorption with precipitation and immobilization of phosphorus compounds in the bed's mineral filling and rhizosphere.

The final stage is an infiltration ditch [6].

Krynica Zdrój commune, Słotwiny and Tylicz pilots

1 Why do we test this technology? Słotwiny

- It was designed in our Institute by experts from Tylicz branch.
- This is one of many instalations of this type in this area, so it is representative.
- Depending on household needs, the technology is easily moddable.
- It fits well the mountainous characteristics of the region.
- The building costs, maintenance and operational costs are low.
- Based on our experience, we want to promote this technology as one of best fitted for single household use in scattered dwellings areas in mountainous regions.

Krynica Zdrój commune, Słotwiny and Tylicz pilots

1

Conclusions

Słotwiny

- The data that we got from our tests confirms, that when the users care for the periodic maintenance of the installation, it easily meets the requirements of the Regulation of the Minister of the Environment from 18 November 2014.
- As tested, the technology applied guarantees high, whole year technological efficiency, even in winter climate conditions.
- We do not plan to change anything in this pilot installation, as it works well and is a bright example of best fitted solution for these conditions – mountainous area single household (agro turistic activity).
- We are not changing anything in this pilot, so Life Cycle Assessment (LCA) of the current state must be made.

Krynica Zdrój commune, Słotwiny and Tylicz pilots

1

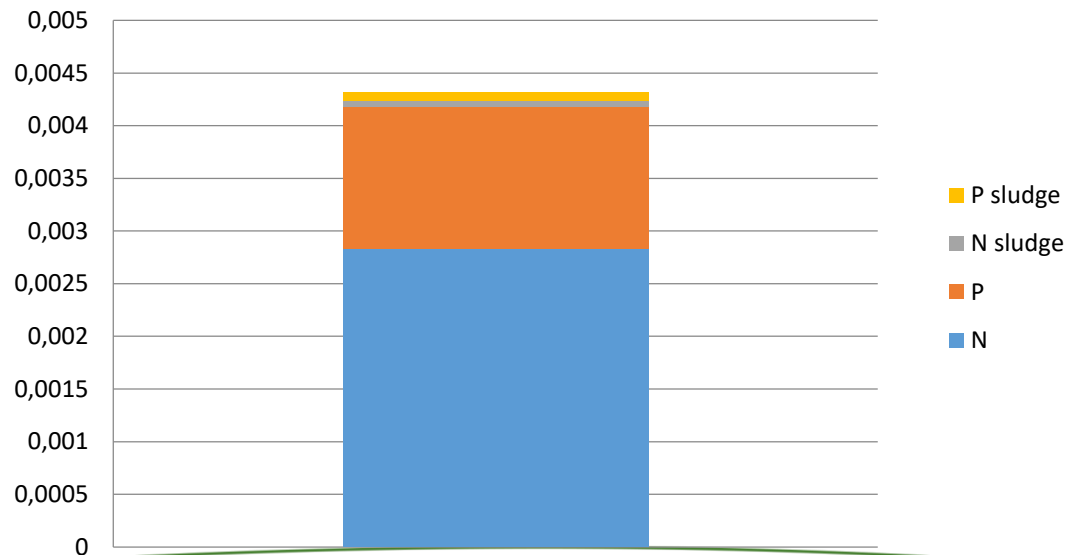
Life Cycle Assessment

Słotwiny

The eutrophication impact of Krynica-Zdrój Słotwiny wastewater treatment plant is 0.0043 kg PO₄-eq/ functional unit. The part of nitrogen was 66 % and phosphorus 31 %, the rest is coming from sludge management. The high part of nitrogen is partly caused by lower purification efficiency (70 %) than phosphorus (80 %).

kg PO₄-eq/
functional unit

The eutrophication impact of Krynica-Zdrój Słotwiny

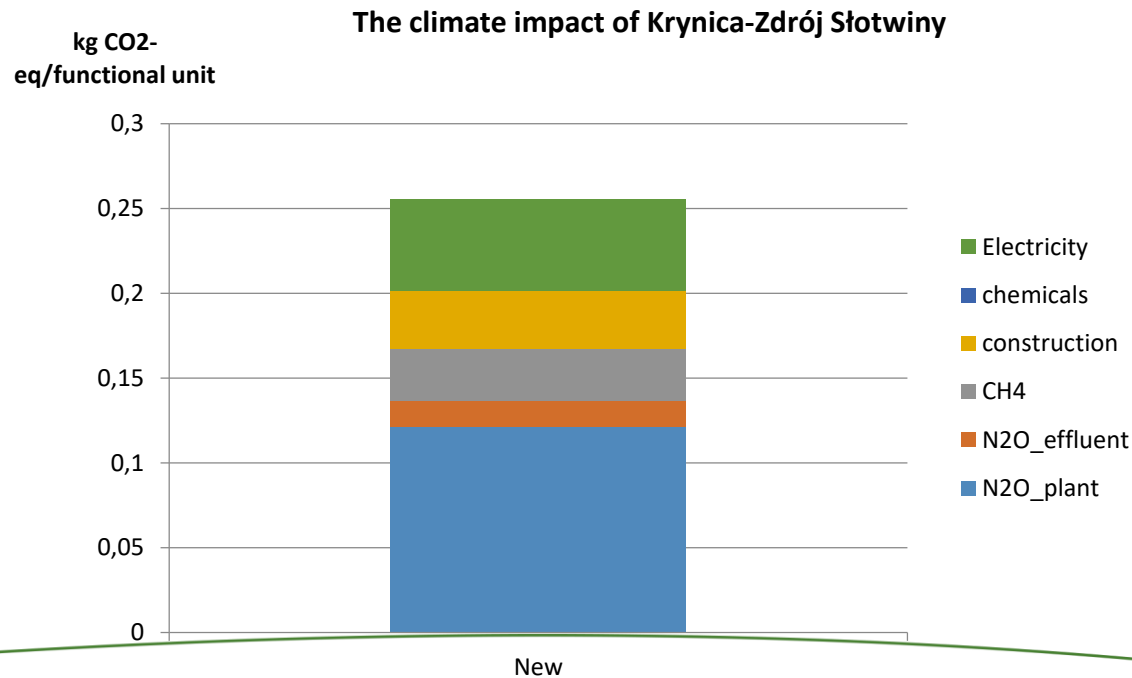


Krynica Zdrój commune, Słotwiny and Tylicz pilots

1 Life Cycle Assessment

Słotwiny

The climate impact of Krynica-Zdrój Słotwiny wastewater treatment plant is 0.26 kg CO₂-eq/ functional unit. The part of electricity production was 21 % and construction 13 %. The part of nitrous oxide was 53 %, methane 12 % and chemicals 0.1 %, which come from liming in sludge stabilization.



Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Technology description Tylicz



„Educational and presentation trail”
of pilot treatment technologies.

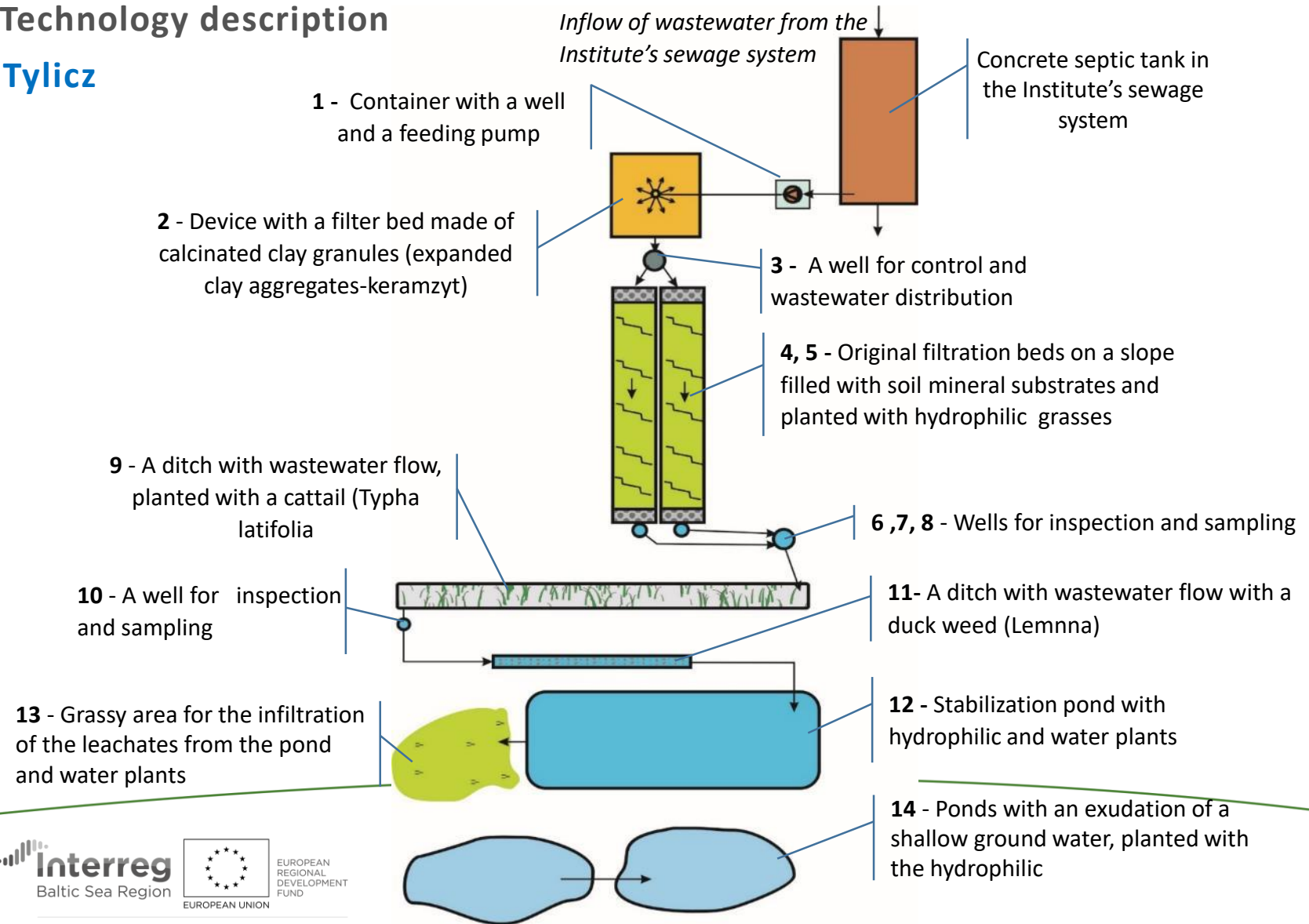
Technology:
sedimentation tank,
vertical flow trickling filter,
slope soil plant filter beds,
water ditches (water eyes, ponds),
grassy soil areas for final sorption and infiltration.

Structural renovation and functional reactivation of the „Educational and presentation trail”
in Tylicz branch of Institute of Technology and Life Sciences
Institute's testing area

Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Technology description

Tylicz



Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Technology description **Tylicz**

Location
of the installation

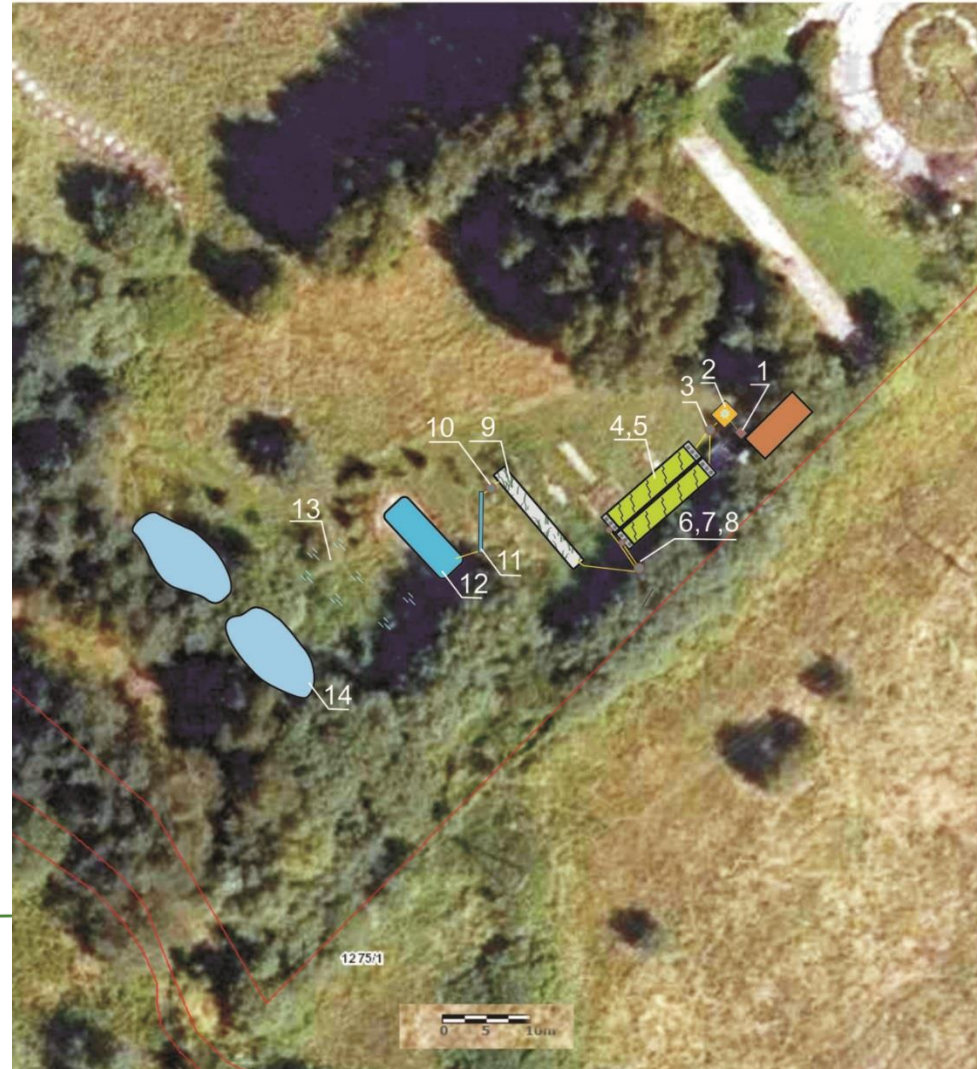


Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Technology description Tylicz

Location of the installation

- 1 - Container with a well and a feeding pump
- 2 - Device with a filter bed made of calcinated clay granulate (expanded clay aggregates-keramzyt)
- 3 - A well for control and wastewater distribution
- 4, 5 - Original filtration beds on a slope filled with soil mineral substrates and planted with hydrophilic grasses
- 6, 7, 8 - Wells for inspection and sampling
- 9 - A ditch with wastewater flow, planted with cattail (*Typha latifolia*)
- 10 - A well for inspection and sampling
- 11 - A ditch with wastewater flow with a duck weed (*Lemna*)
- 12 - Stabilization pond with hydrophilic and water plants
- 13 - Grassy area for the infiltration of the leachates from the pond
- 14 - Ponds with an exudation of a shallow ground water, planted with the hydrophilic and water plants



Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Technology description **Tylicz**

Location of the installation



Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Technology description **Tylicz**

Location of the installation



Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Description of the renovation process **Tylicz**

1 - Container with a well and a feeding pump



a. making of a plate sheet roofing covers

b. making of casing walls with use of impregnated wood


c. replacement of the inside insulation

Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Description of the renovation process Tylicz

2

- a. design and construction of a new roofing cover in form of a removable frame with a polycarbonate transparent sheets,
- b. replacement of the upper filtration layer of granules from expanded clay (30 cm),
- c. modernization of the sprinkler for increasing the coverage of bed surface with sewage,
- d. equipping the lateral inner walls of the bed housing with a layer of synthetic grass in order to weaken the wastewater stream and increase their area of interception and time of retention.



2 - Device with a filter bed made of calcinated clay granules (expanded clay)

3 -A well for control and wastewater distribution

3

- a. making and replacement of wooden frame by use of impregnated wood logs and stones.

Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Description of the renovation process Tylicz

4, 5 - Original filtration beds on a slope filled with soil mineral substrates and planted with hydrophilic grasses



- a. manual earthworks, removing an old soil and plant layer,
- b. profiling the shape of the bed bottom,
- c. purchase and delivery of 15 m³ of gravel with a grain size of 4-12 mm and sand with a grain size of 1-2 mm,
- d. purchase, delivery and arrangement on the bed bottom of two sealing layers of building foil, 1 mm thick,
- e. purchase, delivery and arrangement of prefabricated curb elements to border the sides of the filtration beds,
- f. purchase and making of 2-meter sections of PVC pipes ø160 (8 pieces) and their perforation to create openwork baffles arranged perpendicular to the direction of filtration in designated places along the length of the bed, to equalize of sewage flow inside the bed (alternatively: purchase of a stone and ready-made mesh elements and the making of gabions that meet these requirements).
- g purchase and deliver of concrete elements, manual earthworks related to reinforcing and stabilization of escarpments with use of ready-made "jumbo -type" perforated concrete plates,
- h. mechanical and manual works related to backfilling the filter mixture of the bed ,
- i. preparation of water manna seedlings and planting in the spacing of 20 x 20 cm ,
- j. making of two roofing covers with use of wood and steel sheet elements to cover the concrete housings on the inlet of wastewater into the filtration strips

Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Description of the renovation process Tylicz

9 - A ditch with wastewater flow, planted with cattail (Typha latifolia)



6, 7, 8 - Wells for inspection and sampling

10 - A well for inspection and sampling

6, 7, 8 and 10

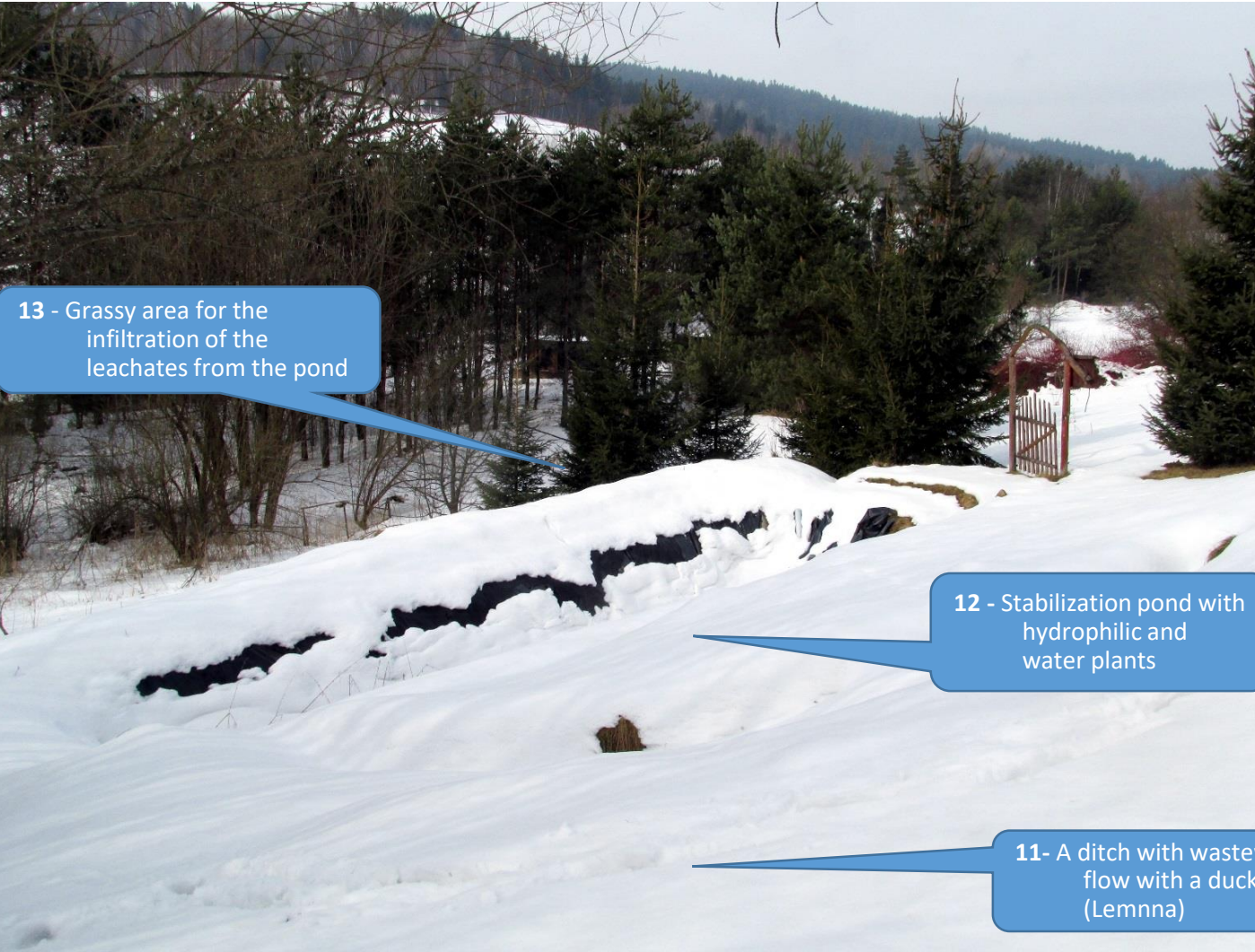
a. purchase of 4 ready-made PVC containers and pipes and fittings (made of PVC) and their workshop adaptation and installation in the bed on a slope.

9

a. purchase of pipe sections (50 mm, 80 mm and 100 mm diameter) with fittings and 2 PVC containers. Making of connections and installation of control well in the ditch,
b. renovation of the pipe installation connecting with the well for outflow of sewage from the ditch.

Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Description of the renovation process Tylicz



13 - Grassy area for the infiltration of the leachates from the pond

12 - Stabilization pond with hydrophilic and water plants

11- A ditch with wastewater flow with a duck weed (Lemna)

- 11
 - a. esthetic and functional renovation of the ditch and making a duct of PVC pipes supplying the sewage to the pond.
- 12
 - a. manual earthworks. Preparation of the surface of the pond for its sealing with the membrane,
 - b. purchase of a sealing membrane and its delivery to the workplace.
 - c. lining the pond with the membrane and fixing it at the edges of the pond,
 - d. manual earthworks: housing and protection of the shore zone of the pond (slabs, stones, turf),
 - e. purchase of pipes and fittings made of PVC with a diameter of 100 mm, making of overflow the sewage from the pond to the infiltration area through a distribution ditch filled with stones, made at the front part of the area .
 - f. purchase of wooden logs (ca. 100 m) at a local forest plant, cutting and debarking, purchase of impregnate means and wood impregnation,
 - g. purchase of ready-made steel elements for embedding of wooden fence posts in the ground, purchase of protective paints and making of anti-corrosion protection,
 - h. construction of 60 m long pond fencing - specialist works with the use of hand tools and a mechanical saw.

Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Description of the renovation process **Tylicz**

14 - Ponds with an exudation of a shallow ground water, planted with the hydrophilic and water plants

14

- a. purchase of poles in the local forest inspectorate (ca. 100 m in total), debarking and cutting, purchase of impregnation and protection of wood logs,
- b. purchase of ready steel elements for embedding wooden posts in the ground,
- c. purchase of anti-corrosion paints and painting of steel elements,
- d. pond fencing works with hand tools and a mechanical saw,
- e. earth and planting works, pond's care works.



Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Description of the renovation process Tylicz

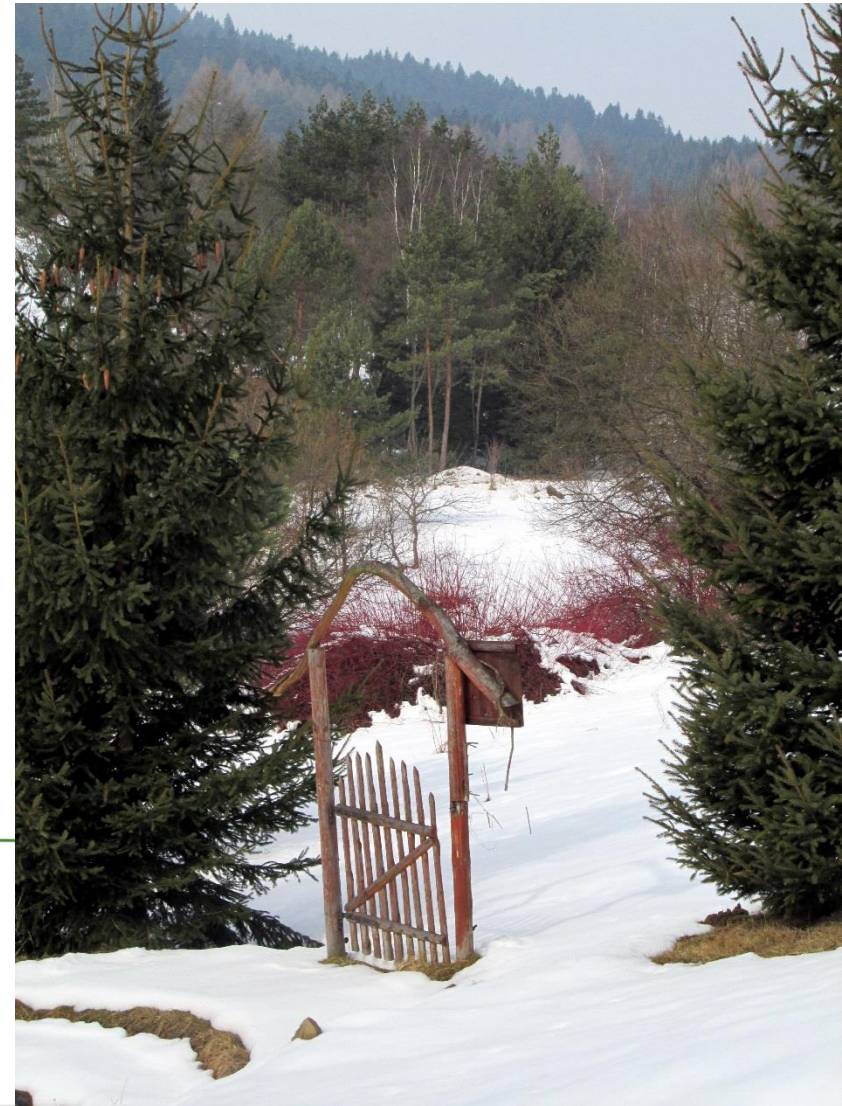
Other works

Making of a new fencing and gate

Designing, making and placing
of information boards along the trail

Making of wooden supports
for the information boards

Designing, making and placing
of an information board
at the entrance to the Institute premises in Tylicz



Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Why do we renovate the pilot installation?

Tylicz

The basic conception of the project contains the following technological objects:

septic tank, the reactor with vertical flow of wastewater with the filtration beds filled with granules prepared from natural mineral materials, original constructional solutions of special filtration beds on a slopes filled with mixtures of soil and sand, planted with chosen species of hygrophilic grasses, the special water ditches (water eyes, ponds) with water plant species, and finally the properly prepared grassy–soil areas for the sorption and final infiltration of treated effluents.

The benefit of the project is a real possibility to show existing and working in full technological scale, wastewater treatment installations, which are possible to build up by future owners themselves, but after competent training and advisory and in an agreement with law conditions in force in this subject.

Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Information dissemination

Tylicz

1. Design and making of leaflets containing the project information, technological data and contact information. Special emphasis will be on an appealing graphic layout. The leaflets will be distributed to the 16 commune offices in the Nowosądecki district.
2. Elaboration of information about the installation „Educational trail” to be included on the internet pages of:
 - Municipal office of Krynica Zdrój and Muszyna,
 - Polish Ecological Club in Krynica Zdrój,
 - Polish Ecological Club in Gliwice,
 - The Main Technical Organization (NOT) in Nowy Sącz in the tab of Scientific and Technical Committee of Environmental Protection and Water Management
 - State Higher Vocational School in New Sącz,
 - Public Library in Krynica Zdrój.
5. Elaboration of a short information and publishing it in local releases of „Krynickie Zdroje” and „ Prosto u źródła”. It will contain the information about the „Educational trail” with a workshop offer for local schools and generally for all rural communities.
6. Elaboration of a descriptive information of the project with an offer of use of the „Educational trail” as a workshop in EKOMUZEUM project, which focused on sustainable tourism and creation of local brands. EKOMUZEUM is realised by the Polish Ecological Club in Krynica.

Krynica Zdrój commune, Słotwiny and Tylicz installations

2 Life Cycle Assessment

Tylicz

- The installation is currently inactive.
- The Institute building has another sewage treatment methods for wastewater, the sedimentation tank is a common element for these installations ($V=80 \text{ m}^3$).
- After the renovation process the sewage will be redirected to the technological line.
- Periodically the wastewater is diluted by Institutes building drainage system.
- After renovation the installation will include more elements that is needed for an effective treatment process.

Krynica Zdrój commune, Słotwiny and Tylicz installations

Overall conclusions

- We continue to promote the soil plant bed technologies.
- The technologies are easily modifiable and should be modified of sort to best fit the specified household conditions, as this is the objective. Depending on the needs the technological line may be equipped with an additional filtration bed (a dephosphatation bed for example), or shortened if the characteristics of inflowing sewage indicate such possibility.
- The modifiable nature of the installations makes them hard to include in full extent in our projects „selection Tool”, as not only the sewage characteristics are taken in account but also the location specifics. For example to use a slope grass filter bed you need an actual slope. Or the use of an infiltration ditch requires requires the information on the groundwater level.



EUROPEAN UNION

EUROPEAN
REGIONAL
DEVELOPMENT
FUND

VillageWaters

Michał Kuźniar
Technician
Institute of Technology
and Life Sciences
Poland
m.kuzniar@itp.edu.pl
Phone: 48 22 243 55 53