

## **Pilots description in Poland**

In Poland, there are two pilots domestic wastewater treatment plants in two different municipalities: Sokoły and Krynica-Zdrój.

### **Sokoły**

First pilot domestic wastewater treatment plant is located in municipality of Sokoły in Idźki-Wykno village. Municipality of Sokoły is situated on the Plateau wysokomazowiecki within the Polish Green Lungs. It lies in the district wysokomazowiecki, in Podlaskie, in the north-eastern of Poland (Fig.1).

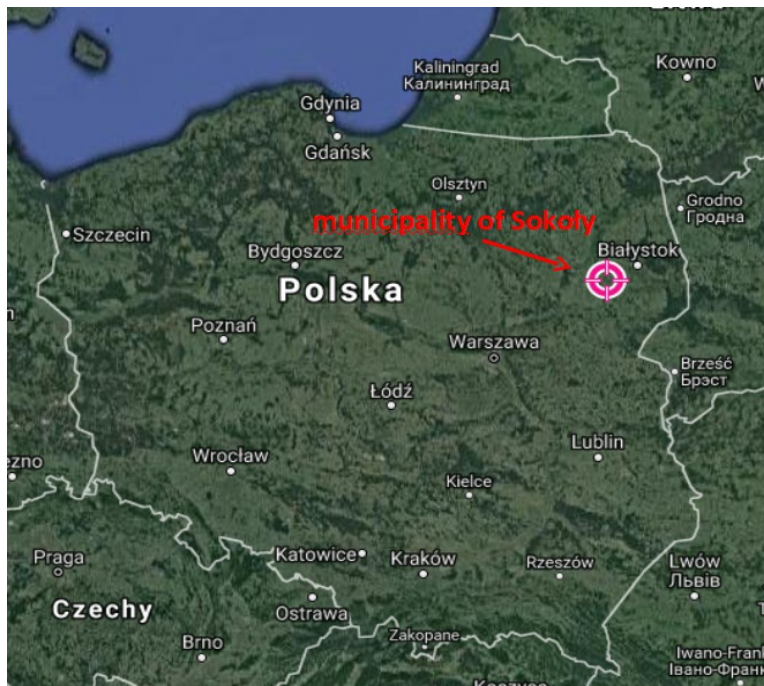


Figure 1. Municipality of Sokoły in Poland

Sokoły is inhabited approx.6100 people and is bordered by the three provinces: Warmia-Mazury, Mazovia and Lublin. From the north neighbor is Lithuania and Belarus to the east. The municipality covers an area of 15 557 ha, and its settlement network consists of 49 villages. It is a typical example of scattered dwellings commune, and currently they have 125 working domestic wastewater treatment plants, out of which 114 are soil-plant system with denitrification pond.

As a pilot installation from the existing plants we chose one in Idźki-Wykno village (Fig.2).



Figure 2. Individual domestic wastewater treatment plant for a single household in Idzki-Wykno village, in the municipality of Sokoly

It is a natural domestic wastewater treatment plant with soil-plant bed and a denitrification pond based on a treatment technology by Halicki (Fig.3).

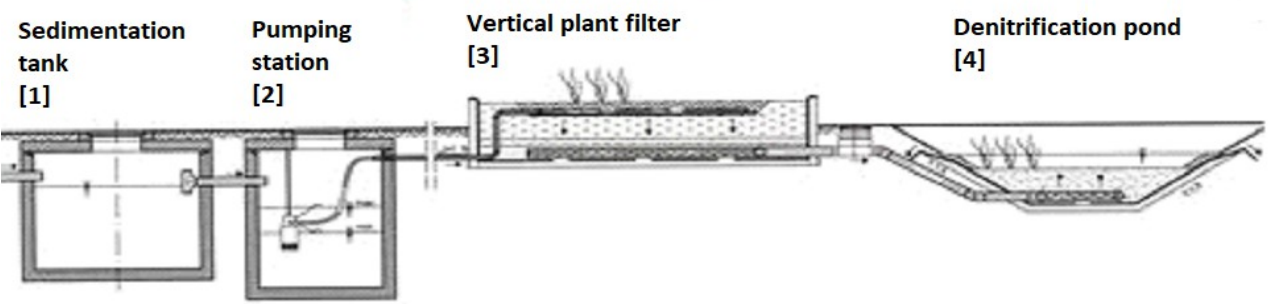


Figure 3. The scheme of the single household (3 people), individual wastewater treatment plant in Idzki-Wykno village (Sokoly municipality)

This is a single domestic installation (3 people) and it was built in 2004. The natural domestic wastewater treatment plant in the Idźki-Wykno village (Sokoły municipality) is composed of 4 elements: a sedimentation tank [1], a pumping station [2], a vertical plant filter [3] and a denitrification pond [4] (Fig.3).

The basic principle of treatment in this technology is the decomposition of pollutants contained in wastewater by microorganisms found in the soil, assisted by the root system of macrophytes. Microorganisms used are native to the soil, but in order to increase the intensity of the pollution reduction process in the treatment plant, an organic layer of BIO-HUMIX is added. The main stage of sewage treatment is the vertical plant filter [3] and the denitrification pond [4] (Fig.4). The sedimentation tank [1] and the pumping station [2]: The sedimentation tank fulfils the function of preliminary mechanical treatment of wastewater. In the sedimentation process, solids fall to the bottom of the sedimentation tank, where they ferment. The pumping station [2] ensures the discharge of liquid to the vertical plant filter [3] when the gravity flow is unobtainable. The vertical plant filter [3]: this is the main component of the treatment plant. It is isolated from the soil by a foil layer. The filling of the filter is composed of soil mixed with organic material. The filter area is planted with carefully selected marsh water vegetation. The following plants were planted on the filter:

- stiff sedge (*Caricetum hudsonii*),
- rush (*Juncus*),
- great manna grass (*Glyceria maksima*),
- yellow flag (*Iris pseudoacorus*).
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The denitrification pond [4]: it is a last, cleaning element, serving for further purification of the sewage, most often it has a round shape. Based mainly on the evapotranspiration process. Like the filter, it is isolated from the soil by a foil layer and is also filled with multi-species macrophytes. The pond can also be a life place for different species of fish and amphibians.

It is important that this type of natural individual household wastewater treatment plant does not have any wastewater outflow, so the last step of wastewater treatment is the denitrification pond, but sometimes, especially during winter when there are no plants in the denitrification pond, purified wastewater can overflow from denitrification pond to the ground.



Figure 4. The elements of domestic wastewater treatment plant in Idzki-Wykno village [own photo, 06.2017]

### **Krynica- Zdrój**

The second pilot domestic wastewater treatment plant is located in the village of Słotwiny (Fig.6) in the municipality of Krynica-Zdrój (Fig.7).

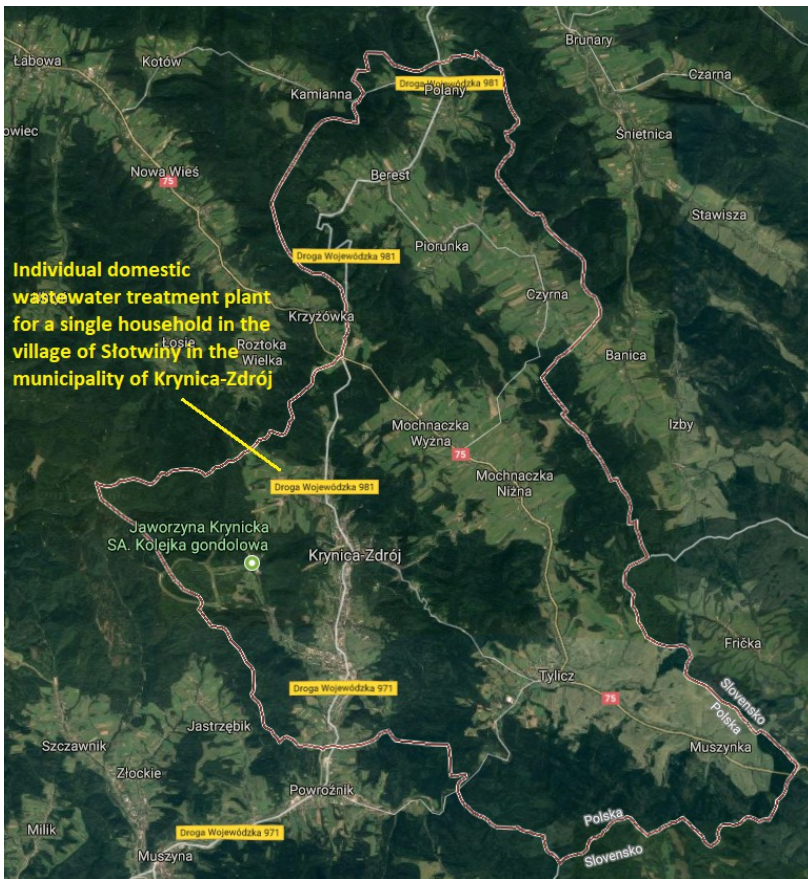


Figure 6. Individual domestic wastewater treatment plant in the village of Słotwiny in the municipality of Krynica-Zdrój in Poland

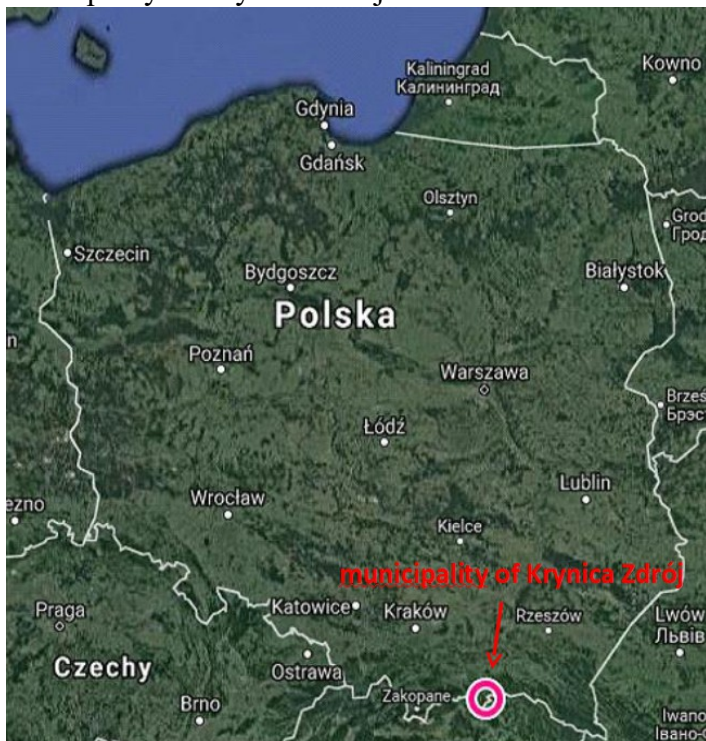


Figure 7. Municipality of Krynica-Zdrój in Poland

It is a typical mountain region and it is located far southern end of Baltic sea catchment. The municipality of Krynica Zdrój has the status of the health resort. The commune is situated in the eastern part of the Beskid Sądecki and on the western edge of the Beskid Niski. The municipality has an area of 145.3 square kilometers, including agricultural land 39% forest land 55%. This represents 9.37% of the county.

This pilot wastewater treatment technology was implemented by Institute of Technology and Life Sciences, and it consists of a slope soil-plant filter bed [4] and vertical flow trickling filter bed [3] (Fig.8).

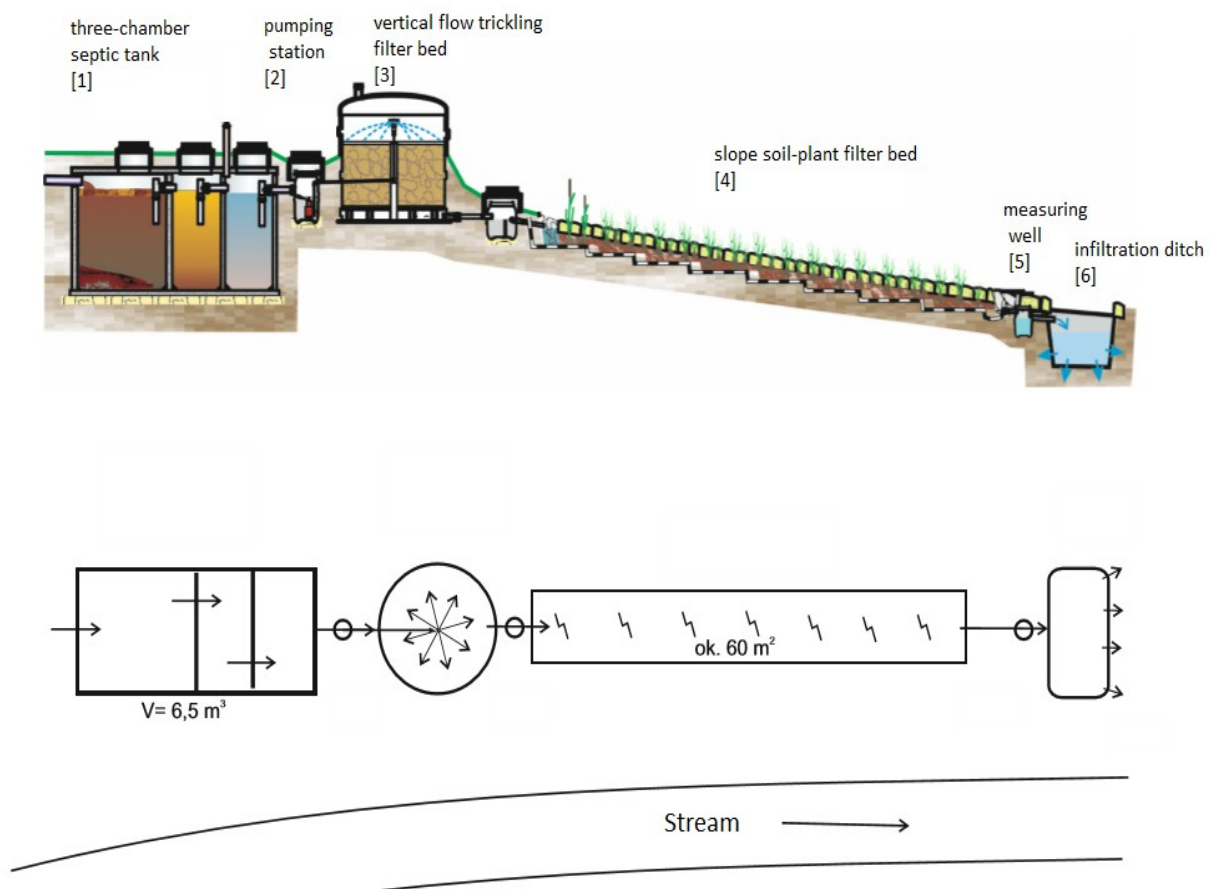


Figure 8. The scheme of the installed small individual domestic wastewater treatment plant for a single household in Słotwiny village (Krynica-Zdrój municipality)

Pre-treatment takes place in a three-chamber septic tank [1] with interchamber separation of floating and easily falling pollution. Sedimentation of suspended solids, anaerobic biochemical decomposition of organic matter, results in organic nitrogen ammonification and sulfur compounds formation. Then wastewater are pumping by pumping station [2] to the vertical trickling filter bed [3]. Biological wastewater treatment takes place in vertical flow trickling filter bed [3] filled with

light expanded clay aggregates in a tight casing. That's where an intensive biochemical aerobic decomposition of organic wastewater pollutants (BOD<sub>5</sub>, COD) and advanced nitrification of ammonium ions takes place. Tertiary treatment occurs in the horizontal flow slope soil-plant filter bed, which is a strip isolated from the ground. On this stage following processes occur: physical filtration of suspensions, mineralization of residues of organic matter (BOD<sub>5</sub>, 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].

### BUILDING THE TECHNOLOGICAL PILOT SYSTEM

We are going to evaluate potentially the best-fitting wastewater treatment system for the household involved in the pilots and then to build the best-fitting wastewater treatment system for school in pilot commune of Sokoły. The first school is located in Bruszewo village. Bruszewo is very old village. Probably it was founded in 1444.

The school in Bruszewo (Fig. 9) need to build wastewater treatment plant because:

- currently the school does not have a wastewater treatment system,
- sewage is collected in old and leaky septic tanks (Fig.10). The septic tanks are 17 years old,
- nowdays they have to dispose of the collected sewage and sludge and in case of a domestic wastewater treatment plant – only the sludge,
- the school is an example of scattered dwellings and must be equipped with an individual wastewater treatment system.



Figure 9. The school in the village of Bruszewo in Sokoły municipality [own picture, 11.2016]



Figure 10. Two septic tanks next to the school in the village of Bruszewo in Sokoły municipality [own picture 11.2016]





Figure 11. A place to build the best-fitting wastewater treatment plant at the school in the village of Bruszewo in Sokoły municipality [own picture 11.2016]