INVESTMENT FACT SHEET

I1 Implementation of passive GW treatment bioreactive wall in Jaworzno Version 2

Project index number and acronym	CE32 AMIIGA
Responsible partner (PP name and number)	PP2 – City of Jaworzno
Linked to pilot action (number and title)	Pilot action 6 (A.T2.6); Implementation of pilot action 6: Passive GW treatment by bioreactive wall in Jaworzno FUA (PL)
Project website	https://www.interreg-central.eu/Content.Node/AMIIGA.html
Delivery date	03.2019

Description and technical characteristics of the investment

Investment in Jaworzno FUA consists of: passive GW treatment bioreactive wall implementation, upgrading existing research points to collect data necessary to identify the effectiveness of the barrier and building new piezometers at the passage of the plume downstream of bioreactive wall.

The main aim of investment implementation is to test the effectiveness of the bioreactive barrier with microbiological deposit (especially prepared for this pilot action), as an appropriate component used for bioremediation of groundwater environment contaminated with persistant organic compounds, to elimination migration of contaminants, as well as to identify possible difficulties and the potential impact of carried works on the health of residents and the environment.

Works related to implementation of the testing bioreactive barrier were conducted in the years 2016-2018. At the beggining, on the basis of documentations concerning the area of waste landfill “Rudna Góra” elaborated so far, two potential localizations of bio-reactive wall were proposed: area 13 – variant 1 and area 4 – variant 2. Although, area 13 was indicated as more proper for investment implementation. Those two propositions were discussed during workshop with FUA experts and local associated partners, organized on 28th of November, 2016, in Jaworzno.

Next, taking into consideration geotechnical characteristics of the the areas, in order to allow the proper design and foundation of reactive barrier for contaminated area in the Chemical Plant "Organika Azot" in Jaworzno, a two-variant non-technical concept for bioreactive wall was developed in the „funnel and gate” system (where funnel is non-permeable wall and gate – bioreactive permeable wall filled with active material and microbiological bed). It allowed to design the final construction of the barrier in final chosen area of the brook Wąwolina - on a plot being in a property of the Municipality of Jaworzno with optimal soil and water conditions, non-forested and with proper access to roads – to cut off selected source of polution on the northern plume coming from the old heap area of, so called, "Stara hałda przy torach". It is the area, where, up to the year 1969, wastes from Chemical Plant „Organika Azot“ had been dumped. The technical documentation was elaborated by INIKO Ltd. and submitted to the attached to the announced tenders. It comprised comprehensive technical solutions for the construction of a bioreactive barrier, the safety and health plan and manual for the contractors as well as cost estimates of the investment.

The bioreactive wall was designed as a passive construction (does not need an additional source of energy from outside) as follows:

- In order to collect and direct contaminated groundwater to the reactive barrier, it was designed to perform a barrier-collecting drainage system. The drainage was designed as a narrow spatial ditch in which the drainage aggregate was being laid. The total length of the drainage panel is 15 meters with thickness up to the level of loam - about 6 meters below ground level.
- Two parts of non-permeable walls (“funnel”) had been provided on the trench wall. The sealed barrier is designed to pile up groundwater and produce a hydrostatic pressure allowing free flow through the reactive barrier. Each part of non-permeable walls is 7.5 meters long with the depth of about 1meter below the top of the Triassic loam to ensure the tightness of the barrier on vertical isolation.
- Construction includes also “gates” - bioreactive permeable walls filled with active material and specialized microbiological bed.
- Active barriers consist of reinforced concrete wells (S1, S2, S3) in which cartridges (K1, K2, K3) with active material are installed, and a flow system with checkpoints allowing the sampling of water. The system allows replacement of cartridges in the active barrier at the time when current control tests show the use of active substances.

- Construction of the installation also provides the S4 well, at a distance of approximately 63 meters from the active barrier. Well S4 is a part of the splash drainage system for purified groundwater, which also includes drainage from the level of the groundwater to the level of the impermeable layer of the Triassic loam. The flow of groundwater between the well S3 and S4 is being carried out by means of a sewer pipe.
- Implemented bioreactive wall is being equipped with monitoring devices to test its efficiency in real conditions. Measurement points are being built into the system of the testing reactive barrier. Each measuring point consists of a pipe anchored to the right place in the system. The whole system is being made of chemical resistant materials. The design of the measuring points allows the connection of an external sewage collection pump. It is also be possible to rinse the tube after the abstraction of the test material.

The task of the barrier is to capture contaminated groundwater and pass them through a system of wells filled with properly chosen sorbents. Originally it was: iron chips in the first cartridge and mixture of sand nad peat (instead of initially planned activated carbon, because of the same properties but much lower price and availability on the market) in following cartridges. Such selection was made during workshops organized on 22nd of March, 2017, in Jaworzno. To check the effectiveness of the sorbent, in December 2018, peat and sand deposits were replaced with new ones, however, before the end of the project, it is planned to test activated carbon instead of peat, to have the clear view of tested sorbents and prepare complete recommendations for future use of this passive remediation technique for reduction of groundwater contamination in full scale.

The desired barrier performance depends mainly on the effectiveness of a suitably selected microbial reagent, which plays a key role in the remediation of contamination. The microbiological part of the wall was specially prepared for Jaworzno by screeing and collecting proper microorganisms for the contaminated site in Jaworzno and growing them in the laboratory conditions. Finally, microbiological inocula was applied into the middle cartridge filled with mixture of peat and sand. The first application happened on 16th of May, 2018. That is the day taken as official initiation of the operation of bioreactive barrier in Jaworzno.

In the meantime of biobarrier implementation, actions aiming at restoring and upgrading the exsisting, partly damaged 33 monitoring points (piezometers with numbers P30 to P45 and wells with numbers from S1 to S17) were conducted in November and December, 2017. The task consisted mainly in cleaning, making them permeable and installing a new closures. Mentioned research points are located in the area of the Chemical Plant „Organika Azot" in Jaworzno and are used to collect data necessary to identify the effectiveness of the testing bioreactive barrier. They were built in 2010 in the framework of an international project acronim FOKS (titled: „Focus on Key Sources of Environmental Risks"), realised in the Interreg CENTRAL EUROPE Programme and coofinanced from the European Union, European Regional Development Funds.

Additionally, few permanent control points (piezometers) had being constructed within AMIIGA project. Single one (No. PJ-1) is located on a plot No. 3866/6 within Jeleń geodesic area in Jaworzno. It is PVC pipe (filter) with a diameter of 110 mm and a length of 19 meters below the ground level, secured (above the surface) with a casing made of PVC, 140 mm in diameter, with a closure. Twin piezometer (No. PŁ-1/1 and PŁ-1/2) had being built on the plot No. 79/1, geodesic area 220 in Jaworzno. Piezometer PŁ-1 (twin) includes two PVC pipes (filters) with a diameter of 110 mm and a length of 13 and 28 meters below the ground level, protected (above the surface) with two housings made of PVC, with 140 mm in diameter, with closures. New monitoring holes are necessary for making observations of hydrogeological condition in the quaternary aquifer at the passage of the plume downstream of bioreactive barrier. Works were fulfilled in May, 2018.

Investment costs (EUR) including a break-down of main cost items

TOTAL INVESTMENT COSTS: 63.288,66 EUR
BREAK-DOWN OF MAIN COST ITEMS:

- 53.536,70 EUR - Implementation of the passive GW treatment bioreactive wall in the funnel & gate system;
- 3.110,15 EUR - Upgrading existing research points to collect data necessary to identify the effectiveness of the testing reactive barrier & monitor state of the environment;
- 6.641,81 EUR – Construction of new monitoring points necessary to identify the effectiveness of the testing reactive barrier & monitor state of the environment.

Investment location

NUTS 3	Address (Street, house number, postal code, city, country)	GPS coordinates
PL22B, Sosnowiecki	Biobarrier location: plot No. 26/1, geodesic area 270, city of Jaworzno	Biobarrier location: - latitude 50.187641 - longitude 19.242897
PL22B, Sosnowiecki	New piezometers No. PŁ-1/1 and PŁ-1/2: plot No. 79/5, geodesic area 220, city of Jaworzno	New piezometers No. PŁ-1/1 and PŁ-1/2: - latitude 50.18169 - longitude 19.225545
PL22B, Sosnowiecki	New piezometer No. PJ-1: plot No. 3866/6, geodesic area Jeleń, city of Jaworzno	New piezometer No. PJ-1: - latitude 50.150284 - longitude 19.248351

PL22B, Sosnowiecki	Upgraded existing research points: wells S1, S2: plot No. 96/2, geodesic area 165, city of Jaworzno wells S3, S4, S5, S6: plot No. 26/2, geodesic area 270, city of Jaworzno wells S7, S8, S9, S10, S11, S12, S13, S14, S15, S16, S17: plot No. 591/106, geodesic area Jeleń, city of Jaworzno piezometer P30: plot No. 314/6, geodesic area 165, city of Jaworzno piezometer P31: plot No. 591/134, geodesic area Jeleń, city of Jaworzno piezometers P32, P33: plot No. 591/140, geodesic area Jeleń, city of Jaworzno piezometers P34, P35, P36, P37, P38: plot No. 778/1, geodesic area Jeleń, city of Jaworzno piezometer P39: plot No. 822/15, geodesic area Jeleń, city of Jaworzno piezometer P40: plot No. 795/1, geodesic area Jeleń, city of Jaworzno piezometer P41: plot No. 16/14, geodesic area 270, city of Jaworzno piezometer P42: plot No. 16/14, geodesic area 270, city of Jaworzno piezometer P43: plot No. 20/13, geodesic area 274, city of Jaworzno piezometer P44: plot No. 24/2, geodesic area 270, city of Jaworzno piezometer P45: plot No. 308/20, geodesic area 165, city of Jaworzno	

Duration and process of investment implementation	
Start date	**End date**
10.2016	05.2018
Major milestones of investment implementation	

- Selection of two potential locations of the biobarrier during workshops organized in Jaworzno (11.2016);
- Determination of geotechnical conditions in two potential localization of the barrier (11.2016);
- The concept of constructing a bioreactive barrier in mention areas (12.2016);
- Preparation of technical project for bioreactive wall implementation in final chosen location (03.2017);
- Selection of appropriate sorbent for the barrier (04.2017);
- The concept for pilot site monitoring (05.2017);
- Preparation and conduct of the procedure for awarding an order in a procedure other than order mode from free hand, for the implementation of the barrier (05.2017-06.2017) - tender was cancelled because offer exceeding 4 times the funds allocated for the task;
- Next preparation and conduct of the procedure for awarding an order in a procedure other than order mode from free hand, for the implementation of the barrier (07.2017-08.2017) - tender was cancelled because there was no offer;
- Preparation and conduct of the procedure for awarding an order in the order procedure from free hand (09.2017-10.2017);
- Implementation of the barrier (10.2017-01.2018);
- Upgrading existing research points (piezometers No. from P30 to P45 and wells No. from S1 to S17) to collect data necessary to identify the effectiveness of the barrier (11.2017-12.2017);
- Building 3 new piezometers (No. PJ-1, PŁ-1/1 and PŁ-1/2) at the passage of the plume downstream of the bioreactive wall (12.2017-05.2018);
- Introduction of the biological inoculum in the passive GW treatment bioreactive wall (16.05.2018)

Ownership and durability of the investment (e.g. maintenance, financing)

All investment in Jaworzno FUA was located on the grounds belonging to the Municipality of the Jaworzno: bioreactive barrier on the plot No. 26/1, geodesic area 270 in the city of Jaworzno, and piezometers in the plot No. 79/5, geodesic area 220 (piezometers No. PŁ-1/1 and PŁ-1/2) and No. 3866/6 in the area of Jeleń (piezometer No. PJ-1). That is why the Municipality of Jaworzno guarantees the maintenance of completed investment during the lifetime of the project - for at least 5 years from the final settlement of the project. As passive groundwater treatment bioreactive wall is part of a larger activity planned to the realization in Jaworzno, so called "The solution to the problem of hazardous waste accumulated in the Wąwolnica stream in Jaworzno", it is planned to establish cooperation with scientific institutions in order to continue researches using the elements of the bioreactive barrier made in order to develop the most effective methods of soil and water remediation against chemical pollution accumulated on the premises of former chemical plant. In addition, the Municipality of Jaworzno (or other proper entity related to the protection of surface or underground water) will conduct systematic water researches using the piezometers made under the project and will maintain them in efficiency.

References to related pilot action (output fact sheet) and relevant deliverables (e.g. pilot action report, studies) and web-links.
If applicable, additional documentation, pictures or images to be provided as annex

Investment implementation in Jaworzno was precisely related to following deliverables made within WP2 (Activity A.T2.6):

- Report on selecting the site for construction of the bioreactive barrier (Deliverable D.T2.6.1) with two potential localizations of bioreactive wall: area 13 – variant 1 and area 4 – variant 2.
- Report from preliminary geo-technical studies (Deliverable D.T2.6.2) on selected areas for barrier implementation includes results from geological analysis as well as expert opinion. Document was a base for designing technical solutions of the barrier enabling the flow of water through its elements.
- Non-technical concept for bioreactive wall implementation (Deliverable D.T2.6.3) is a two-variant non-technical design concept of the passive GW treatment bioreactive wall, due to two propositions of its localization. In the frames of two variants it has been proposed to construct an active barrier in the system of „funnel and gate" (funnel – non-permeable wall; gate – bioreactive permeable wall filled with activated carbon, zerovalent iron, microbiological bed).
- Technical project for bioreactive wall implementation (Deliverable D.T2.6.4) contains all necessary technical parameters of bioremediation wall, including shape, dimensions, diameter, material type and its final location, enabling conducting the public procurement procedure and choosing a contractor and construction of reactive barrier, including manual for the contractor.
- Report from selection of appropriate sorbent for bioreactive wall (Deliverable D.T2.6.5) contains results of technical and scientific papers screening for parameters of appropriate sorbents, and indicated that iron chips and mixture of peat with sand will be introduced to cartridges. Then, cartridges with peat and sand will be enhanced by microbiological inocula that was being prepared in frame of D.T2.6.7.
- Concept for pilot site monitoring (Deliverable D.T2.6.6) comprises preliminary assumptions and structure of monitoring system, as well as characteristics of monitoring points of the reactive barrier.
- Report from preparation of biological inocula (Deliverable D.T2.6.7) which was introduced into the bioreactive wall on 16th of May, 2018.
- Report from implementation of bioreactive wall at Jaworzno site (Deliverable D.T2.6.8) summarises works connected with construction of the reactive barrier comprising description of conducted works and obstacles that occurred, and photos presenting specific stages of the works. The report is complement by the film from implementation of the barrier:
  http://www.um.jaworzno.pl/pl/biznes/projekty_i_programy/112/projekt_amiiga.html
- Final brochure (Deliverable D.C.5.2) https://www.interreg-central.eu/Content.Node/AMIIGA---final-brochure-LR.pdf
- Guidelines including AMIIGA integrated approach to GW management (Deliverable D.T1.4.3):
  - English version https://www.interreg-central.eu/Content.Node/D.T1.4.3-final-version-guidelines---ENG-1.pdf
  - Polish version https://www.interreg-central.eu/Content.Node/DT143-final-version-guidelines-FINAL-PL-31-10-2019.pdf