

Heat Recovery at the Waste Management Facility of Gdansk



European
Regional
Development
Fund

Authors

Andreas Hänel, PhD Eng.
Jan Hupka, PhD DSc. Eng.

Work Package 4

1. Background to pilot

During the UBIS project a demonstration installation will be installed at the area of the Waste Utilization Facility LTD (ZUT) in Gdansk. The goal is to demonstrate the feasibility of the low temperature heat recovery from power generators which can be considered for heating of facilities at the pilot and surrounding area. For this purpose a Spinning Fluids Reactor (SFR) is used which is mounted on a mobile system (see Figure 1). The mobile system will be hooked up and joined with the bioenergy plant, which is generating electricity from landfill gas. Simultaneously the SFR is used to purify the exhaust gases from acidic and particulate matter.

The SFR consists of a corpus (2) with a tubular metal mesh inside (see Figure 2). The head (1) of the SFR provides the liquid to the corpus (2) and causes the spinning of the liquid inside of the metal mesh. The SFR is fed with gas from the side of the corpus (2) and the gas is pressed through the metal mesh, which results in formation of small gas bubbles in the spinning fluid. Due to significant turbulence there is a strong mass and heat transfer between the two phases. Mixed phases flow to the vessel which is at the bottom of the reactor. Gas and liquid are separated in the vessel. The gas is released to stack and the liquid goes to the heat exchanger from which the heat is utilised.



Figure 1: Mobile Reactor System [1]

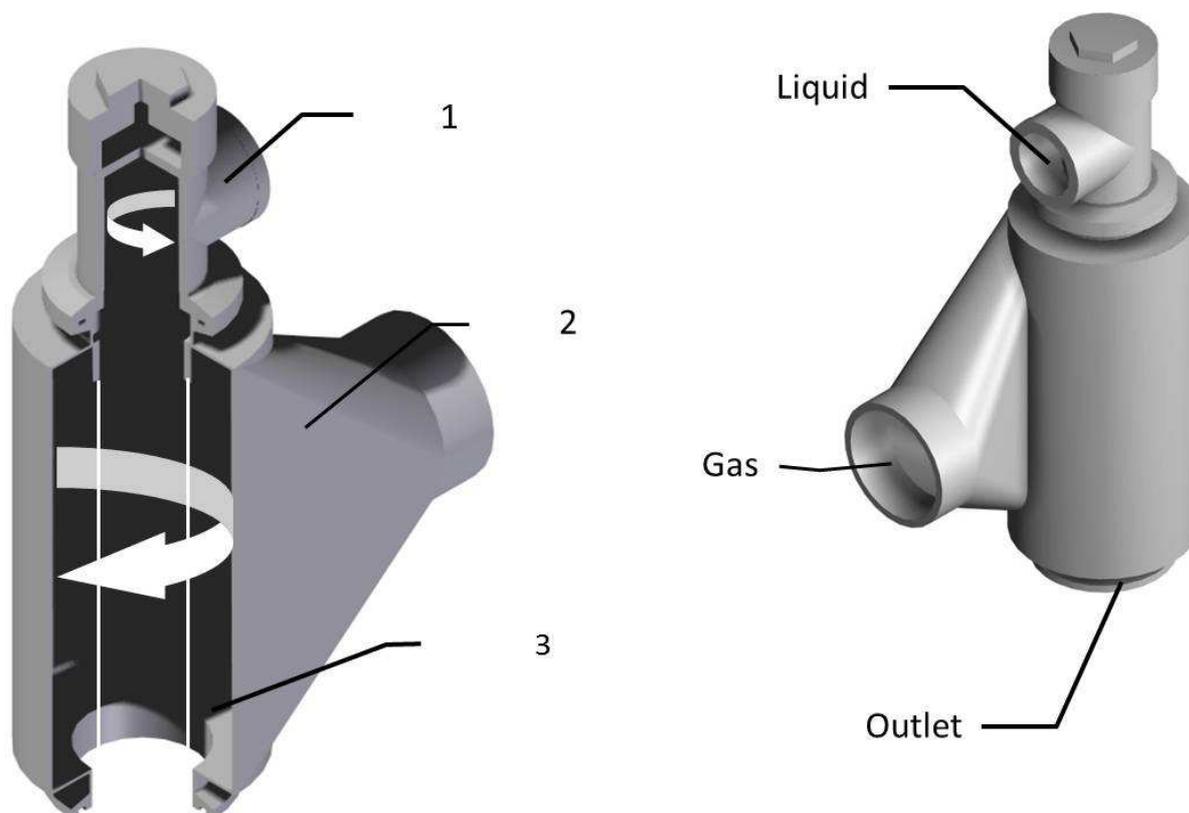


Figure 2: The Spinning Fluids Reactor: 1) Head, 2) Corpus, 3) Mesh [1]

2. Description of the area

The pilot installation is implemented at the area of the Municipal Waste Utilization Facility LTD (ZUT) in Gdansk (see Figure 3 and 4). The facility lies in the south-west of the Gdansk municipality and borders directly to the Kolbudy municipality. The ZUT can be reached by the highway S6/E75. The pilot will be installed in a mixed area. In the direct neighbourhood are located trade companies or other embodiments (eastward, northward and southward of ZUT) or residential areas and areas owned by the state (westward and southward).

Since 1969, the area has been used for landfilling of waste. The terrain has a size of 70 ha. Due to privatisation in 1992, the ZUT company was founded. In August 2008 the modernization of the waste management facility started and was partly financed by European Union (total budget 320 million zł, around 80 million €). The construction of the mechanical-biological treatment plant was finished in 2011. The plant is at the state of the art and comprises (Figure 5):

- sorting facility for mixed waste,
- modern waste disposal facility,
- composting plant,
- biogas energy plant,
- pre-treatment of leachate by reverse osmosis.

The waste utilization facility manages municipal, construction and also hazardous wastes. In 2016 240'000 tons of wastes were processed and 18'300 tones of recyclable materials were obtained. The ZUT company employs around 300 persons.

The pilot will be installed in building No. 6 (see Figure 5), where landfill gases are converted to electricity. In 2016 around 6.3 million m³ of landfill gas was collected and converted.

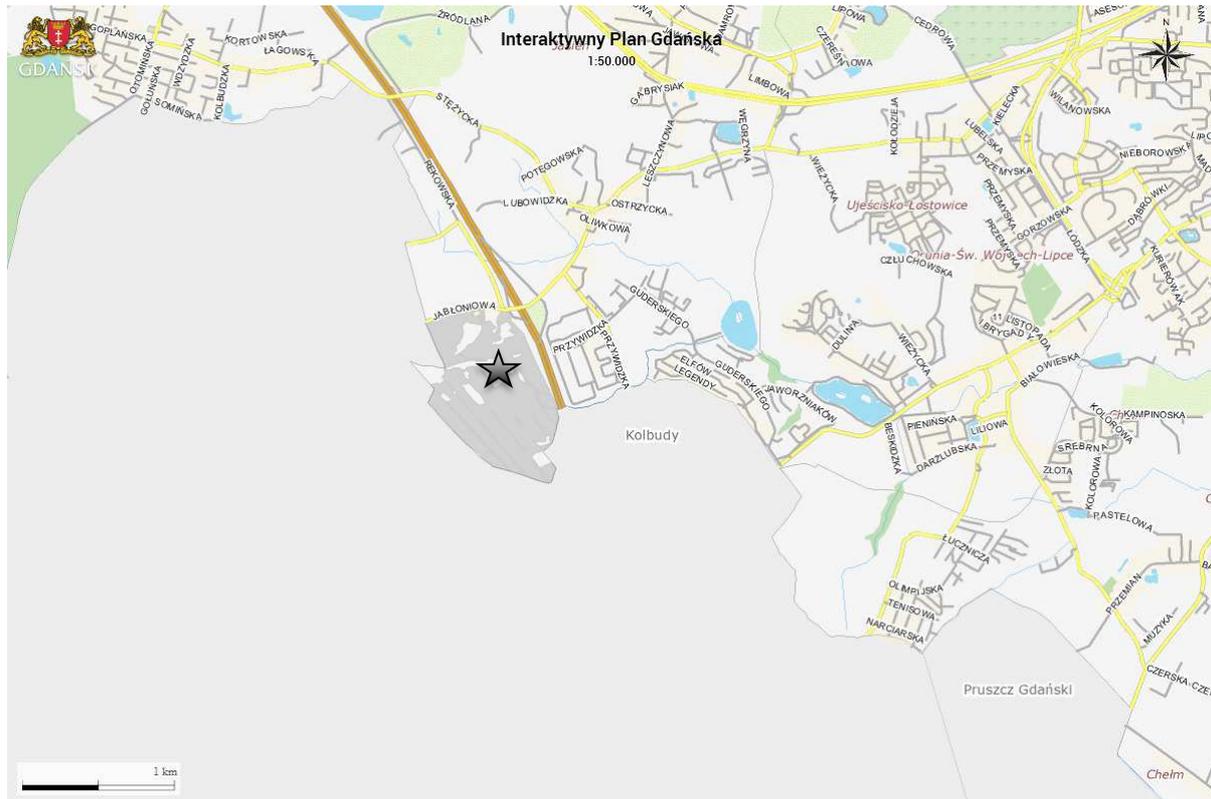


Figure 3: City map of Gdansk [2]

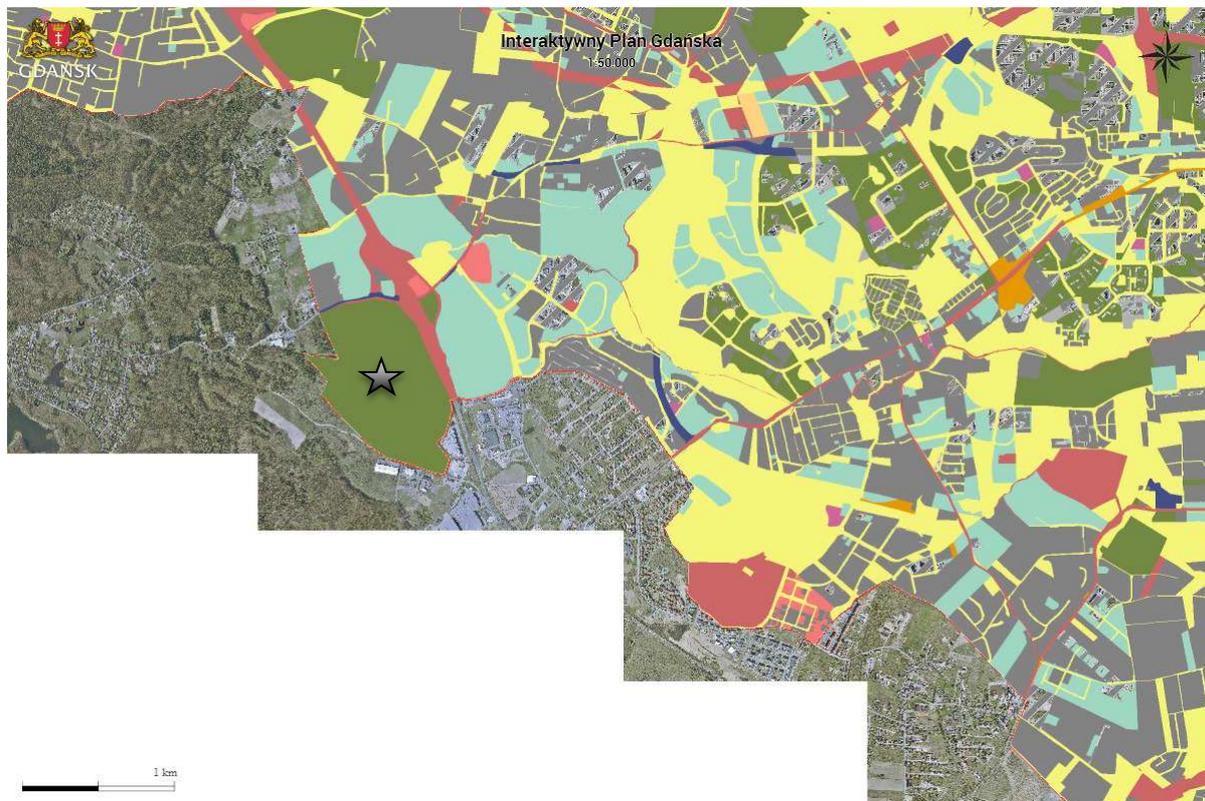


Figure 4: Map of possessions [2]

Legend:

- | | | | |
|---|---|---|--|
|  | Pilot -ZUT |  | Areas used by the municipality or other organs which occur in confluence with perpetual usufruct |
|  | Trading law companies and other registration bodies |  | Areas owned by physical person |
|  | Area of municipality which does not occur in confluence with perpetual usufruct |  | Treasure of the state |

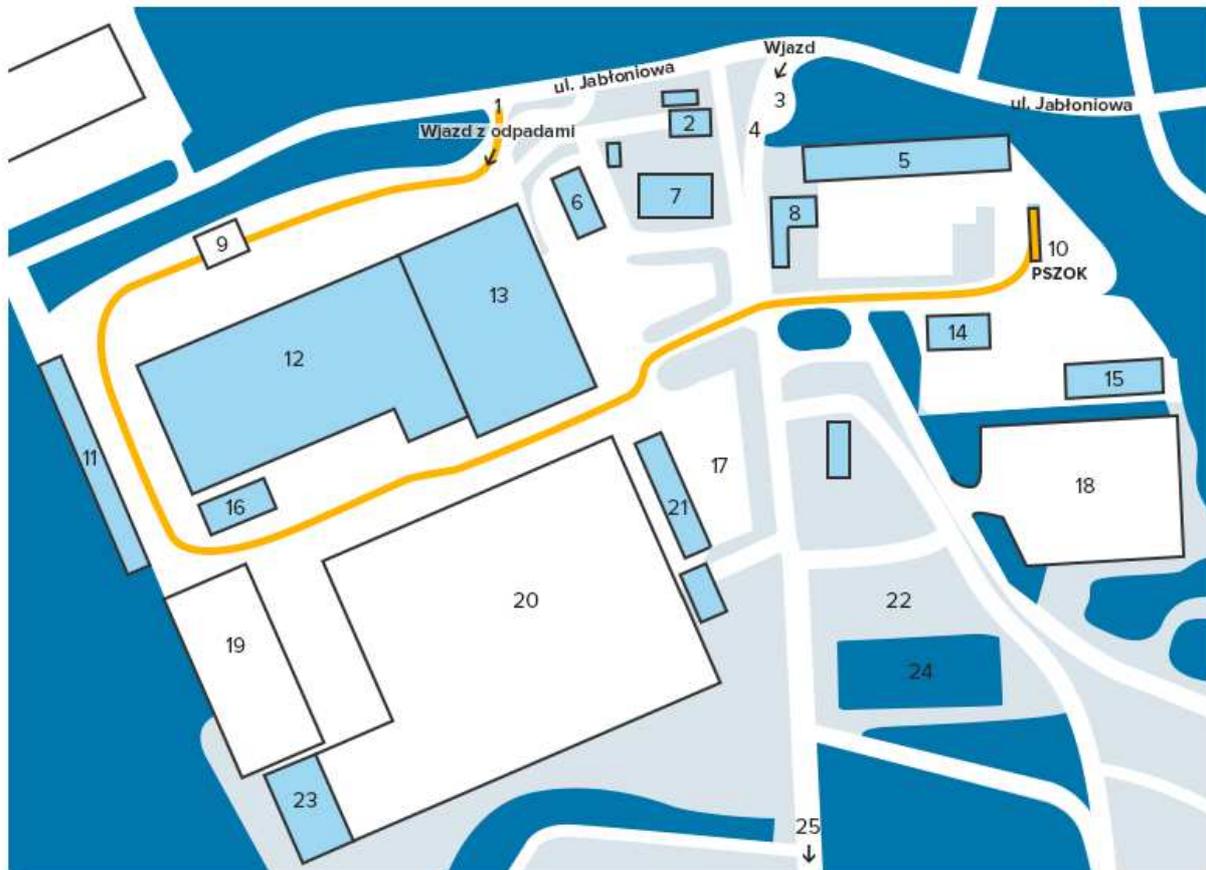


Figure 5: The Waste Utilization Facility in Gdansk [3] with: 1) Entrance, 2) Exploration department, 3) Parking, 4) Gate, 5) Workshop and garage, 6) Bioenergy plant, 7) Social room, 8) Administration, 9) Entrance balance, 10) Point of selective collected municipal wastes, 11) Stock of recycled materials, 12) Sorting, 13) Composting, 14) Stock of hazardous wastes, 15) Container composting unit KNEER, 16) Building with workshop and stock room, 17) Place of dismantling and shredding of large-scale waste, 18) Comminution area of construction waste, 19) Storing area, 20) Compost stabilization area, 21) Odour removing bio-filter, 22) Storing area for selective collection containers, 23) Sieving and packing of compost, 24) Tree nursery, 25) Entrance to the landfill sectors.

3. Type of Industrial Symbiosis

The waste utilization facility ZUT develops symbiosis with the private, commercial and industrial sector. Their vision is to increase the recovery rate of waste materials by retrieval of electricity, heat and material streams (e.g. metals, plastics, compost). In particular, the pilot project focuses on the recovery and utilisation of low temperature heat, which can be used by the surrounding residential, non-residential and public buildings.

4. Involved stakeholders

The key stakeholders which are involved in the pilot are companies and representatives from industry of the Gdansk and surrounding municipalities. The pilot is a demonstration installation to present the feasibility of the low temperature heat recovery. The goal is to promote industrial symbiosis by the pilot installation and to stimulate future investments in order to re-use waste streams. Anticipated stakeholders are:

- Local authorities of the municipalities of Sopot, Gdynia, Cedry Wielkie, Pruszcz Gdanski, Kolbudy and Zukowo
- GPEC company
- Waste utilization facilities e.g. EkoDolina, Stary Las
- Energy providers e.g. Energa
- Biogas plants

5. Objectives

In a short term perspective the SFR mobile system is installed at the area of the ZUT company to recover heat from burning processes. In a long term perspective, the ZUT company is building a moving grate incineration plant at the pilot area, namely Port of Clean Energy (Port Czystej Energii) (see Figure 6). The plant will use the high calorific fraction of the municipal waste, which cannot be returned to the cycle of materials. The construction work begins in 2018 and is planned to be finished in 2020. The installation will occupy around 3 ha of the area and will be able to process 160 thousand tons of municipal waste from around 50 surrounding Pomeranian municipalities. The total costs of the investment will be between 400 to 500 million zł (around 100 to 125 million €). Besides the generation of electricity the incineration plant will produce 34'500 kW heat, which will be used for district heating. The heat will be distributed by the joint venture of the ZUT and the GPEC company. GPEC is the leader in the heating industry in the Pomerania region [4]. The company deals with the distribution of heat and electricity. GPEC's share of the heat market in Pomeranian region is approximately 57%.



Figure 6: Planned location of the Incineration plant at the area of ZUT company [3]

6. Implementation

In a first step, technical parameters, which are required to assemble the bioenergy plant with the SFR mobile system, will be collected. The flue gases are analysed in order to select the construction materials, which will withstand the process conditions. The process will be designed according to the parameters and technical drawings will be prepared. On the basis of the design project, it will be decided, which elements are required to hook-up the mobile system and to assemble it to the bioenergy plant. After the preparation works of both installations, the mobile system is shipped to the ZUT company and connected to the bioenergy plant. During the operation, heat and mass streams are monitored and the composition of the product streams is analysed. Finally, the acquired data is used for and implemented in the planning tools.

7. Follow up

The SFR mobile installation is a research installation, equipped with monitoring and controlling system. Experiments carried out during the UBIS project are used to prepare heat and mass balances which are used to calculate the energy savings and reduction of emissions.

Table 1: Work plan for the implementation of the Pilot in Gdansk

Tasks	2017				2018				2019			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Agreement of Implementation		x	x									
Technical parametrisation of the Installation			x									
Flue gas analysis			x									
Designing of the SFR				x	x							
Procurement					x	x						
SFR hook-up					x	x						
Assembling of the SFR mobile System with the bioenergy plant						x						
Start of operation							x					
Product stream analysis							x	x				
Evaluation of the pilot and technical reporting								x	x	x		

8. References

- [1] J. D. Miller, J. Hupka and R. Aranowski, "Spinning fluids reactor". USA Patent US8313716B2, 31 July 2008.
- [2] Urząd Miejski w Gdańsku, "Interaktywny Plan Gdańska," May 2017. [Online]. Available: <http://gis.gdansk.pl/>.
- [3] Zakład Utylizacyjny Sp. z o.o., May 2017. [Online]. Available: <http://zut.com.pl/>.
- [4] GPEC, May 2017. [Online]. Available: <http://www.gpec.pl/>.

