




SLUDGE TO FERTILIZER: THE EXPERTIZE OF GIG TO CLOSE THE LOOP

Aleksandra Zgórska
Central Mining Institute



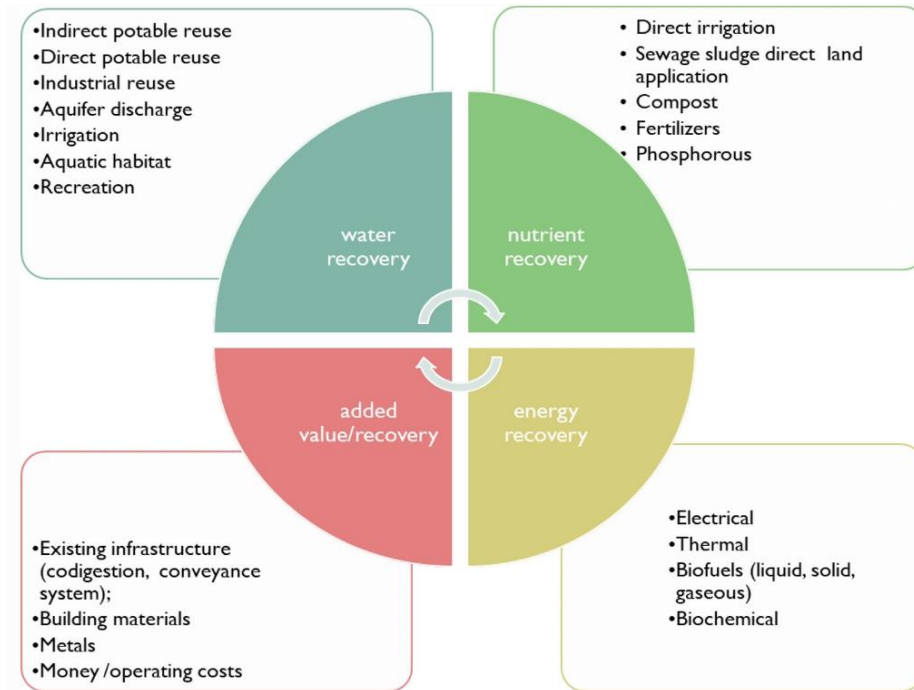
CLOSING THE LOOP — MODEL FRAMEWORKS IN THE WATER AND WASTEWATER SECTOR

“Closing the loop — an EU action plan for the circular economy” from 2015 (EC 2015) indicated a departure from the traditional linear economy model based on obtaining raw materials, production and use and waste disposal. In the new approach, the value of products, materials, and resources is retained for as long as possible.

One of the service facilities in which the “*circular economy*” (CE) model assumptions can be successfully implemented is the water and sewage industry. CE model framework in this sector includes the following actions: **R**eduction, **R**eclamation, **R**euse, **R**ecycling, **R**ecovery, **R**ethink.



CLOSING THE LOOP — MODEL FRAMEWORKS IN THE WATER AND WASTEWATER SECTOR



Resource recovery ways within the *nutrient-energy water* paradigm (NEW), (Wallis-Lage et al. 2015)

Both the European Green Deal and the Circular Economy Action Plan (CEAP) accept the importance of recovery and recycling of materials as a priority area, which are in the line with circular economy principles.

Wallis-Lage suggest that the best option for WWTP sector is an equal priority between the **waste to energy (WtE)** approach that uses the potential of sewage sludge (but also other organic waste) to generate energy, as well as the new **nutrient-energy water paradigm (NEW)**.

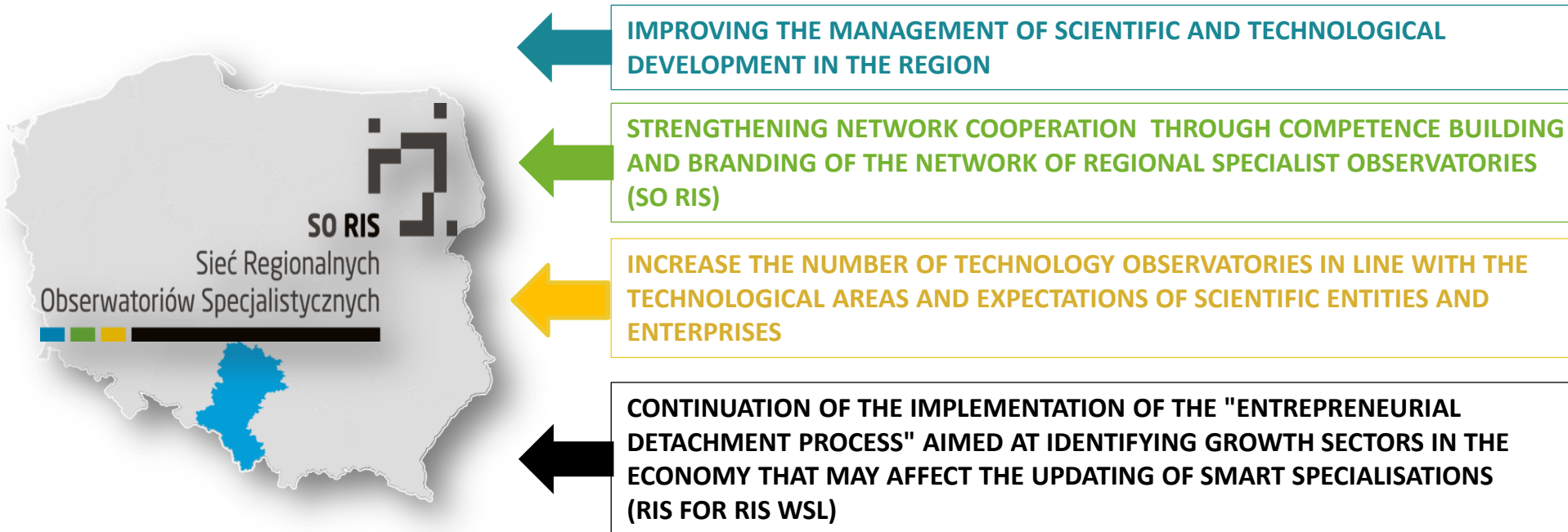
The process of improving the management and cooperation between scientific and technological sectors as well as development of pro-environmental technologies supporting the implementation of the „Closing the loop” assumptions is supported by a number of undertakings at the national and regional level.

Network of Regional Specialist Observatories



RESEARCH TRENDS AND DIRECTIONS OF DEVELOPMENT OF ENVIRONMENTAL TECHNOLOGIES

The Observatory was created in response to the specific needs of the actors in the innovation ecosystem of the Silesian Voivodeship to create a modern mechanism for monitoring the effects of innovative development in the region in the field of environmental technologies.



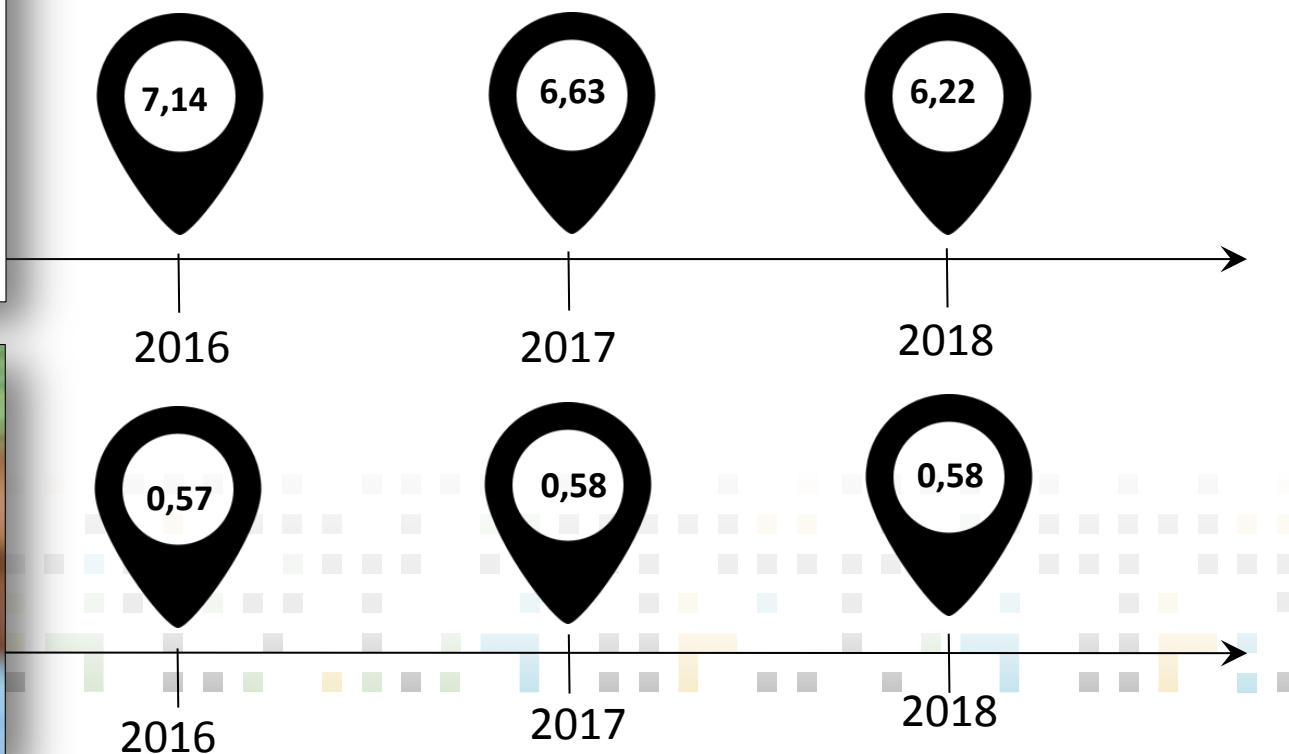
CE MODEL IMPROVEMENTS IN THE SEWAGE SLUDGE MANAGEMENT PROCESS



SEWAGE SLUDGE is the residual, semi-solid material that is produced as a by-product during sewage treatment of industrial or municipal wastewater. Sewage sludge, is a key issue in many countries due to its increasing volume and the impacts associated with its disposal.



SEWAGE SLUDGE PRODUCTION [mln tons dry solids]



SEWAGE SLUDGE MANAGEMENT: WASTE OR RAW MATERIAL??

The agricultural use of sewage sludge is the simplest and cheapest method of its management, giving the possibility of recycling both desirable nutrients and organic matter.

The issue of organic matter is often overlooked in nutrient management, although this plays a key role in soil productivity by improving its physical, chemical and biological properties.

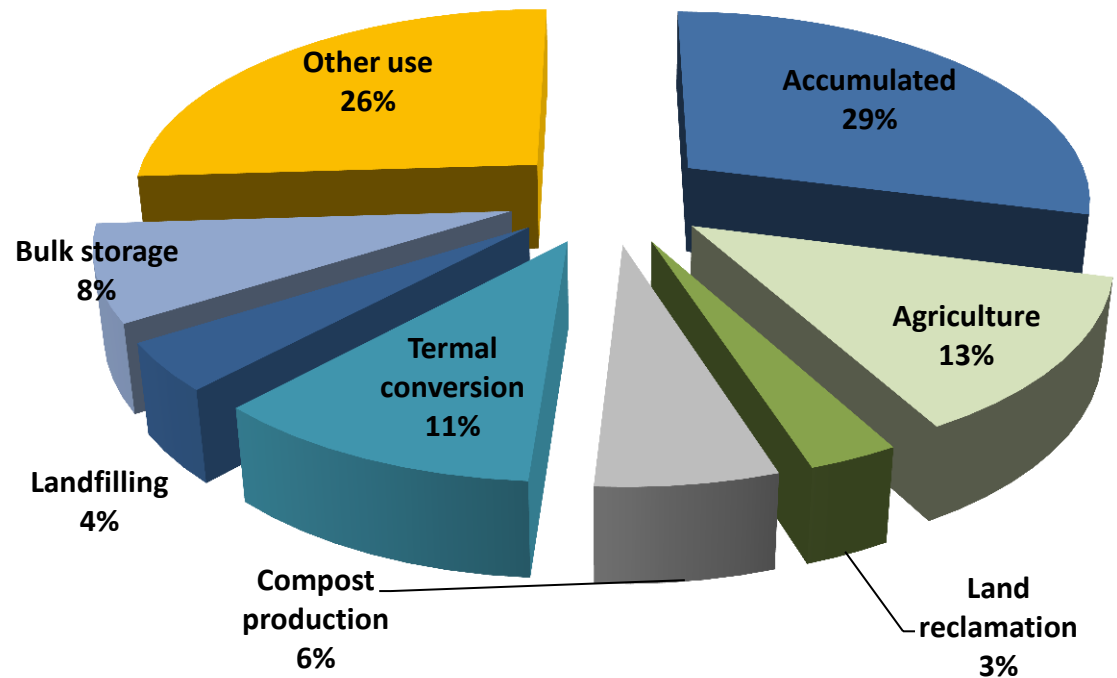


Fig. Sewage sludge management in Poland, 2016 [[DOI:10.2429/proc.2017.11\(1\)006](https://doi.org/10.2429/proc.2017.11(1)006)]



FERTILIZER PRODUCTS BASED ON SEWAGE SLUDGE - GIG CASE STUDY

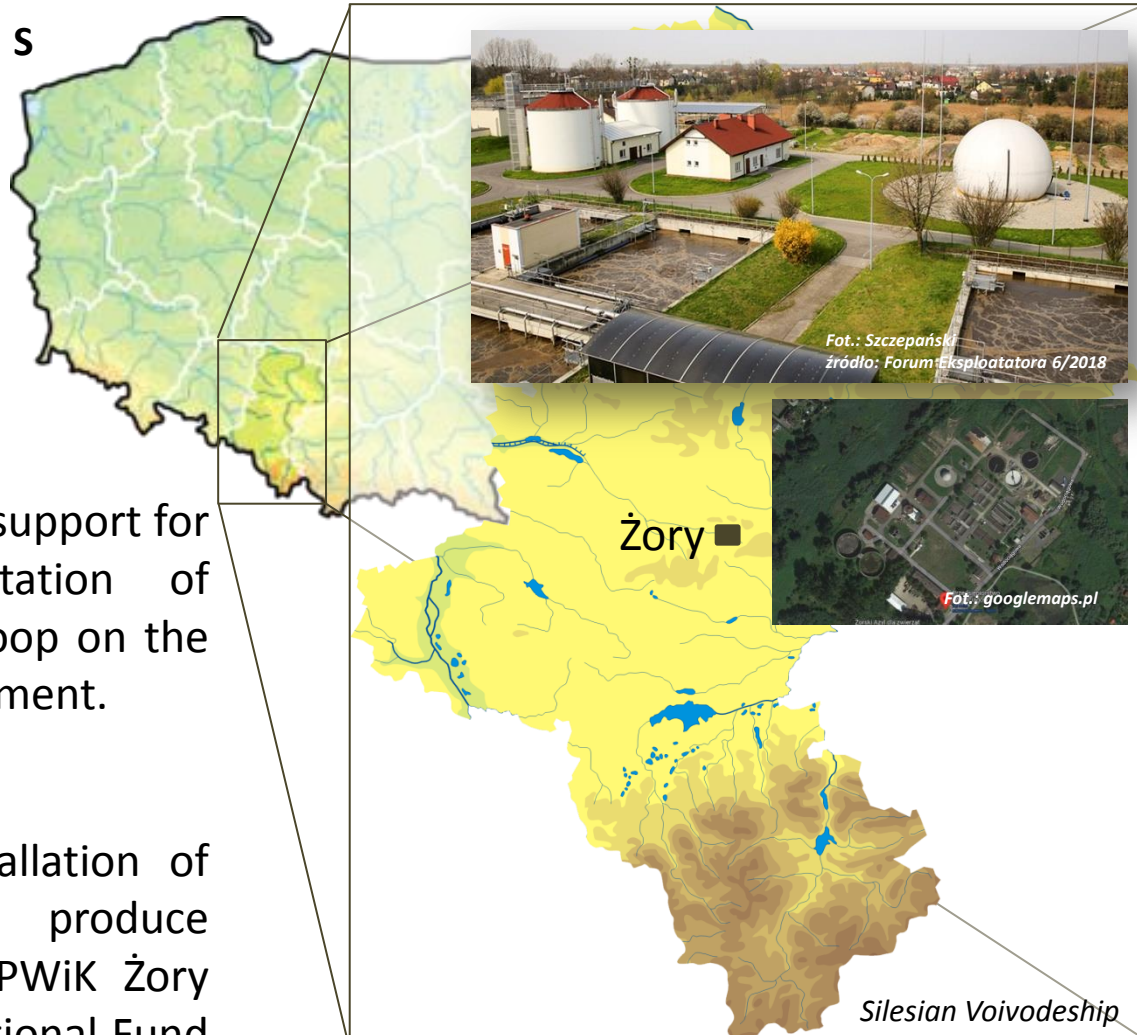


GIG ACTIVITIES:

Development of technologies and support for enterprises in the implementation of solutions conducive to closing a loop on the example of sewage sludge management.

PROJECT TITLE:

„Implementation of a pilot installation of sewage sludge granulation to produce innovative fertilizer products at PWiK Żory Sp. z o. o.", co-financed by the National Fund for Environmental Protection and Water Management.



THE ADOPTED BY GIG FLOWCHART OF COOPERATION WITH EXTERNAL ENTITIES



ANALYSIS OF THE INVESTOR'S POTENTIAL & NEEDS

- TECHNOLOGICAL PROCESS
- RESOURCE POTENTIAL
- PROCESS AND MARKET NEEDS
- OPPORTUNITIES, CONDITIONS, ETC.

01

02

TECHNOLOGY DEVELOPMENT AND TESTING

- TECHNOLOGY ASSUMPTIONS
- PATENTS
- IDEA PRELIMINARY TESTING (LABORATORY SCALE)



PILOTE IMPLEMENTATION / TECHNOLOGY UPSCALING

- PLANT CONSTRUCTION AND COMMISSIONING (PILOTE/SEMI-TECHNICAL SCALE)



03

04



PROCESS/PRODUCT OPTIMIZATION

- OPTIMIZATION OF SYSTEM OPERATING CONDITIONS
- OPTIMIZATION OF PRODUCTS FORMULAS

SUCCESSFUL MARKET IMPLEMENTATION

- OBTAINING APPROVALS FOR PRODUCT LAUNCH
- PRODUCT AUTHORISATION



05

FERTILIZER PRODUCTS BASED ON SEWAGE SLUDGE - GIG CASE STUDY

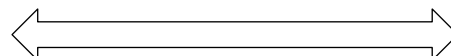
SCOPE OF WORK WITHIN THE PROJECT



WORKING CONCEPT

DATA ANALYSIS

IDENTIFICATION OF OPPORTUNITIES



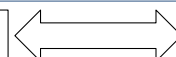
IDENTIFICATION OF NEEDS

R&D WORKS

FERTILIZER PRODUCT FORMULAS DEVELOPMENT

DEVELOPMENT OF FERTILIZER PRODUCTION TECHNOLOGY

FIELD TESTS/ LABORATORY TEST/ PHYSICO-CHEMICAL ANALYSIS

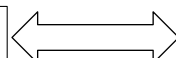


TECHNICAL ASSISTANCE

IMPLEMENTATION

TECHNICAL ASSISTANCE

PRODUCT AND PROCESS OPTIMIZATION

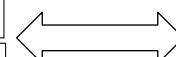


CONSTRUCTION AND COMMISSIONING
OF THE PILOT PLANT

COMMERCIALIZATION

DOCUMENTATION DEVELOPMENT

TECHNICAL ASSISTANCE



OBTAINING OPINIONS AND
ADMINISTRATIVE DECISIONS

FERTILIZER PRODUCTS BASED ON SEWAGE SLUDGE – GIG CASE STUDY

01.

CURRENT STATE ANALYSIS

ANALYSIS OF THE INVESTOR'S
POTENTIAL & NEEDS



AN IN-DEPTH ANALYSIS IN TERM OF THE COMPANY'S SLUDGE MANAGEMENT:

- ☐ analysis of wastewater treatment system performance
- ☐ defining the boundary values and the effectiveness of wastewater treatment processes determining the quality and quantity of generated sewage sludge
- ☐ assessment of physicochemical parameters of sewage sludge
- ☐ evaluation of conditions for the construction and/or extension of a sewage sludge line with a module for the production of fertilizer products
- ☐ market analysis



FERTILIZER PRODUCTS BASED ON SEWAGE SLUDGE – GIG CASE STUDY



TECHNOLOGY DEVELOPMENT/
PRELIMINARY STUDIES

IDEA
DEVELOPMENT
AND TESTING

02.

03.

AND TESTING
TECHNOLOGY

TECHNOLOGY DEVELOPMENT AND PRELIMINARY STUDIES:

- ☐ development a recipes of a fertilizer mixtures taking into account the specificity of sewage sludge and target parameters of final products defined by legal requirements
- ☐ development of the technology to produce fertilizers based on sewage sludge
- ☐ development of assumptions for the technical project of the pilot installation



FERTILIZER PRODUCTS BASED ON SEWAGE SLUDGE – GIG CASE STUDY

03.

IDEA
UPSCALING

PILOTE IMPLEMENTATION /
TECHNOLOGY UPSCALING

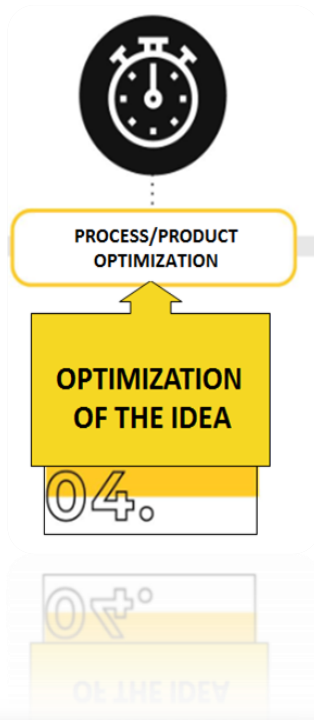


FULL SCALE PILOT INSTALATION:

As a part of the project, co-financed by the National Fund for Environmental Protection and Water Management (NFOŚiGW), a pilot line for the production of fertilizer granules based on stabilized sewage sludge was developed and implemented. The line capacity is about **5 tons per hour**.



FERTILIZER PRODUCTS BASED ON SEWAGE SLUDGE – GIG CASE STUDY



OPTIMIZATION PROCESS INCLUDED THE FOLLOWING ASPECTS:

- quality control of sludge supplied the technological system
- physicochemical composition of fertilizer products
- stimulating effects on plant germination and growth
- reproducible composition of fertilizer granules



FERTILIZER PRODUCTS BASED ON SEWAGE SLUDGE - GIG CASE STUDY



PROCESS/PRODUCT
OPTIMIZATION

OPTIMIZATION
OF THE IDEA

04.

07°

OF THE IDEY

The operation of the granulator has been fully calibrated, resulting in the best form of the final product. The product based on sewage sludge and mineral powder additives requires only short drying before packaging (about 30% of moisture should be removed).



05.

SUCCESSFUL IDEA
IMPLEMENTATION

MARKET
IMPLEMENTATION



SUCCESSFUL TECHNOLOGY IMPLEMENTATION

The implemented technology has achieved full efficiency, both in terms of quality and the assumed quantity of the manufactured fertilizers product.

The developed technology is fully applicable in the technological regimes functioning in industrial plants (TRL 8).

SUCCESSFUL MARKET IMPLEMENTATION



CONCLUSIONS



The depletion of natural resources, energy consumption and environmental issues relating to fertilizer production processes are driving a move towards a more sustainable use of resources and the recycling of nutrients. With regard to the fertilizer industry, this gives the opportunity to use the fertilizing potential of alternative raw materials.

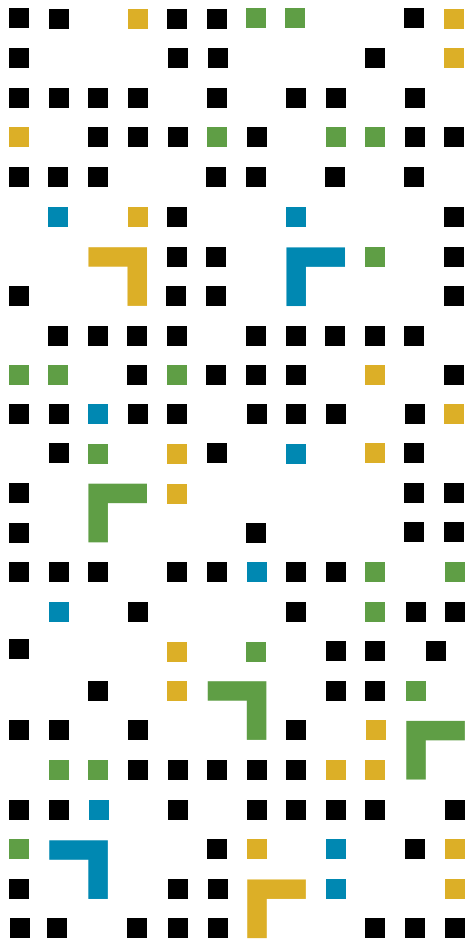
The possibility of designing the composition of fertilizer mixtures, taking into account the individual quality composition of sewage sludge for each sewage treatment plant, allows for adaptation and optimization of technology for a wide range of customers.

Implementation of a technology based on re-use of waste to full value products is a measurable example of a company's efforts to reduce emissions and material consumption compliant with the assumptions of the circular economy.

GIG offers comprehensive cooperation including development and/or selection, testing and optimization of environmental technologies in the area of water, wastewater and waste management.

GIG provides full assistance and technical support in the process of technology implementation in the business, from the selection of an optimal technological solution, through its testing and optimization, to its implementation on a full technical scale along with obtaining the necessary certificates and environmental decisions.





Thank You for your attention

Aleksandra Zgórska

azgorska@gig.eu

+48 32 259 24 80