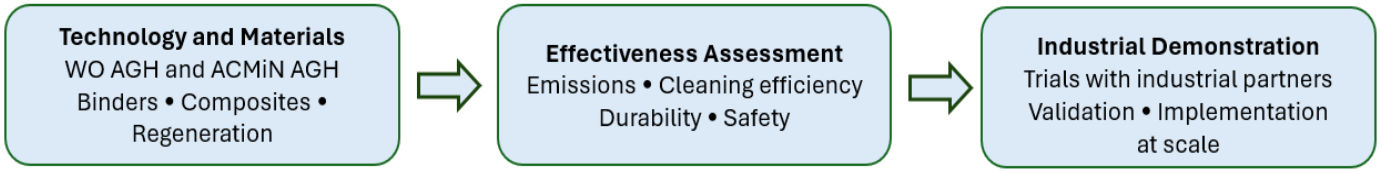
AGH Team for LIFE Projects

Cooperation Proposal for the National Fund for Environmental Protection and Water Management

AGH Faculty of Foundry Engineering • AGH Academic Centre for Materials and Nanotechnology

The team led by Prof. Rafał Dańko, DSc, PhD, and Prof. Angelika Kmita, DSc, PhD, offers cooperation in the preparation and implementation of LIFE projects addressing the reduction of industrial emissions, the circular economy and water protection. We combine foundry technologies with environmental analysis and the design of functional materials. Our key strength lies in linking material-based solutions with the measurement of their environmental impact and the assessment of their suitability under industrial conditions.



Complementary Research and Implementation Expertise

Prof. Rafał Dańko, DSc, PhD — AGH Faculty of Foundry Engineering

His expertise covers foundry moulding and core technologies, as well as the reclamation of spent foundry sands. His work focuses on the recovery of sand matrices, the reuse of raw materials and the optimisation of production processes. These competencies make it possible to reduce waste generation and the consumption of primary raw materials while maintaining casting quality requirements. In LIFE projects, they provide the basis for designing industrial trials and assessing the implementation potential of new technologies.

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Prof. Angelika Kmita, DSc, PhD — AGH ACMiN

She heads the Laboratory of Physicochemical and Environmental Analysis at AGH ACMiN and leads the VERSA research group. Her research focuses on functional materials, metal oxide nanoparticles, magnetic materials and composites, including biopolymer structures and aerogels. She combines materials design with the assessment of their properties, durability and environmental impact. Her work includes the analysis of industrial emissions and the reduction of harmful compound releases, particularly BTEX and polycyclic aromatic hydrocarbons (PAHs). She also develops materials for the removal of water contaminants.

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Two Completed LIFE Projects

Green Foundry LIFE • LIFE17 ENV/FI/000173 • 2018–2022

The project laid the groundwork for the use of inorganic binders in iron foundries. It included a comparison of emissions from binder systems, casting trials, and an assessment of the treatment and reuse of spent sands. AGH carried out emission tests at laboratory and pilot scales. The results were documented in the final report and in materials supporting the update of the BREF document on Best Available Techniques. [1]

Green Casting LIFE • LIFE21-ENV-FI-101074439 • 2022–2026

The follow-up research enabled inorganic binders to be tested in industrial production and further methods for sand reclamation to be developed. The AGH team combined process technology work with emission measurements in cooperation with European partners, including Odlewnie Polskie S.A. The project was completed in 2026; its results confirm that the environmental burden can be reduced through the selection of materials and adaptation of the foundry process. [2]

Measurable Emission-Reduction Results

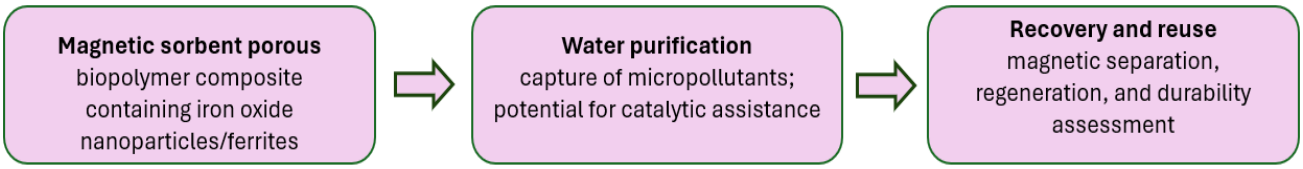
In research conducted by the Green Casting LIFE team and its partners, replacing the tested organic-binder system with inorganic systems reduced BTEX emissions by more than 90%, PAH emissions by more than 80%, and respirable crystalline silica emissions by more than 50%. These results apply to the technologies and test conditions compared. They demonstrate the potential to prevent pollution at the stage of selecting production materials. [3]

BTEX	PAHs	Crystalline silica
more than 90% reduction	more than 80% reduction	more than 50% reduction

The experience gained in both projects covers the entire pathway from materials research to foundry trials, documentation of results and transfer of knowledge to other plants. It provides a basis for preparing new demonstrations with a reference case, environmental performance indicators and a technology dissemination plan.

Functional Materials for Water Treatment

Angelika Kmita's research opens up an additional area for LIFE cooperation focused on the polishing treatment of water and wastewater and their reuse. A promising direction involves magnetic biopolymer composites and aerogel beads containing iron oxide or ferrite nanoparticles. Their porous structure can capture contaminants, while their magnetic properties can facilitate the recovery of the material from liquids.



We propose developing sorption systems for removing selected organic micropollutants, including antibiotic residues, and assessing whether their degradation can be enhanced by catalytic processes. The project could include selecting a material for a real water stream, testing its effectiveness in the presence of other constituents, and investigating regeneration and repeated use. The assessment of component release, environmental safety and end-of-life management of the spent sorbent will form part of the development process in line with the Safe and Sustainable by Design (SSbD) approach. This is a candidate area for demonstration and validation as an additional treatment stage.

Proposed Scope of Cooperation with the National Fund

We are interested in identifying environmental needs and developing LIFE project concepts involving companies and installation operators. As a scientific partner, we can take responsibility for materials development, the research programme, technology demonstration and the measurement of results.

- Industrial emission reduction — low-emission binders, moulding and core materials, and process optimisation.
- Circular economy — sand reclamation, raw material recovery and assessment of the safe use of process residues.
- Water protection — sorbents and magnetic composites for wastewater polishing and preparing water for reuse.

We offer joint development of a demonstration concept, selection of industrial partners, and definition of performance indicators and the potential for applying the solution at other plants.

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Project Information Sources

[1] Green Foundry LIFE — reports and results: greenfoundry-life.com/documentation/deliverables

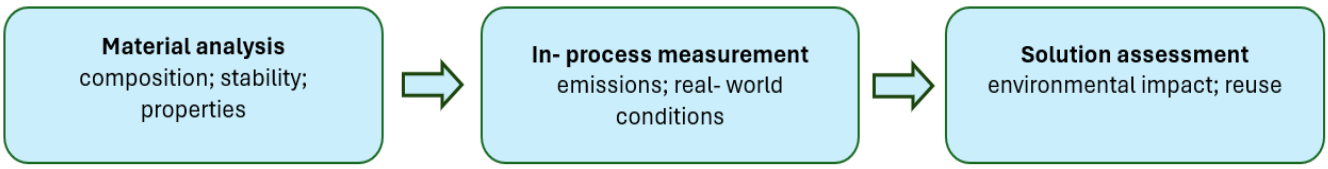
[2] Green Casting LIFE: green-casting.agh.edu.pl; final results: azterlan.es (Advances in the implementation of inorganic binders for iron casting).

[3] Kmita A., Dańko R. et al. Green industrial scale casting production using engineered molding materials: Sustainable strategies to reduce process gas emissions. Process Safety and Environmental Protection 206 (2026), 108238. DOI: 10.1016/j.psep.2025.108238.

Research Equipment and Measurement Capabilities

AGH Team Facilities for Materials Research and Validation of Environmental Technologies

We combine the physicochemical analysis facilities of AGH ACMiN with the process research capabilities of the AGH Faculty of Foundry Engineering and experience in industrial measurements. Methods are selected for the specific material, emission stream or water sample. This makes it possible to link the properties of a developed solution with its effectiveness, durability and environmental performance.



Research Methods and Their Application in LIFE Projects

Equipment / Research Area	Application and Value for the Project
GC–MS and Py–GC–MS	Identification of organic compounds and thermal decomposition products. Testing of binders and investigation of pollutant formation mechanisms, including compounds in the BTEX and PAH groups.
TG / DSC coupled with MS	Assessment of thermal stability, mass loss and thermal effects, combined with analysis of evolved gases. Selection of binders and composites, and optimisation of material reclamation conditions.
FTIR spectroscopy	Identification of functional groups and chemical changes in binders, biopolymers and sorbents. Assessment of material–contaminant interactions and changes following regeneration.
PPMS and VSM magnetometry	Characterisation of magnetic properties and their dependence on temperature and magnetic field. Selection of nanoparticles and composites for magnetic separation, and assessment of changes after use.
Process gas measurements	Gas analysers, flame ionisation detection and sampling systems used in emission testing. Measurement of CO, CO_2, NOx, SO_2 and organic compounds, as appropriate to the method and measurement configuration.
Foundry trials and reclamation	Mould and core trials, assessment of foundry sand properties and sand reclamation efficiency. Validation of material solutions and the potential for reuse of the sand matrix.

Emission Measurements under Industrial Conditions

The Green Casting LIFE experience includes the use of a Horiba PG350 analyser, a MiniFID 3010 analyser and sampling and sample-conditioning systems, including CJP-10, MPG 21 and M&C PSP 4000. The measurement programme may include laboratory-, pilot- and industrial-scale tests, a reference case, and the calculation of emissions per unit of material or production. The test set-up and scope of analyses are agreed with partners for each demonstration.

Validation of Materials for Water Treatment

For sorbents and magnetic aerogel beads, we propose testing the removal efficiency for selected contaminants, process kinetics, magnetic recovery and successive regeneration cycles. Materials characterisation is complemented by analyses of the aqueous phase, selected for the specific analyte. We assess the effect of the composition of real water, material durability and the potential release of its components.

Outcome for the LIFE partner: a research programme and data to assess technology performance, environmental indicators, solution durability and implementation potential.