



HYDROTHERMAL TREATMENT TEAM

Assoc. Prof. Małgorzata Wilk

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Member of Hydrochar Network

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REPUBLIC OF POLAND



Krakow

800 thous. to 1.3 mln

23 universities, 130 thous. students



Fryderyk Chopin



Mikołaj Kopernik



Maria Skłodowska-Curie
2 Nobel Prizes

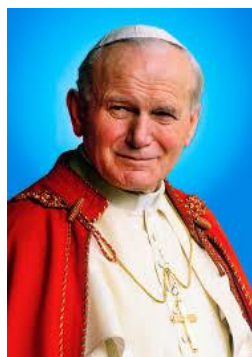


Olga Tokarczuk
Nobel Prize 2022

- Area: 312 thous. km²
- Population: 37.4 mln (98% Poles)
- Religion: 87% catholic
- Capital: Warsaw (1.8 mln)
- Currency: zloty (PLN)



Coat of arms



Pope John Paul II



Robert Lewandowski
volleyball – 3rd team
football player



Iga Świątek
tennis player

AGH UNIVERSITY OF KRAKOW ACADEMY OF MINING AND METALLURGY





AGH UNIVERSITY OF KRAKOW



- One of the oldest and the largest Polish technical universities
- 1 AGH University Doctoral School
- 18 faculties, 88 fields of study, 93 of post-graduate studies
- 17 scientific disciplines
- 19 750 bachelor and master students, 856 PhD students
- 2 279 researchers including more than 530 associate and 246 full professors
- Own attended campus area



AGH UNIVERSITY OF KRAKOW

Basic units:

1. **AGH University Doctoral School**
2. Faculty of Civil Engineering and Resource Management
3. **Faculty of Metals Engineering and Industrial Computer Science**
4. Faculty of Electrical Engineering, Automatics, Computer Science, and Biomedical Engineering
5. Faculty of Computer Science
6. Faculty of Computer Science, Electronics, and Telecommunications
7. Faculty of Mechanical Engineering and Robotics
8. Faculty of Geology, Geophysics, and Environmental Protection
9. Faculty of Geo-Data Science, Geodesy, and Environmental Engineering
10. Faculty of Materials Science and Ceramics
11. Faculty of Foundry Engineering
12. Faculty of Non-Ferrous Metals
13. Faculty of Drilling, Oil, and Gas
14. Faculty of Management
15. Faculty of Energy and Fuels
16. Faculty of Physics and Applied Computer Science
17. Faculty of Applied Mathematics
18. Faculty of Humanities
19. **Faculty of Space Technologies**
20. Academic Centre for Materials and Nanotechnology

Auxiliary units (education and research):

Academic Computer Centre CYFRONET

Main Library

Cybersecurity Centre

Centre of Excellence in Artificial Intelligence

Centre of Energy

UNESCO Chair for Science, Technology, and Engineering Education

Space Technology Centre

Department of Foreign Languages

Department of Sport and Physical Education

17 SCIENTIFIC DISCIPLINES

Engineering and technology:

- automation, electronic, electrical engineering and space technologies
- information and communication technology
- biomedical engineering
- chemical engineering
- civil engineering, surveying and transport
- materials engineering
- mechanical engineering
- environmental engineering, mining and energy

Natural sciences:

- computer and information sciences
- mathematics
- chemical sciences
- physical sciences
- Earth and related environmental sciences

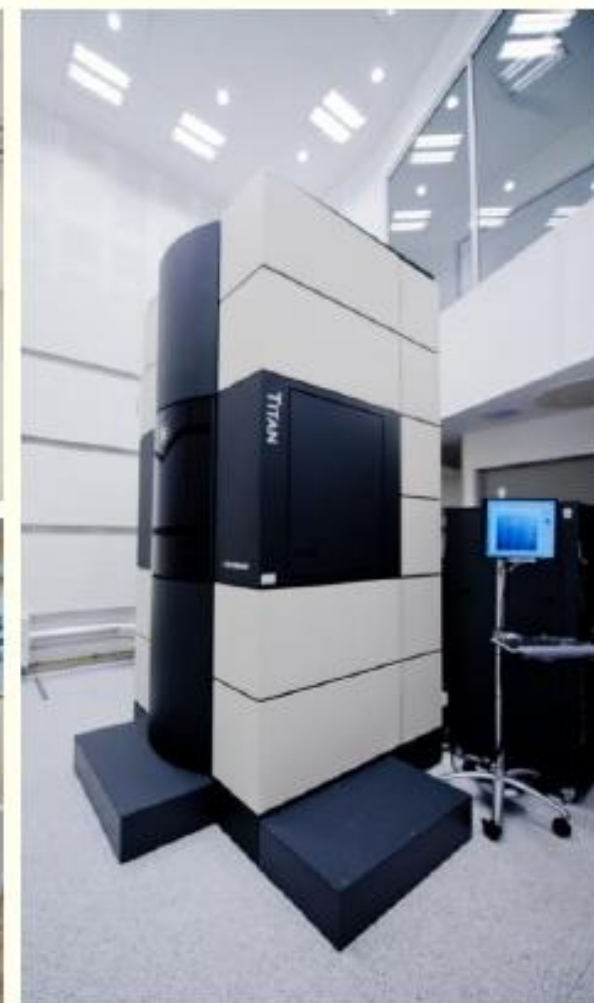
Social sciences:

- management and quality studies
- sociology
- economics and finance

Humanities:

- culture and religion studies

UNIQUE AND MODERN WORLD-CLASS EQUIPMENT



UNIQUE RESEARCH EQUIPMENT

Professional support in scientific and technical issues:

- **Apparatus database** - a list of scientific and research equipment and specialist laboratories of AGH
- **List of software** for AGH employees and students
- **Research teams** - information about leading research teams and opportunities for cooperation

oferta-badawcza.agh.edu.pl



APPARATUS DATABASE

Semi-industrial 2-high rolling mill 11"

Entity: [Faculty of Metals Engineering and Industrial Computer Science](#)

Contact person: [Błoniarz Remigiusz](#)

Technical description: Semi-industrial hot rolling mill in a reversing arrangement. The device is equipped with rolls with a barrel length of 600 mm and diameters in the range of Ø 280-348 mm. It allows rolling flat products with...



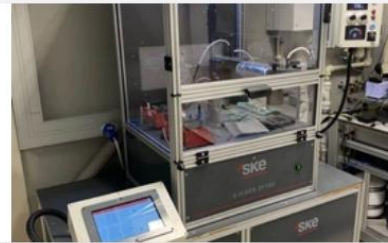
Keywords: [hot rolling](#) [plate rolling](#) [shape rolling](#)

Electrospinning machine with climate control – SKE Research...

Entity: [Faculty of Metals Engineering and Industrial Computer Science](#)

Contact person: [Stachewicz Urszula](#)

Technical description: • max. voltage: +/- 40 kV • climate control range: temperature 20-40 °C and relative humidity 20-65% • 2 pumps delivering the polymer solutions Three types of nozzle: • standard nozzle – single...



Keywords: [electrospinning](#) [membranes](#) [polymer fibers](#)

Transmission Electron Microscope

Entity: [Faculty of Metals Engineering and Industrial Computer Science](#)

Contact person: [Moskalewicz Tomasz](#)

Technical description: The transmission electron microscope is equipped with: cold field emission gun, accelerating voltage: 60 kV and 200 kV, spherical aberration (Cs) corrector, high angle annular dark field detector (HAADF),...



Keywords: [4D STEM](#) [EDS](#) [electron microscope](#) [in situ](#) [microstructure](#) [TEM](#)

Laser system

Entity: [Faculty of Metals Engineering and Industrial Computer Science](#)

Contact person: [Kqc Sławomir](#)

Technical description: The laser system (laser machine) is used for surface heat treatment, welding, cutting materials and coatings deposition (cladding) with additional material in the form of powders. It is used both for...



LIST OF SOFTWARE



IBM SPSS Statistics

Entity: [Centre for IT Support](#)

Contact person: [Chruściel Renata](#)

Additional info: The IBM SPSS Statistics programmes included in the package cover advanced information technologies in statistical data analysis and data mining.

Keywords: [data mining](#) [statistical analysis of data](#)

PS IMAGO PRO Academic

Entity: [Centre for IT Support](#)

Contact person: [Chruściel Renata](#)

Additional info: PS IMAGO PRO Academic computer software includes a suite of tools for data collection, modelling, analysis and reporting.

Keywords: [data analysis](#) [data collection](#) [data modelling](#) [data reporting](#)

Surfer

Entity: [Centre for IT Support](#)

Contact person: [Chruściel Renata](#)

Additional info: Surfer is a program designed for comprehensive visualization of XYZ data, so that it is sometimes most often used for mapping and land surface modeling, but this is not the only application of this program. The...

Keywords: [Golden Software](#) [Surfer](#)

ANSYS

Entity: [Centre for IT Support](#)

Contact person: [Chruściel Renata](#)

Additional info: A suite of modular software and advanced numerical analysis tools on the ANSYS Workbench platform for finite element method (FEA) calculations and computer simulations. Enables comprehensive simulatio...

RESEARCH COOPERATION WITH UNIVERSITIES



And many more...



FACULTY OF METALS ENGINEERING AND INDUSTRIAL COMPUTER SCIENCE



1. Department of Applied Computer Science and Modelling
2. Department of Surface Engineering & Materials Characterisation
3. Department of Physical Metallurgy and Powder Metallurgy
4. Department of Metal Forming and Metallurgical Engineering
5. **Department of Heat Engineering & Environment Protection**
 - Heat and Mass Transfer Research Group
 - **Thermal Processes** Research Group



100
KTCiOŚ
1925-2025

THERMAL PROCESSES RESEARCH GROUP

Thermal Processes



**BIOMASS: SEWAGE SLUDGE,
ORGANIC WASTE, MUNICIPAL SOLID WASTE**



**Low temperature:
drying, torrefaction, HYDROTHERMAL TREATMENT**



**High temperature:
combustion/pyrolysis/gasification**



biofuel, biomaterials, product disposal, operating problems, LCA



HYDROTHERMAL TREATMENT TEAM

TEAM LEADER



Małgorzata Wilk

SENIOR RESEARCHERS

Thermal analysis



Aneta Magdziarz

Biogas



Monika Kuźnia

POST-DOCTORAL FELLOWS

Biofuels, LCA, Process water



Maciej Śliz

Gasification



**Klaudia
Szkadłubowicz**



**Małgorzata
Sieradzka**

PHD STUDENTS



Joanna Mikusińska



Zuzanna Prus

HYDROTHERMAL TREATMENT TEAM



CURRENTLY RUNNING PROJECTS:

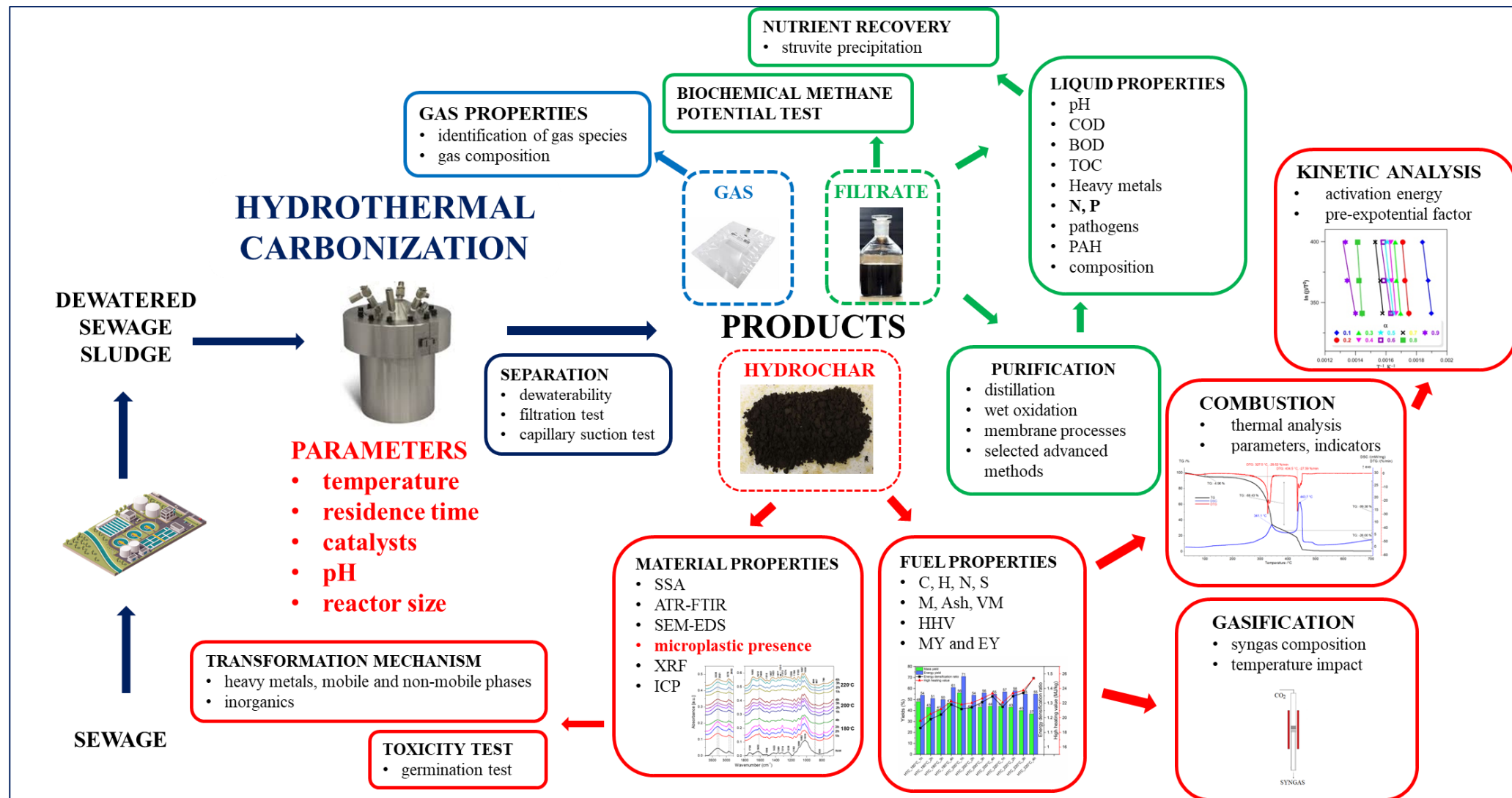
- **PL, NSN OPUS21** „Analysis of hydrothermal conversion of digestate derived from agriculture waste and sewage sludge” PLN 1034,560; 2022-2025
- **EU, HORIZON-MSCA-2021-SE-01-01 (MSCA) CUPOLA** „Carbon-neutral pathways of recycling marine plastic waste”, € 257,600; 2023-2027
- **PL, Research University AGH** „Analysis of the possibilities of using products from hydrothermal processing of wet organic waste” PLN 374,000; 2024-2025
- **PL, NSC OPUS28** „Research and analysis of the degradation process of microplastics as a result of the treatment of digested sewage sludge using the hydrothermal carbonization method”, 1402,756 PLN; 2025-2028



SCIENTIFIC COOPERATION:

- Leibniz Institute for Agricultural Engineering and Bioeconomy, Germany
- University of Cagliari, Italy
- Niccolo Cusano University, Italy
- University of Florence, Italy
- Sapienza University in Rome, Italy
- University of Trento, Italy
- University Twente, Niderland
- Silesian University of Science and Technology, Poland
- Wroclaw University of Science and Technology, Poland
- Universidad de Extremadura, Spain
- Seoul Women's University, South Korea
- Zurich University of Applied Sciences, Switzerland
- University of South Carolina, USA

PL, NSN OPUS21 „Analysis of hydrothermal conversion of digestate derived from agriculture waste and sewage sludge”, 2022-2025





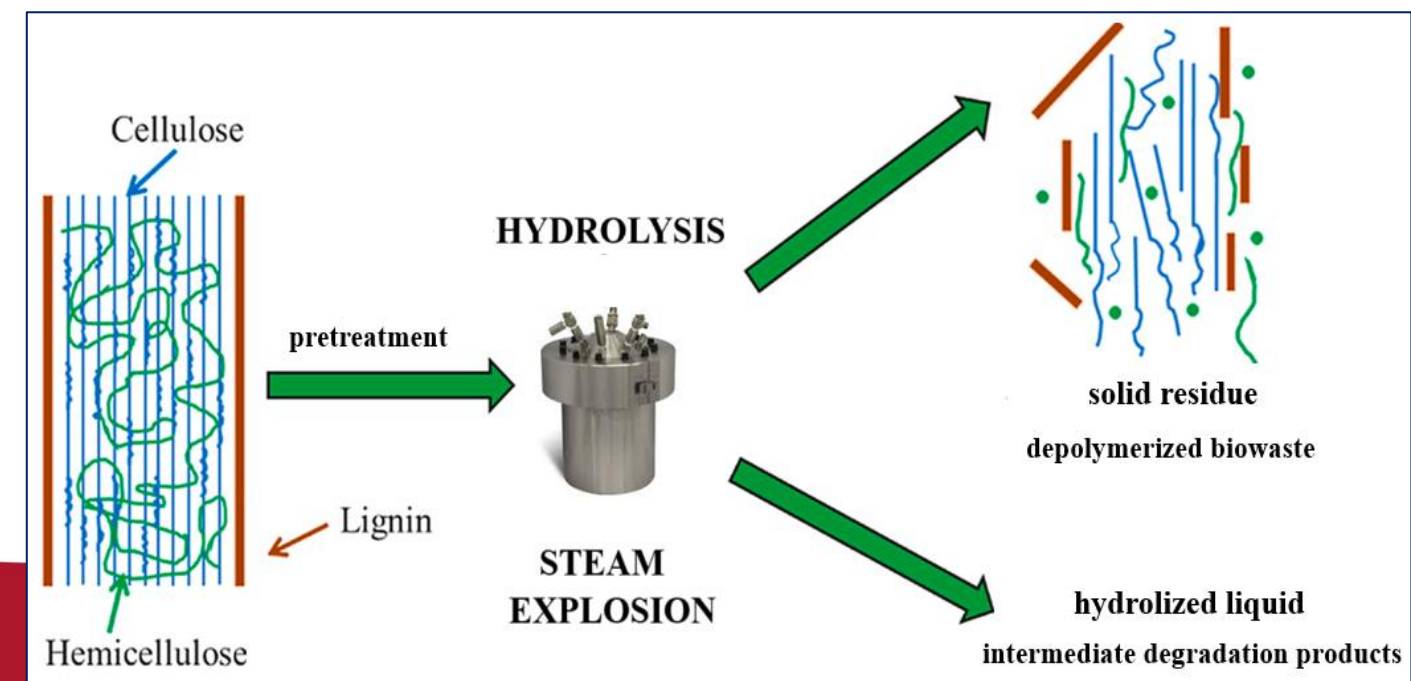
PL, "Excellence Initiative – Research University" for AGH „Analysis of the possibilities of using products from hydrothermal processing of wet organic waste”

Motivation

BIOMETHANE PRODUCTION

2025 **UE GOAL** **2030**
7 bcm/year *REPowerEU plan (EU/2022/230)* **35 bcm/year**
 Top 5: France, Germany, Spain, Italy, Poland

Research plan

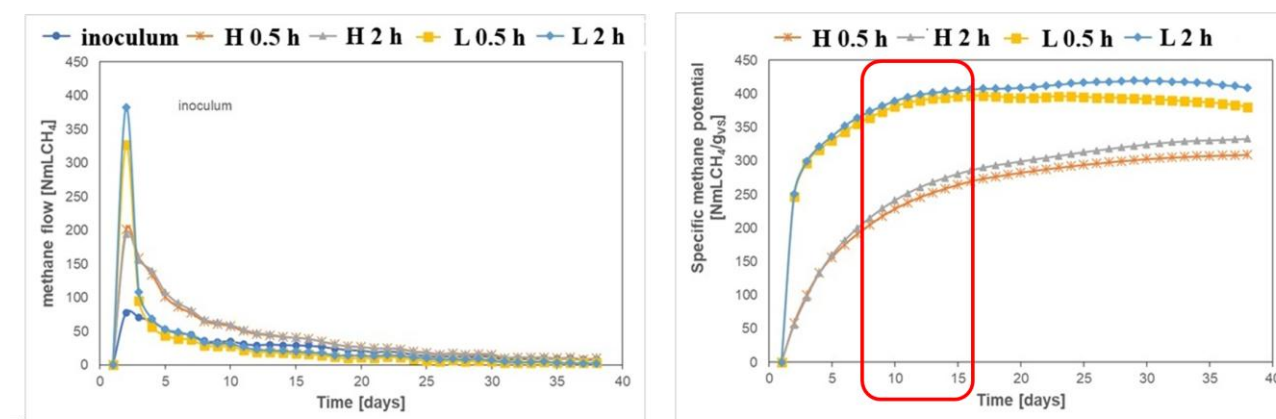


Results

SOLID CHARACTERISTICS

Sample	Fuel properties							Fiber analysis		
	Ultimate analysis, d			Proximate analysis, d				Hemicellulose %	Cellulose %	Lignin %
	Carbon %	Hydrogen %	Nitrogen %	Ash %	VM %	FC %	HHV* MJ/kg			
straw	41.56	6.44	0.58	4.50	78.97	9.56	16.5	32.1	45.6	8.1
H_0.5h	42.36	6.40	0.63	4.99	75.48	8.95	16.81	11.5	45.4	8.5
H_0.5h_cat	41.98	6.18	0.64	8.19	79.25	11.53	16.35	17.8	44.8	8.6
H_2h	43.56	6.07	0.77	6.10	73.38	12.52	16.92	3.3	45.2	8.6
H_2h_cat	34.51	7.13	0.55	7.17	80.16	11.72	14.25	4.5	44.1	8.4

BIOMETHANE POTENTIAL

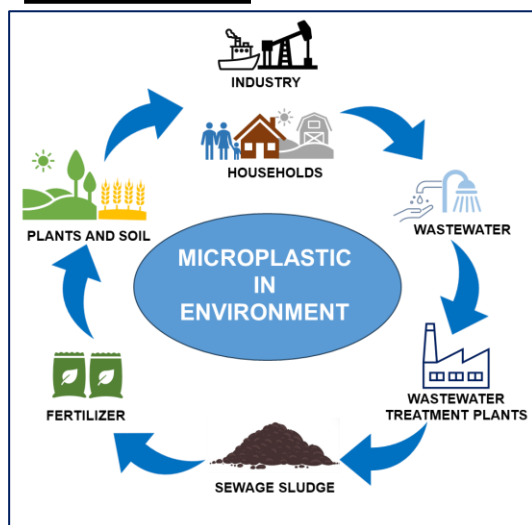


Biomethane potential, NmLCH ₄ /g _{vs}			
H 0.5 h	H 2 h	L 0.5 h	L 2 h
309.38	333.22	397.20	419.80



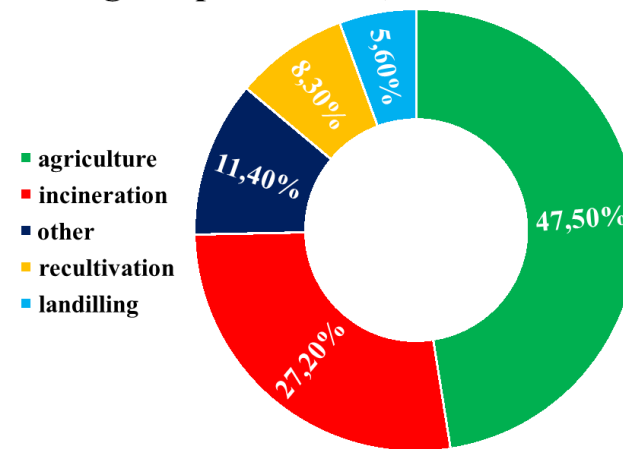
PL, NSC OPUS28 „Research and analysis of the degradation process of microplastics as a result of the treatment of digested sewage sludge using the hydrothermal carbonization method”, 2025-2028

Motivation



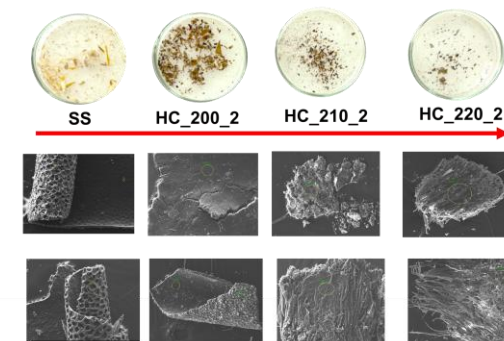
**HIGH RISK OF SECONDARY
ENVIRONMENTAL
POLLUTION
BY
MPs**

Sludge disposal in EU, EurEau 2021



Preliminary results

Degradation with HTC temperature



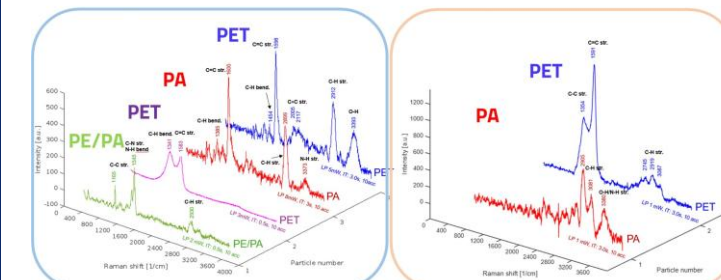
Results of optical microscopy



MPs identified in sewage sludge

MPs identified in hydrochar

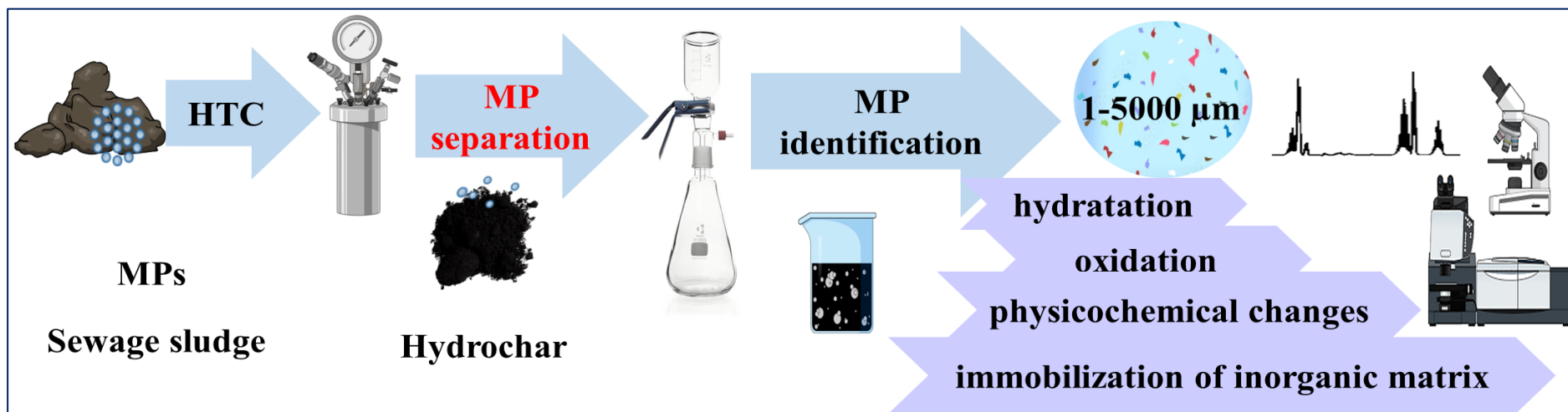
Identification of MPs by Raman spectra



MPs identified in sewage sludge

MPs identified in hydrochar

Research plan





Energies

Special Issue

Biomass, Biofuels
and Waste: 3rd
Edition

Guest Editor

Dr. Małgorzata Wilk

Deadline

05 November 2025

Find out more →



THANK YOU FOR YOUR ATTENTION

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