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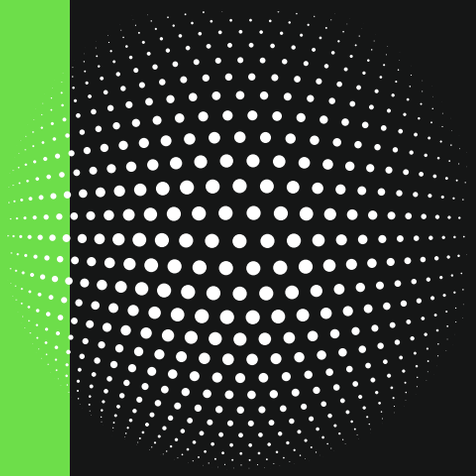
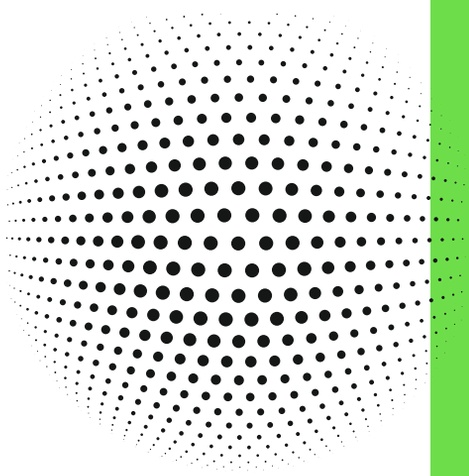


Łukasiewicz
Institute for
Renewable
Resources
Chemistry



There is nothing in chemistry that is not useful

Antoine Lavoisier

ABOUT US

The Łukasiewicz Research Network - Institute for Renewable Resources Chemistry is a leading R&D unit specializing in organic chemistry. We are a trusted partner for both domestic and international companies in the development of advanced chemical technologies.

As a member of the Łukasiewicz Research Network—one of the largest research networks in Europe—we operate under a "Science is Business" model, collaborating with business owners to deliver innovative solutions that enhance their operations and facilitate the development of cutting-edge technologies.

Our primary focus is on green chemistry, which encompasses technologies and products that are safe for people and the environment. We specialize in recycling potentially harmful by-products and transforming them into valuable substances and products that can re-enter the market. Since 1952, we have supported Polish industries and businesses in adopting innovative, energy-efficient, and resource-saving technologies.

Equipped with state-of-the-art measurement and research apparatus, we offer a range of research, analytical, and design services. Our team of experienced researchers also provides consulting in areas aligned with the institute's expertise. We are committed to continuously improving our service standards; our Analytical Chemistry Research Group conducts analyses in accordance with the Principles of Good Laboratory Practice (GLP).

STRUCTURE

- Analytical Chemistry Research Group
- Biobased Resources Technology Research Group
- Advanced Digital Technologies Research Group
- Specialty Formulations Research Group
- Chemical Processes and Technologies Research Group
- Advanced Materials and Circular Economy (CE) Research Group

ANALYTICAL SERVICES

We combine expertise in advanced analytical chemistry and product design to address the pressing challenges of modern industries. By integrating the capabilities of our research group, we provide innovative solutions that focus on the safety, sustainability, and performance of chemicals, materials, cosmetics, and detergents.

INTEGRATED APPROACH

By combining advanced analytical capabilities with R&D expertise in product development, we deliver holistic solutions to:

- Ensure the safety and sustainability of substances and materials.
- Develop innovative, eco-friendly formulations for cosmetics and detergents
- Support industries in meeting regulatory and environmental standards.

Our integrated focus on cutting-edge analytical chemistry and practical product design enables us to provide comprehensive support for industries striving to innovate responsibly and sustainably.

OUR IDEA

Analytical Excellence

We develop and validate advanced analytical methods tailored for the determination of active substances in diverse matrices, including agricultural, industrial, and everyday products. Our key expertise includes:

- Substances of Concern: Identification and quantification of pesticides, antibiotics, per- and polyfluoroalkyl substances (PFASs), and substances of very high concern (SVHC) used in plasticizers, flame retardants, and other applications.
- Metabolite Analysis: Comprehensive analysis of formed metabolites for ecological footprint evaluation and sustainability assessments of chemicals and materials.
- Regulatory Support: Independent Laboratory Validation (ILV) studies for compliance with industry standards.

"Eco-Innovations in Cosmetic and Detergent Design: Formulation, Evaluation, and Sustainable Solutions"

We specialize in the design, formulation, and evaluation of cosmetics and detergents, emphasizing eco-friendly and bio-based solutions. Our expertise spans:

- Formulation of cosmetics and detergents for hygiene, care, and industrial applications.
- Development of new manufacturing technologies and innovative product forms.
- Quality assessment of cosmetics and detergents to ensure high performance and safety.
- Utilization of bioactive substances and biomaterials for creating sustainable, effective products.

Physicochemical and Functional Studies

- Analysis of surfactant solutions and dispersed systems (emulsions, suspensions, foams).
- Investigation of raw materials for cosmetics and detergents to optimize functionality and environmental impact.

CHEMICAL TECHNOLOGIES

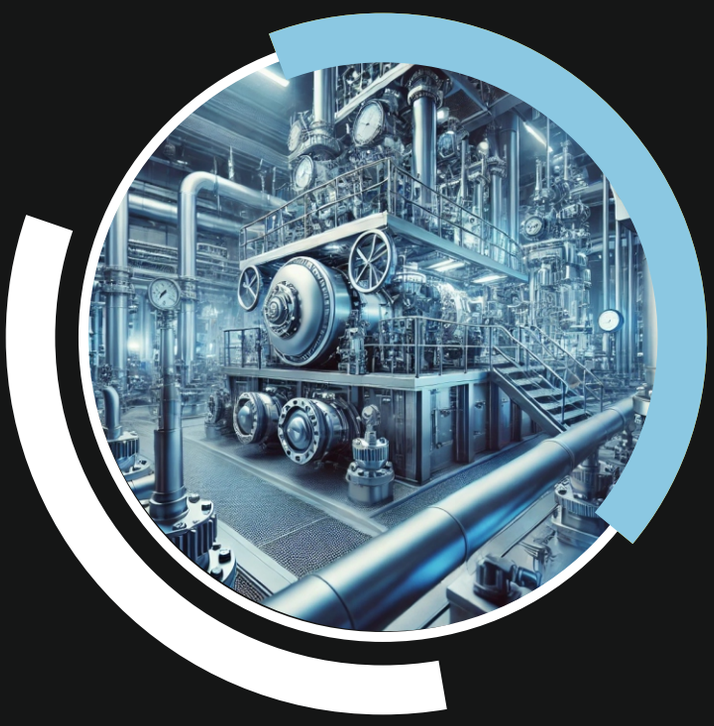
- **literature and patent studies**,
- **development of chemical technologies** - Łukasiewicz – ICSO focuses on the development of innovative chemical technologies for the synthesis of organic compounds and precursors for plastics. These technologies are designed in alignment with current market trends and demands, emphasizing efficiency, sustainability, and environmental responsibility. The research includes creating advanced solutions for producing high-value chemicals, optimizing raw material and energy consumption, and ensuring scalability from laboratory to industrial production. This approach supports industries in addressing modern challenges, such as reducing environmental impact, enhancing product functionality, and meeting the evolving needs of global markets,
- **improving existing chemical technologies** - enhancing and optimizing existing chemical technologies to increase process efficiency and produce higher-quality products. This involves refining operational parameters, addressing technical challenges reported by manufacturers, and implementing solutions that improve product characteristics,.
- **optimization of raw materials and energy consumption rates**,
- **engineering and technical services** – development of design documentation and scaling of processes from laboratory to technical and production level.

HIGH-PRESSURE PROCESSES

- **hydrogen processes:** production, purification, and utilization of green hydrogen. We offer testing and scale-up capabilities for hydrogenation processes, from laboratory-scale units (30 cm^3) to pilot-scale systems (15,000 cm^3),
- **specialized gas conversion:** high-pressure processing of NH_3 , CO, CO_2 , methane and hydrocarbons for industrial applications; etoxylation and propoxylation technologies,
- **sustainable fuels:** developing alternative fuels for a sustainable future, including:

- biofuels for aviation: conversion of used cooking oil (UCO) into aviation fuel meeting ASTM D-7566 standards, proven 8% reduction in fuel consumption with high-quality bio-based jet fuel
- e-fuels from CO_2: conversion of CO_2 into high-value hydrocarbons and fuels and carbon capture, supporting the energy transition with scalable e-fuel solutions

- **catalyst development and testing:** our facilities include packed bed, trickle-bed, and non-gradient suspension reactors, enabling comprehensive testing of heterogeneous catalysts under real flow conditions and catalyst performance monitoring in the long-term trials.



BIOECONOMY & BIOTECHNOLOGY

- **development of renewable raw**-materials processing technologies for the production of liquid biofuels components,
- **processing of fatty substances as base compounds for further processing** - advanced methods for processing fatty substances, such as plant oils and animal fats, into versatile base compounds for further industrial applications. These compounds serve as essential building blocks for the synthesis of bio-based materials, biofuels, and specialty chemicals. The research emphasizes efficiency, sustainability, and the use of renewable resources to create products that align with circular economy principles,

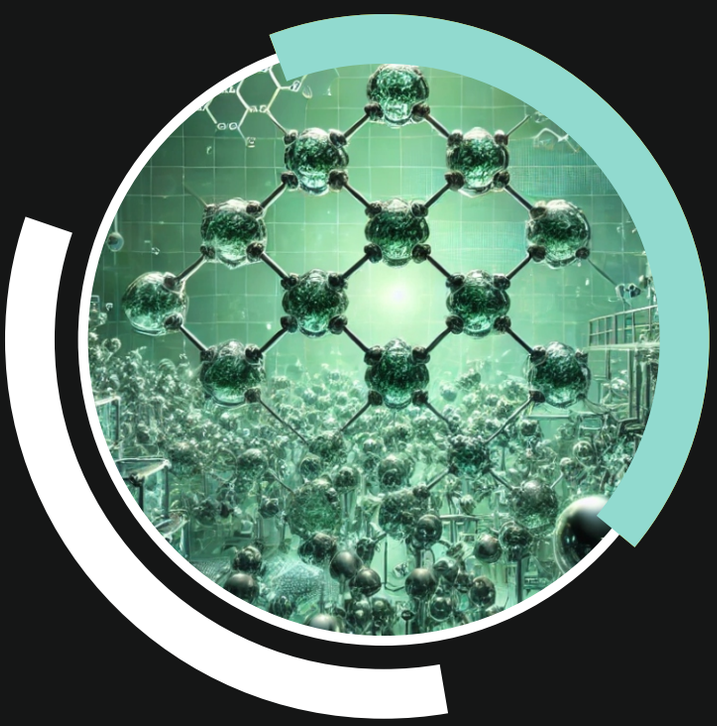
biotechnological processes: enzymatic catalysis and extraction - Enzymatic catalysis is used to achieve precise, eco-friendly chemical modifications, while advanced extraction techniques help isolate valuable components from natural sources.

These methods are applied to produce wide range of chemical compounds, biochemicals and other high-value products, supporting the development of greener industrial processes

- **plant oils** - and fatty acids-based bio-additives for polymer materials: plasticizers, flame retardants, compatibilizers.

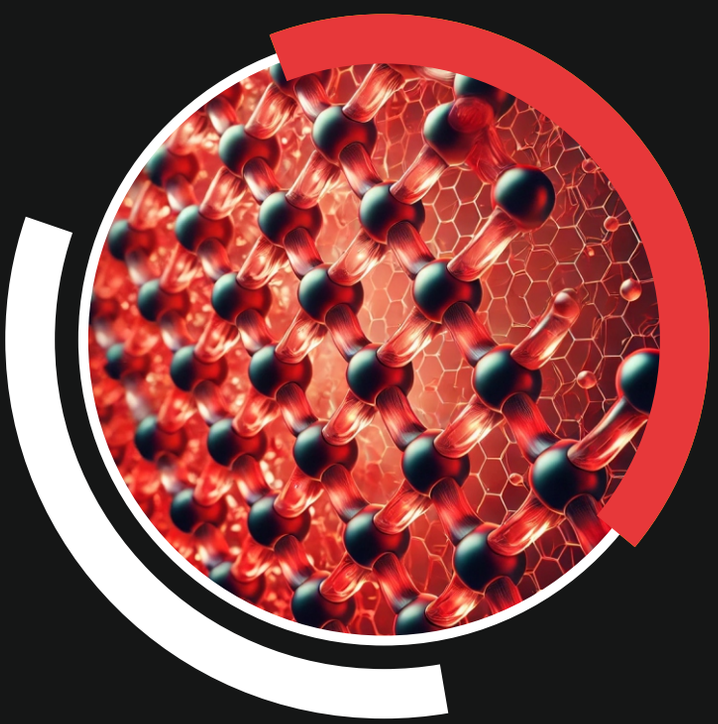
CATALYTIC PROCESSES

- **selection of catalysts for various chemical processes** - selection of catalysts tailored to diverse chemical processes to enhance reaction efficiency, selectivity, and sustainability. By carefully analyzing the requirements of specific reactions, we identify and design different types of catalysts that optimize performance, minimize by-products, and reduce energy consumption,
- **testing of catalysts efficiency and durability in fixed-bed or suspension reactors, from laboratory to semi-pilot scale** - testing of catalyst performance and durability in a range of reactor setups, including fixed-bed and suspension reactors. These evaluations, carried out at various scales - from laboratory to semi-pilot - provide critical insights into the efficiency, stability, and long-term behavior of catalysts under real-world operating conditions,
- **production and application of new-generation heterogeneous catalysts** - ionic liquids (Highly versatile catalysts that offer tunable properties and enable greener chemical processes with reduced waste and energy consumption), organic-inorganic catalysts (Hybrid catalysts that combine the strengths of organic and inorganic components to deliver enhanced activity, selectivity, and durability in a wide range of chemical reactions) and ion-exchange resins (Efficient and reusable heterogenous catalysts that play a crucial role in processes such as condensation, esterification, separation, purification, and polymerization).



POLYMERS & BIOPOLYMERS

- **technologies for the production & modification of synthetic resins:**- epoxy, phenolic, lignin resins, polyurethanes, polycarbonates - developing cutting-edge technologies for the production and modification of a wide range of synthetic resins tailored to meet specific industrial requirements,
- **compounding and processing** of thermoplastic polymers and biopolymers,
- **development of composite materials:** composites, prepregs, SMC and BMC compositions based on epoxy vitrimers – thermosets with the inherent recyclability,
- **biocoatings for paper packaging** providing enhanced barrier properties, biodegradability, and compatibility with recycling processes, aligning with global efforts to reduce single-use plastics and adopt eco-friendly solutions in the packaging sector.
- **crosslinking agents for synthetic resins** intended for applications requiring high-performance polymeric materials, such as in coatings, adhesives, and composites,
- **bioadditives for biopolymers:** flame retardants, plasticizers, compatibilizers - supports the development of safer and more eco-friendly materials for industries seeking to transition towards greener alternatives.



RECYCLING PROCESSES

- **chemical and mechanical recycling** of plastic wastes according to Circular Economy rules,
- **industrial waste water treatment, removing of effluents** - advanced technologies for the treatment of industrial wastewater to ensure compliance with environmental regulations and reduce the ecological footprint of industrial processes. These solutions focus on the efficient removal of harmful contaminants, such as organic compounds, farmaceuticals, PFAS, pesticides and other pollutants, from wastewater.

  By employing innovative treatment methods, such as advanced oxidation processes, membrane filtration, and adsorption techniques with wide range of sorbents (chemically modifies as well), Łukasiewicz – ICSO provides industries with cost-effective and environmentally friendly solutions to mitigate the impact of their wastewater effluents,
- **management of sludge** from sewage treatment,
- **implementation of the PPWR** - Packaging and Packaging Waste Regulations **and SUP** - Single Use Plastics Directive.

COSMETICS & DETERGENTS

Research and development work in the area related to the design, manufacture, quality assessment of products:

- cosmetics (products for hygiene, care, protective preparations),
- detergents (household chemical products for washing, cleaning and scrubbing, detergents for washing and rinsing fabrics, cleaning agents for industrial and institutional applications, etc.).

Scientific research and development work concerns:

- physicochemistry of surfactant solutions,
- physicochemistry of dispersed systems formulation of cosmetics and detergents,
- technologies of production of cosmetics and detergents new forms,
- commodity evaluation of cosmetics and detergents,
- confirmation of compliance of themarket products properties with their technical documentation.

We perform the following R&D works within the topic:

- formulation of cosmetics and detergents,
- manufacturing technology and new forms of cosmetics and detergents,
- quality evaluation of cosmetics and detergents,
- raw materials for the manufacture of cosmetics and detergents,
- isolation from biomaterials and determining the effect of new bioactive substances for use in cosmetics,
- physico-chemical properties of surfactant solutions, and properties of dispersed systems (emulsions, suspensions, foams, etc.).

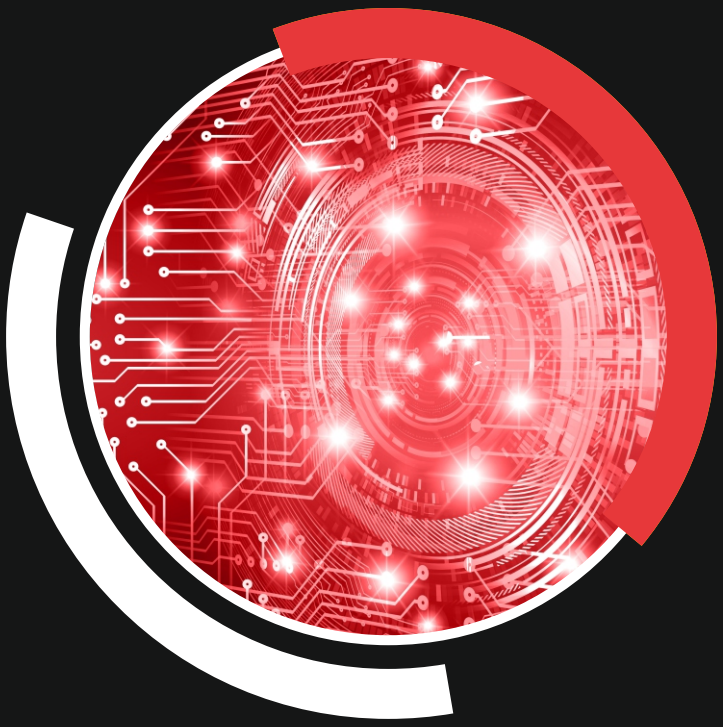
Our interest is driven by new specific applications such as the use of surfactants in newly developed formulations giving a favorable cost/performance ratio and the demand for new ingredients and products, preferably natural, or of natural origin, and manufactured with care for the environment (biodegradable, low irritant).

AGROCHEMISTRY

- **innovative fertilizers technologies:** development of biodegradable materials for coated fertilizers, natural and synthetic zeolites for improving nutrient retention and slow-release properties and production of chelating and complexing agents to enhance fertilizer effectiveness,
- **plant protection products:** development and evaluation of bio-based plant protection agents, testing biological effectiveness and phytotoxicity of active substances, herbicides, fungicides, insecticides, and acaricides,
- **monitoring pest resistance** to ensure optimal performance of plant protection products,
- **assessment of the biodegradation potential** of fertilizers and plant protection products in soil,
- **environmental toxicity evaluation** to ensure safety in practical applications.

DIGITAL TECHNOLOGIES

- **applications of artificial intelligence** and machine learning in chemistry and process engineering,
- **analysis and processing** of large research datasets,
- **modelling and simulation** of chemical processes,
- **digital support for R&D activities**, including maintenance of decision-support tools,
- **application of tools for integrating modern digital technologies** with laboratory and industrial infrastructure,
- **close collaboration** between the Institute's experts in chemical technology and engineering and specialists in AI and ML.



CHEMISTRY FOR THE INDUSTRY

AUXILIARY AGENTS

- **Hydraulic fluids** - specialized fluids designed to transmit power in hydraulic systems, ensuring optimal lubrication, corrosion protection, and thermal stability for industrial and automotive applications
- **Metalworking Fluids for the Mining and Machinery Industries** – lubricants and cooling agents used in machining, cutting, and drilling operations to reduce friction, heat generation, and tool wear, with improving efficiency properties
- **Grases and cooling liquids** - high-performance lubricants and thermal management fluids formulated to provide long-term protection against wear, oxidation, and extreme temperatures in industrial and mechanical applications
- **Biodegradable Cleaning Agents** – environmentally friendly cleaning solutions that effectively remove oils, greases, and contaminants while minimizing ecological impact, ensuring compliance with sustainability regulations
- **Emulsions** - stable mixtures of immiscible liquids used in industrial processes, coatings, and formulations, offering enhanced dispersibility, lubrication, and protective properties

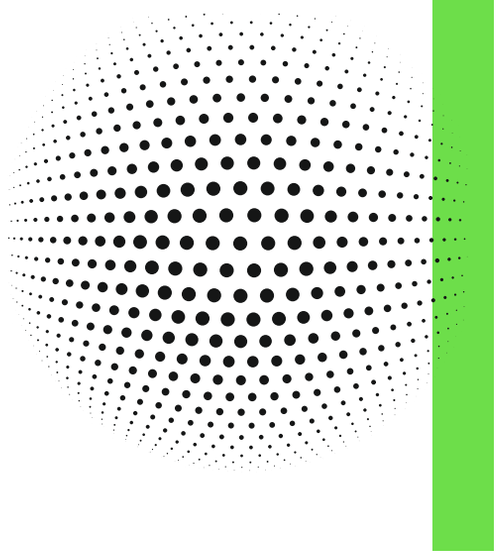
CHEMISTRY FOR THE INDUSTRY

FUNCIONAL ADDITIVES FOR POLYMERS

- **Plasticizers** – specialty additives that increase the flexibility and elasticity of polymers, that improving mechanical performance in soft plastics and coatings
- **Stabilizers** – additives that prevent polymer degradation caused by heat, light, or oxidation, ensuring long-term durability and stability of plastic materials in various applications
- **Sufractants** – surface-active agents that improve the dispersion of fillers, pigments, and other additives in polymer matrices, enhancing material homogeneity and performance
- **Antioxidants** – agents that inhibit oxidative degradation in polymers, extending their lifespan and maintaining mechanical and aesthetic properties under environmental exposure
- **Flame retardants** - additives that reduce the flammability of polymer materials without using hazardous halogenated compounds, enhancing fire safety while complying with environmental regulations

INDUSTRY

COOPERATION



We provide services for the development, improvement, and implementation of manufacturing technologies for chemicals, primarily organic products. We offer:

- research and development services,
- R&D expertise,
- comprehensive research analytics,
- design and consulting services,
- scientific and technical information.

We also have a number of developed technologies and specialty products, mainly in the area of organic and industrial chemistry. We deliver innovative solutions for a wide range of industries, including chemicals, petrochemicals, cosmetics, pharmaceuticals, and environmental protection.

Our offerings include:

Manufacturing technologies:

- Bisphenol A (BPA) manufacturing technology,
- poly(sulfide) phenylene production technology,
- pharmaceutical-grade propylene bioglycol production technology,

Technologies and specialty products:

- cosmetics based on natural raw materials,
- detergents,
- hydraulic fluids for heavy industry,
- impregnants for paper packaging,
- polymer composite manufacturing processes,
- eco-friendly binders for wood-based materials,
- bio-waxes for candles made from vegetable oils,
- PET recycling.

CONTACT

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