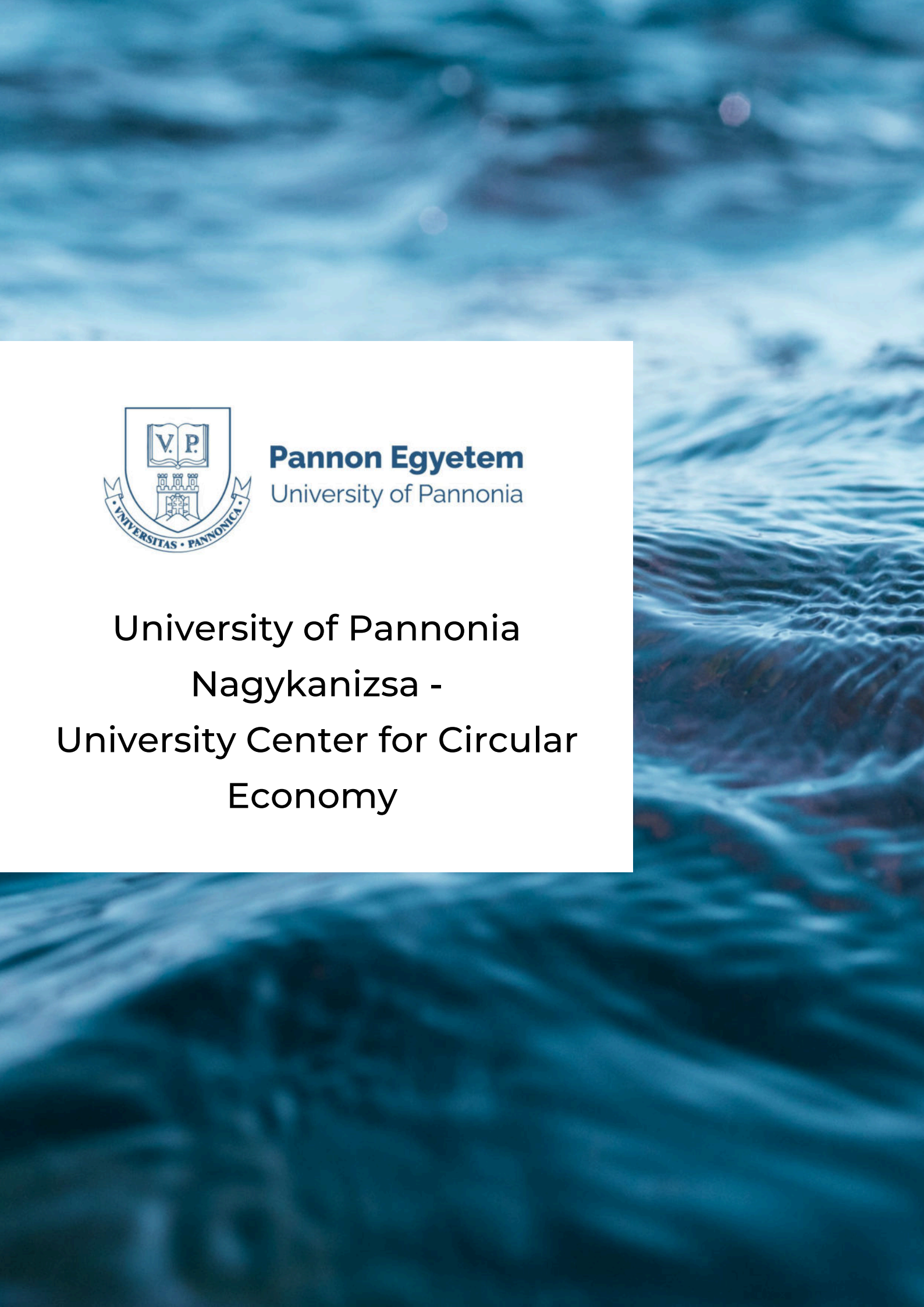

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University of Pannonia

University of Pannonia Nagykanizsa - University Center for Circular Economy

The Soós Ernő Research and Development Center

Soós Ernő Research and Development Center - Water Technology Research Group

The Water Technology Research Group plays a special role in the field of industry and education because with its foundation in 2014 a unique knowledge center was set up in Nagykanizsa in the field of water purification and water treatment.

The work of the Research Group is supported by a network of national and international industrial experts. The staff of the Group are experts in different fields (chemist, biologist, hydrobiologist, environmental engineer, geographer, hydrogeologist engineer), therefore the branching knowledge ensures the wide range of scope of the Research Group.

The main areas of research are water treatment and the development of sustainable technological solutions for industrial water and wastewater treatment. A further research direction is the qualitative and quantitative evaluation of micro-contaminant pollution (organic, inorganic pollution, microplastics) in different water bodies and their removal technologies.

The future objective is to enhance the application of artificial intelligence in current research areas, utilizing data mining tools. In case of particular company needs the Research Group undertakes to hold lectures or complex educational programmes in Hungarian or in English in connection with water treatment, new technological procedures, analytical methods, biological or microbiological questions, etc.

The Research Group has its own well equipped laboratory for doing experiments in batch or pilot scale treatment technologies with the supportation of high sensitivity analytical measurements (LC-MS; GC-MS).

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MAIN ACTIVITIES:

- Reviewing water treatment systems, proposing optimization strategies, and evaluating **water recycling options**, and life-cycle analysis
- Conducting case studies on operational systems, suggesting improvements in chemical usage, and providing **cost-effectiveness calculations.**
- **Exploring "Zero and Minimal Liquid** Discharge" and or similar technologies
- Performing classical and high-sensitive instrumental water chemistry measurements (water and sludge matrices) (not accredited).
- Evaluating obsolete systems and recommending innovative, state-of-the-art technologies based on international practices and/or experiments.
- Designing and performing lab- and pilot-scale **membrane technology** experiments, including microfiltration, ultrafiltration, nanofiltration, reverse osmosis, and forward osmosis.
- Developing low-cost and magnetic adsorbents for wastewater treatment (e.g., pesticide removal, irrigation use).
- Developing biosensors for measuring organic micropollutants.
- Establishing Water 4.0 framework-supervised water treatment and monitoring systems.

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Collaborating partners are:

- "Babes-Bolyai" Univesity, Faculty of Chemistry and Chemical Engineering (Cluj-Napoca, Romania)
- MOL Group
- Aqua-Four Water Technology Ltd.
- Asseco Central Europe Hungary Ltd.
- Carbotech Hungary Ltd.
- Délzalai Water and Sewerage Co., Ltd.
- Escuela Superior Politécnica de Chimborazo, Faculty of Mechanics and Faculty of of Agroindustry Engineering. (Riobamba, Ecuador)
- Falco Zrt.
- General Directorate of Water Management
- Hidrofilt Water Treatment Ltd.
- Hidroproject Technology Ltd.
- Human Telex Advertising Ltd.
- Hungrana Ltd.

Collaborating partners are:

- KAROSINVEST Ltd.
- Labnet Hungary Ltd.
- MOL Plc.
- South-Pest Central Hospital
- Synergy Energy Service Provider, Investment Advisor Ltd.
- University of Maribor, Laboratory for Water Biophysics and Membrane Processes (Maribor, Slovenia)
- University of Cuenca, Aquatic Ecology Laboratory (Cuenca, Ecuador)

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Key persons

Ildiko Galambos, PhD.

Water treatment for pollution removal using complex, membrane based methods, optimization, life cycle analysis.

The head of the Soós Erno Research and Development Center at the University of Pannonia.

Dr. Galambos is focusing on developing and optimizing water treatment methods such as: Purification of surface and groundwater applying various membrane filtration and membrane material transfer operations, both in laboratory and pilot scale.

Special focus is given to organic and inorganic microcontaminant (arsenic, humic acid, and anthropogenic chemicals) removal, as well as the examination of the effects of oxidizing agents.

Reflecting to the challenges of the circular economy further treatment of industrial wastewater with the goal of minimizing freshwater use and environmental pollutant load is highlighted.

Publications: https://www.researchgate.net/profile/Ildiko-Galambos

Key persons

Prof. Etelka Tombacz, PhD, DSc, habil.

Water treatment: adsorption and dispersion stabilization/destabilization. Magnetic nanoparticles, magnetic separation.

Professor Tombacz is a well-known colloid chemist researching aqueous interfacial equilibria, adsorption, pH and ionic strength dependent surface charging of polyelectrolytes, clay mineral and metal oxide particles.

Her expertise covers the desired manipulation of particle-particle interactions in composite natural and model aqueous systems by designed surface modification, coagulation/flocculation to increase or decrease colloidal stability.

Recently, she focuses on the synthesis of magnetic nanoparticles, magnetic fluids and nanocomposites, as well as their environmentally relevant applications, such as magnetic adsorbents for the separation of micropollutants.

Publication:
https://scholar.google.com/citations?pagesize=100&user=OyXyQLQAAAAJ

Key persons

Renáta Berta-Gerencsér, PhD.

Microplastics and organic microcontaminants in different water source – quality control and possibilities of removal.

Dr. Gerencser-Berta is the Director at University of Pannonia Nagykanizsa, University Center for Circular Economy.

She has experiences in the field of classic water chemistry, detection of pharmaceuticals in water, microplastic contaminant detection, and document organization in GMP. In her work, she excels in the following analytical areas: High performance liquid chromatography (HPLC); Elevated temperature liquid chromatography (HT-HPLC); High performance liquid chromatography mass spectrometry (HPLC-MS, UPLC-MS / MS); Classical analytical methods; Non - destructive sample preparation procedures for liquid chromatographic studies.

Publication: https://www.researchgate.net/profile/Renata-Gerencser-Berta

Key persons

habil. Gabor Maasz, PhD

Circular economic approach in pharmacy.

The primary research focus of Dr. Maasz lies in the high-performance analytical examination of organic micropollutants (pharmaceutical residues, pesticides, etc.), determination of their presence, and exploration of possibilities for their removal from various environments.

Till his habilitation in 2020, Gábor Maász has contributed to several impactful researches on the fields of pharmaceuticals in water, efficiency of bank filtration, and the occurrence of pharmaceutically active compounds in environmental water samples.

Since 2020, he has been conducting research engaging in environmental analytical surveys in the field of sustainable pharmacy, and providing analytical support for purification technology developments.

Publication:
https://scholar.google.com/citations?user=n44Nc0UAAAAJ&hl=hu&oi=ao

Key persons

Peter Kesseru, PhD.

Applied microbiological and biotechnological sciences.

Dr. Kesseru is an expert in the examination and degradation of environmental pollutants (like pesticide residues), contributing significantly to the development of applied microbiological and biotechnological methods.

His research includes the study of complex biotic and abiotic reductive systems, production and degradation of biopolymers and biofilms, functional microbiome analysis, aiming to understand and enhance the processes that support the removal of both inorganic and organic substrates.

Publication: https://www.researchgate.net/profile/Peter-Kesseru

MAIN PROJECTS

National Laboratory for Water Science and Water Security (RRF-2.3.1-21-2022-00008, 44 months)

This project is a collaborative research initiative led by University of Pannonia, bringing together 11 consortium partners and encompassing 40 sub-projects aimed at sustainable water management.

This project unites significant educational and research institutions in Hungary specializing in water science.

Covering various research areas from agriculture to integrated urban hydrological management, are addressed, and our collaborative partners include universities, academic research institutes, and public utilities.

Among other tasks, the University of Pannonia and the National Water Directorate collaborate on monitoring pharmaceutical residues and micropollutants, working towards the establishment of a unified database for Hungary.

The measurements of pharmaceutical residues take place at the Soós Ernő Research and Development Center.

Water reuse and membrane separation process for a reliable and sustainable water supply (NATO SPS-MYP G6087, 36 months)

In this project the main tasks are

1) to develop chromatographic methods for contaminants of emerging concern, herbicides, insecticides, and chemical warfare agent simulants;

2) to collect knowledge on all aspects of the efficiency and mechanism of removal of contaminants from water using membrane separation processes; and

3) design of a hybrid process for treatment of wastewater and reuse for drinking and irrigation purposes.

The project will foster strong and lasting collaboration among team partners, as well as develop leadership skills for the potential national and international projects,

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MAIN PROJECTS

Establishment of a National Multidisciplinary Laboratory for Climate Change
(RRF-2.3.1 21-2022-00014, 59 months)

The Climate Change National Laboratory program encompasses 7 consortium partners and several subprojects.

In addition to studying factors causing climate change and their impacts on nature, economic systems, and society, it conducts research and development activities in the field of technological, economic, and social adaptation.

The professional achievements sought during its operation, while delivering concrete economic and social benefits for Hungary in terms of preparing for the consequences of climate change and mitigating its impacts, will significantly strengthen the professional collaboration among participating organizations.

Furthermore, they will enhance the National Laboratory's international integration, scientific recognition, and capacity to generate international funding, bolstering its innovation potential.

The main goal of the sub-project related to Soós Ernő Research and Development Center is creating a Water 4.0 framework-supervised water treatment and monitoring systems: a sensorized environment necessary for assessing water qualities in an industrial setting, supporting proper professional planning, and making appropriate cleaning technology recommendations.

MAIN PROJECTS

Global clean water issue: deteriorating quality of surface waters in the face of growing human demands (2021-1.2.4-TÉT, 24 months)

Surveying pharmaceutical residues and other micropollutants in high-mountain rivers in Ecuador and interpreting the results in an international context.

The measurements are conducted at the Soós Ernő Research and Development Center.

Establishment of a sustainability competence center based on circular economy principles at the University of Pannonia (2019.1.3.1-KK-2019-00015, 58 months)

In the field of water technology, there are three subtopics:

I. Treatment of exhausted oily wastewater from industrial downstream technology;

II. Mitigation of microplastics in well and drinking waters, production of flavored water, and applied technology;

III. Treatment of water for Enhanced Oil Recovery (EOR).

MAIN PROJECTS

Development of cost-effective adsorbents and water filter cartridges for risky drug residues (2020-1.1.2-PIACI-KFI-2021-00309, 48 months)

In modern adsorption operations, one of the main goals is to increase the efficiency of adsorption and/or the selectivity of the adsorbent for a particular adsorbate.

Modifying the adsorbent can result in the possibility of new adsorption interactions. In this ongoing project, during adsorbent development, the research group conducts targeted surface modifications that make the adsorbent suitable for the selective removal of specific micropollutants.

Additionally, in line with the principles of the circular economy, environmentally friendly, waste-based, so-called low-cost (cost-effective) adsorbents are examined for the sequestration of various micropollutants (e.g., pesticides).

Development of an early warning and notification system for spreading of gastroenteral viruses, using wastewater-based epidemiology (2020-1.1.6-JÖVŐ-2021-00007, 36 month)

The wastewater-based epidemiology is an approach to track chemical and biological compounds indirectly, for e.g. virus genetic material.

The COVID-19 pandemic caused this field re-recognition. The SARS-CoV-2 virus which causes the coronavirus disease, is defecates from the gastrointestinal system and can be found in the communal wastewater.

The process of sample preparation contains the steps of virusconcentration and nucleic acid extraction.

The concentrated liquid includes total nucleic acid and the virus detection is specific. Detection is performed by qPCR instrument. In the future plan, the Research Center will monitor gastroenteric viruses from the wastewater.

Aim to creating a virus monitoring system and information platform. In this project the University of Pannonia work with two project partners, University of Pécs and Asseco Central Europe Company.

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MAIN PROJECTS

Monitoring of surface and ground water in Medimurje and Zala county (Interreg HUHR/1901/2.2.1/0128, 24 months)

Europe has pivotal role in global water research and management, highlighting the need for knowledge exchange on water resource reuse. In this project the aim was to foster cooperation among local governments, researchers, industrial specialists, and citizens to achieve good water quality.

The project focused on cross-border cooperation between Croatia and Hungary, sharing information on water quality, especially regarding priority substances.

The leading partner of the project was Délzala Waterworks and Sewerage Works Co. Ltd., monthly monitoring data were collected (43 types of pharmaceuticals and pesticides) and the pollution of ground water the the last section of Mura River and were examined at a transboundary area.

By creating a comprehensive state review, sampling plan, and an online platform, the project aimed to bridge existing gaps in data and methodologies.

MAIN PROJECTS

Collaborative Hospital Information Platform: Development of a Process-oriented Inpatient Care Supporting Medical System (2020-1.1.2-PIACI-KFI-2020-00045, 36 months):

The project aims to develop the Collaborative Hospital Information Platform (KKIP), which breaks away from the fragmented operational model of hospital systems and the episodic approach to patient care.

The main focus during the platform's development is patient-centeredness and the application of a process-oriented approach tailored to the medical profession. Another goal is to expand the boundaries of system usage in multiple directions (temporally and spatially) for both medical staff and patients, aligning with the digital directions designated by the EESZT (Electronic Public Health Services) initiative.

Supported by artificial intelligence and IoT devices, the platform uniquely facilitates the organization, scheduling, and execution of diagnostic and therapeutic events related to patient care (e.g., visits, treatments).

The implementation ensures the utilization of data-intensive solutions based on healthcare data assets, utilizing data science and operations research results applicable in the healthcare sector

MAIN PROJECTS

Development of Multiparameter Analysis Systems for Analyzing the Environmental Effects of Microplastics (2020-1.1.2-PIACI-KFI-2021-00239, 48 months):

The project aims to develop innovative methods in the following areas:

1. Examination of indoor and workplace air microplastic pollution;
2. Characterization of airborne microplastic particles threatening human health;
3. Exploration of microbiological mediation effects of airborne microparticles;
4. Characterization of waterborne microplastic particles;
5. Toxicological evaluation of the effects of microplastics occurring during wastewater treatment processes:

Assessment of environmental risks associated with microplastic particles using microbiological and ecotoxicological studies, as well as, development of a multiparameter analysis system for water and wastewater microplastic content to assess possible risks.

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