



Presentation of research centre Institute of Environmental Technology

VSB-Technical University of Ostrava, Czech Republic

I. General information about centre

II. Research projects in area Energy recovery of waste

III. Research projects in area Protection of air, water and processing of solid residues



VSB – Technical University of Ostrava

- 6th largest university in the Czech Republic
- Established in 1849, in 2019: 170 years old
- 11 535 students, 950 academic staffs
- 7 faculties, 2 university research centres
- 249 study programs (114 in English language)
- One of the largest campus in middle Europe



Faculties

University research centres

FACULTY OF ELECTRICAL
ENGINEERING AND COMPUTER
SCIENCE

FACULTY OF MATERIALS
SCIENCE AND TECHNOLOGY

FACULTY
OF MINING
AND GEOLOGY

FACULTY
OF MECHANICAL
ENGINEERING

FACULTY
OF CIVIL
ENGINEERING

FACULTY
OF SAFETY
ENGINEERING

FACULTY
OF ECONOMICS

ENERGY
AND ENVIRONMENTAL
TECHNOLOGY CENTER

IT4INNOVATIONS
NATIONAL SUPERCOMPUTING
CENTER



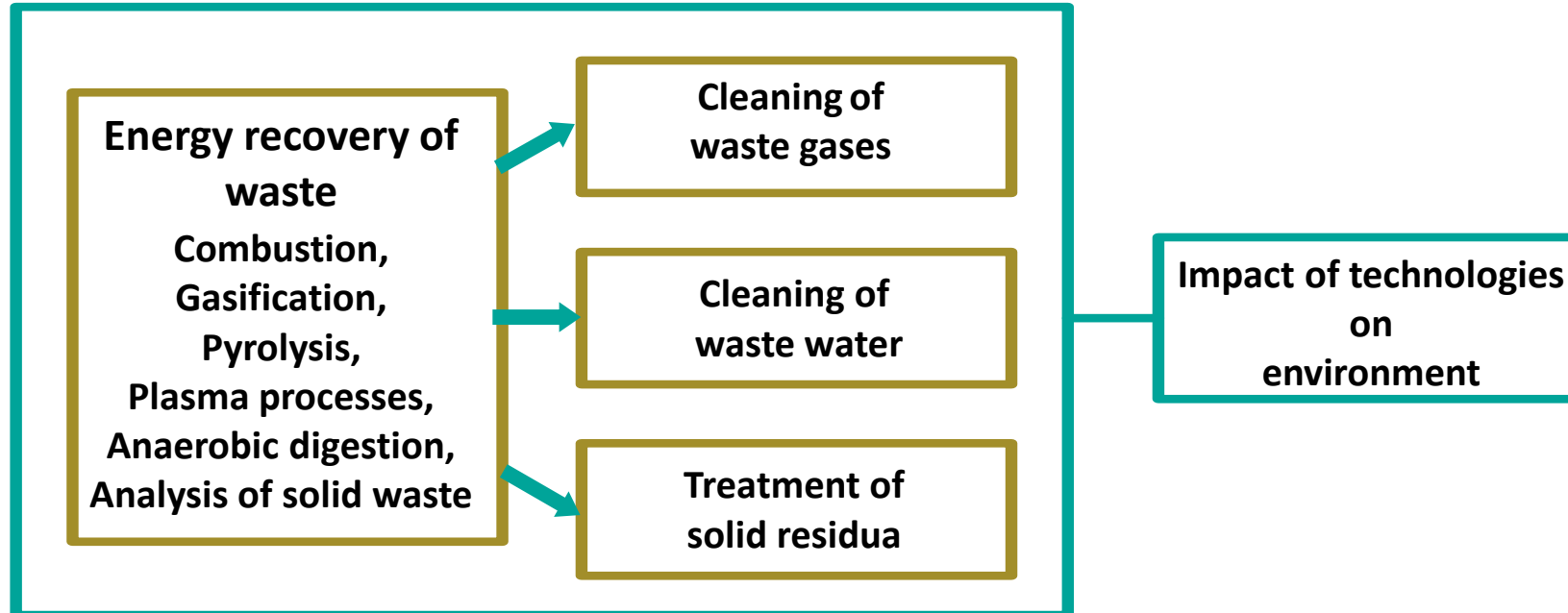
History of Institute of Environmental Technology

- **2004:** Centre of Environmental Technology was established as department of VSB-Technical University of Ostrava
- **2011-2013:** New research pavilion was built with financial support of EU structural funds, Operational Program Research and Development for Innovation, project „Institute of Environmental Technology“ with University of Ostrava
- **1/2014-12/2018:** Sustainability phase of project „Institute of Environmental Technology“ , support from MEYS (National Program of Sustainability I)
- **8/2014:** Center gained the status of university institute according to the Law No. 111/1998 Coll. on universities.
- **2019:** Research infrastructure of IET „ENREGAT“ is included to the Czech Roadmap of Large Infrastructures for Research, Development and Innovation financially supported by Ministry of Education, Youth and Sports.
- **2021:** The merger of the Institute of Environmental Technology with the Energy Research Centre, the ENET Centre and the Centre of Nanotechnology Centre into a new university institute, the Centre of Energy and Environmental Technologies.

FOCUS OF CENTRE: Basic and applied research, cooperation with industry, cooperation with VSB-TUO faculties - tutoring of students thesis.



Research area





Laboratories

Energy recovery of waste

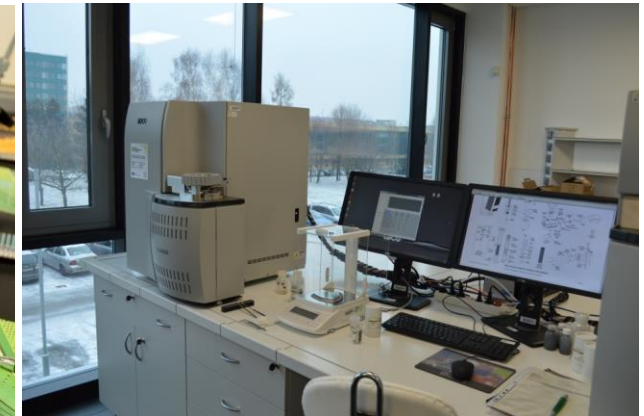
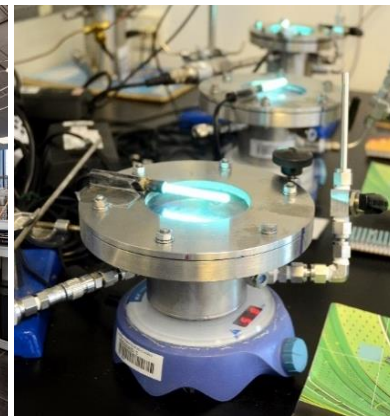
- Laboratory of waste incineration
- Laboratory of reduction processes
- Laboratory of anaerobic digestion

Protection of air, water and processing of solid residua

- Laboratory of air protection
- Laboratory of heterogeneous photocatalysis
- Laboratory of nanostructured materials preparation
- Laboratory of solid residues
- Laboratory of water cleaning

Analytical laboratories

- Laboratory of waste analysis
- Laboratory of trace analysis

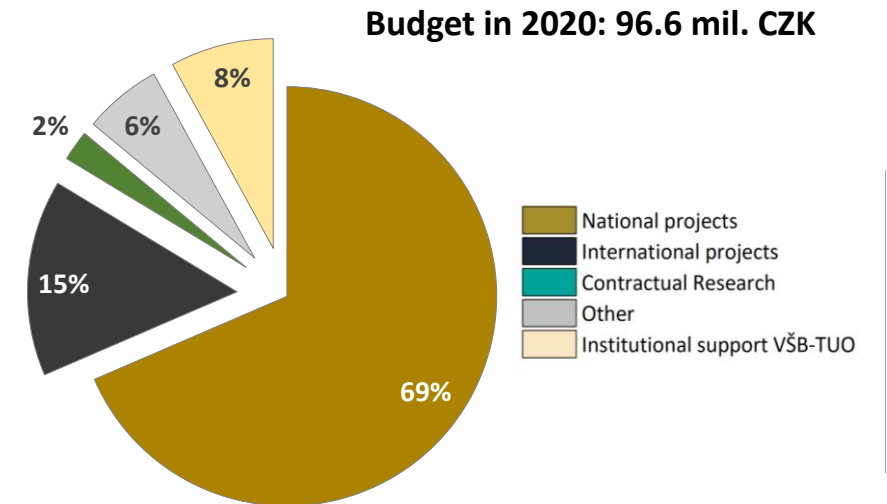




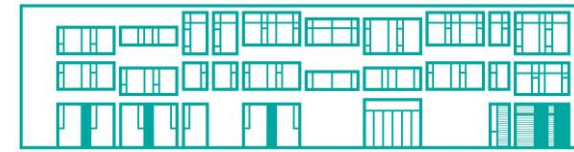
Funding of centre

Research projects

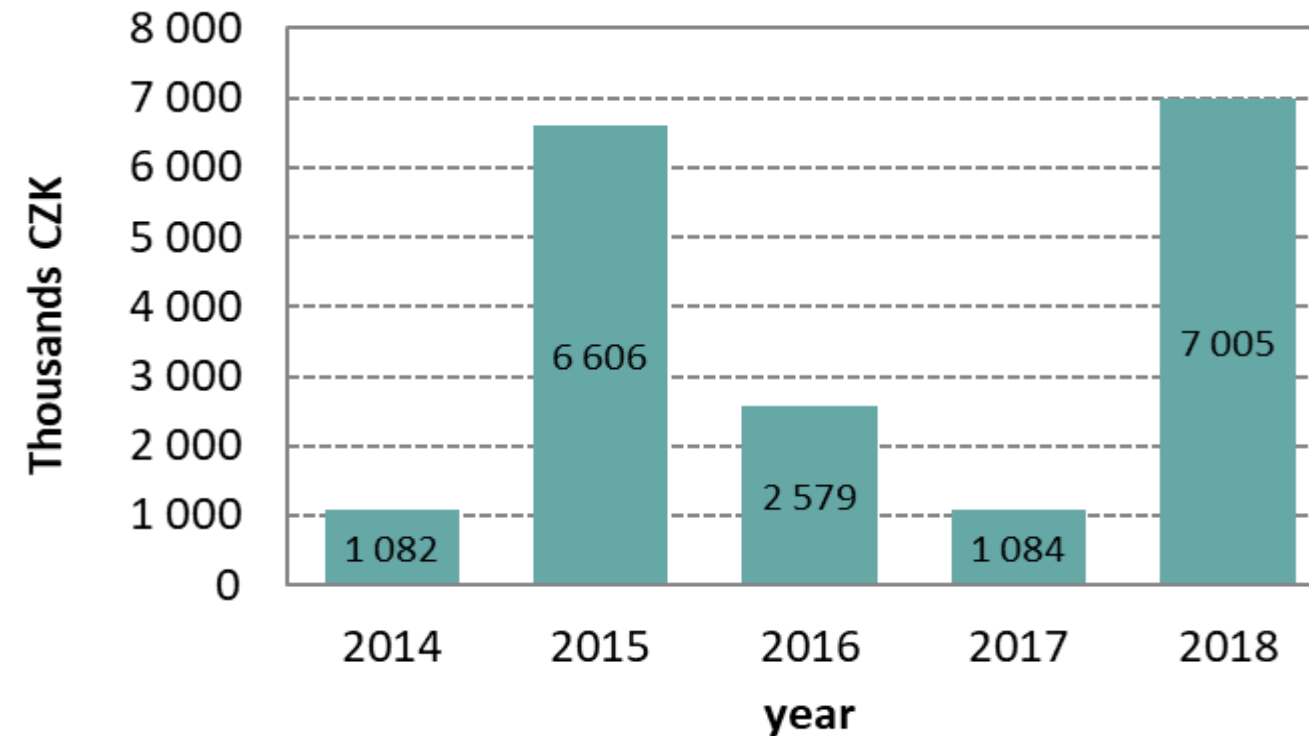
Type	2014	2015	2016	2017	2018	2019	2020
Czech Science Foundation	2	2	3	2	3	3	3
Technology Agency CR	2	2	2	4	4	4	3
International projects	1	1	1	2	3	3	3
Students research	2	1	1	1	1	1	1
MIT TRIO	0	0	2	2	2	3	2
MIT OP PIK	0	0	1	4	4	3	1
MEYS	1	2	2	1	3	3	4
Projects from M-S region	0	2	0	0	0	0	0
Institutional development projects	0	2	1	1	0	0	0
Total	8	12	13	17	20	20	17



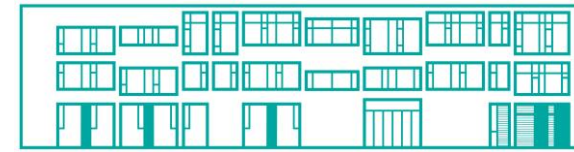
	2014	2015	2016	2017	2018	2019	2020
Budget (mil. CZK)	19.6	27.7	26.1	30.2	43.9	93.7	96.6



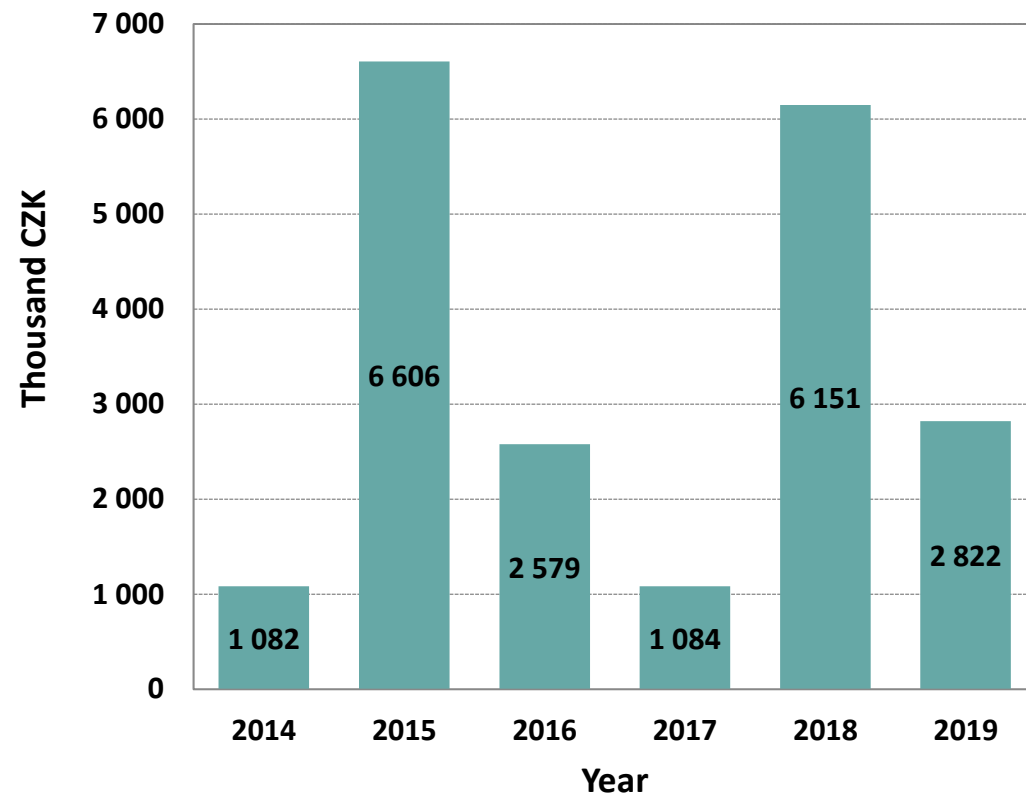
Cooperation with industry - contractual research



Contractual research	2014	2015	2016	2017	2018
thousands CZK / FTE	58	300	117	47	280
thousands Eu / FTE	2	12	4	2	11



Cooperation with industry - contractual research



Contractual research	2014	2015	2016	2017	2018	2019
thousands CZK	1082	6606	2579	1084	6151	2 822
thousands Eu	42	254	99	42	237	109

Contractual research	2014	2015	2016	2017	2018	2019
thousands CZK / FTE	58	300	117	47	246	55
thousands Eu / FTE	2	12	4	2	9	2



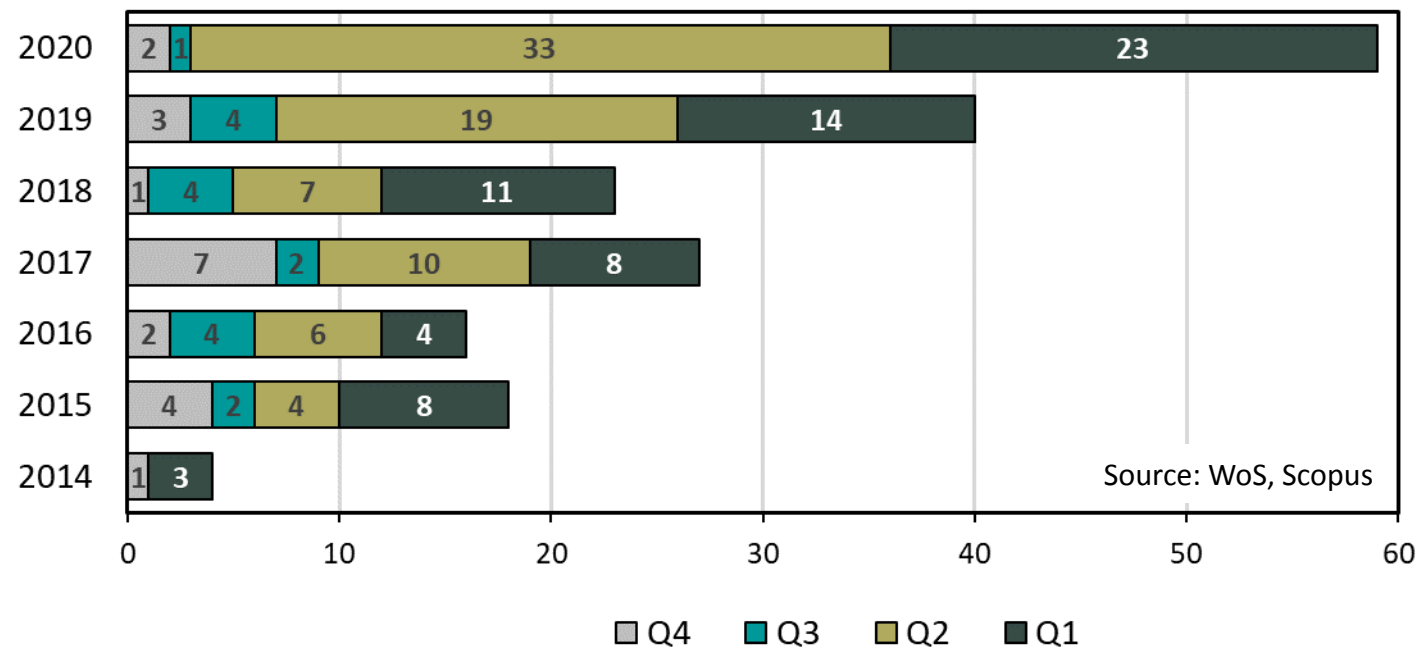
Cooperation with industry, contractual research

Envitech Bohemia
ELVAC EKOTECHNIKA Inc.
CAPITAL REFRACTORIES Ltd.
BorsodChem MCHZ
Ranido
Ústav geoniky AV ČR
I.P.C. Refractories
Bochemie Bohumín
SINEKO Engineering
OZO Ostrava
Refrasil
Nano4People
Conformity
Nošovice town
Nižní Lhoty town
TECHNICKÉ SLUŽBY OCHRANY OVZDUŠÍ
OSTRAVA
Vodní zdroje Chrudim
...





Publications in IF journals

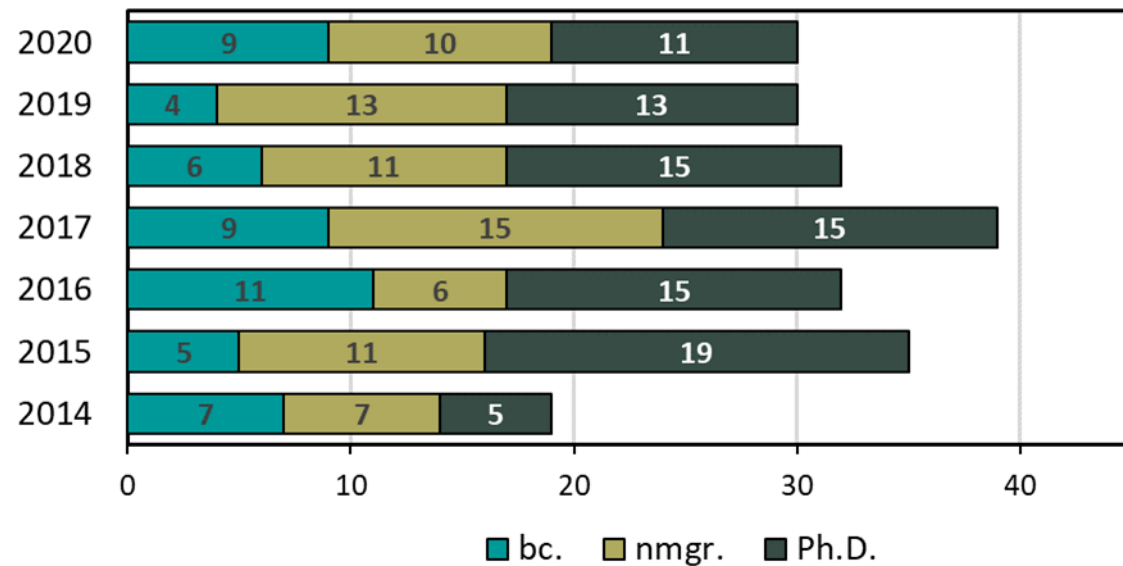


	2014	2015	2016	2017	2018	2019	2020
IF publications/FTE	0.32	0.86	0.72	1.17	0.92	0.82	1.1
FTE	18.63	21.99	22.13	23.0	25.0	51.7	54.4



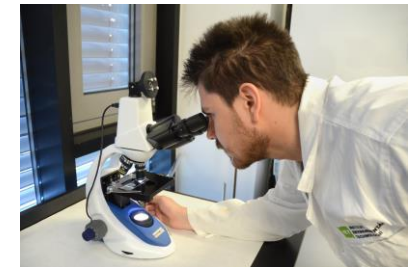
Cooperation with faculties in students education

Students working in IET laboratories (2014-2020)



Study programs

- Process Engineering (FMT)
- Chemical and Environmental Engineering (FMT) inženýrství (FMT)
- Nanotechnology (FMT)
- Tepelná technika a keramické materiály (FMT)





International Cooperation

- Jagellonian University Krakow, **Poland**
- University Marie Curie-Skłodowska in Lublin, **Poland**
- AGH, Krakow, **Poland**
- Lodz University of Technology, **Poland**
- Technical University of Bratislava, **Slovakia**
- Prešov University in Prešov, **Slovakia**
- Technical University of Crete, **Crete**
- University of Oulu, **Finland**
- University of Nova Gorica, **Slovenia**
- University of Antwerp, **Belgium**
- National University of Kiev, **Ukraine**
- Technical University Bergakademie in Freiberg, **Germany**
- University of Oulu, **Finland**
- Nagoya Institute of Technology, **Japan**
- Montanuniversität in Leoben, **Austria**
- Vienna Technical University, **Austria**
- JINR, Dubna, **Russian Federation**
- National Taiwan University, Taipei, **Taiwan**
- National University Littoral, **Argentina**
- Assiut University, **Egypt**
- Griffith University Brisbane, **Australia**
- University Jiangsu, **China**
- National University of Thumbes, **Peru**
- National Engineering University in Lima, **Peru**
- Ariel University, **Israel**
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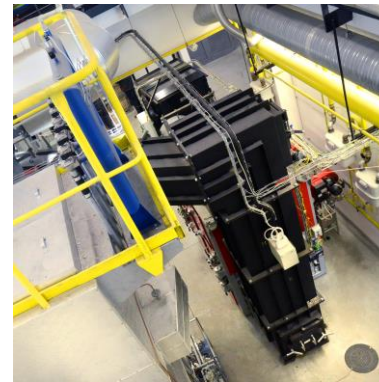
II. PRESENTATIONS OF RESEARCH PROJECTS

Energy recovery of waste



New advanced mobile units for thermal degradation of waste

- Development of mobile equipment for thermal degradation of waste with related technologies for flue gas refining and waste heat utilization
- **Innovative:** minimizing of space requirements
- **Application:** security components and components of civilian protection, a rapidly developing country with unsatisfactory infrastructure



TA CR No. TH02010268, 2017-2019

SMS CZ

ICPF CAS CR, v.v.i.;

VSB-TUO IET, Prof. J. Vlček

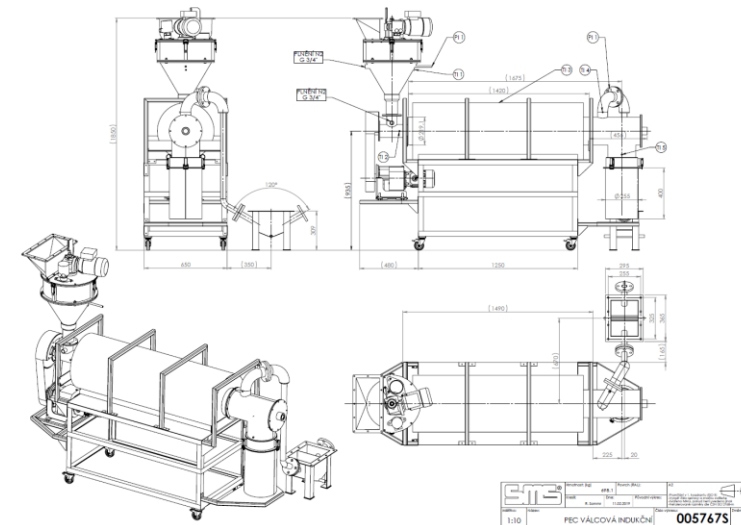
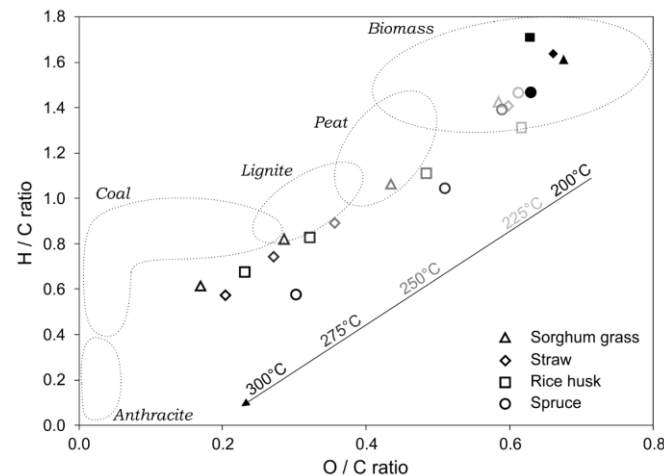
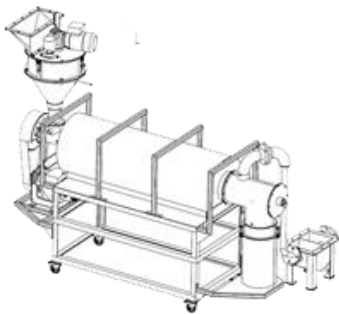
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Torrefaction technology for small and mobile unit

Torrefication is low temperature pyrolysis for waste biomass treatment, temperature of torrefaction is between 220 and 300 °C in inert atmosphere. The torrefied biomass is hydrophobic, sterile (sewage sludge) and it has better properties for energy utilization than raw material.



OP PIK CZ.01.1.02/0.0/0.0/16_084/0010290

SMS CZ

ICPF CAS CR, v.v.i.;

VSB-TUO IET, Dr. Pavel Leštinský



Aerobic - anaerobic mobile contained rotary bioreactor

Bioreactors are facilities for fermentative biomass and biowaste processing. they can produce solid products. These can produce solid, liquid and gaseous products.

Aim of the project: to develop an universal aerobic - anaerobic rotary container bioreactor for production program of DANE-ZAM ltd company.

Use:

- Intensified composting
- Wet process of biogas production
- Dry process of biogas production
- Alternatively also thermophilic stabilization of sludges

Innovation:

- on a small scale, the dry process can be more efficient by mixing
- the container design of the reactor will allow easy movement (mobility)
- modular system for easy process change



TA ČR No. TH03020064, 2018-2020

DANE-ZAM Ltd., Zemědělský výzkum Ltd.

VŠB-TUO, IET assoc. Dr. J. Rusín

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III. PRESENTATIONS OF RESEARCH PROJECTS

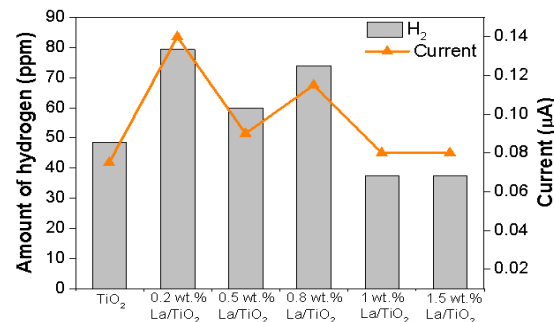
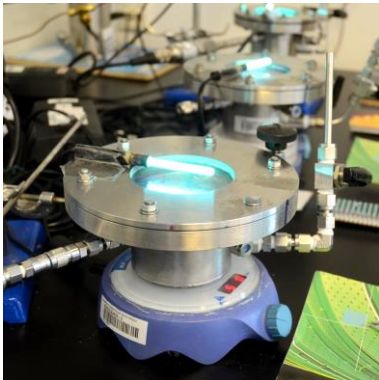
Protection of air, water and processing of solid residua



Advanced analysis of the relationship between optical/electron/ textural /structural properties of TiO_2 doped materials and its photocatalytic activity

Photocatalysis is one of the promising techniques for the decontamination, cleaning and deodorization of air and waste water.

Aim: Fundamental research on the relationship among material and photocatalytic properties of iron- and lanthanide (La-, Nd-) doped TiO_2 photocatalysts for two model reactions - photocatalytic decomposition of an aqueous solution of NH_3 and alcohols.



TA ČR No. TH03020064, 2017-2019

University of Pardubice, prof. L. Čapek

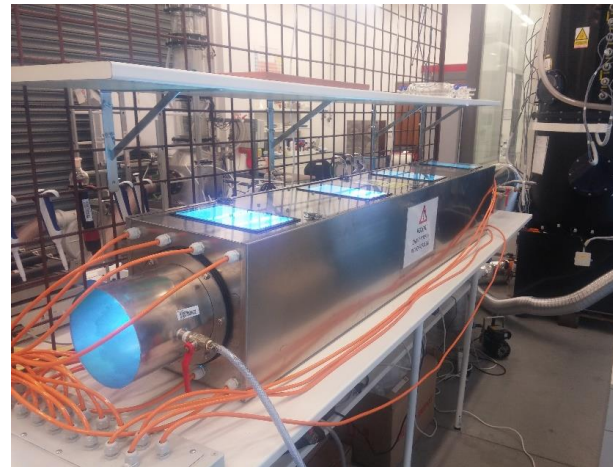
VSB-TUO IET, prof. K. Kočí



The elimination of the waste air emissions by photochemical oxidation

Odorous substances come from industry, agricultural plants, biological and raw materials (biogas stations composting plants) or treatment plants.

Aim: Research of technology for decomposition of organic (especially odorous) substances in waste air by UV radiation and its verification in pilot plant.



Ministry of Industry and Trade FV10674, 2016-2019

DEKONTA, a.s.

VSB-TUO IET, prof. K. Kočí

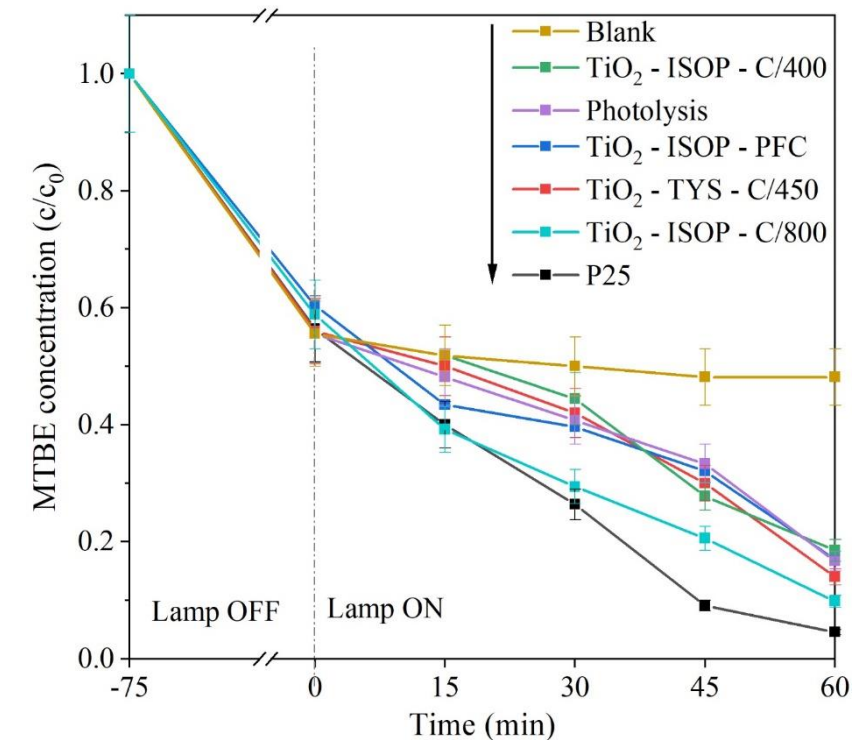


Combined decontamination of waters polluted by engines fuel additives using nanotechnologies

Among the eminent environmental contaminants belong methyl tert-butyl ether (MTBE). MTBE is volatile, flammable, colourless polar compound well soluble in the water.

Aim:. The process of removing MTBE from water presents a challenge due to the concentration of the contaminant reaching only the threshold values.

One way of removing MTBE from water is its **photocatalytic decomposition** under UV irradiation on TiO_2 based photocatalysts.

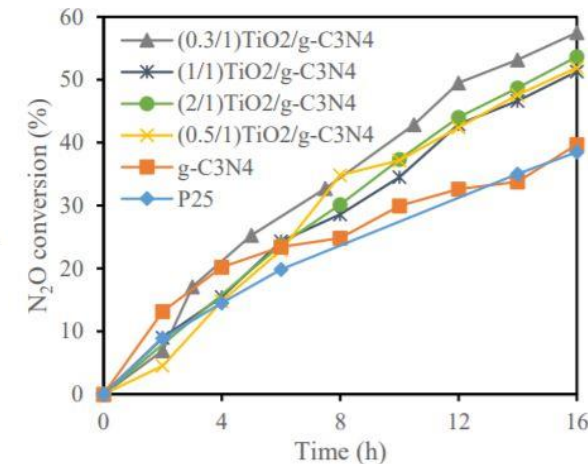
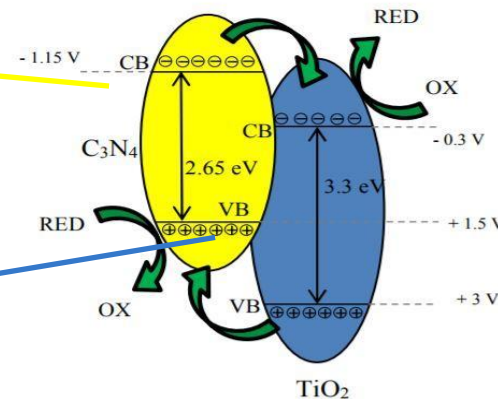
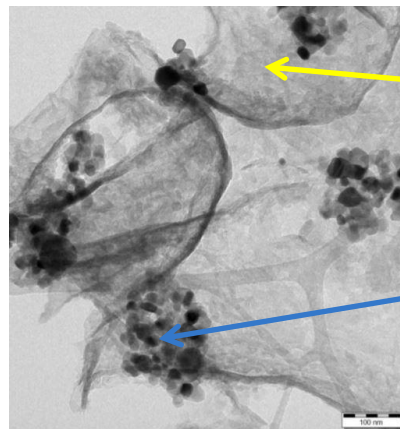




Graphitic C_3N_4 based nanostructures for photocatalytic decomposition of nitrous oxide

Nitrous oxide causes the ozone layer depletion and contributes to the greenhouse effect. One of the ways how to reduce its concentration is its photocatalytic decomposition into N_2 and O_2

Aim: Research of photocatalysts based on graphitized C_3N_4 (g- C_3N_4) in combination with other semiconductors such as TiO_2 , WO_3 , SnO_2 , BiO_4 and $BiVO_4$.

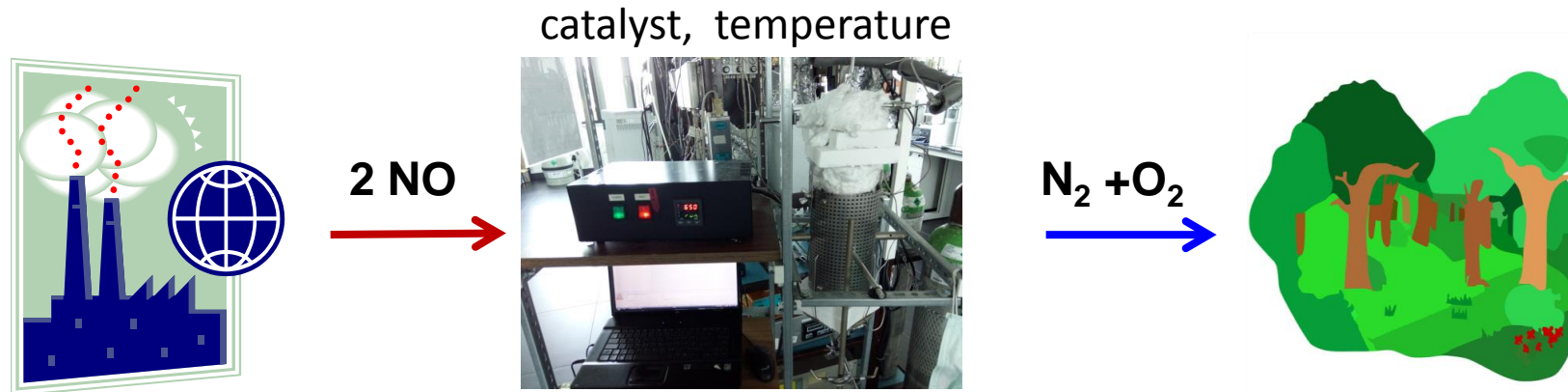




Oxidic catalysts for direct NO decomposition without the use of a reducing agent

Nitric oxide is one of the oxides from a group known as NO_x (NO , NO_2). Nowadays, the selective catalytic reduction or selective non-catalytic reduction is used in commercial applications for NO_x emission abatement. The main drawback is a necessity of reducing agent using.

Aim: Specify key parameters for the preparation of mixed Co, Mn and Al mixed oxides suitable as catalysts for direct catalytic decomposition of NO based on correlation of physico-chemical and catalytic properties.

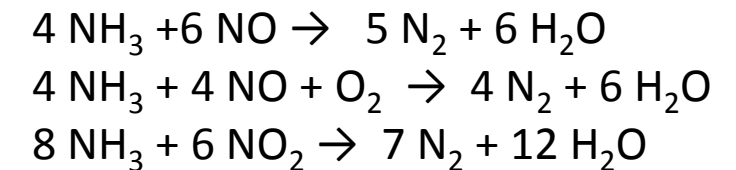




New low-cost technology for catalytic reduction of nitrogen oxides in flue gases for small and medium emission sources

NO_x are reduced by NH_3 without catalyst at temperatures 850 - 1100 °C. Disadvantage: max. efficiency of 60 %.

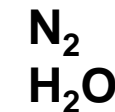
Aim: Enhancement of SNCR efficiency by means of iron-based additives directly fed into the hot flue gas stream from stationary combustion sources.



Combustion process



Fe based additives





Persistent VOC and flue gas treatment by usage of waste material

The caustic sludge is a by-product of calcium carbonate produced in the process of regenerating sodium hydroxide in the production of cellulose by a sulphate process

Object of project: to develop a technology using this byproduct as a sorbent for the refining of flue gas, serving primarily to remove acidic components of flue gas and hazardous organic pollutants

OP PIK, Application, CZ.01.1.02/0.0/0.0/15_019/0004523, 2018 – 2020

SMS CZ s.r.o.

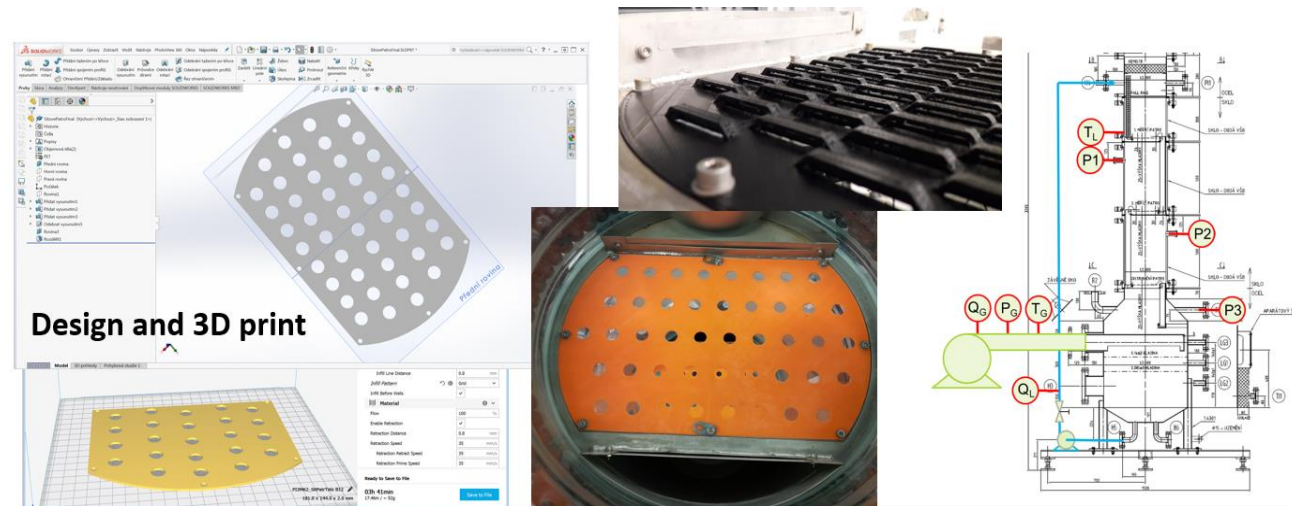
VSB-TUO IET, doc. J. Vlček



R&D of equipment for ammonia separation from coking plant waste water

Ammonia and phenol are separated from water in coke plants by means of stripping. Specificity of the operation is a strong tendency to clog with tars and ferrocyanide complexes.

Aim: Developing a new type of distillation trays and optimizing its geometry in terms of hydrodynamics.



TA CR No. TH02030535, 2017 – 2019

ZVU Engineering

VSB-TUO IET, prof. K. Wichterle

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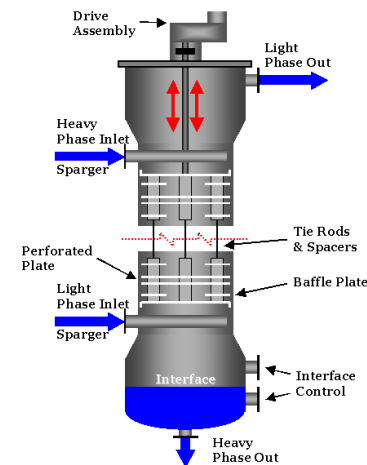
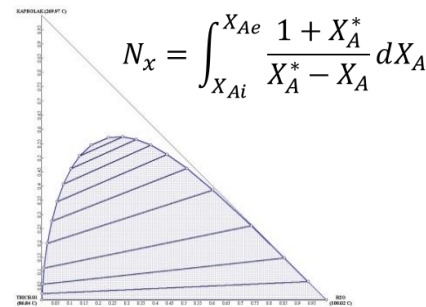




Refining of crude caprolactam

Caprolactam is a raw material for the production of nylon 6. Chlorinated solvents are used in the production and caused pollution of waste water.

Aim: Development of the new process for the refining of crude caprolactam with the elimination of currently used carcinogenic trichlorethylene.



TA CR No. TH01030104, 2015-2018

TECHEM CZ Ltd.

VSB-TUO IET, prof. L. Obalová

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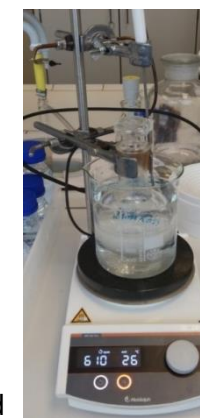
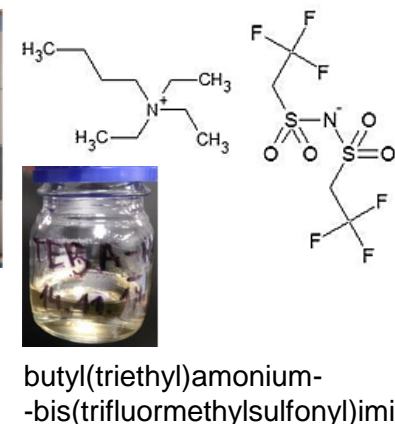
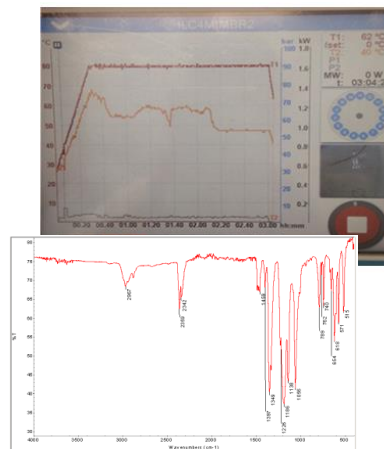
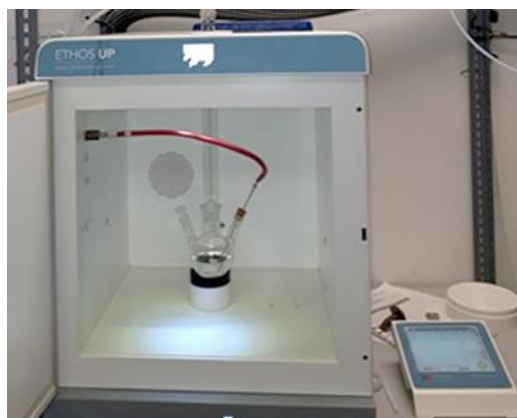




Synthesis of ionic liquids in microwave reactor

Ionic liquid is a salt in the liquid state, whose melting point is below 100°C. They are powerful solvents with very low vapor pressure and electrically conducting fluids (electrolytes).

Aim: Development of ionic liquids for various applications (antimicrobial, dispersant, flame retardants, corrosion inhibitors) and obtaining technical and technological bases for the introduction of IL into commercial small-scale production.



MPO TRIO FV10089, 2016-2020

VUAB Pharma, a.s.

VSB-TUO IET, prof. L. Obalová



Uniform Approach to the Air Pollution Management System for Functional Urban Areas in TRITIA Region

Air quality in excessively polluted areas is still managed at local level. At the same time, air pollution is a specific issue with its cross-boundary overrun so it cannot be effectively managed only at the national or regional level.

Aim: To increase air quality management capacities of public sector bodies through the development of a unified spatial information database, introducing new management and pollution prediction tools and air quality strategies.



AIR Tritia, 2017 – 2020

4 regions of 3 countries (Czech Republic, Slovakia, Poland), 15 partners

VŠB-TUO IET, doc. P. Jančík



Project

„Institute of Environmental Technology – Excellent Research“

Project No. Operational Program Research, Development and Education

Call: Excellent research in prioritized axis 1

Project No.	CZ.02.1.01/0.0/0.0/16_019/0000853
Investigator:	VŠB – Technical University of Ostrava, Institute of Environmental Technology
Duration:	11/2018 – 12/2018 (only administration team) 1/2019 - 10/2022
Budget:	107.3 millions CZK (4.1 millions Euro), 5% own sources
Investment costs:	17.7 % of budget, new laboratory, equipment
Human resources:	7 new jobs (FTE)



EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research,
Development and Education





Project

„Institute of Environmental Technology – Excellent Research“

The solution is done under two research programs (RP):

MATERIAL AND ENERGY RECOVERY OF WASTE

- Reducing the environmental burden of the production of large-scale waste from metallurgical and energy plants.
- Increasing the efficiency of catalytic pyrolysis, especially of polymer materials.
- Increasing the level and safety of anaerobic conversion of waste into high calorific gas.

REDUCING POLLUTANTS IN THE ENVIRONMENT

- Reduction of air pollution (nitrogen oxides, CO₂, VOC) by catalytic, photocatalytic and adsorption methods.
- Elimination of xenobiotics in sewage and surface waters by photocatalytic and adsorption methods.



EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research,
Development and Education



Project

„ Support of cross-sectoral cooperation in the field of environmental pollutants reduction and waste recovery “

Project No. Operational Program Research, Development and Education

Call for long-term cross-sectional cooperation for ITI in prioritized axis 1

Project No.	No. CZ.02.1.01/0.0/0.0/17_049/0008419
Investigator:	VŠB – Technical University of Ostrava, Institute of Environmental Technology
Partners	DEKONTA a.s., GASCONTROL s.r.o., UNIKASSET s.r.o., TECHNICKÉ SLUŽBY OCHRANY OVZDUŠÍ OSTRAVA s.r.o.
Duration:	7/2018 – 12/2018 (only partners + administration team) 1/2019 - 12/2022
Budget:	107.3 millions CZK (4.1 millions Euro), 5% own sources
Investment costs:	65.3 millions CZK (2.5 millions Euro)
Human resources:	19.6 % of budget, new laboratory, equipment



EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research,
Development and Education



Project

„ Support of cross-sectoral cooperation in the field of environmental pollutants reduction and waste recovery “

The solution is done under two research programs (RP):

REDUCING POLLUTANTS IN THE ENVIRONMENT

- Research of methods for the reduction of pollutants in waste gas streams
- Research on methods for the reduction of xenobiotics in surface water and waste water

ENERGY USE OF BIOWASTE

- Research on the management of biogas production by anaerobic digestion of waste materials
- Research on new methods of biogas energy use



EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research,
Development and Education





ENREGAT

Energy Waste Recovery and Gas Treatment “

- Research infrastructure of IET included facilities and technological units focused on energy recovery of waste and off-gases treatment and cleaning is included to **the Czech Roadmap of Large Infrastructures for Research, Development and Innovation** from 2019.
- Due to financial support of Ministry of Education, Youth and Sports, **research infrastructure is available in open access** mode for scientific community.

Project:	ENREGAT – Energy Waste Recovery and Gas Treatment Large Research Infrastructures No. LM2018098
Investigator:	prof. L. Obalová
Duration:	1.1.2019 – 31.12.2022



Involvement of IET in new projects where other VSB-TUO centre is solver:

National Centre for Energetics

Provider:	TA CR No. TN01000007
Investigator:	VŠB-TUO CENET, prof. S. Mišák
Duration:	2019 - 2020
Partners:	23 research institutions and companies

Research on the identification of combustion of unsuitable fuels and systems of self-diagnostics of boilers combusting solid fuels for domestic heating

Provider:	Operational Program Research, Development and Education Call for pre-application research for ITI, No. CZ.02.1.01/0.0/0.0/18_069/0010049
Investigator:	VSB-TUO VEC, prof. T. Ochodek
Duration:	2019 - 2021
Partners:	IET, Dr. J. Bílek, CENET VŠB-TUO



People



Thank you for your attention

prof. Ing. Lucie Obalová, Ph.D.
director

+420 596 997 300
lucie.obalova@vsb.cz

www.iet.vsb.cz