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... FROM FUNDAMENTAL TO APPLIED RESEARCH ...

LABORATORY OF AIR PROTECTION

The laboratory is equipped for research of waste gases cleaning by catalytic and adsorption methods and for the analysis of gas mixtures.

Research activities

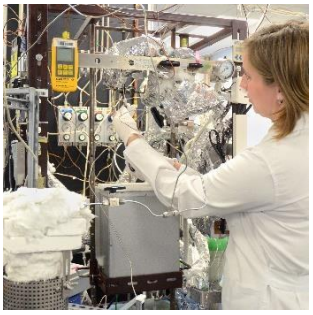
- Research of catalysts for treatment of waste gases from stationary sources – N_2O and NO catalytic decomposition, selective catalytic reduction of NO_x, NH_3 and VOC catalytic oxidation.
- Modeling of reaction mechanisms.
- Research of kinetics of catalytic reactions.
- Research of equilibrium and kinetics of adsorption and desorption processes.

Basic equipment

- Flow experimental units for testing of catalysts and sorbents in the gas phase equipped with reactors and columns of different scale.
- Equipment for gas sampling - a system of passive dosing of the sample, sampling device for personal sampling of organic compounds, automatic cleaning system.
- Gas chromatographs (TCD, FID, MSD), FTIR, continual analyzers (NO_x, NH_3, N_2O, TOC).
- Chemisorption analyzer AutochemII.

Offered services

- Testing of industrial catalysts (tablets, monoliths) for gas phase reactions.
- Simulation and design of chemical reactors.
- Determination of the adsorption capacity of a wide range of gases and vapors.
- Dynamic measurement of breakthrough curves and their mathematical modeling.
- Design of effluent gases adsorber.
- Design of adsorber for balancing the varying concentrations of the components in the flowing gas.
- Chemical engineering calculations.
- Analysis of gases.
- Catalysts and sorbents characterization – amount of reducible and oxidizable components, amount of acidic and basic sites.



Contact

Doc. Ing. Kateřina Pacultová, Ph.D.
e-mail: katerina.pacultova@vsb.cz
phone.: 00420 596 997 327

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... FROM FUNDAMENTAL TO APPLIED RESEARCH ...

LABORATORY OF ANAEROBIC DIGESTION

The laboratory provides basic analytical services and evaluation of biogas technology. Processes of anaerobic conversion of biomass into energy recoverable biogas and material - energy recoverable digestate are modelled and evaluated.

Research activities

- Increase the efficiency of anaerobic methane production during the wet and dry method.
- Application of process on less used raw materials / waste management.
- Development of new designs of bioreactors, especially for mobile units.

Basic equipment

- Respirometric system WTW OXITOP AN6 (6 x bottle 1 dm^3).
- Drum-type bioreactor Terrafors IS.
- Anaerobic bioreactor CSTR 60 dm^3.
- Horizontal bioreactor 500 dm^3.
- Pilot scale anaerobic bioreactor CSTR 650 dm^3.
- Various bioreactors for dry digestion (10 – 30 dm^3).
- Drum-type laboratory gas-meters.
- Infrared and electrochemical biogas analyser (CH_4, CO_2, O_2, H_2, H_2S, balance).
- Moisture analyser with halogen or infrared lamp.
- Elementary analyser (C, H, N, O, S).
- Set for measuring COD, pH, conductivity, ORP, O_2.
- Incubators, dryers, autoclaves, gas holders, crushers, mills, homogenizers.

Offered services

- Analytical analysis of biomass, biowaste.
- Analytical analysis of biogas, digestate.
- Preparation of raw materials (crushing, hydrolysis, acidification).
- Physical modeling of anaerobic (co)digestion.
- Adaptation of process conditions (loading, retention time, mixing).
- Evaluation of the impact of additives (trace elements, buffers, enzymes, microorganisms).

Contact

Dr. Panagiotis Basinas
e-mail:
panagiotis.basinas@vsb.cz
phone: 00420 596 997 06

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... FROM FUNDAMENTAL TO APPLIED RESEARCH ...

LABORATORY OF HETEROGENEOUS PHOTOCATALYSIS

Laboratory is equipped for research of waste gases cleaning processes by photocatalytic way and for analysis of gas mixtures.

Research activities

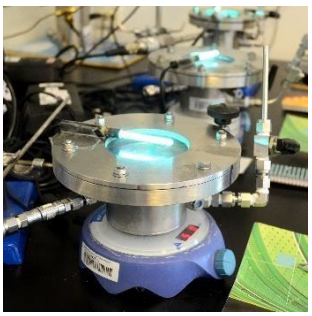
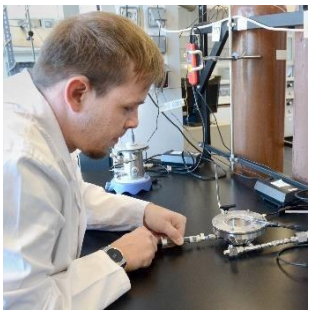
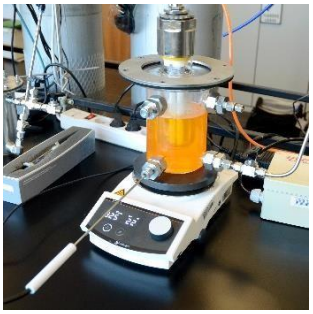
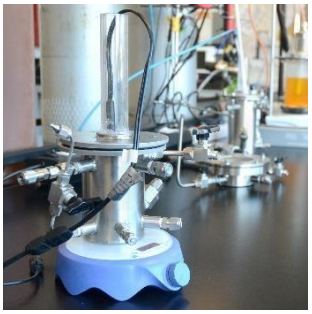
- Research of photocatalysts used for treatment of waste gases from stationary sources (photocatalytic decomposition of N_2O, NO_x, photocatalytic reduction of CO_2) and for air cleaning for indoor and outdoor environment.
- Photocatalytic elimination of MTBE from the drinking water sources
- Production hydrogen from photocatalytic decomposition of methanol-water solution.
- Research of the kinetics of the photocatalytic reactions.
- Advanced oxidation processes for waste gascleaning.

Basic equipment

- Experimental batch reactors (geometrically different) for reactions in the gas and liquid phase, used UV irradiation with wavelength 254 nm, 365 nm and 400 nm.
- Flow photoreactor for testing of decomposition reactions in gas phase.
- Photocurrent, Kelvin probe.
- Pilot plant for advanced oxidation processes.
- Gas chromatograph (TCD/BID).

Offered services

- Testing of the powder photocatalysts for reactions in the gas and liquid phase.
- Testing of the thin film catalysts for reactions in the gas and liquid phase.
- Testing of the thin layer catalysts for reactions in the gas phase according to ČSN ISO 22197.

Contact

prof. Ing. Kamila Kočí, Ph.D.
e-mail: kamila.koci@vsb.cz
phone.: 00420 596 997 309

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... FROM FUNDAMENTAL TO APPLIED RESEARCH ...

LABORATORY OF PREPARATION OF NANOSTRUCTURED MATERIALS

The laboratory of preparation of nanostructured materials does the research in the areas of preparation and preparation optimization of different types of nanostructured materials such as metal oxides or carbon-based materials, in different macroscopic forms, especially for photocatalytic and catalytic decomposition of organic pollutants in the environment, photocatalytic reduction of greenhouse gases and sorption of heavy metals, dyes and drugs from waste water.

Research activities

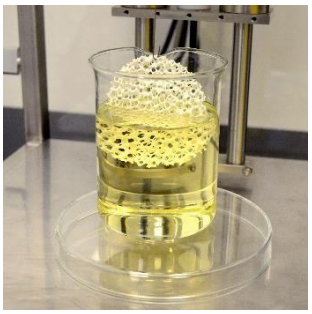
- Preparation of powder photo/catalytic nanostructured materials based on transition metal oxides and lanthanides by sol-gel, precipitation and co- precipitation methods in combination with calcination or using pressurized/supercritical fluids.
- Preparation of photo/catalytically active thin films in nanometric scale.
- Preparation of activated carbon-based adsorbents by microwave pyrolysis.

Basic equipment

- High-pressure laboratory equipment for processing by pressurized hot and supercritical fluids with different high-temperature stainless-steel cells.
- Dip-coater for thin film deposition.
- Ovens for drying and calcination.
- UV-vis spectrometer with optical fibers and in-situ sensor, cover with UV lamps of different wavelengths.
- 3Flex physisortpion set-up.

Offered services

- Preparation of various macroscopic forms of nanostructured photocatalysts, catalysts and adsorbents.
- Determination of specific surface area and mesoporous and microporous structure of solids by using physisorption of nitrogen and krypton, performed on fully-automated physisorption set-up reaching vacuum of $p/p_0=10^{-7}$. Interpretation of physisorption results.
- Investigation of photocatalytic activity of prepared nanomaterials and its correlation with the material microstructure.



Contact

Ing. Lenka Matějová, Ph.D.

e-mail: lenka.matejova@vsb.cz

phone: 00420 596 997 310

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... FROM FUNDAMENTAL TO APPLIED RESEARCH ...

LABORATORY OF WASTE AND FUEL ANALYSIS

Laboratory is equipped with the basic analytical aparatus for determination of thermochemical parameters in solid wastes and fuels samples which are necessary for their assessment from the standpoint of possible energy recovery. Equipment of the laboratory includes other analytical instruments used for determining chemical composition of different samples and materials, not only fuels and waste.

Research activities

- Assessment of thermochemical properties of solid combustible waste materials.
- Optimization and formation of suitable batches for waste combustion furnaces.
- Optimization of waste materials energy recovery in pilot plant and operational plant scales.

Basic equipment

- Thermogravimetric analyzer TGA 701.
- Pilot-automatic calorimeter AC 600.
- Elemental analyzer CHSN628.
- Multi-phase carbon and water determination apparatus RC612.
- Waters HPLC chromatograph equipped with UV/Vis and fluorescence detectors.
- X-ray fluorescence spectrometer Spectro Xepos (XRF).
- Surface characterization analyzer Micromeritics 3 Flex .
- Metrohm 930 Compact Flex ion chromatograph.
- Isotachophoretic analyzer Villa Labeco EA 102.

Offered services

- Moisture/volatile carbon/fixed carbon/ash content determination in liquid and solid samples.
- Determination of total calorific values, calculation of net calorific values in solid samples.
- Determination of basic elemental composition (C, H, N, S) in solid samples.
- Determination of carbon phases by controlled temperature steps.
- Accredited analyses of polynuclear aromatuc hydrocarbons (PAH) and volatile organic compounds (VOC) in air.
- Elemental analysis of solid and liquid samples (XRF).
- Chromatographic analyses (HPLC and IC)
- Isotachophoretic analysis of anions.

Contact

Ing. Pavel Leštinský, Ph.D.
e-mail: pavel.lestinsky@vsb.cz
phone.: 00420 596 997 330

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LABORATORY OF WASTE INCINERATION

Research experimental workplace for the process of thermal treatment of waste equipped with filtration unit for flue gas cleaning by dry method.

Research activities

- Increasing the efficiency of combustion processes within simultaneous reduction of negative impacts on the external environment.
- Incineration of waste with specific parameters (high humidity, high calorific value, content of risk components, etc.).
- Evaluation of the methodology for determination of heat efficiency of furnace for waste incineration.

Basic equipment

- Periodically operating combustion furnace with post-combustion chamber provided with burners for natural gas, maximum batch of 100 kg of waste incinerated in dependence on its specific weight. The premise is that time for combustion of this maximum amount will be about 6 hours.
- Continuously operating combustion furnace provided with post-combustion chamber with burners for natural gas is designed for a nominal capacity of 30 kg of waste incinerated per hour at its calorific value of 17 $MJ.kg^{-1}$. Furnace allows to burn solid and liquid wastes.
- Filtration unit for flue gas cleaning by dry method in pilot plant scale designed to allow sampling of flue gases at different stages of combustion and thus allow research and optimization of the combustion process and cleaning. Parameters of the device: hose filter unit, filtration rate ≤ 13 mm / s, with the option to change the parameters of regeneration during its operation.
- Monitoring of pollutants in flue gas before and after the cleaning. The concentration of CO_2, O_2, CO, NO, NO_2, N_2O and SO_2 can be monitored continuously, discontinuous sampling of flue gas for the measurement of solid particles, heavy metals, and other components is possible. Additional mobile equipment measuring CO_2, O_2 and CO in the flue gas allows monitoring the quality of the combustion process directly in the combustion chamber.

Contact

prof. Ing. Lucie Obalová, Ph.D.
e-mail: lucie.obalova@vsb.cz
phone: 00420 596 997 300

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LABORATORY OF THERMOCHEMICAL PROCESSES

Research and experimental workplace focused on the waste treatment by thermochemical processes – using heat to promote chemical transformations of waste materials into energy, energy carrier, and valuable chemicals.

Research activities

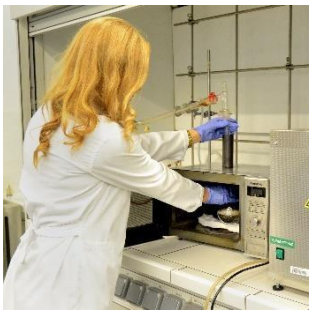
- The chemical recycling of waste polymers for the production of pure monomers.
- Hydrogen production from waste organic compounds by cracking and reforming reactions.
- Treatment of waste biomass for the production of biochar, black pellets or activated carbons.

Basic equipment

- Pilot-scale continuous pyrolysis reactor (feed up to 2 kg/h, max. temp. 800 °C) include cleaning and separation of products.
- Batch pyrolysis reactor (max. temperature 1000°C) and microwave reactor (power up to 1 kW) for the material balance of thermal treatment processes (feed up to 50 g).
- Semi-batch pyrolysis and catalytic reactor with independent heating for chemical recycling of waste polymers (feed up to 10 g).
- Catalytic reactor with continuous flow of organic vapours and gases for cracking and reforming reaction (max. 1 g of catalyst, max. flowrate 100 ml/min).
- Plasma processes module for VOC abatement (plasma is generated by Gliding Arc).

Offered services

- Material and energy balances for thermochemical treatment of waste biomass and other waste materials.
- Analysis of compositions of the gaseous and liquid products from waste treatment using GC and GC-MS.
- Analysis of water content by KF titration.
- Consulting.



Contact

Ing. Pavel Lestinsky, Ph.D.
e-mail: pevel.lestinsky@vsb.cz
phone: 00420 596 997 330

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LABORATORY OF WATER

The laboratory is focused on basic and applied research in the field of water treatment, including analytical determination of surface and waste water quality. Research in the field of water treatment is mainly adsorption, membrane and bioremediation processes, photocatalytic decomposition and application of microwave field. We also provide solutions for industrial applications.

Research activities

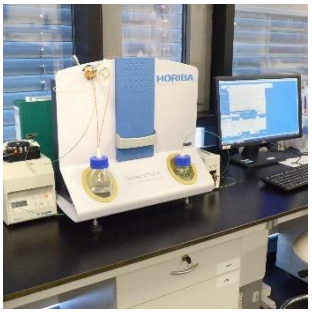
- Research of waste water treatment.
- Sorption from aqueous solutions.
- Macromolecules interactions study.
- Synthesis and decomposition in microwave field.
- AAS, UV-VIS, SPRi analysis.

Basic equipment

- HR-CS AAS contrAA® 700.
- UV-VIS Spectrophotometer Specord 250+.
- Surface Plasmon Resonance imaging HORIBA OpenPlex.
- Milestone Ethos Up Microwave System.
- HPLC Shimadzu.

Offered services

- Basic chemical analysis of surface and waste water, including samples with particularly high absorptions and higher stray light quotient, analysis of solid waste extracts and sludge.
- Multi-element analysis (AAS).
- Analyzes and solutions in aquaponics.
- Biosensor application testing.



Contact

Mgr. Martina Vráblová, Ph.D.
e-mail: martina.vrablova@vsb.cz
phone.: 00420 596 997 311