Environmental Process Engineering Laboratory

HEAD
MIROSLAV PUNČOCHÁŘ

DEPUTY
VLADIMÍR CÍRKVA

RESEARCH STAFF
VÁCLAV GRUBER, MILAN HÁJEK, MIROSLAV HARTMAN, KAREL SVOBODA, MICHAL ŠYC, OTAKAR TRNKA, LEONA VLKOVÁ
Part time: EVA FIŠEROVÁ, MICHAL JEREMIÁŠ, VÁCLAV VESELÝ

PHD STUDENTS
JAN ČERMÁK, PETRA KAMENÍKOVÁ, MICHAEL POHOŘELÝ, STANISLAV RELICH, JIŘÍ SOBEK

TECHNICAL STAFF
JAROSLAV BRUSTMANN, OLEKSIY KHRAMKOV, MARTIN KRČEK, VLADIMÍR POMYKAČ, MARKÉTA TOŠNAROVÁ

Fields of research

- Persistent organic pollutants
- Fluidized bed combustion and gasification
- Gas-solid reactors and operations
- Gaseous and particulate emissions from combustion and industrial processes
- Preparation of the electrodeless discharge lamps for photochemical applications
- Electrodeless discharge lamps coated with the titania-doped thin films for photocatalysis in the microwave field
- Simultaneous cooling at microwave heating - a new method in heterogeneous catalysis

Applied research

- Recovery of precious metals
- Electronic scrap recycling
- Phytoextraction biomass disposal
- Simultaneous disinfection and microwave drying of materials
- Technology of repairing roads with asphalt material
- Microwave method and device for recycling refined steel cord from waste tires
- Low-energy microwave depolymerization of wastes poly(ethylene terephthalate) (PET) and polyurethane (PUR) foam

Research projects

Near zero emission advanced fluidized bed gasification (FLEXGAS)

(M. Punčochář, supported by Research Fund for Coal and Steel (RFCS), project No. RFCR-CT-2007-00005)

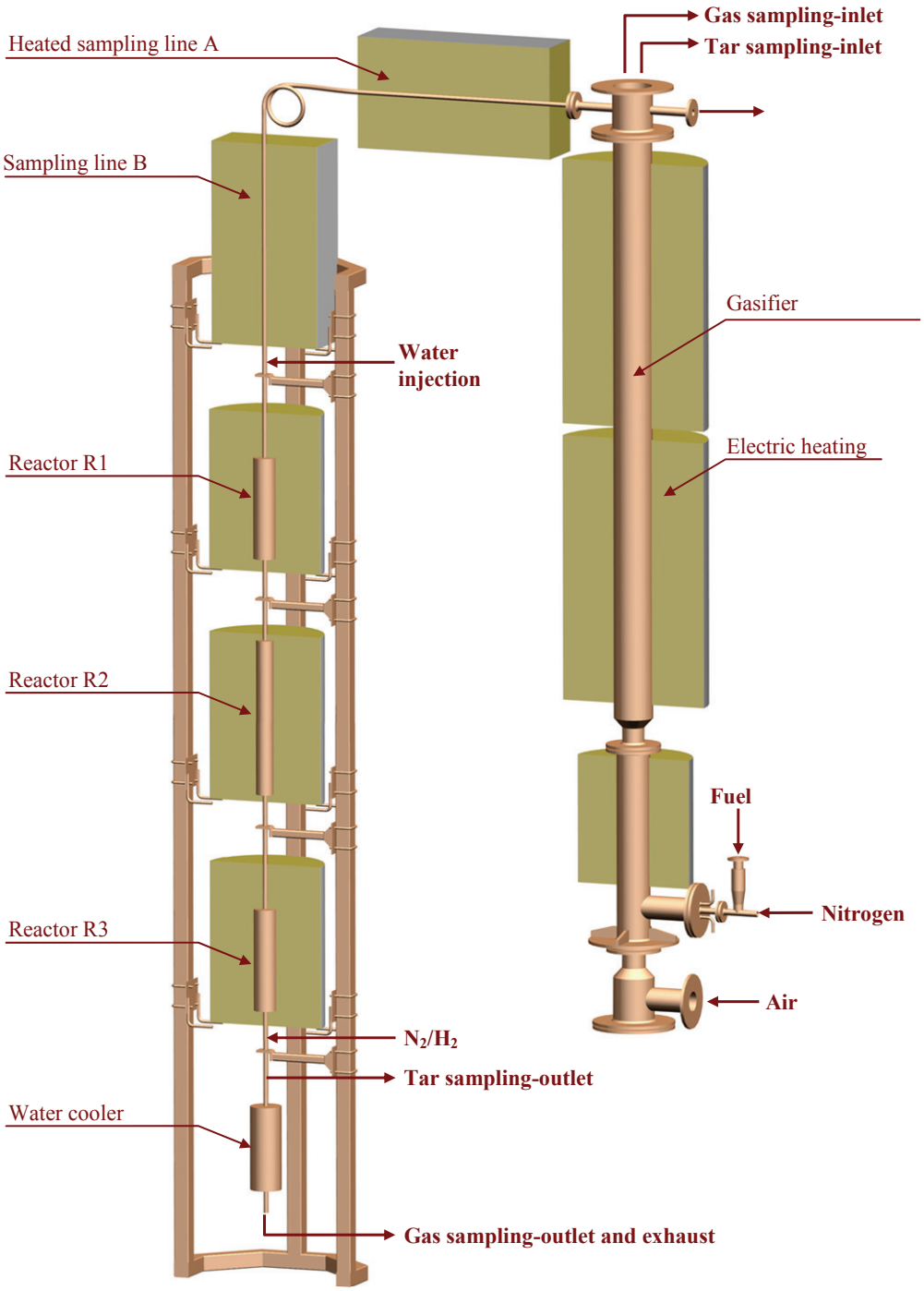
Ways of overcoming the potential disadvantages of fluidized bed gasification, the technology for CO_2 capture/reduction and the advantages in terms of their ability to process biomass/waste in association with coal at different scales of operation and for different applications were examined. [Refs. 6, 18, 37, 44 -48]

Fluidized bed gasifier

Waste as raw material and energy source (WARMES)

(M. Punčochář, joint project with Brno University of Technology, and EVECO Brno s.r.o., supported by MEYS, project No. 2B08048)

The project is concerned with research and application of modern approaches leading to the higher efficiency in using different classes of wastes in energy and recycling processes. Attention is paid especially to the processes of thermal processing of wastes with the aim of maximal use of produced energy with minimization of released harmful substances. Project involves both experiments and computer simulations. [Refs. 8, 19, 20, 23, 41, 42, 52, 53]

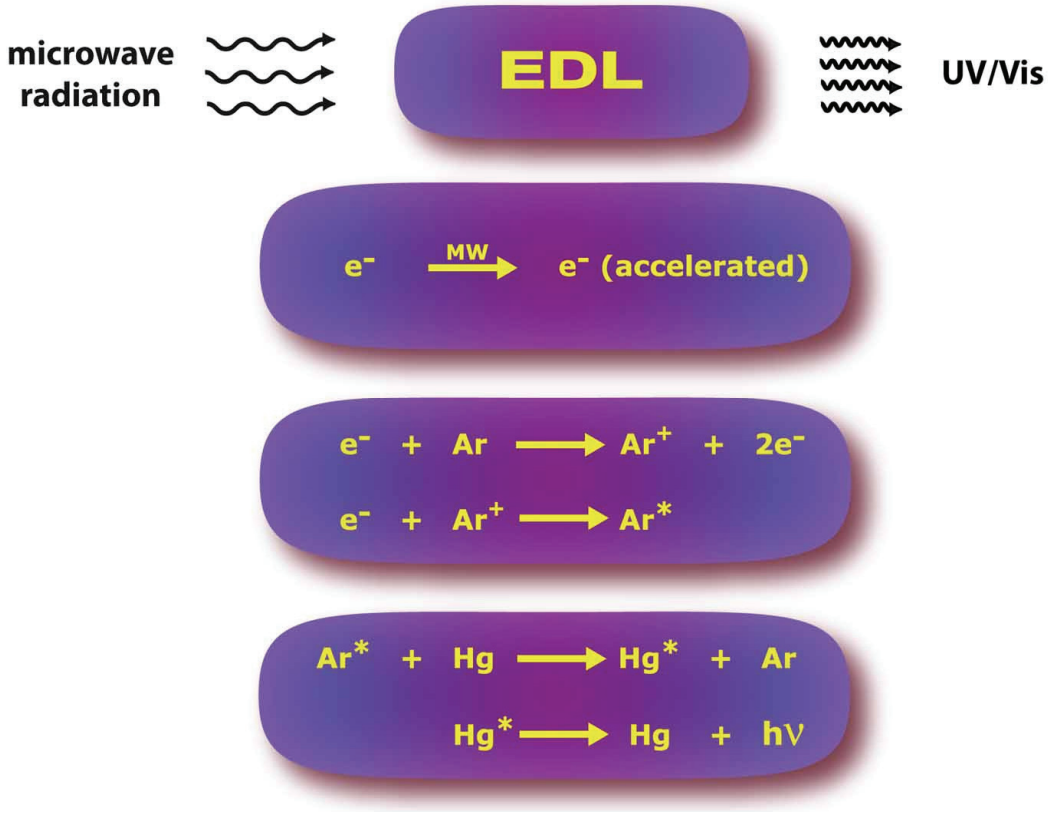


Gasifier and gas cleaning unit

Preparation of the electrodeless discharge lamps for photochemical applications

(V. Církva, supported by ICPF)

The project is concerning on preparation of the electrodeless discharge lamps (EDLs) as a suitable source of UV/Vis light for photochemical reactions. The EDL consisted of a glass tube filled under a lower pressure with an inert gas and an excitable substance (mercury, sulfur), and generated UV/Vis radiation when placed into the microwave field. The effect of operating EDL parameters, the microwave power output and medium properties on spectral characteristics has been studied. [Refs. 1, 7, 21, 22]

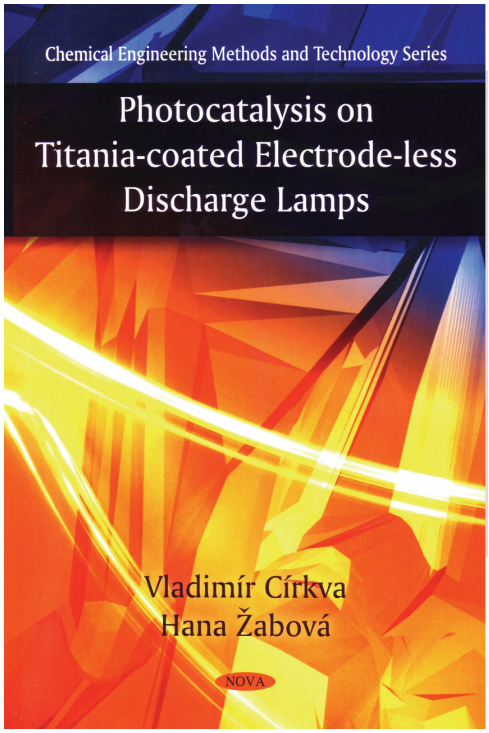


Principle of Hg-EDL operation and the release of emission energy as UV/Vis radiation

Electrodeless discharge lamps coated with the titania-doped thin films for photocatalysis in the microwave field

(V. Církva, supported by ICPF)

Research has been aimed to prepare a visible-light response photocatalyst in the form of thin film on the electrodeless discharge lamps (EDLs). Titanium dioxide nanoparticles were also doped with various ions of transition metals M (i.e. M = Fe, Cr, Mn, Co, V, Zr, Ni, Ag). Thin films of titania were prepared by using the sol-gel methods (titanium isopropoxide, titanium *n*-butoxide, acetylacetone, and a transition metal acetylacetonate) and dip-coating technique. The films were characterized through XRD, Raman spectroscopy, XPS, SEM, AFM, and UV/Vis. Photocatalytic activity of the prepared titania-doped thin films has been evaluated by the decomposition of Rhodamine B in water and on degradation of aqueous solution of mono-chloroacetic acid (0.1 mol l^{-1}) in a microwave field using the coated EDLs. Also the effect of operational parameters was reported for both batch photoreactor (number of coating cycles for EDL, light intensity, initial pH value, and H_2O_2 dosage) and for continuous-flow set-up (flow rate, number of titania-coated EDLs, reaction temperature, and air bubbling). [Refs. 5, 17, 21, 22]



Photocatalysis on Titania-coated EDLs (book), the modified MW oven, and coated Hg-EDL

New technologies for recovery of rare and special metals from electrical and electrotechnical wastes

(V. Gruber, joint project with SAFINA a.s., supported by MIT, IMPULS project No. FI-IMS/075)

The project deals with recovery of rare metals from electrical and electrotechnical wastes. Special attention is paid to the recovery of Eu and Y from TV sets. [Refs. 24, 33]

Apparatus for recovery of rare metals

Simultaneous cooling at microwave heating - a new method in heterogeneous catalysis

(M. Hájek, supported by GACR, grant No. GA104/08/0416)

The research has been focused on application in heterogeneously catalyzed reactions in liquid phase. It has been observed that selectivity of catalytic reaction can be significantly improved. These important findings evoked continuation to study this effect in more detail, what is the subject of this project. Scope and limitation of this method including possibility of potential applications has been studied on model reactions with non-polar (non-absorbing) reactants (alkylation of aromatics by cycloalkenes) in the presence of strong acidic (strong absorbing) solid catalysts. [Refs. 4, 15, 16, 38–40, 43]

Simultaneous disinfection and microwave drying of books and similar paper-based materials

(M. Hájek, supported by ICPF)

An advanced microwave drying technology has been developed using a microwave continuous dryer combined with an air cooling unit and a simultaneous disinfection process. This new technology uses microwave absorption filters made from special porous ceramics which act as both absorbent and transparent material for microwaves. Ceramic slabs reduce the intensity of the microwave radiation to such an extent that overheating and hot-spot formation as well as red-heating of metallic objects and other kinds of damage is prevented. [Refs. 2, 34]

Continuous microwave drying equipment

Device for repairing roads with asphalt material

(M. Hájek, supported by ICPF)

The device and method of microwave heating has been applied for repairing roads with asphalt material. [Refs. 25, 29]

Microwave method and device for recycling refined steel cord from waste tires

(M. Hájek, supported by ICPF)

This method was used for refining metal material separated from crushed waste tires by microwave heating the metal material (comprising steel cord containing 82-98 % of steel by weight) and distilling off a portion of non-metallic constituents. [Refs. 26, 28, 56, 57]

Low-energy microwave depolymerization of waste poly(ethylene terephthalate) (PET) and polyurethane (PUR) foam

(M. Hájek, supported by ICPF)

Microwave energy has been applied for total depolymerization of waste PET material, especially waste PET bottles. The products were terephthalic acid and ethylene glycol. The process included the following steps: depolymerization, purification and separation. Total depolymerization was achieved by applying microwave energy of 2450 MHz frequency with energy consumption of 0.5 - 1.0 kWh/kg PET. A developed recycling process has been based on the chemolysis of polyurethane (PUR) foam using proper diols or triols in combination with microwaves heating. The product was a liquid recyclate with active hydroxyl groups. [Refs. 27, 30, 31]

Purified terephthalic acid

Fluidization and decontamination of organic-polluted solids in a fluid-bed reactor

(M. Hartman, supported by ASCR, grant No. IAA400720701)

A fundamental understanding of such viable reaction systems for the thermal oxidation of organic liquids entrapped (absorbed) within porous solids is still lacking. The hydrodynamic behaviour of the "g"-"s" suspensions with such polluted (wet and sticky) particles is explored with the aid of pressure fluctuations also with respect to their unwanted tendency to stick together and lie down. Hitherto unexplored, inert and porous particles

soaked in model organic compounds will be fired in a bench-scale, fluid-bed reactor operated in different regimes. Experimental and modelling efforts seek to explain and describe the dependence of the reactor's combustion efficiency as a function of residence time, excess air, operating temperature and particle size. The study focuses on the overall picture of formation and oxidation destruction of main gaseous pollutants (NO, NO_2, N_2O, CO, organic residuals, persistent organic pollutants, SO_2, and HCl) and their interrelationships. [Refs. 3, 12, 13]

Fluidized bed reactor

Immobilization of heavy metals in municipal waste incinerator materials

(M. Šyc, supported by European Economic Area (EEA) and Norway grant intermediate by the National Training Fund, project A/CZ0046/1/0027)

The combustion of municipal waste is one of ways to meet nowadays the EU requirements to reduction of amount of dumped waste. The municipal solid waste incinerators (MSWI) convert waste to energy and certain amount of solid waste materials – fly ash and bottom ash. These solid residuals contain, besides other components, toxic heavy metals which have to be stabilized against leaching out from the waste material before it can be safely stored at a land-fill. The MSWI solid waste materials have latent hydraulic or puzzled

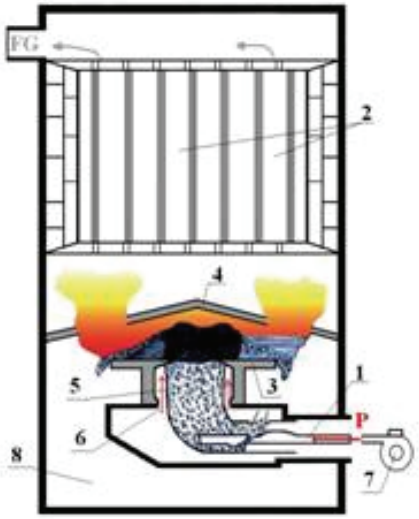
properties. This fact offers an effective way of heavy metals immobilization which is studied in the present project. [Refs. 9, 19, 50, 51]

Samples of concrete immobilizates

Emission factors of POPs and heavy metals from small sources

(M. Šyc, V. Pekárek, joint project with TU of Ostrava, supported by MEYS, project No. SP/1a2/116/07)

Determination of emission factor for selected POPs compounds and heavy metals is solved. The following topics were studied (i) the validation of the original air dilution unit for the sampling, (ii) effect of different combustion units from the standpoint of toxic compound emission, and (iii) effect of different fuels on the toxic compounds formation. [Refs. 11, 49]

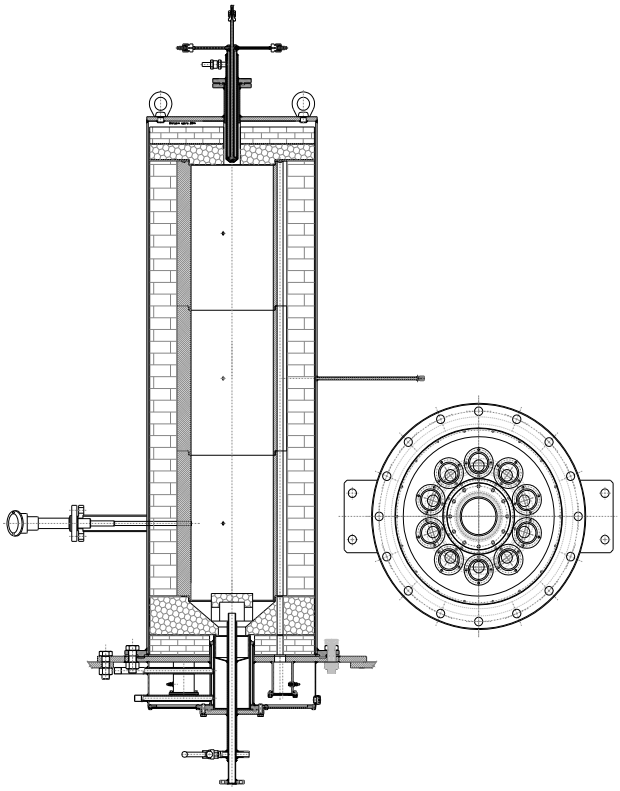


Scheme of automatic under-fire boiler with screw conveyor

Research of hydrogen and synthesis gas production by gasification of waste biomass originating from the production of biofuels

(V. Veselý, J. Hanika, joint project with Research Institute of Inorganic Chemistry, Ústí n/L, supported by MIT, project No. 2A-2TP1/024)

Project is focused on gasification of waste biomass which comes from the production of bio-ethanol and bio-diesel. The aim is to produce hydrogen from biomass, to capture CO_2 rising in the process and to separate present heteroatoms. A specific task of the project is to develop the integral process which includes the processing of biomass into existing technology of crude oil waste gasification. [Refs. 10, 14, 32, 35, 36, 54, 55]



Pilot plant gasification reactor

International co-operations

Central Mechanical Engineering Research Institute, Durgapur, India: Gasification
Institute for Energy, Joint Research Centre, Petten, the Netherlands: Pressurized fluidized bed combustion/gasification technologies; Waste incineration/gasification
University of KwaZulu-Natal, Durban, Republic of South Africa: Gaseous and particulate emissions
Vienna University of Technology, Vienna, Austria: Gasification

Teaching

V. Církva: ICT, Faculty of Chemical Technology, postgraduate course "Microwave Chemistry"
V. Církva: ICT, Faculty of Chemical Technology, postgraduate course "Photochemistry"
M. Punčochář: Czech University of Life Sciences Prague, course "Renewable and alternative sources of energy"
K. Svoboda: UJEP, Faculty of Environment, courses "Decontamination and Bio-remediation Technologies" and "Energetics (Power generation) and Protection of the Environment"

Publications

Original papers

[1] Církva V., Relich S., Hájek M.: Microwave Photochemistry V: Low-Pressure Batch and Continuous-Flow Microwave Photoreactors with Quartz Mercury Electrodeless Discharge Lamps. Photohydrolysis of Mono-Chloroacetic Acid. (Eng) J. Chem. Technol. Biotechnol. 85(2), 185-191 (2010).

[2] Hájek M., Ďurovič M., Paulusová H., Weberová L.: Simultaneous Microwave Drying and Disinfection of Flooded Books. (Eng) Restaurator 31(1), 1-7 (2011).

[3] Hartman M., Trnka O., Pohořelý M., Svoboda K.: High-Temperature Reaction in the Freeboard Region above a Bubbling Fluidized Bed. (Eng) Ind. Eng. Chem. Res. 49(6), 2672-2680 (2010).

[4] Kaštánek P., Kaštánek F., Hájek M.: Microwave-Enhanced Thermal Desorption of Polyhalogenated Biphenyls from Contaminated Soil. (Eng) J. Environ. Eng.-ASCE 136(3), 295-300 (2010).

[5] Kment Š., Kmentová H., Klusoň P., Krýsa J., Hubička Z., Církva V., Gregora I., Šolcová O., Jastrabík L.: Notes on the Photo-Induced Characteristics of Transition Metal-Doped and Undoped Titanium Dioxide Thin Films. (Eng) J. Colloid Interface Sci. 348(1), 198-205 (2010).

[6] Martinec J., Šen H., Svoboda K., Martincová J.V., Baxter D.: The Thermal Protection of a Specific Experimental Instrument for Monitoring of Combustion Conditions on the Grate of Municipal Solid Waste Incinerators. (Eng) Appl. Therm. Eng. 30(8-9), 1022-1028 (2010).

[7] Musilová L., Jun D., Paleček J., Církva V., Musilek K., Paar M., Hrabinová M., Pohanka M., Kuca K.: Novel Nucleophilic Compounds with Oxime Group as Reactivators of Paraoxon-Inhibited Cholinesterases. (Eng) Lett. Drug Des. Discov. 7(4), 260-264 (2010).

[8] Pohořelý M., Jeremiáš M., Skoblia S., Vosecký M., Kameníková P., Šyc M., Tošnarová M., Punčochář M., Svoboda K.: Alotermní fluidní zplyňování biomasy. (Czech) Allothermal Fluidized Bed Biomass Gasification. Paliva 1, 23-30 (2010).

[9] Pohořelý M., Šyc M., Tošnarová M., Zychová M., Keppert M., Punčochář M.: Imobilizace těžkých kovů z popelovin ze spalovny komunálních odpadů. (Czech) Immobilization of Heavy Metals from Municipal Solid Waste Incineration Plant Solid Residuals. Paliva 2(5), 113-118 (2010).

[10] Poloncarzová M., Vejražka J., Veselý V., Izák P.: Effective Purification of Biogas by Condensing-Liquid Membrane. (Eng) Angew. Chem.-Int. Edit. 50(3), 669-671 (2011).

[11] Tydlitát V., Kotlík B., Punčochář M., Mikešová M.: Comparison of the Concentration Profiles of 12 Polycyclic Aromatic Hydrocarbons from Different Sources with Monitoring Data from Prague Using a Similarity Measure. (Eng) Polycycl. Aromat. Compd. 30(4), 208-221 (2010).

[12] Hartman M., Trnka O., Svoboda K., Pohořelý M.: Úletové rychlosti částic vápencového kalcinátu z fluidní vrstvy. (Czech) Entrainment Velocities of Calcined Limestone Particles from Fluidized Bed. Chem. Listy, submitted.

[13] Hartman M., Trnka O., Veselý V., Svoboda K.: Termická oxidace oxidu uhelnatého ve spalných plynech. (Czech) Thermic Oxidation of Carbon Monoxide in Flue Gas. Chem. Listy, in press.

[14] Kárászová M., Vejražka J., Veselý V., Friess K., Randová A., Izák P.: Condensing Water Membrane in Biogas Enrichment. (Eng) Green Chem., submitted.

[15] Kaštánek F., Kaštánek P., Hájek M., Sobek J., Šolcová O.: Dehalogenation of Polychlorinated Biphenyls (PCB) by Nucleofile Reactants at the Presence of Ionic Liquids and under Application of Microwaves. (Eng) Global NEST J., in press.

[16] Kaštánek F., Sobek J., Kaštánek P., Šolcová O., Hájek M.: Dehalogenation of Polyhalogenated Compounds Dissolved in Organic Solvents with the Help of AOPs in a Two-Phase Solvent-Water System under the Influence of Ultrasound. (Eng) J. Hazard. Mater., submitted.

[17] Kaštánek F., Žabová H., Církva V., Šolcová O., Kaštánek P.: Photodebromination of Polybrominated Diphenylethere in Microwave Field. (Eng) Chemosphere, submitted.

[18] Punčochář M.: Mechanics of Bubble Swarms – A Critical Analysis. (Eng) Chem. Eng. Sci., in press.

[19] Šyc M., Pohořelý M., Kameníková P., Habart J., Punčochář M.: Willow Trees from Heavy Metals Phytoextraction as Energy Crops. (Eng) Biomass and Bioenergy, submitted.

Review papers

[20] Pohořelý M., Jeremiáš M., Kameníková P., Skoblia S., Svoboda K., Punčochář M.: Zplyňování biomasy. (Czech) Biomass Gasification. Chem. Listy, submitted.

Books and monographs

[21] Církva V., Žabová H.: Photocatalysis on Titania-coated Electrode-less Discharge Lamps. (Eng) 76pp., Nova Science Publisher, New York 2010.

Chapters in books

[22] Církva V., Žabová H.: Thin Nanoporous Titania Films on the Electrodeless Discharge Lamps for Photocatalysis. (Eng) In: Handbook of Photocatalysts: Preparation, Structure and Applications. (Castello, G.K., Ed.), pp. 103-151, Nova Science Publishers, New York 2010.
[23] Šyc M., Pekárek V., Novák P., Šolcová O., Pohořelý M., Punčochář M., Ocelka T.: Chapter 2: Fly Ash Properties, Disposal, and Treatment in Modernized Waste Incineration Plant with Catalytic Filter. (Eng) In: Fly Ash: Reuse, Environmental Problems and Related Issues. (Telone, P.H., Ed.), pp. 33-60, Nova Science Publishers, New York 2010.

Patents

[24] Gruber V., Rousková M., Heyberger A., Staf M.: Způsob získávání extraktů s obsahem europia a yttria. (Czech) Method for Reclaiming of Organic Extracts Containing Europium and Yttrium Ions. Pat. No. PV 2010-928. Applied: 10.12.14.
[25] Hájek M., Sobek J.: Zařízení pro opravu vozovek asfaltovým materiálem. (Czech) Equipment for Reparations of Roads by Asphalt Material. Pat. No. 20918/PUV 2010-22518. Applied: 10.04.06, Patented: 10.05.24.
[26] Hájek M., Sobek J.: Způsob rafinace kovového substrátu ze zpracování odpadních pneumatik a zařízení k jeho provádění. (Czech) Method and Devicefor Refining Metal Material. Pat. No. PV 2009-5/CZ301761. Applied: 09.01.09, Patented: 10.05.06.
[27] Hájek M., Sobek J., Brustman J.: Method for the Chemical Depolymerization of Waste Polyethylene Terephthalate. (Eng) Pat. No. EP2176327. Applied: 08.07.09, Patented: 10.08.16.
[28] Hájek M., Sobek J.: Method and Device for Refining Metal Material. (Eng) Pat. No. PCT/IB2009/055986. Applied: 10.01.08.
[29] Hájek M., Sobek J.: Způsob opravy poškozených míst vozovek a komunikací. (Czech) Method of Reparation of Demaged Roads. Pat. No. 2010-316. Applied: 10.04.27.
[30] Hájek M., Sobek J., Brustman J.: Method for the Chemical Depolymerization of Waste Polyethylene Terephthalate. (Eng) Pat. No. US 12/452,630. Applied: 10.01.12.
[31] Kruliš Z., Horák Z., Beneš H., Hájek M.: Způsob recyklace odpadních polyuretanových pěn. (Czech) Method for Recyclation of Waste Polyurethan Foams. Pat. No. CZ301686/PV 2007-576. Applied: 07.08.23, Patented: 10.04.14.
[32] Veselý V.: Způsob izolace kyseliny tereftalové. (Czech) Isolation Method of Terephtalic Acid. Pat. No. PV 2006-313/CZ301474. Applied: 06.05.16, Patented: 10.02.03.

International conferences

[33] Gruber V.: Recyklace luminoforu z použitých elektrotechnických zařízení. (Czech) Recovery of Phosphors from WEEE (Waste Electrical and Electrotechnical Equipment). Mezinárodní vodohospodářský a ekologický veletrh WATENVI 2010, p. 1-3, Brno, Czech Republic, 25-27 May 2010.
[34] Hájek M., Ďurovič M.: Simultaneous Microwave Drying and Disinfection of Flooded Books. (Eng) International Symposium on Heating by Electromagnetic Sources, Induction, Dielectric and Microwaves, Conduction and Electromagnetic Processing (HES-10), Book of Abstracts, pp. 407-411, Padua, Italy, 18-21 May 2010.
[35] Hanika J., Lederer J., Tukač V., Veselý V.: Produkce vodíku parciální oxidací řepkového šrotu a ropných zbytků. (Czech) Hydrogen Production by Rape Meal and Waste Crude Oil Mixture Partial Oxidation. 62. Sjezd asociací českých a slovenských chemických společností, Sborník, Chemické listy 104(6), p. 561, 2010, Pardubice, Czech Republic, 28-30 June 2010.
[36] Hanika J., Lederer J., Tukač V., Veselý V.: Investigation of Hydrogen Production by Biomass Partial Oxidation. (Eng) XIX International Conference on Chemical Reactors CHEMREACTOR-19, Abstracts, p. 19 (pp. 180-182 full text on CD-ROM), Vienna, Austria, 05-09 September 2010.
[37] Jeremiáš M., Pohořelý M., Kameníková P., Skoblia S., Svoboda K., Punčochář M.: The Influence of H_2O and CO_2 Addition to the Gasification Media during Oxyfuel Fluidized Bed Gasification of Biomass. (Eng) 18th European Biomass Conference & Exhibition, p. VP2.1.12, Lyon, France, 03-07 May 2010.

[38] Kaštánek F., Sobek J., Šolcová O., Hájek M.: Dehalogenation of Polyhalogenated Compounds Dissolved in Organic Solvents with the Help AOPs in a Two-Phase Solvent-Water System Under Influence of Ultrasound. (Eng) 2nd International Conference on Hazardous and Industrial Waste Management, Proceedings, p. 229 (9 pp. full text on CD-ROM), Chania, Crete, Greece, 05-08 October 2010.
[39] Ludvíková J., Jirátová K., Kovanda F., Krúpa L., Sobek J.: Total Oxidation of Ethanol over Calcined Transition Metal LDH-like Precursors. (Eng) 10th Pannonian International Symposium on Catalysis, Proceedings, pp. 192-202, Kraków, Poland, 29 August - 02 September 2010.
[40] Ludvíková J., Jirátová K., Kovanda F., Krúpa L., Sobek J.: Transition Metal Mixed Oxides from LDH Precursors and Their Activity in Total Ethanol Oxidation. (Eng) 42nd Symposium on Catalysis, Book of Abstracts, p. P27A, Prague, Czech Republic, 01-02 November 2010.
[41] Pohořelý M., Jeremiáš M., Kameníková P., Svoboda K., Skoblia S., Tošnarová M., Šyc M., Punčochář M.: Možnosti uplatnění plynu ze zplyňování biomasy. (Czech) Possibilities of Application of Producer Gas from the Gasification of Biomass. 8. mezinárodní konference Chemie energetických cyklů CHEO 8, Sborník přednášek, pp. 1-6, Praha, Czech Republic, 07-08 September 2010.
[42] Punčochář M., Šyc M., Pohořelý M., Kameníková P., Vosecký M.: Biomass from Remediation – Raw Material for Energy Production. (Eng) 37th International Conference of Slovak Society of Chemical Engineering, Proceedings, p. 98, Tatranské Matliare, Slovakia, 24-28 May 2010.
[43] Sobek J., Hájek M.: Microwave Activation of Heterogeneous Catalysts. (Eng) 37th International Conference of Slovak Society of Chemical Engineering, Proceedings, p. 181 (3 pp. full text on CD-ROM), Tatranské Matliare, Slovakia, 24-28 May 2010.
[44] Svoboda K., Pohořelý M, Jeremiáš M., Kameníková P., Skoblia S., Šyc M.: Fluidized Bed Gasification of Coal-Oil and Coal-Water-Oil Slurries by a Gas Containing Carbon Dioxide-Oxygen Mixture. (Eng) 19th International Congress of Chemical and Process Engineering CHISA 2010 and 7th European Congress of Chemical Engineering ECCE-7, Summaries 4, p. 1687 (6 pp. full text on CD-ROM), Prague, Czech Republic, 28 August - 01 September 2010.
[45] Svoboda K., Pohořelý M., Jeremiáš M., Kameníková P., Skoblia S., Šyc M., Punčochář M.: Fluidized Bed Gasification of a Sub-Bituminous Coal, Biomass and Coal-Biomass Co-Gasification by a Gas Containing Oxygen-CO_2 Mixtures. (Eng) 19th International Congress of Chemical and Process Engineering CHISA 2010 and 7th European Congress of Chemical Engineering ECCE-7, Summaries 5, pp. 2058-2059 (14 pp. full text on CD-ROM), Prague, Czech Republic, 28 August - 01 September 2010.
[46] Svoboda K., Pohořelý M., Jeremiáš M., Kameníková P., Skoblia S., Šyc M.: Fluidized Bed Gasification of Coal-Oil and Coal-Water-Oil Slurries by a Gas Containing CO_2-Oxygen Mixture. (Eng) 13th Intenational Confeence on Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction, Proceedings of Pres 2010, pp. 211-216, Prague, Czech Republic, 28 August - 01 September 2010.
[47] Svoboda K., Pohořelý M., Jeremiáš M., Kameníková P., Hartman M.: Gasification of Coal-Oil and Coal-Water-Oil Slurries in a Fluidized Bed Reactor. (Eng) 37th International Conference of Slovak Society of Chemical Engineering, Proceedings, p. 97 (12 pp. full text on CD-ROM), Tatranské Matliare, Slovakia, 24-28 May 2010.
[48] Šulc J., Richter M., Svoboda K., Vacek J.: Obnovitelný zdroj energie - zplyňování biomasy s kogenerací. (Czech) . 19. Chemicko-technologická konference se zahraniční účastí APROCHEM 2010 . Technologie . Ropa . Petrochemie . Polymery . Bezpečnost . Prostředí ., Sborník přednášek, pp. 2382-2387, Kouty nad Desnou, Czech Republic, 19-21 April 2010.
[49] Šyc M., Horák J., Krpec K., Hopan F., Dej M., Ocelka T., Tomšej T.: Effect of Non-Stationary Combustion Phases on Emission Factors of Selected Pollutants and PCDD/F from Domestic Combustion. (Eng) 30th International Symposium on Halogenated Persistent Organic Pollutants (POPs), Symposium Proceedings, 4 pp. full text on CD-ROM, p. 1-4, San Antonio, USA, 12-17 September 2010.
[50] Šyc M., Keppert M., Pohořelý M., Novák P., Punčochář M., Fišerová E., Pekárek V.: Fly Ash Treatment Technology in Modern Waste Incineration Plant. (Eng) 2nd International Conference on Sustainable Construction Materials and Technologies, Volume One of Three, pp. 405-412, Ancona, Italy, 28-30 June 2010.
[51] Šyc M., Keppert M., Tošnarová M., Zychová M., Pohořelý M., Punčochář M.: Heavy Metals Immobilization by Admixture of MSWI Solid Residuals into the Concrete Materials. (Eng) 37th International Conference of Slovak Society of Chemical Engineering, Proceedings, p. 100 (8 pp. full text on CD-ROM), Tatranské Matliare, Slovakia, 24-28 May 2010.
[52] Šyc M., Pohořelý M., Jeremiáš M., Vosecký M., Kameníková P., Punčochář M., Tlustoš P.: Energetic Utilization of Phytoextraction Crops. (Eng) 19th International Congress of Chemical and Process Engineering CHISA 2010 and 7th European Congress of Chemical Engineering ECCE-7, Summaries 5, p. 1849, Prague, Czech Republic, 28 August - 01 September 2010.

[53] Tlustoš T., Punčochář M., Szaková J., Balík J., Habart J., Šyc M., Pohořelý M.: Ability of Plants to Clean Soils Contaminated by Heavy Metals. (Eng) 19th International Congress of Chemical and Process Engineering CHISA 2010 and 7th European Congress of Chemical Engineering ECCE-7, Summaries 5, p. 1874, Prague, Czech Republic, 28 August - 01 September 2010.
[54] Tukač V., Hanika J., Veselý V., Kovač D., Lederer J., Nečesaný F.: Simulace produkce vodíku z biomasy. (Czech) Simulation of Hydrogen Production Based on Biomass. 19. Chemicko-technologická konference se zahraniční účastí APROCHEM 2010 . Technologie . Ropa . Petrochemie . Polymery . Bezpečnost . Prostředí ., Sborník přednášek, pp. 1163-1169, Kouty nad Desnou, Czech Republic, 19-21 April 2010.
[55] Tukač V., Hanika J., Veselý V., Lederer J., Kovač D., Nečesaný F.: CFD Simulation of Hydrogen Production by Biomass Partial Oxidation. (Eng) 19th International Congress of Chemical and Process Engineering CHISA 2010 and 7th European Congress of Chemical Engineering ECCE-7, Summaries 1, p. 38 (4 pp. full text on CD-ROM), Prague, Czech Republic, 28 August - 01 September 2010.
[56] Znamenáčková I., Lovás M., Hájek M., Sobek J.: Kinetika mikrovlnného a klasického lúhovania elektronického odpadu. (Slov) . XVIII. vedecké sympózium s medzinárodnou účasťou Situácia v ekologicky zaťažených regionoch Slovenska a Strednej Európy, Zborník, pp. 195-198, p. 195-198, Hrádok, Slovakia, 22-23 October 2010.
[57] Znamenáčková I., Lovás M., Hredzák S., Hájek M., Sobek J.: The Intensification of Leaching Process of Electronic Wastes by Microwave Radiation. (Eng) 14th Conference on Environment and Mineral Processing, Part III, pp. 173-177, Ostrava, Czech Republic, 03-05 June 2010.