bons, and NO_x storage & reduction catalysts have been developed and successfully applied. Current projects involve also the analysis of complex, non-linear dynamic regimes observed in certain reaction sub-systems, modelling of Diesel particulate filters, selective catalytic reduction of NO_x by NH_3, combined exhaust-gas after-treatment systems, and development of novel methods for the modelling of porous catalysts in micro/nano-scale (including 3D digital reconstruction from electron microscopy and X-ray microtomography images). The research group is headed by Prof. Miloš Marek. The research partners from automotive industry include, *e.g.* Daimler, Ecocat and Johnson Matthey.

Finally, the *"Chemical Robotics Laboratory"* was established in 2008 with the launch of the CHOBOTIX project. This five-year project, funded by the European Research Council, is multidisciplinary and covers many scientific fields, ranging from chemical engineering, materials science, biophysics, and microbiology to applied mathematics and computer simulation. The group is headed by Prof. František Štěpánek, who is the first recipient of such an ERC research grant in the Czech Republic. The project is focused on the design and synthesis of so-called "chemical robots", which are envisaged as internally structured particulate entities in the 10 micrometres size range that can move in their environment, selectively exchange molecules with their surrounding in response to a local change in temperature or concentration, chemically process those molecules and either accumulate or release the product. Many aspects of the structure and function of chemical robots are inspired by those of single cellular organisms. The fundamental understanding of the behaviour of "chemical robots" and their functional subsystems, will open up new opportunities in diverse areas, including next-generation of chemical processing, the synthesis and delivery of personalised medicines, the recovery of valuable chemicals from dilute resources, and environmental clean-up.

Web site of the Institute: www.vscht.cz/uchi

Institute of Chemical Process Fundamentals of the ASCR: State of the Art

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Introduction

The Institute of Chemical Process Fundamentals of the ASCR, v. v. i. (ICPF) is one of six institutes constituting the Section of Chemical Sciences of the Academy of Sciences of the Czech Republic (ASCR). In cooperation with several Czech universities, the Institute serves as a centre for fundamental research in the fields of chemical, biochemical, catalytic and environmental engineering, and it acts as a graduate school for PhD studies in the fields of chemical, biochemical, pharmaceutical, environmental engineering and processes, physical chemistry, organic and inorganic chemistry, industrial chemistry including petrochemistry and biotechnology. The multi-disciplinary character of the Institute's activities is great advantage for solving of complex problems and for external cooperation.

The ICPF is the only institute in the field, both in process and chemical reaction engineering, and in the novel instrumentations and technology development. In the Czech Republic, the Institute is leader in fundamental chemical process engineering research. Moreover, there is no doubt that ICPF is the responsible partner in teams of EU Framework Programme projects.

At present, more than 70 different projects are granted every year by different national grant agencies (Czech Science Foundation, Grant Agency of ASCR, Ministry of Industry and Trade CR, Ministry of the Environment CR, Ministry of Education, Youth and Sports CR, *etc.*) and by industrial companies covering both fundamental and applied research. Research teams of ICPF are largely involved in the Framework Programmes of the EU, NATO Research Programmes and bilateral cooperations based on agreement between ASCR and foreign research institutions, as well as on the basis of other various forms of joint research projects and partnerships.

The ICPF research activities are based on a long tradition and cover a wide range of fundamental scientific topics. The acquired know-how enables high-quality research in the fields ranging from pure chemical disciplines, like inorganic, organic, analytic and physical chemistry, applied chemistry in homogeneous and heterogeneous catalysis, chemical reaction engineering, separation and material science, to other related technical and technological areas such as hydrodynamics of multiphase flow systems, environmental biotechnology, aerosol formation and transformation, and chemical processes accelerated by laser beams or microwave field. These aspects are beneficial for the solution of integrated projects.

The Institute is nowadays a well-recognized and respected partner in this field, participating in top class European projects (*e.g.* F^3 FACTORY, IMPULSE, HUGE, EUSAAR, EUCAARI, MULTIPRO, *etc.*). In recent years, the Institute has organized or co-organized many international events, among others the biannual International Congresses of Chemical Engineering (i.e. CHISA meetings, the last one – the 20th in this series – held in 2012), the 7th Liblice Conference on the Statistical Mechanics of Liquids in Lednice in 2010, the 18th International Conference on Nucleation and Atmospheric Aerosols held in Prague in 2009. The Institute benefits from its international recognition based on the long-term scientific contacts, intensive publication activities, high rate of success in acquiring grant and project funding, as well as from the close links to companies involved in chemical industry business of the Czech Republic.

Scientific Departments and their facilities

Department of Separation Processes
(Dr. Vladimír Jiřičný, Head)

Mathematical modelling of complex multiphase systems based on sophisticated experiments is a useful tool in the design and/or optimization of modern chemical processes. Research of super-

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critical extraction, membrane separation and liquid/liquid extraction as perspective methods of separation of gas and/or liquid mixtures covers traditional and new fields. Recently, supercritical extraction concentrating on extraction of valuable substances from natural materials (herbs, seeds) was investigated. Membrane separation by pervaporation and nanofiltration with ionic liquids, upgrading biogas to natural gas is another novel and applied research topic. Research of microsystems such as micromixers, microseparators and microreactors for practical industrial operations capitalizes low diffusion interfacial resistance and represents a modern trend in scale down of process units for chemical specialties. The department now possesses the experimental equipment covering the basic requirements for currently conducted fundamental and applied research. Very helpful in this aspect is the cooperation with foreign universities as well as industrial research centres having additional sophisticated instruments that are shared in mutual research.

It is worth mentioning the following equipment employed in the current research:

– Set of vibrating plate extraction columns (diameters 25, 50, 75 mm with length up to 4.5 m) developed in the department, retaining strong application potential until present time. Since the beginning of development of the extractor, 69 patents have been submitted/granted and 30 practical technologies have been applied in the Czech chemical industry. Currently new attractive tasks are being solved. Some of these columns are located in the "fume-hood" of the reconstructed pilot plant hall.

– The supercritical extraction research is conducted on several laboratory-scale experimental setups (extractor/reactor 4 to150 cm^3) with the option of scale-up up to the reference pilot plant extractor unit, 1500 cm^3 in size. Both setups have a wide versatility of the custom-made equipment.

Membrane separation techniques such as pervaporation and permeation are conducted in the laboratory scale using custom-made experimental setups. Recently, a cell for gas permeability, diffusivity and solubility assessment in dense polymeric membranes has been designed and manufactured. The cell allows, beside the measurements of the vapour permeation fluxes and diffusion coefficients, also in situ measurements of steady-state and equilibrium sorption of the permeate in the tested membrane.

The research of microdevices had started in the department in 2005 in conjunction with the EU project IMPULSE. New original visualization cell for the hydrodynamic study of two-phase gas-liquid flow in a narrow gap with gas generated electrochemically inside the cell has been developed and utilized in the project. New evaluation techniques have been developed to measurement the bubble size distribution and enabled measurement and evaluation of the unique dependencies of bubble distribution on the electrolyte flow rate and the current applied to the cell. Based on this experience, two types of bipolar electrochemical microreactors have been developed and successfully operated in cooperation with project partners. In the frame of the project, a new visualization cell for the control of the emulsification process on the micro scale has been designed and the cell was utilized in the scope of the project with the University of Tarragona, Spain, and another one in the research centre of the Procter&Gamble, Brussels, Belgium. In addition, the team has developed the two-phase packed bed column that is suspended on a tensometric strain gauge enabling weighing of the column during operation. This enables measurement of current liquid holdup in the column and monitoring transient states of the column hydrodynamics.

Laboratory E. Hála of Thermodynamics
(Dr. Karel Aim, Head)

Research focuses (i) on the development of experimental methods for the determination and measurement of phase equilibria and thermophysical properties in multicomponent systems over a range of state conditions, and on the handling and processing of such data, and (ii) on applying the methods of statistical mechanics to development of molecular-level theories and computer simulation techniques capable of describing the behaviour of systems of different complexity by physically-based models needed for reliable design of chemical and separation processes.

The most important devices and parts of equipment are currently as follows:

– A set of tuned recirculation equilibrium stills (based on the generic Dvořák–Boublík still) developed in the laboratory, which enable us accurate measurement of vapour–liquid equilibria (including systems with chemical reaction) at low and normal pressures. Swietoslawski-type ebulliometers, allowing accurate measurement of vapour pressures (up to 400 °C in a quartz version of the instrument).

– *VLE-602 Experimental Station* (Fischer, Germany) equipped with an all-glass recirculation still, allowing semi-automated operation and measurements up to 300 kPa.

– A high-pressure assembly developed in the laboratory, with several types of visual static equilibrium cells. The most recent model (volume 65 cm^3) allows measurement of vapour–liquid equilibria at pressures up to 10 MPa and temperatures up to 100 °C.

– *SPM20 Super Phase Monitor* (Thar Technologies, Inc., USA) equipped with a view equilibrium cell of variable volume 5–15.5 cm^3, allowing measurement of up to maximum pressure of 69 MPa.

– Experimental assemblies were set up in the laboratory for the measurement of liquid–liquid equilibria by volumetric and cloud-point methods.

– *Densitometer Anton Paar DMA 58 with external density measuring cell DMA 512P* allowing density measurement at sample pressures up to 70 MPa and temperatures up to 150 °C.

– *Density & Speed of Sound Meter Anton Paar DSA 5000*, allowing measurement at temperatures up to 100 °C (on applying pressure line designed by the Laboratory).

Department of Catalysis and Reaction Engineering
(Dr. Olga Šolcová, Head)

Research of excellence in catalysis, reaction engineering and other related areas represents the traditional pillar of the ICPF activities. The main expertise covers all aspects of heterogeneous catalysis, material science with special focus on texture of porous materials and morphology studies of polymer catalysts, transport phenomena, preparation of hierarchic nanomaterials, environmental processes, theoretical analysis of bonding changes and electron transfer correlation in chemical reaction systems, *etc*.

Experimental techniques used:

– Two new top devices ASAP 2020 and ASAP 2050 (Micromeritics, USA) for automatic scanning of adsorption isotherms of gases at pressures from 10^{-5} Pa up to 1 MPa at diverse temperature (including the normal boiling point of liquid nitrogen or argon). Software has been developed for advanced isotherm analysis, *e.g.* modified BET equation, t-plot comparison plots and pore-size distributions based on Broekhoff and deBoer approach, which utilize our standard isotherms.

– High pressure mercury porosimeter AutoPore III (Micromeritics, USA) for study of mercury intrusion into pores with radii down to 1.5 nm (i.e. at pressure 400 MPa) equipped with helium pycnometer for precise analysis of the true (helium) density.

– Graham isobaric diffusion cell for measurement of isobaric diffusion of inert gases (*e.g.* nitrogen, hydrogen, argon and helium) or their mixtures at laboratory temperature and pressure through the pores in porous materials is available. The cell of own design is unique and does not require analysis of gas mixture. Results are presented in the form of textural parameters.

– Permeation cell for studying permeation of inert gases (*e.g.* hydrogen, helium, nitrogen and argon) in pores of pelleted porous solids is available as well. The cell works under pseudostationary conditions and permits the obtaining of effective permeability coefficients at different pressures, thus leading to determination of transport parameters of the studied pore structure.

– Equipment for perm-porometric study of gas transport in pores can follow flow of inert gases in porous materials filled up with a suitable liquid. By decreasing the pressure, the pores with gradually smaller size are emptied. Pore-size distributions, determined from permeation flow analysis in the transition region can be compared with results from mercury porosimetry and physical gas adsorption.

– Apparatus for gas pore diffusion under dynamic conditions is based on ICPF conception and is designed for study of gas diffusion in pores. Pellets of porous solids fill a column with diameter only slightly larger than that of the pellets (Single-Pellet-String Column arrangement – SPSC). Two inert gases serve as carrier gas and tracer gas. At the column outlet a detector monitors the tracer gas concentration. The transport parameters of pellets can be determined from column responses for several trace-carrier gas pairs and several carrier gas flow velocities via fitting in the time domain.

– Automatic pressure flow reactor units with fixed bed of catalysts equipped by on-line GC analyses for hydrodesulphurisation, hydrogenation and hydrodenitrogenation of model compounds are comparable with commercial units. Common working conditions are *in situ* pretreatment, reactions up to 400 °C at overall pressure up to 2 MPa. It is frequently used for catalyst testing with reactants such as thiophene, pyridine or lighter hydrocarbons mixtures.

Department of Multiphase Reactors
(Dr. Marek Růžička, Head)

Essential research is related to the fluid flow in both single-phase and multi-phase systems. A broad spectrum of gas–liquid–solid systems has been studied, both on the micro- and macro-scale, with the accent on the physical nature of the underlying mechanisms governing their behaviour (hydrodynamic particle interactions, flow regimes and stability, etc.). Also, the rheology of complex fluids (microdispersions, nanofluids) are studied and the basic features of these systems are investigated (new geometry for rheometry, apparent slip). The original electrodiffusion methods for flow diagnostics were developed.

Available experimental equipment and apparatuses:

– A special KK-sensor was developed for measuring apparent wall slip (AWS) in microdisperse liquids (polymer solutions and colloidal suspensions). The sensor employs axial shift in commercial rotational viscometers like HAAKE RS to adjusting gap thickness between cup and bob. A series of these sensors is available with various quality of the working surface (smooth or sand-blasted stainless steel, titanium, anodized hard aluminium). A comparable experimental technique does not exist on a commercial level. Recently, it has been used for a thorough research of AWS effect in a series of polymer solutions.

– A setup for electro-diffusion (ED) flow diagnostics consists of a hybrid EDIK (PC-controlled multi-channel current follower), rotational viscometric calibrator, LabVIEW-based system for process control and data acquisition, a set of direction-specific probes for measuring wall-shear rate, and a collection of the task-specific software applications including programs for a downstream treatment (dynamics of ED probes in fluctuating flows). The system has been used at several French universities (Paris, Grenoble, La Rochelle, Nantes) and is now also available commercially. There is no comparable technique on the scientific instrumentation market.

– The bubble generator is a device developed by ICPF team that allows on-demand formation of bubbles in a vertical array (bubble chain). Three parameters can be controlled: the bubble size, the bubble–bubble spacing and the number of bubbles in the chain (cluster). The generator was also successfully tested for the controlled production of drops (both in gas and in immiscible liquids). It is used primarily for the fundamental investigation in multiphase fluid mechanics and chemical engineering for the evaluation of complicated interfacial properties, which cannot be easily examined by other methods (*e.g.* the interfacial elasticity and viscosity).

– The PIV equipment (Dantec Co.) is used for measurement of velocity fields in either single-phase or two-phase flows. In single-phase flows, the instrument was used for evaluating the flow field around a solid particle and also for interpretation of a bubble motion in such a flow field. In two-phase flows, it was used in the study of the velocity field around an oscillating bubble, from which the information about the interface mobility can be deduced. The instrument was also used for characterization of the velocity field in an electrolytic microreactor.

Department of Organic Chemistry and Analytical Chemistry
(Dr. Jan Sýkora, Head)

Research and development of new processes for environment-friendly and energy-saving manufacturing is carried out. The novel processes are often based on innovative use of organo-metallic catalysis in one- or multiphase systems and biocatalysis by organic-inorganic materials containing biological parts. Organic syntheses in microwave field connecting the atom-economy advantages of catalysis with energy savings of microwave heating represent a novel tool for technologies development. The effort is focused on chemical and biochemical destruction of selected hazardous compounds. Analytical team of ICPF with its modern instrumentation supports all departments of the ICPF.

Service analyses within the ICPF are performed with efficient instrumentation – HPLC, GPC, AAS, NMR, etc. The members of LC-NMR laboratory carry out their own research on the development of new methods for the analysis of organosilicon compounds. Experimental facilities:

– An analytical HPLC system (Watrex). Besides a UV detector, it is equipped with an ELS detector (Polymer Laboratories, PL-ELS2100), allowing detection of compounds which do not exhibit UV absorption. It is mainly used for the analysis of natural extract mixtures. Other analytical as well as preparative HPLC are available, too. The preparative system is mainly used by the synthetic team of organic chemists.

– A new efficient lyophilisator (Thermo Scientific, LL1500) is used for preconcentration of diluted and temperature sensitive samples.

– The mineralization unit (ERTEC, Magnum II) is used for mineralization of various inorganic materials for analysis. The AAS spectrometer (GBC, GF3000) serves for the quantitative analysis of metal elements. These analyses are necessary *e.g.* to determine the efficiency of transition metals recyclation, and identification of heavy metals in the ash from biomass burning processes.

– The 300 MHz HR NMR Spectrometer (Varian, MercuryVX) is equipped with an autosampler, PFG unit, variable temperature unit (–100 to 120 °C), $1H\{^{15}N–^{31}P\}$ indirect detection probe and/or four nucleus $^{1}H/^{19}F/^{13}C/^{31}P$ autoswitchable probe. It is an open access instrument which is used by synthetic chemists as well as by researchers in the NMR laboratory.

– The 500 MHz HR NMR Spectrometer (Varian, Inova) is equipped with the PFG unit, variable temperature unit (–100 to 120 °C), $1H\{^{15}N–^{31}P\}$ 5 mm indirect detection probe, $^{1}H–^{19}F/^{15}N–^{31}P$ 5 mm switchable probe. Furthermore, it is equipped with the $^{103}Rh–^{15}N$ 10 mm broadband probe suitable for measurement of low abundant and low gamma nuclei. The spectrometer is directly coupled with HPLC system (Varian, ProStar 230) thus forming a unique LC-NMR hyphenation in the Czech Republic. Two 60 μL flow probes ($^1H\{^{13}C/^{15}N\}$ and $^1H\{^{13}C/^{29}Si\}$) are available enabling analysis of organic and organosilicon compounds.

Environmental Process Engineering Laboratory
(Dr. Miroslav Punčochář, Head)

Research in the department covers broad spectrum of fundamental and applied research projects, like gasification of biomass in fluidized bed, synthetic gas production, high temperature gas cleaning, phytoextraction of heavy metals with subsequent energy utilization of biomass, PCDD/F chemistry (formation of POP – persistent organic pollutant – compounds from precursors, destruction of POP), microwave chemistry and photochemistry (electrodeless discharge lamps, heterogeneous catalysis, photocatalysis, organic photoapplications), and sustainable technologies (total recycling of PET, recycling of luminophors from TV sets, microwave sintering of powders). Experimental facilities:

– Atmospheric fluidized-bed gasifier is coupled with a unit for high-temperature producer gas cleaning. Gasifier is made of heat resistant stainless steel with maximum operating temperature of 1000 °C, and maximum input of 10 kW. The whole unit is equipped with measuring devices and is completely computer--controlled. Online analysers of CH_4, CO_2, CO, and H_2 are available as well.

– Fluidized-bed combustor is capable of effectively destroying a variety of organic wastes such as sewage sludge. The apparatus consists of three fundamental parts: an electrically heated reactor, 0.98 m height and 93 mm diameter; a facility for the continuous withdrawal and analysis of gas samples, and a feeder of solids. Pre-dried sewage sludge particles are injected near the base of a shallow, air-fluidized, bubbling bed of expanded clay under different operating conditions. Generated flue gas can be cooled and cleaned when needed.

– The high technical level analytical instrument GC/MS Focus DSQ (Thermo Scientific, USA) is sufficient for organic analysis and structure determination. The FOCUS™ DSQ™ is a space-saving quadruple GC-MS designed for laboratories wanting the ultimate in GC-MS performance but have limited space and funds. The system combines the advanced, next-generation curved optics of the industry leading DSQ with the small footprint of the FOCUS GC to create a compact but powerful analyser for environmental, petrochemical, forensics, and QA/QC applications. The system operates under Xcalibur™, Thermo Electron's premier data system, for complete system control and automated data processing.

– The microwave oven MicroSYNTH (Milestone, Italy) of top design is suitable for organic and catalytic synthesis. The oven is the most advanced system available for microwave-enhanced chemical reactions. It combines a microwave cavity for generating the microwave field, sensors to monitor reaction parameters for feedback-based process control, and sophisticated process control software.

– Spectrophotometer USB2000 (Ocean Optics, USA) enables measurement of spectral distribution for electrodeless discharge lamps.

Department of Aerosol Chemistry and Laser Studies
(Dr. Vladimír Ždímal, Head)

The broad area of studies includes aerosol formation, behaviour, fate in the environment both outdoor and indoor and in working places, and technological devices. Although most of the scientific staff consists of experimentalists, theoretical work of the department is also internationally recognized. Aerosol as a multiphase system where momentum, heat, and mass transfer between particles and their surroundings play a key role in aerosol lifetime and where various catalytic processes can be expected both within and on the phase boundary of a particle is a natural and inherent subject of study in ICPF.

Research on laser-induced synthesis of novel materials produced by IR and UV laser irradiation of polymers, volatile compounds and solutes is focused on topics like laser ablative deposition of polymeric films, laser-induced co-pyrolytic gas-phase deposition of nanosized inorganic compounds, laser chemical gas-phase and liquid-phase deposition of nanocomposites, laser-induced reactive etching of inorganic surfaces, laser-induced carbothermal reduction of oxides, laser-induced gas-phase co-pyrolytic deposition of metastable metal alloys, preparation of nanosized encapsulated magnetic particles and pyrolytic approach to preparation of Ge nano-objects. Experimental facilities:

– Compact time of flight aerosol mass spectrometer (Aerodyne Research Inc.) enables on-line determination of size-resolved (40 – 1000 nm) chemical composition with high time resolution. The highest sensitivity allows measuring fractionated aerosols.

– Semi-continuous OCEC field instrument, (OC/EC Sunset Labs) is applied to on-line determination of aerosol organic and elemental carbon; two identical instruments allow comparative studies.

– Highly size-resolved determination of aerosol particle size distributions in the submicron range, precise and reliable is made by several models of Scanning Mobility Particle Sizers (TSI Inc.), and Aerodynamic Particle Sizer (TSI Inc.) is used for supermicrometer size range. Highly time-resolved aerosol particle number concentration in the submicron range can be monitored by Condensation Particle Counters (TSI Inc.).

– Humidity tandem differential mobility analyser, ICPF–EUSAAR is useful for determination of size-dependent particle hygroscopicity.

– Berner low pressure impactor (25/018/Hauke) separates aerosol into 10 size-resolved fractions, allows gravimetric and chemical analysis.

– FTIR spectrometer Nicolet Impact 400 is used for collecting IR spectra between 400 and 4000 cm^{-1}. The spectrometer is equipped with specula reflection and ATR accessories.

– Raman spectrograph Nicolet Almega XR is connected to a scientific Olympus BX51 microscope. The device is modern, automatically tuned and equipped with two excitation semiconductor lasers (473, 780 nm). A built-in unique sample compartment is useful for bulk sample spectra acquisition. The spectrograph represents one of the top research facilities in the ICPF.

Recently published books, monographs and chapters in books

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Annual Reports of the ICPF can be downloaded in pdf at:
www.icpf.cas.cz/en/annual-reports

Institute of Chemical Process Fundamentals of the ASCR: Expectation

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Introduction

The Institute of Chemical Process Fundamentals of the ASCR, v. v. i. (ICPF) covers a wide variety of topics of fundamental and applied research in the field of chemical, catalytic, combustion, biochemical and environmental engineering. This specific role places the Institute among workplaces, which deal with basic research in chemical engineering as well as with design of chemical equipment, not only due to the available system of pilot plants laboratories. These facilities enable the transfer from laboratory investigation to large-scale applications. Consequently, such a background determines the position of ICPF both in the process and chemical reaction engineering research and in the development of novel instrumentation and technology. The basic aim in the forthcoming period is to strengthen and further develop this position.

Historically, the ICPF was established in 1960 by fusion of the Laboratory of Chemical Engineering of the Czechoslovak Academy of Sciences, and the Department of Technology of the Institute of Organic Chemistry of the Academy. Thus, the Institute consists of departments, which reflect chemical engineering unit operations or deal with catalysis and organic synthesis. With a certain simplification, the chemical engineering part of the Institute consists of *Department of Separation Processes*, *E. Hála Laboratory of Thermodynamics* and *Department of Multiphase Reactors*, while the *Department of Catalysis and Reaction Engineering* together with the *Department of Organic Synthesis and Analytical Chemistry* belongs to the "more chemically oriented" laboratories of the Institute. The list is completed by the *Department of Aerosols and Laser Studies*, which has grown due to the development of new specializations in chemical engineering science and organic synthesis. Last but not least, the *Environmental Process Engineering Laboratory* unifies a great deal of applied research for the protection of the environment and the development of new, environmentally friendly technologies. An important aspect is to use experimental facilities in pilot plant labs, which will be exploited for solution of projects leading to industrial applications.

In this historic manner, a somewhat wide range of research topics has emerged, which gradually distinguished themselves into the five following main areas forming simultaneously the frame of our scientific interests for the near future:

1. Physico-chemical processes in multiphase systems,
2. Up-to-date catalytic processes applicable also to environmental protection,
3. Development of processes for synthesis of chemical specialties and their modelling,
4. Investigation of new processes under unconventional conditions,
5. Chemical-engineering aspects applicable in biotechnology.

These general directions of investigation are connected with the research plan of individual departments and/or are realized with their mutual cooperation.

Concept of further development of ICPF

The above-described structure of departments is optimal for fulfilment of our current tasks and I can state that ICPF is a stabilized institution with a well-established system of research. However, this virtual stability might result in a certain preservation of such "steady state" with following consequences:

– Unsatisfactory personnel situation – lack of new acquisitions, low alteration on the leading positions,

– Keeping of traditional directions of research.

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