Otto Vogl, ***Polymer Institute Slovak Academy of Sciences Bratislava, Slovakia,***
Polymer News, 19(5), 151 -157 (1994)

Polymer Institute. Slovak Academy of Sciences Bratislava, Slovakia

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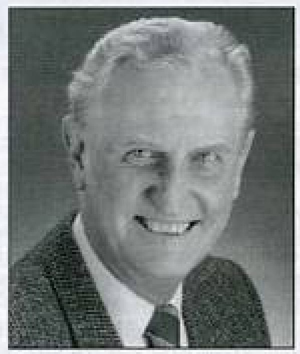
Six MetroTech Center,
Brooklyn, NY



Otto Vogl

Bratislava, a city of about 450,000 inhabitants, is the capital of the newly created country of the SLOVAK REPUBLIC. It is located on the Danube river, about 40 miles east of Vienna, Austria, less than one hour by car, bus, train or by boat. Bratislava is also a little more than 2 hours from Budapest, the capital of Hungary. Budapest is located southeast from Bratislava, downstream on the Danube.

The Slovak Republic, also called Slovakia, has 5,5 million inhabitants and it borders to the east on Austria and the Czech Republic, to the south on Hungary, to the east on the Ukraine and to the north on Poland. Polymer science and the polymer industry play an important part of the entire science and economy of Slovakia.

The Polymer Institute of the Slovak Academy of Sciences, the scientific arm of Slovak polymer science, is located in Brastislava, Slovakia. It was founded in 1967 with the principal objective to carry out fundamental research in the field of polymeric and macromolecular materials. The Polymer Institute is the succeeding organization of the Laboratory of Polymers which had been established in 1963.

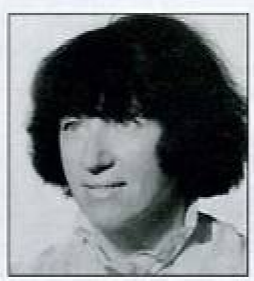
The address is Polymer Institute, Slovak Academy of Sciences, Dúbravská cesta 9, SK-842 36 Bratislava, SLOVAK REPUBLIC. fax: SAVPOLYMER Blava 42-7-375-923; telex: 933–55

The Institute has as its director Milan Lazár, as deputy director, Pavol Hrdlovič, as its Scientific Secretary Lyda Rychlá and as the Chairman of the Scientific Board Juraj Pavlinec.

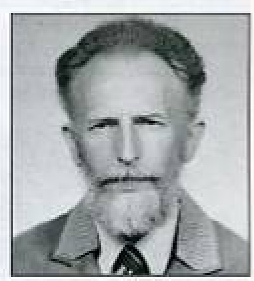
Responsible for the directors office is V. Borňinová, tel. 42-7-373-448; for the Information Center and the Library M. Kulíčková, tel. 42-7-377-404 and for the Department of Finances and Budget Z. Hloušková, tel. 42-7-307-409.

M. Lazár

P. Hrdlovič



L. Rychlá



J. Pavlinec

Polymer Institute Bratislava, Slovakia

For many years the scientific program of the Polymer Institute was focussed on the synthesis of polymeric materials and on the studies of the relationship between the structure and properties of polymeric materials. A substantial part of the research was and is directed at the preparation and the study of the properties of modified polymers. New experimental and theoretical approaches were developed for the studies of structure/property relationship of polymers with special emphasis on the increase of the oxidative (thermal and photochemical) stability, the general aging behavior and the flame resistance of polymers.

For the chemical modification of polymers, radical reactions are primarily investigated, employing organic peroxides. Such reactions lead to functionalization, grafting or crosslinking. The optimization of the reaction conditions is being studied together with the reaction mechanisms.

In connection with the stability of macromolecular compounds, photophysical and photochemical processes in polymers are being investigated. Attention is being paid to the mechanism and the kinetics of processes proceeding under high-temperature degradation and polymer combustion. The influence of additives on the chemical, physical and on the overall properties of polymers and their composites is being studied.

Another important project of the Institute is the radical polymerization of polar and non-polar unsaturated monomers in emulsion and in inverse emulsion systems. New facts about the locus of initiation, propagation and termination of macroradicals, the formation and growth of polymer particles and of copolymer structures have been obtained.

Silica gel and carbon sorbents, which serve as column filling materials for high performance liquid chromatography, are being developed along with active polymer fillers and carriers of specific functionalities.

Another investigation is the interaction of polymer systems and the characterization of oligomers, homopolymers and copolymers in solution by experimental and theoretical methods. They are also studying the thermodynamics of polymer solutions and of condensed polymer systems and their phase transitions. The Monte Carlo method is used for modelling microstructure, molecular properties and for the overall equilibrium and dynamic behavior of polymers. Theoretical methods are describing the electron structure of molecules and radicals, their reactivity for the description of the influence of the medium on the properties of molecules.

Scientists of the Institute are also involved in the training of University students and PhD candidates. In 1992, six of the scientists of the Institute were lecturers at the Slovak Technical University and at the Comenius University on such subjects as: Macromolecular Chemistry, Physical Chemistry of Macromolecules, Biophysical Chemistry, Photochemistry, Atomic and Molecular Collisions, Theories of Molecular Spectra and Programming and Computer Science. The scientists of the Institute organized also laboratory courses on the unique equipments of the Institute for University students.

At the laboratories of the Institute 10–15 students are studying for their Ph.D. Together with the Macromolecular Departments of the Slovak Technical University of Bratislava, post graduate programs have been developed. In series of lectures and seminars, these programs cover the most recent problems of macromolecular chemistry. The program and the

Bratislava, Old Town

City Hall, Bratislava

Old City, Bratislava

defence of the PhD and DSc theses in macromolecular chemistry and chemical physics are supervised by high-level committees. The senior members of the Institute are also members of the Examination Boards of Slovak Universities.

The Polymer Institute has also developed a number of bilateral cooperative programs and has extensive contacts within the global polymer community.

The Following Scientists are Members of the Polymer Institute

Jaroslav Bartoň (1932) Influence of chemical and physical factors on the kinetics and mechanism of radical polymerization in homogeneous and heterogeneous systems. Optimization of the conditions for the preparation of polymeric materials for conventional and special purposes.

Dušan Berek (1938) Preferential solvation of macromolecular systems in mixed liquids – its determination, its role in liquid chromatography and the effect of pressure on its parameters. Development of silica gel and carbon – based chromatographic column packings.

Tomáš Bleha (1943) Theoretical characterization of interactions and flexibility of macromolecules; molecular thermodynamics of polymeric materials; conformational statistical of chain molecules.

Eberhard Borsig (1936) Mechanism and kinetics of radical reactions in the processes of functionalization of grafting and crosslinking of polymers and their properties.

Ignác Capek (1947) Kinetics and mechanism of radical emulsion polymerization and copolymerization of two- and multifunctional unsaturated monomers initiated by water and oil-soluble initiators in the presence of surface-active additives.

Peter Cifra (1955) Thermodynamics and computer simulations of polymer blends and their phase behavior: effects of molecular interactions, flexibilities of polymer chains and other molecular properties on the thermodynamic behavior of polymer materials; effects at interfaces in geometrically constrained systems.

Štefan Chmela (1950) Synthesis and study of the mechanism of light stabilizers – sterically hindered amines (HALS). The influence of the structure and molecular weight on the effectiveness during the photooxidation of polyethylene and polypropylene.

Ivan Chodák (1943) Crosslinking of thermoplasts, rubbers and thermoplastic elastomers. Properties of multiphase polymer systems (composites, polymer blends) with polyolefin matrix, modification of polyolefin matrix by radical reactions.

Štefan Florián (1936) Properties of macromolecules in solution. Determination of molecular and supermolecular parameters of polymers in relation to physico-mechanical and adhesive properties of polymer systems.

Pavol Hrdlovič (1939) Photochemical and photophysical processes in macromolecular systems leading to degradation reactions. The study of photo-Fries rearrangement, Norrish type II reaction, photoaddition reactions of aromatic compounds. Photooxidation of polyolefins and inhibition of degradation reactions of polymers.

Ivica Janigová (1956) Calorimetric methods for the study of polymers; electron microscopy and properties of polymer composites.

Ondrej Kyseľ (1937) Application of theoretical quantum-chemical methods describing the properties of molecular interactions. Search for relationships between electronic structure of particular molecules and their function during inhibition of the photoinitiated oxidative degradation of synthetic polymers.

Dieter Lath (1939) Solution properties of polymeric compounds; Interaction in multicomponent systems by viscometry, light scattering and phase separation studies.

Milan Lazár (1927) Radical reactions in polymer systems: crosslinking and grafting of polyalkanes; initiation of polymerization reactions of multicomponent systems; studies of the formation of defective structures in macromolecules; effects of anomalous units on the chemical properties of polymers.

Ivan Lukáč (1941) Synthesis of new monomers, primarily of vinyl aromatic ketones and their polymers; photochemical properties of the polymers.

Jozef Lustoň (1944) Stabilization of polymers; synthesis of polymer additives and polymer-bound functional derivatives.

Tibor Macko (1955) Sorption equilibria of liquid mixtures on the gel surface under the conditions of liquid chromatography, their influence on chromatographic separation of polymers, preparation and properties of silica gels for specific applications.

Pavol Mach (1952) Applied quantum chemistry (semiempirical methods) aimed primarily at degradation and stabilization of polymers. Effect of the medium on the properties of molecules.

Igor Novák (1951) Relationship between structure, physical and mechanical properties of polymers; polymer blends, thermodynamic aspects of their miscibility. Effects of supermolecular structures on their properties. Adhesive and creep properties of polymers and their blends.

Ivan Novák (1933) Synthesis and characterization of new types of microparticulate sorbents for liquid chromatography based on silica and carbon.

Juraj Pavlinec (1933) Radical reactions in polymerization systems. Initiation of radical reactions, recombination of polymer radicals, radical reactions with macromolecules which can be used for preparing polymer networks and composites.

Ján Plaček (1944) Structure and reactivity of radicals in solid polymers by electron spin resonace. Computational techniques and simulation of spectra.

Lyda Rychlá (1942) Problems associated with thermooxidative degradation and stabilization of polymers. Antioxidant efficiency of new stabilization systems based on the measurements of chemiluminescence and thermal analysis.

Josef Rychlý (1944) Polymer ignition in relation to their decomposition into volatile products and to the presence of additives with the characterization of the transition region from slow oxidation to combustion.

František Szöcs (1935) Structure and reactivity of free radicals in solid polymers, polymer blends and composites by electron paramagnetic resonance. Effect of molecular motions on the transport of radical centers. Reactions between macroradicals and oxygen, monomers and antioxidants. Effect of physical ageing and mechanical stress of polymers on the stability of free radicals.

Jozef Tiňo (1932) Molecular mobility in solid polymers and its effect on the transport phenomena in the system by a theoretical approach.

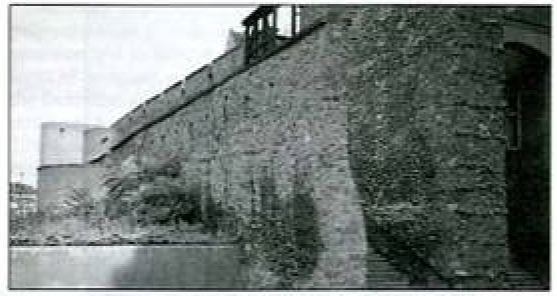
Ján Urban (1952) Molecular mobility in polymers (free-radical decay, charge transfer, proton transfer). Reactivity of small molecules during combustion.

Viera Vašková (1945) Kinetics and mechanism of radical polymerization of hydrophilic monomers and their copolymerization with hydrophobic monomers in inverse emulsion systems.

Several members of the Institute have national positions in Slovakia: Tomáš Bleha is the Vice President of the Slovak Academy of Sciences for Natural Sciences and Dušan Berek is a member of the Executive Board of the Slovak Academy of Sciences. Eberhard Borsig is the President of the Slovak Chemical Society.

The Polymer Institute of the Slovak Academy of Sciences consists of ten laboratories which are the focus of the Institute's research activities.

Laboratory of Polymerization Reactions (tel. 42-7-378-2792): J. Bartoň, I. Capek, V. Vašková, V. Juraničová, I Lacík, P. Potisk, M. Stillhammerová and M. Ležovič.

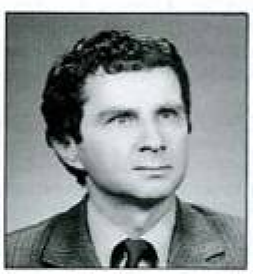


Bratislava, Medieval Walls

Scientists of the laboratory are studying the synthesis of polymers and copolymers in homogeneous and heterogenous systems. The efforts are concentrated on the factors that affect the mechanism and kinetics of radical polymerization. This includes the elucidation of the elementary reactions under both stationary and non-stationary conditions, and in systems which have specific interactions between components. Emphasis lays on the understanding of the principles of regulation of the reactivity of radicals and monomers and on the phenomenological study of the processes responsible for the formation and for the changes in polymer particles. The objective is to obtain data which would enable the preparation of materials with predetermined chemical and physical properties for conventional and for special applications.

Laboratory of Polymer Reactions (tel. 42-7-378-2198): E. Borsig, A. Fiedlerová, L. Hrčková and A. Kleinová.

This laboratory is investigating the results, the mechanism and the kinetics of reactions of polymers with low molecular weight reagents aimed at binding functional groups to polymer chains. Grafting and crosslinking of polymers especially polyolefins is also being studied. The main attention is devoted to reactions initiated with free radicals. The objective is to design and regulate polar properties of polymers, with special emphasis on polyolefins and thus improve their compatibility with other more polar polymers and with inorganic fillers. The preparation of interpenetrating networks based on polyolefins and vinyl polymers and their characterization are also the research objectives of this laboratory.



T. Bleha

D. Berek

E. Borsig

Laboratory of Composite Thermoplasts (tel. 42-7-378-2253): I. Chodák, J. Pavlinec, I. Novák, Z. Brunovská, Z. Nogellová, I. Chorváth and S. Nováková.

Many years of experience in the studies of radical chain reactions have given the basis for the investigation of the modification and properties of multiphase systems based on thermoplastics. The investigations include the effect of crosslinking on the properties of polymer blends and composites, the preparation of thermoplastic elastomers, of branched, oriented and of microparticulate polymeric materials and of foams.

Laboratory of Photochemistry of Polymers (tel. 42-7-378-2187): P. Hrdlovič, I. Lukáč, S. Chmela, C. Kosa and L. Horinová.

Basic aspects of the photodegradation of polymers and model compounds, especially photochemical, photooxidation and photothermooxidation reactions are being investigated by scientists of this laboratory. Reactions leading to main chain scissions, Norrish type II reactions and photooxidative degradation of polyolefins are particularly studied. Considerable attention is also being devoted to the efficient inhibition of these processes and to the identification and development of effective stabilizing additives.

Laboratory of Calorimentry (tel. 42-7-378-2306): J. Rychlý, L. Rychlá, I. Janigová, A. Busci, K. Csomorová, J. Lustoň and J. Broska.

Calorimetry has been an important tradition at the Polymer Institute. The condition of ignition of polymeric materials in relation to the kinetics of the processes leading to the decomposition of polymers into volatile products are being studied. The efficiency of flame retardants, antioxidants and other additives is also being examined. DSC, TG, DTA, solution calorimetry and chemiluminescence methods are being utilized for evaluating thermooxidative stability of polymeric materials. Part of the activities of this laboratory is oriented to the evaluation of the crystallization of polymers and the compatibility of polymer blends or individual polymers with inorganic additives.

Laboratory of Liquid Chromatography (tel. 42-7-378-2306): D. Berek, I. Novák, T. Macko, J. Lipták, M. Jančo and M. Petro.

This laboratory is engaged in the synthesis, modification, testing and utilization of microparticulate porous systems based on silica gel, carbon and their composites with organic polymers. Materials are intended to serve as chromatographic column packings, filler for polymers and carriers of several different additional functions. Unconventional methods of liquid chromatography are being worked out for the characterization of complicated polymer systems, which include a combination of the size exclusion principle with adsorption, precipitation and partition mechanism to increase the selectivity of separation. The preferential solvation of macromolecules in two-component solvent is also being investigated by means of size exclusion chromatography. New procedures for the diagnostics of HPLC columns are being developed utilizing the effect of pressure on the preferential sorption of two-component liquids on the column packing surface.

Bratislava, Danube Bridge

Laboratory of Polymer Solutions (tel. 42-7-378-2973): D. Lath, S. Florián, E. Lathová, R. Anovčin and M. Murgašová. The activities of the laboratory are directed towards properties and characterization of oligomers of homo- and copolymers in solution using viscometry, light scattering (including dynamic light scattering), osmometry, fractionation, differential refractometry and phase separation techniques. Attention is being paid to the determination of the interaction parameters in polymer – mixed sovent and polymer – polymer systems. This includes the characterization of the behavior of polymer complexes, of blends as well as of associated polymer systems. A special area of interest is the study of the adhesion properties of high solid polymer solutions and of polymer blends with low glass transition temperatures.

Laboratory of Molecular Thermodynamics (tel. 42-7-378-2379): T. Bleha, P. Cifra and M. Omastová. The laboratory of Molecular Thermodynamics is developing theoretical descriptions of conformations of polymer structures, of molecular interactions and of some thermodynamic properties of polymeric materials. Structure and phase equilibria are modelled by computer simulations for homo- and copolymers and for polymer blends. Conformational analysis of natural and synthetic polymers, including the effect of pressure and mechanical stress are being developed. Properties of macromolecules in random (porous) media are also being examined. Electrochemical preparation of conductive polymers – polypyrrole – by a modified procedure is under development and its electrical properties, its morphology and the doping mechanisms of these systems are being investigated.

Laboratory of Radiospectroscopy (tel. 42-7-378-2572) : F. Szöcs, J. Plaček, M. Klimová, K. Miklešová and J. Bartoš. Radical processes, the mechanism and the kinetics of radical reactions proceeding in solid polymers, copolymers and composites are being investigated in this laboratory. In several polymer systems, radicals are formed by gamma-irradiation or by UV irradiation, by mechanical action or by chemical reactions. Stabilizing processes are being examined as polymer samples are subjected to mechanical stress as well as to chemical and physical ageing. Molecular motion in polymers which plays and important role in the transport and in the decay of radicals are being followed. ESR spectroscopy in combination with computational techniques are being used. ESR spectra are simulated and the kinetics of the decay of radicals is being investigated.

Laboratory of Chemical Reactivity (tel. 42-7-378-2565): J. Tiňo, J. Urban, O. Kyseľ, P. Mach and J. Koreň.

The activities of this laboratory are associated with the reactivity of radicals in solid polymers. The molecular mobility and its influence on the transfer phenomena in solid polymers is

Museum, Bratislava

the focus of the research. The dynamics of polymer systems is being studied by the Monte Carlo method, which allows the selection of submolecular structures undergoing motion at various temperatures. Intra- and intermolecular interactions are being calculated either from known empirical relations or by quantum-chemical methods. Part of the activities of the laboratory are devoted to the study of the dynamics of elementary chemical processes. Theoretical quantum-chemical methods are being used for the deeper understanding of the mechanism of light stabilization and the effect of light stabilizers on synthetic polymers. Methods are being developed for describing the influence of the environment on spectral properties (electronic, ESR and NMR spectra) of molecules and of radicals which are involved in the processes of polymer degradation and light stablization.

Technological Laboratory (tel. 42-7-377-406): V. Polák and O. Žigo.

The Technological Laboratory is responsible for solving the problems of the technology of production of the materials developed in the Institute. It provides larger samples for further characterization in development quantities and is the source of the practical outlets of the achievements of the projects of the Institute.

The following specific projects have been studied in the period 1991 to 1993: "A Theoretical Study of Reactive Molecular Collisions during Polymer Burning" (V. Klimo): "Preparation of Composite Polymer Dispersions" (I. Capek); " The Influence of Molecular Mobility on Transport Phenomena in Solid Polymers" (J. Tiňo); "Thermally Initiated and Photoinitiated Radical Reactions in microheterogeneous Systems" (J. Bartoň); "Photophysical, Photochemical and Photooxidative Processes in Polymers in the Solid Phases" (P. Hrdlovič); " The Influence of Topology and Composition of Macromolecules on the Properties of Polymer Systems" (J. Pavlinec); "Multicomponent Polymer Systems in Solution" (D. Lath); "Chemical Modifications of Polyolefins for the Preparation of Polymer Blends and Filled Polymers" (E. Borsig); "Interaction of Multicomponent Systems of Copolymers Containing Various Polar Groups" (Š. Florián); "Determination of Conditions for the Decomposition of Polymer Materials and Their Ignition in the Presence of Non-Halogen Flame Retardants and Antioxidants" (J. Rychlý); "Microparticulate Porous Polymer Systems" (D. Berek); "Molecular Thermodynamics of Polymers" (T. Bleha).

At the present time the following projects are being investigated at the Institute" "Additives to Polymers with Increased Molecular Mass" (Š. Chmela); "The Effect of Crosslinking on the Properties of Polyolefin-Based Blends and Composites" (I. Chodák); "Modern Carbon Sorbents for Analytical Applications" (I. Novák).

Additional projects have been started" "Grafting of Polyolefins in the Solid or Quasi-Solid State" (E. Borsig); "Radical Polymerization in Concentrated Disperse and Organized Systems" (J. Bartoň); "Photochemical Reactions of Polymers in the Solid State" (P. Hrdlovič); "Unconventional Materials, Procedures and Application of Liquid Chromatography of Macromolecules" (D. Berek); "Thermodynamic Properties of Polymer Materials and Their Surfaces: the Relation to Conformational Structure and Interactions of Macromolecules" (T. Bleha); "Organized Structures in Polymer Solutions and Blends" (D. Lath); "Dynamic Relaxation in Polymers and its Influence on the Reactivity of Macroradicals" (J. Tiňo); "Principles of the Design of Multiphase Polyolefin-Based Composites Using Reactive Processing" (I. Chodák); "Preparation of NM-Polymer Networks and Their Influence on the Properties of Composite Materials" (J. Pavlinec); "Physical Aspects of Polymer Stabilization" (J. Lustoň); "Kinetics and Preparation of Submicron Polymer Particles" (I. Capek).

Smolenice Castle, Meeting Center, Slovak Academy of Sciences

The Polymer Institute also provides research and consulting services in the following areas:

Kinetics of Polymerization and Copolymerization in Homogeneous and Heterogeneous Systems; Determination of Propagation and Termination Rate Constants of Free Radical Polymerization; Preparation of Polymer Dispersions (Aqueous and Non-Aqueous) via an Oil-in-Water and Water-in-Oil Emulsion Polymerization and through Dispersion Polymerization in Non-Aqueous Systems; Characterization of Polymer Dispersions (Particle Size, Particle Size Distribution); Determination of Parameters for the Decomposition of Thermo- and Photo-Initiators Based on Polymerization Kinetics; Determination of the Residual Monomer Concentration in the Final Product; Determination of the Degree of Crosslinking of Polymers and Polymer Blends by the Method of Swelling, Kinetics of Swelling; Calorimetric Measurements During Tensile

Deformation of a Polymer Sample; Measurements of the Changes in Sample Dimensions under Various Loads and at Various Temperatures; Measurements of the Change in the Volume of a Sample During Tensile Deformation; Preparation of New Photosensitive Monomers; Preparation of Photosensitive Homo- and Copolymers and Their Characterization (Viscometry, GPC); Spectral and Photochemical Characteristics of Photosensitive Polymers and Copolymers; Evaluation of Various Light Stabilizers and Their Mixtures During the Stabilization of Homopolymers, Blends and Composites, Evaluation of Synergistic and Antagonistic Effects; Determination of the Molecular Properties of Polymers Including Polymer Mixtures by the Methods of Polymer Fractionation, GPC, Viscometry, Osmometry, Light Scattering and Phase Separation.

Determination of the Molar Mass and Chemical Composition of Copolymers and the Influence of Parameters such as Structure (Branching), Interaction Parameters between Polymer-Polymer or Polymer-Solvent and Unperturbed Dimensions of Polymer Chains; Determination and Prediction of Polymer Compatibility in Blends with Copolymers in the Region of Formation of Supermolecular Structures and Polymer Complexes; Crosslinking of Polyethylene by Peroxides, Silanes or by Radiation; Preparation of Foamed Materials Based on Polyolefins, Rubbers, and Blends of Polyolefins with other Polymers; Oxidation and Ageing of Crosslinked Polyolefins (Methods of Chemiluminescence, DSC, Thermomechanical Oxidation – Brabender); Analysis of Crosslinked Polymers, Including the Determination of the Crosslink-Density, Sol-Gel Content, Crystallinity, Mechanical Properties, Composition of Crosslinked Materials; Crosslinking of Polypropylene and Polypropylene Blends; Preparation of Composites with a Matrix of Crosslinked Polyethylene or Polypropylene; Characterization of Ignitability of Polymeric Materials by the Study of Induction Period and Ignition Temperature; Determination of Effects of Exothermic Processes on the Surface on Polymer Ignition; Characterization of the Thermooxidative Stability of Polymers and Optimization of the Choice of Stabilizers on the Basis of Several Tests (Determination of the Formation of Volatile Products, Thermoanalytical Methods and Chemiluminescence under the Conditions of Static and Circulating Oxidizing Atmosphere, Determination of the Effectiveness of Oxidation Inhibitors in Model Systems of Hydrocarbons).

The Technological Laboratory of the Institute provides: Silica gel for a variety of applications as column packing material for both high performance and low pressure chromatography, sorbents for solid phase extraction, polymer composite fillers, spherical microparticulate and macroporous materials with tailored properties, microparticulate cellulose based materials, microparticulate carbon-based spherical and non-spherical sorbents, disposable "SPE PLAST and SPE GLASS" sorbents for solid-phase extraction; more then 30 sorbents are available in limited quantities.