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Centers of Polymer Research; Polymer Science in Silesia, Poland: Gliwice, Zabrze

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Centers of Polymer Research

POLYMER SCIENCE IN SILESIA, POLAND: GLIWICE, ZABRZE

by

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Gliwice is one of the main cities in the Silesian district of Poland whose capital, Katowice, is the largest industrial center not only in Poland but in this part of Europe. The city takes pride in its urban traditions which date back 800 years. In the forties Gliwice became a modern center of the chemical and particularly of the plastics industry. In the immediate vicinity of the city are the largest Polish chemical plants and until quite recently the Ministry of Chemical Industry was located in Gliwice. Now the central authorities of the largest centers of the chemical and plastics industry have their offices there. An important industrial research center is the Institute of Plastics and Paint Industry organized in 1945 by Professor Z. Klonowski, which has now 500 employees with specialization in technology (synthesis and modification) of condensation polymers and in their processing. The Institute for Heavy Organic Synthesis and its pilot plant located in the vicinity of Gliwice employs over 1500 research scientists and technicians; work is done in the Institute on the synthesis and technology of polyolefins and vinyl polymers. The Central Development and Design Institution of the Chemical Industry with a staff of over 3000 scientists, engineers and designers, is also located in Gliwice. The dynamic growth of industry and industrial research in this region created the need for teaching and fundamental research in neighboring universities.

At the Silesian Technical University (Politechnika Slaska) the Institute of Polymer Chemistry and Polymer Technology was established in 1958 under the directorship of Professor Zbigniew Jedlinski; shortly thereafter the Institute of Polymer Processing was created with Professor Jerzy Bursa as its head. Both institutes employ jointly approximately 45 persons as permanent staff of which over one-half are people with advanced degrees, including 4 professors and 15 senior lecturers. The main goal of these institutes is the education of graduate students for master's or doctor's degrees in polymer chemistry or polymer chemical engineering.



Institute of Physical Chemistry and Polymer Technology, Technical University, Gliwice.

Research groups of both institutes carry out studies in different fields of polymer science. Professor Eligia Turska and her group study the kinetics of poly- and copolycondensation under various conditions with emphasis on new developments and interpretations.

The group, headed by Professor Z. Jedlinski, is investigating the stereochemical aspects of polyreactions; particular attention is paid to the study of the influence of conformation and configuration of cyclic monomers, especially of substituted cyclic acetals, on their reactivity. Studies are also being done to evaluate the mechanisms of the ring-opening polymerization.

Professor J. Podkowka and his group are interested in kinetic and thermodynamic aspects of the transport of gases and vapors through polymeric membranes with emphasis on the influence of polymer morphology on the course of transport processes and the methodology of measurements.

Associate Professor J. Maslinska-Solich is studying charge-transfer polymerization processes, chemical modification of polymers, and applications of hydrophilic polymers.

Professor J. Bursa developed a strong research group in the field of polymer processing. Its main interest is the investigation of the influence of methods and parameters of the manufacturing processes on polymer properties, the properties of polymer composites, and finished products.

Increasing research demands in the field of polymer science in Silesia brought about the creation, in 1968, of the Institute of Polymer Chemistry of the Polish Academy of Sciences which is located in the city of Zabrze, 5 miles from Gliwice. The Institute of Polymer Chemistry is now under the directorship of Professor Z. Jedlinski with Professor E. Turska as the Deputy Director of Research.

At the present time, the institute employs a total of 160 people, one-half of whom have advanced degrees. The institute cooperates closely with the Institute of Physical Chemistry and Polymer Technology of the Technical

University, Gliwice. Some senior members have joint appointments and have research groups in both institutions. The main research objective of this institute is the study of the relationship between chemical structure and physical properties of polymers, studies of the kinetics and the mechanisms of polymerization, particularly of ring-opening polymerization. Syntheses of polymers, based on unconventional raw materials and monomers, i.e. coal based polymers, problems of the formation of ordered structures in polymers, as well as studies of structure and morphology of polymers in solution and in the solid state are also important problems under investigation.

Research in Professor E. Turska's group is concentrated on the morphology of polymers, particularly in the solid state. Initially, the group was interested in polymer



Institute of Polymer Chemistry, Polish Academy of Sciences, Zabrze.

solutions and molecular weight distribution functions, and in experimental methods for the estimation of the distribution functions; at the same time this group also developed methods for kinetic studies of polymer crystallization. In recent years the attention of Professor Turska and her coworkers focused on studies of the character of morphological changes which take place in polymers in the swollen state.

Professor Tadeusz Urbanski, member of the Polish Academy of Sciences, an organic chemist known for his achievements in the field of cellulose derivatives and biologically active compounds, is presently devoting his attention to the study of selected polymers of natural origin, and polymers based on monomers derived from coal; he is also consulting extensively with individual scientists in other research groups of the institute.

Professor Zbigniew Jedlinski and his research group are engaged in studies of the mechanisms of ring-opening polymerization processes of cyclic monomers mainly of mono-substituted oxiranes and epoxyaldehydes. The polymerization studies of oxiranes with different substituents on the ring made it possible to control the polymerization process and enabled the synthesis of polyethers of different types of structures and degree of tacticity and crystallinity; the results of these studies clarified also the effects of the influence of monomer structure and type of substituent on the reactivity of oxiranes. During the studies of the polymerization of epoxyaldehydes, a new type of reaction was discovered in which the 3-membered oxirane ring of the epoxyaldehyde was transformed into a 4-membered β -lactone ring; this reaction involves a novel modification of the well-known Tishchenko-Claisen reaction.

Studies on the relationship between polymer structure and thermal stability carried out in this group led to the elaboration of general rules in this field and were particularly useful for crosslinked polymers which seem to have important practical applications. Several studies in the institute resulted in technical processes for the synthesis of new engineering plastics of high thermal and chemical stability.

Other groups led by junior members of the institute are contributing significantly to the overall efforts. Associate Professor Jerzy Szafko is interested in the kinetics of the free-radical polymerization and copolymerization of vinyl monomers and made contributions to the kinetic copolymerization equations.

Associate Professor Aleksander Janik is a specialist in the field of analytical chemistry of polymers, in gas and gel chromatography; his interests are also concerned with the characterization of polymer properties.

The late Associate Professor Marian Knopf was interested in adhesion and in the phenomena taking place at the interface of polymer-polymer and polymer-non-polymer compositions, and especially in mixtures of polymers and fillers.

Two professors of the Silesian University in Katowice cooperate closely with the Institute of Polymer Chemistry of the Polish Academy of Sciences in Zabrze; Professor Ludomir Tokarzewski is studying the phenomena of thermal resistance and flammability of polymers and plastics; he is also interested in flame retarding additives, especially for polyurethane foams. Professor Maria Tokarzewska is concentrating on crosslinked polymers such as polyepoxides and unsaturated polyesters.

In total, 10 professors are active at the universities and in the Institute of Polymer Chemistry of the Academy of Sciences, and a similar number of professors are working in polymer research in industrial institutes in the area of Gliwice/Zabrze in Silesia.