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Research Institute for Plastics Industry
Budapest, XIV. Hungaria krt. 114
Director: Prof. Dr. Gyula Hardy

The task of the Research Institute for Plastics Industry has been the realization and the development of the Hungarian plastics industry. In principle, the Institute is concerned with the problems of polymerization and polycondensation, that is to say, with the synthesis of plastics, with the modification of the properties of the polymers, with the investigation of the processing possibilities of plastics, and with the possible use of plastics in different fields of application. To provide for these tasks, the Institute carries out its activity in three locations. Chemical and physical laboratories, offices and the central library are dwelt in the central building; the Department for Processing Technology, engaged with the processing of plastics and with the testing of processed plastics articles, is located in the Gyarmat utca, and the pilot-plant of plastics production processes resides at the premises in Soroksár.

Research is supported by our library, comprising about 9000 books on technical literature, dealing with the practical and theoretical aspects of the plastics industry and related sciences. Moreover, 120 journals from all parts of the world inform regularly our scholars on developments in their special branch of research.

The organization of the Institute is adapted to the scope of activities. Research is carried out by departments and sections. The program of the Institute is in close correlation with the development program of the Hungarian plastics industry.

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It is the task of our Institute to place experts of suitable training at the disposal of the plastics plants to be errected and to contribute to the development of processes to be realized.

Section Prespective Research

The group is engaged with polymerization in the solid phase. The polymerization of various monomers in crystalline state opon irradiation is studied. Comparison is made between the crystal structure of the initial substance and that of the formed polymer. During these investigations, an exceptionally high rate of polymerization was found in the undercooled liquid state, and it was this very research group to call first attention to this phenomenon. The co-polymerization of eutectic mixtures, thus the co-polymerization of N-vinyl-pyrrolidon with N-vinyl-succinimide has been also investigated.

Section-leader: Prof. Dr. Gyula Hardy, Director of the Institute, Candidate of Chemical Sciences

Section Radiation Chemistry

A 60 Cobalt isotope of 500 curies os operated at the Institute. The effect of irradiation on plastics is investigated with this source, with a smaller Cobalt-gun of about 50 curies and with X-ray apparatus. The radiation source was used also in the investigation of graft mechanism. In this field, the influence of various factors on grafting reaction, e.g. monomer diffusion, radical concentration, were investigated primarily on a styrene model grafted on Teflon and polyethylene sheets. These experiments were recently supplemented by the measurement of Electron Spin Resonance with an apparatus built in our Institute: ESR-research is carried out under the leadership of Candidate Dr. Péter Hedvig. Experiences

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gained in the studying of graft mechanism are utilized in the production of grafted sheets, to be used for the preparation of ion exhange membranes. The prototype of a laboratory apparatus hes been constructed by the group for the preparation of polyethylene foils, cross-linked by irradiation and thus shrinkable.

Irradiation polymerization, proceeding in an electric field, is investigated by Candidate Dr. László Kiss.

Also novel type radiation-dosimeters based on plastics have been developed. One of them changes its electrical resistance in dependence of the actual radiation-dosis and thus, is suitable for the direct determination of the dosis. The other mehod involves a change in colour upon radiation.

Section leader: Dr. János Dobó, Candidate of Chemical Schiences.

Division for Polymer Micromorphology

This division deals with the investigation of polymer structure and the determination of the molecular weight, and chepe.

Work in the division is divided as follows:
X-Ray investigations
Electron microsoopy
IR-Spectroscopy
Determination of molecular weight by ultracentrifuging, by light scattering and by osmotic pressure measurements, respectively.

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The division is equipped with the most modern apparatus, permitting a thorough investigation of polymers. The following is a list of more important instruments available for structural analysis:

X-ray fine structure analysator, Type Müller-Micro 111
Low angle X-ray chamber, Type Rigaku-Dánki
Zeiss electronmicroscop
Zeiss IR spectrophotometer
Ultracentrifuge for the determination of molecular weight, Manufacture: MOM, Budapest.
Zeiss Schlieren-apparatus for the determination of the diffusion coefficient
"Sofica" light scattering meter, and other special instruments.

The division participates in several works of the Institute by carrying out measurements and tests. The crystalisation process of synthetic fibres, conditions of polyamide crystallisation and the change in dye uptake of polyamide fibres with the degree of crystallinity are studied thoroughly.

Important results were attained primarily in the investigation of polypropylene especially of fibres polypropylene.

A new method was developed on the basis of X-ray diagrams of polypropylene fibres, which permits the determination of deviations on the Y-rayinterferogram producted by changes in crystallinity and particle size of the crystalline phase, as well as the determination of the ratio of the amorphous and the crystalline part.

Investigations with the electronmicroscope and the analysis of the IR spectra of various plastics are in connection with this field of investigations.

The group concerned with the determination of molecular weight established correlations between the change in the con-

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ditions of formation and the molecular weight for polycarbonates and between the molecular weight for polycarbonates and between the molecular weight and the intrinsic viscosity for PVC. Interactions for different solvents were also studied.

Leader of the department: Dr. Géza Bodor, Candidate of Chemical Sciences.

Polyolefine Department

In accordance with the Hungarian program for industrial development, research in the polyolefine department of the Institute is concerned with the production of polyethylene, polypropylene and various co-polymers. The scope of these investigations involves both theoretical and technological problems. Among the theoretical problems, the investigation of the action mechanism of the Ziegler-Natta-catalysts is of primary importance. These investigations are carried out by Candidate Dr. József Várady. Candidate Dr. Antal Dankovits is engaged in the production of various olefinic co-polymers and in the determination of optimum conditions for the polymerization. In the research work pertinent to action mechanism, the proportions of the different component of the catalysts, the preparation technique of the catalyst komplex, and the relations between the crystal structure of the catalyst and the kinetics of the polymerization process are studied. In the investigation of the possible production methods of various co-polymers, a polymer of high softening point, having at the same time thermoplastic properties, was synthetized from ethylene and divinylbenzene.

Int the field of technological research, the manufacture on pilot-plant scale of triethyl aluminium and diethyl alumi-

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nium, respectively, required in the production of low pressure polyethylene, has been realized. Production of alkyl metal catalyst in the plant errected on the premisses in Papkeszi of Nitrokémia Ipartelepek is based on the process developed in and patented by the Institute. A continuous reactor, also on pilot-plant scale, for the polymerization of ethylene has been built, which proved satisfactory in every respect. The plan documentation of a larger continuous polymerization reactor has been handed over to the People's Republic of Poland.

Leader of the department: Dr. Arthur Simon, Candidate of Chemical Sciences.

Synthetic Fibre Department

In this department, research is concerned with the production technology of synthetic fibres and with the development of polymers suitable for synthetic fibres. The investigation of the effect of various acid catalysts on the polymerization mechanism of caprolactam is an example of this latter objective. When using phosphoric acid as catalyst, the polymerization rate of caprolactam is three times as high as that to be attained with water or catalysts deliberating water. The process may be utilized in the manufacture of polyamide fibres. When hydrochloric acid is used as catalyst, different sections can be distinguished in the rate of polymerization, the mechanism of each section having been interpreted individually. A polyamide type of low melting point, soluble in alcohol, has been developed, which can be used as a powder, for adhesive in tailoring, while plates formed of it may be made sensitive to light and can be used, therefore, in the printing industry as stereo-plates.

For the changing of the properties of polyester fibres,

polyethylene glycole therephthalate fibres were modified with various glycide ethers and polyglycol ethers. This procedure permitted to develop a polyester fibre of improved dye uptake and reduced rigidity.

Research on polypropylene fibres involved besides the development of the technology of fibre forming on the mechanical properti - of the obtained fibres. To improve the stability to light of the fibre, several stabilisators were examined. With the aim to improve the dye uptake of plypropylene fibres, the technique of grafting on the fibre was investigated. Besides the irradiation of the fibres with gamma-rays, also the chemicaly iniciated grafting was studied. With this method, several types of fibres, easy to dye, could be produced on a laboratory scale. Experiments on the fibre forming properties of plastic mixtures on polypropylene basis are in course.

Leader of the department: Dr. Frigyes Geleji, Deputy Director, Candidate of Chemical Sciences

Polyester Section

Different polyester resin types, suitable for the various intended uses, have been developed. To interpret the mechanism of polyesterification, the influences of various monomers were investigated. In the first place, the polycondensation reaction of maleic acid and fumaric acid with different glycols has been studied. The thermal stability of the resins and the polycondensation reaction proper were investigated by differential thermogravimetric analysis. /with a Derivatograph/. The Section works also on the development of novel type, self-estinguishing polyester resins. On the basis of laboratory experiments, types suitable for the electric industry and for glass-fibre reinforced materials of construction on polyester basis have been manufactured on an industrial scale. For special purposes, also optical adhesives have been developed. This adhesive was used succesfully for the setting up of lense combinations for microscopes,

resistant to tropical conditions.

Section leader: Mrs. Ibolya Vancsó- Szmercsányi, M.S.

Light-Sensitive Polymers Section

This Section has been carrying out investigations for the priting industry on the production of plastics sheets based on acrylates and methacrylates, which, besides polyamids, may be made sensitive to light. The basis of the plates is amino-ethyl--methacrylate homopolymer's- methacrylic acid salt, to which light iniciators and other additives are componended. The experimental manufacture on industrial scala will take place in the next future.

Section leader: Miss Gabrielle Pogány, M.S.

Section: Modification of Macromolecules

This group is engaged in secondary modification of various polymers. The most important out of this work is the production of chlorinated polyethylene, a component in the manufacture ofshockresistant PVC. Candidate Dr. Pál Kriston works in the production of sulphoclorinated polyethylene, which is suitable for weatherprof coatings. Experiments on the secondary modification of PVC showed aluminium nitrate to be an efficient stabilizer for PVC.

Section leader: dr. Zoltán Wolkóber, Candidate of Chemical sciences.

Ion-Exchange Section

The task of this group is the synthesis and the testing

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of various, especially porous, ion-exhange resins and related products.

Several types of ion-exchange resins have been developed and produced on industrial scale. Strong and weak anion and cation exchange resins have been synthetized. Recently, research work on bipolar resins have been undertaken beside the experiments for increasing of the capacity of the resins. /Candidate Dr. József Szántó works on the synthesis and on the testing of complex-forming /chelating/ resins.

Promising research work has been in course with the objective to prepare different types of ion-exchange membranes. This work involves, beside a basic research on the action mechanism of ion-exhange membranes, research on their practical application, primarily in aluminium oxide manufacture.

Section leader: János A. Mikes Ph. D., M.S.

Department for Plastics Application

The ask of this department is to expand the field of plastics applications. Experts workung in this department are specialists of the single branches, who, on the other side, disposing of a wide knowledge in the plastics industry, take the initiative to apply certain plastics in the individual fields of life. The Institute collaborates with the electircal industry, the building industry, the machine building industry, with agricultural institutions, etc. In accordance with this task, enterprises consulting the Institute also receive advise and active help from the Department in realizing different plastics applications. Beside plastics developed in the Institute, the department also recommends imported plastics types, should these be more suitable for the intended purpose. The department performs also economic analyes showing the savings attained by the application of plastics. Moreover, it helps in the establishing of the national

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economic plan, by evaluating from the economic aspect the developments of the worlds plastics industries and their expected influence on Hungarian conditions.

Leader of the department: Hugó Macskásy, chem. eng.

Department for Processing Technology

The department is equipped with machines for the processing of plastics and with devices for their testing. The department has been concerned with the qualification, from the point of view of processing, of the plastics types developed in the institute and has got the ask to become aquainted with the processing details of a wide variety of foreign types of plastics Beside the clarification of the rundamental principles of vacuum forming, research is carried out also on the manufacture of foamed plastics. Int this field attention is centered on the production of soft and hard PVC foams, on foamed polyethylene and polyvinyl alcohol. In connection with this work, microporous filters accumulator plates etc. have been developed in addition to the above mentioned materials.

This practical work is supplemented by fundamental research in the field of the compatibility of plastics. Among others, fundamental problems concerning the possibilities of the preparation of polymer mixtures, with special reference to shatterproof PVC, are dealt with.

Leader of the department: Tamás Pazonyi, chem.eng.

Pilot plant

In the Sorokšár Division, the production of various products prepared in the laboratory is being realized, on a

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pilot-plant scale.

On the basis of experiences gained in the operating of the pilot-plant, our processes are recommended for industrial realization. Polyvinyl alcohol, various polyvinyl acetals, polyamide blocks, different types of polyester resins, different types of epoxy resins, etc. have been developed in the pilot plant.

On the premises of the pilot plant, there are also a few research laboratories in wich work is carried out on the production of certain types of epoxy resins and their cross-linking agents. Fundamental research on the mechanism on the cross-linking of epoxy resins, with the aim to clear also the action mechanism of the catalysts, is also in course.

At present, research on laboratory scale is carried out also on the production of polycarbonates, with the objectives to compare different methods of condensation and simultaneously, to aquire knowledge in its polycondensation techniques. On hand of these experiences, the construction of a pilot plant for the manufacture of polycarbonates is under way.

Leader of the Pilot Plant Division: László Csillag, chem. eng.

Section for Mechanical Engeneering and Technology Research.

This Section has a double task. In has to carry out design work necessary both for the research groups of the Institute and for industrial realization. Construction is done for special equipment and automatic devices, and technological experiments are carried out with these facilities. As their own research work, the section develops special processes and machinery. Emphasis is laid on the processing technology of glass fibre reinforced plastics.

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Among others, the Section has realized the development of a continuous experimental equipment for the manufacture of low pressure polyethylene; the realization of the manufacture of metallic alkyls on industrial scale; the realization of a continuous manufacture of corrugated reinforcet polyester sheets.

Section leader: Géza Kecskeméthy, mech. eng.

Plastics Standards Section.

The program of the section comprises the preparation of Standards, Tentatives and Proposals for the chemical production, for the transformation and application of plastics. The Section is controlling standardization problems of products of 8 factories.

The Section cooperates with the work of ISO/TC 61, /International Standard Organization for Plastics/, in supervising the methods of material testing and by elaborating new proposals, for such. The Section has been active in the work of Standardization for Plastics in the Hungarian Bureau of Standardization and is an expert in the standardizing problems for the Ministery of Heavy Industry.

Research work for finding new Methods of Testing, is done in the course of the above mentioned work, too.

Problems of interest are e.g.: Standardization of polyurethane foams, investigation of the effects caused by impurities in urea-formaldehyde molding powders; thermal stability, - loss of plasticizer - content, - ageing of PVC-products, etc.

Section Leader: Mrs. Martha Laczkó M.S.

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