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Final Report

14th UNIDO In-Plant Group Training Programme in the Field of Plastics Technology

AUSTRIA 1983

US/INT/83/070
Fourteenth UNIDO Austria Group Training Programme
in Plastics Technology

Organized by the United Nations Industrial Development Organization (UNIDO) in co-operation with the Government of Austria

to be held

from 11 October to 19 November 1983 in Vienna, Austria

Final Report

by
H.HUBENY
Programme Director

Z1.2T 138/Hu/Dö, 19 November 1983
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TECHNOLOGISCHES GEWÄRBMUSEUM
1. Acknowledgments:

The LKT-TGM is deeply indebted to the following institutions for organizing the seminar and for the excellent and successful cooperation.

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Mrs. I. Lorenzo
Mr. R. Gumien
Mr. Sato
Dr. D. Gardellin
Mrs. A. Uchida
Dr. H. May

Mr. H. Pichler
Mr. N. Yousef
Mrs. U. Vassudeva
Mr. E. C. Bull
Mr. K. Sepic

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Mr. U. Stacher
Mrs. B. Dekrout

Austrian Federal Ministry of Education and Arts:
Mr. W. John
Mr. O. Tischler
Mr. D. Uyka
Mr. F. Plank

Austrian Federal Chamber of Commerce:
Mr. K. Haas
Mr. F. Hlawati
Mme. S. Zemek

Austrian Society for Polymer Engineering (GFKT):
Mr. A. Herrman
Mr. H. Margarítha
Mr. E. Papst

Mr. P. Roos
Mr. G. Schwerz
Mr. L. Katzmayr

The Community of Tauplitz:
Mr. Raimund Geyer
Mr. Sepp Lösch

Hochfellner Hausmusik

We have of course, also appreciated any contribution towards the programme, in form of free materials, lectures, invitations and visits presented to us by companies and individual persons in Austria and abroad.
2. History of the UNIDO/AUSTRIA Training Programme in Plastics Technology

Group Training Programmes for engineers and advanced technical personnel from developing countries are organized by UNIDO in co-operation with the Governments and Industries of countries having the specialized know-how and experience in the field in which the training is carried out. It is being increasingly recognized that intensive, systematic and closely controlled training in a suitable industrial environment is one of the most effective ways of acquiring industrial experience in a relatively short time. Through these programmes a means has been found of providing an experience that might not otherwise we possible in developing countries.

The programmes help to bridge the gap between the specific requirements of industry and the theoretical knowledge the participants have acquired through their studies. They also provide an opportunity for an exchange of ideas and experience both among senior personnel of industry and research institutes in industrialized and developing countries and among those from the developing countries themselves.

Austria and IKT-TGM are responsible in the field of plastics technology since 1970.

Since 1970 IKT-TGM held fourteen programmes with a total of 243 participants from 66 countries.

The regional distribution was the following:

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60% of the participants came from companies, 40% from institutes and government organizations.
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(66) 166 9 22 20 26 243
3. Background and Objectives

The programme, organized by the United Nations Industrial Development Organization (UNIDO), in co-operation with the Government of Austria, is one of the series of UNIDO training programmes on specific sectors of industry for engineers from developing countries. The programme will be carried out by the Laboratorium für Kunststofftechnik (LKT-TGM). This programme, the fourteenth in succession, has been implemented annually since 1970.

The rapid increase in the use and application of plastics in industry, agriculture and homes in recent years has places plastics among the leading basic materials used for economic development of the developing countries. Parallel to this increase in the demand for plastics products, the developing countries have embarked on the establishment and development of a plastics industry to meet their own demands and even export to other countries. However, besides the financial difficulties, they are also encountering technological difficulties in processing and in acquiring raw materials.

The principal objective of the programme is to bring together a group of selected persons whose work is expected to benefit from a concentrated programme in modern plastics technology which otherwise would require a long period of training, research and development work. The programme is designed mainly to emphasize plastics fabrication technology, including the use and selection of modern processing equipment, quality control and testing, as well as various applications of plastics.

The programme has received the support of the Austrian Federal Chancellery, the Austrian Federal Ministry of Foreign Affairs, the Austrian Federal Ministry of Education and Fine Arts and the Austrian Federal Chamber of Commerce.

The Laboratorium für Kunststofftechnik (LKT-TGM), a leading technological institute has promised full co-operation in running the theoretical and practical course in plastics technology in its premises, utilizing its laboratories and equipment for this purpose. The institute has a staff of highly qualified specialists.

The programme will consist of theoretical and laboratory training, study visits and an evaluation session.

The theoretical part of the training will cover a general introduction to the plastics industry, the chemical and mechanical technology of plastics, raw materials, utilization of plastics equipment and tools, etc.

The practical training will be implemented in laboratories of LKT-TGM in Austria. The participants will be assigned to small groups according to their field of specialization and training needs as much as possible.
4. The Training Programme

4.1. Subject List

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<td>MEM</td>
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<td>FI</td>
<td>Finishing</td>
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<td>FO</td>
<td>Foaming</td>
<td>6</td>
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<tr>
<td>IC</td>
<td>Injection and Compression Moulding</td>
<td>18</td>
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<tr>
<td>MF</td>
<td>Machining and Forming</td>
<td>6</td>
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<td>MM</td>
<td>Mould Making</td>
<td>2</td>
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<tr>
<td>PC</td>
<td>Polymer Chemical Analysis</td>
<td>4</td>
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<td>PP</td>
<td>Polymer Physical Analysis</td>
<td>10</td>
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<td>QC</td>
<td>Quality Control</td>
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<tr>
<td>RF</td>
<td>Reinforced Plastics</td>
<td>6</td>
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<td>TS</td>
<td>Trouble Shooting</td>
<td>4</td>
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</table>

Subtotal Practice: 110

Grand Total: 174
4.2. Content of Lectures and Lecture Notes

4.2.1. Design of Lecture Notes

The lectures notes have been adapted and developed in accordance with UMIDO, with the participants and with the experience of eleven programmes since 1970. To meet the general, practical and theoretical needs of the participants three levels of comprehensive information are offered in form of:

- general lecture notes (880 pages)
- special lecture notes (270 pages) and
- research papers (60 pages).

For this programme the following lecture notes have been edited or revised:

- Plastics Physical Technology (226 pages)
- Plastics Application Engineering (46 pages)
- Polymer Physical Analysis (24 pages)
- Polymer Chemical Technology (6 pages)

4.2.2. General Lecture Notes (Theory)

TECHNOLOGY TRANSFER AND DEVELOPMENT (TTD)

H. Hubeny

The Global Situation (selected Indicators):

Principles of Development:
Historical Models - Development Analysis

Technology Transfer:
Assumptions - Definitions - Concepts - Cost of Technology Transfer - Characteristic Stimuli and Barriers - Effects

Documents:
Code of Conduct - OECD Classification - National Paper of Austria

Models of Execution:
Macro-Level Conditions - Micro-Level Conditions - Plastics Technology - Plastics Development Activities

Personal Questions:
References:
Classification of plastic materials
Formation reactions
Functionality
Polymerization reactions: Addition polymerization (free radical mechanism - ionic mechanism) - Condensation polymerization - Copolymerization - Auxiliary materials for polymerization.

Physical Behavior of Plastics

Transition States: Hard-elastic state - Setting or Softening range - Glass transition - Brittle point - Elastomeric state.

Polyolefines - Polyethylene (PE)-Modified Polyethylene-
-Chlorinated Polyethylene (CPE)-Sulfochlorinated Polyethylene-
-Crosslinked-Copolymers with Ethylene-Ethylene/Vinylacetate (EVA)-Ethylene/Vinyl Alcohol (EVAL)-Ethylene/Ethylacrylate (EEA)-Ethylene/Butene or Hexene (see also LLDPE)-Degradation of Polyethylene-Polypropylene (PP)-Modified Polypropylene-
-Copolymers with Ethylene (EPM and EPDM)-Polybutene -1 (PB)-
-Polyisobutylene (PIB)-Poly-4-methylpentene -1 (PMP)-
-Unsaturated Polyolefines-1,2-1,4-Polybutadiene-Polyisoprene-
-Polyoctenamer-Ionomers-Other Polyolefines,Trends in research and development.

Polyvinylchloride (PVC) - Plasticized PVC-Modified PVC-
-Compounds (Blends) with CPE-Compounds with EVA and graft polymers of EVA with VC-Compounds with Acrylo/Polymer-
Copolymers with Vinylidenechloride VDC/Acrylonitrile-
-Copolymers with Maleic-imide.

Polystyrene (PS) - Unipolymers-Copolymers-Copolymers with
-α-Methylstyrene-Copolymers with Acrylonitrile (SAN)-High impact Polystyrene-Styrene/Polybutadiene graft polymers-
-Styrene/Acrylonitrile-butadiene-Styrene/Maleic Anhydride
(SMA)-Expanded polystyrene (EPS).

Acrylcs - Polycrylonitrile (barrier plastics)-Polyacrylates-
-Polymethylenacrylates (PMMA)-Polymethacrylimides-
-Reclamation of MMA from Acrylic wastes.

V-Vinylpolymers
Polyethers - Polyoxymethylene (POM)-Polyethylenoxide (PEO).

F-Polymers - Polytetrafluorethylene (PTFE)-Polytrifluorochloroethene (FCFSE)-Copolymers-Copolymers with Hexafluoro-
-propylene-Polytetrafluorethylene-co-perfluoromethylvinylether-
--Polyperfluoralkylvinylether (Teflon FFA)-Polyvinylfluoride
(PVF)-Polyvinylidenefluoride (PVDF).

Silicones - Methylpolysiloxanes-Phenylpolysiloxanes (PSI).

Polyamides (PA) - Polyamide 6 and 6,6-Polyamide 4 and other aliphatic Polyamides-Aromatic Polyamides.
Polycarbonate (PC)
Polyterephthalates (PET, PBT)
Polyphenyleneoxide (PPO)
Polysulfone (PSU)
Polyphenylenesulfide (PPS)
Polyethersulfones (PES)
Phenol/Formaldehyde Resins (PF)
Urea/Formaldehyde Resins (UF)
Melamine/Formaldehyde Resins (MF)
Unsaturated Polyesters (UP) - UP-Resins-Crosslinking of UP-Chemistry of Peroxides-Alkyd Resins.
High Temperature Resistant Polymers - Polyimides (PI)-Polybenzimidazole-Polyimidazopyrrole (Pyron)-Polycyclodubadiene.
Polyepoxides (EP)
Flame Retardancy of Polymeric Materials
Auxiliary Chemicals
Health Hazards and Toxicity
Degradation and Stabilization
Environmental Behaviour of Plastics Materials
Plastics Waste Management
Reclamation, Recycling and Reuse of Plastics Waste.

PLASTICS PHYSICAL TECHNOLOGY (PPT)
H. Hubeny

Plastics Technology
Introduction
Cycle Process
Model Matrix
Quality and Polymer Processing: Materials - Processes - characteristic functions

Conversion Processes: Refining - Syntheses - Compounding - Fabrication - Machining and Forming - Finishing - Application - Recycling

Molecular Structure
Linear Macromolecules: Molecular Models - Molecular weight - Helical Conformation - Polarity
Crosslinked Macromolecules
Thermodynamics of Molecules: Potentials - Molecular Motion

Morphological Structure: Amorphous - Mesomorphic - Crystalline Structure
Additives: Stabilizers - Fillers and Reinforcement Materials - Plasticizers - Colorants - Flame Retardants - Antistatic Agents - Blowing Agents - Antimyotika (Biozides) - Lubricants - Activators - Nucleating Agents

Rheology
Elasticity: Crystalline Elasticity - Rubber Elasticity
Viscosity: Newtonian Fluids - Non - Newtonian Fluids - Flow Theory - Morphological Interpretation

Properties of Plastics
Classification: Oscillation Twisting Test - Definitions (Thermoplastics, Thermosets, Elastomers, Thermoelastics)

Abbreviations
Price

Statistical Data
Thermoplastics Moulding Materials
Bulk Polymers: Polycrystallines (PE, PP, PB, PMP Ionomers) - Styrene Polymers (PS, BS, ABS, SAN) - Vinylchloride Polymers (PVC + Cop).
General Thermoplastics: CA, CAB - Chlorinated Polyethers - Fusible Polyfluoro-carbons (FCTFE, FZFEP, PVDF)

Thermosetting Moulding Materials:
PF - UF - MF - UP - EP - PUR

Thermoelastic Moulding Materials (PMMA)

High Temperature Resistant Moulding Materials:
PTFE - PI - PBI - PBT - Developing Products.
Compounding

Terms

Particle size reduction: Crushing - Grinding


Pelletizing

Compounding parameters: Homogeneity - Gross uniformity - Texture and local structure - Melt behaviour - Colour matching.

Continuous Processing

Classification


Calendering: Operation - Calender types - Rheological calculations - Calender coating and laminating.

Extrusion: Operation - Classification of extruders - Single-screw extruder design - Function - Extruder size and L/D-ratio - Feed screws - Theory of plasticating single screw extruders - Feed section - Transition section - Metering section - Screw and die characteristics - Multiple screw design - Twin screw extruder design - Function - Calculations - Screw and die characteristics - Extrusion processes - Internal flow design - Basic rheological relations - Rheology applied to die design - Tubular extrusion - Sheet and film extrusion - Profile extrusion - Extrusion coating and laminating - Foam extrusion - Extrusion controls and instrumentation - Process parameter control - Thickness control - Supervisory control loops - Cooling stresses.

Discontinuous Processing (Moulding)

Classification


Compression moulding: Operations - Moulds - Flow and curing behaviour - Shrinkage behaviour - Preheating - Wet moulding - Controls.

Transfer moulding: Operations - Moulds.


Fabricating of Semi-Finished Goods

Technical terms

Machining: Operations - Physical conditions.


Separating

Finishing

Painting


Hot stamping

Embossing

Irradiation

Application

Systematic development of application

Standards

Waste

Recycling

Cutting mills

Reprocessing lines

Extruder screen changers

Incineration

Outlook
MECHANICAL ENGINEERING AND MOULD DESIGN (MEM)
R. Hillisch, H. Revesz

Extrusion
Extruder Plants and Dies: Pipe Manufacturing - Blown Film - Flat Film - Sheet Extrusion - Lamination - Wire - Covering - Pelletizing Plants - Monofilaments - Profile Extrusion Plants.

Pre-Set Elements: Silos - Transporting Systems - Compounding and Reworking Machines - Mixers - Kneaders - Mills - Pre-heating- and Drying Equipments - Vent Systems.


Annexed Equipment: Sizing Dies - Cooling - Take off - Control Devices - Signators - Preliminary Treatment - Separating Equipment - Post Forming Equipment.

Principles of Extruder Die Design


Molding of Thermosets.
Processing Techniques: Compression Molding - Transfer Molding - Injection Molding


Additional Equipment: Dosing - Preforming - Preheating - Finishing

Molds: Open Flash Mold - Positive Molds - Split Molds - Transfer Molds - Runners and Gates - Transfer Pot and Plunger Leaders - Ejector Pins - Mold Heating - Types of Steel - Special Machining Molds.

Design of Compression Molded Parts
Requirements - Draft of Surface - Wall-Thickness - Roundings and Ribs - Undercuts - Holes - Slots - Design of Threads - Metal Inserts.

Injection Molding

Machines: Classification - Technical Data - Injection Units - Screw Plunger - Nozzles - Closing Units - Safety Devices.

Molds: Elements - Design of Sprue, Runner and Gate - Types of Molds: Single Cavity, Multiple Cavity, Three Plate, Four Plate, Split, Side Pull, Hot Runner, Calculation - Design of Molds.

PLASTICS APPLICATION ENGINEERING (PEN)
W.R. Jessenig

Plastics Survey
Shear modulus temperature function
Plastics, materials for constructions
Thermoplastics
Thermosets
Composites
Hybrid systems
Long-time behaviour (static)
Stress-strain behaviour depending on temperature test speed and moisture
Economic aspects
Plastic points, tolerances
Construction of models and prototypes
Basic principles for mechanical calculation
Temporary variable deformations
Characteristic dimensional functions
POLYMER PHYSICS (PPH)
H. Dragun, H. Muschik

Density Measurement
Measurement of Melt Viscosity
Measurement of K-Value
Measurement of Viscosity, Number and Determination of Intrinsic Viscosity
Optical Microscopy and Preparation
Electron Microscopy and Preparation
Thermal Analysis
DSC - Differential Scanning Calorimeter
TMS - 2 Thermomechanical Analyzer
TGS - 2 Thermogravimetric Analyzer

CONTROL ENGINEERING (CEN)
F. Gregori

Control Loop

Controlled System: Time-Behaviour - Heating-zone as Controlled System

Temperature Measurement

Thermocouples

Controllers
Continuous Controllers
Two-Position Controllers: Galvanometric Controller - Chopper bar Controller - Controller with inductive Pick-Up - Controller with Photoelectric Scanning - Electronic Controllers - Thermocouple as Detecting Element - Resistance Thermometer as Detecting Element.

Temperature Control
Hunting
4.2.3. General Lecture Notes (Practice)

**COMPOUNDING AND CALANDRING (CC)**
H. Wolanek

The Production of PVC-Compounds by Heater-Mixing
Testing Methods for PVC-Compounds

**COMPUTATION ENGINEERING (CE)**
F. Mayer

General Facts
Structure of an Computer
Programming Operations
Connection with an EDV-Plant

Practical execution of a Programme at the Computer
Other Possibilities of Application in Plastics Engineering.

**CONTROL TECHNIQUES (CT)**
G. Minarovich

Open-Loop-Control
Voltage supply
Standardized connection diagrams and symbols
The Use of Instruments for measuring the Current, Voltage and Resistance

Functional Description of a Reversing Contactor
Combination Automatic-Control

Definitions
Automatic Control System and Block Diagram

Transient Response of a Controlled Member

Temperature Behaviour of a Barrel Zone Controlled by
Two-Step Action Controller without Feedback

Temperature Behaviour of a Controlling Member with
Two-Step Action Controller and Feedback

Electrical Methods for Measuring the Temperature
EXTRUSION (EX)
H. Revesz
Production of Tubular (Blown) Films
Extrusion of Blown Double-Layer Films
Production of Sheets
Production of Rigid PVC-Pipes
Blow Moulding
Production of Polyethylene Pipes

FINISHING (FI)
J. Smelik
Electroplating
Materials
Part Design
Moulding Factors
Chemical Pretreatment

FOAMING (FO)
H. Hubeny
Classification of Plastic Foams: Material – Stiffness
- Cell Morphology – Density – Density Distribution –
Fabrication Process

Properties
Processing: Expandable Bead Methods – Reactive Foam
Moulding (Low Pressure – High Pressure – Mould Carrier –
Foaming Plant – Slab Stock Foaming) – Thermoplastic
Foam Moulding – Foam Extrusion

Polyurethane Technology:

Polyurethanes (Isocyanates – Polyethers – Polyesters)
- Mould Materials – Practical Exercises.

INJECTION AND COMPRESSION MOULDING (IC)
H. Graf, R. Hillisch

Introduction
Adjustment of Processing Parameters.
Influence of the Mass Temperature and Injection Pressure
on Shrinkage and Mechanical Strength of Polystyrene Test
Bars.
Testing of Performance Properties of Standardized Panels
made of Expanded Thermoplastics with a varied injections
Speed.
The Principles of Process Control in Injection Moulding

Compression Moulding of Testing-Cups
Determination of Curing time (Stiffness)

MACHINING AND FORMING (MF)
E. Strohmeyer

Machining: Cutting - Guillotine shears - Drilling
- Screwing - Turning - Planing - Milling - Filing
- Grinding - Polishing.

Welding: Press-Welding - Hear-Impulsive Welding
- High Frequency Welding - Hot-Gas Welding.

Forming: Bending - Whirl-Sintering - Vacuum Forming.

Workshop - Drawings - Work Instructions.

TESTING (PC, PP, QC)
W.R. Jessenig, H.J. Fischer, H. Ruben

Part I

Molecular Investigations
Viscometry - Viscosity number - Intrinsic viscosity -
K-value - Distribution of Molecular Weight - Density and specific Volume.

Structural Investigations
Oscillating twisting test - Thermoplastics - Elastomers -
Thermosetting Materials - Glass Temperature - Dynamic
Glass Transition Temperature (according to DIN standards) -
Melting Temperature - Decomposition Temperature - Melt
Viscosity and Flow - Flow - Rheology - Terminology -

Stability Behaviour
Permeation of Gases and Vapours - Mechanism of a Solution Diffusion - Gas Permeability.

Mechanical Behaviour
Optical Behaviour

Photoelasticity

Thermal Behaviour
Determination of characteristic physical values - Dimensional stability under heat - Dimensional stability under heat according to Martens - Vicat Softening Point WSP - Dimensional Stability under Heat according to ISO - Brittleness Temperature Tests according to DIN and according to ASTM - Shrinkage behaviour - Proof of Orientation in Moulded Parts - Classification of High Building Materials according to their Combustion Behaviour - General Facts - Executing of Test I - Evaluation - General Facts Test II - Execution of Test II - Evaluation.

Heat - and Sound Technology

Thermal Conductivity - Steam Permeability - Thermal Insulation - Step Sound Insulation - Air Sound Insulation - Degree of Acoustic Absorption - Dynamic Elasticity Modulus and Loss Factor.

Electrical Properties

Volume-and Surface Resistance - Tracking Resistance - Polarization and Dielectric Constant - The polarization of an insulating material - The dielectric constant is a criterion for the amount of polarization of an insulating material - Dielectric Loss Factor.

Part II

Hardness Testing by the Indentation Test
Dimensional Stability after Heat Storage (Shrinkage Test)
Testing of Homogeneity
Testing of Flammability
Compression Test
Tensile Test

Part III

Ultrasonics in Processing and Testing Materials

Ultrasonics in the Processing of Semi-Finished Goods
General Facts - Method - Sound Sources - Ultrasonic Rivetting - Ultrasonic Embedding.

REINFORCED PLASTICS (RF)

R.Hubacek, W.R.Jessenig

Technology
Reinforcing Materials
Types of Plastics
Practical Hints of Processing
4.2.4. Special Lecture Notes

The objective of the special lecture notes is to inform on new developments in processing, application, recycling and quality control of plastics technology at a higher comprehensive level.

DATA CONVERSION IN INJECTION MOULDING
H. Graf, P. Mayer

General Remarks
Measuring Pressure: Piezoelectric Transducer - Charge Amplifier.

Measuring Temperature: Fluctuation Compensation - Temperature Sensors - Preheatable Thermocouples - Plotter System

Measuring Front Flow
Measuring Distance: Inductive Measuring Sensors - Carrier Frequency Amplifier

Computerised Measuring: Digital Voltmeter - Interface - RS 232 Interface - System Computer

QUALITY CONTROL AND DAMAGE ANALYSIS BY MORPHOLOGICAL METHODS
H. Dragaun

Introduction: Definition of Quality - Increase in Quality - Technological Problem - Continuous melt viscosimetry - Polypropylene Pressure Pipes - Morphology


Practical Application in Damage Analysis:
Crack Formation in Polyethylene (PE)-Pipe - Irregular characteristics of Polyethylene (PE) sheets during finishing - Different Abrasion Characteristics of a Polypropylene (PP) Drive-Component - Differentiation of Polyblends in various Polyethylene (PE) types - Different Fracture Behaviour of Polypropylene/Polyethylene Copolymer - Fracture in a Moulded Part (fitting) of Rigid Polyvinylchlorid (PVC).
QUALITY CONTROL OF GRP PIPES
W.R. Jessenig

Designation Control:
Company Control: Resin Control (Purity - Viscosity - Solid Body Content - Gel-Time - Reactivity - Thermal Stability)
Textile-Glass Test (Fineness of Strand - Humidity - Rod Bending Test)
Filler Control (Resin Absorption - Sieve Analysis)
Reactant Control

Production Control:
Regular Production Control - Choice of Specimens and Test Frequency - Requirements - Test Procedure - Gel-time - Wall thickness
Random Production Control

Acceptance Control

External Control:

NEW RURAL APPLICATIONS OF PLASTICS
H. Muschik

Introduction.
Protection of Plants by Nets.


Containers for Plants.
Non Wovens for Mulch-Technique.

Irrigation: Introduction - Spray Tube - Sprinkler Irrigation Plants.

Waste Water and Drainage: Waste Water - Drainage.

Heating of Greenhouses.


Coating.
Technological Transfer.
ENVIRONMENTAL ASPECTS OF PLASTICS TECHNOLOGY
E. Wogroly

Introduction.
UN-Activities in the Field of Environmental Protection.

The Environmental Impact of Plastics:
Air Pollution: The Properties and Effect of Pollutants - Ozone, its possible biological Effects and Reduction in the Atmosphere - MAK-Values

Formaldehyde Odor and Health Problems within Residences:
Toxicity of Formaldehyde.
The Vinyl Chloride Problem.
Waste Water Treatment.


4.2.5. Research Papers

The objective of research papers is to offer information in the field of polymer science and technology of LKT-TGM at applied research level.

DATA CONVERSION IN TECHNOLOGY AND MORPHOLOGY

Extrusion:


Injection Moulding:


Morphology:

A Comparison of Critical Elongation as Determined by the Ball Indentation Method and by Creep Test on Injection Moulded Rigid PVC Test Specimens - The Technology and Morphology of Polypropylene Pressure Pipes - Microfibrils in Brittle-Fracture-Surfaces on Isotactic Polypropylene at 4.2 K - Shear-Induced B-form Crystallization in Isotactic Polypropylene.
POLYURETHAN STRUCTURAL FOAMS


RECYCLING

The Behaviour of Household Refuse containing PVC in Incinerators.
4.3. Special Lectures

20 October 1983:  Mr. Kaminski
Chemische Werke München, Otto Bärlocher
Ges.m.b.H.
Stabilizers for PVC-extrusion and injection moulding processing

31 October 1983:  Dr. O. Abu Zaid
Director General of PDC-Alexandria Egypt
Plastic Development Centre
Plastics in agriculture

8 November 1983:  Mr. A. Schätzschock
Elwas Company
Manufacturing of Elwas-file and application

18 November 1983:  Prof. Dr. Hermann F. Mark
Progress in Polymer Science and Technology
5. Participants

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6. **Staff for the Training Programme**

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Director of IKT-TGM: AV Dipl. Ing. Dr. techn. H. Hubeny

Deputy Programme Director: Ing. R. Hillisch, Ing. W. Michel

**Organisation Committee:**

AV Dipl.-Ing. Dr. techn. H. Hubeny  
Prof. Dipl.-Ing. Dr. techn. E. Wogroßy  
Ing. R. Hillisch  
Ing. W. Michel  
Ass. Ch. Fabiankovitsch  
B. Dörr  
H. Braunsteiner

**Lectures:**

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Prof. Ing. Dkfm. H. Graf  
Ing. R. Hillisch  
AV Dipl.-Ing. Dr. techn. H. Hubeny  
Prof. Dipl.-Ing. Dr. techn. W. R. Jessenig  
Sts. Ing. R. Jirsa  
Prof. Dipl.-Ing. W. Mähr  
Prof. Dipl.-Ing. Dr. techn. F. Mayer  
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Prof. Dipl.-Ing. Dr. techn. E. Wogroßy  
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A. Imre  
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Ing. W. Michel  
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Ass. Ing. M. Radak  
Ass. A. Revesz  
Ing. H. Schermann  
FL H. Seifert
7. **Plant visits**

To the special interest of the participants 13 plant visits during the six-week course in Austria were organized by LKT-TGM. The selection of the plant according to the interest of the participants gave a regional and technical survey on the Austria plastics industry:

**RATTENFELD Kunststoffmaschinen Ges.m.b.H.**
Wr. Neustädter-Straße 81
2542 Kottingbrunn

**CHEMIE LINZ AG**
St. Peter-Straße 25
4021 Linz

**CINCINNATI MILACRON AUSTRIA**
Laxenburger Straße 276
1232 Wien

**COUDEHOVE Ges.m.b.H.**
Gorskgasse 15
1230 Wien

**LUDWIG ENGEL KG**
4311 Schwertberg

**FEPLA-HIRSCH**
Wiener Straße 113
2700 Wr. Neustadt

**GABRIEL CHEMIE**
Stipcakgasse 6
1234 Wien

**HALVIC**
5400 Hallein

Injection moulding equipment, blow moulding machines

PE, PP-Compounds, Staple Fibres, Films, Plastics-Processings

Twin Screw Extruder, Dies, Down-Stream-Equipment

Reaction injection moulding of GUP

Injection Moulding Machines, Mould Making

PE, PP film blowing, finishing, welding

Thermoplastic masterbatches, coloration, formulations

PVC raw material production
IFW-Manfred Otte
Pyhrnstraße 73
4563 Micheldorf

INTERNORM Ges.m.b.H.
Ganglgutstraße 131
4091 Oedt

NAUE & NAUE
8974 Mandling

POLOPLAST
Polooplaststraße 1
4060 Leonding

KARL WESS ORG
Wiener Straße 54-56
2640 Gloggnitz

Moulds, dies

PVC window profiles, windows

Moulded foam, slabstock foam, special purpose machines

Pipe Extrusion, Injection Moulding, Pipe and Fittings Systems

Mould- and Die-Making

Individual plant visits have been arranged to

OSWAG-Österr.Schifffs Werfte AG
Derrflingerstraße 15
4027 Linz

Chemiefaser Lenzing AG
4860 Lenzing

Reichhold Chemie AG
Breitenleerstraße 97-99
1220 Wien

Para-Chemie
Hauptstraße 53
2440 Gramatneusiedl

Extruders, down stream equipment

Stretch film equipment

Microscops

PMMA casted sheets
8. Equipment for the Training Programme

ALPINE, BRD; Extruders
AVL, Graz; Electronic Control Systems
BATTENFELD, BRD; Injection Moulding and Blow Moulding Machines
BATTENFELD-KUHNE, BRD; Extruders (actually: Kuhne GmbH, BRD)
BAUER, Schweiz; Measuring Instruments
BOY, BRD; Injection Moulding Machines
BRABENDER, BRD; Plastograph
BRENSON, USA; Ultrasonic Welding
BROSA, BRD; Control Instruments
BRUELL & KJAER; Acoustical Instruments
BUCHER-GUYER, Schweiz; Presses
CHURCHILL, England; Water and Oil Circulating Controllers
CINCINNATI MILACRON, Wien; Extruders
COUDENHOVE Poly-Spray, Wien; Spray-Up Machines
DEMES, BRD; Pre-Treatment Instruments
ENGEL, Schwertberg; Injection Molding Machines
FRANK, BRD; Testing Equipment
FUCHS, Wien; Mills
GOERZ Electro, Wien; Instruments
HAGEDORN & BAILLY, BRD; Water and Oil Circulating Controllers
HARTMANN & BRAUN, BRD; Control Systems
HASCO, Wien; Moulds
HENSCHEL, BRD; Mixers
HONEYWELL Bull, Wien; Time Sharing
HOTTINGER, Wien; Torque Measurement Equipment
JOENS, BRD; Control Systems and Recorders
JUMO, M.K. Juchheim, BRD; Control Instruments
ILLIG, BRD; Vacuum Forming Machines
KIEFEL, BRD; Film-Extruder
KRAUSS-MAFFEI, Injection Moulding, Foaming, Extrusion, Recycling
LODIGE, BRD; Mixers
BATTENFELD Kunststoffmaschinen GmbH., Kottingbrunn; Injection Molding
MEDEK & SCHÖRNER, Wien; Signator (Marker)
METRAWATT, BRD; Control Systems
NETSTAL, Schweiz; Injection Moulding Machines
PERKIN-EIMER, USA; Analytical Instruments
PHILIPS, Wien; Control Systems and Recorders
POLYROLL, BRD; Foaming Machines
PVL, Waldbreitbach (Austria); Electronic Equipment
FWF, DDR; Presses
SCHLUMBERGER, Wien; Electronic Equipment
STAINGER & MOHILÓ, BRD; Instruments
STOUGAARD, Dänemark; Instruments
TIEDEMANN, BRD; Optical Instruments
TROESTER, BRD; Calendars, Roll Mills
UNILABOR, Wien; Electronic Equipment
VEB Werkstoffprüfmaschinen, DDR; Testing Equipment
VIKING, UK; PUR-Foaming Machines
WITHOF, BRD; Control Systems
ZWICK, BRD; Testing Equipment
9. Special Industrial Development (SID) Programme in Plastics Technology

9.1. Objectives

To increase the efficiency of the 14th Training Programme it will be useful to continue the contacts between participants, institutions, companies and authorities. One facility besides contracts between institutions is a tailor-made research programme for candidates to help them solve their problems in plastics technology.

LKT-TGM have had considerable experience in conducting postgraduate research programmes in German language, especially for participants from various institutions in Austria. We are now interested in extending this experience to include postgraduate SID-programmes conducted in the English and French language for foreign participants. The success of the first arrangements encourage us to take on more participants on a similar basis together with UNIDO.

The programme is planned as a professional tuition by development work in a specific field of plastics technology including theoretical introduction, project work, plant visits, individual contacts with national and international organizations, companies and other institutes, educational training, publications, membership of the Austrian Association for the Promotion of Plastics Technology (GFKT).

9.2. SID-Programme in Brief

Detailed fields of study

Biomedical Application), Testing (Quality Control), Polymer Physics (X-Ray diffraction, Electron Microscopy, DSC), Polymer Chemistry (Analysis), Environmental Technology (Recycling, Re-use of Waste and Litter, Combustion, Protection), Training Technology, Research Management.

Conducted by: Laboratorium für Kunststofftechnik IKT-TGM Vienna

Address: A-1200 Vienna, Wexstraße 19-23, Austria

Admissions requirements: B.Sc. or equivalent in a scientific faculty and research experience

Language: English, German (French, Spanish partly)

Location: Vienna

Tuition fee: UNIDO

Commencing date: to be arranged

Duration: to be arranged

Deadline for enrolment: two months in advance

This SID-Programme is organized by Laboratorium für Kunststofftechnik IKT-TGM of the Association for the Promotion of Plastics Technology (GWKT) in co-operation with the United Nations Industrial Development Organization (UNIDO).