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LKT-TGM international

Austrian Laboratory for Plastics Technology

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Final Report

17th UNIDO In-Plant Group Training Programme in the Field of Plastics Technology AUSTRIA 1986



LKT-TGM international

Austrian Laboratory for Plastics Technology

**Seventeenth UNIDO In-Plant Group Training Programme
in the Field of Plastics Technology**

Wendy House 10, 1100, A-1200 Wien - Tel. (0220) 35 21 06 0 - Telex 131824

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

to be held

from 29 September to 14 November 1986 in Vienna, Austria

F I N A L R E P O R T

by

H. IKOBENY
Programme Director

Z1.ZT 152/Hu/DÖ, 14. November 1986

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TECHNOLOGISCHES GEWERBEMUSEUM

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Mr. V. Bysyuk	Ms. L. Muthsam
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Mr. S. Hand	Mr. H. Pichler
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Technologisches Gewerbemuseum:

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Mr. H. Pint	Mr. J. Honeder

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	Mr. R. Schwaminger

The Community of Pruggern:

Ms. B. Hollwiger (Singkreis)	Mr. Resch
Mr. M. Pichler (D'Freistoaner)	
Mr. H. Stocker (Blasmusik)	

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.



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Background and Objectives

1. The programme in the field of plastics technology is one of a series of the United Nations Industrial Development Organisation (UNIDO) activities on specific sectors of industry which is being organized for the developing countries through the Chemical Industries Branch. This "In-Plant Group Training Programme" has been implemented annually since 1970 through a special contribution of the Government of Austria to UNIDO. The implementation of the 1986 programme as well as the previous ones has been successfully conducted by the Laboratorium für Kunststofftechnik LKT-TGM (Laboratory for Plastics Technology).

2. The trend of training activities in the field of plastics technology is characterized by the increasing sophisticated nature of the programme requiring high level experts, consultants and specialized equipment for the workshop. There is also an increasing demand for visits to plants, companies and institutes which are advanced in their field of specialisation. Group discussion to deal with specific technological problems in manufacturing and application is also an important feature of current training activities.

3. Plastics are already one of the world's main groups of industrial materials. World plastic consumption is now greater than that of all non-ferrous metals in terms of weight and of steel in terms of volume. The numerous uses and applications of plastics which are still increasing, have caused this industry generally to grow at a faster rate than most branches of manufacturing industries and to contribute in growing proportion economy.

4. The demand for plastics materials is steadily growing at a very high rate and this situation is expected to continue in the future. Engineering plastics will find many new applications and replace traditional materials. Important factors in the research and development activities will be the drive to save energy and feedstocks. Plastics allow for a large potential of energy saving, partly by replacing traditional heavier materials and partly by reducing the use of energy in the various production processes.

5. Through the acquisition of technological know-how and skills in the field of mould design and mould making, the plastics industry could achieve further development. The lack of experienced personnel in this field in the developing countries and the need to acquire and exchange experience, are the main reasons for the organization of this programme. Its aim is also to bring together a group of selected persons whose work is expected to benefit from a concentrated training programme which otherwise could require a long period of training, research and development work. This assistance to the developing countries in the development of their plastic industry and the development of manpower is in accordance with items i, ii and k of Article 58 of Lima Declaration and Plan of Action as well as in line with the New Delhi Declaration and Plan of Action and the Fourth General Conference of UNIDO on development of human resources.

6. The programme is designed as a group training course covering the whole field of modern plastics technology at an industrial - not academic - level including

- Theory (Plenary Session)
- Practice (Small Group Work)
- Seminar (Small Group Discussion)
- Special Topics (Practical Experiments,
Small Group Work)
- Problem Solving (Group Moderation)

7. The programme has received the support of the Austrian Federal Ministry for Foreign Affairs, the Austrian Federal Ministry of Education and Fine Arts, the Austrian Federal Economic Chamber and Association and Industrialists. The Laboratorium für Kunststofftechnik LKT-TGM (Laboratory for Plastics Technology), a leading technological institute, will conduct, utilizing its facilities, the theoretical and practical training in plastics technology. The institute has a staff of highly qualified specialists.

Since 1970 LKT-TGM held seventeen programmes with a total of 307 participants from 77 countries. The regional distribution was the following:

Far East (FA)	100	33%
Middle East/		
North Africa (NE)	72	24%
Latin America (LA)	68	22%
Africa (AF)	44	14%
Europe (EU)	23	7%

65% of the participants came from companies, 35% from institutes and government organizations.

Programme - Programme 11. Total

Country	Region	1977	1978	1979	Total
Algeria	AF	1	-	-	1
Angola	AF	2	-	-	2
Argentina	LA	-	-	2	2
Australia	EU	-	-	3	3
Austria	EU	-	-	1	1
Bahrain	ME	-	-	1	1
Bangladesh	AF	-	-	1	1
Barbados	LA	-	-	1	1
Belize	LA	-	-	1	1
Bhutan	AF	-	-	1	1
Bolivia	LA	-	-	1	1
Brazil	LA	-	-	1	1
Bulgaria	EU	-	-	1	1
Cameroon	AF	-	-	1	1
Canada	EU	-	-	1	1
Cape Verde	AF	-	-	1	1
Cuba	LA	-	-	1	1
Czechoslovakia	EU	-	-	1	1
Dominican Republic	LA	-	-	1	1
Dominica	LA	-	-	1	1
Egypt	AF	-	-	1	1
Ecuador	LA	-	-	1	1
El Salvador	LA	-	-	1	1
Equatorial Guinea	AF	-	-	1	1
Ethiopia	AF	-	-	1	1
Finland	EU	-	-	1	1
France	EU	-	-	1	1
Ghana	AF	-	-	1	1
Greece	EU	-	-	1	1
Guatemala	LA	-	-	1	1
Guinea	AF	-	-	1	1
Guinea-Bissau	AF	-	-	1	1
Haiti	LA	-	-	1	1
Honduras	LA	-	-	1	1
Hungary	EU	-	-	1	1
Iceland	EU	-	-	1	1
India	AF	-	-	1	1
Indonesia	AF	-	-	1	1
Iran	AF	-	-	1	1
Ireland	EU	-	-	1	1
Israel	AF	-	-	1	1
Italy	EU	-	-	1	1
Jamaica	LA	-	-	1	1
Japan	EU	-	-	1	1
Jordan	AF	-	-	1	1
Korea	AF	-	-	1	1
Korea DPR	ME	-	-	1	1
Lebanon	AF	-	-	1	1
Lesotho	AF	-	-	1	1
Liberia	AF	-	-	1	1
Lithuania	EU	-	-	1	1
Luxembourg	EU	-	-	1	1
Macao	LA	-	-	1	1
Madagascar	AF	-	-	1	1
Malawi	AF	-	-	1	1
Malaysia	AF	-	-	1	1
Malta	EU	-	-	1	1
Mauritania	AF	-	-	1	1
Mexico	LA	-	-	1	1
Morocco	ME	-	-	1	1
Mozambique	AF	-	-	1	1
Nepal	AF	-	-	1	1
Nicaragua	LA	-	-	1	1
Nigeria	AF	-	-	1	1
Pakistan	AF	-	-	1	1
Panama	LA	-	-	1	1
Paraguay	LA	-	-	1	1
Peru	LA	-	-	1	1
Philippines	AF	-	-	1	1
Poland	EU	-	-	1	1
Romania	EU	-	-	1	1
Saudi Arabia	ME	-	-	1	1
Senegal	AF	-	-	1	1
Singapore	AF	-	-	1	1
Somalia	AF	-	-	1	1
Sri Lanka	AF	-	-	1	1
Sudan	AF	-	-	1	1
Syria	ME	-	-	1	1
Taiwan	EU	-	-	1	1
Tanzania	AF	-	-	1	1
Thailand	EU	-	-	1	1
Trinidad Tobago	LA	-	-	1	1
Turkey	EU	-	-	1	1
Uganda	AF	-	-	1	1
Uruguay	LA	-	-	1	1
Venezuela	LA	-	-	1	1
Vietnam	AF	-	-	1	1
Yemen PDR	ME	-	-	1	1
Yugoslavia	EU	-	-	1	1
Zambia	AF	-	-	1	1
Zimbabwe	AF	-	-	1	1

Korea	FE	1	-	1
Korea DPR	ME	3	1	4
Lebanon	AF	2	-	2
Madagascar	AF	1	-	1
Malawi	AF	3	-	3
Malaysia	FE	3	-	3
Malta	EU	2	-	2
Mauritania	AF	4	-	4
Mexico	LA	1	-	1
Morocco	ME	1	-	1
Mozambique	AF	1	-	1
Nepal	FE	1	1	2
Nicaragua	LA	1	-	1
Nigeria	AF	4	-	4
Pakistan	FE	6	1	7
Panama	LA	1	-	1
Paraguay	LA	2	-	2
Peru	LA	6	-	6
Philippines	FE	4	1	5
Poland	EU	6	-	6
Romania	EU	2	-	2
Saudi Arabia	ME	1	2	3
Senegal	AF	1	-	1
Singapore	FE	7	-	7
Somalia	AF	3	-	3
Sri Lanka	FE	5	-	5
Sudan	AF	4	-	4
Syria	ME	6	-	6
Taiwan	FE	2	-	2
Tanzania	AF	6	-	6
Thailand	FE	8	1	9
Trinidad Tobago	LA	2	-	2
Turkey	EU	5	-	5
Uganda	AF	-	1	1
Uruguay	LA	6	-	6
Venezuela	LA	-	1	1
Vietnam	FE	4	-	4
Yemen PDR	ME	6	1	7
Yugoslavia	EU	2	-	2
Zambia	AF	2	1	3
Zimbabwe	AF	1	-	1
-----		77	286	21
				307



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5. SUBJECT LIST

5.1. THEORY (Plenary Session)

Hours

Technology Transfer and Development	2
Trends in Polymer Chemistry	6
Trends in Polymer Physics	10
Principles of Plastics Technology	10
Principles of Mould Design	10
Principles of Control Engineering	4
Plastics Application Engineering	6

5.2. PRACTICE (Small Group Work)

Compounding	6
Computation	10
Controlling	10
Extrusion	12
Finishing	4
Foaming	6
Injection and Compression Moulding	12
Machining and Forming	6
Mould Making	2
Polymer Chemical Analysis	4
Polymer Physical Analysis	10
Quality Control	8
Reinforced Plastics	4
Trouble Shooting	2

5.3. SEMINAR (Small Group Discussion)

Plastics in Agriculture: Water Management Cultivation Packaging Plastics Recycling	8
Special Topics: Quality Control Polymer Science Injection Moulding Extrusion	8

5.4. SPECIAL TOPICS (Practical Experiments, small group work)

Quality Control Polymer Science Injection Moulding Extrusion	8
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5.5. PROBLEM SOLVING (Group Moderation)

Moderation	4
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Total: 172 hours

6. LECTURE NOTES

6.1. DESIGN OF LECTURE NOTES

The lecture notes have been adapted and developed in accordance with UNIDO, with the participants and with the experience of fifteen programmes since 1970.

To meet the general, practical and theoretical needs of the participants three levels of comprehensive information are offered at 1263 pages in form of

- general lecture notes (1034 pages)
 Saechtling (International Plastics Handbook)
- special lecture notes (279 pages) and
- research papers (72 pages)

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

Polymer Chemical Analysis (49 pages)



6.2. GENERAL LECTURE NOTES (Theoretical Introduction)

TECHNOLOGY TRANSFER AND DEVELOPMENT

H. Hubeny

The Global Situation (selected Indicators):

World Development Report - Population - Non-Renewable Resources - Energy - Education - Income

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

PLASTICS CHEMICAL TECHNOLOGY

E. Wogroly

Classification of Plastic Materials

Formation Reactions

Functionality

Polymerization Reactions:

Addition Polymerization (Free radical mechanism - Ionic mechanism) - Condensation Polymerization - Copolymerization - Auxiliary Materials for Polymerization

Physical Behaviour of Plastics

Secondary bonds:

Dispersion Forces - Dipolar-orientation Forces - Glass Transition - Brittle Point - Elastomeric State

Thermoplastics:

Polyolefines, Polyethylenes and Copolymers - 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 - Trends in Research and Development

Polyvinylchloride (PVC) and Copolymers - Plasticized PVC - Modified PVC - Compounds (Blends)

Polystyrene (PS) and Copolymers - Expanded Polystyrene (EPS)

Acrylics - Polyacrylonitrile (Barrier Plastics) - Polyacrylates - Polymethylmethacrylates (PMMA) - Polymethacrylimides

Polyethers - Polyoxymethylene (POM) - Polyethylenoxide (PEO)

F-Polymers - Polytetrafluorethylene (PTFE) - Polytrifluorchloroethylene (PCTFE) - Copolymers

Silicones - Methylpolysiloxanes-Phenylpolysiloxanes (PSI)

Polyamides (PA)

Polycarbonates (PC) - Polyterephthalates (PET, PBT) - Polyphenyleneoxides (PPO) - Polysulfones (PSU) - Polyphenylenesulfides (PPS) - Polyethersulfones (PES)

Thermosets:

Phenol/Formaldehyde Resins (PF) - Urea/Formaldehyde Resins (UF) - Melamine/Formaldehyde Resins (MF) - Unsaturated Polyesters (UP)

Polyepoxides (EP)

Polyurethanes (PUR) - Diisocyanates-PU Elastomers-Relations between Structure and Properties of PUR-Manufacture and Properties of PUR-Foams

High Temperature Resistant Polymers:

Polyimides (PI) - Polybenzimidazole - Polyimidazopyrrolone (Pyron) - Polycyclobutadiene

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

H Hubeny

Plastics Technology:

Polymers - Cycle Process - Model Matrix - Quality - Technological States - Conversion Processes

Molecular Structure:

Description - Linear Macromolecules - Cross-linked Macromolecules - Thermodynamics of Molecules - Degradation of Molecules

Supramolecular Structure:

Molecular Arrangement - Amorphous Structure - Mesomorphic Structure - Crystalline Structure

Rheology:

Definition - Elasticity - Viscosity - Viscoelasticity

Polymers:

Classification - Designation - Survey - Standard Thermoplastics - Engineering Thermoplastics - Specialty Thermoplastics - Thermoplastics - Thermosets - High Temperature resistant Polymers

Additives:

Compatibility and Efficiency - Antioxidants - Light Stabilizers - Heat Stabilizers - Enhancer - Colorants - Flame Retardants - Antistatic Agents - Biostabilizers - Blowing Agents - Nucleating Agents - Activators - Plasticizers - Lubricants

Compounding:

Terms - Particle Size Reduction - Mixing - Pelletizing - Compounding Parameters

Continuous Processing:

Classification - Continuous Casting and Laminating - Calendering - Extrusion

Discontinuous Processing (Moulding):

Classification - Liquid Phase Moulding - Compression Moulding - Transfer Moulding - Injection Moulding - Blow Moulding

Fabricating of Semi-finished Goods:

Technical Terms - Machining - Forming - Assembly - Separating

Finishing:

Painting - Printing - Metallizing - Hot Stamping - Embossing - Irradiation

Application:

Systematic Development of Application - Standards

Waste

Recycling:

Equipment - Cutting mills - Reprocessing Lines - Extruder Screen Changers - Incineration - Outlook

PLASTICS MECHANICAL ENGINEERING

R.Hillisch, H.Revesz

Extrusion:

Extruder Plants and -Dies - Pre-set Elements - Elements of the Extruder - Annexed Equipments - Principles of Extruder Die Design - Plants and Moulds for Blow Moulding

Moulding of Thermosets:

Processing Techniques - Machines - Additional Equipment - Moulds - Design of Compression Moulded Parts

Injection Moulding:

Techniques - Machines - Additional Equipments - Moulds

MOULD DESIGN

R.Hillisch

General:

Injection Mould - Classification of Injection Moulds - Methodical Mould Design - Size of Mould - Flow Path/Wall Thickness Rate - Number of Cavities - Arrangement of Cavities

Feeding:

Sprue Design - Runner Design - Gating - Pin Gate - Edge Gate - Sprue Gate - Film Gate - Diaphragm Gate - Ring Gate - Tunnel Gate - Sprue Puller Pin Gate - Ante-Chamber Type Pin Gate - Sprueless Moulding - Insulated Runner - Hot Runner

POLYMER PHYSICS

H.Dragaun, H.Muschik

Morphological Structure:

Structure and Morphology - Models of Crystalline Structure - Expressions of Crystallinity - Experimental Methods

Differential Thermal Analysis:

Introduction - Application of DTA - Principles of DTA
Evaluation of DTA Curves - Caloric Informations - Thermometric Information Applications - Physical Transitions - Chemical Reactions
Concluding Remarks

PLASTICS APPLICATION ENGINEERING

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

Reactive Resin Systems

Design of Constructional Parts:

Friction and Wear - Snap-fit Joints - Press-fit Joints

Ultrasonic Plastic Assembly

Outsert Technik

Screw-fit Joints

Plastic Screws

Adhesive Joints

CONTROL ENGINEERING

F.Gregori

Control Loop

Controlled System:

Time Behaviour - Heating Zone as Controlled System

Temperature Measurement:

Resistance Thermometer - Thermocouples

Controllers:

Continuous Controllers - Two-Position Controllers - Galvanometric Controller - Electronic Controllers

Temperature Control:

Control Oscillation - Two-Position Control with Feedback - PD-Control behaviour - PID-Control behaviour

6.3. GENERAL LECTURE NOTES (Practical Introduction)

COMPOUNDING

H.Wolanek

Compounding Methods

Additives and Formulations:

PVC Stabilizers - Action of Heat Stabilizers - Groups of PVC Stabilizers - Lubricants - Processing Aids - Impact Modifiers - Fillers

Compounding Machinery

Mixing Procedure:

Sintering of PVC - Agglomerating of PE-chips - Coloration - Drying

Test Methods:

Bulk Density - Heat Stability Tests - Static Tests - Dynamic Tests - Plastograph - Mixing Rolls - Rheometer

COMPRESSION MOULDING

R.Hillisch

Toggle Lever Press

Up-Stroke Press:

Tabletting - Preheating

100 ton-Laboratory-Press:

Compression Mould for Testing-Cups - Determination of Closing-Time (Closing Force) - Determination of Curing Time (Stiffness)

160 ton Down-Stroke Press:

Boiling Test

COMPUTATION

F.Mayer, P.Freisler

General Facts

Structure of a Computer

Programming Operations

How the Computer Counts

Description of the Z80 Microprocessor System:

Memory Allocation - Floppy Diskettes - Data Files - System Start-up - Warm Start and Drive Selection - Directory

The Programming Language BASIC:
Introduction - Operators - Important Instructions and Commands

Example:

The Problem - Flowchart - Solution of the Problem

CONTROL TECHNIQUES

G.Minarovich

Open-Loop-Control

Voltage Supply:

Supply for Power Unit - Supply for Control Unit

Standardized Connection Diagrams and Symbols:

Connection Diagrams - Wiring Symbols

The use of Instruments for Measuring the Current, Voltage and Resistance:

Test Lamp - Multimeter

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 and Feedback:

Feedback - Optimization of the Feedback

Electrical Methods for Measuring the Temperature:

Measuring by Means of a Thermocouple - Resistance Thermometer

EXTRUSION

H.Revesz

Production of Tubular (slow) Film

Extrusion of Blown Double-Layer Films

Production of Flooring

Blow Moulding

Production of Rigid PVC Pipes

Production of Pipes

FINISHING

W.Mähr

In-mold Metal Coating

Vacuum Metallizing:

Base Coating - Vacuum Metallizing - Top Coating - Test-methods

Electroplating:

Molding - Part Design - Preliminary Treatment - Cleaning - Sensitizing - Nucleiation - Electroless Plating Initial Electroplating - Final Electroplating - Applications - Test Methods

Appendix:

Process Sequence for Plating ABS-Plastics - Formulations

FOAMING

H.Hubeny

Classification of Plastic Foams:

Material - Stiffness - Cell Morphology - Density - Density Distribution - Fabrication Process

Properties

Processing:

Expandable Bead Methods - Reactive Foam Moulding - Thermoplastic Foam Moulding - Foam Extrusion

Polyurethane Technology:

Polyurethanes - Mould Materials - Practical Exercises

INJECTION MOULDING

H.Graf

Adjustment of Processing Parameters:

Box Mould - Processing Temperature Mould Temperature - Adjustment of Pressure - Internal Pressure Clamping Pressure - Loss Factor - Cooling Time - Machine Protocol

Orientation - Mechanical Properties:

Test Bars - Injection Moulding Machine - Processing Conditions - Interpretation of Test Results

Foamed Thermoplastics:

Introduction - Production of Mixtures - Test Panels - Physical Properties - Possibilities in Design of Machine and Equipment - Production of Panels - Machine Protocol

The Principles of Process Control in Injection Moulding:

General - Internal Pressure - Influences on Internal Pressure - Influences of Internal Pressure on the Quality of Products - Computerprogramme for the Calculation of cooling time - Location of the Pressuresensors in the Testbar - PVT-Diagram for Polystyrene - Machine Protocol - Surveyor's Protocol
Simulating Diagram



MACHINING AND FORMING

E. Strohmayr

Machining:

Cutting - Guillotine Shears - Drilling - Screwing - Turning -
Planing - Milling - Filing - Grinding - Polishing

Welding:

Press-Welding - Heat-Impulsive Welding - High Frequency Welding -
Hot-Gas Welding

Forming:

Bending - Whirl-Sintering - Vacuum Forming

Workshop - Drawings - Work instructions

POLYMER PHYSICAL ANALYSIS

H. Dragaun, H. Muschik, M. Radax, H. Braunsteiner

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

QUALITY CONTROL

M. Radax

Statistical Evaluation - Preparation of Specimen - Tensile Test -
Determination of the E-Modulus - Flexural Test - Modulus of Elasticity
(Flexural Test) - Tensile Impact Test - Impact Flexural Test -
Hardness - Shore Hardness - Vicat Softening Temperature -
ISO / R 75 - Martens Temperature - Oscillating Twisting Test -
Environmental Stress Cracking - Pipe Testing

REINFORCED PLASTICS
W.R.Jessenig

Theory

Resins

Reinforcements:

Fibrous and Wire Reinforcements - Fibre Constructions - Nonwove Constructions

Fillers:

Filler to Resin Bonding

Manufacturing Processes:

Contact Moulding (Hand Lay-up, Spray-up) - Bad Moulding - Vacuum Bag - Pressure Bag - Autoclave Moulding - Resin Injection System - Matched Die Moulding, Compression Moulding - Centrifugal Casting Process - Continuous-Pultrusion Process - Continuous-Laminating Process - Filament Winding Process (cont. and discont.) - Injection Moulding

Aspects to Practical Processing:

Surfacing - Gelcoat - Topcoat - Models - Moulds - Release Agents

Transportation and Handling

Prepreg and Sheet Moulding Compounds

Precautions and First Aid

Dimensional Fundamentals

Constructional Fundamentals

Economic Aspects and Future Outlook

6.4. SPECIAL LECTURE NOTES

DATA CONVERSION IN INJECTION MOULDING

H.Graf, F.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 OF GRP-PIPES

W.R.Jessenig

Designation

Company Control:

Control of Goods Received - Resin Control - Textile-Glass Rest - Filler Control - Reactant Control - Production Control - Regular Production Control - Random Production Control - Acceptance Control

External Control:

Test Volume - Recording - Designation - Condition at Delivery - Measurements - Pipe Stiffness - Longitudinal Tensile Force - Circular Tensile Force - Choice of Specimens - Expertise and Test Report

NEW RURAL APPLICATIONS OF PLASTICS

H.Muschik

Introduction

Protection of Plants by Nets.

Foils in Agriculture: Introduction - Flat Foils - "Mulch-Foils" - Plastic-Covered Tunnels - Foils for Sealing - Recycling of Foils - Greenhouses.

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.

Storage of Agricultural Products: Storage of Wood - Storage of Fruit and Vegetables in Foils - Storage of Fruits and Vegetables in Sacks - Storage of Liquids and Food.

Coating.

Technological Transfer.

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

Morphological Methods:

Optical Microscopy - Electron Microscopy - X-ray Diffraction - Wide-Angle X-ray Scattering (WAXS) - Small-Angle X-ray Scattering (SAXS) - Thermoanalytical Methods - Calorimetric Methods - Dilatometric Methods - Spectroscopy - Infrared Absorption (IR) - Electron Spin Resonance (ESR) - Nuclear Magnetic Resonance (NMR)

Practical Application in Damage Analysis:

Crack Formation in Polyethylene (PE)-Pipe - Irregular Characteristic 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)

ENVIRONMENTAL ASPECTS OF PLASTICS TECHNOLOGY

E. Wogrolly

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 - Some Aspects of Waste Disposal - Plastics Wastes in the Solid Wastes Stream - Reclaim, Recycling and Reuse of Plastics - Recycling Mixtures of Plastics - Separation of Plastic from mixed Refuse - Biodegradation - The Technology of Biodegradable Fillers

The Competiveness of Plastics with traditional Materials after the 1973 Oil Crisis

6.5. RESEARCH PAPERS

DATA CONVERSION IN TECHNOLOGY AND MORPHOLOGY

Extrusion:

New Possibilities of a Cascade Control of Extruders by Means of a Torsion-Sensitive Screw Tip - Continuous Measurement and Control of Viscosity throughout the Extrusion Process - Novel Systems for Viscosimetry of Polymer Melts and Solutions

Injection Moulding:

The Principles of Process Control in Injection Moulding - Degassing of Plastics Materials on Injection Moulding Machines

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 -form Crystallization in Isotactic Polypropylene - Determination of the Avrami Exponent of Partially Crystallized Polymers by DSC-(DTA)-Analysis - Qualitative Analysis of Molecular Structure of Polypropylene Fibres on the Basis of X-ray Diffraction Patterns

POLYURETHAN STRUCTURAL FOAMS

Non-Destructive Determination of the Density Profile in Polyurethane Structural Foams - Measuring and Influencing of the Density Distribution in Polyurethane Structural Foams - Statistic Examination of Cell Size Distribution in Polyurethane Structural Foams

RECYCLING

The Behaviour of Household Refuse containing PVC in Incinerators.

7. PLANT VISITS

To the special interest of the participants 14 plant visits during the six-week course in Austria has been organized by LKT-TGM.

The selection of the plants according to the interest of the participants gives a regional and technical survey on the Austrian plastic industry:



actual®

Anlagen- Maschinen- und
Werkzeugbau Gesellschaft m b H
Ing. W. Ganzberger

A-4053 Haid/Linz, Actual-Straße 31
Austria
Tel: 0 7220 1884 01 Seite
Telex: 02-1693

Battenfeld

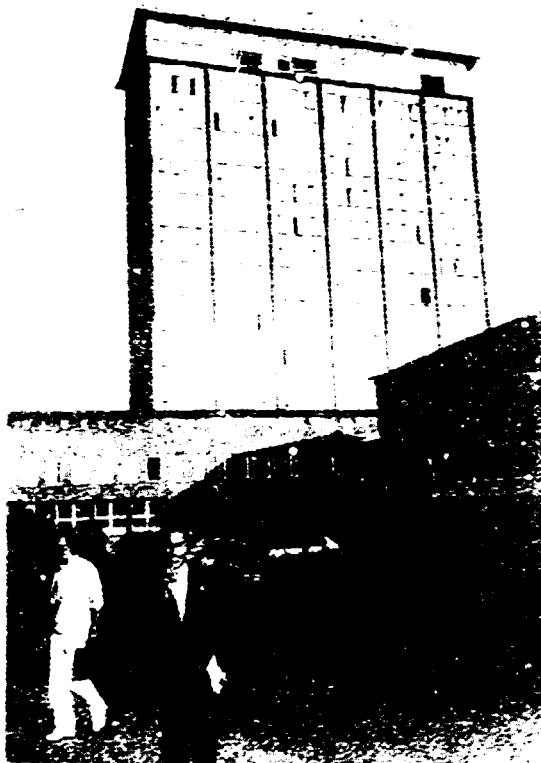
Kunststoffmaschinen Ges.m.b.H. 

Wohn- und Geschäftshaus
Battenfeldstraße 1
A-4053 Haid/Linz
Austria
Tel: 0 7220 1884 01 Seite
Telex: 02-1693



CHEMIE LINZ

Chemie Linz AG

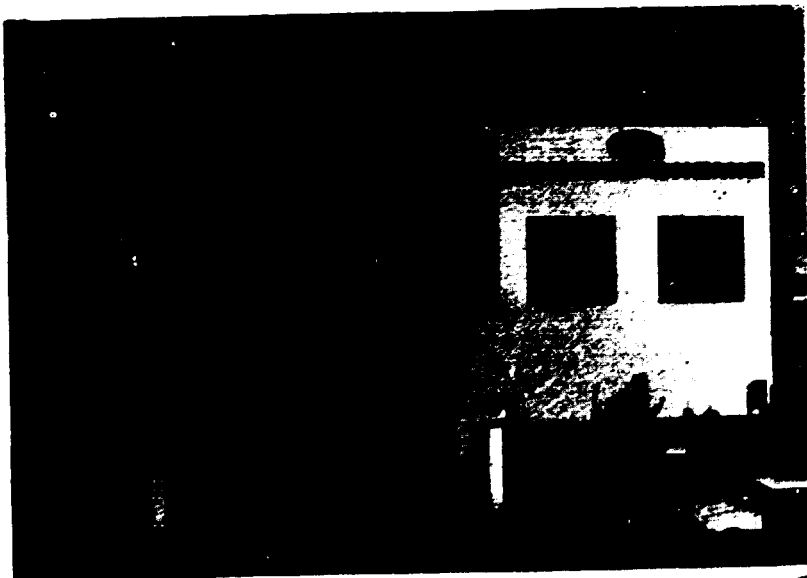




ENGEL

Ludwig Engel KG
Maschinenfabrik

A-4311 Schwertberg, Austria
Telefon 07262/62171-0
Telex 02-174521
Telegramme: Engel Schwertberg



GABRIEL-CHEMIE

WIEN-SIEBENHIRTEN, STIPCAKGASSE 6 POSTANSCHRIFT 1234 WIEN
POSTFACH 18 TEL. 67 26 46 Δ TEL. 67 46 23 Δ
TELEX 131376





greiner

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Postfach 6, Telefon (07583)
7251-0, Telex 23370
Telefax (07583) 7251-282



IFW — MANFRED OTTE
Gesellschaft m.b.H. & Co. KG.
A-4563 Micheldorf, Box 2

IFW

Tel. 07582/2556
Telex 23325 ifw a
Telefax No. 7582/4753

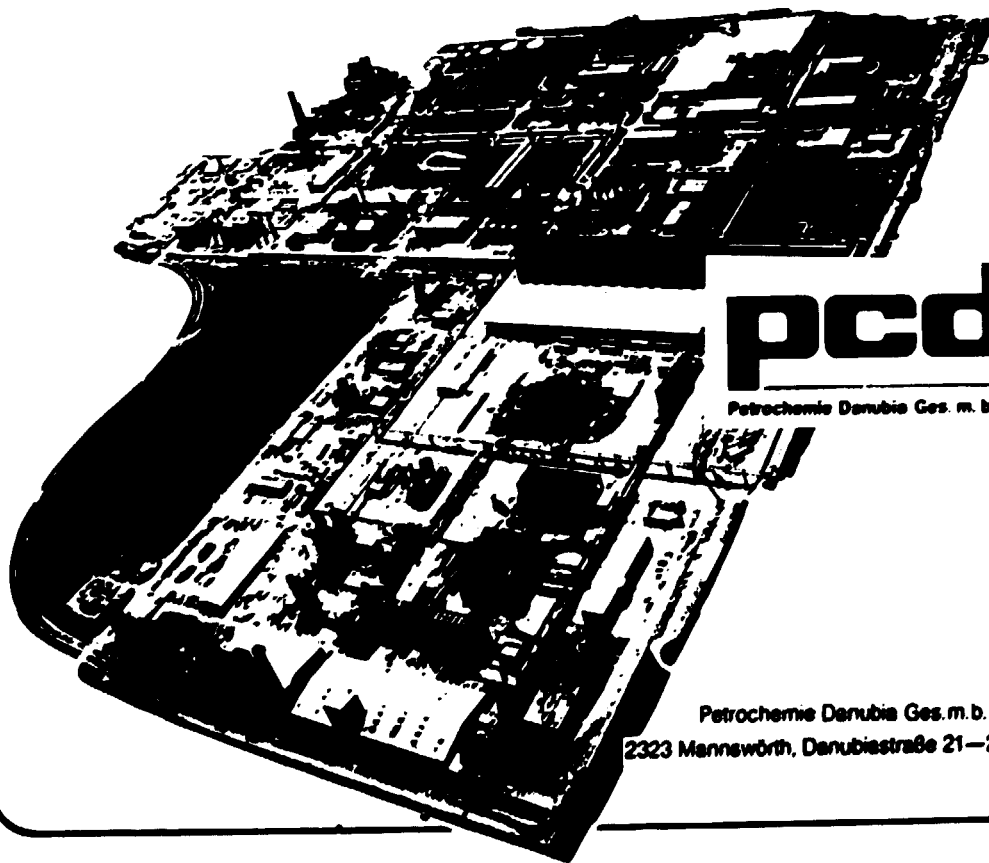


Lenzing AG

Plastics-Machinery Division

A-4860 Lenzing - Austria

Tel. 07672/2511, Tx. 026-606 lenfa



pcd

Petrochemie Danubia Ges. m. b. H.

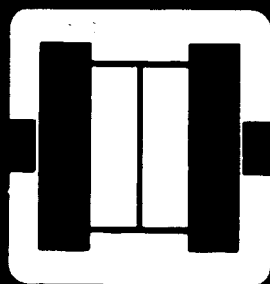
Petrochemie Danubia Ges. m. b. H.
2323 Mannwörth, Danubiastraße 21-25



Zentrale:
Leonding bei Linz, Ploplast-Straße 1
A-4021 Linz, Postfach 276
Telefon: (0732) 806 21-0
Telex 02-1131 pololz a
Telegramm Ploplast Linz



Kunststoffwerk der Eternit-Werke
Ludwig Hatschek und der
Durit-Werke Kern & Co.



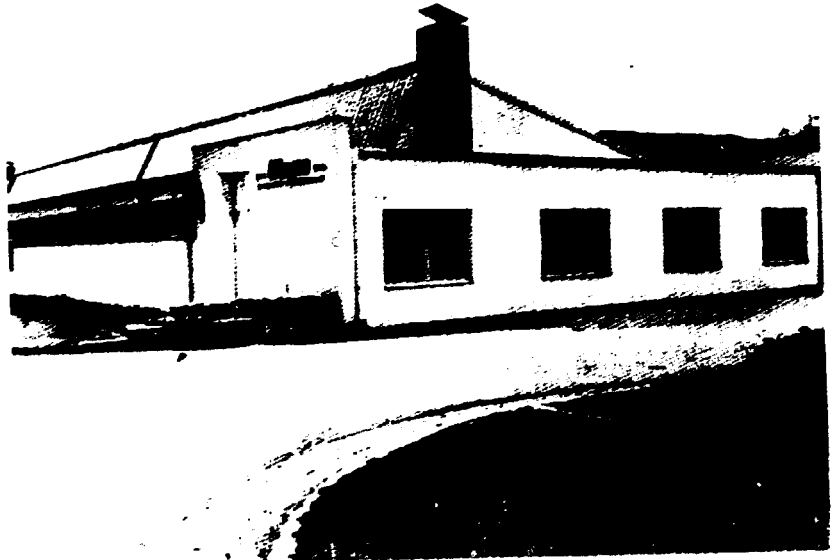
**Ludwig
Praher**





SALEN

Österreichische SALEN –
Kunststoffwerk Gesellschaft m. b. H.
A-1072 Wien, Kaiserstraße 45
Telefon 0 22 2 / 96 15 01-0 Serie
A-3500 Krems/D., Symalenstraße 2-6
Telefon 0 27 32 / 55 01-0 Serie



KARL WESS Ges.m.b.H.

Maschinen- und Formenfabrik
Wiener Straße 54-56
2640 Gloggnitz
Tel. 02662/2291, 2559
Telex 16675 wess a

WESS

8. SPECIAL EQUIPMENT FOR THE TRAINING PROGRAMME

ALPINE, BRD: Extruders
AVL, Graz: Electronic Control Systems
BATTENFELD, BRD: Injection Moulding and Blow Moulding Machines
BATTENFELD-FISCHER, BRD: Blow Moulding
BATTENFELD Kunststoffmaschinen GmbH., Köttingbrunn: Injection Moulding Machines
BAUER, Schweiz: Measuring Instruments
BECKMANN, USA: IR-Equipment
BIZERBA, Vienna: Silo-Installation
BRANSON, USA: Ultrasonic Welding
BROSA, BRD: Control Instruments
BUCHER-GUYER, Schweiz: Presses
BULL, USA: EDV-Equipment
CEAST, Italy: Testing Equipment
CHURCHILL, England: Water and Oil Circulating Controllers
CINCINNATI MILACRON, Vienna: Extruders, Injection Moulding Machines
COUDENHOVE UND HUBNER, Vienna: Spray-Up Machines
DEMES, BRD: Pre-Treatment Instruments
ENGEL, Schwertberg: Injection Moulding Machines
EPSON, Japan: EDV-Equipment
ERBA, Italy: Gaschromatography
FRANK, BRD: Testing Equipment
FUCHS, Vienna: Mills
GOERZ Electro, Vienna: Instruments
GÜTFERT, BRD: Rheological Equipment
HAACK, Vienna: Laboratory Equipment
HAGEDORN & BAILLY, BRD: Water and Oil Circulating Controllers
HARTMANN & BRAUN, BRD: Control Systems
HASCO, Vienna: Moulds
HENSCHEL, BRD: Mixers
HONEYWELL Bull, Vienna: Time Sharing
HOTTINGER, Vienna: Torque Measurement Equipment
JEOL, Japan: Electron Microscopic 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, BRD: Foaming, Extrusion, Recycling
K-TRON SODER, Schweiz: Metering-Computer
LINK, GB: X-Ray Analytical Equipment
LÖDIGE, BRD: Mixer
MEDEK & SCHÖRNER, Vienna: Signator (Marker)
METRAWATT, BRD: Control Systems
METTLER, Schweiz: Analytical Instruments
MIKRONIX, Pulkau: Electronic Equipment and Computer
NETSTAL, Schweiz: Injection Moulding Machines
PAAR, Austria: Electron Microscopic Preparation
PERKIN-ELMER, USA: Analytical Instruments
PHILIPS, Vienna: Control Systems and Recorders
PRODISTRIBUTION, Schweiz: Dosage Equipment
PVI, Waldbreithach (Austria): Electronic Equipment
REICHERT-JUNG, Vienna: Microscopic Equipment
SATORIUS, BRD: Analytical Instruments
SCHLUMBERGER, Vienna: Electronic Equipments

SINGLE, BRD: Water and Oil Circulating Controllers
STAIGER & MOHILO, BRD: Instruments
STOUGAARD, Dänemark: Instruments
TIEDEMANN, BRD: Optical Instruments
TROESTER, BRD: Calanders, Roll Mills
UNILABOR, Vienna: Electronic Equipment
UNITEK, Vienna, Extruder heads for cables
VIKING, UK: PUR-Foaming Machines
WITHOFF, BRD: Control Systems
ZWICK, BRD: Testing Equipment



SALZBURG



PRUGGER





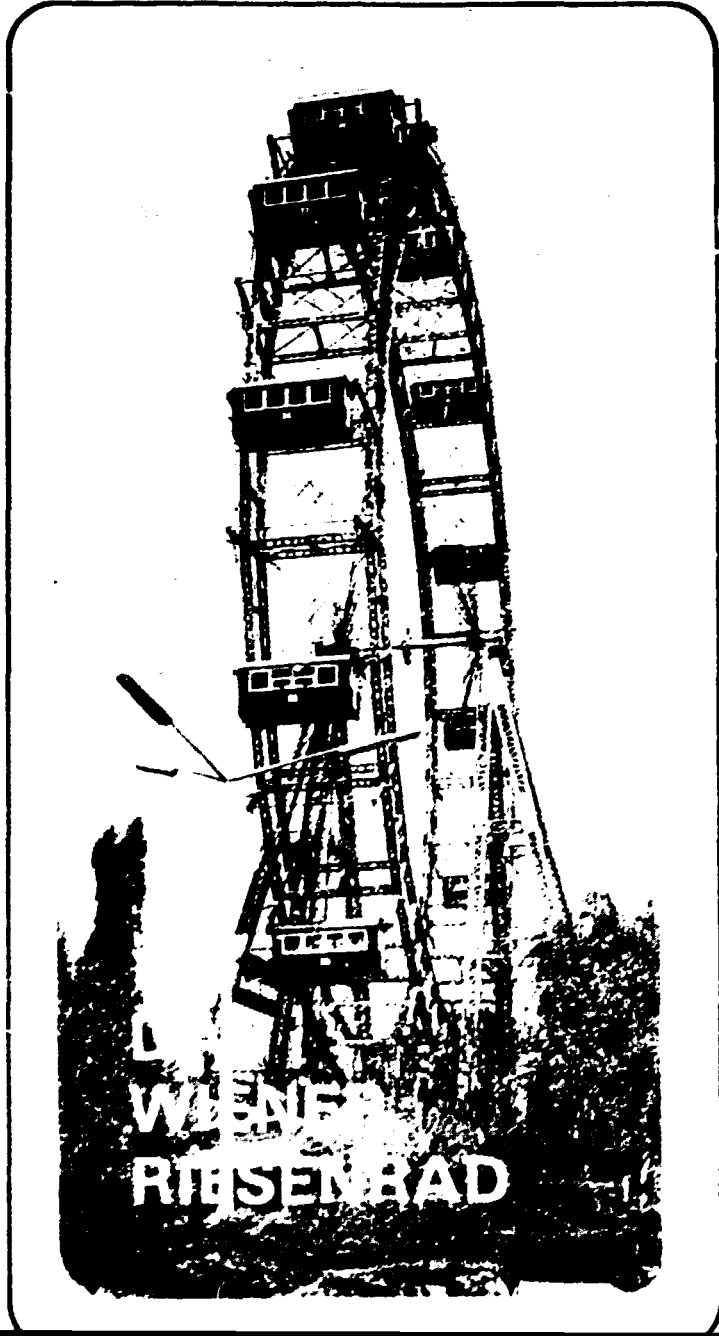


LKT-TGM international

Laboratory for Plastics Technology

The LKT-staff members
invite

all UNIDO-Seminar participants



for a

PRATER

BUMMEL

and a

DINNER

on

Saturday

4th of Oct. '86

at 4.30 p.m.

Meeting point:

Entrance to Riesenrad

Dinner: 7 pm. in

Wieselburger Bierinsel

All further information:

Robert Hillisch

LKT-Mitarbeiter:

Teilnahme wird gewährt
mit Frau und Kindern!

86.09.30/85

Lli

Laboratory for Plastics Technology LKT-TGM
Austrian Society for Polymer Engineering

17th UNIDO Group Training Programme in
Plastics Technology, Austria 1986

**INVITATION TO THE FAREWELLE
PARTY**

ON THURSDAY, 13 November 1986 6.30 p.m.

AT

Vienna and Wine are inseparable

Robert Helm
Weinbau — Buschenschank
Stammersdorfer Straße 121
1210 Wien
Telefon (0222) 39 12 44

The »heuriger« is an unusual form of wine tavern in Vienna due to the close proximity of vineyards to the city. The genuine »heuriger« can be recognised by the sprig of pine hung up above the door and a small plaque informing the passer-by that the wine grower serves wine on the premises.

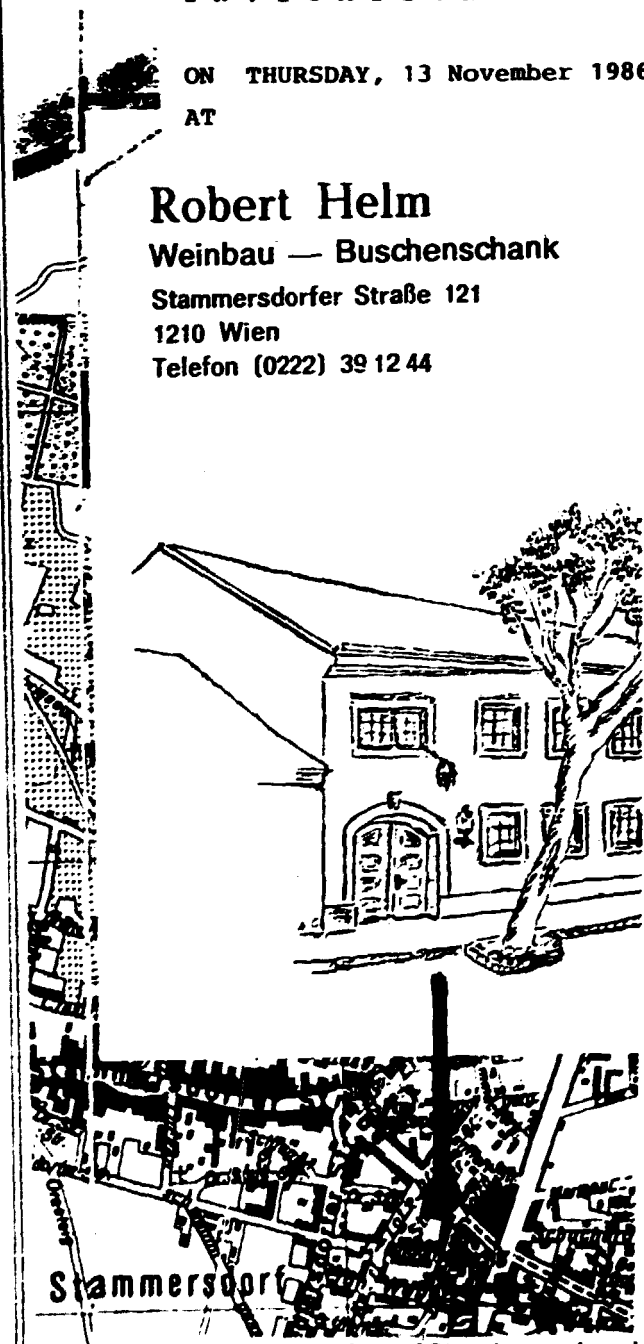
The sale of wine in Vienna is governed by a special law — the so-called »Buschenschankgesetz« — which stipulates that only establishments that grow their wine entirely in Vienna or the surrounding rural districts may call themselves »heurigers«. The wine growers are strictly forbidden to purchase grapes or wine, and are only allowed to sell their wine in the wine-growing districts for a maximum of 300 days a year. Apart from wine, they also serve various kinds of food. In Vienna it is usual for guests to fetch their food from the buffet themselves, whilst the wine is served in glass mugs by a waitress. The wine which you buy at a »heuriger« is also known as »heuriger« if it is wine from the last vintage. After Martinmas (11th November) the following year, the »heuriger« becomes an »alter« (old) wine.

The wine is usually a »mixed batch«, a blend of several different varieties of good wines which gives these wines their characteristic flavour, making them refreshing, fruity, sparkling and palatable. You can drink several »viertels« (1/4 litres) of wine without feeling the effect of the alcohol particularly. Of course pure unmixed wines are also sold in 1/2 litre glasses or filled into 0,7 litre bottles. These are full-bodied, heavier wines which people often like to drink at the end of a heuriger evening.

Today there are 700 families in Vienna growing wine over an area of about 1,800 acres. The majority of these vineyards — about 1,000 acres — are on the slopes of Kahlenberg and Nussberg, where you will also find the better known wine-growing districts such as Nussdorf, Heiligenstadt, Grinzing, Sievering and Neustift. There are about 600 acres of vineyards at the foot of Bisamberg on the left bank of the Danube in the wine-growing districts of Stammersdorf, Strebersdorf and Jedlersdorf, and the rest of the vineyards are in the south of the city in the wine-growing districts of Mauer and Oberlaa. The annual grape harvest in Vienna produces around 30,000 hectolitres of wine — about 12 million »viertels«!

No matter whether you decide to drink your wine in a secluded country lane with wine cellars on either side or at a fashionable heuriger, at a tavern specially recommended by your friends or in world famous Grinzing, you will enjoy Vienna and its wines. Cheers!

Stammersdorf, at the foot of Bisamberg, a long low hill to the north of the city, is Vienna's largest wine-growing district. There are more than 100 wine growers here who produce around 30% of all Viennese wine. More than 40 of them are open at any one time during the summer months. It is well worth visiting the comfortable wine taverns with attractive heuriger gardens in Stammersdorfer





LKT-TGM international

Austrian Laboratory for Plastics Technology

SID-Programme

Special Industrial Development Programme in Polymer Engineering and Plastics Technology

Top Level A

Description:

The Special Industrial Development Programme (SID-Programme) is a unique service offered by the Austrian Laboratory for Plastics Technology (LKT-TGM) to assist industrial companies in the development of new plastic products and processes. The programme is designed to provide a comprehensive service, covering all aspects of the development process, from the initial concept to the final production. The SID-Programme is available to all industrial companies, regardless of their size or location. The programme is designed to be flexible and adaptable to the needs of individual companies. The SID-Programme is a valuable service for any industrial company looking to develop new plastic products and processes.

Content:

The SID-Programme includes a wide range of services, including: product development, process development, material selection, and technical support. The programme is designed to provide a comprehensive service, covering all aspects of the development process, from the initial concept to the final production. The SID-Programme is available to all industrial companies, regardless of their size or location. The programme is designed to be flexible and adaptable to the needs of individual companies. The SID-Programme is a valuable service for any industrial company looking to develop new plastic products and processes.

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Organization:

The SID-Programme is organized and managed by the Austrian Laboratory for Plastics Technology (LKT-TGM). The programme is designed to provide a comprehensive service, covering all aspects of the development process, from the initial concept to the final production. The SID-Programme is available to all industrial companies, regardless of their size or location. The programme is designed to be flexible and adaptable to the needs of individual companies. The SID-Programme is a valuable service for any industrial company looking to develop new plastic products and processes.

Qualifications:

The SID-Programme is staffed by highly qualified experts in the field of polymer engineering and plastics technology.

Language:

The SID-Programme is available in German and English. For further information, please contact the Austrian Laboratory for Plastics Technology.



SID-Programme

... ..

Special Industrial Development Programme in Polymer Engineering and Plastics Technology

High Level B

Description:

The SID programme is a special development programme for industrial companies in the field of polymer engineering and plastics technology. It is a special development programme for industrial companies in the field of polymer engineering and plastics technology. It is a special development programme for industrial companies in the field of polymer engineering and plastics technology.

Content:

The SID programme covers the following areas:

Services:

The SID programme offers the following services:

Organization:

The SID programme is organized as follows:

Qualifications:

The SID programme requires the following qualifications:

Language:

The SID programme is conducted in the following language:

SID-Programme

Special Industrial Development Programme in Polymer Engineering and Plastics Technology

Basic Level C

Description:

The SID-Programme C is an industrial development programme in polymer engineering and plastics technology. It is designed for the training of technicians in the field of polymer engineering and plastics technology.

Content:

The programme is divided into three main areas: polymer engineering, plastics technology and industrial development. The content includes: polymer engineering, plastics technology, industrial development, polymer engineering, plastics technology, industrial development.

Services:

Introduction, training, development, industrial development, industrial development, industrial development, industrial development, industrial development, industrial development.

Organization:

The programme is organized by the Austrian Laboratory for Plastics Technology (LKT-TGM) in cooperation with the Austrian Ministry of Education and Science. The programme is organized by the Austrian Laboratory for Plastics Technology (LKT-TGM) in cooperation with the Austrian Ministry of Education and Science. The programme is organized by the Austrian Laboratory for Plastics Technology (LKT-TGM) in cooperation with the Austrian Ministry of Education and Science.

Qualifications:

Experience in industry after completion of a technical school or equivalent.

Language:

English (German interpreters for other languages can be arranged by request).



VIENNA INTERNATIONAL CENTRE (UNO-CITY)

Laboratorium für Kunststofftechnik
Gesellschaft zur Förderung der Kunststofftechnik

SECTION 1

To
U N I D O
att. Mr. D. Gardellin
Acting Head Purchase and Contract
Service
P.O. Box 300
1400 Wien

B 024/M1

1986-12-23

Betrifft: **CONTRACT No. 86/56**
UNIDO Project No. US/INT/86/068
Activity Code: US/05/32.1

Financial Statement

a. Introduction theory: 48h & 560,-	26.880,-
b. Introduction practice: 96h per group & 975,-	280.800,-
c. Seminar 16h per group & 765,-	36.720,-
c ₁ . Problem Solving 8h & 1.120,-	8.960,-
d ₁ . Practical experiments 8h per group & 975,-	23.400,-

Financial Statement

a. Introduction theory: 48h á 560,-	26.880,-
b. Introduction practice: 96h per group á 975,-	280.800,-
c. Seminar 16h per group á 765,-	36.720,-
c. Problem Solving 8h á 1.120,-	8.960,-
d. Practical experiments 8h per group á 975,-	23.400,-
e. Equipment and material, 450h á 600,- and 104h per group á 400,-	394.800,- 79.000,-
f. Programme directory	
g. Plant visits (travel expenses, accompaniment) 8 travel days in Austria	98.722,-
h. Lecture notes, new edition of 94 pages á 350,- reprint of 612 pages, 15 sets á 4,- per page and technical books (plastics handbook) á 548,-	77.840,- 6.735,-
i. Mailing	
<u>Grand Total</u>	<u>1.033.857,-</u>

SECTION 2

H. Hubeny
H. Hubeny
Programme Director

W. Michel
W. Michel
Organisation

Training

Training and education are provided by the following institutions:

Division of Plastics Technology
Institute of Applied Sciences, University of Applied Sciences
Technische Universität Wien, Vienna, Austria

College of Plastics Technology

College of Plastics Technology, University of Applied Sciences, Technikum Wien, Vienna, Austria
College of Plastics Technology, University of Applied Sciences, Technikum Wien, Vienna, Austria
College of Plastics Technology, University of Applied Sciences, Technikum Wien, Vienna, Austria
College of Plastics Technology, University of Applied Sciences, Technikum Wien, Vienna, Austria

Vocational Training Courses

Vocational Training Courses, University of Applied Sciences, Technikum Wien, Vienna, Austria
Vocational Training Courses, University of Applied Sciences, Technikum Wien, Vienna, Austria

International Programmes

International Programmes, University of Applied Sciences, Technikum Wien, Vienna, Austria
International Programmes, University of Applied Sciences, Technikum Wien, Vienna, Austria

Testing

Testing and certification are provided by the following institutions:

Federal Centre of Testing Materials for Plastics Technology

Federal Centre of Testing Materials for Plastics Technology, University of Applied Sciences, Technikum Wien, Vienna, Austria
Federal Centre of Testing Materials for Plastics Technology, University of Applied Sciences, Technikum Wien, Vienna, Austria
Federal Centre of Testing Materials for Plastics Technology, University of Applied Sciences, Technikum Wien, Vienna, Austria

Fields of Authorization:

Fields of Authorization, University of Applied Sciences, Technikum Wien, Vienna, Austria
Fields of Authorization, University of Applied Sciences, Technikum Wien, Vienna, Austria
Fields of Authorization, University of Applied Sciences, Technikum Wien, Vienna, Austria
Fields of Authorization, University of Applied Sciences, Technikum Wien, Vienna, Austria

Research

Research Institute of the Austrian Society for Polymer Engineering