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LKT-TGM international

Austrian Laboratory for Plastics Technology

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

Wexstrasse 19/23 · A 1200 Wien · Tel. (0222) 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 28 September to 13 November 1987 in Vienna, Austria

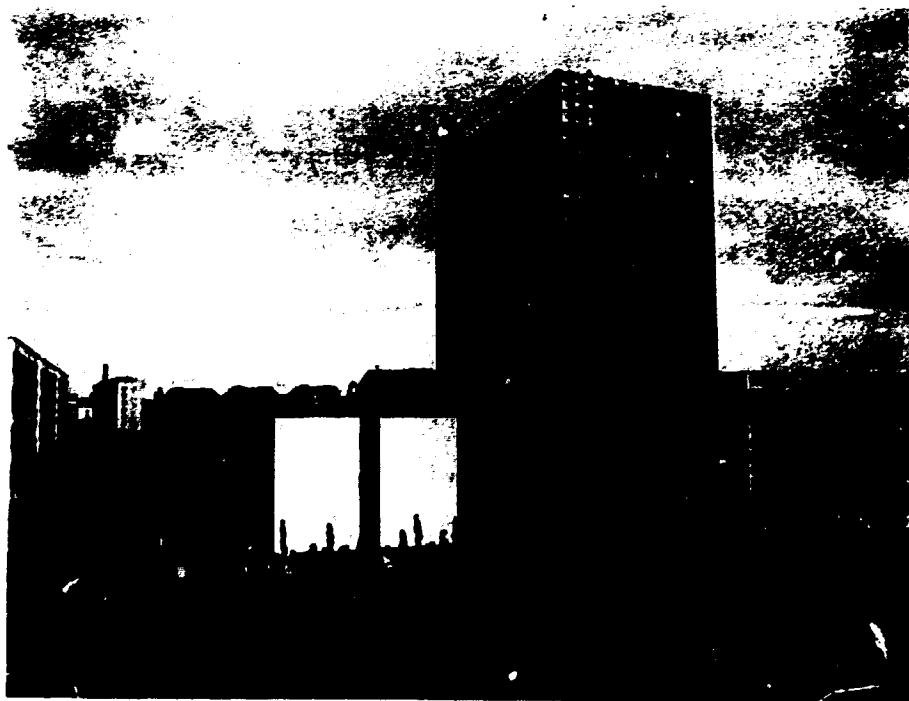
F I N A L R E P O R T

by

**H. HUBENY
Programme Director**

Z1.ZT 156/Hu/DÖ, 13. November 1987

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TECHNOLOGISCHES GEWERBEMUSEUM

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Ms.Gerlinde Schwaiger
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Zithergruppe Bad Mitterndorf, Duo Tauplitz,
Jung-Schuhplattlergruppe Tauplitz

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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 material . 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, j 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

Introduction:

- Theory (Plenary Session)
- Practice (Small Group Work)

Seminar:

- Special Small Group Discussion
- Special Practical Experiments (Small Group Work)

Group Moderation:

- Selection of Priorities
- Methods of Problem Solving

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 326 participants from 77 countries. The regional distribution was the following:

Far East (FE)	107	33%
Middle East/ North Africa (ME)	74	23%
Latin America (LA)	74	23%
Africa (AF)	48	15%
Europe (EU)	23	6%

67% of the participants came from privat and public companies, 33% from institutes and non-profit government organizations.

Place	Region	Programs 1.-17.	18. Programs	Total
Afghanistan	ME	1	-	1
Algeria	ME	2	-	2
Argentina	LA	7	-	7
Bangladesh	AF	6	2	8
Bhutan	AF	2	-	2
Bolivia	FE	3	-	3
Bulgaria	LA	7	-	7
Burma	EU	1	-	1
Canada	L'	5	1	6
Chile	FE	4	1	5
China	LA	13	2	15
Colombia	LA	4	-	4
Costa Rica	LA	4	-	4
Cuba	LA	4	-	4
Cyprus	EU	3	-	3
Czechoslovak Republic	LA	2	-	2
Dominican Republic	LA	2	-	2
Egypt	ME	14	1	15
El Salvador	LA	2	-	2
Ethiopia	AF	4	1	5
Ghana	AF	4	1	5
Guatemala	LA	2	-	2
Haiti	LA	1	-	1
Honduras	LA	1	-	1
India	FE	3	-	3
Indonesia	FE	12	-	12
Iran	FE	10	-	10
Israel	ME	18	1	19
Japan	ME	10	-	10
Jordan	ME	3	-	3
Korea DPR	FE	4	-	4
Korea REP	FE	4	-	4
Lebanon	ME	2	-	2
Madagascar	AF	7	-	7
Malawi	AF	6	-	6
Malaysia	FE	2	-	2
Mali	AF	3	-	3
Mauritius	EU	3	-	3
Mexico	LA	7	-	7
Morocco	AF	1	-	1
Mozambique	AF	5	-	5
Nepal	FE	4	-	4
Nicaragua	LA	1	-	1
Nigeria	AF	4	-	4
Pakistan	AF	4	-	4
Panama	LA	4	-	4
Paraguay	LA	3	-	3
Peru	LA	2	-	2
Philippines	FE	3	-	3
Poland	EU	1	-	1
Romania	EU	15	-	15
Saudi Arabia	ME	2	-	2
Senegal	AF	4	1	5
Singapore	AF	1	-	1
Somalia	AF	2	-	2
Sri Lanka	FE	1	-	1
Sudan	AF	1	-	1
Syria	ME	1	-	1
Taiwan	FE	3	-	3
Tanzania	AF	2	-	2
Thailand	FE	6	-	6
Togo	FE	2	-	2
Trinidad and Tobago	LA	3	-	3
Tunisia	AF	5	-	5
Uganda	AF	1	-	1
Uruguay	LA	1	-	1
Venezuela	LA	6	-	6
Vietnam	FE	4	-	4
Yemen PDR	FE	7	-	7
Yugoslavia	EU	4	-	4
Zambia	AF	3	-	3
Zimbabwe	AF	1	-	1

Place	Region	Programs 1.-17.	18. Programs	Total
Korea DPR	FE	1	-	1
Korea REP	FE	1	-	1
Lebanon	ME	2	-	2
Madagascar	AF	4	-	4
Malawi	AF	3	-	3
Malaysia	FE	2	-	2
Mali	AF	2	-	2
Mauritius	EU	4	-	4
Mexico	AF	1	-	1
Morocco	ME	1	-	1
Mozambique	AF	1	-	1
Nepal	AF	2	-	2
Nicaragua	LA	1	-	1
Nigeria	LA	1	-	1
Pakistan	AF	4	-	4
Panama	FE	7	-	7
Paraguay	LA	1	-	1
Peru	LA	2	-	2
Philippines	LA	6	-	6
Poland	FE	2	-	2
Romania	EU	5	-	5
Saudi Arabia	EU	6	-	6
Senegal	ME	2	-	2
Singapore	AF	3	-	3
Somalia	FE	7	-	7
Sri Lanka	AF	3	-	3
Sudan	FE	5	-	5
Syria	AF	5	-	5
Taiwan	ME	6	-	6
Tanzania	FE	2	-	2
Thailand	FE	6	-	6
Togo	FE	2	-	2
Trinidad and Tobago	LA	3	-	3
Tunisia	LA	5	-	5
Uganda	EU	1	-	1
Uruguay	AF	1	-	1
Venezuela	LA	6	-	6
Vietnam	LA	1	-	1
Yemen PDR	FE	4	-	4
Yugoslavia	ME	7	-	7
Zambia	EU	3	-	3
Zimbabwe	AF	2	-	2
	AF	1	-	1
	FE	77	-	77
	ME	30	-	30
	EU	19	-	19
	LA	336	-	336



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5. SUBJECT LIST

5.1. INTRODUCTION

5.1.1. THEORY (Plenary Session)

Hours

Technology Transfer and Development	2
Trends in Polymer Science	12
Trends in Polymer Physics	10
Principles of Mould Design	10
Principles of Control Engineering	4
Plastics Application Engineering	6

5.1.2. PRACTICE (Small Group Work)

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

5.2. SEMINAR

5.2.1. SPECIAL SMALL GROUP DISCUSSION

Quality Control	4
Polymer Science	4
Injection Moulding	4
Extrusion	4

5.2.2. SPECIAL PRACTICAL EXPERIMENTS (Small group work)

Quality Control	8
Polymer Science	8
Injection Moulding	8
Extrusion	8

5.3. GROUP MODERATION

Selection of Priorities	4
Methods of Problem Solving	4

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 seventeen programmes since 1970.

To meet the general, practical and theoretical needs of the participants three levels of comprehensive information are offered at 1344 pages in form of

- general lecture notes (962 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:

Control Engineering (31 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) - Polymethacrylamides

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 - Nucleiating Agents - Activators - Plasticizers - Lubricants

Compounding:

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

Continuous Processing:

Classification - Continuous Casting and Laminating - Calandering - 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**

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, without Feedback

Temperature behaviour of a Controlled Member with 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

Controllers:

Continuous Controllers - Two-Position Controllers - Electronic Controllers - Thermocouple as Detecting-Element - Resistance-Thermometer as Detecting Element.

6.3. GENERAL LECTURE NOTES (Practical Introduction)

COMPOUNDING

H.Wolank

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

EXTRUSION

H.Revesz

Production of Tubular (Blow) 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 Pressure sensors 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 - Continous-Pultrusion Process - Continous-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, P.Mayer****General Remarks****Measuring Pressure:****Piezoelectric Transducer - Charge Amplifier****Measuring Temperature:****Fluctuation Compensation - Temperature Sensors - Programmable
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.**

to be maintained for some reasons, it would be recommended to search for an unconventional technologies that could not be incorporated into the analysis of HTO PDA.

The detailed results of the analysis are appended to the volume that reports the case study.

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

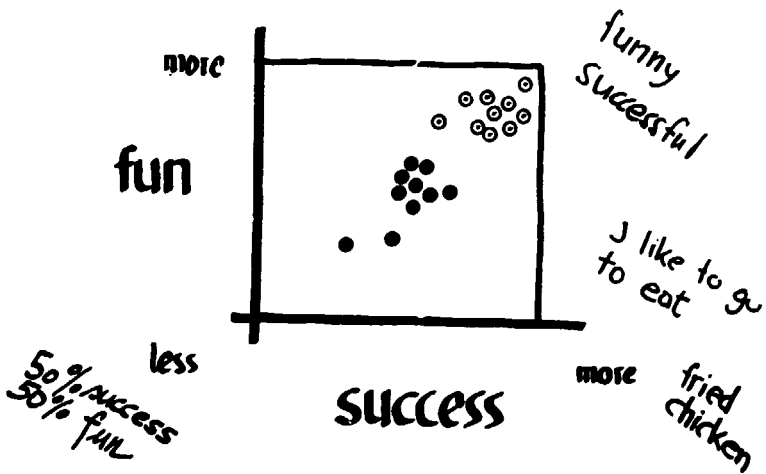
Non-Destructive Determination of the Density Profile in Polyurethane Structural Foams - Measuring and Influencing of the Density Distribution in Polyurethane Structural Foams - Statistic Examination of Cell Size Distribution in Polyurethane Structural Foams

RECYCLING

The Behaviour of Household Refuse containing PVC in Incinerators.

Selection of priorities

My expectation:
How to find our priorities?



- before
- after



7. PLANT VISITS

To the special interest of the participants 18 plant visits during the seven-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:



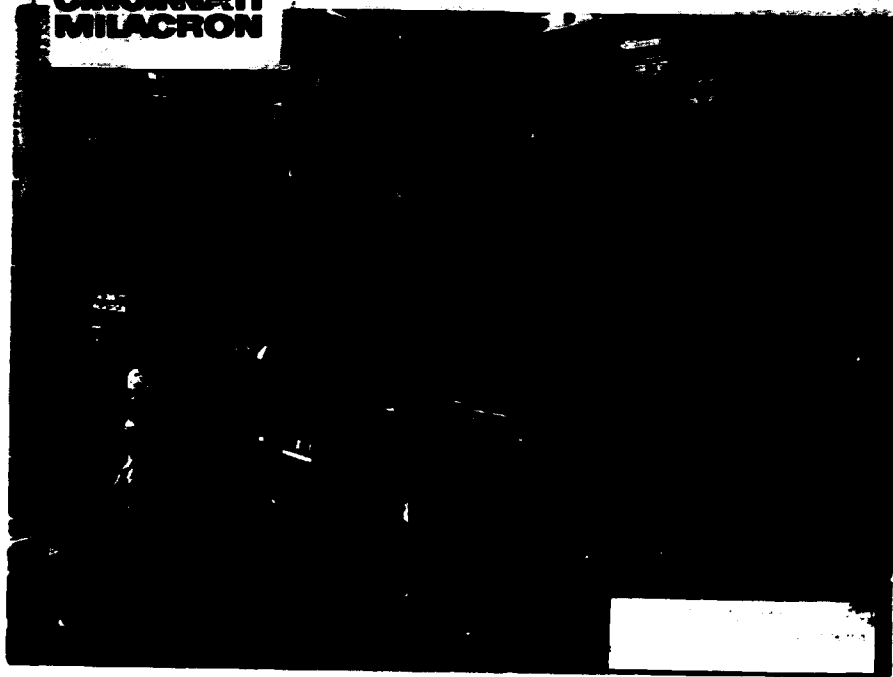
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Anlagen-, Maschinen- und
Werkzeugbau Gesellschaft m. b. H.
ing. W. Günzberger

A-4053 Haid/Linz, Austria
Actual-Strasse 31
Tel. 07222/88401 Serie
Telex 02-1093

**CINCINNATI
MILACRON**



ENGEL

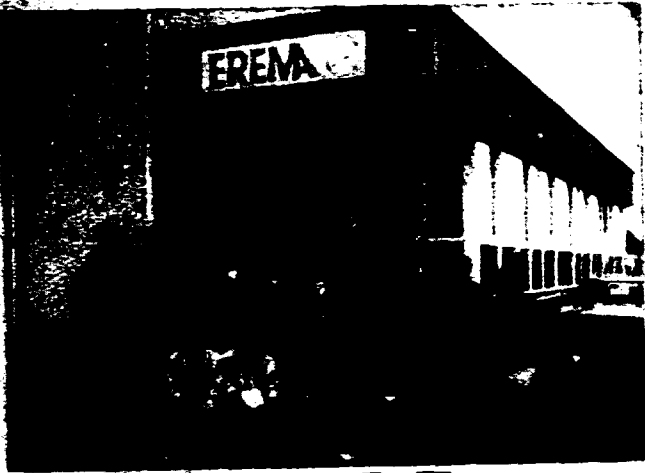
Ludwig Engel KG
Maschinenfabrik

A-4311 Schwertberg, Austria

Telefon 07262/821 71-0

Telex 02-174821

Telegramme: Engel Schwertberg



INGENIEUR-
RECYCLING-
MASCHINEN-
ANLAGEN
GMBH & CO.

EREMA

Freudorf, Unterfeldstraße 3, P.O.B. 38
A-4052 Ansfelden/LINZ, Austria
Phone 07 32 / 48 0 56-58
Telex 22 300 erema s

Ebreichsdorfer Straße 97-99
2512 Oeynhausen
Telefon 0 22 52 / 80 2 33



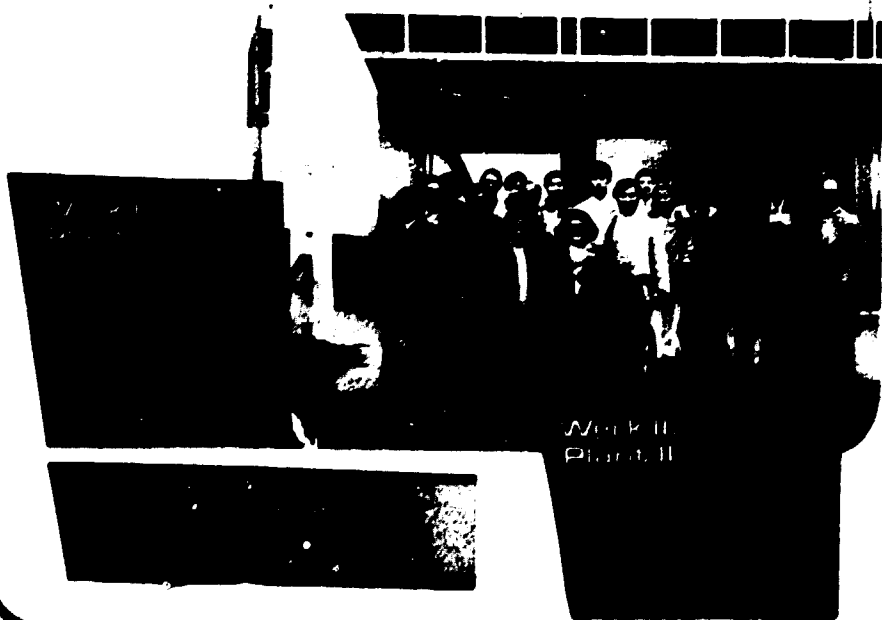
FEPLA HIRSCH ::::

GESELLSCHAFT f. u. H. FOLIENVERPACKUNGEN

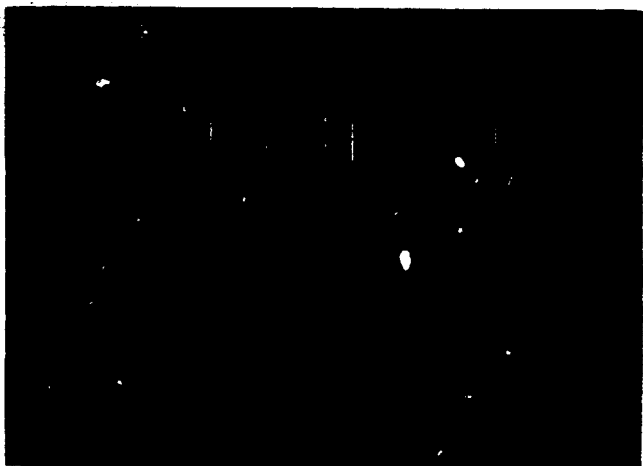
A-2700 Wiener Neustadt, Wiener Straße 113

Telefon (02622) 24541, Postfach 211, Telex 16629

Teletax (02622) 24541 276

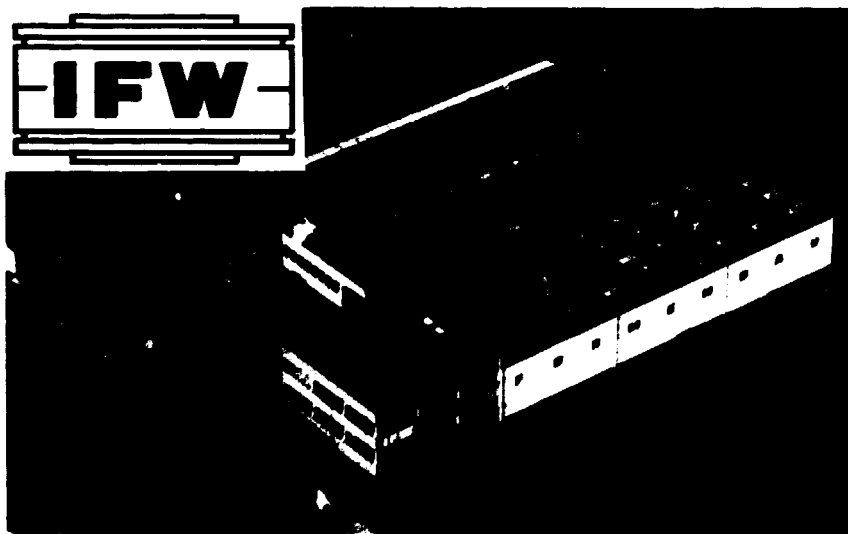


Werk II
Plant II



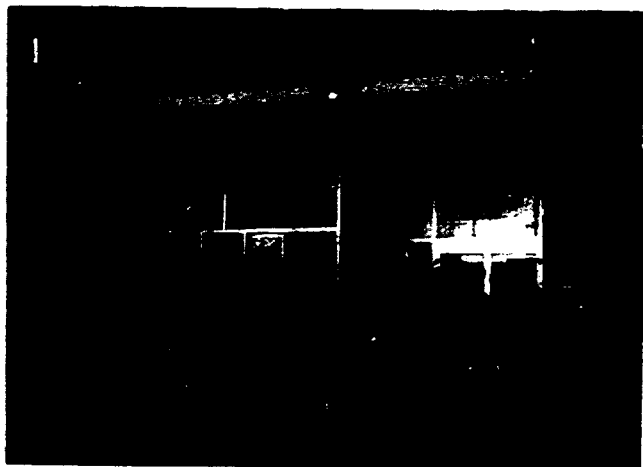
Hesonwerk

Nachfolger Colli KG
 A-4855 VORCHDORF · OO.
 Tel. 07614/8301-0 Serie
 Telex 024466hesona



IFW - M. Ote Ges.m.b.H. & Co. KG

A-4563 Micheldorf P O Box 2, Austria
 Tel. 07592/2556. Telex 23325 ifw a



 **poloplast** 

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



UNIPLAST

Kunststofftechnik Ges. m. b. H.

Austria

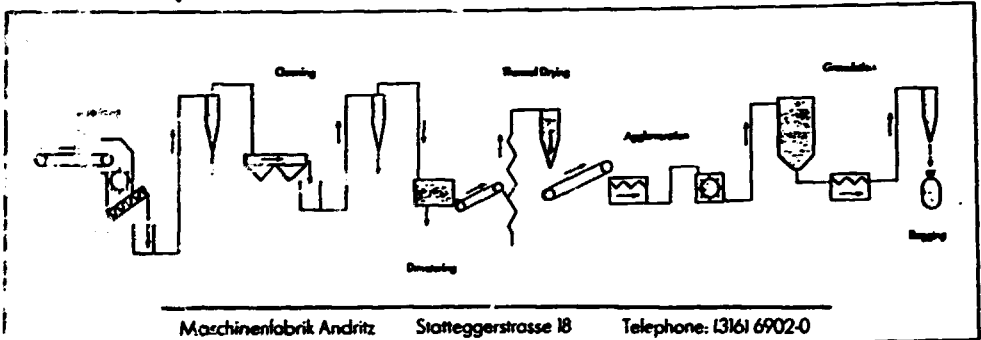
A-6862 Wirtberg, Altem 100

Telefon (075 87) 504

Telex (081) 376820Z, Telefax 075 87418



Flow Process Chart



Maschinenfabrik Andritz
Actiengesellschaft
Graz, Austria

Statteggerstrasse 18
Postfach 24
A-8045 Graz

Telephone: (3161) 6902-0
Telex: 31-1313
Telefax: (3161) 6902-2503

... ED LECTURE

ERBA SCIENCE

WISSENSCHAFTLICHE GERÄTE

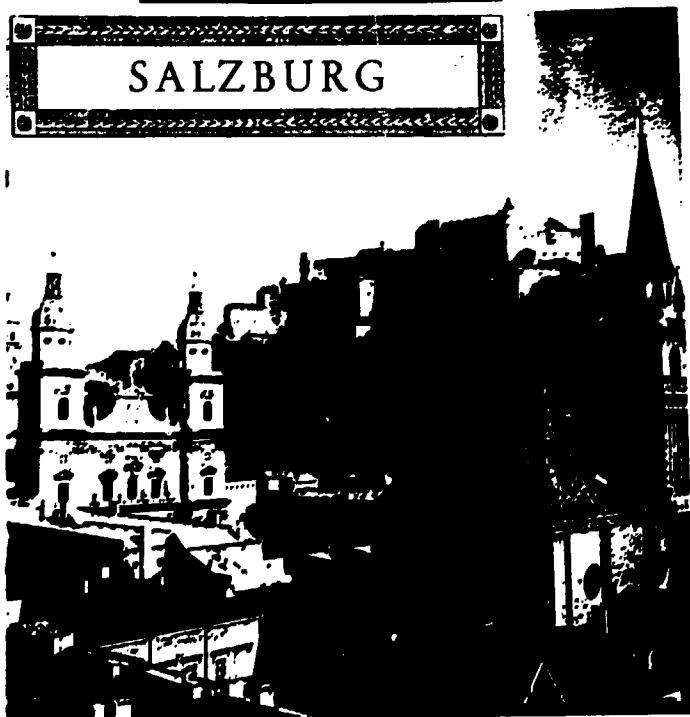


Schottenfeldgasse 79, A-1072 Wien
Tel. (0222) 93 28 11-0, Tlx 13-5021

8. SPECIAL EQUIPMENT FOR THE TRAINING PROGRAMME

ALPINE, FRG: Extruders
 AVL, Graz: Electronic Control Systems
 BATTENFELD, FRG: Injection Moulding and Blow Moulding Machines
 BATTENFELD-FISCHER, FRG: Blow Moulding
 BATTENFELD Kunststoffmaschinen GmbH., Kottlingbrunn: Injection Moulding Machines
 BAUER, Switzerland: Measuring Instruments
 BECKMANN, USA: IR-Equipment
 BIZERBA, Vienna: Silo-Installation
 BRABENDER, FRG: Testing Equipment
 BRANSON, USA: Ultrasonic Welding
 BROSA, FRG: Control Instruments
 BUCHER-GUYER, Switzerland: Presses
 BULL, USA: EDV-Equipment
 CADMOLD, FRG: Expert System for Molding
 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, FRG: Pre-Treatment Instruments
 ENGEL, Schwertberg: Injection Moulding Machines
 EPSON, Japan: EDV-Equipment
 ERBA, Italy: Gaschromatography
 FBW, Vienna: Process Control Systems
 FRANK, FRG: Testing Equipment
 FUCHS, Vienna: Mills
 GOERZ Electro, Vienna: Instruments
 GÖTTFERT, FRG: Rheological Equipment
 HAACK, Vienna: Laboratory Equipment
 HAGEDORN & BAILLY, FRG: Water and Oil Circulating Controllers
 HARTMANN & BRAUN, FRG: Control Systems
 HASCO, Vienna: Moulds
 HENSCHEL, FRG: Mixers
 HOTTINGER, Vienna: Torque Measurement Equipment
 JEOL, Japan: Electron Microscopic Equipment
 JOENS, FRG: Control Systems and Recorders
 JUMO, M.K.Juchheim, FRG: Control Instruments
 ILLIG, FRG: Vacuum Forming Machines
 KIEFEL, FRG: Film-Extruder
 KISTLER, Switzerland: Piezo-Quarz Sensors
 KRAUSS-MAFFEI, FRG: Foaming, Extrusion, Recycling
 KRAUTKRÄMER, FRG: Ultrasonic Equipments
 K-TRON SODER, Switzerland: Dosage-Systems, Dosage-Computer
 LINK, GB: X-Ray Analytical Equipment
 LÖDIGE, FRG: Mixer
 MEDEK & SCHÖRNER, Vienna: Signator (Marker)
 METRAWATT, FRG: Control Systems
 METTLER, Switzerland: Analytical Instruments, Balance
 MIKETRONIX, Pulkau: Electronic Equipment and Computer
 MOULDFLOW, Australia: Expert System for Molding
 NETSTAL, Switzerland: Injection Moulding Machines

OMYA, FRG: Ultrasonic Measuring Systems
PAAR, Austria: Electron Microscopie Preparation
PERKIN-ELMER, USA: Analytical Instruments
PHILIPS, Vienna: Control Systems and Recorders
PRODISTRIBUTION, Switzerland, Dosage Equipment
PVL, Waldbreitbach (Austria): Electronic Equipment
RAPL, Austria: EDV-Measuring Equipment
REICHERT-JUNG, Vienna: Microscopic Equipment
SATORIUS, FRG: Analytical Instruments
SCHLUMBERGER, Vienna: Electronic Equipments
SINGLE, FRG: Water and Oil Circulating Controllers
STAIGER & MOHILO, FRG: Instruments
STOUGAARD, Dänemark: Instruments
TESATRONIC, Switzerland: Measuring Equipment
TMC CONCEPT, Italy: Expert System for Molding
TIEDEMANN, FRG: Optical Instruments
TROESTER, FRG: Calanders, Roll Mills
UNILABOR, Vienna: Electronic Equipment
UNITEK, Vienna, Extruder Heads for Cables, Digital Processing
Control Systems
VIKING, UK: PUR-Foaming Machines
WITHOP, FRG: Control Systems
ZWICK, FRG: Testing Equipment



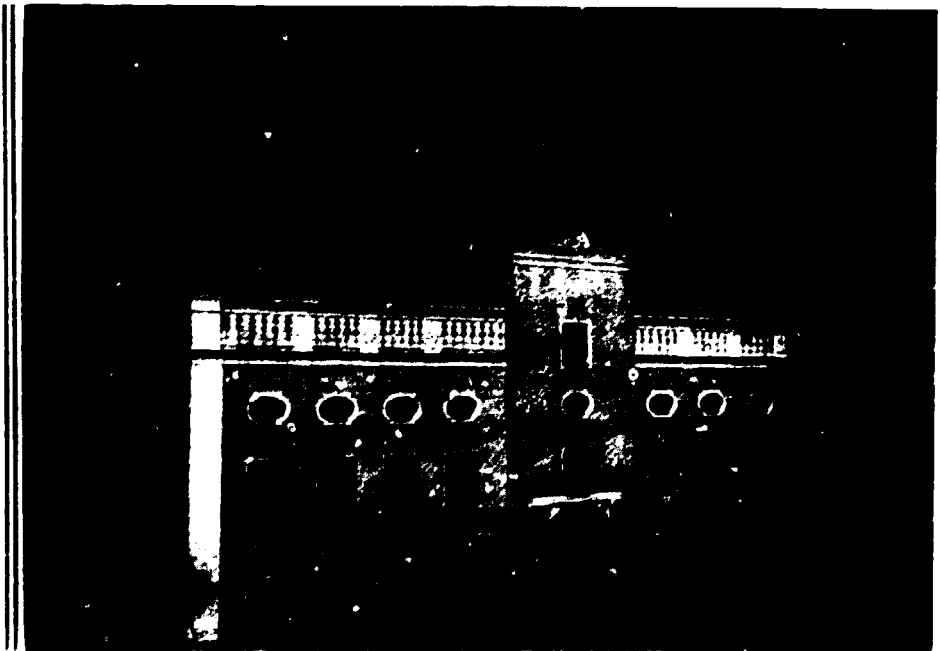
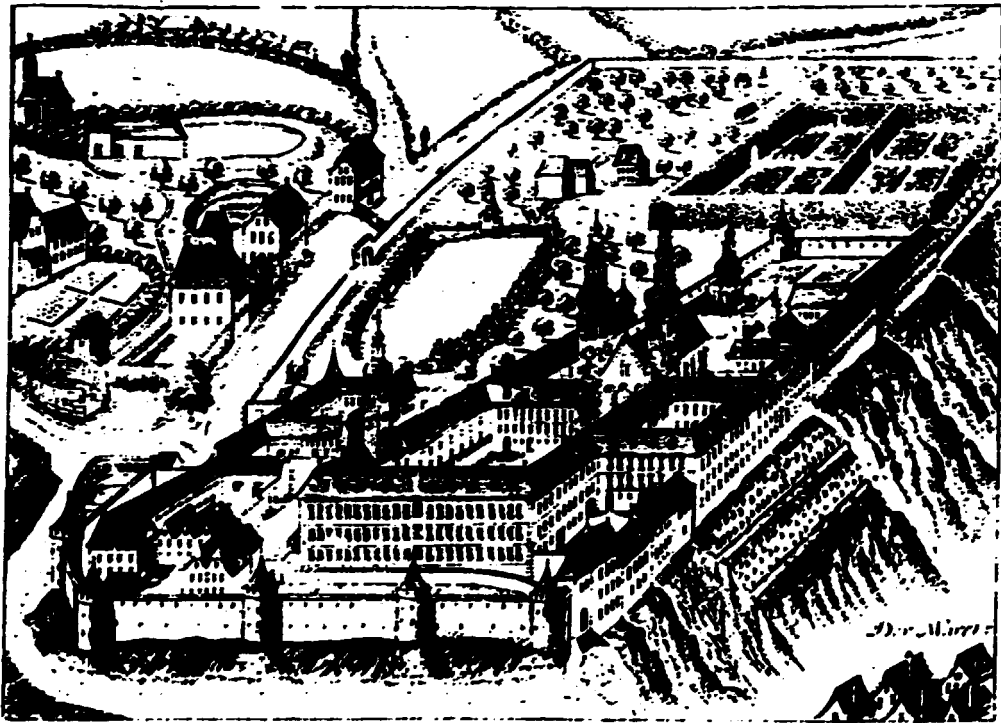
TAUPLITZ



TAUPLITZ



KREMSMÜNSTER





INVITATION

to all
UNIDO-Seminar
Participants

and
LKT-staff members

for a

»Praterbummel«

on Saturday
3rd of October 1987
at 5 p.m. (17.00h)

Meeting point
Entrance to
Riesensrad

All further information
by Robert Hillisch

LKT-Mitarbeiter: Teilnahme mit Frau/Mann, Freund/Freundin,
Begleitung, Kind, Kindern, usw.

87 09 29/Hi /80

Aus'steckt

Vienna and Wine are inseparable

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 recognized 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 »Bauschenchankgesetz« — which stipulates that only establishments that grow their wine entirely in Vienna or the surrounding rural districts may call themselves »heuriger«. 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 »viertel« (1/4 litres) of wine without feeling the effect of the alcohol particularly. Of course pure unmixed wines are also sold in 1/4 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.

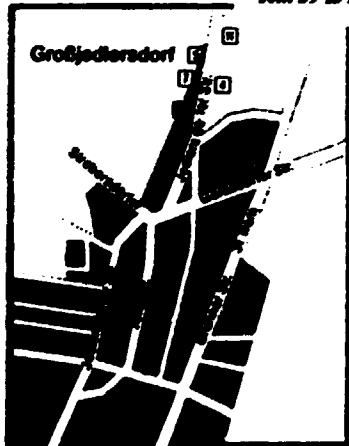
Today there are 700 families in Vienna growing wine over an area of about 1,800 acres. The majority of these vineyards — about 1,000 acres — are on the slopes of Kahlenberg and Nussberg, where you will also find the better known wine-growing districts such as Nusdorf, Heiligenstadt, Grinzing, »Severing« 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 »viertel«!

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!



„BACKSTUBE“

□ Spindler Anton
Fruenzstiftg. 4, 1210 Wien
Tel.: 39 13 26, 39 43 443



A small wine-growing district, where most of the heurigers are scattered along the main road, Jedlersdorfer Strasse. They are frequented mostly by regulars who appreciate not only the outstanding wines, but also the excellent buffet offered. Much of the food in the buffet, such as roast pork, smoked meat, etc. is still produced on the landlord's own farm. The heurigers in Jedlersdorf also have sufficient room to cater for large parties.

ID-Programme

(Standard 1987)

Industrial Development Programme in Polymer Engineering and Plastics Technology

Description:

The ID-programme is an individually arranged top-level programme for experienced candidates to help them solve their specific problems in polymer engineering and plastics technology. It is designed as an individual tuition course through project work in a specific field of polymer processing, engineering, application and recycling including theoretical introduction, practical work, educational training methods, computer-aided skills, publications, and membership to the Austrian Society for Polymer Engineering (GFKT).

Content:

The project work is selected from the following fields of study:

Plastics processing and control engineering; injection moulding, extrusion, blow moulding, foaming, compounding, machining, forming, welding, bonding, finishing, mould design, reinforced materials – application engineering; mechanical engineering, electrical engineering, electronics, ecotechnology, energy conversion, pipe- and lining systems, transport and packaging, composites – quality control; polymer physics (X-ray diffraction, electron microscopy, thermal analysis); polymer chemistry (analysis, IR-spectroscopy, chromatography), testing (mechanical, thermal, optical, electrical behaviour, ageing, stability and flammability) – environmental technology; waste management (collection, transportation, disposal, composting, combustion, refuse derived fuel), reclamation / secondary usage and recycling of polymeric materials; hazardous waste – automation and computation; programming, microprocessors, robotics – control engineering – quality assurance.

Services:

Permanent individual tuition by senior lectures – individual lectures – planning, review and evaluation of project work – permanent assistance – operators services – preparation and use of equipment and materials – introduction to computer aided literature and patent services – documentation – basic administrative facilities – computer aided skills.

Organisation:

Austrian Laboratory for Plastics Technology LKT-TGM (Laboratorium für Kunststofftechnik), Werdstrasse 19-23, A-1200 Vienna, Austria, Tel: (0) 222 35 21 06-0 and (0) 222 35 35 11-478, Telex: 13 18 24 in co-operation with UNWCO Headquarters, Chemical Industries Branch, Division of Industrial Operations, Vienna International Centre, PO Box 300, A-1400 Vienna, Telefon: (0) 222 26 31-0, Telex: 13 56 12.

Qualifications:

Graduation and experience in industry.

Language:

English, German.



VIENNA INTERNATIONAL CENTRE (UNO-CITY)

Training

**Technologisches Gewerbemuseum TGM, Top-Level Secondary Industrial School
Division of Plastics Technology**

Five-year course in German after completion of school grade 8 or equivalent
Three-year course in German after completion of a technical school or equivalent

College of Plastics Technology

Post-secondary four-semester course in German after matriculation examination or equivalent

Foreign applicants must have an adequate command of German

Certificates in foreign languages must provide certified translations into German and have to be recognized by the Federal Ministry of Education and Arts

The courses lead to a qualification for university studies and for civil service and after three years in profession to the right to use the professional title "Ingenieur"

Vocational Training Courses

Training courses for foremen and technicians in German in co-operation with the Industrial Promotion Institute (IWI)

International Programmes

UNIDO training programmes and Special Industrial Development (SID) programmes in English
Interpreters for other languages can be arranged by request

Testing

Staatliche autorisierte Versuchsanstalt für Kunststofftechnik am TGM

Federal Centre of Testing Materials for Plastics Technology

Certification and licenses according to DIN, VDE, ADR, ISO, DIN, ASTM, ONA, RET, AUSTRIA, GOST, Regulation, GRIS and other national and international standards in physical and chemical plastics technology

Certificates of the Federal Centre of Testing Materials are official Austrian documents

Fields of Authorization:

Investigation and examination of polymer materials (thermoplastics, thermosetting and elastomers) materials including processing and application (mechanical behavior, creep behavior, fatigue, thermal, optical and chemical behaviour, compounding, stability, ageing, flame retardancy, properties and recycling). Examination of plastic components and materials for the following products: packaging, household and plastic.

Investigation and examination of raw materials for plastic processing and application (additives, compounds, additives and stabilizers).

Corrosion and protection (including gas testing) and fire and explosion tests, examination of environmental problems related to polymers (pollution, protection and recycling).

Research

Forschungsinstitut der Gesellschaft zur Förderung der Kunststofftechnik GFKT

Research Institute of the Austrian Society for Polymer Engineering

200 national and international projects of applied research and development exist in the following fields:

Plastics processing — compounding — control engineering — mould design — application engineering — quality control polymer physics polymer chemistry testing — environmental technology — automation and computation

Major equipment for training, testing and research includes: 5 injection moulding machines, 6 extruders with down stream equipment, 2 blow moulding machines, 1 foaming machine, 2 rolling mills, 3 presses, 4 mixers, various machine tools, 1 spray-up machine, 6 microprocessors, 3 electronic universal testing machines up to 200 kN, walk-in climatic chamber (— 25°C + 80°C), 3 weathering testers, cold check tester, endurance testing beds, optical tension (for scanning electron microscope), gas chromatograph, 2 spectrometers, differential scanning thermo-analysis systems, 5 torque and capillary viscosimeters. Testing equipment for gas and water pipes, fittings, containers, roofing materials, thermal isolation elements, windows, doors, low temperature heating systems, solar energy systems.