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FINAL REPORT

Workshop on

ENVIRONMENTALLY DEGRADABLE PLASTICS,
PLASTICS RECYCLING
AND POLYMERS WASTE MANAGEMENT

Concepcion, Chile 17-19 December 2003

UNIDO PROJECT TF/GLO/00/105
CONTRACT No 2002/278
Objectives

- The main objectives of the meeting were:
  - To raise public awareness on the impact of increased plastic production and waste on the environment, and to emphasize the positive contributions of environmentally degradable plastics (EDPs) to the environment.
  - To introduce and to transfer the recent industrial and academic developments and the actual application of plastics recycling and EDPs.
  - To simulate international research and technology transfer and enhance international cooperation through possible collaboration and joint projects.
  - To help ICS in identifying qualified academic and industrial centers for future joint ventures for EDPs development.

Organization

The workshop was jointly organized by the International Centre for Science and High Technology of the United Nations Industrial Development Organization (ICS-UNIDO) and the University of Concepcion (Faculty of Physical Sciences and Mathematics).

The local organizing Committee consisted of:

- **Galo Cárdenas**
  Departamento de Polímeros  
  Facultad de Ciencias Químicas  
  Universidad de Concepción (Chile)  
  gcardena@udec.cl

- **Francisco Martínez**
  Departamento de Química  
  Facultad de Ciencias Físicas y Matemáticas  
  Universidad de Chile (Chile)  
  polimart@uchile.cl

- **Carlos von Plessing**
  Departamento de Farmacia  
  Facultad de Farmacia  
  Universidad de Concepción (Chile)  
  cvonples@udec.cl

- **Patricia Miranda**
  Facultad de Estudios Superiores, Cuautitlán  
  UNAM, México  
  mircas@servidor.unam.mx
The ICS-UNIDO Committee consisted of:

*Stanislav Miertus*
ICS-UNIDO Trieste, Italy

*Emo Chiellini*
ICS-UNIDO and University of Pisa

*Andrej Krzan*
Nacional Chemical Institute – Ljubljana, Slovenia and ICS-UNIDO Trieste, Italy

**Conference Venue**

The Workshop was held at the Facultad de Ciencias Químicas, Auditorium located in the Universidad de Concepción Campus. Edmundo Larenas 129 Street, Concepción (Chile).

**Funding**

The ICS-UNIDO contribution for the organization of the workshop amounted to US$15,000, of which US$12,000 were received before the starting date of the workshop. The total actual disbursement amounted to US$14,997, which were used to cover air tickets for international lecturers and participants, accommodation expenses, local transport and publication of proceedings. Participants not resident in Concepción were sponsored (partial or total airfare, full living expenses and accommodation): Participants resident in Concepción were sponsored for all social activities and meals relating to the workshop.

The University of Concepcion should therefore receive the remaining amount of US$2,997. Please refer to detailed budget table under Annex 1.

**Scientific program**

Monday 25 November:

09:00 hrs. 09:30hrs. Credentials
09:30 hrs. a 10:30.- Dr. Emo Chiellini ITALY : ICS ENVIRONMENTALLY DEGRADABLE PLASTICS AND ICN-UNIDO GLOBAL PROGRAMME.

10:30 hrs. a 11:00.- Coffee

11:00 hrs. a 12:00.- Dr. Ramani Narayan U.S.A. : NEW DEVELOPMENTS IN BIOBASED PRODUCTS AND BIODEGRADABLE PLASTICS

12:00 hrs. a 12:50 hrs. Dr. Joost Meijer, CONAMA STGO. CHILE : PLASTIC WASTE MANAGEMENT: ENVIRONMENTAL IMPACTS AND REGULATIONS

13:00 hrs. a 14:00 hrs. Lunch

14:30 hrs. a 15:30hrs. Dr. Fernando Maya MÉXICO : SISTEMA DE GESTION DE RECICLADO DE PLÁSTICOS EN MÉXICO (UNAM)

15:30 hrs. a 16:30hrs. Sr. Gerhart Braunegg AUSTRICHE : ENVIRONMENTAL LEGISLATION

16:30 hrs. a 17:00hrs Coffee

17:00 hrs. a 18:00 hrs. Dr. Emo Chiellini ITALY : STANDARDS ON PLASTIC WASTE MANAGEMENT IN EUROPE INCLUDING EDP’S

18:00 hrs. a 18:30 hrs. Inauguration

18:45 hrs. Cocktail

:::::::Tuesday 26 November:::::::

08:30 hrs. a 09:30 hrs Emo Chiellini / ICS : ENVIRONMENTALLY DEGRADABLE PLASTICS. AN OVERVIEW (University of Pisa)

09:30 hrs. a 10:00 hrs. Dra. Lucia Mei BRASIL : AN OVERVIEW OF SOME CASE STUDIES OF ACADEMIC WORKS ON BIODEGRADABLE POLYMERS IN BRAZIL AFTER WEDPLA 98 (UNICAMP)

10:30 hrs. a 11:30 hrs. Dr. Sylvio Ortega BRASIL : BIOCYCLE PRODUCT AND PROCESS TECHNOLOGY OF POLY (3 - HIDROXYBUTYRATE ) - PHB OBTAINED FROM SUGAR CANE.

10:30 hrs. a 11:00 hrs. Coffee

11:00 hrs. a 11:45 hrs. Dr. Patricia Miranda MÉXICO : CHITOSAN FILMS. APPLICATIONS IN FOOD STORAGE. (UNAM)

11.30hrs. a 12:15 hrs. Dr. Galo Cárdenas CHILE : CHITOSAN DERIVATIVES AS SLOW RELEASE BIOCIDES (University of Concepción)

12:15 hrs. a 13:00 hrs. Dr. Miguel Bahiense / Instituto de PVC. MÉXICO : PVC MECHANIC RECYCLING IN BRAZIL

13:00 hrs. a 14:00 hrs Lunch
14:30 hrs. a 15:15 hrs. Dr. Alicia Ronco ARGENTINA: PLASTICS AND THE ENVIRONMENT SITUATION FROM ARGENTINA

15:5 hrs. a 16:00 hrs. Dr. Javier Nakamatsu PERU: PLASTICS IN PERU, WHERE COME FROM AND WHERE THEY GO. CONTROLLED RELEASE FROM CHITOSAN MATRICES.

16:00 hrs. a 16:50 hrs. Dr. Ramani Narayan U.S.A. STANDARDS FOR BIODEGRADABLE PLASTICS & BIOBASED PRODUCTS

16:50 hrs. a 17:15 hrs. Coffee

17:15 hrs. a 17:45 hrs. Dr. Edgard Resto Puerto Rico: POLYMERIC MATERIALS CHARACTERIZATION BY SURFACE MICROSCOPY TECHNOLOGIES


19:00 hrs. Dinner " Riquen Restaurant "

:::::::Wednesday 27 November:::::::

08:30 hrs. a 09:30 hrs. Dr. Andrej Krzan SLOVENIA: ICS POLYMER RECYCLING: AN OVERVIEW

09:30 hrs a 10:30 hrs. Dr. Peter McKrostie ASIPLA CHILE: THE DYNAMICS OF THE PLASTIC INDUSTRY IN CHILE

10:30 hrs. a 11:00 hrs. Coffee

11:00 hrs. a 12:00 hrs. Dr. Gerhart Braunegg Technical University of Graz, Austria: BIOPOLYESTERS - A CONTRIBUTION TO SUSTAINABLE INDUSTRIAL DEVELOPMENT

12:00 hrs a 13:00 hrs. Dr. Andre Vilhena CEMPRE BRASIL: RECYCLING IN LATIN AMERICA: TRENDS AND OPPORTUNITIES

13:00 hrs. a 14:30 hrs. Lunch

14:30 hrs. a 15:30 hrs. Dra. Ofelia Noceti URUGUAY: PLASTIC RECYCLING POLYCLING POLICIES IN URUGUAY

15:30 hrs a 16:15 hrs Dr. Jovino Avaria CHILE: PETROQUÍM WASTE MANAGEMENT IN POLYPROPYLENE PLANT CHILE

16:30 a 18:30 hrs. Conclusions

19:00 hrs. Dinner
PARTICIPATION

Lecturers were selected for their expertise in the issues dealt with in the workshop. Lecturers and participants came from a variety of countries and institutions and are listed in table 1. Their affiliations included universities, R & D institutes. A copy of the lecture notes has been included (on Cd-Rom) as Appendix 4.

Table 1. Lecturers

<table>
<thead>
<tr>
<th>European Lecturer</th>
<th>Institution</th>
<th>Country</th>
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</thead>
<tbody>
<tr>
<td>Emo Chiellini</td>
<td>ICS-UNIDO</td>
<td>ITALY</td>
</tr>
<tr>
<td>Andrej Krzan</td>
<td>ICS UNIDO</td>
<td>SLOVENIA</td>
</tr>
<tr>
<td>Gerhart Braunegg</td>
<td>Technical University of Graz, Austria</td>
<td>AUSTRIA</td>
</tr>
<tr>
<td>Ramani Narayan</td>
<td>Chemical ENG. Michigan U.S.A.</td>
<td>U.S.A</td>
</tr>
<tr>
<td>Patricia Miranda</td>
<td>UNAM</td>
<td>MÉXICO</td>
</tr>
<tr>
<td>Fernando Maya</td>
<td>UNAM</td>
<td>MÉXICO</td>
</tr>
<tr>
<td>Lucia Innocentini Mei</td>
<td>Campinas University</td>
<td>BRAZIL</td>
</tr>
<tr>
<td>Andre Vilhena</td>
<td>CEMPRE</td>
<td>BRAZIL</td>
</tr>
<tr>
<td>Miguel Bahiense</td>
<td>Instituto do PVC</td>
<td>BRAZIL</td>
</tr>
<tr>
<td>Silvio Ortega</td>
<td>BIOCYCLE</td>
<td>BRAZIL</td>
</tr>
<tr>
<td>Edgard Resto</td>
<td>University of Puerto Rico</td>
<td>PUERTO RICO</td>
</tr>
<tr>
<td>Alicia Ronco</td>
<td>University of the Plata</td>
<td>ARGENTINA</td>
</tr>
<tr>
<td>Javier Nakamatsu</td>
<td>Pontificia Universidad Católica del Perú</td>
<td>PERU</td>
</tr>
<tr>
<td>Ofelia Noceti</td>
<td>Chemical and Pharmacy Society</td>
<td>URUGUAY</td>
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<tr>
<td>Peter Mcrostie</td>
<td>ASIPLA</td>
<td>CHILE</td>
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<tr>
<td>Joost Meijer</td>
<td>CONAMA</td>
<td>CHILE</td>
</tr>
<tr>
<td>Jovino Avaria</td>
<td>PETROQUIM</td>
<td>CHILE</td>
</tr>
<tr>
<td>Francisco Martínez</td>
<td>University of Chile</td>
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<tr>
<td>Rosa Catalán</td>
<td>University of Concepcion</td>
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<tr>
<td>Carlos von Pleasing</td>
<td>University of Concepcion</td>
<td>CHILE</td>
</tr>
<tr>
<td>Claudio Sandoval</td>
<td>PETROQUIM</td>
<td>CHILE</td>
</tr>
</tbody>
</table>
In addition, country reports were solicited from participants selected to attend the workshop. Each presented an outline of the industries and natural resources in their country, the major industrial pollutants and an indication of the presence or availability of less polluting technologies.

The organizers sent the applications by means of Chemical Societies of North, Central, South América and emailed to Institution. In addition the workshop was advertised on the Internet.

Table 3 details the geographical and institutional origin of participants. Table 3.
Participants according to countries

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>NUMBERS OF PARTICIPANTS</th>
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<td>Austria</td>
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<tr>
<td>Italy</td>
<td>1</td>
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<td>Mexico</td>
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<td>Peru</td>
<td>1</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>1</td>
</tr>
<tr>
<td>Slovenia</td>
<td>1</td>
</tr>
<tr>
<td>Uruguay</td>
<td>1</td>
</tr>
</tbody>
</table>

**WORKSHOP MATERIALS**

Each participants and lecturers was provided with a folder bag containing the following:

- A CD-ROM containing files of the lectures
- Detailed workshop program
- List of participants with their mailing addresses
- Pen and notebook
- Identification badge

**OPENING CEREMONY**

The workshop was officially opened by the President of the Chilean Chemical Society (Prof. G. Cardenas) and the representative of ICS-UNIDO (Prof. Emo Chiellini).

**SOCIAL EVENTS**

Coffee and lunches were provided for all participants of the workshop. A welcome reception was held at the Faculty of Chemical Sciences on the evening of November 25th. A conference dinner was held at the Riquen Restaurant on the final evening of the workshop.

**ASSESSMENT**

The workshop was assessed by the participants by means of an anonymous and optional questionnaire. Participants evaluated the workshop organization as being very good.

The general sense among participants was that the lecturer presentation were good.

**POSSIBLE FOLLOW-UP**

The workshop was considered a success amongst participants. There is now a greater awareness of state-of-the-art catalytic technologies and the design aspects of green chemistry. The establishment of a Centre for EDP's policies in a number of Latin
America countries is expected to facilitate communication between academic and industrial institutions in this important area.

During the concluding session, a general discussion based on country reports was held. The following conclusions were drawn:

- There was general agreement that the workshop had been valuable in discussion of pollution problems by plastics. The replacement for EDP’s and the importance to establish laws and rules in Latin America and regional policies was discussed. A summary of the workshop, including key lectures and country reports will be written up and submitted to the Journal Green Chemistry, with the intention of having this publish in the "News and Views" section of the journal.

- A certified laboratory to classify and measured some parameters of EDP’S from a Synthetic Polymers will be set up in the only existing Department of Polymers in Chile, under direction of Prof. Galo Cárdenas.

- Preparation of a detailed action plan of the proposed follow-up activities will be done jointly by ICS-UNIDO and the Chilean Chemical Society.

APPENDIXES

Appendix 1:
Summary of budget and expenditure

Appendix 2:
Detailed programme of the workshop

Appendix 3:
List of lecturers and participants (with full addresses)

Appendix 4:
CD-ROM of key lectures presented in the workshop