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FINAL REPORT

**WORKSHOP ON ENVIRONMENTALLY DEGRADABLE
AND RECYCLABLE POLYMERS IN LATIN AMERICA -
WEDPLA'98**

**STATE UNIVERSITY OF CAMPINAS , CAMPINAS/ SÃO
PAULO STATE – BRAZIL
NOVEMBER 15 th – 20 th , 1998**

UNIDO Project No. : TF/GLO/96/105

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OBJECTIVES

To inform participants, mainly from those of emerging countries like Brazil and his neighbours from Latin America, on new management strategies developed and applied to solve the issues dealing with plastic waste pollution in different situations; to discuss the prospects for the decontamination of polluted sites which could be used to restore their original functionality; to discuss general strategies on plastic waste management and their economic aspects; to evaluate the applicability of viable alternatives, modern strategies and operational methodologies in preventing from pollution and recovering of the environment taking into account the local resources. To stress the central role that EDP's are going to held within the frame of a sustainable industrial development, opening the oportunity to all countries of Latin America, and in special to Brazil, that is the only producer of environmentally degradable plastics in these group, to take part of this important niche in the world.

The main objectives of these Workshop were focused in the following points:

- State of Art on Environmentally Degradable Polymers (EDP's) in the world;
- Recycling as option in the plastic waste management;
- Applications and economical aspects of EDP's;
- Academic versus Industrial experiences on EDP's and Recycling;
- Local natural sources of degradable polymeric plastic materials;
- Success histories with plastic waste recovery in the world;
- Environmental policy and plastic waste management;
- Case studies relevant to production & processing and applications of EDP's;
- Standards and legal issues on EDP's

ORGANISATION & SCIENTIFIC COMMITTEE

The Workshop was jointly organised by the International Centre for Science and High Technology (ICS-UNIDO) in Trieste/Italy , advised by Prof. Dr. Emo Chiellini and Prof. Dr. Stanislav Miertus; by Academics of Campinas State University (UNICAMP), Santa Catarina Federal University (UFSC) and by representatives of the Research Centre of Brasilian Telecommunication (CPqD), Cooperativa dos Produtores de Cana de Açúcar, Açúcar e Alcool do Estado de São Paulo (COPERSUCAR) and the Brazilian Association of the Chemical Industries (ABIQUIM). The list of the local organizers and the Scientific Committee follow below:

Organisers

- Lucia Helena Innocentini Mei (Coordinator) - UNICAMP
- Derval dos Santos Rosa – CPqD
- Elisa Espósito – UFSC

- Leila Peres – UNICAMP
- Rodrigo Cirillo Baltieri – UNICAMP
- Roberto Nonato Vianna – COPERSUCAR
- Silvia Piedrahita Rolim – ABIQUIM
- Sergio Persio Ravagnani - UNICAMP
- Vera Lucia Covolan – UNICAMP

Scientific Committee

- Carlos Eduardo Vaz Rossell – COPERSUCAR / Campinas - Brazil
- Emo Chiellini – University of Pisa / Pisa – Italy
- Edison Bittencourt – UNICAMP / Campinas – Brazil
- Eloisa Biasotto Mano – IMA - UFRJ / Brazil
- Ernesto Teixeira Weber – ABIQUIM / Brazil
- Fernando Galembek – UNICAMP / Campinas – Brazil
- Giacomo Ruggeri – University of Pisa / Pisa – Italy
- José Augusto Marcondes Agnelli – UFSCar / São Carlos – Brazil
- João Sinézio Carvalho Campos – UNICAMP / Campinas – Brazil
- Lucia Helena Innocentini Mei – UNICAMP / Campinas – Brazil
- Maria do Carmo Gonçalves – UNICAMP / Campinas – Brazil
- Marcos Lopes Dias – IMA - UFRJ / Brazil
- Stanislav Miertus – ICS-UNIDO / Trieste – Italy

VENUE DATES AND FACILITIES

The Workshop was held in Campinas City at the State University of Campinas from november 15th to november 20th 1998.

All the facilities needed for the lecturers presentation like local availability, **video, multi-media** equipments and guests hospitality were provided by the FUNCAMP Hotel inside the State University of Campinas in a very reasonable price.

FUNDING

The total expenditure from the UNIDO contribution of R\$ 38,038.40, was of R\$ 31,910.87. Therefore there has been a left-over of R\$ 6,127.53, which will be refunded to UNIDO.

The expenditure was lower than the planned budget for the following reasons;

1. Four participants from Latin America (Mexico, Cuba, Uruguay) cancelled their participation just few days before the Workshop starting, turning impossible the replacement.

2. All brazilian participants from industries were supported by their Companies.

3. All invited lecturers and participants flew by the cheaper travel tickets.

The State University of Campinas provided all administrative support needed for the project approval and execution, advised by Prof. Dr. Fernando Galembe, the General Coordinator of the University.

In any case the objectives of the Workshop were fully reached.

LECTURERS AND PARTICIPANTS

A total of 09 participants and key lecturers (table 1) were responsible for 12 oral presentations. A total of 47 participants coming from developing or emerging countries (table 2 and table 3). 19 participants (table 2) were responsible for 21 oral presentations in a total of 33 oral presentations, including the Companies and Research Centers. They all were invited by the President of the organizing committee between those scientists and people from Industries & Research Centers that are deeply involved with "Plastics Wastes" and/or "Environmentally Degradable Polymers" issues. It was given more time for the presentations of the lecturers in order to have a full overview of the researches that they are being developed in those areas. In general, we could have a good idea of this kind of work in the world as we had contributions from many different and important countries as listed below:

Table 1 : List of the industrialized countries that presented lectures in WEDPLA'98.

COUNTRY	INTITUTIONS	No. of LECTURES
Austria	University of Technology of Graz	01
Canada	Queens University	01
Germany	Universität Ulm	01
Italy	University of Pisa	03
Sweedden	Combustion Institute	02
Taiwan	Tainan District Agricultural Improvement Station	01
USA	Michigan State University	01
	University of Arizona	01
	University of Massachusetts & BEDPS	01

Table 2 : List of the participants countries that presented lectures in WEDPLA'98.

COUNTRY	INTITUTIONS	No. of LECTURES
Argentina	University of Mar del Plata & National Research Council (INTEMA)	01
Brazil	State University of Campinas (UNICAMP)	01
	State University of São Paulo (UNESP)	01
	Federal University of Rio de Janeiro (UFRJ) & Macromolecules Institute (IMA)	02
	Instituto do PVC	01
	Brazilian Business Commitment for Recycling – CEMPRE	01
	Solvay Indupa do Brasil S.A.	01
	COPERSUCAR	01
	CPqD Telecomunicações	01
Chile	Universidad de Concepción	01
Colombia	Universidad del Valle	01
Egypt	Alexandria University	02
Peru	Pontificia Universidad Católica del Perú	01
Turkey	Hacettepe University	02
Qatar	Faculty of Technology	01
Slovakia	Slovak Academy of Science	02
Venezuela	Universidad de Oriente	01

The majority of the lectures came from Academics Institutions since the subjects of the Workshop, that are “Environmentally Degradable Polymers” & “Plastic Waste”, may be considered a niche even not fully explored in industrialized countries, as well as in the emerging countries, by their Industries. In this way, one of the main contribution of this Workshop was to bring together people from Academic and Industrial Institutions in order to discuss together the best form of contribution of each part in order to reach a common

sense for the sustainable development of the plastic Industries keeping the environmental pollution on acceptable levels.

All lecturers and participants from academic institutions gave oral presentations about "Plastic Waste & the Environment" and/or "Environmentally Degradable Polymers", followed by a wide discussion of the subject presented, giving opportunity for a full exchange of ideas and opinions.

All lecturers and participants invited for oral presentation, not resident in Campinas, were sponsored (air or surface, living expenses and/or accommodation). For those living in Campinas or nearby, it was offered meals related to the Workshop.

The advertise of the Workshop was done by Internet (www.unicamp.br/~sette/wedp.html) and personally by the President of the Organising Committee by using e.mail, Fax and phone. The help of Profs. Dr. Emo Chiellini and Stanislav Miertus from ICS was very important to facilitate the contact of the Organizing Committee with people from various countries.

The participants from Academies, Industries & Research Centres in Brazil, who attended the Workshop, were in a limited number of people between the most representative in the area of plastics. They were all invited by the President of the Organising Committee, on behalf of ICS-UNIDO, according to their activity in the area of plastics and environment. All of them (table 3) had their diaries and/or travel sponsored by the Organizing Committee.

Table 3 - List of the participants (not presenting lecturers) from Academies, Researches Centres and Companies that attended the WEDPLA'98

INSTITUTION	No. of PARTICIPANTS
Vice-Presidency of UNICAMP	01
COPERSUCAR	02
Manah	02
Plastivida	01
Instituto do PVC	01
Institute of Technological Reserch –IPT	02
ALCOA S.A.	02
Brazilian Chemical Industries Association - ABIQUIM	01
Cromex-Brancolor	01
Polibrasil Resinas Co.	02
GE Plastics of South America & Brazilian Polymer Association	01
3M do Brasil	01
Federal Fluminense University –UFF	01
Chemical Engineering College-FEQ	06
Mechanical Engineering College – UNICAMP	01
University of São Paulo- USP	01
Federal University of Santa Catarina-UFSC	01
Federal University of São Carlos- UFSCar	01

The full address of each participant and lecturers is given in the Appendix 2.

MATERIAL DISTRIBUTED , PROGRAMME & PROCEEDINGS

The Organising Committee offered to all lecturers and participants a Workshop bag containing all material necessary like **Programme in detail (Appendix 3)**, pen, cultural folders of UNICAMP and Campinas city. A xerox copy of all the lectures disposable at the date of the Workshop was provided for each lecturer and participant. At the end of the Workshop every lecturers and participant received a certificate of participation, signed by Prof.Dr. Emo Chiellini as the ICS-UNIDO representative; by Prof. Dr. Fernando Galembek as the Vice-President of UNICAMP ans by Dr. Lucia H. Innocentini Mei, the President of the Organising Committee.

The Proceedings of the Workshop is being doing in a CD-Rom format and a copy will be addressed for each Workshop participant . The option for CD-Rom to do the Proceedings was based in two important points, that are; the less cost of the material and the possibility of printing all papers without cut important data necessary for the enrichment of the texts.

Some delay was caused by some lecturers who didn't send their papers in time to publish the Proceedings before the Workshop.

OPENNING CEREMONY

The Workshop was officially opened on november 15th at 7:00 p.m. by the official Chief of Ceremony of UNICAMP that invited Dr. Lucia H. Innocentini Mei and Prof. Dr. Fernando Galembek , the President of the Organising Committee and the Vice-President of State University of Campinas, respectively, to welcome all lecturers and participants . Following, Prof.Dr. Emo Chiellini, made an explanation about ICS-UNIDO programme regarding to the transfer of know-how and technology from industrialized countries to developing countries.

After declared the session closed, at 8:00 p.m., the Chief of Ceremony invited all for the Welcome dinner at Funcamp Hotel.

MEETINGS

During the Workshop, some important meetings took place between Prof. Emo Chiellini and representatives of Local Authorities and Institutions. The meeting with the COPERSUCAR representatives

was very important since they are the only EDP's producers in Latin America. In this meeting they expressed their aim to stress all the possibilities of developing projects with ICS-UNIDO in order to explore all the alternatives to improve their production of EDP's and to find applications of these products in the National and International market, mainly in the Mercosul.

Others important meetings occurred between Prof. Emo Chiellini and the Press. The divulgation about ICS-UNIDO activities and the Workshop purposes was done in the local TV, Radio and in a Magazine (**Appendix 6**).

TECHNICAL VISITS

A visiting to the Cooperative of Sugar, Sugar-cane and Alcohol Producers – COPERSUCAR in Piracicaba, a little town near Campinas was organised with the objective to show the unique Industry in Latin America that produces Polyhydroxyalcanoates (PHA's) like PHB and PHB/V , that belongs to the family of Environmentally Degradable Polymers (EDP's) . In this oportunity it was shown, by video , the sugar cane plantation and production of its derivatives. Samples of PHB, whose explanation about its production was done during the Workshop, was distributed to all visitors . Some laboratories for chemical and biological control of the sugar cane species were visited.

SOCIAL EVENTS

The social part of the Workshop was covered by the Organising Committee that provided all facilities for the meeting of all lecturers and participants in a very informal environment. It was offered :

- Welcome dinner after the opening ceremony on november 15th ,
- City tours to the touristic, historical and cultural points of Campinas city and region were offered for all lecturers and participants of the Workshop.
- A lanch in a tipical barbecue house was offered during the Workshop in order to have the participation of all people who attended the Workshop.
- An excursion to the tipical dutch town near Campinas, were people take care of many different kinds of plants and flowers for exportation inside and outside Brazil.
- An excursion to two small tipical brazilian towns near Campinas, well-known by their mineral water, their knitted cloths, different kinds of stones and many kinds of cheese.

ASSESSMENT

The Workshop was assessed by the participants via anonymous and optional questionnaire enclosed with this report. A **model of the questionnaire** as well as the analysis of the responses are presented in the **Appendix 4** and **Appendix 5**, respectively.

In the average, the balance of the Workshop evaluation was very positive, considering that the Workshop was Organized in 6 month.

MEDIA IMPACT

During the Workshop, Prof. Chiellini hold another interview with a magazine named "ÉPOCA" that has a great circulation in the country. After holding na interview with Dr. Lucia Mei, about a month later, they published one article entitled "Em busca da vida curta" what means "Searching for brief life for the plastics" (**Appendix 6**). In this article they comment about the industries in the world that are getting good results in the search for plastic that degrade on the environment. To avoid mistakes related to the industries that produces synthetics plastics, Dr. Mei made clear that the EDP's are an alternative , not a substitute, for the problem of plastics wastes. They are very important to attend the appeal of the environment, mainly in Europe and USA where the concern with the environment is being part of the dairy life.

RESULTS

Based in the results of the impact caused in the media and by the opinion of all participants, the Workshop (WEDPLA'98) was considered a success. In terms of Latin America, the impact of WEDPLA'98 overcome the expectative and surely it will bring many benefits to

all sectors of the industry of plastics that is looking forward to work with EDP's, mainly in Brazil because it is the only EDP's producer in Latin America.

During the Workshop, the local TV hold an interview with Prof. Chiellini, as the ICS-UNIDO representative, and Dr. Lucia Mei. Prof. Chiellini made some comments about the purposes of ICS-UNIDO and about the aim of the Workshop. In the same way, Dr. Mei hold na interview with the local Radio when she took the opportunity to resume in few words the talk of Prof. Chiellini during his interview in the TV.

FOLLOW-UP

Many representative from plastic industries, mainly COPERSUCAR that produces PHA's in Brazil, became very interested to interact with ICS-UNIDO in order to develop some bilateral projects that may help them to put their products in the market in a short time.

In the moment, Copersucar is interested to develop a project with ICS-UNIDO, Coordinated by Dr. Lucia H. Innocentini Mei from the State University of Campinas (UNICAMP) and Dr. Carlos Vaz Rossell (COPERSUCAR), as the representatives of Brazil, and Prof. Gerhart Braunegg from the University of Technology (Institute of Biotechnology) – Graz / Austria; Prof. Ramani Narayan from University of Michigan / USA; Prof. Emo Chiellini from University of Pisa and Prof. Stanislav Miertus as the Coordinators by ICS-UNIDO.

Another project probably will be developed with one other brazilian Company (MANAH) that is interested in the developoment of the Controlled Delivery Fertilizers Systems using EDP's as matrix. At the moment they are in contact with Prof. Chiellini in order to get all informations necessary to propose a project to ICS-UNIDO.

About the representatives of the others countries that partipated in the Workshop, that are; Colombia, Argentina, Perú, Venezuela and Chile , they became very interested in the possibility of doing a project with ICS-UNIDO mainly after the presentation of Prof. Emo Chiellini who showed clearly that this was one of the main goal of these events.

The tendency of the Latin-american EDP's market is to grow fast in the next few years, stimulating the Companies to develop projects involving this kind of materials to full a very important niche in the market.

APPENDIX 1

Workshop on Environmentally Degradable and Recyclable Polymers in Latin America - WEDPLA '98 November 15th – 20th, 1998 - BRAZIL

FINANCIAL REPORT

Table A1 : Expecting Incomes from UNIDO and others sources.

SOURCE	EXPECTED INCOME	ACTUAL INCOME
	US\$ / R\$	US\$/ R\$
UNIDO	40,000.00 / 47,548.00	32,000.00 / 38,038.40
FAPESP	12,942.00 / 15,384.16	0.00 / 0.00
COMPANIES	14,500.00 / 17,236.15	12,500.00 / 14,858.75
TOTAL	67,442.00 / 80,168.31	44,500.00 / 52,897.15

OBS: The exchange rate used was R\$ 1.1887 to US\$ 1.00. At the moment this value is fluctuating significantly (~ R\$ 1.50 on January 20th /1999).

Table A2 : The Original expenditure and the new proposal.

EXPENDITURE	UNIDO R\$	
	ORIGINAL BUDGET	ACTUAL EXPENDITURE
Transport	40,861.56	24,541.41
Accommodation	6,686.44	7,351.63
Bank fare	17.83	17.83
TOTAL	47,565.83	31,910.87

OBS: Income (R\$ 38,038.40) – Expenditure (R\$ 31,910.87) = **Balance (R\$ 6,127.53)**
This money shall be refunded to UNIDO by UNICAMP

APPENDIX 2

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APPENDIX 3

**INTERNATIONAL WORKSHOP ON ENVIRONMENTALLY
DEGRADABLE AND RECYCLABLE POLYMERS IN
LATIN AMERICA
WEDPLA '98**

Campinas State University - UNICAMP

Campinas, SP

November 15 – 20th, 1998

PROGRAMME

SUNDAY EVENING, November 15th, 1998

- **Opening Session at 7:00 p.m. at the ADUNICAMP AUDITORIUM.**
 - Prof. Hermano de Medeiros Tavares - Rector of UNICAMP, Brazil
 - Prof. Emo Chiellini – ICS-UNIDO/University of Pisa, Italy
 - Dr. Lucia H. Innocentini Mei – President of the Organizing Committee

- **Welcome Dinner**

MONDAY MORNING, November 16th, 1998

First Session - Chairman: Lucia H. Innocentini Mei - Campinas State University - Brazil

- 9.00 - 9:50: Emo Chiellini (University of Pisa – Italy)
“Environmentally Degradable Polymers and Plastics. An Overview”
- 9.50 - 10.40: Sherif Hussein Kandil - Alexandria University - Egypt
“Plastic Waste Issue & EDPs in Egypt. Country Report”
- 10.40 - 11.00: Coffee Break

Second Session - Chairman: Ivan Chodak - Slovak Academy of Science - Slovakia

- 11:00 – 11:50 Erhan Piskin - Hacettepe University - Turkey
“Environmentally Degradable Polymers in Turkey. Follow-up of ICS-UNIDO Workshop Held in Turkey in 1998”
- 11:50 – 12:40 Ziad F. M. Said - University of Qatar - Qatar
Plastic Waste Issue & EDPs in Qatar. Forthcoming EDPs Workshop. Country Report”
- 12:40 – 13:00 General Discussion
- 13:00 – 15:00 Lunch & Mid-day Intermission

MONDAY AFTERNOON, November 16th, 1998

Third Session - Chairman: Eloisa B. Mano - Federal University of Rio de Janeiro - Brazil

- 15:00 - 15:50 Gerhart Braunegg - University of Technology Graz - Austria
“Biodegradable Plastics: Production and Use of Polyhydroxyalkanoates”
- 15:50 - 16:40 Bruce A Ramsay – Queens University -Canada
“Possibilities for Inexpensive Biodegradable Plastics (PHAs)”
- 16:40 – 17:00 Coffee Break

Fourth Session - Chairman : Sherif Hussein Kandil -Alexandria University - Egypt

- 17:00 – 17:50 Erhan Piskin – Hacettepe University -Turkey
“Solid Waste Management in Turkey. Country Report”
- 17:50 – 18:10 General Discussion

TUESDAY MORNING, NOVEMBER 17TH, 1998

First Session - Chairman: Bruce A Ramsay - Queens University - Canada

- 9:00 – 9:30 Eloisa Mano - Federal University of Rio de Janeiro - Brazil
“Recycling of Polyaddition Polymers versus Environmental Pollution”
- 9:30 – 10:00 Roberto Nonato Vianna– Cooperativa dos Produtores de Cana, Açúcar e Álcool do Estado de São Paulo Ltda -COPERSUCAR – Brazil
“Plastic Waste Issue in Sao Paulo (Brazil) & EDPs. Country Regional Report”
- 10:00 – 10:30 Marco Aurélio de Paoli – Campinas State University - Brazil
“Plastic Waste Issue & EDPs in UNICAMP. Local Report”
- 10:30 – 10:50 Coffee Break

Second Session - Chairman: Ziad F. M. Said - University of Qatar - Qatar

- 10:50 – 11:15 Edmundo Velarde Laos –Pontificia Universidad Católica de Perú - Peru
“Plastic Waste Issue & EDPs in Peru. Country Report”
- 11:15 – 11:40 Roxana Alejandra Ruseckaite – University of Mar del Plata
“An Overview Of The Research Activities Of INTEMA on Biodegradable Polymers : Country Report ”
- 11:40 – 12:05 Hector Fabio Zuluaga Corrales - Universidad del Valle -Colombia
“Polymer Recycling in Colombia. Country Report”
- 12:05 – 12:30 Edison Carlos – Solvay Indupa do Brasil
“PVC Waste Management – The Industry Point of View”
- 12:30 – 12:55 Blanca H. Rojas Hernández de Gáscue – Universidad de Oriente – Venezuela
“The Funcionalization as Via for Increasing the Capacity of Recycling in the Polyethylenes”

- 12:55 – 13:15 General Discussion
- 13:15 – 15:00 Lunch & Mid-day Intermission

TUESDAY AFTERNOON, November 17, 1998

Third Session – Chairman: Wilson Rughes, University of Arizona, USA

- 15:00 - 15:25 Derval dos Santos Rosa – CPqD - Brazil
“The use of EDPs on Telecommunication”
- 15:25 - 15:50 Marcos Lopes Dias – Federal University of Rio de Janeiro -Brazil
“Plastic Waste Issue - Recycling of (PET) Bottles. A Case Study”
- 15:50 – 16:15 Paulo Figueiredo - PVC Institute - Brazil
“Life cycle’s Analysis - PVC. A Case Study”
- 16:15 – 16:30 Coffee break

Fourth Session – Chairman: Gerhart Braunegg - Technische Universität, Graz - Austria

- 16:30 – 16:55 Helio Wiebeck- University of São Paulo (USP) –Brazil
“Recycling of Plastics at the Escola Politécnica- University of São Paulo”
- 16:55 – 17:20 Ivan Chodak - Academy of Science - Slovakia
“Plastic Waste Management and the Position of EDPs in Slovakia”
- 17:20 – 18:00 General Discussion

WEDNESDAY MORNING, November 18th, 1998

First Session – Chairman: Erhan Piskin – Hacettepe University - Turkey

- 9:00 - 9:50 Steve Goodwin – University of Massachusetts -USA
“The Bio/Environmentally Degradable Polymers Society”
- 9:50 – 10:40 Ramani Narayan- Bioplastics Inc., Hokemus, MI - USA
“An Overview on Assessing the Compostability of Biodegradable Plastics – ASTM-ISR Study and Experimental Guide to Practicing The Evolving National & International Standards”

- 10:40 – 11:00 Coffee Break

Second Session – Chairman : Steve Goodwin – University of Massachusetts -USA

- 11:00 – 11:50 Wilson Rughes – University of Arizona -USA
“Inside Landfill”
- 11:50 - 12:40 Emo Chiellini – University of Pisa -Italy
“Environmentally Degradable Plastics. Hydrosoluble Biodegradable Polymeric Materials. A Case Study”
- 12:40 – 13:00 General Discussion
- 13:00 – 14:00 Lunch
- 14:00 – 18:00 VISIT TO COPERSUCAR COMPANY

THURSDAY MORNING, November 19th, 1998

First Session – Chairman: Stig Johansson - PackForsk, Jönköping - Sweden

- 9:00 - 9:50 Emo Chiellini - University of Pisa – Italy
“Environmentally Degradable Plastics. From Waste Gelatin to Agro-Industrial Applications. A Case Study of ICS-UNIDO Follow-up Policy”
- 9:50 – 10:40 Ramany Narayan – Bioplastics Inc., Hokemus, MI - USA
Rationale & Drivers for Biodegradable Plastics & A case Study of Starch-Polycaprolactone Reactive Blend Technology”
- 10:40 – 11:00 Coffee Break

Second Session – Chairman: Hector Fabio Zuluaga Corrales - Universidad del Valle - Colombia

- 11:00 - 11:50 Ivan Chodak - Slovak Academy of Science – Slovakia
“Environmentally Friendly Materials via Modification of Plastics”
- 11:50 - 12:40 Y. J. Lee - Universität Ulm - Germany
“Chemical Synthesis and Properties of Biodegradable Polyesterurethanes”

- 12:40 – 13:00 General Discussion
- 13:00 – 15:30 Lunch & Mid-day Intermission

THURSDAY AFTERNOON, November 19th, 1998

Third Session – Chairman: Lucia H. Innocentini Mei - Campinas State University - Brazil

- 15:30 – 16:20 Stig Johansson - PackForsk, Jönköping - Sweden
“The Adiabatic Energy Recovery Criterion for Meeting the EU Packaging Directive Requirements”
- 16:20 – 16:45 Alcides Leão – State University of São Paulo (UNESP) – Brazil
“Natural Polymers and Ecomposites in the Automotive Industry”
- 16:45 – 17:00 Coffee Break
- 17:00 – 19:00 Round Table on EDPs and Recovery of Plastics

FRIDAY MORNING, November 20th, 1998

First Session – Chairman: Ramany Narayan – Bioplastics Inc., Hokemus, MI - USA

- 9:00 – 9:45 Shaw-rong Yang – Tainan District Agricultural Improvement Station - Taiwan
“Degradable Plastics Films for Agricultural Application in Taiwan. Country Report”
- 9:45 – 10:10 Galo Cardenas Triviño - Universidad de Concepción - Chile
“Plastic Waste Issue & EDPs in Chile: Country Report”
- 10:10 – 11:00 - Coffee Break
- 11:00 – 11:25 Sheriff Hussein Kandil – Alexandria University - Egypt
“Follow-up of ICS-UNIDO TC held in Egypt in 1997. Country Report”
- 11:25 – 11:50 Stig Johansson - PackForsk, Jönköping - Sweden
“What’s in a flame”

- 11:50 – 12:40 André Vilhena – Brazilian Business Commitment for Recycling – CEMPRE
“Plastic Waste Management in Brasil & EDPs. Country Report”
- 13:00 – 14:00 General Discussion and Closing Session

APPENDIX 4

**ICS Workshop/Training Course:
EVALUATION QUESTIONNAIRE**

Course/Workshop: _____

A. Organization:

1. How did you obtain information about this workshop/course?

	Excellent	Very Good	Good	Fair
2. The information process was	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. The announcement and pre-course material was • Describe the content of the workshop/course:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4. I found the scientific programme	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.1. Applied Lecture/Workshop	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.2. Use of small working groups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.3. Case Studies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.4. The time spent by lecturers in class and after class on specific questions/examples	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.5. Students scientific knowledge was	Balanced <input type="checkbox"/>	Unbalanced <input type="checkbox"/>		

B. Duration of programme:

	Just right	Too long	Too short
1. Number of days	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Length of working days	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

C. Training facilities & Hotel:

	Excellent	Very Good	Good	Fair
1. Lecture/Training Rooms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Breaks/refreshments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Hotel accommodation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Meals at the hotel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If "Fair" please explain why: _____

D. Organizer's response to participants needs

E. Overall programme organization

F. Would you recommend to others from your institution/
country to attend a similar activity in the future?

Yes Maybe No

1. Which part of the Activity did you find most useful?

2. Which part of the activity do you think should be expanded?

3. Which part of the activity do you think should be dropped?

4. Any other suggestions for future improvements to the programme?

5. Do you think that the topics/tools you studied during the course could be used by industries in you
country? If so, how? If not, why not?

5. contd.

6. Can you suggest any programme and future activities which ICS could pursue in order to help with the technological and scientific advancement of your country?

7. Do you think you have benefited from participation in this course/workshop? If so, how? and your Institution?

8. How do you intend to disseminate the information you have acquired during the activity once back in your own country?

G. Evaluation of Lectures and Speakers

	Excellent	Very Good	Good	Fair
1. Course material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Resident Lecture presentation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. International Lecture presentation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Ability of lecturers to answer specific questions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Any comments:

Thank you for your collaboration.

APPENDIX 5 : Summary analysis of Workshop Evaluation

A. ORGANISATION	EXCELLENT %	VERY GOOD %	GOOD %	FAIR %
Information process	39	39	22	0
Announcement	39	39	22	0
Scientific programme	67	28	5	0
Applied lecture/workshop	61	33	6	0
Case Studies	56	22	22	0
Question time spent by Lecturer	50	44	0	6
D. Organiser's response to participants needs	84	16	0	0
E. Overall Programme Organisation	50	45	5	0

B. PROGRAMME DURATION	JUST RIGHT %	TOO LONG %	TOO SHORT %
Number of days	84	16	0
Length of working days	100	0	0

C. TRAINING FACILITIES AND HOTEL	EXCELLENT %	VERY GOOD %	GOOD %	FAIR %
Lecture /Training rooms	56	44	0	0
Breaks/refreshment	61	23	16	0
Hotel accommodation	61	28	11	0
Meals at hotel	61	27	12	0

F. Would you recommend to others from your institution to attend similar activity in the future?	Yes %	Maybe %	No %
	100	0	0

G. Evaluation of Lecturers and Speakers	EXCELLENT %	VERY GOOD %	GOOD %	FAIR %
Course materials	50	39	11	0
Resident Lectures presentation	50	44	6	0
International presentation	78	22	0	0
Ability to answer specific questions	67	33	0	0

APPENDIX 6

Copy of the Magazine "EPOCA" with the report of Prof. Chiellini and Dr. Mei about EDP's.

Acuado nos EUA, Clinton ataca Iraque

ÉPOCA

A MODERNA REVISTA SEMANAL DE INFORMAÇÃO

GLOBO

Ano I N.º 31 21 de dezembro de 1998
RS 3.50

Opinião pública segura
aumentos para os Três Poderes
NOVO TETO PODE CAIR

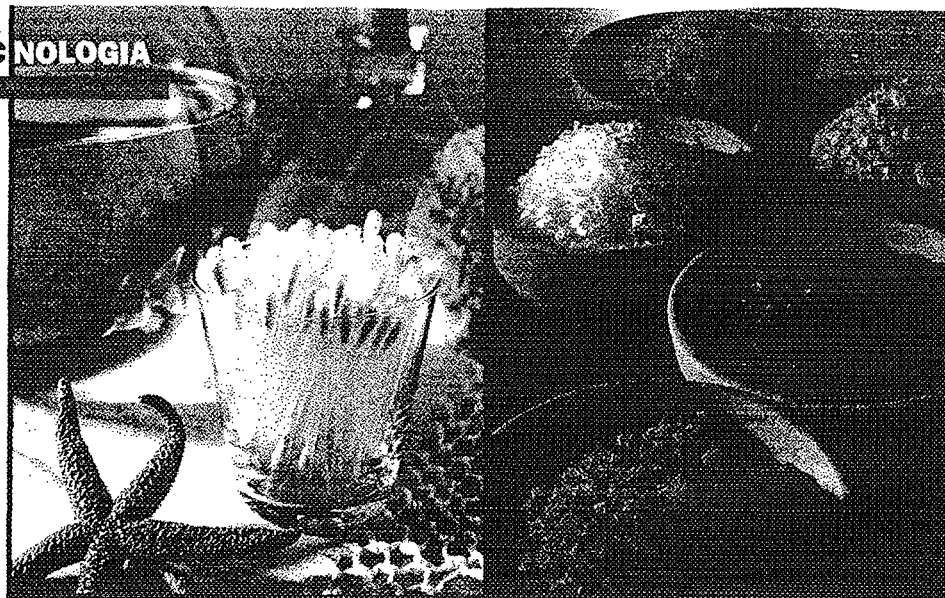


As aparições de **MARIA**

Cresce a devoção à Virgem. Só no Brasil, mais de 300 visões foram relatadas.
A Igreja examina os casos com cautela, mas eles arrastam multidões



9 17714 15 54900 2



BASTÕES com ponta de algodão se dissolvem em contato com a água

SEMELHANTE à tradicional, a matéria-prima alternativa é mais cara

AMBIENTE

Em busca da vida curta

Indústria investe na pesquisa de plásticos biodegradáveis para atenuar o problema do lixo

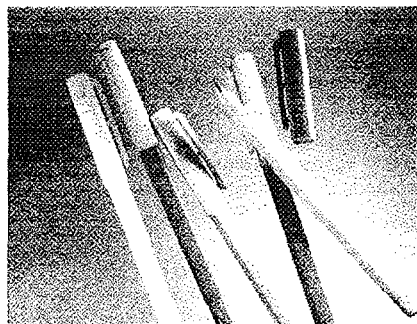
Talheres, sacos de lixo, filmes para proteger alimentos, escovas de dentes e até brinquedos já estão sendo feitos de plástico biodegradável, que se dissolve em contato com a água ou com o ar. Mas isso é raro. No mundo, apenas 27 empresas têm unidades dedicadas à fabricação desse tipo de material: dez na Europa, dez nos Estados Unidos e sete na Ásia. Só que, com o acúmulo dos plásticos sintéticos convencionais, o apelo do ecologicamente correto deve falar mais alto, e a produção, crescer, aposta o professor de Química Emo Chiellini, da Faculdade de Engenharia da Universidade de Pisa, na Itália – país com duas empresas dedicadas à produção de biodegradáveis, a Novamont e a Idroplast. Chiellini esteve no Brasil para participar de um seminário que reuniu es-

pecialistas em biodegradáveis e em reciclagem na Universidade Estadual de Campinas (Unicamp). Todos preocupados com o problema causado pelo acúmulo de plástico nos lixões e aterros. Uma garrafa de refrigerante feita de polietileno tereftalato (PET), largamente usado pela indústria, pode levar 400 anos ou muito mais para se dissolver.

Calcula-se que, desde o começo da década, foram compradas mais de 600 mil toneladas de plástico no Brasil, entre embalagens de refrigerante, água mineral e outras feitas de PET. Ainda é cedo para contar com os plásticos biodegradáveis para substituir esse material, principalmente por causa do custo. "Enquanto o quilo de plástico comum é vendido a US\$ 1,60, o quilo de biodegradável varia de US\$ 4 a US\$ 10",

explica Luís Roberto Raysel Cruz, diretor industrial da Usina da Pedra, em Serrana, no interior de São Paulo. Ali foi instalada uma unidade experimental de produção de matéria-prima obtida de uma variante das bactérias *Ralstonia eutropha*, alimentadas com açúcar, como parte de um projeto da Copersucar com o Instituto de Pesquisas Tecnológicas (IPT) e a Universidade de São Paulo. A experiência é pioneira. Bactérias naturais ou selecionadas no laboratório são capazes de fabricar plástico biodegradável a partir de outros alimentos, como milho, batata e trigo. É o que ocorre na fábrica italiana Novamont, detentora da marca Mater-Bi. No Brasil, a biomassa resultante do processo de fabricação na Usina da Pedra contém 70% de poliéster. Purificado e seco, esse material resulta em um polímero termoplástico granulado com 99,5% de pureza. A partir de 1999, a unidade piloto espera produzir cerca de 150 toneladas de matéria-prima.

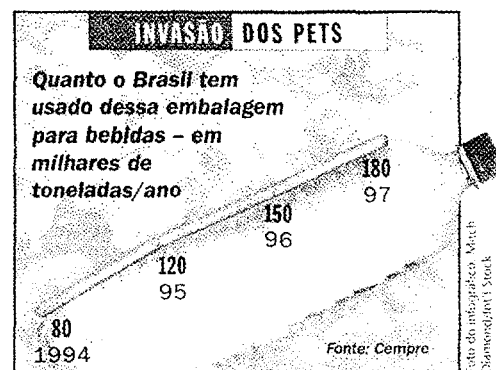
Esse é o início do processo. Em seguida, é necessário que os polímeros sejam combinados com outros elementos para ganhar qualidades como dureza, flexibilidade e resistência. Depois dessa



CANETAS feitas com Mater-Bi, da empresa Novamont



A PARTIR da batata ou do milho podem ser feitos utensílios



Fotos: divulgação

ÉPOCA 21 DE DEZEMBRO, 1998

O HYDROFILM, da Itallana Idroplast, pode ser usado como embalagem



FRALDAS descartáveis para bebês, de material solúvel, não contribuem para ampliar o volume mundial de lixo



mistura, poderão ser usados como matéria-prima de produtos industrializados. Por isso mesmo, a produção de plásticos biodegradáveis só será possível no Brasil no prazo de dois anos, quando a unidade piloto da Copersucar estiver trabalhando a pleno vapor. Trata-se do único experimento do gênero na América Latina e, quando tudo estiver funcionando, os fabricantes pretendem ganhar mercados na Europa e nos Estados Unidos, onde a preocupação com o ambiente é levada mais a sério.

Entre os produtos biodegradáveis já à venda no mercado europeu, por exemplo, há sacos para embalar mudas de plantas que são absorvidos no contato com a terra, permitindo que as raízes novas fiquem protegidas até ganhar forças. Nos Estados Unidos, algumas indústrias oferecem brinquedos feitos de plástico não apenas descartável mas também comestível, com uma mistura de amido e corantes não tóxicos. Mas, é bom que se diga, a matéria-prima biodegradável nunca substituirá os plásticos comuns. Segundo a professora Lucia Helena Innocentini Mei, da Faculdade de Engenharia Química da Unicamp, ela servirá mais para "ocupar um nicho importante

dos setores de embalagens e utensílios domésticos e para uso em áreas específicas como agricultura e jardinagem ou em dispositivos médicos descartáveis sujeitos a contaminação".

Por isso mesmo, os fabricantes procuram garantir a sobrevivência do produto durante o tempo que for necessário. A grande vantagem do plástico comum, criado a partir de derivados do petróleo, é o fato de durar muito. Em compensação, acaba criando um problema. O que fazer com os resíduos indesejáveis e indestrutíveis a curto prazo? A saída tem sido reaproveitar esse material para outros fins. O PET, por exemplo, pode transformar-se em fibras para não-tecidos, fios, cordas, tapetes, carpetes, cerdas de vassouras.

Mas a reciclagem depende, em grande parte, da coleta e seleção do produto. Embora 85% dos municípios brasileiros tenham programas de coleta seletiva, eles não alcançam todas as casas. Enquanto os técnicos não conseguirem outras bactérias para degradar esse material, o problema terá de ser resolvido pelas comunidades. ■

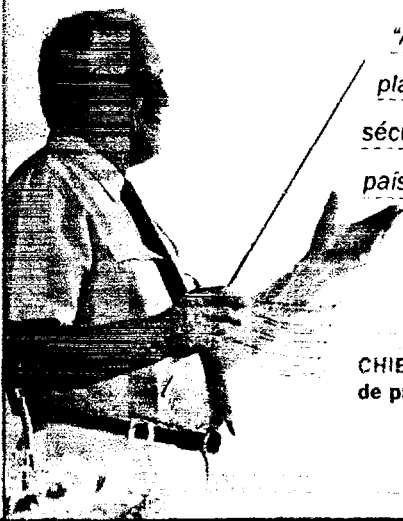
MIRIAN IBÁÑEZ



LUCIA MEI não crê na extinção dos sintéticos conhecidos

"No Brasil, cada habitante descarta 15 quilos de plástico por ano, cinco vezes menos que os americanos, um dos maiores consumidores do mundo."

LUCIA H. I. MEI, professora da Faculdade de Engenharia Química da Unicamp



"A produção mundial de plásticos pode triplicar no século 21 pela demanda dos países em desenvolvimento."

EMO CHIELLINI, professor da Universidade de Pisa, na Itália

CHIELLINI observa procura de produtos ecológicos

DEGRADADOS PELA NATUREZA

As características dos plásticos ecológicos

■ Origem

São produzidos por microorganismos selecionados para se alimentar de açúcar, milho, batata ou trigo.

■ Resistência

No aspecto e na forma, os polímeros assim formados são semelhantes aos plásticos convencionais de longa duração,

com diferentes formulações apropriadas para cada caso.

■ Processo

Depois de usados, sua composição se altera pela ação combinada de agentes físico-químicos e microorganismos; no final do processo se reduzem a dióxido de carbono e água.

Fonte: Emo Chiellini, da Universidade de Pisa