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FINAL REPORT

**International Workshop on
ENVIRONMENTALLY DEGRADABLE PLASTICS**

Position of EDPs in Plastic Waste Management

Łódź-Pabianice, Poland 4-8 June 2001

UNIDO PROJECT No : TF/GLO/00/105

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INTRODUCTION

A workshop on ENVIRONMENTALLY DEGRADABLE PLASTICS was organized by ICS UNIDO, Trieste and Centre of Molecular and Macromolecular Studies, Polish Academy of Sciences, Lodz, Poland.

Poland was selected as the workshop place due to the importance of the degradable plastic production and plastic waste management issue in the countries of Central Europe. These countries possess rather high industrial potential with a great deal of plastics consumption and developed plastics industry. On the other hand, the knowledge on EDPs is not satisfactory and the applications are limited.

OBJECTIVES

The main objectives of the workshop were defined as follows:

- To provide the participants from Central European countries with updated knowledge and information on recent researches as well as new technologies regarding environmentally related problems in polymer producing, processing and end of life disposal industries.
- To update the scientific and technological knowledge of the participants in terms of the waste management of polymeric materials and to stimulate planning for the limiting of waste generation.
- To provide recent information regarding legal aspects of plastic waste formation and waste disposal management and the role which environmentally degradable plastics can play in the whole system, especially taking into account the effort of the countries of the region to join European Community in near future.
- To raise industrial, academic and public concern on the issues of environmental effects of plastics, and to emphasize the positive contributions which manufacturing industries can make including the increased utilization of environmentally degradable polymers (EDPs) in those production segments in which they can play an exclusive role.
- To stimulate international research and technology transfer and enhance international co-operation through possible, joint, or follow-up projects, and feasibility studies by identifying regional R&D centres in developing countries through contacts established with the participants in the workshop, thus giving ICS the possibility for identifying competent academic and industrial centres for future joint ventures for the EDPs development.

ORGANIZATION

The workshop was organized by Centre of Molecular and Macromolecular Studies, Polish Academy of Sciences, Lodz, Poland in cooperation with ICS UNIDO Trieste. Following bodies took responsibility for the scientific and organization of the event:

Local Organizing Committee :

Prof. Andrzej Galeski, chairman

Dr. Andrzej Pawlak, secretary

Prof. Ewa Piorkowska

Dr. Mirosław Pluta

Ms. Magdalena Bednarek

Ms. Krystyna Gadzinowska

Scientific Committee of the Workshop:

For ICS-UNIDO:

Prof. S. Miertus, ICS Trieste, chairman

Prof. E. Chiellini (Italy), co-chairman

International faculty Members:

Prof. R. Narayan (USA)

Dr. S. Imam (USA)

Dr. G. Braunegg (Austria)

Dr. F. Degli Innocenti (Italy)

For the CMMS PAS:

Prof. S. Penczek (Poland)

Prof. A. Galeski (Poland)

CEE countries representatives:

Dr. I. Chodak (Slovakia)

Prof. S. Fakirov (Bulgaria)

Prof. Z. Florjanczyk (Poland)

Dr. I. Fortelny (Czech Republic)

Prof. V. Privalko (Ukraine)

Prof. B. Pukanszky (Hungary)

Prof. T. Spychaj (Poland)

Prof. H. Struszczyk (Poland)

Prof. C. Vasile (Romania)

Dr. W. Lubiewa-Wielezyski (Poland)

DATE AND SITE

The workshop was held in the Hotel "Piemont" in Pabianice, Poland on June 4 - 8, 2001. The facility provides both accommodation including full board services and conference hall equipped with projecting and audio tools.

FUNDING

The total expenses for the organization was 137223.58 zlotys which is around 34 416.89 US \$ compared to planned US \$ 40 500. The amount received from UNIDO was US \$ 24 000 (it corresponds to 94200 zlotys at the day of receiving the funds) and additional US \$ 6 000 (expected 23922.6 zlotys at the day of receiving) will be invoiced to the total US \$ 30 000 (total 118122.6 zlotys) planned as UNIDO contribution.

The local travel expenses (1163.63 US \$) were higher than planned (1000 US \$) by 11.6 % which is outside the 10 % limit. It resulted from some unpredicted complications of the transport between Lodz, Pabianice and Warsaw. The excess is covered by the funds of the Centre of Molecular and Macromolecular Studies PAS, Lodz, Poland

The expenses for accommodation and meals are within 10% limit difference.

Other expenses were covered by the funds of the Centre of Molecular and Macromolecular Studies, PAS and by the Lodz Province Foundation of Environment Protection.

PARTICIPATION

In total 67 persons from 15 countries participated in the Workshop, among them 27 from abroad and 40 domestic. Participants have been selected with the aim to cover fully the scope of the workshop regarding the key lectures and to cover the participation from all the countries from the region. From the latter point of view, participation from Slovakia, Czech Republic, Hungary, Poland, Ukraine, Bulgaria, Russia, Slovenia and Romania was considered to be necessary. We had 40 lectures and communications, each 20-60 minutes long, presented by 19 invited speakers, 1 UNIDO representative and 16 other participants. Two from industrial participants, presenting lectures, attended meeting by their own expenses.

1) Lecturers (keynote speakers)

19 keynote speakers participated in the workshop. They presented 23 lectures covering whole range of the workshop's scope. The list of the lecturers together with the topics of the lectures is given in Table 1.

Table 1: Keynote lecturers

<i>Lecturer</i>	<i>affiliation, country</i>	<i>topic of the lecture</i>
G. Braunegg	Univ. Graz, Austria	polyhydroxyalkanoates from renewable resources; plastic waste management -country report
M. Cazana	Ministry of Industry and Resources, Romania	plastic waste management—country report
E. Chiellini	Univ. Pisa, Italy	degradable polymeric materials
I. Chodak	Acad. Sci., Slovakia	environmentally friendly materials from thermoplastics; EDP – country report
A. Duda	Acad. Sci., Poland	synthesis of degradable polyesters
I. Fortelny	Acad. Sci., Czech Republic	recycling of municipal plastic waste
H. Galina	Techn. Univ. Rzeszow, Poland	recycling of RIM polyurethane

Z. Horak	Acad. Sci., Czech Republic	compatibilization of polyolefins and composites with cellulosic fibers
S. Kandil	Univ. Alexandria, Egypt	environmentally degradable plastics
Y. Ha Kim	Inst. of Science and Technol. Seoul, Korea	polylactide with star-shape architecture; EDP – country report
A. Krzan	Nation. Inst. Chemistry Slovenia	EDP – country report
S. Miertus	ICS UNIDO, Italy	activities of UNIDO, introductory talk
R. Narayan	Michigan State Univ., USA	biobased and biodegradable plastics
V. Privalko	Nation. Acad. Sci., Ukraine	biodegradable composites from thermoplastic/wood wastes
B. Pukanszky	Techn. Univ. Budapest, Hungary	EDP - country report
A. Rebrov	Acad. Sci., Russia	oriented fibers of biodegradable poly(hydroxy butyrate)
S. Slomkowski	Acad. Sci., Poland	polymerization of lactides and caprolactone
G. Swift	GS Polymer Consult., USA	environmentally degradable plastics
P. Vaisanen	Ekono Energy, Finland	gasification and combustion of municipal waste
C. Vasile	Inst. Macromol. Chem., Romania	polymer degradation – environmental pollution or protection

2) Participants

More than 200 announcements have been sent to various institutions, companies and governmental as well as non-governmental organizations. The workshop was announced at the web site as well. The total 47 participants (not including invited speakers) from Central Europe countries attended the meeting. They presented 16 special contributions. During the special session 7 country reports have been presented, covering the situation concerning the Environmentally Degradable Plastics application and plastics waste management in countries of participants.

Table 2: Participants according to the countries and affiliation (including invited speakers)

Country	Total number	Universities	Research and Development	Companies	Government
Austria	1	1			
Bulgaria	1	1			
Czech Rep.	2	2			
Egypt	1	1			
Finland	1			1	
Hungary	3	3			
Italy	2	2			
Korea	1		1		
Poland	40	23	5	6	6
Romania	3	1		1	1
Russia	3	3			
Slovakia	1	1			
Slovenia	1	1			
Ukraine	4	4			
USA	2	1		1	
UNIDO	1				1
Total	67	44	6	9	8

The portion of the scientists coming from the companies R&D and government organizations was around 1/3 of the total number of participants.

WORKSHOP MATERIALS

Each participant and lecturer obtained conference materials. The Aide Memoire was distributed as electronic version by e-mail and could be find on Internet page of CMMS PAS. This was sent not only to the participants and lecturers but it was a part of the announcement sent to all the persons and institutions which were informed about the event prior to the workshop. The invitation containing the main objectives of the workshop and some details on the organization was distributed by the e-mail or regular mail.

At the registration the following materials were given to all the registered persons:

- Book of Abstracts with Program and List of participants
- Brochures
- Office supplies

The proceedings of ICS UNIDO Workshop in Seoul, September 2000 was distributed free among the country representatives during the workshop.

OPENING CEREMONY

Several inviting guests participated in the opening ceremony. The opening remarks were presented by Prof. Andrzej Galeski (chairman of the Workshop). The opening addresses were delivered by: Prof. Stanislav Miertus (ICS - UNIDO Area Coordinator and chairman of the Scientific Committee), Prof. Marian Kryszewski (Polish Academy of Science), Prof. Marian Mikolajczyk (director of Centre of Molecular and Macromolecular Studies PAS), Dr. Maria Karasinska-Fendler (director of European Institute in Lodz) and Prof. E. Chiellini (co-chairman of the Scientific Committee of the Workshop) .

PROGRAM

The scientific programme consisted of several topics, which are listed below together with the number of contributions:

- general 4 lectures
- synthesis 4
- blends, compatibilization 6
- composites 3
- recycling 2
- degradation 1
- biodegradable polymers 10
- municipal waste processing 2
- plastics modification 1
- country reports 7

The time for each presentation was between 20 and 60 minutes, depending on the importance of the discussed subject. Each presentation was followed by few minute of discussion.

An excursion to a polymer recycling company PolyEko Plast, Pabianice was a part of the programme (June 6th). The workshop participants have seen a recycling line, obtained information about polyolefins and PET wastes processing methods. For part of scientists it was a first contact with the real recycling company.

SOCIAL EVENTS

Since the workshop was held in a closed facility where the participants stayed for the whole day with little possibility to leave, the social events were carefully selected to enjoy the participant and to show them the life in the region. The following social events were organized:

- Monday, June 4 Visit in the European Institute in Lodz with coctail and walk through Lodz downtown with a beer testing in a pub.
- Tuesday, June 5 Opera G. Verdi "Trubadur" in the Great Theater in Lodz

Wednesday, June 6 Picnic with a barbecue and a horse riding in the farm/forest 10 km from Pabianice
 Thursday, June 7 Conference dinner

ASSESSMENT

A standard questionnaire was distributed to participants, 20 participants returned the filled questionnaire to organizers. The opinion of the participants is summarized in Table 3.

<i>A. Organization</i>	<i>Excellent</i> %	<i>Very good</i> %	<i>Good</i> %	<i>Fair</i> %
Information process	62	38	0	0
Announcement	25	60	15	0
Scientific Program	29	71	0	0
Applied lectures	10	75	15	0
Case studies	9	64	27	0
Time spent in class	41	54	5	0
	<i>Balanced</i> %	<i>Unbalanced</i> %		
Students' knowledge	93	7		
<i>B. Duration of program</i>	<i>Just right</i> %	<i>Too long</i> %	<i>Too short</i> %	
No of days	95	5	0	
Length of working days	100	0	0	
<i>C. Training facilities</i>	<i>Excellent</i> %	<i>Very good</i> %	<i>Good</i> %	<i>Fair</i> %
Lecture room	71	19	10	0
Breaks/refreshments	75	25	0	0
Accommodation	85	10	5	0
Meals	86	14	0	0
<i>D. Organizers response</i>	86	14	0	0
<i>E. Overall organization</i>	76	24	0	0

F. Would you recommend the participation in the future to the others ?

<i>Yes</i>	<i>Maybe</i>	<i>No</i>
%	%	%
90	5	5

G. Evaluation of Lectures and Speakers

	<i>Excellent</i>	<i>Very good</i>	<i>Good</i>	<i>Fair</i>
	%	%	%	%
Course material	35	42	23	0
Resident lecture presentation	29	71	0	0
International lecture present.	35	65	0	0
Ability to answer questions	24	62	14	0

Regarding the written part of the questionnaire, following suggestions and comments are worth to mention:

1. Most useful part of the activities

Lectures, informal contacts and visit in the recycling company

2. Which part should be expanded

The participants usually accepted the workshop formula and found it well balanced. The following parts could be expanded:

- Collaboration of research groups from different countries, also through informal contacts and discussion during coffee breaks or between lectures.
- Plenary lectures.
- Visits in industrial companies.

3. Which part should be dropped

Chemistry of synthesis (one participant)

4. Other suggestions to the programme

- Organizing a few round-table discussions on issues
- Copied of overheads of lectures and distribution to participants
- Give full addresses of participants
- More lectures about biodegradability (one participant)

5. Could the topics of the workshop be used by the industry ?

Yes, however participants usually think that at this moment the possibilities of implementation of EDP in industry plants are limited. The focus point should be improving the contacts between industry and science and propagate scientific ideas in European countries.

6. Suggestion for future activities

Organization of international research and financial support of studies.

More information on waste management and help in distribution of information in particular countries.

Continue with the series of workshops on the same level.

7. How do you and your institution benefit from the workshop ?

The majority of participants appreciated mainly the established personal contacts and seeing problems concerning EDP.

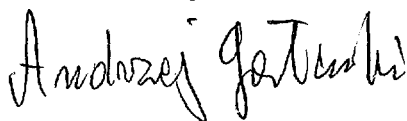
8. How will you disseminate the information acquired ?

Local professional journals, implementation of some information in student graduate courses, lectures in local scientific and industrial meetings, start a research project on EDPs.

RESULTS AND SUGGESTIONS FOR FOLLOW UP

The workshop was generally considered as very successful and useful by most of the participants. A friendly atmosphere and balanced programme were welcomed by the participants. Some proposals of joint projects on EDPs have been discussed during the workshop among participants. This will speed up the process of spreading the know-how in the region. The presentation of the workshop subject in Polish TV and local newspapers resulted in increasing interest from local polymer industry during the meeting and with perspectives to focus scientific activities (with cooperation of industry) on the most important practical EDPs subjects. The Workshop emphasized two main areas of studies on environmentally friendly plastics: biodegradable polymers and polymer recycling. The invited lectures and other selected contributions will be published in "Polimery" journal (IF=0.341).

Professor Andrzej Galeski



Chairman of Local Organizing Committee

APPENDIX 1

Summary of the final budget

<i>UNIDO contribution</i>	<i>planned in US\$</i>	<i>actual, zlotys</i>
Accommodation and meals		
International lecturers and participants	12 000	43 690.50
Accommodation and meals		
Polish participants	7 000	30 076.50
Travel - invited speakers and international participants	9 000	36 317.07
Transport - local	1 000	4 639.51
Publication of Proceedings	1 000	4 000.00
TOTAL	30 000	118 723.58

29.06.2001 official exchange rate 1 USD=3.9871 zlotys

The exchange rate at the day of receiving of the first payment was 3.9425

Contribution of hosting institution and other co-sponsoring organizations

	USD	zlotys
Conference hall	2 000	2 250.00
Fax / telephone / post	3 000	700.00
Training materials	1 500	1 750.00
Secretariat	3 000	7 800.00
Possible contribution to cover local participants (optional)	-	-
Publication of Workshop Abstracts	1 000	6 000.00
TOTAL	10 500	18 500.00
TOTAL EXPENSES	40 500	137 223.58

APPENDIX 2

LIST OF PARTICIPANTS

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