A Process to Engineer and Manufacture Medium to High Value 3D Products Using Mixed Polymer Recyclate

PRIME Dissemination of the Foreground

Leading Contractor Organization:	EuPR (European Plastics Recyclers)
Partners (Short names):	EuPR, EuPC, Recoup, Caro, Acorn, Mikrolin, MaTRI, Armines, Brunel, EuPC Services

1. Introduction

Together the associations participating in this project (EuPC, EuPR and Recoup), represent over 50,000 polymer processing and recycling SMEs as well as over 70 national organisations.

They have recognised one of the biggest challenges facing the recycling industry is what to do with mixed plastic waste – whilst there have been many advances in recycling technology, this type of waste remains an area for development. In order to develop sustainable pathways to recycle mixed plastic waste, innovative technologies that can use it as a raw material and create something productive and beneficial are vital, and the recognition that increasing the re-use of mixed post-consumer plastics waste is an excellent opportunity to reduce the impact of high raw material prices. It will also significantly reduce the cost burden of EU WEEE and Waste Directives, help reduce Europe's growing plastics waste problem and increase its resource efficiency.

Although it will be difficult to re-use mixed waste plastics for most high value products (i.e. aerospace), this waste stream is appropriate for low to medium value products such as building materials, flood barriers, temporary structures, flooring and marine products. This is also the main market segment that is losing out to non-EU competition. Enabling this segment to reduce materials costs will lower demand for virgin polymers (and potentially other materials such as plywood and metals), which will have a downward effect on raw material prices. Simultaneously, the increased demand for recyclate will help the polymer recycling industry.

PRIME seeks to create a 'cradle to cradle' approach for this waste, to eliminate it from landfills and turn it into a valuable resource that can be used in high value products. It was proposed to develop a cost-effective flexible moulding technology using a combination of established and innovative techniques, and use mixed polymer waste to manufacture high value, complex, recycled polymer products (80-98% mixed waste polymers) with good surface quality that have similar properties to timber or aluminium. The materials will have with a mixed recyclate core and a reinforced skin, balancing stiffness, surface quality and strength, and designed to be suitable for a wide range of complex products such as flood barriers, temporary walkways, emergency structures and buildings, and marine products.

Ten partners from four countries participated in the project.

The Association project partners were:

- EuPR (Plastics Recyclers Europe) – also the Project Co-ordinator
- EuPC (European Plastics Converters)
- Recoup (Recycling of Used Plastics Ltd)

The SME project partners were:

- Caro
- Acorn Project Management
- Mikrolin

The Research and Technology Development project partners were:

- ARMINES / EMA
- MaTRI
- Brunel University
- EUPC Services

The technical management of the project was undertaken by MatRI.

2. Overall Dissemination and Use Approach

This section describes the general, consortium-wide dissemination and use approach and actions by the PRIME project as a whole.

To prepare the market for the PRIME system developed a comprehensive dissemination strategy and have now collected a wealth of information on the individual scientific and technological advancement, along with the commercial advantages. The scientific and recycling communities have been informed through a range of activities outlined in '1.3 Outline of Activities'.

The Dissemination and Exploitation Manager is responsible for the implementation of the dissemination strategy, which was reviewed during the course of the project. The Dissemination and Commercial Exploitation Manager is Steve Morgan from Recoup, and is assisted by Rūta Tamošiūnaitė from EuPC.

3. Outline of Activities

A wide range of dissemination activities were used during the project:

- Project website – created to contain information and news about the project
- Media coverage – press releases in both plastics and recycling trade sources
- Scientific and technical publications – any technically specialist books i.e. not news sources
- Conferences – the PRIME project has been promoted at a variety of European exhibitions and trade shows
- General meetings – the PRIME project has been promoted at a variety of meetings across Europe organised by the plastics associations
- Dissemination tools – leaflet, A3 poster, banner stand and dissemination presentation
- Direct mailing – from Caro to their customer base
- Training and technology transfer – to develop the target market for the PRIME process a dissemination strategy has been used that is focused on raising awareness, training, technology transfer and overcoming potential end-user concerns

These are outlined in Table 1:

Table 1 – Dissemination Activity

Activity	Main Leader	Date	Place	Audience	Number	Countries Addressed
Website						
Website active	MaTRI / EuPC	From 2010	-	Any visitors to the website	In excess of 716 (Unique visitors)	Global
Inclusion on Caro's website	Caro	From 2010	-	Any visitors to the website	Unknown	Global
Media Coverage						
Describing the project and the benefits that are hoped to be achieved	Caro	July 2011	-	Any visitors to the website	12,000	Global, mainly UK and EU
Introduce the project, explain the objectives and progress to date	Recoup	24/07/2012	-	Recycling and plastics industry – collections, manufacturing, recycling, reprocessors, end markets	26 plastics and recycling trade news sources – known coverage is provided in Table 2	Global, mainly UK and EU
Restate the project objectives and provide an update on progress	Recoup	12/04/2013	-	Recycling and plastics industry – collections, manufacturing, recycling, reprocessors, end markets	26 plastics and recycling trade news sources – known coverage is provided in Table 2	Global, mainly UK and EU
Scientific and Technical Publications						
2012 UK Household Plastics Collection Survey	Recoup	March 2013	-	Plastics industry	All 432 local authorities in the UK, 49 Recoup members and unknown number of stakeholders across the plastics supply and recycling chain	Mainly UK and also Europe

Conferences						
Easyfairs – Packaging Innovations 2013	Recoup	27/02/2013	Birmingham, UK	Packaging (brand owners, retailers, primary packaging manufacturers, packaging designers) and recyclers (reprocessors and converters)	38 registered attendees plus others not registered	Global, mainly UK and EU
TOTAL Packaging Exhibition (PAKEK) 2013	Recoup	04-06/06/2013	Birmingham, UK	Packaging (brand owners, retailers, primary packaging manufacturers, packaging designers) and recyclers (reprocessors and converters)	10	UK and Europe
Plastics Design & Moulding Exhibition & Summit	Brunel University	19/06/2013	Telford, UK	Plastics design and moulding	?	Mainly UK
European Polymer Congress	ARMINES	16-21/06/2013	Pisa, Italy	Plastics producers	?	Europe
General Meetings						
National Plastics Association Meeting	EuPC	21/09/2010	Madrid	Converters	25-30	Spain
Plastics Recyclers Annual Meeting 2010	EuPR	18/11/2010	Berlin	Recyclers	125-140	Germany
Recoup Board Meeting	Recoup	14/12/2010	Peterborough	Recycling	10	UK

EPRO Meeting	Recoup	08/03/2011	Brussels	Recycling	8	Europe
Recyclers Meeting	EuPR	8/03/2011	Warsaw	Recyclers	45-50	Poland
National Plastics Association Meeting	EuPC	15/03/2011	Brussels	Converters	25-30	Belgium
Recoup Board Meeting	Recoup	22/03/2011	Mansfield	Recycling	14	UK
EuPC General Assembly	EuPC	18/05/2011	Nice	Converters	100-120	France
Recyclers Meeting	EuPR	21/06/2011	Linz	Recyclers	45-50	Austria
Recyclers Meeting	EuPR	7/09/2011	Vienna	Recyclers	45-50	Austria
National Plastics Association Meeting	EuPC	27/09/2011	Amsterdam	Converters	25-30	The Netherlands
Plastics Recyclers Annual Meeting 2011	EuPR	16/11/2011	Barcelona	Recyclers	130-150	Spain
EPRO Meeting	Recoup	01/12/2011	Brussels	Recycling	25	Europe
Packaging Excom	EuPC	13/09/2011	Brussels	Converters	10-15	Belgium

Packaging Excom	EuPC	29/11/2011	Brussels	Converters	10-15	Belgium
Recoup Board Meeting	Recoup	01/12/2011	Peterborough	Recycling	12	UK
National Plastics Association Meeting	EuPC	13/03/2012	Brussels	Converters	25-30	Belgium
Recoup Conference	Recoup	03/05/2012	Peterborough	Recycling	120	UK and Europe
Packaging Excom	EuPC	27/11/2012	Brussels	Converters	10-15	Belgium
Project Meeting	Recoup	13/02/2013	Peterborough	Recycling	5	UK and Europe
Project Meeting	Recoup	23/04/2013	Swindon	Recycling	5	UK
Project Meeting	Recoup	23/04/2013	Swindon	Recycling	4	UK
Project Meeting	Recoup	05/06/2013	Birmingham	Recycling	3	UK
Project Meeting	Recoup	20/06/2013	Peterborough	Recycling	4	UK
Recoup Board Meeting	Recoup	25/06/2013	Peterborough	Recycling	25	UK
Dissemination Tools						
Leaflet	Recoup and EuPC	01/09/2012	-	All stakeholders and interested parties	Unknown	Unknown
A3 Poster	Recoup	01/09/2012	-	All stakeholders and interested parties	Unknown	Unknown

Banner Stand	Recoup	01/09/2012	-	All stakeholders and interested parties	Not used as yet	Not used as yet
Dissemination Presentation	Recoup	01/09/2012	-	All stakeholders and interested parties	Unknown	Unknown
Direct Mailing						
Email circulation - describing the project and the benefits that are hoped to be achieved	Caro	July 2011	-	Email circulation list	15,400	Mainly UK
Product cards (x4) - describing the project and the benefits that are hoped to be achieved	Caro	July 2011	-	Contractors, architects, surveyors and other professionals within the construction sector	60,000	Mainly UK
Included in general information	Caro	October 2011	-	Building	17,000	Mainly UK
Article	Caro	October 2011		Flood defenders	25,000	Mainly UK
Product cards	Caro	April 2012	-	Construction	17,000	Mainly UK

4. Project Website

A public website was developed by the partners and it is available at www.fp7prime.eu. This has been used as the main dissemination activity for interaction with the public who seek information and news about the PRIME project.

The website is structured to show the keys aims and goals of the project and provide information about the partners in the consortium.

5. Media Coverage

Press releases have been prepared by the partners within the consortium and issued periodically to communicate key information and increase and maintain project visibility. Although the press releases have been issued in English they could have been translated and launched by partners in the other countries. Table 2 summarises the press release issued to date, with another one planned after the project closes to disseminate the final results.

Table 2 – Summary of Issued Press Releases

Date	Purpose	Coverage
24/07/12	To introduce the project, explain the objectives and progress to date	26 plastics and recycling trade news sources – known coverage: • Plastics & Rubber Weekly – www.prw.com/subscriber/newsmail2.html?id=1234 • British Plastics and Rubber – www.britishplastics.co.uk/x/newsletterSample.html (front page) and www.britishplastics.co.uk/x/guideArchiveArticle.html?id=34853 (actual article) • Resource UK – www.resource.uk.com/article/UK/Consortium_create_complex_polymer_products_recycled_plastics • Plastics Information Europe – www.pieweb.com/default.aspx?pageid=976543&docid=223215&key=84pf3r8nzk
12th April 2013	To provide an update on project progress and when final (and non-commercially sensitive) results will be published	26 plastics and recycling trade news sources – known coverage: • Full page feature article in Recycling & Waste World Magazine – http://content.yudu.com/A24k7w/RW11Apr2013/resources/index.htm?referrerUrl= • British Plastics & Rubber – www.britishplastics.co.uk/articles/positive-developments-for-mixed-waste-recycling-project/ • British Plastics & Rubber (from British Plastics Insight newsletter) – www.britishplastics.co.uk/Environment/positive-developments-for-mixed-waste-recycling-project/ • edieWaste – www.edie.net/news/5/Mixed-plastics-waste-reuse-flood-defence-/ • Resource UK – www.resource.uk.com/article/Futurevision/Mixed_polymer_waste_used_build_flood_defences-2960 • Plastics News – www.plasticsnews.com/article/20130417/NEWS/130419923/mixed-plastics-creates-recycling-challenge-in-europe#email_recycle • Plastics & Rubber Weekly – www.prw.com/subscriber/newsmail2.html?id=2678 • Plastics Information Europe – http://pieweb.plasteurope.com/default.aspx?pageid=976543&docid=225123&key=83pf3r8czk • Plasteurope.com (from Plastics Information Europe) – www.plasteurope.com/news/detail.asp?id=225123&referrer=NLD

The press releases and associated images that have been circulated are shown below.

24th July 2012:

Press Release

One of the biggest challenges facing the European recycling industry is what to do with low grade mixed plastic waste. In order to develop sustainable pathways to recycle this plastic, innovative technologies that can use it as a raw material and create something productive and beneficial are vital.

PRIME is a pan European consortium that proposes to use mixed polymer waste to manufacture high value products with strength and good surface quality that have similar properties to timber or aluminium. The process is designed to be suitable to manufacture a wide range of complex products such as flood barriers, marine and construction products.

This is to be achieved by developing cost-effective flexible moulding technology using a combination of established and innovative techniques. Experts in material science and innovators in manufacturing using mixed polymers are currently researching and developing pressure forming methods for innovative composite formulations and high efficiency heat transfer, and developments will be communicated as the project progresses.

The PRIME consortium is made up of ten partners from the European Community, with five partners in the UK, three in Belgium, one in France and one in Hungary working in partnership with the REA (European Commission's Research Executive Agency). The partners have very diverse backgrounds, including universities, research centres and SMEs:

- ARMINES, MaTRI, and Brunel University have strong capabilities in mould design, process optimisation and material science
- Acorn are a proven innovator in manufacturing using mixed polymers
- Caro will be developing a flood defence system and Mikrolin cable channel that to be used in, for example, railway construction

For more information please see the website - www.fp7prime.eu.

The research leading to these results has received funding from the European Commission's Seventh Framework Programme managed by REA-Research Executive Agency http://ec.europa.eu/research/rea ([FP7/2007-2013] [FP7/2007-2011]) under grant agreement n° [243756-2].

12th April 2013:

Press Release

PRIME (Plastic Recyclate Impression Moulding Engineering) is a pan European consortium that proposes to use mixed polymer waste to manufacture high value products, with strength and good surface quality that have similar properties to timber or aluminium. The process is designed to be suitable to manufacture a wide range of complex products such as flood barriers, and in marine and construction applications.

Experts in material science, and innovators in manufacturing using mixed polymers, have combined their expertise to build a prototype rig that has now manufactured the first test barrier panel which can be used in flood defences. In doing this, optimum process conditions have been determined, with more than 50 different processing conditions being evaluated based on variables such as heating time and flame mode.

Environmental testing on the panels including UV, humidity, moisture and flame testing are continuing, and further production trials are now to be carried out to manufacture a final prototype flood barrier.

The technical and manufacturing developments have also been complemented by Life Cycle Analysis (LCA), comparing panels manufactured using mixed plastic waste and aluminium panels currently used in flood defence barriers. The project is to be completed in June 2013, and the final results of the project, including LCA analysis, will be communicated later in the year.

Steve Morgan from Recoup, who is also the PRIME Dissemination and Commercial Exploitation Manager, stated: "We have seen some very promising results in the manufacture of the panels, and this clearly demonstrates the increasing potential of using mixed polymer waste to create high end products that can be used in many industries".

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For more information please see the website (www.fp7prime.eu) or contact Steve Morgan (steve.morgan@recoup.org or 01733 375679)

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An additional quote was added for the article in Resource UK:

> "The use of recycled plastics as a raw material can add to companies' environmental credentials, such as carbon footprint reductions, lifecycle analysis benefits or in developing its corporate social responsibility agenda. PRIME provides an impressive example of the versatility of used plastics packaging in new products and applications."

Considerable additional content was required for the full feature in Waste & Recycling World.

Flood Defence Barriers

PRIME Prototype Rig

6. Direct Mailing

A range of direct mailing from Caro to their customer base was completed in the form of an email circulation, product cards and articles. These have been provided in Table 1.

7. Scientific and Technical Publications

The PRIME project has addressed the plastics supply and recycling industry, including recyclers, reprocessors and convertors, as well as the academic community. As such there has been a range of trade and scientific journals that have been be targeted for publication and have been prepared as the project results are identified and validated and sufficient evidence is developed to satisfy the peer review process. The media coverage and publications have been documented in Table 2.

8. Conferences and General Meetings

The PRIME project has been promoted at internal meetings and by direct member contacts at of variety of European exhibitions and trade shows which will be identified and agreed upon by the consortium.

Seminars and workshops will take place to demonstrate technology developed as result of the project. These events will possibly be timed to concise with major conference events in order to maximise exposure and attendance.

Potential opportunities that were identified were:

- Plastics Recyclers Annual Meetings and quarterly meetings (EUPR)
- EuPC General Assembly, National Plastics Associations meetings and sectorial meetings
- Plastics Recyclers Annual Meeting (EUPR)
- EPRO (European Association of Plastics Recycling and Recovery Organisations) quarterly and annual meetings
- Materials KTN (Knowledge Transfer Network) meetings in UK (polymer and composite groups)
- European Conference on Composite Materials
- RWM (Resource and Waste Management) Exhibition
- K Trade Fair
- Resource Ireland
- JEC (Europe) Composites Show & Conferences
- SMARTeST (Smart Resilience Technology, Systems and Tools) International Conference – Implementing Flood Resilience
- Composite Expo 2013
- Society of Plastics Engineers Annual Technical Conference (ANTEC 2012)
- Interplas
- BEST (Built Environment Solutions & Technologies)

The conferences where PRIME was given coverage in presentations, discussions and /or use of dissemination tools are provided in Table 1.

PRIME was also raised at many general meetings. These are also provided in Table 1.

9. Dissemination Tools

A range of dissemination tools have been used in the project to communicate key information at relevant meetings, conferences, etc. These have been produced for partners to use to disseminate the key areas of the project – the need and opportunity for the project, the objectives and aims, the partners involved, timescales and the current status. These tools can both be used during the project, or adapted to use after the project has closed.

These tools are a leaflet, poster, banner and PowerPoint presentation for public dissemination.

9.1 Leaflet

This is a 6 page folded leaflet.

Partners

caro

RECOUP

Brunel UNIVERSITY WEST LONDON

EuPC

PERA

ARMINES

EuPC

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Scan to follow us online!

The research leading to these results has received funding from the European Community's Seventh Framework Programme managed by REA (Research Executive Agency) http://ec.europa.eu/research/rea ([FP7/2007-2013] [FP7/2007-2011]) under grant agreement n° 246766-2

SEVENTH FRAMEWORK PROGRAMME

PRIME

Engineering High Value Products Using Mixed Plastic Waste

A Process to Engineer and Manufacture Medium to High Value 3D Products Using Mixed Polymer Recyclate.

Introduction

Our modern life would be impossible without the availability of versatile plastics—bottles, packaging, electrical items, cars, construction—the list is almost endless.

One of the biggest challenges facing the recycling industry is what to do with mixed plastic waste. Whilst there have been many advances in recycling technology, this type of polymer waste still remains an area for development.

PRIME seeks to create a 'cradle to cradle' approach for using mixed polymer waste, eliminating it from landfills and turning it into something productive and beneficial.

Running time: July 2010 – June 2013

Objectives

PRIME will find innovative solutions for turning mixed plastic waste into a valuable resource.

The project proposes to develop a cost effective flexible moulding technology using a combination of established and innovative techniques, and using mixed polymer waste to manufacture high value products.

These products will have a mixed recyclate core and a reinforced skin, providing strength and good surface quality that have similar properties to timber or aluminium.

This process is designed to be suitable for a wide range of complex products and applications such as flood barriers, temporary walkways, emergency structures and buildings.

Technical Aims

This project will achieve its goals by delivering on advancements in moulding techniques, material technology and product design:

- Capability to manufacture complex 3D components from a combination of virgin polymer, mixed recycled polymer, and reinforcing materials.
- To achieve mechanical strength/stiffness adequate enough to replace aluminium alloys for some applications without excessive increases in cross section (strength to weight ratio, etc).
- The option of being able to incorporate either discrete reinforcing materials or composite skins without compromising recyclability.
- Capability to produce components that are resistant to UV, Ozone, water, fire and other environmental degradation mechanisms.

Partnership

Project Partners

The PRIME consortium is made up of 10 partners from diverse backgrounds: Associations, SME's and Research & Technological Development performers.

PRIME

Engineering High Value Products Using Mixed Plastic Waste

9.2 A3 Posters

Two A3 posters were produced, in both portrait and landscape format.

9.3 Banner Stand

10. Training and Technology Transfer

In order to develop the target market for the PRIME process a dissemination strategy has been used that is focused on raising awareness, training, technology transfer and overcoming potential end-user concerns.

A detailed training manual has been produced to train key members of the Associations in all aspects of the PRIME technology. This training will then enable the Associations to train their members, potential plastics processing and recycling end users across Europe as and when required.

This knowledge transfer also included a technology demonstrator workshop for PRIME project partners which took place on 6th February 2013.

The project website, attendance at relevant trade shows and conferences, technical publications and media coverage supplement the training and knowledge transfer.

For further information please contact Roger Wood (roger@caro.co.uk).