



COOP-CT-2006-032766

RECFINMIX

**PRIMARY RECYCLING OF POLYOLEFIN-MIXED FILMS FOR HIGH-ADDED VALUE
APPLICATIONS IN THE BLOW MOULDING INDUSTRY (RECFINMIX)**

Co-operative Research Projects
Integrating and strengthening the ERA

Publishable Final Report

Deliverable #D25

<i>Start date of project:</i>	1 st September 2006
<i>Duration:</i>	28 months
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<i>Project coordinator organisation name:</i>	Fundación L'Urederra

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1. PROJECT OBJECTIVES

The purpose of the RECFINMIX project was to fulfil three main scientific / technological objectives:

S&T objective: To develop a method for the separation of mixed post-consumer polyolefin film waste, with an average composition of 71.4 % LDPE, 17.5 % HDPE and 11.1 % PP into a high added-value LDPE stream suitable for the production of blown film and with less than 5 % HDPE and PP impurities, and a low value HDPE-PP stream with less than 20 % LDPE impurities, only suitable for injection moulding, therefore recovering effectively more than 90 % of the original LDPE for high added-value applications. The referred method is based on the fact that due to their different crystallinities and therefore level of stretching in their amorphous phase, LDPE, HDPE and PP films shrink in a different manner when heated. Thus, when exposed to temperatures slightly higher than 100°C, shredded LDPE film specimens will shrink forming sphere-like bodies, whereas pieces of HDPE and PP will remain unchanged as flat sheets up to temperatures of around 120°C. This change in shape is sufficient to allow afterwards an efficient separation of the LDPE by centrifugation, sieving, vibrating inclined planes, electrostatics or other methods.

S&T objective: To construct a suitable semi-industrial pilot separator for mixed polyolefin film waste based on the principle described, capable to fulfil the purity targets set and with a production capacity in the range of 100-200 Kg/hour. Optimisation of the construction and processing parameters of the referred prototype separator will allow the design of an industrial separator in the range of 1000 Kgs/hour, suitable for the medium and medium-small companies which are characteristic of the plastic recycling sector, and with an affordable price range of 200.000 Euros.

S&T objective: To demonstrate the validity of the technologies developed by the trouble-free production, specially regarding processing bubble integrity, of 50 to 250 micron blown film using exclusively the purified LDPE material obtained from mixed waste polyolefin films. Although the validity of the method will be demonstrated using 100% recyclates, film using mixtures of recycled and virgin LDPE will be also produced.

The RECFINMIX project was also formed on the basis of fulfilling industrial and economical objectives, including:

Industrial objective:

To develop a new complete, innovative and cost-effective technology for the recovery of high value LDPE suitable for film blowing from until now quite valueless mixtures of polyolefin films, available in large amounts over the whole of Europe. A success in the project would open a market estimated at its

consolidated point in 205.9 million Euro/year just in value of LDPE recycled pellets and without including the sales of the LDPE-film end products, plus an additional 16 million Euro/year in sales of separation lines for waste polyolefin film mixtures and perhaps somewhat like 6 million Euro/year more in sales of LDPE-depleted polyolefin mixtures for second class applications.

To be the first companies in the market of high added-value recycling of LDPE from Mixed polyolefin film wastes, therefore profiting by the current demand of first class LDPE recycled and from the extremely low cost –or no cost- of the initial raw material.

Economical objective:

To be first companies in producing and marketing separation lines designed specifically to obtain high quality, filmable LDPE from polyolefin film wastes, gaining therefore a competitive edge against other companies producing plastic recycling equipment. Due to their envisaged low cost and high benefits of separation process for polyolefin film mixtures, it is expected that this type of line might become standard equipment within the recycling industry, and nearly as essential equipment such as mills and shredders, washers/sink-float systems or extruders.

The most important societal and policy objectives were:

Employment:

To create new jobs in the plastic industry in general by the opening of a new very large source of plastic raw materials that can be processed very profitably and in very strong demand. Recyclers will have the high quality, low price recyclable wastes that they require, as well as an assured market for their recyclates. LDPE blown film manufacturers will be able to acquire raw materials at reduced prices, likely sending into the non-foodstuffs packaging market large volumes of blended virgin LDPE-recycled LDPE films, therefore increasing their profits and capability to expand. In turn, the manufacturers of processing equipment will benefit from the sales of recycling lines, additional mills, washers and others, in the case of producers of recycling equipment, and from the sales of extruders, blow-filming systems and auxiliary equipment, in the case of companies producing standard plastic processing machinery. Furthermore, the location near the recycling plants of large amounts of mixed polyolefin film wastes will result in advantages for the recyclers to acquire such wastes against their Far East competitors, therefore promoting activity and employment in Europe.

Environment:

To promote the fulfilment of the European policy on plastic recycling, specially the Directive 94/62/EC on packaging and packaging waste. Achieving in the middle term a level of recycling of 20% for waste mixed polyolefin films, equivalent to the current level for plastic bottles, will imply to raise the level of plastic recycling from the current 1.5 million tonnes/year to 1.9 million tonnes/year, that is, an increase of more than 25%. Furthermore, production of 1 tonne of LDPE requires 310 Kgs of oil and

860 m³ of natural gas. Therefore, to reach in the medium term the referred level of 20% recycling of LDPE from polyolefin film mixtures would represent huge savings of scarce natural resources, from which Europe is a heavy importer.

2. WORK PERFORMED

A method to separate mixed polyolefin film wasted has been developed. Two streams of polyolefin has been obtained, a high added-value LDPE stream suitable for production of blown film and with less than 5% HDPE and PP impurities, and a low value HDPE-PP stream with less than 20% LDPE impurities, only suitable for injection moulding, therefore recovering effectively more than 90 % of the original LDPE for high added-value applications. A semi-industrial pilot separator for mixed polyolefin film wasted has been constructed.

During the project technical deviations were found and they were successfully solved. For instance, it was shown that the temperature distribution along the drum was heterogeneous, since only the first part of the cylinder was heated at the programmed temperature. After a deep study, the problem was located and solved. Therefore, modifications were made on the semi-industrial cylinder, like isolated with rock wool in order to obtain a better heating along the cylinder

Mixtures of plastics composed of 70% LDPE, 18% HDPE and 12 % PP and post consumer waste were tested and analyzed in heater drum.

3. MAIN PUBLISHABLE RESULTS / CONCLUSIONS

The results achieved by project RECFINMIX were documented in project deliverables. A list of deliverables were published during the project is given below. Deliverables that were published had a dissemination level of “public” (PU). It is expected, that these deliverables contain a significant part of the project achievements and therefore dissemination activities will largely base on the results reported in these documents.

Number	Deliverable Title	Delivery Month	Dissemination Level
D1	Project Presentation	2	PU
D3	Set up and maintenance of a project Website with public and restricted areas	6	PU

D19	Publication in relevant international papers, including Journal of Applied Polymer Science, Plastics Technology & Engineering, Journal of Polymer Science & Technology, Polymer Recycling and Waste Management, among others	28	PU
D21	Brochures containing characteristics and applications of the material and processes developed and results obtained	28	PU
D25	Publishable Final Report	28	PU

Research and results of RECFINMIX, can be seen on the project website, <http://www.recfinmix.com>.

4. IMPACT

The project Recfinmix intends precisely to develop a method to separate from mixed polyolefin film wastes a stream of LDPE with less than 5% in other fractions, and therefore suitable for film blowing. Since clean recovered LDPE for film applications is in higher demand than the HDPE, which is the fundamental component in the plastic bottles, and considering that the level of recycling of post-consumer plastic bottles is about 20%, it could be safely assumed that a success in Recfinmix would enable in the medium term to reach at least the referred level of 20% recycling on the whole of Europe, multiplying by almost six times the current level of 3.5%. To recover 20% of the 2.14 million tonnes LDPE film currently available at municipal separation facilities in polyolefin film mixtures would represent a yearly total of around 428.000 tonnes LDPE with maximum 5% other polyolefins, with a market value of **205.9 million Euros** and increasing yearly about 2.5%.

As part of the exploitation of knowledge, the partners have investigated the potential of exploitable aspects of the RECFINMIX project results.

5. CONTRACTORS INVOLVED

Partic. Role	Partic. no.	Participant name	Participant short name	Country
RTDP	1	L'Urederra, Fundación para el Desarrollo Tecnológico y Social	LUREDERRA	Spain

SMEP	2	Riojana Navarra de Plásticos S.L.	RINAPLAS	Spain
OTHERS	3	Plastic Herverwerking Brakel BV	PHB	The Netherlands
SMEP	4	Perplastic 2 S.L.	PERPLASTIC	Spain
SMEP	5	Dr Zaber Spzoo	ZABER	Poland
RTD	6	Smithers Rapra Limited	RAPRA	United Kingdom
RTD	7	Uniwersytet Zielogorski	UZG	Poland
SMEP	8	Vilniaus Vingio Mechanika UAB	VVM	Lithuania
SMEP	9	Machinefabriek Otto Schouten B.V.	MOS	The Netherlands

6. CO-ORDINATOR CONTACT DETAILS

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