DESIGN AND DEVELOPMENT OF A DEMONSTRATIVE RECYCLING LINE FOR THE SEPARATION OF POST-CONSUMER POLYOLEFIN MIXTURES

GRANT AGREEMENT: LIFE10 ENV/ES/000460

ACTION 2: SPECIFICATIONS OF THE PRODUCTS AND EQUIPMENTS

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Responsible Beneficiary : Lurederra

Duration: 4 months

Objectives:

- Identify waste materials of different collection centers and waste management.
- Definition of the requirements that the polyolefins to be treated must satisfy at the recycling plant and separation process.

Deliverables involved during this task:

-D2.1: Report of waste materials. Identification of mixtures of polyolefins in film existing landfills. (Month 4)
-D2.2: Report the characteristics required by the polyolefin mixture. (Month 4)
-D2.3: LCA of recycled polyolefins (Month 4)

ACTION 2: SPECIFICATIONS OF THE PRODUCTS AND EQUIPMENTS

Waste materials

NAVARRA

Manc. Bortziriak-Cinco Villas
Ayto. de Baztan
Ayto. de Goizueta
Manc. de Basuras Alto Araxes
Ayto. de Leitza
Manc. de Servicios Generales de Malerreka
Manc. de Sakana
Manc. de la Comarca de Pamplona
Manc. para la gestión RSU Zona 10
Manc. de RSU Bidausi
Manc. de RSU Esca Salazar
Manc. de Servicios de Sangüesa
Manc. de Montejurra
Manc. de Valdizarbe
Manc. de Mairaga
Manc. de RSU de la Ribera Alta
Manc. de RS de la Ribera

Report of waste materials

NAVARRA

The sources of the wastes can be divided in 5 different categories:
Category 1: Urban solid waste authorized management.
Category 2: Non-hazardous waste authorized management.
Category 3: Agricultural plastic waste authorized management.
Category 4: Film consumer little companies.
Category 5: Film producers little companies without recycling capacity.

Report of waste materials

NAVARRA

Category 1: Urban solid waste authorized management.

MANCOMUNIDADES	tn. RSU	tn. film RSU	% film de RSU
Bortziriak-Cinco Villas	5.035	24	1,4
Baztan	3.319	22	1,3
Goizueta	219	24	1,4
Alto Araxes	358	3	0,2
Leitza	2.457	15	0,9
Malerreka	2.239	15	0,9
Sakana	9.485	58	3,4
Comarca de Pamplona	159.275	923	53,6
Zona 10	2.282	14	0,8
Bidausi	1.520	15	0,9
Esca Salazar	1.545	10	0,6
Sangüesa	4.376	29	1,7
Montejurra	25.912	153	8,9
Valdizarbe	5.675	31	1,8
Mairaga	13.424	50	2,9
Ribera Alta	15.935	98	5,7
Ribera	41.182	239	13,9
TOTAL	**294.400**	**1.723**	

Report of waste materials

NAVARRA

Category 2: Non-hazardous waste authorized management.

MANCOMUNIDADES	tn. film RNP	% film de RNP
Bortziriak-Cinco Villas	159,00	11,20
Baztan	0,11	0,01
Goizueta	0,10	0,01
Alto Araxes	0,10	0,01
Leitza	9,00	0,63
Malerreka	0,38	0,03
Sakana	50,00	3,52
Comarca de Pamplona	547,00	38,51
Zona 10	0,36	0,03
Bidausi	0,10	0,01
Esca Salazar	0,10	0,01
Sangüesa	21,00	1,48
Montejuerra	129,00	9,08
Valdizarbe	0,02	0,00
Mairaga	276,00	19,43
Ribera Alta	105,00	7,39
Ribera	123,00	8,66
TOTAL	**1.420**	

Report of waste materials

NAVARRA

Category 3: Agricultural plastic waste authorized management.

- The amount of Agricultural plastic waste generated 1526 tons distributed according to their use:

Agricultural platic waste		Amount (tn)	
Protection of crops	Greenhouse	356,6	1214,6
	Tunelillo	2,4	
	Acolchado	855,6	
Wrap Silage		151,2	
Tubes		98,4	
Others		61,9	
TOTAL		**1526,1**	

80 % → Protection of crops : Film (acolchado: PE) (56 %)

Report of waste materials | **NAVARRA**

Category 4: Film consumer little companies.

- Films are mainly used in packaging for foodstuffs, but there are also substantial market segments for medical, electronic, automotive and construction applications
- Plastic film wastes comes from raw material packaging and wastes of packaged finished products.
- Most of the companies have implanted a quality system that let them manage the plastic film wastes that finally go to commonwealths as non-hazardous industrial waste.

Category 5: Film producer little companies without recycling capacity.

Film manufacturers companies from Navarre:

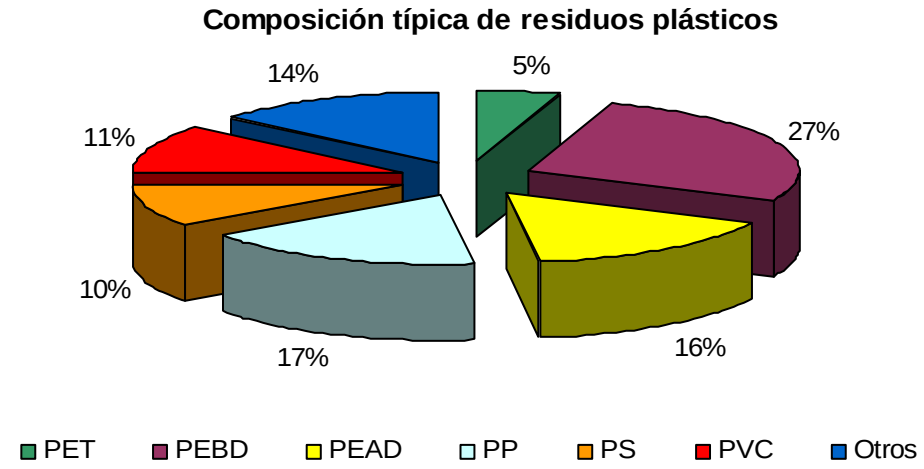
BACAICOA INDUSTRIAS PLASTICAS
ONENA S.A
PAPELES EL CARMEN
BOLSAS OSES S.L

- These companies have an annual average capacity production of plastic films generated a 10 % of production wastes.

ACTION 2: SPECIFICATIONS OF THE PRODUCTS AND EQUIPMENTS

Characteristics required by the polyolefin mixture.

- **Urban solid waste**



Approximately polyolefins (HDPE, LDPE and PP) represent 50 % of Urban solid waste

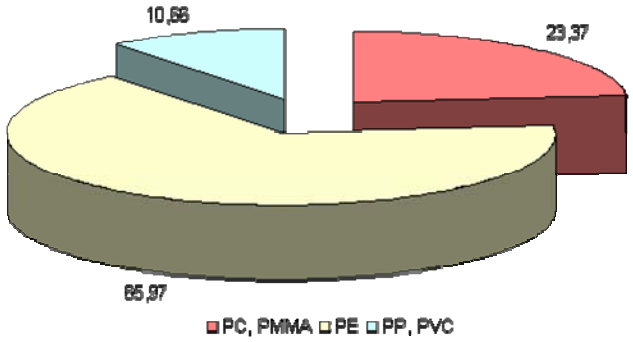
Characteristics required by the polyolefin mixture.

- **Industrial solid waste**

Plastic waste generated by industrial and commercial sector are largely packaging waste.

The main characteristic of commercial and industrial films waste are relatively homogeneous, clean and concentrate on a limited number of points.

- **Agricultural plastic waste**



Problem is the contamination by soil, vegetal material, moisture and fermentation.

ACTION 2: SPECIFICATIONS OF THE PRODUCTS AND EQUIPMENTS

Characteristics required by the polyolefin mixture.

Polyolefins fractions according to the study in Navarre are:

LDPE	HDPE	PP
75 -70 %	20 - 15 %	10 - 15 %

Characteristics required by the polyolefin mixture.

Background of project

The separation of Polyolefin films (LDPE, HDPE and PP) from contaminants including other plastics is very easy by flotation or hydrocycloning, further separation of LDPE, HDPE and PP is extremely difficult since their respective densities are very similar.

While mixtures of LDPE, HDPE and PP do have a degree of compatibility allowing them to be used in low-added value applications, they cannot be used for high demand applications such as blown film production since it is impossible to form a consistent film bubble due to the materials inhomogeneity.

Characteristics required by the polyolefin mixture.

Background of project

- Tests performed in the laboratory

Very clear difference among the three plastics is the temperature of use.

While **LDPE** softens under short-term operation in the temperature range of around 100ºC, **HDPE** is more resistant, softening in the area of 120ºC, while **PP** resists up to somewhat like 140ºC.

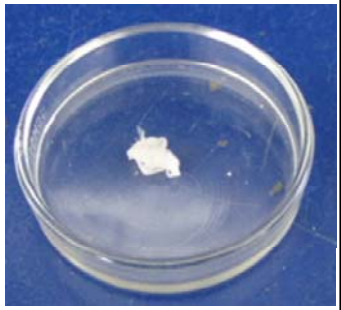
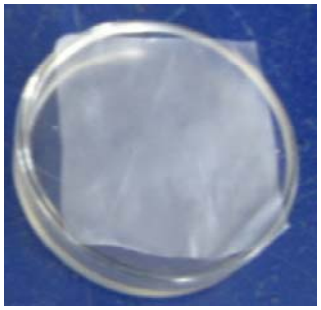
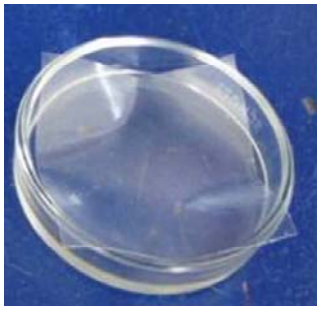
Therefore, if a mixture of shredded LDPE, HDPE and PP films is exposed for a short time to homogeneous temperatures in the range slightly above 100ºC, the **LDPE will greatly soften**, the **HDPE will not be affected or will be affected to a very little extent** and **PP will be completely unaffected.**

The softening caused is just due to the fact that the high temperature has caused a separation between the polymer chains and therefore increased their level of freedom and mobility, largely for LDPE, very little for HDPE and nearly nothing for PP.

Characteristics required by the polyolefin mixture.

Background of project

- Tests performed in the laboratory

		
LDPE after treatment	HDPE after treatment	PP after treatment

Characteristics required by the polyolefin mixture.

- **Tests performed to characterize polyolefins mixtures**

Process conditions: temperature, rotational speed (drum and brush) and lead angle.

Rotational Drum 200 kg/hour

Characteristics required by the polyolefin mixture.

- **Tests performed to characterize polyolefins mixtures**

The samples consisted of polyolefin films of different colors, red for HDPE, yellow for PP and transparent for LDPE, for the simulated samples. The mixtures of plastics were composed of 70% LDPE, 18% HDPE and 12 % PP.

Simulated samples

Characteristics required by the polyolefin mixture.

• Tests performed to characterize polyolefins mixtures

The temperature range for the essays was comprised between 200 and 230ºC.

The results were follows:

- At 200 ºC the material did not suffer the wished effect; none of the samples suffered any change of form.
- At 210 ºC, the LDPE showed a small shrinkage. The PP samples did not show any change, whereas the HDPE suffered a small change.
- At 220 ºC the best results were obtained because the material suffered the desired contraction.
- At 230 ºC the films of LDPE melted with the HDPE.

Best results of contraction: Temperature Range (210-220)° C

Characteristics required by the polyolefin mixture.

- **Tests performed to characterize polyolefins mixtures**

At temperature fixed, test have been carried out in order to observe the influence of the speed.

High velocity	Médium velocity	Low velocity

The best results were obtained for low speed rates.

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Characteristics required by the polyolefin mixture.

- **Tests performed to characterize polyolefins mixtures**

Test have been carried out in order to observe and the lead angle of the drum.

High lead angle	Low lead angle

The best results were obtained for low lead angle.

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