REPSOL PORTFOLIO FOR AGRICULTURAL APPLICATIONS

MB PE, LDPE, EVA, EBA, mLLDPE, HDPE, PP

- Repsol Alcudia  [PE] Agricultural masterbatches
- Repsol Alcudia  Repsol Primeva®
- Repsol Alcudia  Repsol Ebantix®
- Repsol Alcudia  Repsol Resistex®
- Repsol Alcudia  [LDPE/EVA/ EBA/ mLLDPE] Greenhouses, double chamber, tunnel, mulch silage, agricultural stretch film, silo bag disinfection and solarisation
- Repsol Alcudia  [HDPE] Shading net, frost protection, cover net
- Repsol Isplen  [PP] Frost blanket, netting and twines, raffia

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AGRICULTURAL MASTERBATCHES
<table>
<thead>
<tr>
<th>Grade</th>
<th>Additives</th>
<th>Recommended dosage</th>
<th>Thickness $\mu$m</th>
<th>TGLV EN 13206 [%]</th>
<th>Haze ASTM D-1003 [%]</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMB UV2120/5</td>
<td>Hals, UV absorbers, antioxidants</td>
<td>5% for 2 agricultural seasons 160 kLy</td>
<td>180</td>
<td>90</td>
<td>22</td>
<td>Greenhouses and tunnels</td>
</tr>
<tr>
<td>IMB UV2130/6</td>
<td>Hals and other additives</td>
<td>6% for 2 agricultural seasons 160 kLY</td>
<td>180</td>
<td>90</td>
<td>40</td>
<td>Greenhouses and tunnels</td>
</tr>
<tr>
<td>117/TD</td>
<td>Nickel quencher (green), UV absorbers, AO</td>
<td>7% for 2 agricultural seasons / 10% for 2 years 160 kLY</td>
<td>180</td>
<td>90</td>
<td>22</td>
<td>Greenhouses and tunnels</td>
</tr>
<tr>
<td>IMB UV2000</td>
<td>Hals</td>
<td>6% for 3 agricultural seasons / 6.5% for 4 agricultural seasons 2000ppm sulphur 100 kLY</td>
<td>200</td>
<td>92</td>
<td>8</td>
<td>Greenhouses and tunnels</td>
</tr>
<tr>
<td>IMB UVH3A</td>
<td>Hals, UV absorbers, AO</td>
<td>5.5% for 3 years 2000ppm sulphur / 6.5% for 3 years 3000ppm sulphur 160 kLY</td>
<td>200</td>
<td>92</td>
<td>17</td>
<td>Greenhouses and tunnels</td>
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<tr>
<td>IMB UV3020</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

*AO - Antioxidants

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## REPSOL ALCUDIA - AGRICULTURAL MASTERBATCHES

**UV Masterbatch for agricultural and industrial applications**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Additives</th>
<th>Recommended dosage</th>
<th>Application</th>
</tr>
</thead>
</table>
| IMB UVSTRETCH | Hals      | 2-4% agricultural stretch film  
1-3% mulch  
1-2% industrial film | Cover hay bales  
Mulching  
Industrial film  
Silage |
| IMB FI1A    | Hals      | 0.7-2% shrink film  
2-5% stabilisation silo bags | Shrink film  
Silo bags |

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**REPSOL ALCUDIA - AGRICULTURAL MASTERBATCHES**

**Thermal and antidrip MB**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Property</th>
<th>Additives</th>
<th>Recommended dosage</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMB TERMIC</td>
<td>Thermicity</td>
<td>Mineral fillers</td>
<td>4% for thermicity 80% in EVA &gt; 5% AV</td>
<td>Greenhouses, tunnels and mulching</td>
</tr>
<tr>
<td>IMB CARGA</td>
<td>Thermicity</td>
<td>Mineral fillers</td>
<td>3% for thermicity 80% in EVA &gt; 5% AV</td>
<td>Greenhouses, tunnels and mulching</td>
</tr>
<tr>
<td>IMB TERMICLARO</td>
<td>Thermicity</td>
<td>Mineral fillers</td>
<td>8% for thermicity 80% in EBA &gt; 3% AB</td>
<td>Greenhouses, tunnels and mulching</td>
</tr>
<tr>
<td>IMB TER60</td>
<td>Thermicity</td>
<td>Mineral fillers</td>
<td>6% for thermicity 80% in EBA &gt; 3% AB</td>
<td>Greenhouses, tunnels and mulching</td>
</tr>
<tr>
<td>IMB AGCD</td>
<td>Antidrip</td>
<td>Antidrip additive and HALS</td>
<td>5% for 200 microns; 7.5% for 50 microns</td>
<td>Greenhouses and double chambers</td>
</tr>
</tbody>
</table>

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BLOWN FILM

- Repsol Alcudia
- Repsol Resistex®
- Repsol Primeva®
- Repsol Ebantix®
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# FILMS APPLICATIONS

**The polymer**

<table>
<thead>
<tr>
<th>LDPE</th>
<th>EVA/EBA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td><strong>Advantages</strong></td>
</tr>
<tr>
<td>• The most used for durations less than 3 Agricultural Seasons</td>
<td>• The most used for durations longer than 2 Agricultural seasons</td>
</tr>
<tr>
<td>• Good mechanical properties</td>
<td>• High photostability</td>
</tr>
<tr>
<td>• Greater creep resistance</td>
<td>• Optical properties</td>
</tr>
<tr>
<td>• Cost</td>
<td>• High thermicity</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td><strong>Disadvantages</strong></td>
</tr>
<tr>
<td>• Less transparency</td>
<td>• Low creep resistance</td>
</tr>
<tr>
<td>• Less thermicity</td>
<td>• Greater dust accumulation</td>
</tr>
<tr>
<td>• Less photostability</td>
<td>• Cost</td>
</tr>
</tbody>
</table>

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## FILMS APPLICATIONS

### Polymer properties

<table>
<thead>
<tr>
<th>Property</th>
<th>LDPE</th>
<th>mLLDPE</th>
<th>EVA</th>
<th>EBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photostability</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Transparency</td>
<td>+</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Thermicity</td>
<td>–</td>
<td>–</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Mechanical properties</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Creep</td>
<td>++++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Sealability</td>
<td>++++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Extrusion (Wider blowing)</td>
<td>++++</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
</tr>
</tbody>
</table>

EVA: Ethylene copolymer + vinyl acetate (9 %)
EBA: Ethylene copolymer + butyl acrylate (5.5 %)

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Below there are some examples of structures and formulations, although it is recommended to contact the technical service to obtain the most appropriate recommendations in each particular application.
GREENHOUSES

What are its advantages?

- Crops out of season
- It allows to establish the most suitable climatic conditions for each crop
- Greater protection and/or control against extreme weather conditions
- Precocity in production
- Higher productions and better quality
- Greater control over pests, weeds and diseases
- More efficient use of productive resources
GREENHOUSES

What properties are sought?

**MECHANICAL:**
- Tensile strength
- Tear resistance
- Impact resistance
- Creep resistance

**DURATION:**
- High stability against UV radiation
- Resistance to phytosanitary chemicals

**RADIOMETRIC:**
- Maximize PAR transmission
- Control the IR transmission
- Filter and transform UV, NIR, MIR, FIR radiation
GREENHOUSES

Thermal covers

DIFFUSER THERMALS:
- They are suitable for Mediterranean climate zones (low cloudiness, high irradiation and low rainfall)
- Avoid shadows inside the greenhouse
- They are based on mineral charges with the best IR block and light diffusion
- They are not prodegradant

CLEAR THERMALS:
- They are preferred in areas of wetter climate
- The diffuse component of global solar radiation is the majority because of the high cloudiness
- They are based on “transparent” mineral fillers
- They are not prodegradant
GREENHOUSES
Repsol formulation proposal

It is recommended the use of Repsol Resistex® 1810F/FG mixed with the LDPE and EBA grades to improve mechanical properties and temperature resistance in areas of contact with the greenhouse structure.

**THERMAL**

A: E303 + UV MB*
B: E803 o E1303 + UV MB* + Thermal MB**
A: E303 + UV MB*

**NOT THERMAL**

A: 2303F/PE033/2203F + UV MB*
B: 2303F/PE033/2203F + UV MB*
A: 2303F/PE033/2203F + UV MB*

* Select the type of UV MB and dosage based on duration, UV radiation, thickness and exposure to contaminants such as sulphur, chlorine, etc.
** For diffuse thermal films, dose IMB CARGA or IMB TERMIC; for clear thermal films dose IMB TERMICLARO
The double chamber is a passive heating technique. It consists of a plastic sheet that divides the greenhouse into two chambers - lower and upper - with the aim of increasing the accumulated heat during the day in the lower one and slowing down the loss of this heat during the night. [*]

- Increase in minimum night temperature
- Reduction of temperature and relative humidity oscillations, combined with adequate ventilation management during the day.
- Elimination of drip on the crop.

A: 1810FG
B: 2212FG or E303 + 7.5% IMB AGCD*
C: 1810FG or E303 + 5% IMB AGCD*

[*] IMB AGCD: Antidrip + HALS
TUNNEL

Requirements and advantages

The tunnel is a technique that protects crops from the moment of sowing until the time of harvest. They are used for crops of high commercial value such as strawberries, raspberries and blueberries.

The main advantages associated with the use of this type of structure, among others, can be classified into advantages of structure, protection, management and production:

- Ease of installation, maintenance and assembly
- The crop is protected from adverse weather conditions
- Higher crop yield and quality
TUNNEL

Repsol formulation proposal

A: E303 + 2-4 % MB HALS*
B: E1303 + 2-4 % MB HALS*
A: E303 + 2-4 % MB HALS*

* Ex: Film 100 microns, 160 kLy, 2 winters:
- 4% IMB UV2130 / 6 for high diffusion
- 3.5% IMB UV2120 / 5 for medium diffusion
- 2.5% IMB UV2000, for high transparency
Requirements and advantages

They are forage conservation processes, which allow the producer to store the product in their own field, thereby reducing uncertainty and the risks of not being able to have an adequate storage and transportation place, before marketing.

The properties sought in the plastic are:

- To preserve the forage of light, water and air.
- During its period of use, the forage is kept in optimal condition.
- Avoid fermentation of stored grass for cattle.
AGRICULTURAL STRETCH FILM

Repsol formulation proposal

A: MF1810F + 50-70 % P1820F/P1807F + 20 % PIB + 2-4 % IMB STRETCH*
B: P1820F/P1807F + 2-4 % IMB STRETCH*
C: MF1810F + 10-20 % 2308F + 2-4 % IMB STRETCH*

*Dosage depending on thickness
MULCHING

Requirements and advantages

What is it?
- It is a technique that involves covering the soil to protect the crop from atmospheric agents and promote better results in our crops.
- It can be applied in horticultural crops such as: eggplant, watermelon, zucchini, melon, tomato, strawberry, lettuce, broccoli, pepper, etc.

What requirements should plastics have?
- Good mechanical properties, must be resistant to:
  - Strength
  - Tear
  - To the impact of very low temperatures
  - To stretching (elongation)
- Thermicity in certain geographical regions

What are the advantages?
- Increase soil temperature by retaining heat
- Precocity in production due to the increase in soil temperature
- Good mechanical properties
- Increase the performance of fertilizers and irrigation water
- Reduce the presence of weeds

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MULCHING

Repsol formulation proposal

Thermal mulching

- It is recommended the use of Repsol Ebantix® EBA copolymers to increase film thermacity and the use of Repsol Resistex® mLLDPE grades to meet mechanical property requirements.

- The IMB UVStretch is recommended for UV protection.

A: 1810FG + 1-3 % IMB UVSTRETCH
B: E1303 + PEBD + 1-3 % IMB UVSTRETCH
C: 1810FG + 1-3 % IMB UVSTRETCH
DISINFECTION AND SOLARISATION

Requirements and advantages

What is it?

- **Chemical disinfection**: it is the disinfestation of the soil through chemical agents. Films are required to protect the cover from the action of pesticides.
- **Solarisation**: this is the disinfestation of the soil by means of the heat generated from the captured solar energy and is carried out in the hottest months. A thermal and drip film is required to increase the temperature in order to kill the pathogenic microorganisms.
- **Mixed**: uses the technique of chemical disinfection, taking advantage of high ground temperatures.
DISINFECTION AND SOLARISATION

Repsol formulation proposal

Solarisation by temperature

Structure | Materials
---|---
A/B/A | LDPE/EBA/LDPE
A*: Repsol Ebantix® E303 • Repsol Resistex® 1810F/FG
B*: Repsol Ebantix® E1303
*It is recommended to add 1% of IMB UV2120/5 for UV protection

Disinfection with chemical agents

Structure | Materials
---|---
A/B/C/B/A | PE/tie layer/EVOH/tie layer/PE
A: 2308F or Repsol Resistex® 1810F/FG for less haze
B: Not available in Repsol
C: Not available in Repsol

Thermicity vs thickness EBA films

<table>
<thead>
<tr>
<th>Thickness (micron)</th>
<th>Thermicity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>68</td>
<td>E303, E803C</td>
</tr>
<tr>
<td>84</td>
<td>E303, E803C</td>
</tr>
<tr>
<td>102</td>
<td>E303, E803C</td>
</tr>
<tr>
<td>155</td>
<td>E303, E803C</td>
</tr>
</tbody>
</table>

*BA: Butyl Acrylate

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For a 130 micron industrial film exposed during 1 year and with 150 kLy radiation, it is recommended to dose 1.3% of the IMB FI1A.

- These concentrations are recommended for film applications not exposed to prodegradant agents. Some pollutants such as sulphur, chlorine and other chemicals used in the field can affect the stabilizing action of this MB due to its prodegradant effect.
- In this case, it will be necessary to reinforce the additivation or to use another type of UV MB specific resistant to this type of contaminants, such as the IMB UV2000 grade.
## POLYETHYLENE TECHNICAL TEXTILES

<table>
<thead>
<tr>
<th>Melt Flow Index</th>
<th>Density</th>
<th>PDI</th>
<th>Properties</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 1133g/10’</td>
<td>948</td>
<td>Medium</td>
<td>Low fibrillation, high tensile strength at break, easy processing</td>
<td>Blown film for stretched tapes: fabrics, nets and twines</td>
</tr>
<tr>
<td>190° C 2.16 kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISO 1183/kg/m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R4805EP</td>
<td>0.55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R4805D1</td>
<td>0.55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R4806HT</td>
<td>0.60</td>
<td>Narrow</td>
<td>Low fibrillation, high tensile strength at break and toughness, easy processing</td>
<td>Blown film for stretched tapes: fabrics, nets and twines</td>
</tr>
<tr>
<td>M5204</td>
<td>0.45</td>
<td>Narrow</td>
<td>Highest toughness, high stretching ratio</td>
<td>Monofilaments for very high strength ropes</td>
</tr>
<tr>
<td>M5206</td>
<td>0.60</td>
<td>Narrow</td>
<td>Very high toughness</td>
<td>Monofilaments for very high strength ropes</td>
</tr>
<tr>
<td>M5305</td>
<td>0.50</td>
<td>Medium</td>
<td>High toughness</td>
<td>Ropes and twines</td>
</tr>
<tr>
<td>M5309</td>
<td>0.95</td>
<td>Medium</td>
<td>Medium toughness, soft yarns</td>
<td>Monofilaments for fabrics (netting and twines)</td>
</tr>
</tbody>
</table>

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RAFFIA AND MONOFILAMENT

Requirements and advantages

- Shading Net: reduce direct sun radiation that damages plans. Reduce irrigation requirements.
- Greenhouses net: these nets control the light getting through, allowing advantages for pest control. Anti-insect net: acts like a barrier against trips, whitefly, aphids and other small size insects.
- Anti-hail net: fabrics with optimize mechanical properties that protect the crops against hailstorm.
- Anti-birds net: protect fruit trees, seedlings and vineyards from the attack of birds.
- Anti-weeds net: these textiles have a good resistance and easy to install. They prevent the growth of weeds by not enter the sunlight to the soil.
<table>
<thead>
<tr>
<th>Type</th>
<th>Melt Flow Index</th>
<th>Flexural modulus of elasticity</th>
<th>Tensile strength at yield</th>
<th>Izod impact strength notched</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP020G3E</td>
<td>1</td>
<td></td>
<td>1350</td>
<td>34</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Strapping</td>
</tr>
<tr>
<td>PP030G1E</td>
<td>1.7</td>
<td></td>
<td>1350</td>
<td>34</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High toughness raffia and monofilaments for netting and twines</td>
</tr>
<tr>
<td>PP031G1E</td>
<td>2</td>
<td></td>
<td>1400</td>
<td>35</td>
<td>5</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High toughness raffia and monofilaments for netting and twines</td>
</tr>
<tr>
<td>PP040G1E</td>
<td>3</td>
<td></td>
<td>1450</td>
<td>35</td>
<td>4.5</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High toughness raffia and monofilaments for netting and twines</td>
</tr>
</tbody>
</table>

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# REPSOL ISPLEN  PP HIGH MFI HOMOPOLYMER

**Multifilament – nonwoven**

<table>
<thead>
<tr>
<th>Type</th>
<th>Melt Flow Index</th>
<th>Flexural modulus of elasticity</th>
<th>Tensile strength at yield</th>
<th>Izod impact strength notched</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP050Y1E</td>
<td>PPH</td>
<td>5.5</td>
<td>1550</td>
<td>35</td>
<td>High tenacity staple fiber, monofilament, BCF/CF, geotextiles.</td>
</tr>
<tr>
<td>PP086Y3E</td>
<td>PPH</td>
<td>25</td>
<td>1600</td>
<td>36</td>
<td>Multifilament, hygiene nonwoven, BCF/CF.</td>
</tr>
<tr>
<td>PP086U6E</td>
<td>PPH</td>
<td>25</td>
<td>1600</td>
<td>36</td>
<td>Multifilament, hygiene nonwoven, BCF/CF, UV protection.</td>
</tr>
<tr>
<td>PP089Y1E</td>
<td>PPH</td>
<td>30</td>
<td>1650</td>
<td>36</td>
<td>Last generation spunbond lines, BCF/CF, staple fibre, hygiene nonwoven.</td>
</tr>
</tbody>
</table>

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FROST BLANKET
Requirements and advantages

What is it and which are its advantages?

It is light textile sheets designed to be used directly on the crop. It is used during the first few weeks after the transplant. This type of fabric extend the growing season and protect plants from cold outdoor temperatures and other environmental threats such as fungal spores, wind, and precipitation.

Its advantages are:

- Increase temperature between 3º to 4ºC
- Avoid frost, protecting the state of the crop
- Sun protection
- Allows ventilation in crops
- Protect crops against insect attack
FROST BLANKET

Repsol formulation proposal

Repsol recommends **Repsol Isplen PP086U6E** to produce frost blankets (woven non woven)

- With stability and extra resistance to UV radiation, even in high radiation areas
- Maximum resistance and durability outdoors
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