Welcome at GAP

Annular microlayered biaxially oriented barrier film with improved barrier and toughness performance

Giovanni Stocchetti
Since 2004
Double bubble line
Multy-bubble
Water quench line
Extrusion coating line

Since 2017
Annular microlayer die
head up to 27 layer

Since 2013
Shrink barrier bags
Shrink barrier films
Specialty shrink barrier
Film up to 9 layer

From 2020
27 layer film line in
operation
Today flexible packaging producer need to reduce packaging weight

Reduce, recycle, and increase performance for barrier and monomaterial

- Reducing the thickness, weight of the packaging
- Avoiding further converting steps if possible
- Recyclability
- Anyway, maintaining the same performance of the film in terms of barrier, mechanical properties etc.
we have ways to reduce consumption of material and down gauging film, increase performance and recyclability of films

no-contact simultaneous orientation double and multy bubble line up to 4.000 mm
we have ways to reduce consumption of material and down gauging film, increase performance and recyclability of films

annular micro-layer die technology x layers MIRA LAYER to be used in all annular process
Combination of Both

We have experimented it, we achieve great result from 30% up to 50% thickness reduction
Simultaneous orientation a key to reduce film thickness, improve barrier performance

Applying an orientation, the films obtain a wealth of advantageous properties, due to a change in the morphology of the film’s molecular structure especially shrinkability.

- **excellent convertibility**, printability and saleability
- **attractive glossy appearance**, thanks to brilliant surface quality and high transparency
- **dimensional stability** and scratch resistance
- **excellent mechanical properties**, e.g. stiffness, tear, shock or puncture resistance
- **higher barrier characteristics**
- **high resistance to oils**, fats and solvents, as well as to heat and cold

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Double Bubble

**Simultaneous orientation lines**

1- Primary tube extrusion

2- Simultaneous orientation TD and MD

3- Rotating double turret winder

Up to 4,000 mm up to 700 Kg/h
Short view of the process
Multy Double Bubble
simultaneous orientation lines

1- Coextrusion section
2- Primary tube extrusion
3 - MD-TD orientation
4 – Annealing
5 Winder

Up to 2.000 mm up to 500 Kg/h
Large Double Bubble and annealing simultaneous orientation lines

Up to 4.000 mm up to 1000 Kg/h
Not oriented film blown up or down
we have ways to reduce consumption of material and down gauging film, increase performance and recyclability of films

annular micro-layer die head technology x layers MIRA LAYER to be used in all annular process
New 27 microlayer trend

There is a need to produce annular multilayered structures with:

- Larger number of layers
- Produce annular multilayered structures having improved physical and mechanical properties
- Reduced the number of processing steps
- Increased flexibility in annular structure production equipment
The present *invention relates to multilayer structures having annular profiles* and methods and apparatus used to manufacture film.

- **Cast film**: Produces flat plastic film and sheet, 15% edge trim typical difficult to recycle
- **Blown film**: Produces film in an *annular form*
  - Provides greater flexibility in film or sheet, Width changes on the same line
  - Provides better economics, lower volume specialty applications, with frequent product changeovers
  - Avoids the yield losses associated with edge trim
  - Orient the film in both direction
Extruders section before multiplication

21 layer 7 x 3 or 27 layer 9 x 3
Annular Microlayered Film Structures layer advantages

• Having a larger number of and/or thinner layers
• Produce blown film in which the circumference of the structure avoids a conventional welding or overlapping area where structure properties will be undesirably or adversely affected
• Crystallization was slower and more confined in the films with thinner layers.

<table>
<thead>
<tr>
<th>SEQUENCE OF LAYERS</th>
<th>EXAMPLE</th>
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<tbody>
<tr>
<td></td>
<td>1-2-3-4-5-6-7-8-9-10-11-12-13-15-16-17-18-19-20-21-22-23-24-25-26-27</td>
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Internally develop the annular microlayering die technology in order to establish a competitive advantage in manufacturing:

- combination of several polymers with different viscosities and processing temperatures into a single film
- Thinner films
- Superior performance
- Less raw materials used
- Significant cost reduction
- have greatest improvement if alternating “Hard/”Soft” layers
- The repeated layering of two materials with a different properties can create a new film that can exceed the average or the maximum value of the individual layers.
## Miralayer results

<table>
<thead>
<tr>
<th>Test line</th>
<th>From</th>
<th>To</th>
<th>result</th>
<th>% of improve</th>
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</thead>
<tbody>
<tr>
<td>Tear</td>
<td>DB</td>
<td>15 gsm</td>
<td>9 gsm</td>
<td>15 gr</td>
</tr>
<tr>
<td>Tensile</td>
<td>DB</td>
<td>15 gsm</td>
<td>9 gsm</td>
<td>19-20 psi</td>
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<tr>
<td>Elongation</td>
<td>DB</td>
<td>15 gsm</td>
<td>9 gsm</td>
<td>110-125%</td>
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<tr>
<td>Additive</td>
<td>MB</td>
<td></td>
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<tr>
<td>Barrier after</td>
<td>Crack test</td>
<td>10 OTR x 100</td>
<td>10 OTR Over</td>
<td>+1000%</td>
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<tr>
<td>flex crack</td>
<td>cycle</td>
<td>cycle</td>
<td>1000 cycle</td>
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<td>Under further</td>
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<tr>
<td>evaluation</td>
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<td></td>
<td>Reduction of additive</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Reduce tie layer microlayer improve the layer adhesion</td>
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</tbody>
</table>
Evidence of result

➢ Advantages of Annular Microlayered Film Structures
  • Annular profiles that are cost-effective for various applications with at least one of:
    ▪ Improved barrier Prevention of crack formation
    ▪ Improved layer uniformity
    ▪ Improved strength
    ▪ Improved toughness
    ▪ Improved tear resistance
    ▪ Improved puncture resistance
    ▪ The thinner the EVOH layer, the easier it was to orient biaxially.
Conclusion

1. Microlayered film from 35% to 50% thinner than conventional film

2. Layer sequencing microlayers significantly improves physical properties

3. Less expensive material could be substituted without sacrificing performance

4. Easier to orient EVOH

5. Improved barrier Prevention of crack formation

6. More reclaimed material can be added without sacrificing performance