

# (DM2) HIPS – Refrigerator Liner

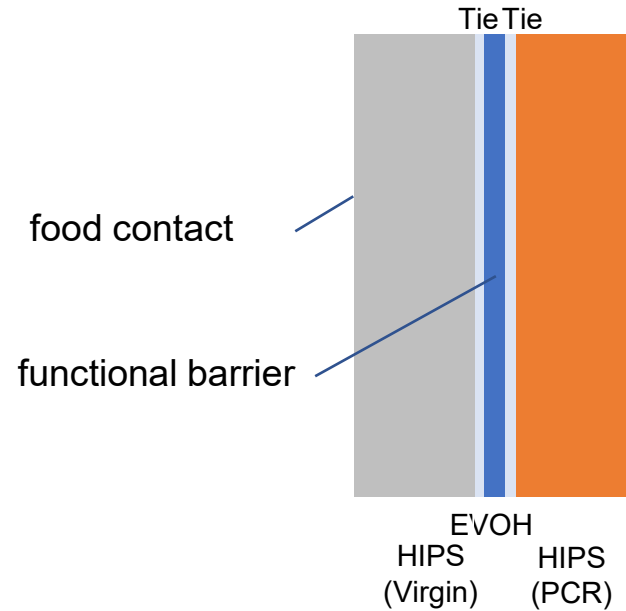


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# HIPS – Refrigerator Liner (DM2/6)



**Figure 2.1** Target Demonstrator (for illustration).  
Pictures from amazon.com



**Figure 2.2** Demonstrator from NONTOX from small scale Thermoforming validation trials (TRL4)

Responsible Compound Formulation	Processing Small Scale	Demo pilot scale	Target/Final TRL	Demonstrator	Material Concept	Application	Key CTQs	PCR Origin/ Recycling /Purification
VTT	AIMPLAS (ML Cast XT) (TF)  NORNER (ML Cast XT) (TF)		6/4	<b>Refrigerator Liner</b>	<ul style="list-style-type: none"> <li>CE friendly materials</li> <li>Food contact parts from recycling</li> <li>Monomaterial multicomponent</li> <li>Multilayer ABCBD</li> <li>Design from /for Recycling</li> </ul>	<b>Target:</b> E&E Appliances	MFR Extrudability Migration Processability (Cast XT,TF)	<b>Main Origin:</b> HIPS WEEE / SR/ Creasolv®  <b>Alternative:</b> ABS WEEE / SR/ Creasolv®



# Upgrading of Recycled PS

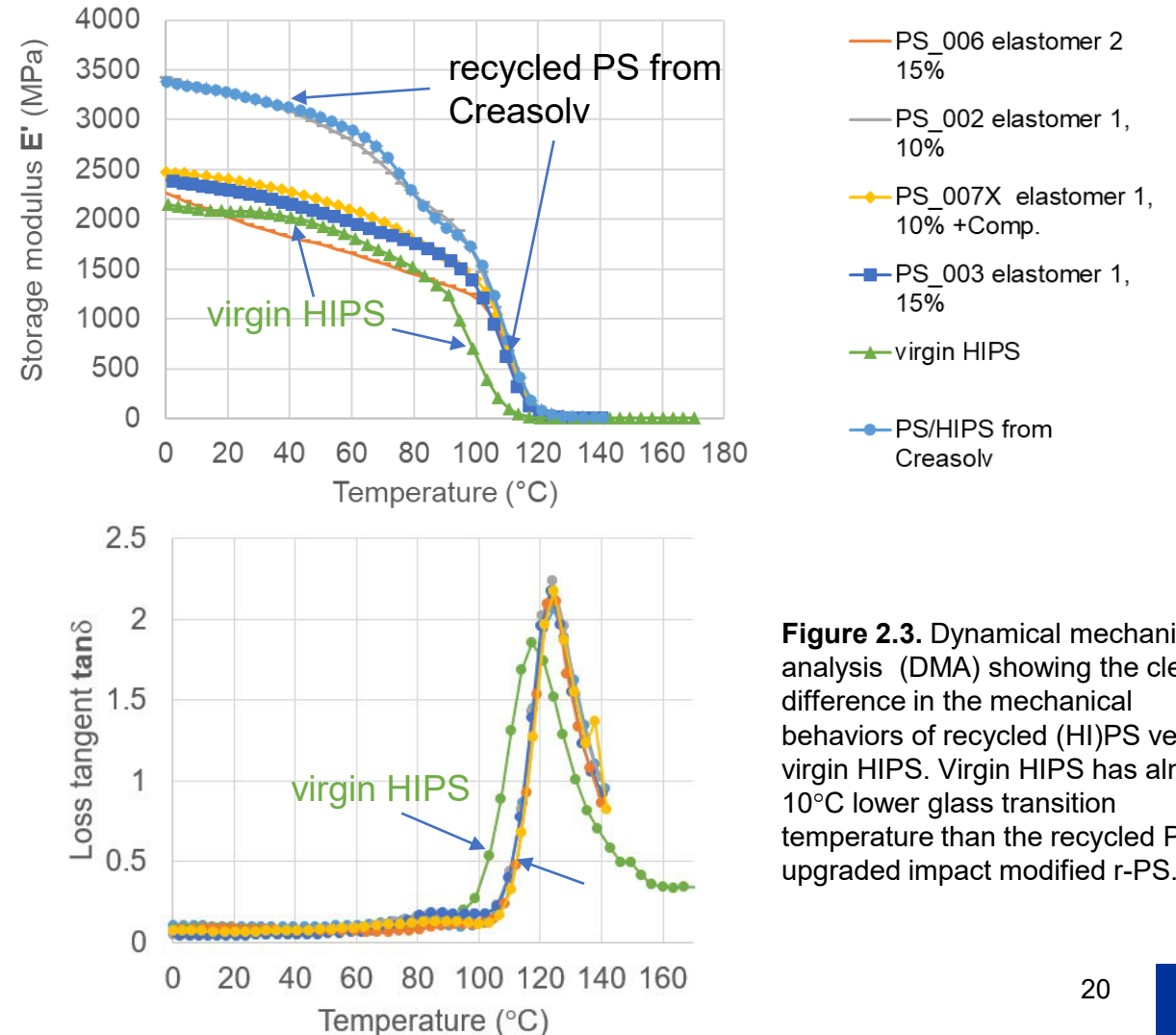


Recycled HIPS typically has lost most of the original “high impact” properties and become “just PS”

(see the DMA analyses data on the right)

The task in upgrading r- PS from Creasolv® for the multilayer laminate application (DM 2) is to restore and validate:

- Notched impact to the 15 kJ/m<sup>2</sup> range
- Melt flow properties for sheet extrusion (MFR ~ 3.5)
- Drawability/Thermoformability
- **Elastic modulus** matching with the food contact grade virgin HIPS used in the inner liner
- Adhesion to the tie layers
- All these could be optimally achieved by compounding r-PS with 15% styrenic elastomer #1



**Figure 2.3.** Dynamical mechanical analysis (DMA) showing the clear difference in the mechanical behaviors of recycled (HI)PS versus virgin HIPS. Virgin HIPS has almost 10°C lower glass transition temperature than the recycled PS or upgraded impact modified r-PS.



# Co-Extrusion of Multilayer Laminate inc. Recycled PS

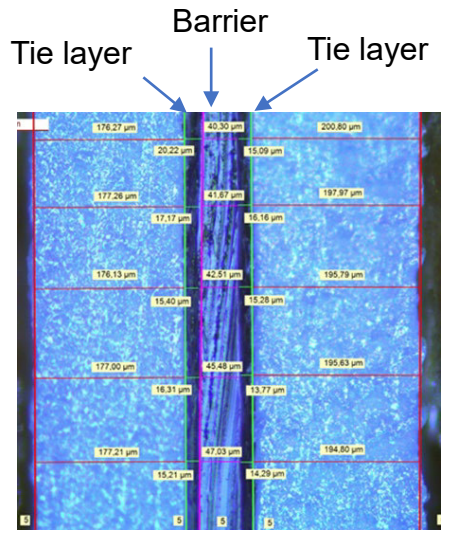


**Co-extrusion line at Aimplas**  
enabling 3 to 5-layers with 3 (but not 4) extruders/materials



## 5-layer co-extrusion

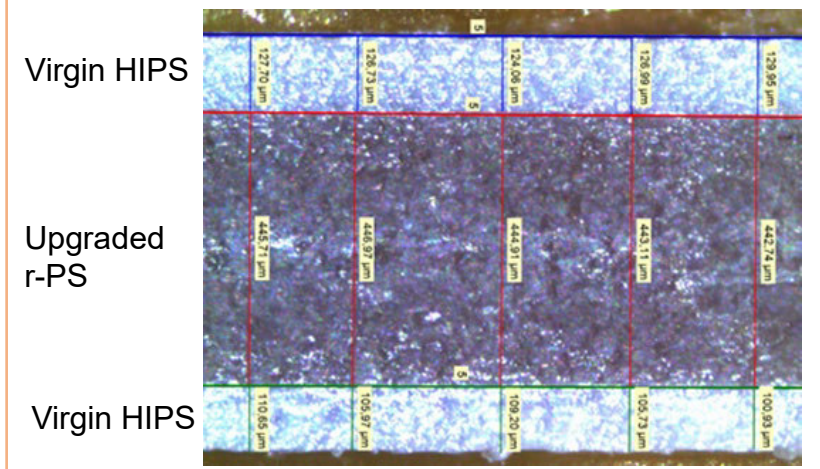
Adhesion of the HIPS to the tie layer



Virgin HIPS      Virgin HIPS

## 3-layer co-extrusion

Testing mechanical compliance and thermoformability of the HIPS / r-PS laminate



**Figures 2.4.** Processability of this upgraded sample (\_009, 85% recycled content), and a sample (\_010 53% recycled content) diluted with virgin grade HIPS behaved similarly in co-extrusion tests at Aimplas



# Thermoformed 3-layer HIPS laminate

