

(DM1) PC-ABS - Shaving Machine Cover



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| Responsible Compound Formulation | Processing Small Scale | Demo pilot scale | Target/Final TRL | Demonstrator | Material Concept | Application | PCR Origin/ Recycling /Purification |
|----------------------------------|-------------------------|------------------|------------------|------------------------------|--|---|--|
| VTT | AIMPLAS (1K IM) (2K IM) | NORNER (1K IM) | 6/? | Shaving Machine Cover | <ul style="list-style-type: none"> • CE friendly materials • Monomaterial multicomponent • Demonstration of Circularity of PC/ABS enabled by CREASOLV • Design from /for Recycling | <p>Target: E&E Appliances</p> <p>Also for: Automotive</p> | <p>Main Origin: PC WEEE / SR/ CREASOLV</p> <p>Alternative: ABS WEEE / SR/ CREASOLV</p> |

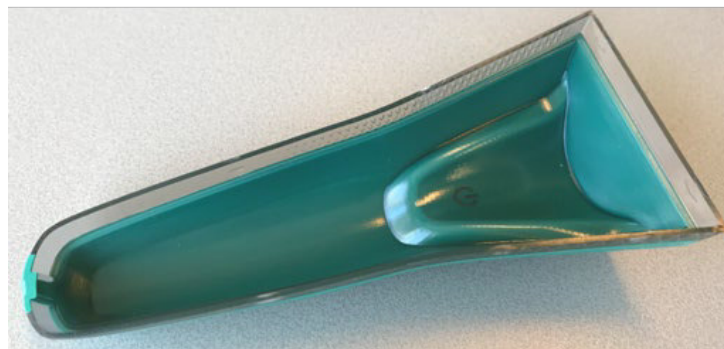


Figure 1.1 Target Demonstrator. Pictures from H2020-POLYCE (for illustration)

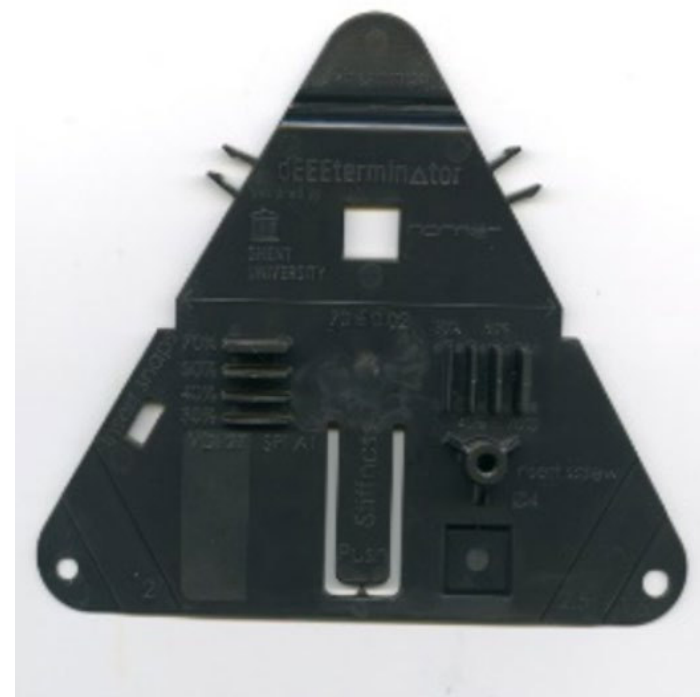


Figure 1.2 Demonstrator from NONTOX from small scale Injection Molding validation trials (TRL4)



Properties of Recycled r-PC/ABS

- The below example are from r-PC/ABS (60/40%) blends from 2-5 kg scale experiments, containing 38% *virgin ABS*, and 5% *compatibilizer* (B or C) and in one case chain extender
- Impact strength has been significantly upgraded by the proper choice of compatibilizer
- PC from Creasolv® from two different batches C2 and C3 - with some variation between batches in their melt viscosity and M_w
- Chain extender has a large effect on the melt viscosity, but not on the impact strength (which for r-PC is in the range of $< 7 \text{ kJ/m}^2$)

| | Recycled PC / Virgin ABS (60/40%) Creasolv® batch/ Compatibilizer (B or C, chain extender) | Charpy Notched impact @RT (kJ/m ²) | E-modulus / tensile strength at break @RT (MPa) | | Glass temp. T_g ABS ⁴ / PC ⁵ (CELS) | | MFI +260°C / 2.16 kg (g/10 min) |
|---------|--|---|--|------|--|-----|---|
| | | | | | | | |
| Ref_u | PC Creasolv®2-(Add ³) no compatibizer | 14.4 | 2378 | 51.4 | 104 | 146 | 12.5 |
| S2_u_C2 | PC Creasolv®2- Comp B (rigid) | 22.5 | 2427 | 52.9 | 105 | 148 | 7.0 |
| S5_u_C2 | PC Creasolv®2- Comp B - chain extended | 23.4 | 2423 | 55.6 | 105 | 148 | 1.6 |
| S3_u_C2 | PC Creasolv®2 - Comp C (elastic) | 21.9 | 2103 | 46.2 | 103 | 147 | 3.8 |
| S2_u_C3 | PC Creasolv®3- Comp B | 36.2 | 2433 | 53.5 | 107 | 150 | 3.9 |

PC-ABS –Material Upgrading



Polycarbonate derived from bromine contaminated mixed plastics by Creasolv® can be upgraded into a good performance PC/ABS 60/40% blend

- Good processability by injection molding, except for the marks that imply degradation (under study) (Figure 1.3 below)
- Appropriate thermomechanical properties - comparable to virgin PC/ABS
- Satisfactory impact properties (OEMs: Charpy notched >20 kJ/m² @RT) in compatibilized blends having 57.5% recycled content, and a practically attractive >15 kJ/m² can be reached even at much higher recycled content >75%
- Black color, limited gloss but good contrast between matt and glossy areas

Remaining challenges

- Stability of the M_w of PC polymer after the Creasolv® process (→ batch-to-batch variations)
- Upscaling to larger >30 kg scale-enabling TLR 6 demo
- Drying or VOC removal from recycled PC or PC/ABS, or recycled plastics in general

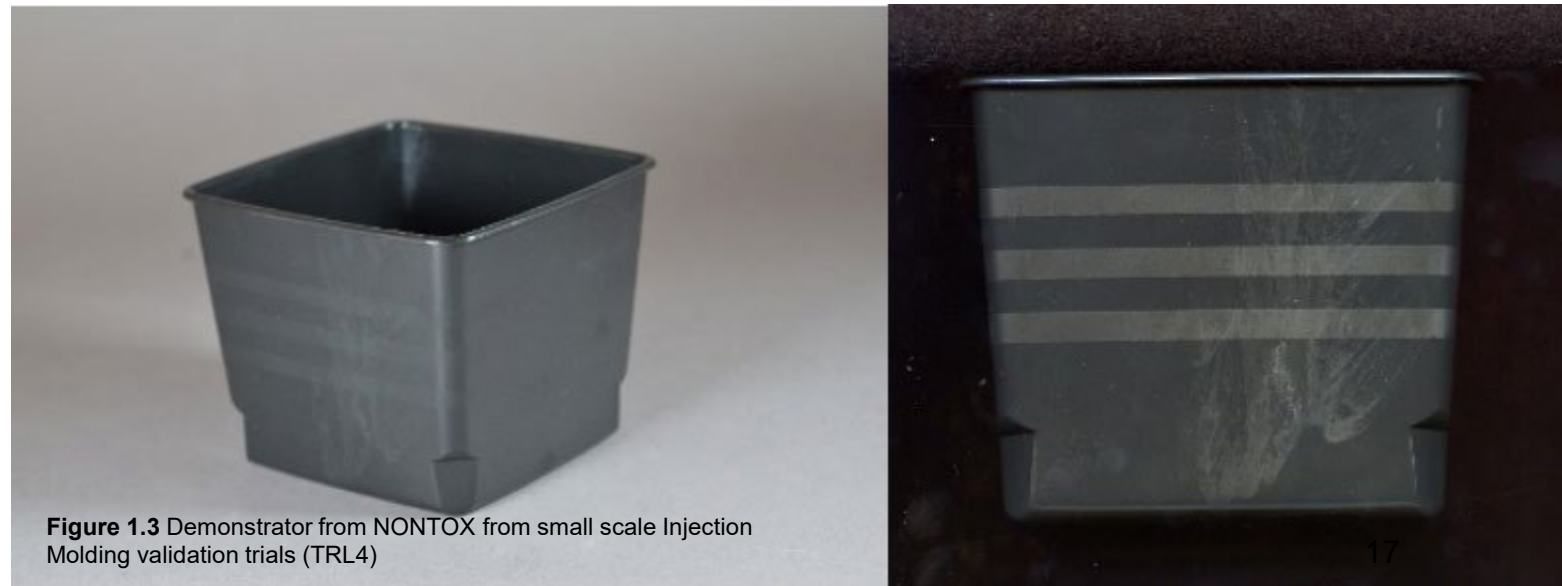


Figure 1.3 Demonstrator from NONTOX from small scale Injection Molding validation trials (TRL4)