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Filled polypropylene – Furniture

Title	FAILURE ANALYSIS OF POLYMER FURNITURE COMPONENTS
Date	2013
Objective	To determine the cause of failure of a polymer furniture component.
Photo	 Figure 1. Close-up of Sample B – failed sample (cracks circled).

	 Figure 2. A Specimen showing voids in the material removed from Sample B prior toashing.
Testing Undertaken	FT-IR analysis according to ASTM E 573, using an Alpha Measurement Module byBrukerOptik Thermal analysis by DSC according to ASTM D 3418, using a DSC Q20 by TA instruments Ash testing according to the residue on ashing procedure described in ASTM D 2584.
Failure Mode and Recommendations	The failures are due to **shrinkage cracking** where the polymer undergoes **post-moulding shrinkage** but is **constrained by the metal insert** causing the polymer to be placed in tension. The presence of a **high level of filler** and the **use of PPhomopolymer** make the polymer less able to resist these tensile forces so cracking occurs. The internal voids are moulding defects due to volatiles or shrinkage voids and these lower the material strength of the polymer. Mould shrinking can be limited by increasing mould temperature, controlling the moulding variables, the thermal history of the moulding (temperature, cooling rate, part thickness and gate dimensions). Heating the metal inserts close to the mould temperature before moulding removes differences in thermal expansion that can lead to stress build-up at the metal/plastic interface.

Flexible polypropylene (RPP) – Geomembrane

Title	TESTING OF REINFORCED FLEXIBLE POLYPROPYLENE (R-PP) GEOMEMBRANE SAMPLES

Date	2013
Objective	Comparative testing of five reinforced flexible polypropylene (R-PP) cover samples
Testing Undertaken	Breaking Strength: Procedure A – Grab Test Method (ASTM D 751) Trapezoidal Tear (ASTM D 4533) Carbonyl Index (based on ASTM F2102) Surface microscopy (photographs for assessing micro-cracking) Weld Shear (ASTM D 6392) Ply Adhesion (ASTM D 6636)
Conclusion	ATR FT-IR data indicated that all the used samples had undergone significant oxidation. Micrograph showed considerable crazing of the exposed samples but no micro-cracking was evident.

Flexible polypropylene (RPP) – Liners

Title	TESTING OF REINFORCED FLEXIBLE POLYPROPYLENE (RPP) GEOMEMBRANE SAMPLES
Date	2013
Objective	To conduct comparative testing on three reinforced flexible polypropylene (RPP) cover samples.
Photo	

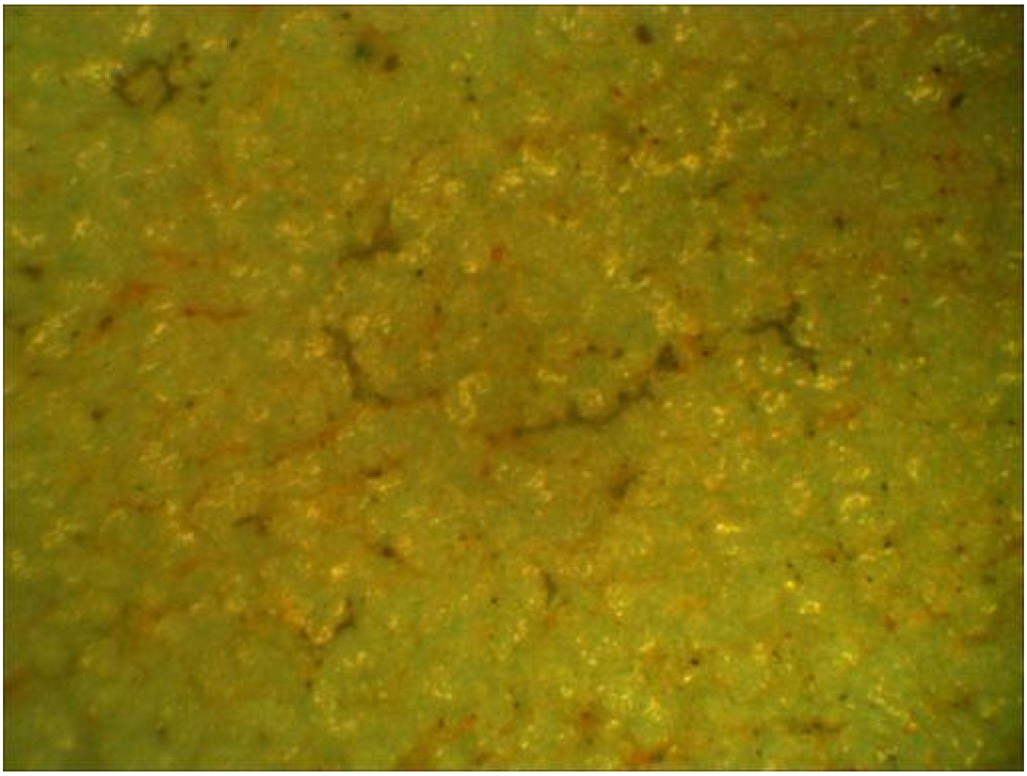


Figure 1. Surface Detail x200 magnification – no surface micro-cracking evident but slight crazing only.

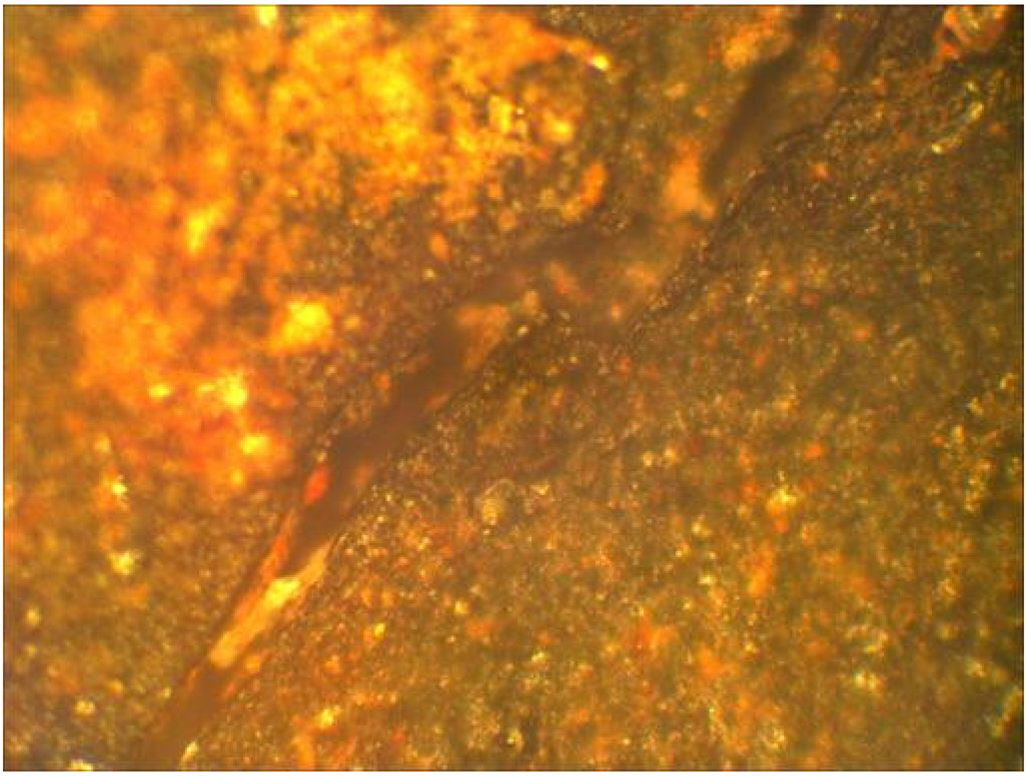


Figure 2. Surface Detail x200 magnification – surface micro-cracking and fissuring evident.

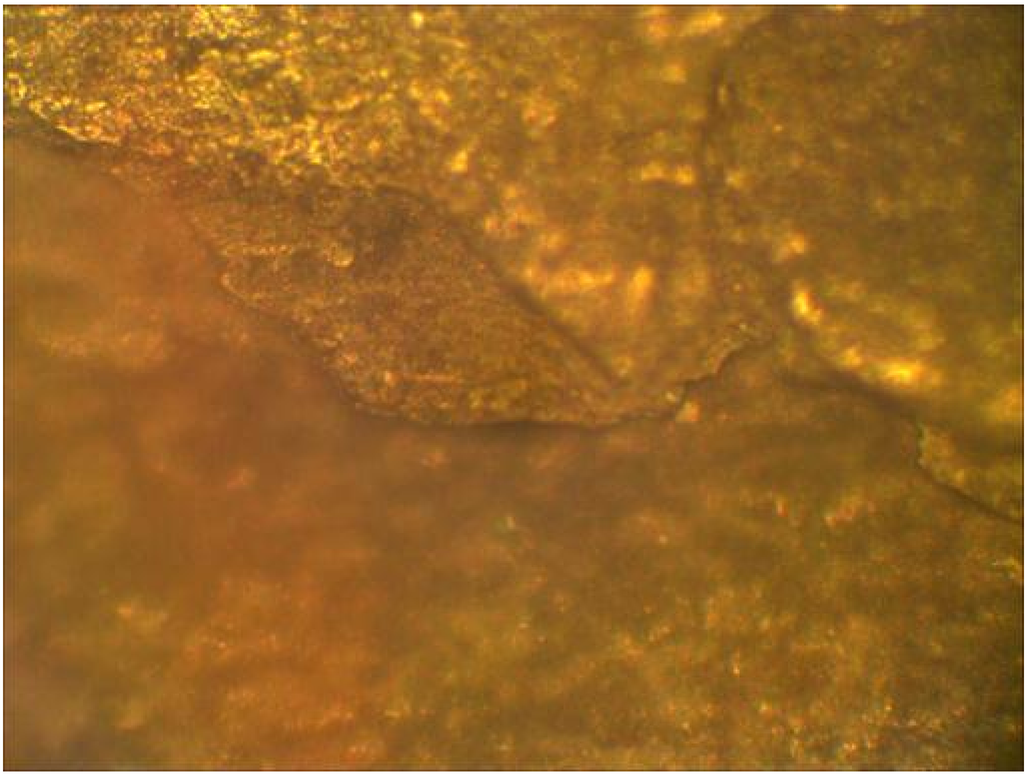


Figure 3. Surface Detail x200 magnification – surface micro-flaking evident.

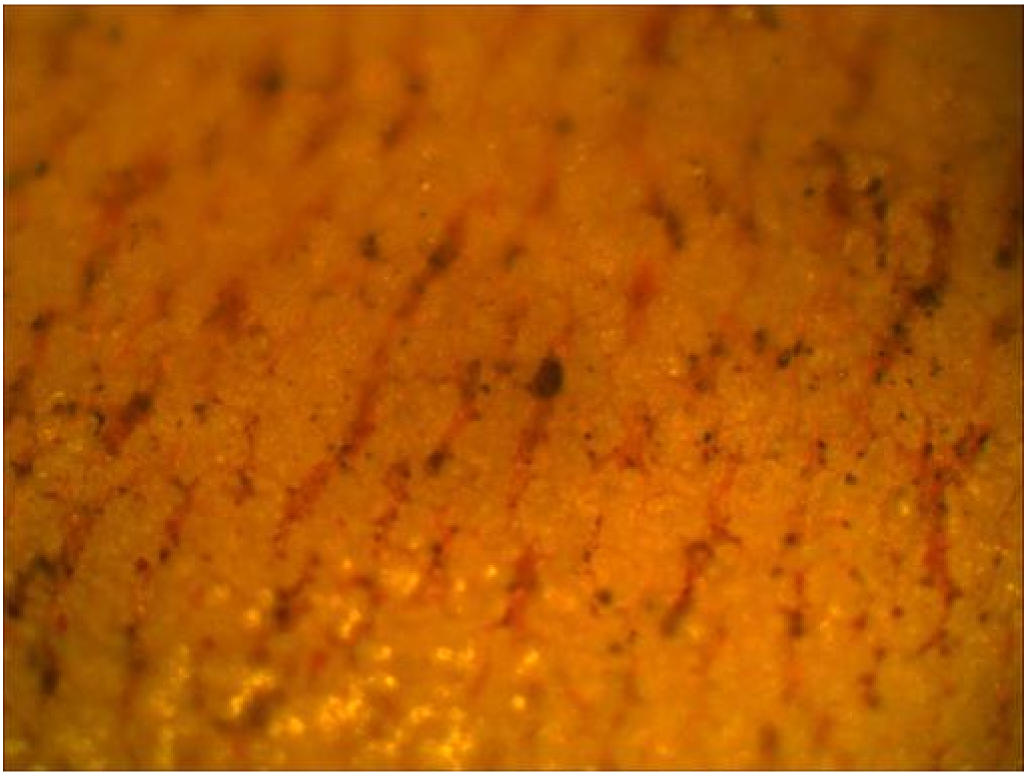
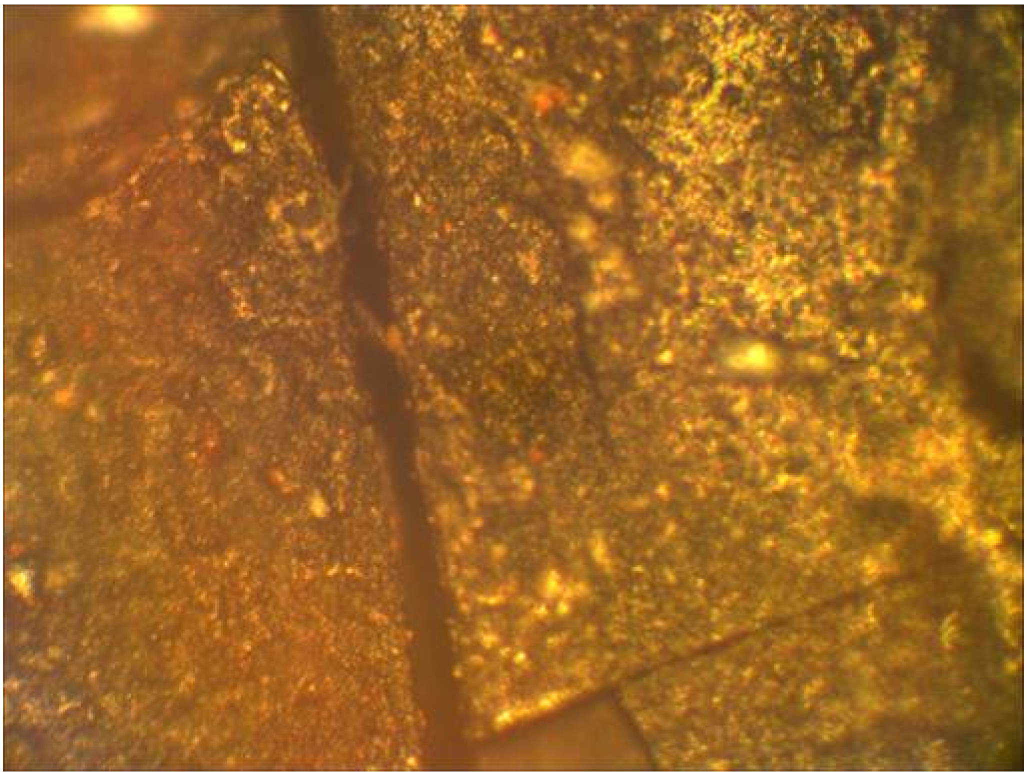
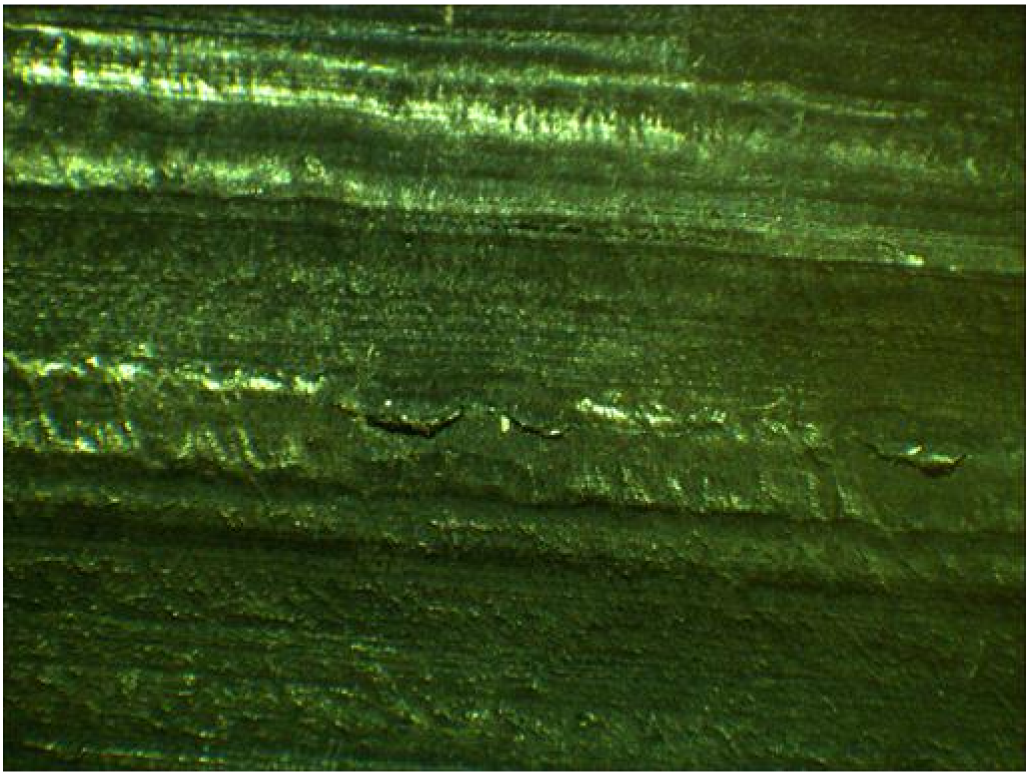
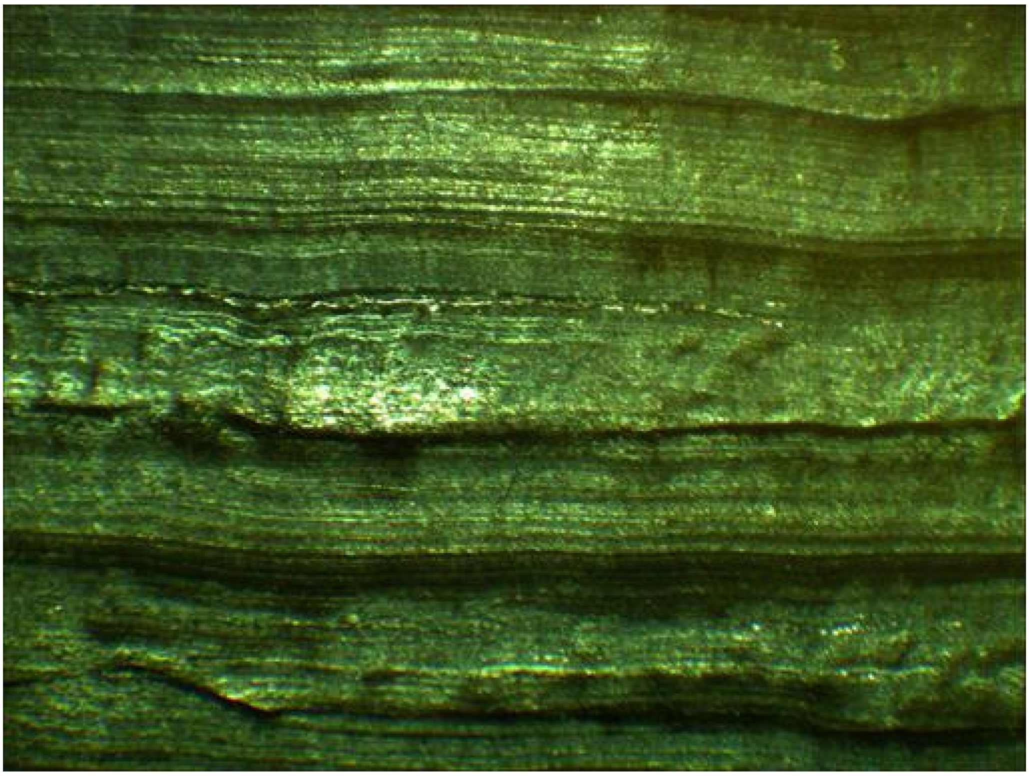


Figure 4. Surface Detail x200 magnification – surface crazing/chalking evident.

	 Figure 5. Surface Detail x200 magnification – surface micro-cracking and flaking evident.
Testing Undertaken	Surface microscopy Grab Tensile Strength: ASTM D751, Procedure A Trap Tear Strength: ASTM D4533 HP-OIT: ASTM D5885 IR: ASTM F2102 Surface infra-red analysis and carbonyl index
Conclusion	The sample L was the most degraded (lowest HP-OIT values and lowest mechanical properties, with the black surface showing extensive cracking consistent with its relatively high carbonyl index (0.12). The black side appears to have been subject to chlorine attach leading to destruction of the stabilizers and oxidative embrittlement of the black ply. Samples L and Ware less degraded than Sample L but still show evidence of oxidation and cracking of the black side and some crazing of the coloured side. Sample U had the highest retained stabiliser levels on the coloured side, the lowest carbonyl index for the coloured side, and the highest retained grab tensile strength and trap tear strength in direction 2.

High density polyethylene (HDPE)- Electrofusion weld

Title	ASSESSMENT OF AN ELECTROFUSION WELD
Date	2013
Objective	To assess the condition of electrofusion weld assembly samples.
Photo	 Figure 1. Mating surfaces of specimen showing some melting of the surfaces (as evidenced by visible ridges)  Figure 2. Socket magnified surface

	 Figure 3. Pipe magnified surface
Testing Undertaken	Failure analysis
Failure Analysis	The weld failure was most likely caused by the mating surfaces not being hot enough for the materials to meld together.

High density polyethylene (HDPE) – Pipe

Title	TENSILE TESTING OF BUTT FUSED HDPE PIPE SAMPLES
Date	2013
Objective	To measure the tensile properties of HDPE pipe samples for qualification or production testing purposes
Photo	

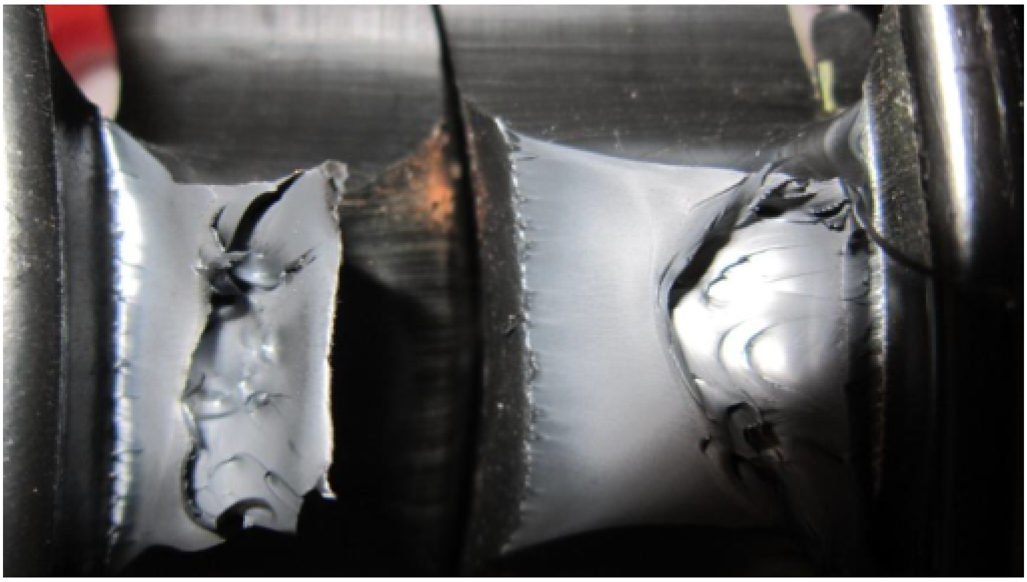


Figure 1. Specimen 1 failure mode (ductile break)

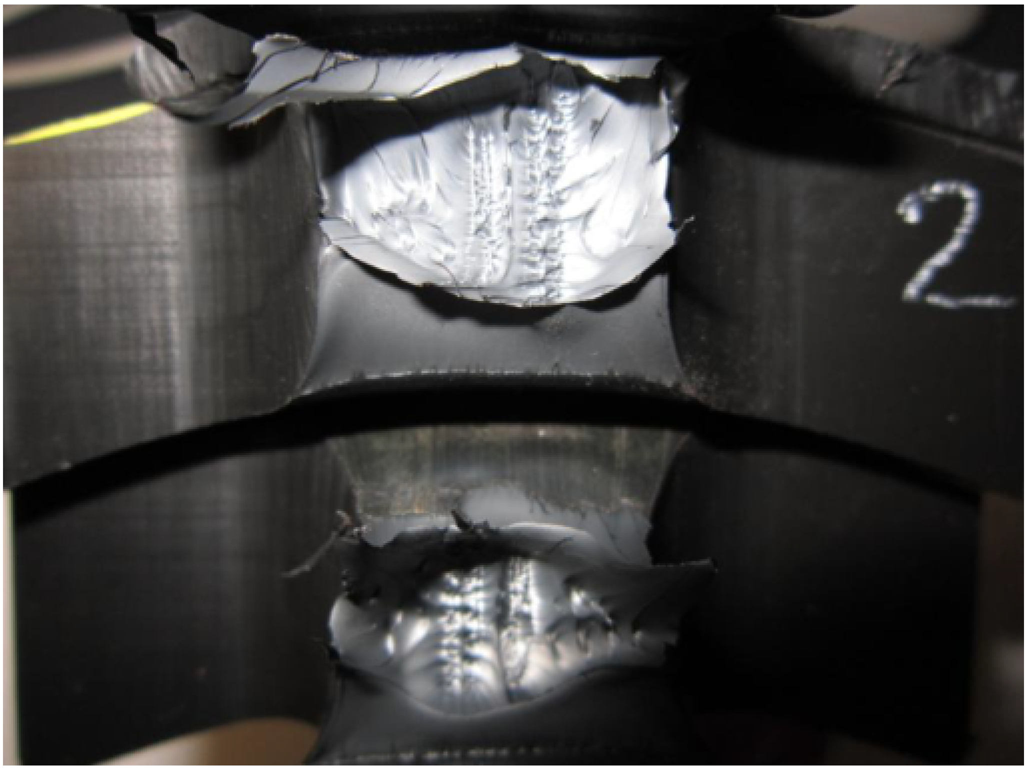
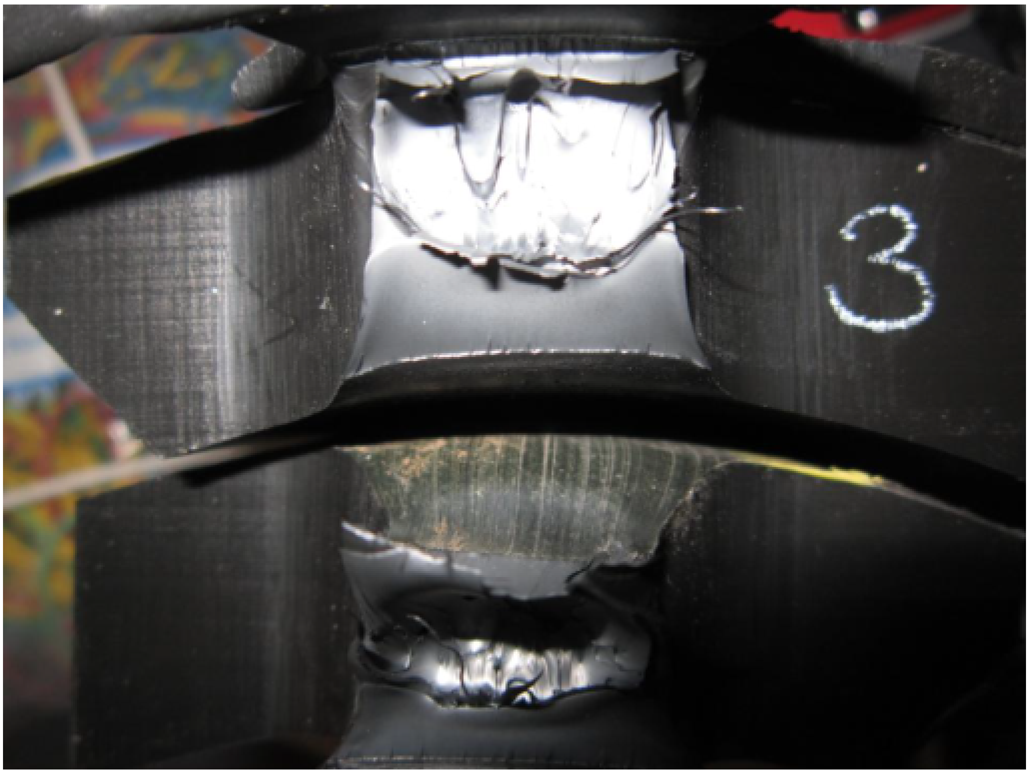
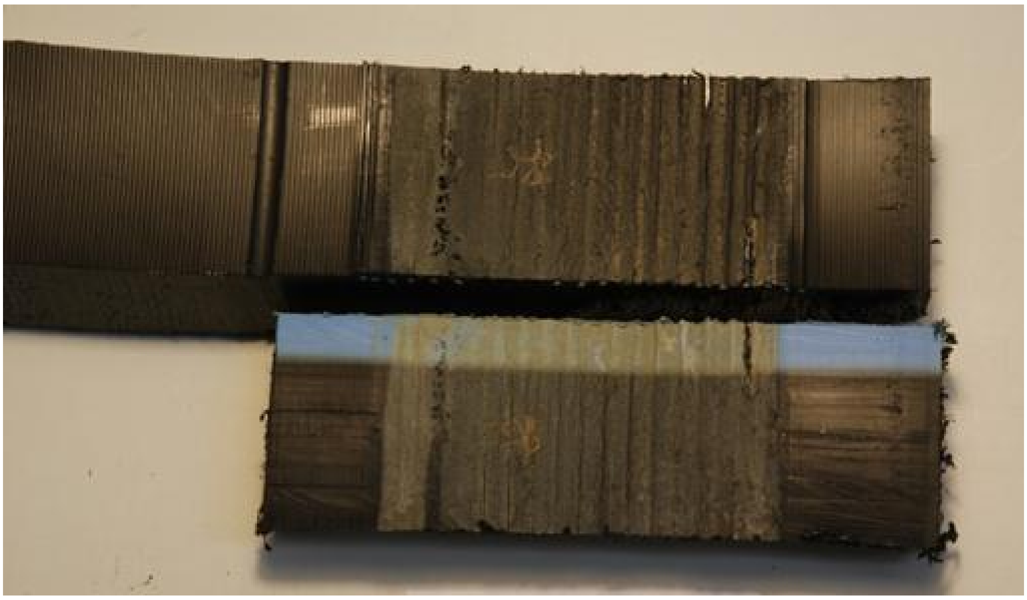
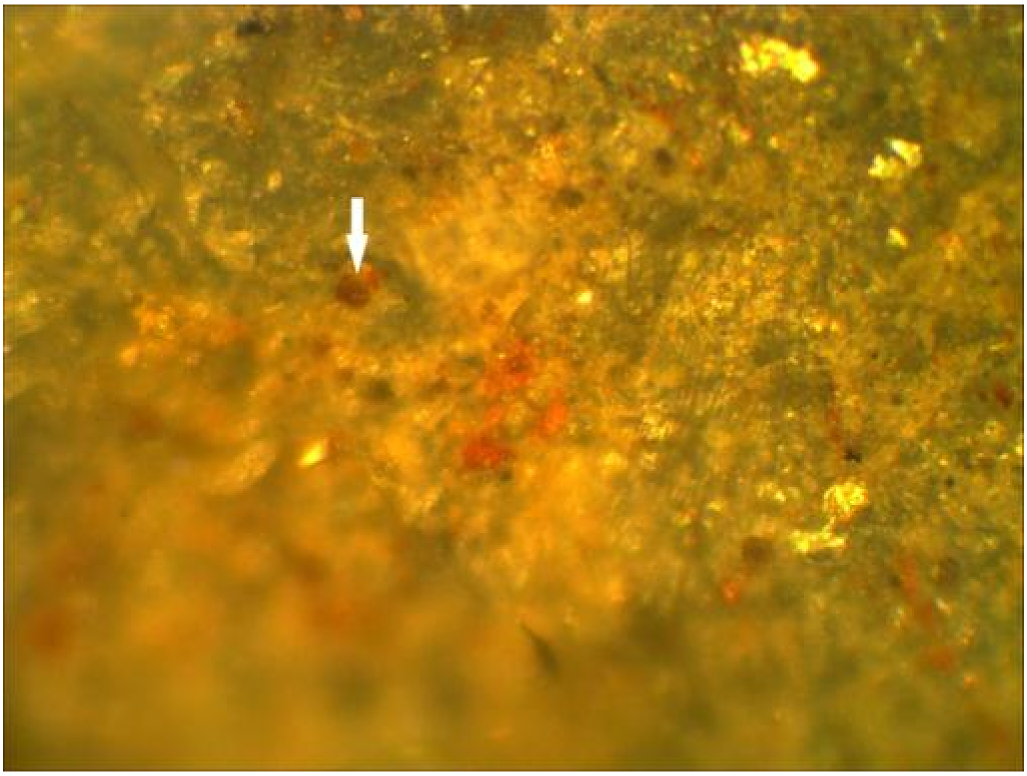


Figure 2. Specimen 2 failure mode (ductile break)

	 Figure 3. Specimen 3 failure mode (ductile break)
Testing Undertaken	Tensile properties testing per ISO 13953:2001(E)

High density polyethylene (HDPE) - Pipe electrofusion weld

Title	FAILED ELECTROFUSION WELD
Date	2013
Objective	To investigate the cause of a failed Electrofusion weld
Photo	

	 Figure 1. Pipe weld section after extensive cleaning. Some mud remained in weld. Long thing contaminant noticed that had mirror image on the fitting surface.  Figure 2. Weld Area at x200 magnification revealing dirt particles melted into surface of specimen
Testing Undertaken	Failure analysis under microscope
Failure Mode	Although the pipe and fitting were hot enough to melt the polymer, the **surfaces were never close enough or clean enough** for a proper joint to form.

High density polyethylene (HDPE) – Sewer liners

Title	CRACKING OF 5MM HDPE SHEET LINER IN A SEWER
Date	2012
Objective	To test coupons/retrieved samples to determine the root cause of embrittlementand cracking failures of a 5mm thick HDPE lining sheet installed in a sewer tunnel approximately 4 years ago.
Photo	 Figure 1. Observed cracking
Testing Undertaken	DSC Thermal analysis OIT Melt flow index Density determination Microscopy Peel testing
Failure Analysis	The 5mm HDPE sheet failed by brittle stress cracking (environmental stress cracking). The root cause of the cracking was poor material selection as the grade of HDPE used was a homopolymer grade which has excessively high density and high %crystallinity and a marked propensity to undergo stress cracking.

Low density polyethylene (LDPE) – Safety wear(kneepads)

Title	KNEE PAD MATERIAL IDENTIFICATION AND PERFORMANCE TESTING
Date	2013
Objective	To determine the performance properties and possible identity of the materials used in a kneepad sample
Testing Undertaken	FT-IR DSC Flexural crack (cyclic fatigue) Hardness (DurometerShore A)
Conclusion	FT-IR and DSC analysis indicated the kneepad was constructed from LDPE foam with a small amount of EVA. No flex cracking or flex damaged was observed after 1,000,000 oscillations. The kneepad tested had a larger hardness value than the two kneepads previously tested.

Multilayer Plastic Laminate – Packaging

Title	DELAMINATION FAILURE OF MULTILAYER PLASTIC LAMINATE PACKAGING
Date	2013
Objective	To investigate the origin of delamination defects (ie. adhesion failure of the top clear coating) of a plastic laminate used in packaging bags for dog food.
Photo	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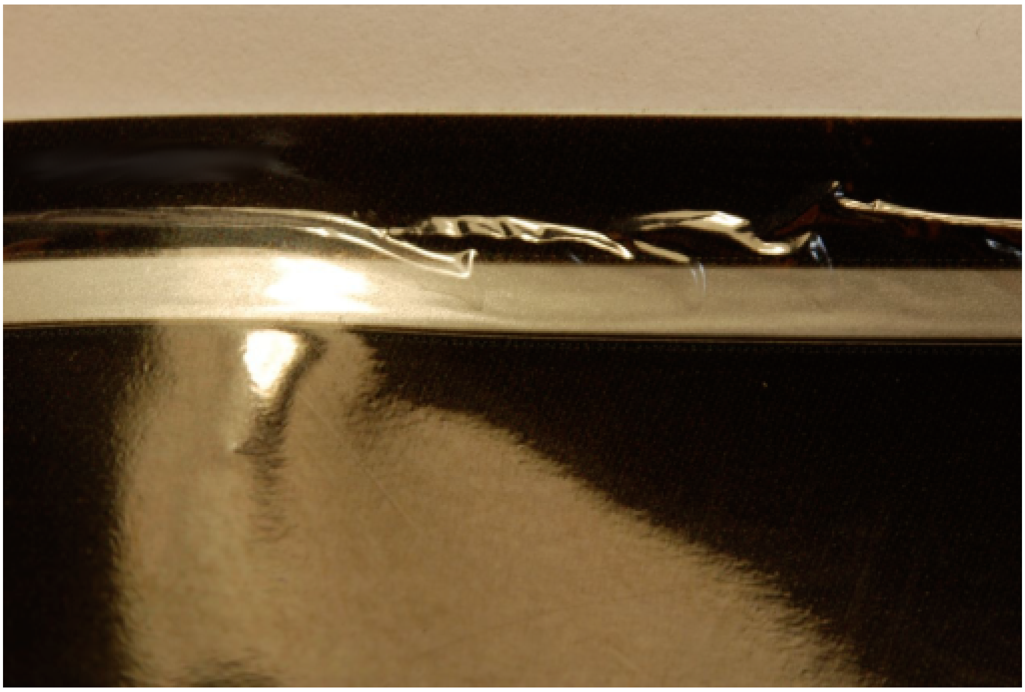

	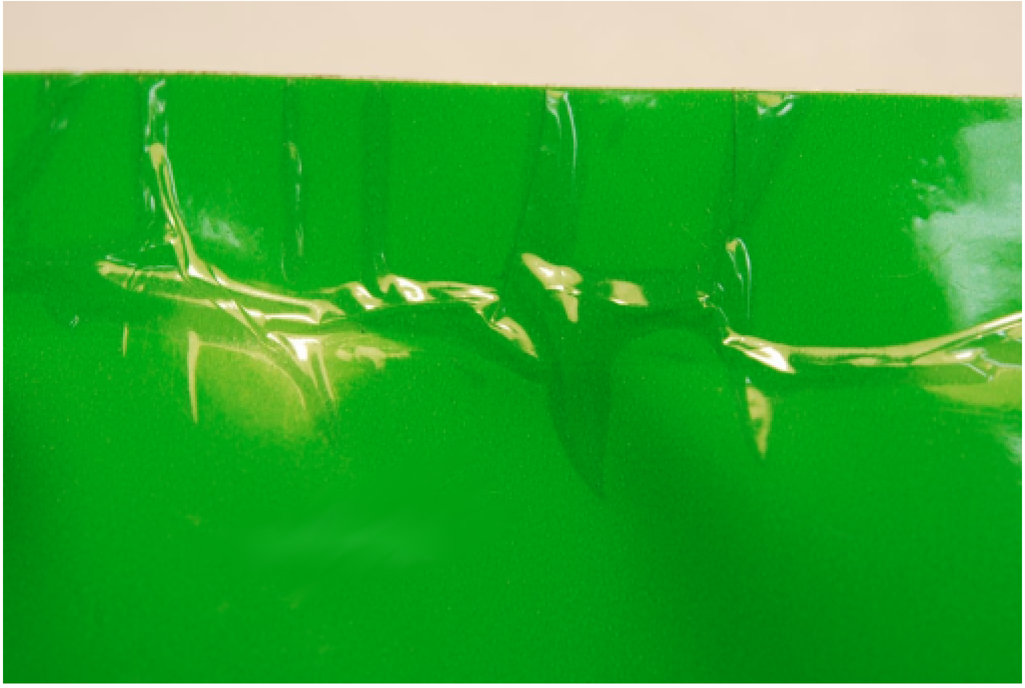 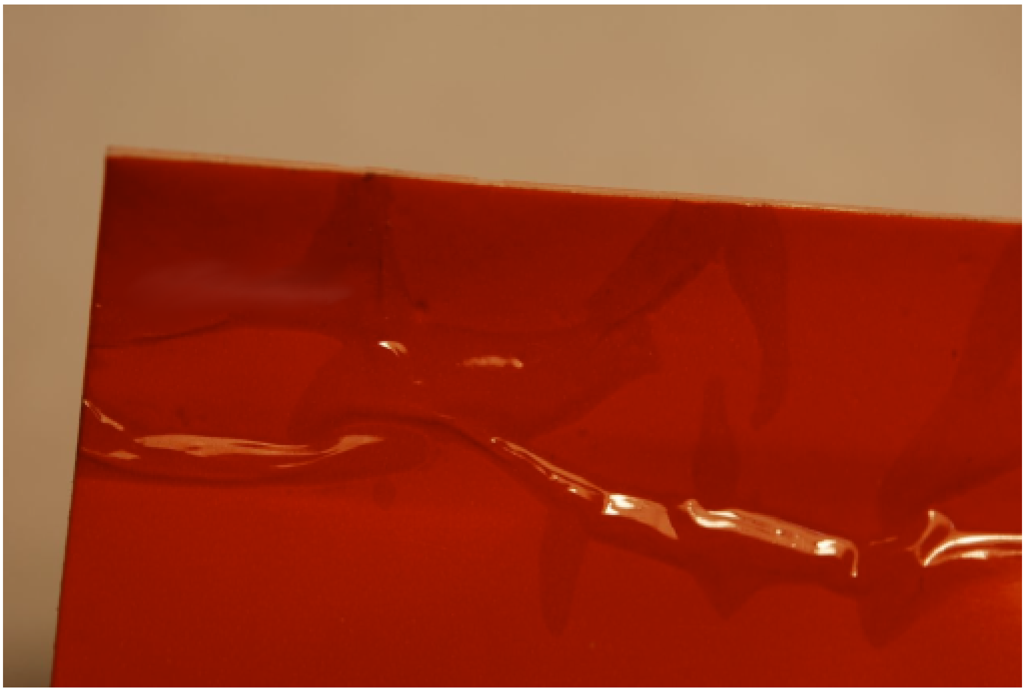 Figure 1a, 1b, 1c, 1d. Photomicroscopy of samples 1, 2, 3 and 4.
Testing Undertaken	Photomicroscopy FTIR TOF-SIMS
Failure Analysis	Delamination was associated with the presence of areas of silicone contamination.

Nylon – Fibres

Title	PURITY OF NYLON SAMPLES
Date	2013
Objective	To measure the nylon 6,6 content of two samples. Samples were recycled material. Not supplied with identification/description, identified in report as Green Fibre Mixture and Grey w/ Green Fibre Mixture.
Photo	
Testing Undertaken	ASTM D 3418 Thermal properties were tested using Differential scanning calorimetry (DSC),crystallinity was also measured
Conclusion	DSC indicated the green fibrous sample was Nylon 6. Crystallinity measurements of the Grey w/ Green sample indicated it contained Nylon 6

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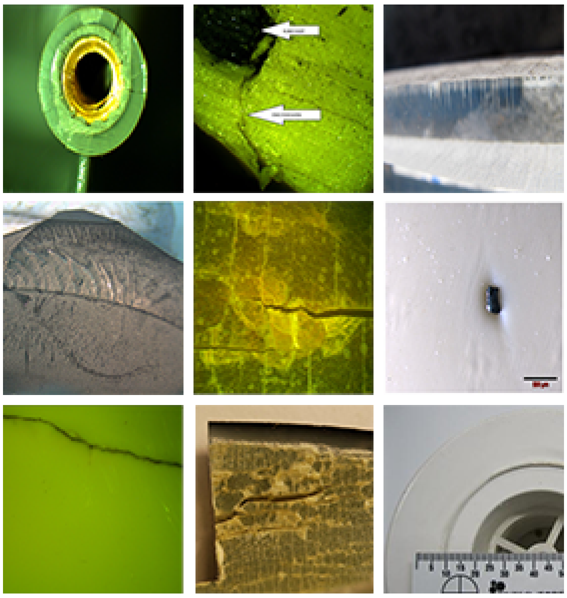
Gallery



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