

GCC

Plastic Alternative Packing Materials Research

Produced by GCC
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Many 'green' or 'eco-friendly' plastic alternatives now exist on the market but their viability as packing materials depends on the nature of the artwork, as well as the mode and length of the journey or storage period.

Whilst these materials can be viable replacements for short-term use, due to their organic composition they will disintegrate quicker than plastics, making them inappropriate for long-term protection of artwork in storage. Organic materials are more prone to mould, acidification, off-gassing, and pest infestations, which do not generally affect non-organic materials.

Before purchasing and using any material it is important to understand their properties and exactly what context they will be used in. This document provides details on the alternatives to plastic. For information about these products correct uses refer to GCC's **Alternative Packing Materials - Correct Uses** document. Consult that document for more information about the items listed here.

The 'Oddy Test' is used as a subjective method for determining whether or not a material, such as wood, fabric, or paint, is appropriate for use in an enclosed space with artwork or other cultural heritage artifacts. If you are in any doubt about the suitability of a packing material for an artwork, contact a conservator or experienced art handler.

The following research charts have been developed by the GCC Packaging & Materials Research Group. They give a good indication of which materials to use in what context but have not been peer-reviewed and should be only used as reference and - until further testing has been conducted - cannot be considered GCC ap-

Plastic Film Alternatives

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Material / Composition	Company / Distributor	Sustainability Information	Characteristics / Packing Info	Conservation / Shelf-life
<p>PLA film (Polylactic Acid) Thermoplastic polyester made from renewable resources, such as beet, corn starch, cassava roots, or sugarcane</p>	<p>Bioviron https://www.bioviron.com/ A Warne & Co Ltd https://www.awarne.com/pla-film-supplier-converter/</p>	<ul style="list-style-type: none"> - Industrially compostable at high temperatures under the influence of moisture and bacteria - often not accepted. - Smaller carbon footprint than petroleum-based foams. - Recyclable (theoretically) 	<ul style="list-style-type: none"> - Transparent - Varying thicknesses - good dead-fold - Water resistant 	<ul style="list-style-type: none"> - Failed the Oddy test - Loses mechanical properties and can turn opaque as it ages (room temp) - Degrades under UV light - Hygroscopic - Permeable to water vapor and gases - Shelf life: 1-2 years
<p>NatureFlex™ Modified cellulose from wood-pulp</p>	<p>Futamura https://www.natureflex.com/packaging-solutions/</p>	<ul style="list-style-type: none"> - Renewable resource - Industrial and home compostable (some grades) in 6-7 weeks - FSC and PEFC certified wood pulp 	<ul style="list-style-type: none"> - Transparent - Varying thicknesses - Excellent dead-fold - Can be heat sealed - Water resistant 	<ul style="list-style-type: none"> - Available in varying grades of moisture permeability - Emits VOCs as it ages - Shelf life: 6 months - Sensitive to moisture - Failed the Oddy test
<p>Cellophane™ Regenerated cellulose</p>	<p>Futamura http://www.futamuragroup.com/en/divisions/cellulose-films/products/cellophane/</p>	<ul style="list-style-type: none"> - Renewable resource - Not recyclable - Untreated cellophane is biodegradable 	<ul style="list-style-type: none"> - Transparent - Varying thicknesses - Excellent dead-fold - Anti-static - Can be heat sealed - Easily torn - Water resistant 	<ul style="list-style-type: none"> - High permeability to water vapor - High permeability to gas - Emits VOCs as it ages - Becomes brittle with age
<p>Glassine Cellulose</p>	<p>Local distributor</p>	<ul style="list-style-type: none"> - Biodegradable - Recyclable 	<ul style="list-style-type: none"> - Translucent - Water resistant, but not water proof - Sharp creases when folded 	<ul style="list-style-type: none"> - Initially acid-free pH 7 - Becomes acidic over time - Becomes brittle over time

Bubble Wrap Alternatives

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Material / Composition	Company / Distributor	Sustainability Information	Characteristics / Packing Info	Conservation / Shelf-life
Acid-free Kraft Paper	Local distributor	<ul style="list-style-type: none"> - Renewable resource - Recyclable/biodegradable 	<ul style="list-style-type: none"> - Low shock absorption - Low compression resilience 	<ul style="list-style-type: none"> - Hygroscopic - Acid-free pH 7 - Becomes acidic over time - Susceptible to microbiological attack / rot
Shredded Cardboard	Local distributor	<ul style="list-style-type: none"> - Renewable resource - Recyclable/biodegradable 	<ul style="list-style-type: none"> - Low shock absorption - Low compression resilienc 	<ul style="list-style-type: none"> - Hygroscopic - Acidic and emits VOCs as it ages - Susceptible to microbiological attack / rot
Paper "Bubble Wrap"	Local distributor	<ul style="list-style-type: none"> - Renewable resource - Recyclable/biodegradable 	<ul style="list-style-type: none"> - Low shock absorption - Low compression resilience - Same functional characteristics as kraft paper 	<ul style="list-style-type: none"> - Hygroscopic - Susceptible to microbiological attack / rot - Acidic and emits VOCs as it ages
"Compostable" Bubble Wrap (Assmed PLA)	Bioviron https://www.bioviron.com/	<ul style="list-style-type: none"> - Claims home compostable - Composition unknown 	<ul style="list-style-type: none"> - Transparent - Good insulation 	<ul style="list-style-type: none"> - More information required

Poly-foam Alternatives

GCC

Material / Composition	Company / Distributor	Sustainability Information	Characteristics / Packing Info	Conservation / Shelf-life
Corn Starch Foam	<p>Green Cell Foam https://greencellfoam.com/</p> <p>Bioviron https://www.bioviron.com/</p>	<ul style="list-style-type: none"> - Renewable resource - Biodegradable (60 days in moist soil) - Dissolves in water 	<ul style="list-style-type: none"> - Lightweight - Similar to extruded polystyrene - Shock absorption data unknown - Low compression modulus 	<ul style="list-style-type: none"> - Extremely hygroscopic and sensitive to moisture - Limited shelf-life - No off-gassing / VOCs - Microbiological attack / rot - Susceptible to insect infestation - Failed the Oddy test
Cellulose Foam cellulose from wood pulp	<p>Cellutec / Stora Enso https://www.storaenso.com/en/products/bio-based-materials/cellulose-foam</p>	<ul style="list-style-type: none"> - Lightweight - Renewable resource - PEFC wood - Biodegradable / compostable - Recyclable with paper or card board 	<ul style="list-style-type: none"> - Shock absorption unknown - Compression modulus unknown - Compression resilience unknown 	<ul style="list-style-type: none"> - Lightweight - Emits VOCs - Susceptible to microbiological attack?
Mycelium Foam (Dried mycelium / hemp fiber substrate)	<p>Grown Bio https://www.grown.bio/mycelium-packaging/</p> <p>Ecovative Design https://ecovativedesign.com/</p>	<ul style="list-style-type: none"> - Renewable resource - Biodegradable in soil and water (90 days) - Compostable (home / industrial) - Shelf life of a few years 	<ul style="list-style-type: none"> - Customized forms - High shock absorption - Expensive / time consuming to produce 	<ul style="list-style-type: none"> - Hygroscopic - Bio-based waterproof coating in the works - Degrades when exposed to moisture - Susceptible to microbiological attack / rot - Failed the Oddy test
Corrugated Cardboard Wood / paper pulp	Local distributor	<ul style="list-style-type: none"> - Virgin = energy-intensive production - Recycled = 1/6-1/3 amount of energy - Biodegradable/compostable - If uncoated + with natural adhesives 	<ul style="list-style-type: none"> - Lightweight - Medium shock absorption 	<ul style="list-style-type: none"> - Hygroscopic - Emits VOCs - Susceptible to microbiological attack / rot

Poly-foam - alternatives

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Material / Composition	Company / Distributor	Sustainability Information	Characteristics / Packing Info	Conservation / Shelf-life
Archival Corrugated Cardboard (corners + insulating lining)	Preservation Equipment https://www.preservationequipment.com/Catalogue/Conservation-Materials/ShippingPacking/Corner-Protectors-Archival-Board https://www.preservationequipment.com/Catalogue/Conservation-Materials/Paper-Board/Corrugated-Board/Corrugated-Archival-Buffered-Board-16mm-3mm	<ul style="list-style-type: none"> - Lightweight - Renewable resource - Recyclable / biodegradable - Virgin = energy-intensive production - Recycled = 1/6-1/3 amount of energy - Biodegradable/compostable - If uncoated + with natural adhesives 	<ul style="list-style-type: none"> - Corner protection - Good insulator - Good shock absorption (corrugated cardboard) 	<ul style="list-style-type: none"> - Buffered pH 8.5 - Archival
Moulded Pulp	Cullen https://www.cullen.co.uk/products/	<ul style="list-style-type: none"> - Renewable resource - Biodegradable, compostable, recyclable - Dissolves in water 	<ul style="list-style-type: none"> - Lightweight - Similar to extruded polystyrene - Shock absorption ? - Compression modulus? 	<ul style="list-style-type: none"> - Hygroscopic and sensitive to moisture - Emits VOCs over time - Susceptible to microbiological attack / rot
Paper Cushions Paper bags filled with either cornstarch chips or shredded paper	Biobiene https://www.biobiene.com/plastikfreie-innenverpackung/polsterkissen.html	<ul style="list-style-type: none"> - Renewable resource - Biodegradable (*potentially toxic inks/coatings on shredded paper?) - Recyclable - Repurposing paper waste 	<ul style="list-style-type: none"> - Can become punctured - Low shock absorption - Low compression modulus (cornstarch chips) - Low compression resilience 	<ul style="list-style-type: none"> - Emits VOCs over time - Slightly acidic (pH: 5.5 - 6) becomes more acidic over time - Susceptible to microbiological attack / rot
Thermoplastic Starch Foam (industrial potato starch, fibers, water)	Paper foam https://www.paperfoam.com/	<ul style="list-style-type: none"> - Lightweight - Renewable resource - Low carbon/energy production - Biodegradable / compostable (decomposes in weeks - industrial ?) - Recyclable with paper 	<ul style="list-style-type: none"> - Customized forms - injection mold - Shock absorption unknown - Compression modulus unknown - Compression resilience unknown 	<ul style="list-style-type: none"> - Potentially susceptible to microbiological attack / rot

Poly-foam Alternatives

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Material / Composition	Company / Distributor	Sustainability Information	Characteristics / Packing Info	Conservation / Shelf-life
<p>Honeycomb cardboard (corners + insulating lining)</p>	<p>Bewi https://bewi.com/solutions/honeycomb/</p>	<ul style="list-style-type: none"> - Lightweight - Renewable resource - Recyclable / biodegradable 	<ul style="list-style-type: none"> - Corner protection - Good insulator - Good shock absorption (corrugated cardboard) 	<ul style="list-style-type: none"> - Acidic and will become more acidic over time
<p>PLA Foam (polylactic acid) Expanded PLA (polylactic acid): aliphatic polyesters. Monomer derived either from fermented plant starch (corn, cassava, sugarcane, sugar beet) or condensation of lactic acid monomers</p>	<p>BioFoam Synbra https://bewisynbra.com/raw/</p>	<ul style="list-style-type: none"> - Industrially compostable at high temperatures under the influence of moisture and bacteria - often not accepted. - Smaller carbon footprint than petroleum-based foams. - Recyclable (theoretically) 	<ul style="list-style-type: none"> - Similar to EPS-expanded polystyrene - Lightweight - Retains its shape - High shock absorption - Customized forms 	<ul style="list-style-type: none"> - Hygroscopic - No VOC's (?) - Resistant to termites - Shelf life: 1-2 years - Susceptable to microbiological attack - Failed the Oddy test
<p>PHA foam Expanded PHA (polyhydroxyalkanoates) polyesters produced through the fermentation of sugar</p>	<p>Nature plast (supplier of non-extruded PHA) http://natureplast.eu/en/matiere/phas-polyhydroxy-alcanoates/</p>	<ul style="list-style-type: none"> - biodegradable - 2 months in soil - also in aquatic environments - compostable (both home/industrial) 	<ul style="list-style-type: none"> - Similar to EPS-expanded polystyrene 	<ul style="list-style-type: none"> - higher moisture barrier than other biodegradable foams
<p>Insulating Crate Liners Paper panels encased in a paper shell</p>	<p>CelluLiner - IPC Pack https://ipcpack.com/products/paper-based-insulated-packaging/ https://www.gwp.co.uk/packaging/inserts/insulated-box-liners/ https://sealedair.co.uk/en-gb/node/264031</p>	<ul style="list-style-type: none"> - Renewable resource - Curbside recylcable 	<ul style="list-style-type: none"> - Customizable 	<ul style="list-style-type: none"> - Emits acids / VOCs over time - Hygroscopic