

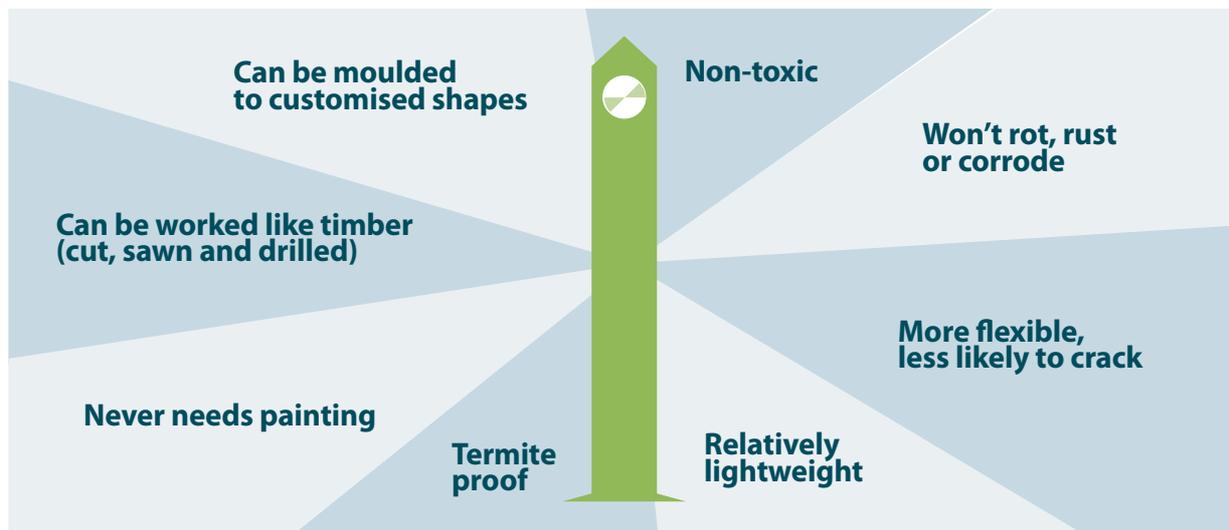
Making sure your product is fit-for-purpose

Recycled mixed plastic is made from a wide range of waste plastics.

Understanding the unique properties of recycled mixed plastic is important as it will help you choose the one that is best for your application.

This fact sheet explains the key properties of recycled mixed plastic and provides guidance on design considerations to assist your purchase.

Key characteristics of recycled mixed plastic



Successful applications

Recycled mixed plastic is ideal for many outdoor applications including for decking, walkways, stair treads, seats, benches, bollards, rails and fenders.



More information:

Examples of applications can be found in Fact Sheet 1 – Why use recycled plastic products?

This and other factsheets are available on our Recycled Mixed Plastic Purchasing Toolkit page: <http://ecobuy.org.au/recycled-plastics-toolkit>

How recycled mixed plastic products are made

Recycled mixed plastic products can be made from 100% plastic or from a recycled plastic composite.

100% recycled mixed plastic



100% recycled mixed plastic contains only plastic components. It may contain a mix of plastic types for example HDPE, LDPE and/or PP. The mix may change depending on the availability of plastic and processor needs.

Recycled plastic composite (RPC)



Fine ground wood flour is added to the recycled content mix during processing at the rate of up to 50%. It adds stiffness (increases the modulus of elasticity). This material is also called wood plastic composite.

For the purposes of this document, the term recycled mixed plastic refers to either material, unless otherwise specified.

Production techniques

Plastic products are made in one of two ways; they are either moulded or extruded shapes.

Moulded



Moulding allows the production of three dimensional shapes.

- o Can be used in features such as pyramid tops and recesses for reflectors
- o Hollow mouldings can be produced using this method

Extruded



Extruded shapes allow a continuous length to be produced and docked to length. Intricate profiles can be made, including hollow sections. However the shape must conform to a predominately two dimensional form unless machined after processing.

- o Great for long continuous profiles
- o Lends itself to larger production volumes
- o Has properties closer to timber.

Key design considerations for using recycled mixed plastics

As recycled mixed plastic products can be made from a wide variety of plastic sources, their properties may vary between manufacturers.

While manufacturers undertake regular testing to verify product performance according to expected use, any change to product formulations over time may limit the use of test results as a basis for engineering calculations.

Instead, when designing with recycled mixed plastic products it is recommended that you consider a number of simple principles and focus on the purpose or function the product will serve.

1 Performance testing

Many suppliers are able to provide performance results in the following key areas:

- o Slip test
- o Flexural strength test
- o Water absorption
- o Screw pull test

There are a growing number of standard tests being developed which are relevant to recycled plastics. We have collated a list of the most relevant standards which can be used to help interpret supplier test results. **Download a list of relevant standards at:** www.ecobuy.org.au/s/relevant_standards.pdf

2 Use in load bearing applications

Recycled mixed plastic is not considered a primary structural material as variations in physical properties between different blends limit its use in such applications.

However, when combined with a suitable primary substructure (such as steel or timber), recycled mixed plastic has a proven track record for use in decking, walkways and stair treads.

New development: Glass reinforced plastic (GRP) extrusions are being used as substructures under recycled plastic decking in coastal and marine environments to replace steel or timber. This eliminates the potential for corrosion or rot.

3 Allowing for thermal expansion

Nearly all building/structural materials expand and contract with temperature and recycled mixed plastic is no exception. Allowing for thermal expansion, by providing adequate clearance around surrounding structures, will avoid the likelihood of buckling under extreme temperatures

How much to allow?

The coefficient of thermal expansion for recycled mixed plastic is around 1.1×10^{-4} (ASTM D 696). This means that for a one metre long section, there needs to be an expansion allowance of at least 2.2 mm per 20 degrees of temperature change.

Use the following guide for installing longer lengths (*assuming 20 degree temperature range*).

Length (m)	1	2	3	4	5	6	7	8
Expansion gap (mm)	2-3	6	9	12	15	18	21	24

Tip When installing recycled mixed plastic products, try to complete in temperature conditions around the middle of the range likely to be experienced for that location. For example around 20 Deg C for most locations in Australia. This helps ensure the correct load is placed on the fixings.

4 Dealing with creep

As plastic is a flexible product an inherent property is 'creep'. Creep means that over time the plastic elongates when placed under moderate load (even its own weight). The result of creep is that horizontal components sag between supports.

Creep is proportional to temperature, so will be most pronounced at elevated temperatures and where it has the least support.

Wood plastic composite products were developed to minimise creep and sagging. They offer better performance than 100% recycled plastic products used in the same application.

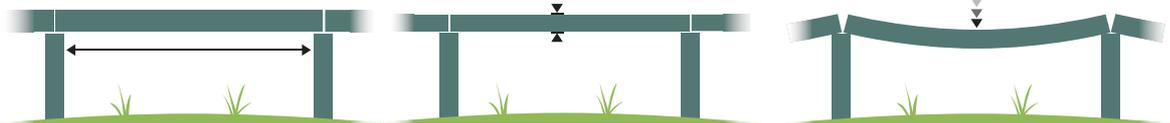
Creep can be minimised or eliminated by using thicker components with more frequent supports.

Creep occurs when...

...uprights are too widely spaced, or...

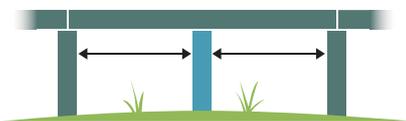
...cross spans are not vertically thick enough.

This results in the sagging of cross spans over time.



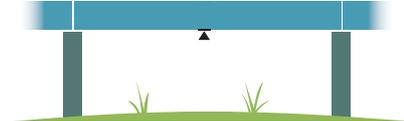
Solutions:

Increase the frequency of uprights.



or

Increase the vertical thickness of the cross spans.



5 Effect of UV on physical properties

Research shows that ultraviolet rays (UV) have very little impact on the strength of recycled mixed plastic products. Due to their thick wall sections (or even solid construction), any degradation of the outside surface is superficial and has minimal impact on the product's performance as a whole.

Modern recycled plastic products also incorporate state-of-the-art hindered light amine (HAL) based UV protection. This protection does not diminish over time.

Tip Black products have greater natural UV protection compared with coloured products.

6 Moisture and immersion

100% recycled mixed plastic products are well suited to high moisture environments as they will be less susceptible to water absorption and pest infiltration over time.

Due to the wood fibre content, moisture absorption can affect the performance and appearance of recycled plastic composite (RPC) products to a greater extent than 100% recycled mixed plastic products. However, manufacturers have reduced this risk through correct management of organic content and more advanced processing techniques.

Tip It is important to make sure the product has been tested to ASTM D570 and also to choose the product with the lowest water absorption. Also confirm that the test conditions match the likely duration of moisture exposure in the application. For example if the product is likely to be immersed for a long period of time, ensure that the moisture absorption test uses figures for a similar time period.

7 Painting and aesthetics

One of the key benefits of recycled mixed plastic products is that, as colour is added during production, it never requires painting. Paint does not adhere to recycled mixed plastic products due to its hydrophobic nature.

- o Choose a colour already in use.
- o As there are many colours to choose from you should be able to find those that match your corporate design guidelines.
- o Mix plastic colours to create innovative colour schemes that never need painting.
- o Use black in circumstances where maximum UV resistance is needed.

The benches, pictured here, were made using standard colours. If this were a painted product it would be virtually impossible to maintain. Each piece would need to be removed and painted separately.

Graffiti: Feedback from users is that graffiti is easy to clean off recycled mixed plastic products. The properties that make it hard to paint can also make it difficult to graffiti.



Comparing recycled mixed plastic with other materials

The following table compares the properties of different materials, outlining the good points and the not so good points.

	Good points	Not so good points
Recycled Mixed Plastic (RMP)	<ul style="list-style-type: none"> Won't rot, split or crack Not affected by borers Long life Versatile, can be worked with normal tools 	<ul style="list-style-type: none"> Lack of structural properties Flex and creep Limited colours Higher embodied energy than some alternatives
Hardwood	<ul style="list-style-type: none"> Low embodied energy per product Low upfront cost Structural properties Versatile, can be worked with normal tools 	<ul style="list-style-type: none"> Rots Attacked by termites Requires maintenance Forest destruction (for more durable timbers)
Pine <i>Non-treated</i>	<ul style="list-style-type: none"> Some structural properties Plantation grown Versatile, can be worked with normal tools 	<ul style="list-style-type: none"> Rots very quickly (not viable for outdoor use) Attacked by termites Requires maintenance Forest destruction/impact of plantations
Pine <i>CCA Treated</i>	<ul style="list-style-type: none"> Value for money Longevity Some structural properties Plantation grown Versatile, can be worked with normal tools 	<ul style="list-style-type: none"> Toxicity of arsenic treatment limits use, applications and disposal options
Concrete <i>Reinforced</i>	<ul style="list-style-type: none"> Durable/solid Structural properties 	<ul style="list-style-type: none"> Only suitable for limited applications Cannot be worked with normal tools May suffer corrosion due to salt exposure (internal)
Steel	<ul style="list-style-type: none"> Durable Structural properties 	<ul style="list-style-type: none"> Corrosion unless plated Not suitable for marine environments More difficult to work
Aluminium	<ul style="list-style-type: none"> Durable Structural properties 	<ul style="list-style-type: none"> High upfront costs Limited applications More difficult to work High embodied energy

These resources have been developed by ECO-Buy with the support of the Australian Packaging Covenant, Zero-Waste South Australia, and Sustainability Victoria in consultation with users and suppliers of recycled mixed plastic products.

For further information contact ECO-Buy at: www.ecobuy.org.au/contact/