MECHANICAL DEGRADATION OF RECYCLED PLASTICS IN MUSEUM COLLECTIONS

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Introduction

Plastic use has increased rapidly across industries. Designers are responding to waste concerns by using recycled plastic. This project investigates recycled plastic objects in museum collections.

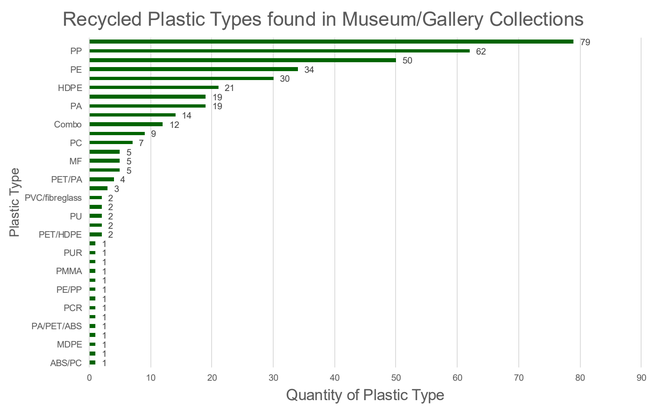
Key questions include:

- What counts as 'recycled plastic' in a museum?
- How does it differ from virgin plastic?
- What indicators signal mechanical degradation?

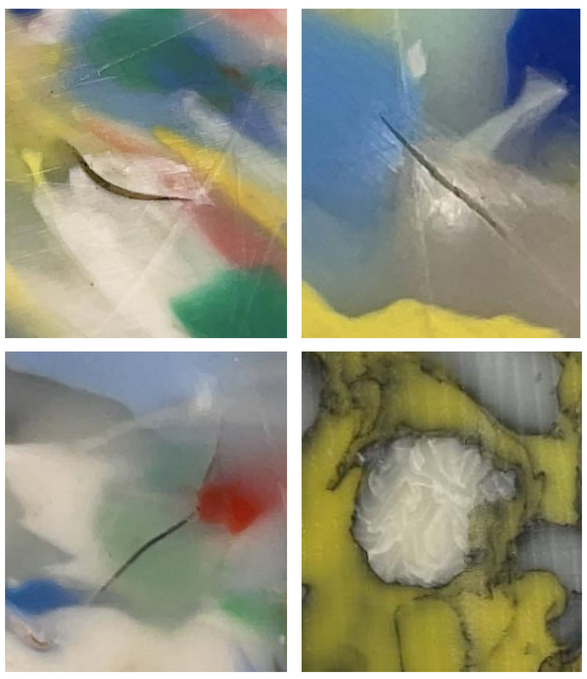
Survey of Recycled Plastics in Museum Collections

Objects made from recycled plastics in museum collections reflect past and ongoing trends in contemporary design. Below is a summary of a survey of 400+ recycled plastic objects within museum collections. These were limited to museum collections which were publicly available online and which could be filtered or searched by material type.

The graph below shows the types of recycled plastics found within collections. Where the plastic was unclear or unspecified, a question mark was used.



In addition to reviewing online collections, some objects were examined in person to identify signs of mechanical degradation. Most showed no visible damage, despite ranging in age from recent acquisitions to over 30 years old.



Objects with a ‘confetti’ appearance—where multiple colours of plastic are combined—showed cracks, delamination, and possible localised microcracking. Cracks often appeared near specific colours, suggesting different plastics may degrade at different rates. Variation within a material makes predicting long-term behaviour complex.

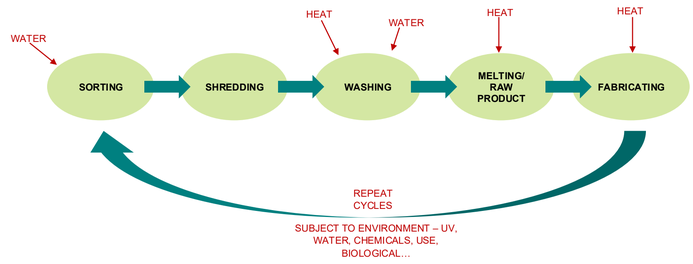
Types of Recycled Plastic

Recycled plastic is, in the most basic terms, plastic waste that has been processed to produce a new product. In industry terms this is distinguished into:

- **Chemical recycling**: changing chemical structure of waste plastics to return it to raw materials
- **Mechanical recycling:** sorting, washing, grinding and re-pelletising plastic waste.

There are also objects that are made using plastic waste, and they are categorised in this research as follows:

1. **Repurposed** – Objects that have been upcycled, cut, woven, or adhered together without substantial alteration to their original form
2. **Reformed** – Objects created by partially melting, casting, or compressing multiple plastic items together.
3. **Recycled** – Objects that have undergone a complete mechanical recycling process in accordance with industrial standards.



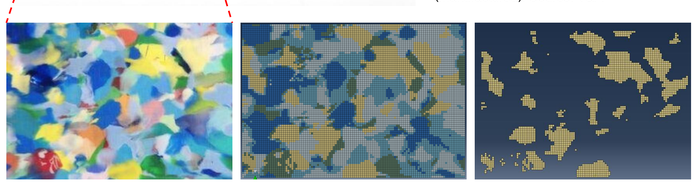
Modelling and Testing

To investigate the ageing and degradation patterns of recycled plastics, a case study was selected: the Jane Atfield RCP2 chair, which fits the 'reformed' category described above. The chair was fabricated by shredding waste plastics, followed by heating and compressing them into sheets. The original chair was designed in 1992 using high density polyethylene (HDPE).

Planned research stages include selecting objects with known histories, mechanical testing of aged samples, and creating finite element models.

Models simulate temperature and RH cycling to predict degradation, such as crack propagation. The goal is to validate these simulations by comparing them with test and object data.

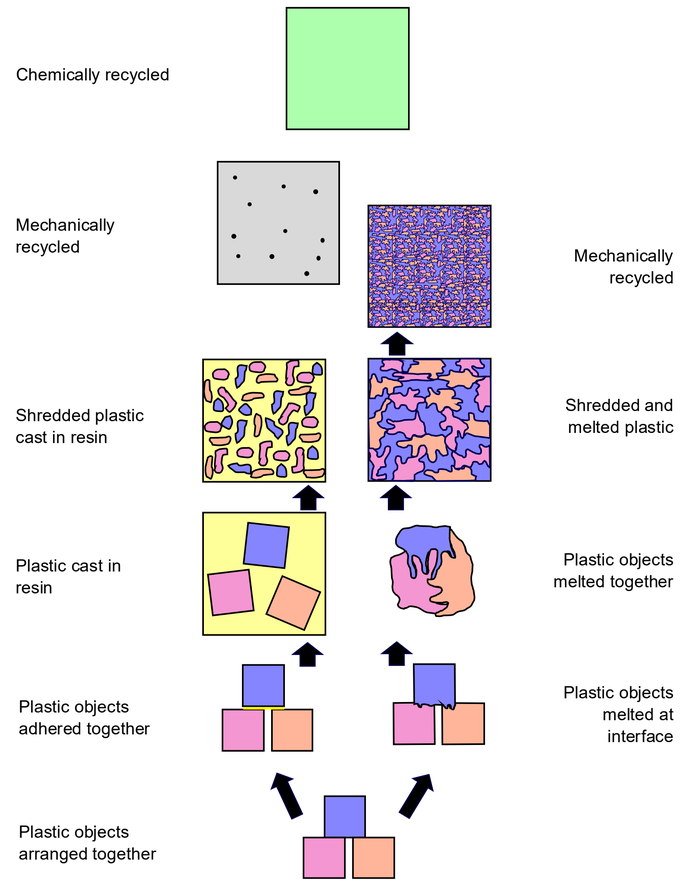
RCP2 Chair, 1992 (designed) 1996 (manufactured). Source: V&A



The samples will be based upon the HDPE RCP2 chair, and the mechanical testing will inform the computer model. By comparing all three, it should be possible to determine the effectiveness of the modelling in predicting mechanical degradation to this type of material.

Fabrication

Understanding how recycled plastics were fabricated is essential to predicting mechanical stability and preservation strategies. Recycled plastics may contain impurities, additives, or signs of prior degradation, even when made from a single polymer type.



Recognising Degradation Factors

Based on the literature review, speaking with designers and examined objects, the manufacturing process, such as the amount of heat used, can significantly affect mechanical degradation. In objects like the RCP2 chair, heat alters how waste plastics blend, making it important to assess how much was applied during production.

For example, objects that were heated to a high level will have more of a mix of the plastics with less defined edges. There may also be folds and/or drying cracks within the material.

Research Outcomes

- Present different types of recycled plastic objects that may be found in museum collections.
- How to identify different types of fabrication and degradation observed in different materials.
- Highlight any differences in how recycled plastic degrades compared to virgin plastics.
- Present case study comparing real object, tests on samples and FEA model. Can be used as a framework for testing similar objects.

References

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