

Plastics are Forever: Wraps, Tools, Films and Containers used in Conservation Practice

Introduction

Nearly everything we use in the twenty-first century has a plastic component, from food and product wraps and containers to our clothes, computers, and workplaces. Although plastics are made from oil or gas—highly valued, non-renewable resources—they are manufactured into some of our most disposable, briefly used products. We see the evidence of this use along roadsides, in parks, in oceans, in the air, and in our bodies.

Plastic production is an energy-intensive endeavor. Many plastics do not degrade and will remain in our ecosystem indefinitely, adding to landfills and pollution. Some plastics can be recycled, but the process is expensive, complex, involves detailed sorting by type, and requires considerable amounts of energy and water. Changing the way we use plastics has environmental and financial incentives. Most plastics are made from non-renewable fossil fuel, so reducing plastic use will decrease dependence on finite resources.

Although there are environmental problems associated with plastics, from manufacture through use and disposal, plastics serve many important functions. They are generally inert, strong, and often a lightweight option to cardboard, metal or glass, making them ideal for many conservation applications. The Committee for Sustainable Conservation Practices (CSCP) encourages individual conservators and cultural institutions to examine their habits regarding plastic use, such as re-using plastic materials before disposal and practicing good recycling habits.

The following article addresses only plastics used in conservation for containers, tools, packaging, and storage materials. The CSCP hopes to look at plastics such as those used in resins, suspensions, and paints in a later publication. Issues concerning the conservation of artifacts made from or including plastic materials or components are not discussed here. Instead focus is on the ramifications of production, use, and disposal.

What Are Plastics?

Modern plastics are polymers, or macromolecules, made from smaller repeating monomers. Generally, the monomers in plastics are derived from hydrocarbons made from crude oil and natural gas. To obtain monomers from hydrocarbons in fossil fuels, the hydrocarbons are broken into smaller units by a process called cracking that requires high temperatures and pressure. Separated by distillation, monomers are then obtained to create polymers, which are processed into resins and the resins are used to make the final plastic products. Thousands of plastic types exist, each made from a different type of polymer combined with a different

additive and/or filler and often pigment. Many handbooks and websites describe these processes; some are listed in Box 1.

There are two main categories of plastics: thermoplastic and thermoset. Thermoplastics are polymers that soften and melt when heated, solidify when cooled, and make up the majority of plastics (approximately 80%). Thermoset resins and rubbers are comprised of large, cross-linked molecules that are formed under high pressure and do not melt when heated. Thermoset plastics include polyurethanes, epoxy resins, and unsaturated polyester resins. Common thermoplastic resins include polyethylene (PE), low-density polyethylene (LDPE), high-density polyethylene (HDPE), polypropylene (PP), polyethylene terephthalate (PET), polyvinyl chloride (PVC), and polystyrene (PS). These common thermoplastics are widely used in conservation, for example storage bags for artifacts made of PE and PP, Mylar (PET), bubble wrap made of PVC, and foam board made of PS.

Conservators use plastics for treatment and storage of artifacts, among other tasks. Table 1 briefly summarizes some common plastics used in conservation for packing, as tools, as containers, for storage materials, and for display. The table also includes plastic composition, resin code, ability to be recycled/down-cycled, and whether there is a similar product available made of post-consumer recycled content. Note that most plastics used in conservation are not classified as recyclable, either due to the relatively small quantities that conservators use or the structure of the plastic itself. For many of these products, there are no options for post-consumer recycled content.

Disposal

Commonly available methods of plastics disposal currently include recycling and down-cycling, incineration, and disposal in landfills.

Recycling

The recycling process for plastics is multi-stepped, energy intensive, and varies with plastic type, location, and recycling plant technology. Briefly, recycling plastics involves extensive and costly manual labor to sort plastic types, as well as large amounts of water and energy to clean, granulate, heat, melt, press, and process into a reusable form. In addition, plastic recycling cannot be truly accomplished in a “closed loop” like glass, metal, and fiber, so re-processing of plastics really results in down-cycling of the material.

Individual localities determine what types of plastics they will recycle, how they collect, and if they sort the plastic. The collection guidelines are often confusing and conflicting, resulting in minimal recycling results. One source of confusion is the Society of the Plastic Industry (SPI) numbering system, which was created in 1988 to identify the resin content of household bottles and containers. A numerical designation indicates the plastic type (denoted by resin codes 1–7) imprinted inside a triangle on the bottom of containers. The number is misleading especially because it is always inside a triangle, which closely resembles the recycling chasing arrows.

Just because a plastic has a number does not mean that it can be recycled. Table 2 contains the seven plastic types with their resin codes and recycling potential.

Down-cycling

Although we refer to plastics as a uniform material group, our ability to recycle them is based on polymer type and the presence of additives. As a result, most plastics are mixed together or "single streamed" and "down-cycled"—an energy intensive process where the final product is an entirely different polymer from the original. Most importantly, once a plastic has been down-cycled, the final product cannot be recycled or down-cycled further because the original polymer chain length and configuration have been completely altered by heat and pressure. The new down-cycled product has inferior strength and purity from the original product. Consequentially, the only disposal options for down-cycled plastics are disposal via landfill or incineration, both of which have greater environmental consequences than recycling/down-cycling. This points to the value of sorting plastics for potential re-processing, and minimizing the use of virgin material.

Incineration

Burning plastics is essentially burning fossil fuels, the main factor in creating greenhouse gases and inducing global warming. While reducing waste bulk by approximately 80%, incineration emits massive amounts of CO₂, carcinogens and fine particulates into the air, threatening human health and ecosystems. For example, burning (and manufacturing) PVCs produces many persistent pollutants, including furans and dioxins. Proper filtration systems can capture and reduce waste from incineration, but such filtration systems are expensive, newly developed, and are often not instituted.

Landfills

Landfills are lined with clay and plastic, layered with soil, and capped with concrete block, thus encapsulating the deposited waste. Most landfills are anaerobic because they are so tightly compacted, creating space with minimal sunlight, moisture and oxygen. Consequently, plastic waste deposited in landfills, such as plastic bags, will take 500 to 1,000 years to degrade. Plastic bags exposed to air and sunlight will take 10 to 20 years to degrade. Newly developed "biodegradable" plastics do not break down, they just break up. Other problems with landfills include leakage from broken or torn liners plastic liners, and subsequent leaching into nearby soil or water resources. Leaching can result in the release of toxins, such as phthalates (endocrine disruptors) into the groundwater.

The Challenge: Measuring The Cradle To Grave Impact Of Plastic

Measuring how plastics impact the environment is a complicated process. Various metrics are used to calculate carbon footprint—the total amount of greenhouse gases emitted by a company, organization, event, or person at a given time. Michael Berners-Lee defines carbon footprint as "the best estimate that we can get of the full

climate change impact of... an activity, an item, a lifestyle, a company, a country, or even the whole world.” (Brenners-Lee, 2011 p. 5)

For a realistic carbon footprint evaluation, the cradle-to-grave calculation must account for the entire life cycle of a particular plastic, from the “cradle” when the fossil fuels are extracted, to the “grave” when the plastic item is disposed as waste. Included in that life cycle are the transportation of the oil or natural gas, the manufacture of the plastic resins and products, and the transportation of the product to its intended destination.

Variables involved in calculating carbon footprints make it difficult to evaluate the carbon footprints for the plastics that were examined as part of this article. In his 2011 book, *How Bad are Bananas? The Carbon Footprint of Everything*, Michael Berners-Lee attempted to estimate the climate change impact of our daily lives by assigning a carbon dioxide equivalent (CO₂e) in grams and pounds to specific objects and actions. These numbers are used in Table 3 to “rate” the different plastic types.

Since measuring the cradle-to-grave impact of plastics used by conservators is complicated, time would be better spent implementing waste management principles into the conservation workflow with a primary emphasis on reduction and re-use before recycling.

Now What?: Suggestions for Development of Sustainable Plastics Practices

Information Distribution

Understanding the factors that contribute to global warming and waste disposal is essential for developing sustainable practices and facilitating changes in practice. Information regarding sustainable practices should be distributed throughout workplaces.

Recycling

Results from the AIC 2010 Green Task Force survey indicated that recycling of materials seems to be prevalent at many institutions, but recycling of plastics remains problematic. Research about locally available options for recycling of particular types of plastics (such as PE) might be fruitful. However, implementing a different recycling program for each type of plastic may be unrealistic, so other options for reducing waste should be explored.

Alternative Materials

For many of the products we use in conservation there are no alternative plastics. Conservators generally avoid using post-consumer recycled products due to concerns about product purity and consistency across batches. Evaluating post-consumer recycled products for conservation use and involving environmental considerations in our decision making process are long-term goals that merit further discussion. Reflection on these issues may lead to the use of alternative

products in some of our most common activities. For example, Mylar, Ethafoam, and Coroplast are all available in alternative forms that include a percentage of post-consumer plastic content. Some products that could replace plastics are: glass pipettes, glass jars, metal jars, cotton gloves, aluminum foil, and re-purposed paper wrap.

Reducing

As previously mentioned, reducing use is the best practice. In carefully considering this topic, it has become clear that removing plastics from the conservation workplace is not completely possible. However, conservators can use plastics as a valued material instead of as a disposable commodity.

Institutions and individuals should consider incorporating the re-use, minimal-use and re-purposing of plastic products into their workflow. Many conservators re-use or re-purpose a variety of materials already. More thought about specific procedures may help reduce the overall bulk of plastic waste. Re-use practices at an institutional level can be implemented through collaboration with different departments. Just as recycling is now fully integrated into most institutional practices, we hope that developing re-use and minimal-use techniques will also become common practice. For instance organizing and maintaining a communal stock of scraps, such as Mylar, by size and storing them in size-specific boxes facilitates easy finding of materials when needed. In addition, re-use of materials like Mylar scraps within an institution, or a private practice, may also save money. We encourage re-use of many materials, the following (to name a few): Mylar sleeves, plastic gloves, plastic pipettes, sample containers, measuring tools, plastic wrap, plastic sheeting, and zip-lock bags.

Conclusions

Although plastic tools and materials are an essential part of twenty-first century conservation practices, conservators should routinely re-evaluate how they use plastics and the amount of plastic waste they produce. The CSCP recognizes that finding alternative sustainable materials for plastic items—from plastic sheets such as Mylar and bubble wrap to solvent containers and fabrics—will be challenging, if not impossible in some instances. However, the hope is that the information in this article will encourage conservators to integrate environmentally conscious decision-making into their use of plastics, with a focus on minimizing waste and finding more environmentally friendly materials. For more information from the CSCP on sustainable practices, please visit the AIC WIKI [www.conservation-wiki.com].

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