



UPCYCLING PLASTIC BAGS MANUAL

Useful methods to employ plastic bags as a medium for product manufacture.

By Cesar Marulanda



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Having worked with plastic bags for over 10 years as a medium for creation, Cesar Marulanda has been part of the maker community that has taken plastic waste as a serious matter and developed methods to re-purpose plastic materials into new products. He has been focus on plastic bags and his developments took him to study Industrial Design at RMIT in Melbourne Australia, where he learned more about plastics and methods of fabrication.

This manual is part of his submission for his final year of Industrial design at RMIT, and it is also the legacy of all of Cesar's work that is inspired by and complements all the amazing efforts by many other people around the world within the DIY community, that employ plastic waste as a medium for creation.

He runs a small business selling backpacks and accessories that are manufactured using the methods in this book, and his mission is to share these methods far and wide so that other creatives can make use of plastic so that we can all work together as a collective to upcycle plastic waste into new beautiful products.

CONTENTS

Introduction	Page 6
The materials	Page 7
Identification	Page 8
Safety	Page 9
What are they good for?	Page 10
Making the base material	Page 15
Decorating methods	Page 17
Stencils and symmetrical pattern	Page 17
Colour combinations	Page 19
Abstract patterns	Page 20
Embossing	Page 21
Moulding methods	Page 23
Compression Molding	Page 23
Hand molding	Page 25
Vacuum forming at home	Page 26
Thermo-forming	Page 31
Conclusion	Page 33
References	Page 34

Acknowledgments

This book is for all the people that want to contribute towards the plastic problem. Thank you for holding this in your hands, because it means that someday or another you are interested in how to deal with the incessant amount of plastic waste that is generated every single day, and the intentions are what count here.

Thank you to my family and friends, and all the people that have believed and supported what I do, because small or big, every plastic bag that does not go into landfill or pollutes the environment is a win for all of us, and I am proud of what I have developed to now also show you how. Lets go!

Introduction

Plastics were introduced to the world as a replacement for natural resources like ivory, coral and tortoise shell that were used for a number of products in the early 1900's. This effort saved animal species from early extinction as plastics demonstrated to outperform natural materials in terms of production yield, sourcing and quality. (Meikle, 1995) However, plastics now impose a major concern to the environment.

Only about 3 billion metric tons of plastics out of the 8.3 billion that has been created until 2017 has been recycled, or incinerated, leaving around 4.9 billion metric tons of plastic waste still in landfill or polluting the environment. (Barnes, 2019) There is an unlimited and readily available resource that in many ways it can be accessed for free due to the lack of infrastructure to deal with the enormous amount of waste produced daily.

The majority of these plastics are polyethylene based polymers used for packaging and there is thousands of tonnes of soft materials that do not make it to recycling due to contamination issues. My work with plastics has led me to establish contacts with local businesses where I can collect and upcycle plastics that normally would end up in landfill, storage or through a lengthy and energy hungry recycling process.

What is upcycling?

Upcycling is reusing or re-purposing things that break or become useless or unwanted products. I have been upcycling plastic bag into products for the last 10 years.

My intention with this book is to put together all of the years of experimentation and developments into an introductory manual that others can access in order to learn how to use polyethylene plastic bags as a medium for creating new products.

The method to iron plastic bags is well known to the maker community and there is a plethora of Online tutorials that explain the basic method to fuse layers of plastics into a workable material. However, a lot of this content is only focused on how the method works, it does not explain the capabilities of the materials at play and it also, so far has not been developed further than just ironing flat sheets of materials.

My aim is to teach you a highly creative and easily accessible method you can do at home or at your art or design studio to re-purpose plastic bags into products using common household equipment and DIY techniques that can be replicated virtually anywhere.

If you are in a place where soft plastic pollution is a problem, and you want to do something about it, you are in the right place to start contributing to the global effort in cleaning and re-purposing plastic materials into long lasting goods, that avoid the destruction of our beautiful world.

Materials

It is extremely important to know the materials we will be using for our learning experience. These are polyethylene materials that have incredible properties that can be helpful to your creative process. This is a synthesized description of the properties and disadvantages of the materials we will be using for our learning experience that has been sourced from Omnexus which is like a bible for all different types of plastics. I present the advantages and disadvantages that I have encountered in my process, that are relevant for the applications I will show you later, but if you need more detailed information about polyethylene materials I suggest you check this link: <https://omnexus.specialchem.com/selection-guide/polyethylene-plastic>

High density polyethylene



HDPE

HDPE is one of the most used types of plastic in the world mainly used for packaging food because it is durable, affordable to manufacture and it is safe for containing certain consumables. This material comes in a variety of forms, from cloudy white milk bottles to detergent containers and of course plastics bags. HDPE has incredible properties that are useful for many applications.

Properties

- Low melting point: 120° - 140° Celsius
- Excellent resistance to most solvents
- Relatively stiff material (When fused it can behave similar to paper)
- Good tensile strength (Its hard to pull apart)
- Good low temperature resistance
- Excellent electrical insulating properties
- Very low water absorption
- Good UV protection if material has been treated

Disadvantages:

- Can be noisy due to rigidity
- It shrinks a lot when exposed to high heat
- Susceptible to cracking

Low density polyethylene



LDPE

LDPE is also one of the most used types of plastics for packaging and it is probably my favorite to work with, because of its shiny and translucent features. This material can be found in the form of padding foams, bottle tops and of course plastic bags, from small to sometimes quite large formats of bags used to protect things like mattresses and construction fittings.

Properties

- Low melting point: 105° - 115° Celsius
- Good resistance to alcohol and acids
- High impact strength
- Excellent electrical insulating properties
- Very low water absorption
- Transparent when thin like in plastic bags
- Its Flexible in soft and rigid form
- Low shrinkage compared to HDPE

Disadvantages:

- Poor UV resistance
- Highly flammable



HDPE



LDPE

Identification of materials

Sound, translucency, and level of glossiness are key factors for identifying plastic types when you find them. The more you handle the materials, the more you will get used to what is what. These are my own methods to identify them and previously I made a video where I introduce myself and you can see me explaining how to identify the materials in a way that will definitely make you remember. Scan the QR code for video:



Sound: HDPE has a high pitch sound. When you scrunch a bag, depending on the thickness it can be quite loud.

Translucency: HDPE is opaque

Glossiness: HDPE has a matt shine compared to the LDPE

Sound: LDPE has a low pitch sound. When you scrunch a bag, depending on the thickness it can be quite loud.

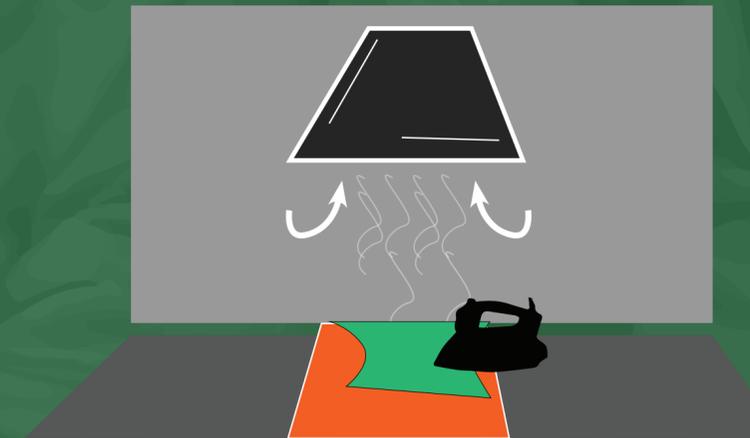
Translucency: LDPE is translucent if raw or has a low pigment added. Many times it is printed or made non-transparent with pigments

Glossiness: LDPE shines strongly compared to HDPE

Safety

To process the materials safely we must follow basic steps to ensure we never get exposed to harmful fumes from the plastic materials when applying heat, or get burned from the plastic or the equipment. The process involves fusing plastic layers, and an iron

- Wear an organics **fumes mask** with a carbon filter when fusing plastic
- Make sure you are in a **well ventilated space** ideally with an air extraction unit. Many kitchens have this installed above the stove, so if you are at home you could set up a wooden board below the extractor or just near a window.
- Wear **gloves** if you feel that when ironing the plastics it gets too hot. I have worked as a barista for years handling hot coffee groups so I have built a tolerance for heat on my hands and fingers, but for some people it can get too hot and indeed, the iron reaches and oscillates between 190° and 220° Celsius.
- These materials are made from hydrocarbons, and even though some fire retardants may be added to some bags, like anything, it will still burn. So do not work or leave materials near naked flames.



Air extraction or ventilated space



Gloves and mask

What are they good for?

HDPE and LDPE plastic bags can be used in many different ways. It does not matter if they are bags or in rigid forms like a bottle, you can melt these materials using regular household equipment like an iron as mentioned or toaster oven a sandwich press, or literally anything that can produce a temperature above the melting points of these materials.

Hard plastics require more time, and it is easier if you cut the materials. On the contrary, plastic bags are the easiest to process because they are already thin enough that they can melt easily.

However, melting HDPE and LDPE plastic bags is not the only thing we can do with them.

First of all let's get this clear, plastic bags can be reused over and over but, not many people do. So because of that we got to upcycle it.

I have focused this manual on how to use plastic bags because they are the easiest to manipulate, and in saying so, plastic bags specially HDPE type from shopping bags that are probably the thinnest version of these materials, can be used as they are as yarn.

Many people around the world use knitting needles and crochet techniques to upcycle these materials that end up in super strong, flexible and durable knits that can be used for a variety of applications.



Crocheted bags made by my mentor using HDPE crocheted plastic bags that were cut into rings to make a continuous yarn thread.

I have chosen to develop methods that use an iron to fuse several layers of plastic bags into materials that can be useful to make fabrics useful for sewing a variety of products.

This method allowed me to express my art using different colours and techniques to decorate the materials, and it pushed me to learn better sewing skills to establish a small business that manufactures and sells backpacks, shoulder bags, pannier bike bags and more. All made from trash. These are some examples of the techniques that you will learn with this manual and I hope that seeing what I have made inspires you to explore these materials using your own ideas to create new products that divert waste from landfill.



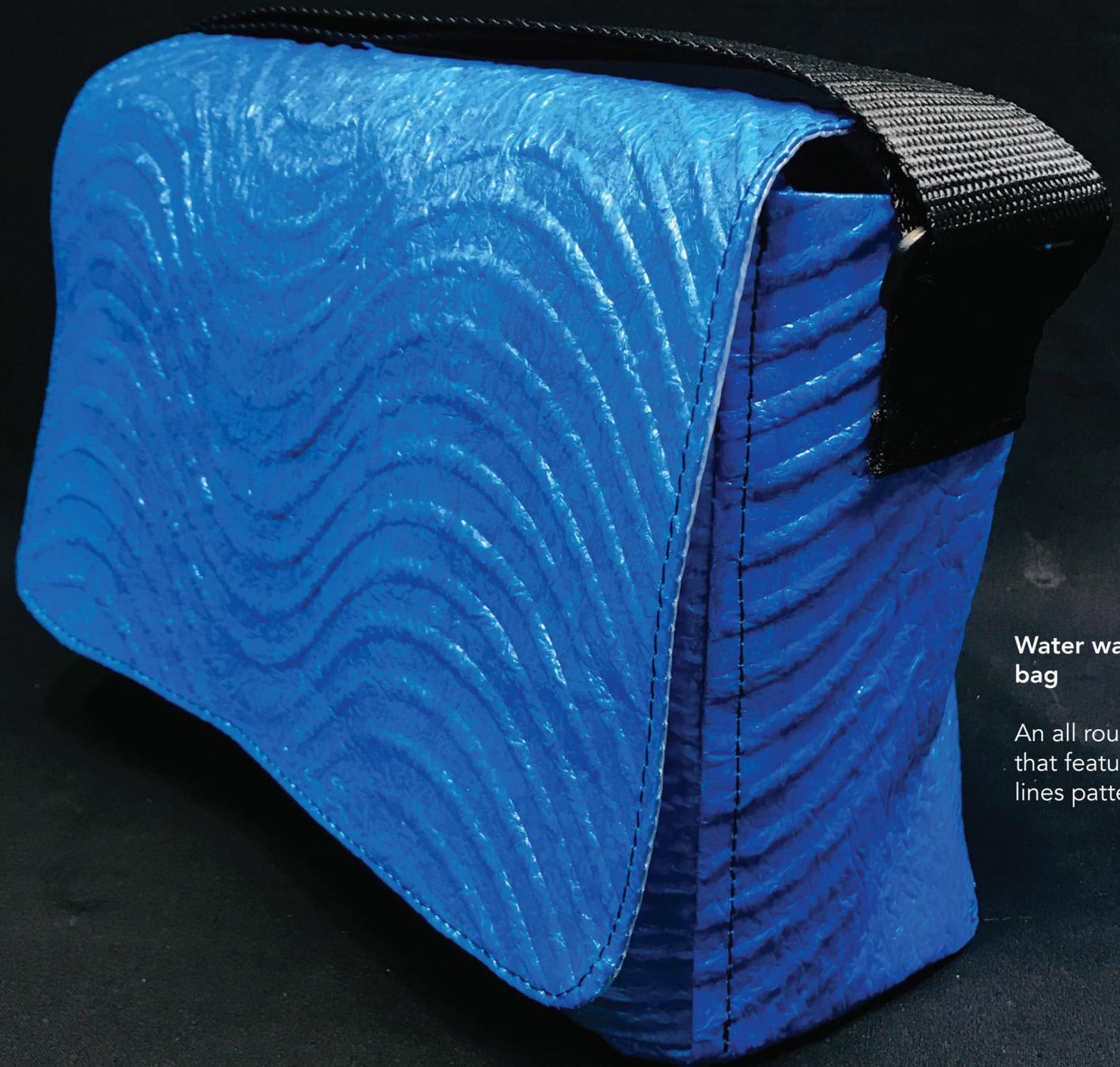
Italia - Amigos backpack

Using plain colour combinations of LDPE materials from agricultural produce bags used to store and transport carrots and raw coffee beans. Made in 2020



Santa cruz - Commuter backpack

A different bag style using symmetrical stencil patterns fused onto the materials using contrast colours of LDPE materials.



Water wave - Messenger bag

An all round messenger bag that features embossed wavy lines patterns.

Green blocks - Laptop bag

A small day pack with a unique 3D pattern made using vacuum forming techniques.



Making the base material - Basic method

This is the very basic method on how to transform several layer of plastic bags into a single thicker sheet that could allow you to make a bag like the one on the previous page. If you collect bags to experiment, make sure to clean and dry them. This example is with a very small HDPE shopping bag that is folded to fuse 4 layers of a relatively thin plastic.

Click or Scan the QR code to see an in depth video of how to iron both materials:



MATERIALS

1. Baking paper / tracing paper / Teflon sheet
2. Regular clothes iron
3. Scissors, Stanley knives or rotary cutter.
4. Carbon fumes face mask
5. Gloves

METHOD:

1. Flatten and position bags into the desired number of layers (fig. 1)
2. Cut out the handles and bottom and keep for further experiments. (With a Stanley knife you can cut several bags at the same time) (fig.2)
3. If bags are printed, the ink may stick to the paper, so turn inside out. If you use a Teflon sheet you don't have to worry about it sticking. (Fig. 3)
4. Expand the bag so there is no folds and flatten again making sure there is very little air in between the layers. (fig.4) Put mask on.

5. Place baking paper or Teflon sheet over (fig 5)
6. Set the Iron on cotton to linen setting. (Depends how your plastics react. If they feel thin,
7. Iron on both sides of the bags Making sure you apply the heat evenly, so there is no mayor (Fig. 6)
8. Immediately after ironing, flatten the sheet with your hands as it cools, so it remains nice and straight.



WHAT YOU GET

A lightweight, water resistant and durable material that you can use for creating new things. Sewing is the most common method to put these fabrics into use and it makes sense to make bags and accessories that benefit from the characteristics of the materials.

There is a variety of colours you can find, and in my experience HDPE offers the widest range. Also, the quality and thickness of plastics varies from source to source. So, it is a matter of sourcing the places where you can obtain a range of colours so you can go crazy making new funky things.



WHAT YOU WILL FIND

- Debris or dirt. Most plastics I collect are from dry goods distributors because they use large and good quality plastics to store and transport things like grains, coffee beans, pasta and many other perishable products that we consume every day. If you are collecting these kinds

of plastics make sure to clean them as soon as possible, otherwise it may attract rodents or other creatures that may want to feast on left over nuts or food left on the bags.

- Inks and printing on the bags. Turning bag inside out can work, but sometimes the printing may be on the inside and if it is a translucent bag, it is really hard to tell. Make sure you test the materials, and if possible have the two options of the Baking or Tracing paper and a Teflon sheet.
- Even though LDPE and HDPE are the most common plastics used in plastic bags, there are a lot more types of plastics you may encounter. If unsure of some plastics, make sure you test them first with a small piece.

TIPS:

- If your bags are very thin, make sure you add more layers you achieve a material that is sturdy enough for sewing.
- Also if they are very thin HDPE bags they will shrink if you iron too slowly. The more layers you fuse the slower you can go so the heat can bond all of the bags as you go.
- Once you finish ironing, flatten the material with your hands as it cools down, to make sure you get a nice flat sheet of that is easy to work with.

Decorating the base material Symmetrical patterns



Fig 6

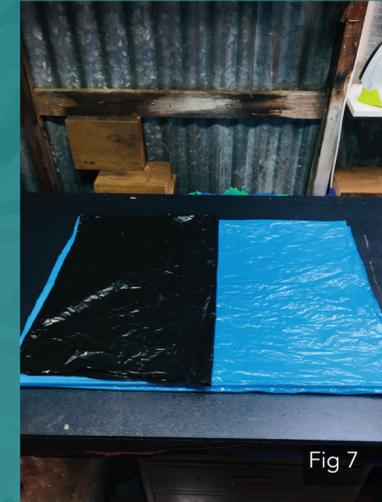


Fig 7



Fig 8

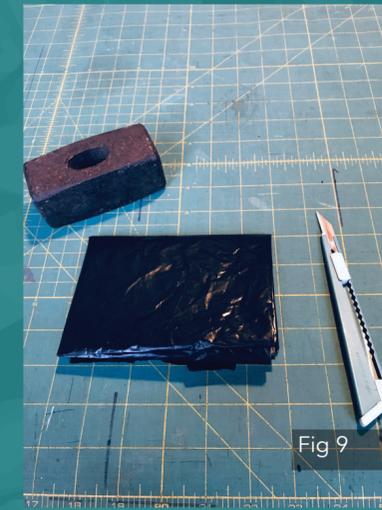


Fig 9



Fig 10

This method works best with LDPE plastics, because it does not shrink and the detail of the cuts can withstand the heat. It's a great way to decorate the materials and there are unlimited possibilities of making one of a kind stencils and patterns using geometrical or random cuts.

Using a thin layer for the stencil and a base of a contrast colour, it is possible to apply complex patterns to our materials using a very simple but effective technique.

Fig 6 - 10. Folding one single layer in half or quarters or whichever way you like you can cut symmetrical patterns easily and quick. Make sure you hold or tape the plastic so it does not move.

Fig 1 - 6. After, carefully unfold over the base material to reveal an amazing symmetrical pattern that you can cover with the paper and iron like before.

Explore with folding the pattern in different ways and you can get different arrangements every time. This is certainly one of my favorite ways to make materials.

Of course this is just one way to cut things in a cool way, but you can go mad and cut realistic stuff like I did trying to cut a self portrait which ended up being just my eyes cut from a white sheet of fabric and fused onto a black sheet.

Cutting out realistic stencils can be super rewarding but really slow, so make sure that, if you eventually sell products made from your own materials, that you count your time and charge for your works, like a any other visual artists does. The fact that we are dealing with trash does not mean it is easy or less valuable.



Fig 1



Fig 2



Fig 3

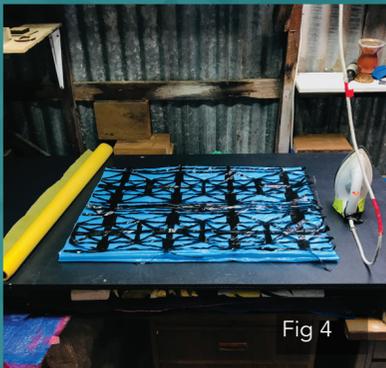


Fig 4



Fig 5

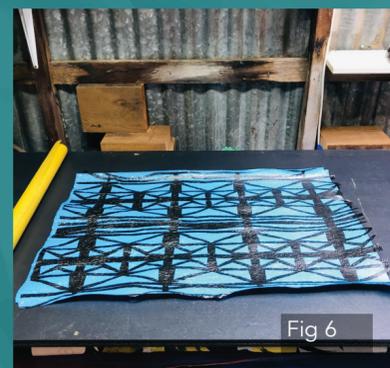


Fig 6



Click or scan the QR code to see the ironing of an example of a symmetrical pattern.



Colour combinations

The translucency of the materials either HDPE or LDPE works to combine the colours to make new ones like in the example below. Imagine like combining colors when painting but with some limitations. There is different types of tones in primary coloured bags, so the possibilities are endless when it comes to the thousands of types of plastic bags out there.

Combining the materials using a colour wheel as a guide can be helpful to make striking compositions of colours that come in matt finish with HDPE or shiny with LDPE.

It is important to make sure when you mix the materials that they are the same type, otherwise the bond may not work.



Abstract patterns

If you have ever been into painting abstract things, I suggest you try this. Free materials for the long foreseeable future in an incredible variety of colours, and now you know you can make your own colours, well. Why not?

The colours on HDPE and LDPE are so vibrant and the combination outcomes can change depending on how you cut and arrange your "brushstrokes".



To see a quick video tutorial on how to do it, click or scan this QR code.



And what if I told you that with HDPE materials you can create the pattern below and that it happens like magic. Yes that's right, well, kind of. There is no spell to it, but definitely a trick. When ironing materials using a single HDPE layer of a contrast colour on top of a thicker base, instead of pressing while ironing, just hover with the weight of the iron first, and you will start seeing the material disintegrate in as you iron just like magic.



To see a quick video tutorial on how to do it, scan this QR code.



Embossing

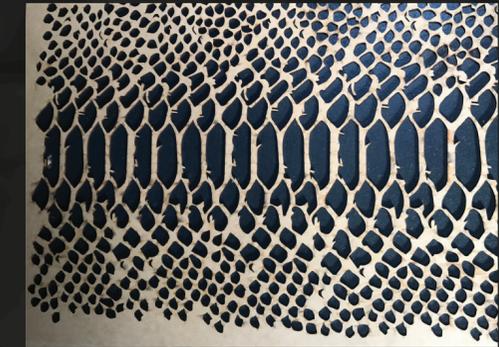
The previous methods explore the visual possibilities on how to decorate flat sheets of material in endless ways, but plastics can be shaped too.

Using laser cutting technology we can cut out stamps using vector drawings done in computer programs like Adobe Illustrator. But, it is not necessary to have or know how to use these programs as now you can submit a photo of a drawing made by hand that the laser cutter service can change to use as they need.

You can also find phone apps that can convert your photos of drawings to vector files. Vector files are the kind of image that laser cutters can process to cut out your drawing from say, a thin sheet of cardboard or wood, and those are the types of files a laser cutting service needs to process your order. In other words it is very easy to get laser cut things done nowadays. It is important to know how laser cutting works, so inform yourself before the process.

HOW?

The technique requires to reheat a pre-made piece of material preferably LDPE using a Teflon sheet. The idea is to place the material over the laser cut stamp, and iron small sections whilst pushing down with a cloth as if you wanted to push the plastic through the wood. I resolved to keep the iron on the material without holding it and as I push down, I also push the iron around so I can press with both hands. This technique is better done with another person, as it can be extremely exhausting to iron and push at the same time, but totally worth it, and possible with an A2 size material.



Laser cut patterns of your choice.



Place material over pattern, then Teflon sheet.



Iron at the same time you push the material against the patterns.



Voila!! Crocodile skin.



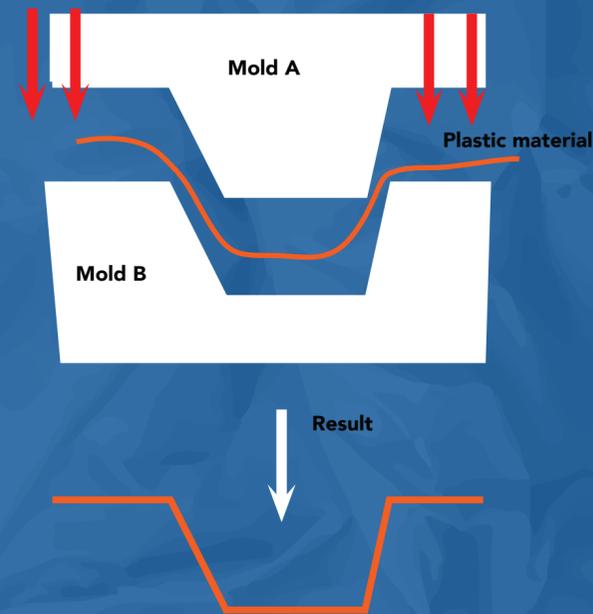
With this technique it is possible to add texture to our materials, and since I make bags, I attempted to make crocodile skin texture so I can show you that these trash materials are not trash. These are materials that can be treated like leather, or paper and that offer unlimited possibilities for creation.

To see a quick video tutorial on how to emboss, click the or scan the QR code.



Molding methods - Compression molding

Compression molding is a technique used to shape materials using pressure and molds to achieve specific forms or 3D shapes from molten plastics or flat sheets of materials



I made a compression device inspired by videos in YouTube by Precious Plastic and Brothers Make. It is made using an upcycled 750kg car jack, a frame made from hardwood and 10mm bolts, nuts and brackets. It was fairly easy to build and you can do it to! There is plenty of tutorials, but essentially it is a wooden frame reinforced with metal so it can withstand the pressure of the jack.

This device can be useful to compress molten plastics that can take specific shapes using small molds up to a width of 30cm.

Now instead of using the iron to melt the plastics, we can use another piece of household equipment like a toaster oven or a sandwich press. If you are employing this technique, DON'T use the same equipment used for cooking foods.

These pieces of equipment can be obtained second hand or new for very cheap. I got a little second hand toaster oven for \$20 and a new sandwich press from Kmart for \$35.

These items are great to melt plastics because they can reach temperatures above the melting point of our materials.

Common kitchen equipment like cake molds and trays can be useful to shape the material.

I found useful and quite interesting to make flat sheets of molten offcuts from my sewing process, to later cut them in to tiles, or small shapes that I can turn into pieces of Jewellery, coasters and small bowls that I can achieve with the kitchen molds.



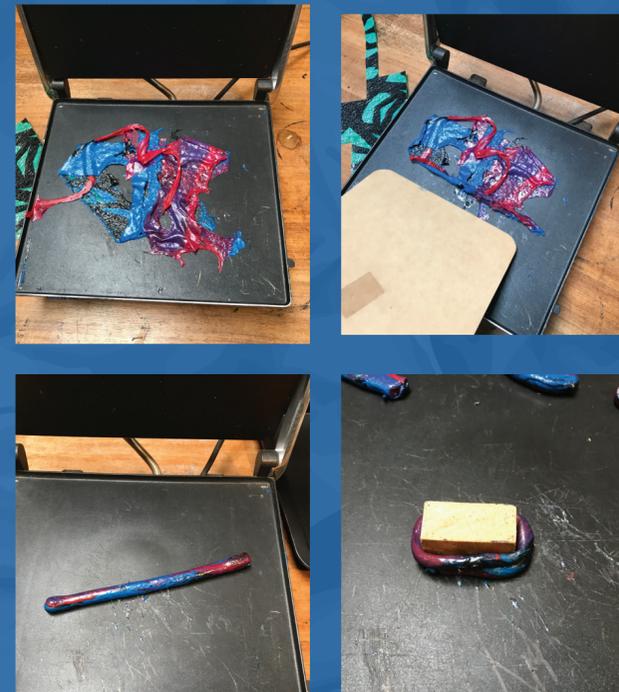
To see a quick video tutorial on how to do compression molding and hand molding, click the [link](#) or scan the QR code.



Hand molding

The material can be molded by hand using the sandwich press to melt small amounts, when the materials are soft they can be manipulated and shaped like plasticine to form virtually anything. The only downside is that the material is hot when you do it, so you must find ways to manipulate the plastics without burning your fingers. I use this technique to make, rings, hooks and adjusters that I use with my bags so I don't have to always buy the components I need for my products.

This is a great way to recycle our plastic waste from cutting materials for sewing.



Vacuum forming at home

This is a very fun technique to do that also it is very accessible using household equipment. The way it works is by using air suction to pull softened plastic materials towards a base whilst wrapping the material to a mold in between.

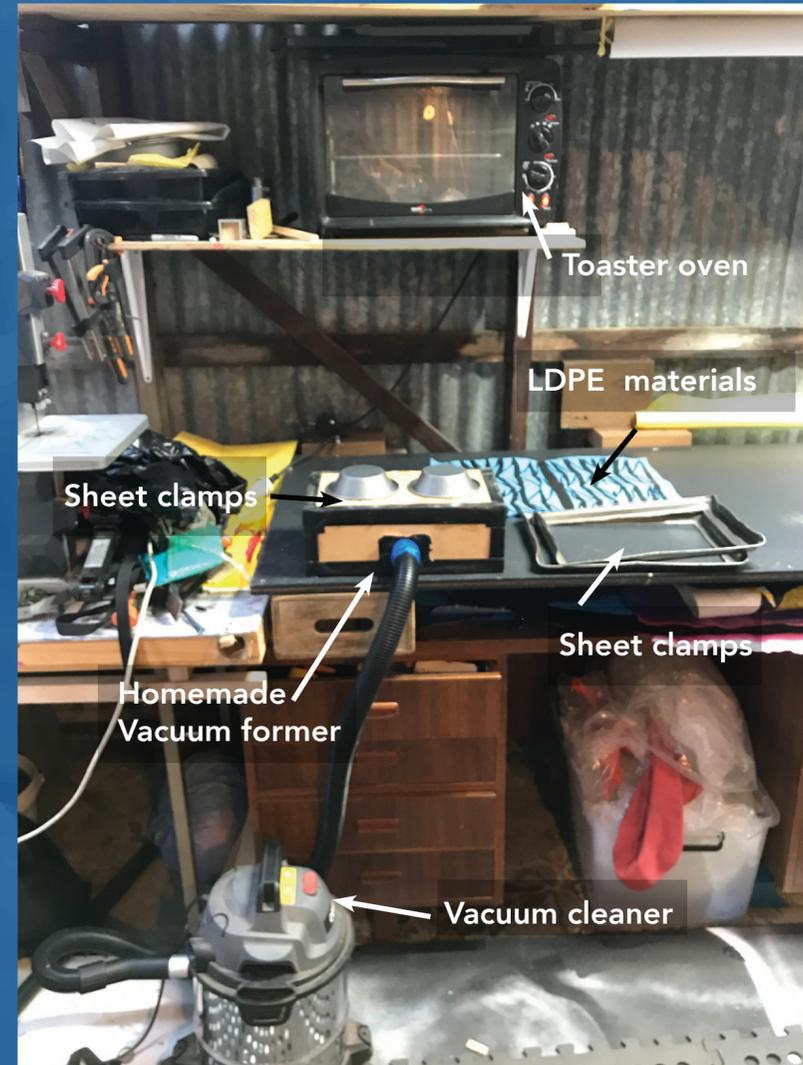
This technique is common for shaping plastics in the industry using expensive machines. However we can device our own, by building a suction box out of wood that has a grid of holes on the top and a hole for the vacuum cleaner tube.



The method I will show you only works with LDPE materials that you can make at home with the techniques you have now learned.

This is probably the most advanced method of shaping the materials, because it requires accuracy in the process to achieve a good outcome. Here I will show you my very own recipe on how vacuum form plastic bags, so you can learn how to do it too.

WHAT YOU NEED

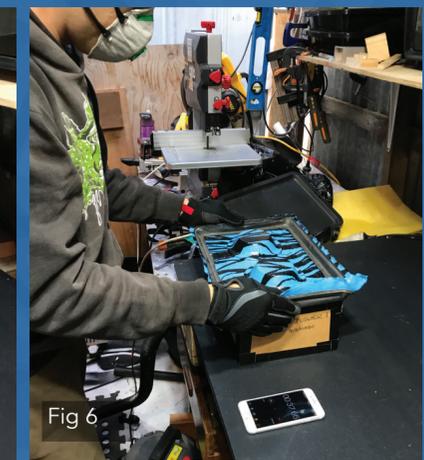
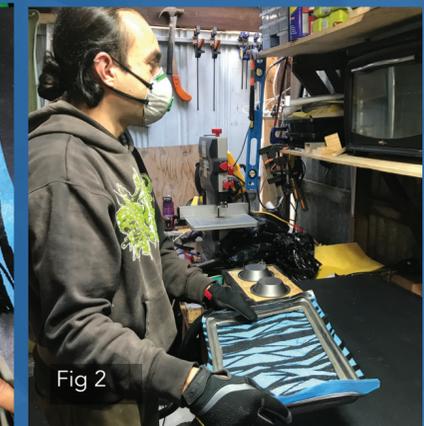
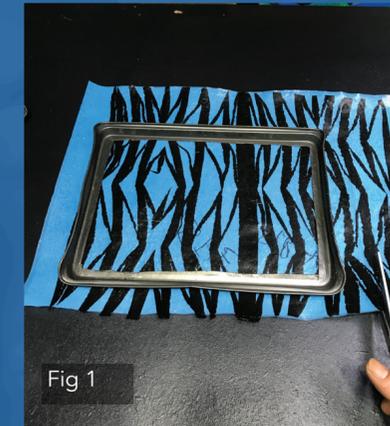


To make the sheet clamps I used two of the same size cooking trays that were slightly bigger than the oven cavity. I cut a hole on both with an angle grinder just to leave the frames of the tray. Then I bent the sides, while the trays were on top of each other, so that I could snap my material in between, to hold it in place inside the oven.



MY RECIPE TO VACUUM FORM PLASTIC BAGS

1. Iron LDPE materials into 4 or more sheets, making sure all the layers are well pressed so there is no air bubbles. You can decorate the materials but make sure they would all be of the same thickness.
2. Cut out a piece of material that is slightly larger than the sheet clamps. Fig.1
3. Preheat oven at a Temperature of 200°.
4. Clamp the sheet in between the clamp trays, making sure the material is well stretched. Fig.2
5. Get a stopwatch, your molds and your vacuum cleaner hooked to your suction unit and ready to go.
6. Place the material in the oven, close it and immediately start the stopwatch. Fig.3



7. Observe the material as it reacts to the heat. It will do random movements and then it will straighten, that's when you know it's ready to pull out.

Normally, all this would happen within 30 to 40 seconds, but it really depends on the temperature and your material thickness. Sometimes it may take one minute to soften the material enough. Just make sure it does not smoke at all. Fig.4

8. Switch on vacuum cleaner, and remove material from oven using gloves. Fig.5

9. Immediately place over objects and suction unit pressing down until the material molds around the objects. This should take a matter of seconds. Fig.6

10. And there you have it. Our LDPE materials can be shaped, to create cavities and complex 3D shapes. Fig.7 - 8

The size of my home Vacuum former is small, but it allows me to create pockets (fig.9), or cavities that I can use for padding in backpacks (fig.10)



Fig 9



Fig 7



Fig 8

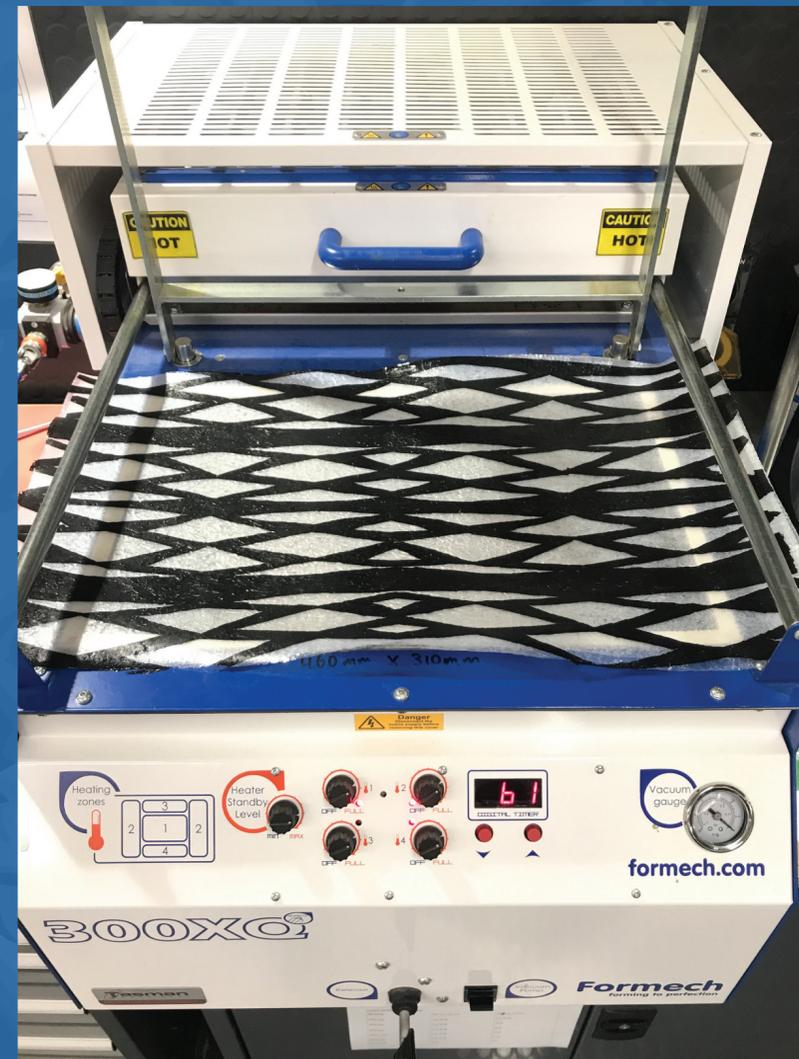


Fig 10

Using an industrial vacuum former can be useful to form bigger and more complex things. Accessing these may be hard as they can be quite expensive and only used for very specific purposes. There are some tutorials in YouTube that teach you how to make your own vacuum former, and essentially you could make it as big as you need.

This method requires some knowledge in making molds; it is very easy, and it can be useful to make unusual 3D shapes that make my sewn products stand out.

This technique can be developed further, and I am very eager to see what other people can do with this method.





Laptop bags made using vacuum formed shells as a front panel. The possibilities are endless when it comes to shaping the material.



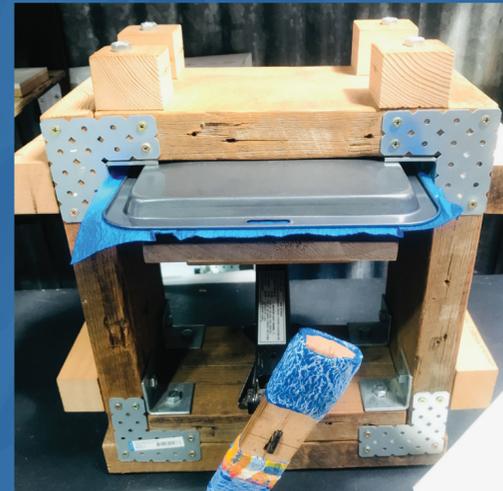
To see the process of vacuum forming, click or scan the QR code.



Thermoforming with compression

Alternatively to vacuum forming, you can use the compression device to shape the materials straight after they have been ironed. This is only useful to create shallow cavities on both LDPE and HDPE materials. Any deeper than 2 cm, will have major folds, when pressed, but these can be eliminated or reduced with the material being hotter. It works really well if you have a heat press that can heat large pieces of material.

In this example I used a 12" roasting tray to shape a HDPE material to create the cavity to make a laptop sleeve. But it can be useful with other shapes to also create pockets and parts for other products.





Here I used baking molds to shape the materials to make the sides of this handle bar bag. Normally making a pattern for angled shapes can be difficult, but with the compression device it takes only a matter of seconds to shape it.

Conclusion

I hope you found this books useful. i believe in the area of recycling plastics there is a lot that you can find, but when it comes to soft plastics. There is not much available information.

My aim is to develop these methods further and to explore new things with plastic bags. There is certainly a lot more to learn about this subject and this is the very first time I compile all of this information, into one book. and it is also a very brief but concise piece of information that can help you see plastic bags not as these annoying things that are everywhere and damaging the environment, or as waste but as a precious resource that at the moment is readily available.

If you find this book useful and employ any of the methods I explain, it would be amazing if you could share what you do with me. My plan is to develop this book further, refine it and bring better versions of it in the future, so your contributions may be featured but most importantly share what the global collective is doing specifically with plastic bags.

Also, if you are someone that is already involved in making things with plastic bags and believe your methods should also be shared with the world, I would be more than happy to collaborate to create a better and more complete version of this manual that talks specifically about upcycling soft plastics.

Thank you for spending time reading this, and I hope this can help you to complement your own projects further by using the amazing properties of polyethylene materials at the same time you contribute to the diversion of precious materials from landfill.

Thank you for reading!

Contact

Cesar is based in Melbourne - Australia.

You can contact Cesar on his instagram account [@aoracreo](#) or through his website www.aoracreo.com

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