STUDIO
FROST~
WOOD

THE PRICE OF CLAY

SUSTAINABILITY REPORT 2023

INTRODUCTION

We are Natalie J Wood and Hazel Frost and we founded Studio Frostwood in September 2021. As ceramicists, we have both worked in shared studios and various educational institutes, experiencing first hand the opportunities that can come from open studio access. Equally we found the difficulties of working with multiple materials and the waste that can be created in the production process of ceramic art. We began our research into studio sustainability in September 2022, setting out with the goal of examining studio materials and carbon impact.

There is an inherent cost to creating any item, this includes carbon emissions and material waste. Our sustainability project seeks to minimise these costs by analysing our materials and studio set up.

Within the niche of ceramic production, there are already lots of ways we can recycle the materials we use. A pot that's been thrown incorrectly on the wheel can be reclaimed, recycled and remade almost indefinitely until the point it is fired. Shavings that are scraped away during the refining of a vase can be slaked down with water and turned into something new. Plastic bags are valuable and are used within the studio for wrapping up work, and buckets find endless lives within a studio for storing materials.

Despite the fact many materials in the studio are recycled, there is always more waste being created, this includes the contaminated material that gathers at the bottom of buckets used for cleaning tools and tables. The ceramics that were fired, but could not be used. The test glazes that were unsuccessful, the plaster moulds that were no longer needed. This project is to analyse each area of wastage and to see where we can improve.

This research project will discuss all of these areas in relation to Studio Frostwood, as well as looking into the origins of our materials and how community can be a key part of any studio's pledge to reduce waste and ultimately emissions. We hope that we are able to provide practical advice through sharing the exact methods that we used.

Blended sphere, constructed purely from studio micro clay waste.

This project has taken us on a long journey where we realised our potential and limitations as ceramicists and we would like to preface this document by saying that while we must wear many hats, we are not:

Chemists

Geologists

Toxicologists

Plumbers

Electricians

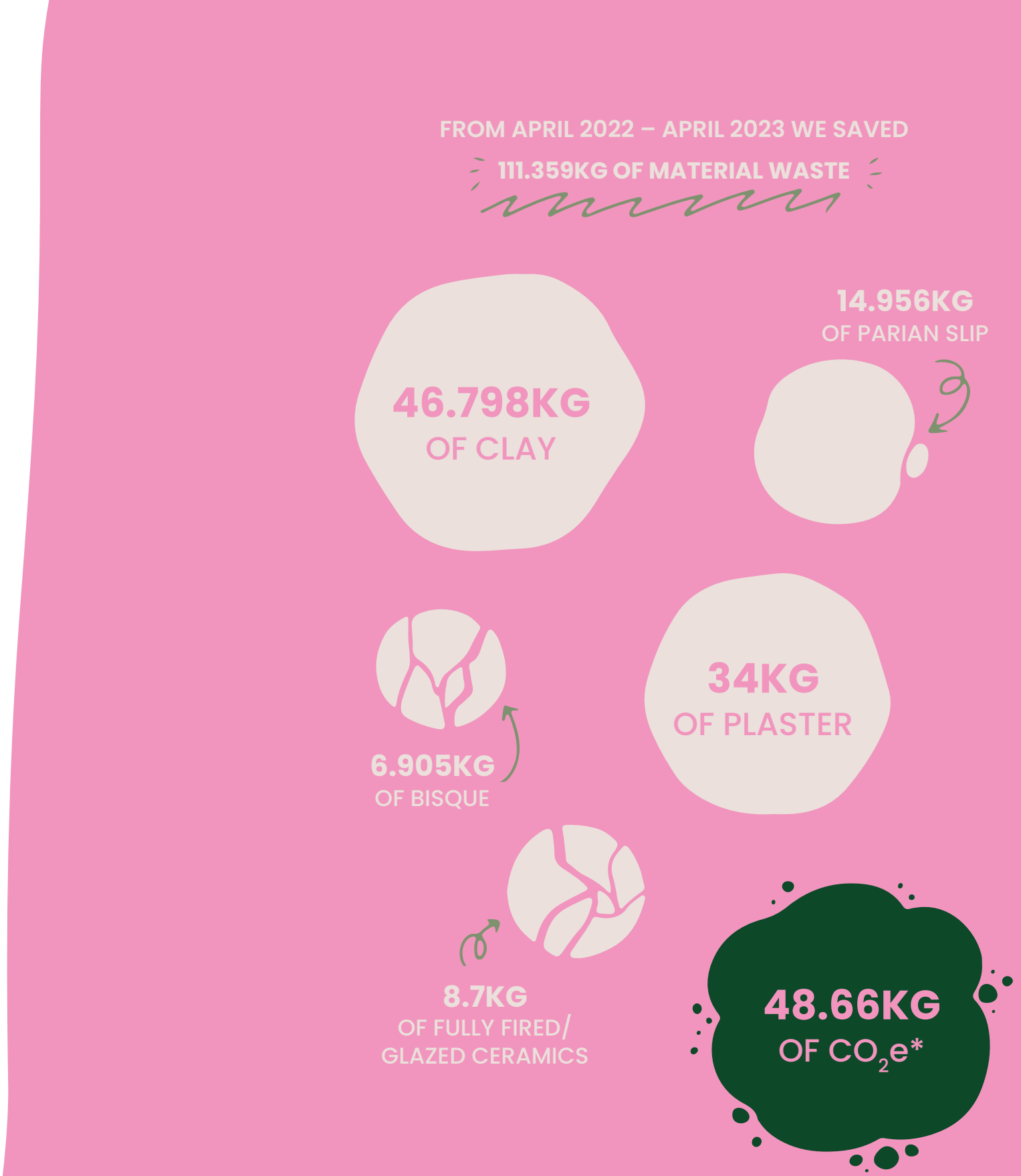
Copywriters

Data analysts

Carbon Specialists

Throughout this document you will see elements of all these specialisms and while we try our best, we do suggest doing your own testing of any of the processes mentioned or matching up with specialists to build on any of the work we have created.

All of our carbon values have been taken from Creative Carbons Scotland's quick conversion framework. We understand these conversions are created for household waste and may not be completely accurate for the waste we work with. We also used The Carbon Trusts Green Business Funds tools and found the data outputs to be within a very similar range: **gbfcalc.azurewebsites.net/gbf**



* CO_2e: CARBON DIOXIDE EQUIVALENT

PART 1

OUR MATERIALS AND WHERE THEY COME FROM

There are many ways to examine consumption and try to calculate the ecological impact of those processes. These are:

CRADLE-TO-GATE considers all activities starting with the extraction of materials from the earth (the cradle), their transportation, refining, processing and fabrication activities until the material or product is ready to leave the factory gate.

CRADLE-TO-SITE is as cradle-to-gate but with the emissions associated with transportation to their workshop

CRADLE-TO-GRAVE is as cradle-to-site but with the emissions associated with its use and end of life/recycling processes.

For this project we will be taking a **SITE-TO-GRAVE** approach, as the information behind the extraction and processing of our materials is for the most part incalculable by us due to its complexity and lack of transparent information. We will share the information we have gathered but we will not be attempting to calculate their carbon impact from before they leave the distributor. We contacted our distributors for all of the basic geographical information.

OUR CLAY

In our studio we mostly use a clay called **ES5.** The base materials for ES5 are mined primarily in the UK except for the feldspar which comes from Norway.

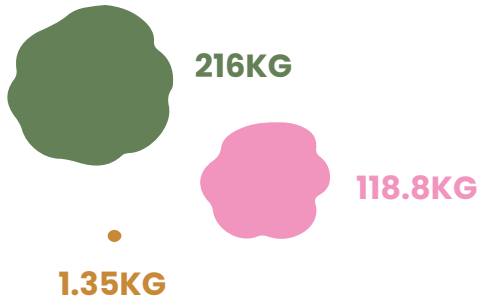
DISTRIBUTER A
800 MILES
ROUND TRIP TO STUDIO

DISTRIBUTER B
400 MILES
ROUND TRIP TO STUDIO

DISTRIBUTER C
5 MILES
ROUND TRIP TO STUDIO

In our studio we buy clay from several different suppliers. For this report, we'll call them Distributors A, B and C. Distributor C is our local distributor, at a distance of only 5 miles round trip from the studio. By switching to a local distributor we can cut down on our carbon transportation footprint as local suppliers have much more bulk buying power. If you do not have a supplier close by, we recommend buying in bulk as much as possible. You can also join up with other local makers and make joint orders.

CO_2e PER JOURNEY



In 2022 we ordered from Distributor A a total of 13 times and Distributor B 7 times using a total of 3639.6kg CO_2e for the year.

If we had used our local supplier for all of our orders we would have saved

3612.6KG

of CO_2e!

PART 2

COLLECTING AND COLLATING MATERIALS

As the aim of this project was to try and get to a place of zero materials waste, first we had to examine our materials and the waste they created. In the studio we had clay, glaze, plaster, bisque fired ceramics and glaze fired ceramics. So we separated all our waste into these 5 categories.

Throughout this report you will see us use the word 'waste' continuously – clay waste, glaze waste etc. When using the word 'waste' we are referring specifically to the micro-waste created just by the running of the studio. This includes washing our hands, tools and surfaces.

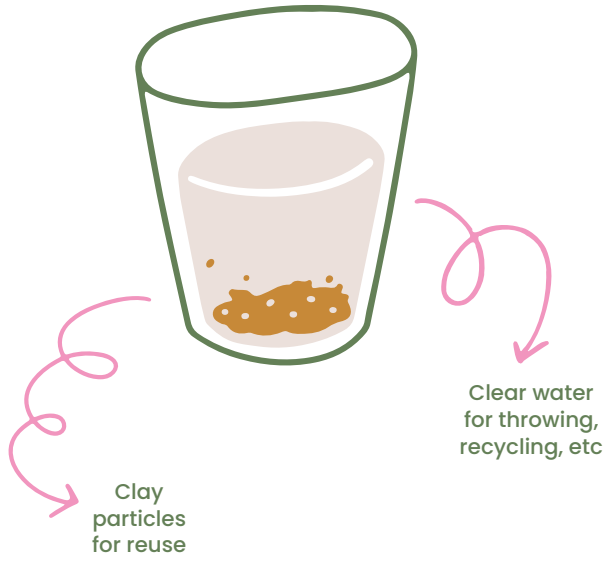
Every potter should recycle the bulk of their clay. It is a simple process of keeping clay scraps and adding them back into water, then drying the clay on plaster batts until it becomes plastic and usable again. This process can become complicated within a shared studio as there is a risk of cross contamination between different types of clay. Contamination can be mitigated through keeping a clean studio and using separate plaster batts and boards for dark and light clay.

When working in a pottery studio, most waste clay, glazes and other items will be washed down the sink and caught in a trap. A sink trap is a must for any pottery studio as materials can build up over time and clog pipes. However, this means that the materials are contaminated by each other.

The first step in our sustainability journey was separating our waste collection systems. Take for instance our clay waste – we started with two buckets, one to wash out all our tools once, then another for rinsing. As we use the buckets, sediment collects and settles at the bottom. After a few days, the water at the top becomes clear and can be siphoned off. The clear water can be reused for throwing, recycling clay or a multitude of other uses. The settled clay particles are then collected and dried on plaster batts back into a clay form.

As we run a busy studio with multiple artists and workshops, the bucket system quickly became overwhelming and we needed to upgrade. To do this we created a self-contained sink system in our studio utilising an IKEA Sunnersta Mini-kitchen and a water pump. This way we could have a flow of clean water and give the waste time to settle without having different buckets all over the studio. The limit with this system is that it cannot be used for all waste. For our glaze waste we still use a bucket system as we glaze more infrequently. We have found these systems to be incredibly useful but if you did need a more advanced system there are options like the Cink, which is a self-contained mobile clay and water recycling system.

SIMPLE SYSTEM
2 BUCKETS
£5-10 TOTAL

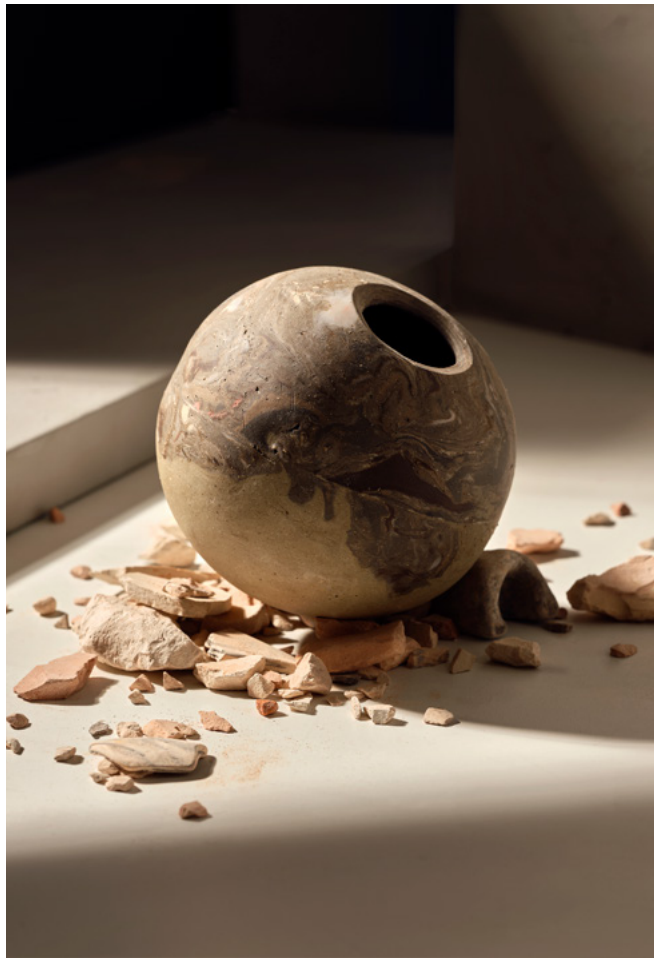


UPGRADED SYSTEM
MINI KITCHEN
£160 SUNNERSTA MINI KITCHEN
£15 PUMP
£15 CONTAINERS
£190 TOTAL

ADVANCE SYSTEM
THE CINK
diamondcoretools.com/
collections/the-cink
£2090 TOTAL

PART 3

EXPERIMENTATION



First experimentation using micro waste clay.

CLAY

Waste clay is the material we collect the most of, as we continuously build up waste through cleaning our tools and equipment. Therefore, finding a way to process everything we were collecting was paramount. We began by firing small samples to make sure the waste clay could survive the kiln and wouldn't be at risk of melting into a puddle. Once we were certain we weren't risking our kiln shelves we started to develop ways to process the clay.

The waste clay has a higher water content than processed, shop bought clays, therefore drying out on a batt can take significantly longer. However, this can be a bonus when working with the clay – since it takes longer to reach a leather-hard state, you can carve and manipulate it for longer periods of time.

In our first experiment we wedged the clay in increments of 5. As the clay had natural colour veins from the mixing of different types and colours of clays we wanted to know if it would be better to work with the clay in a raw or amalgamated form. We found that we enjoyed seeing the veins of colour in the clay as it seemed to really represent the studio and showed a progression of how much each clay was in production.

While we want our studio to be able to use clay bodies creatively and generally do not want to limit which clays we use, we found the success of being able to use our clay waste was due to only using high fire clays such as buff stoneware, crank and porcelain. We do not use earthenware within the studio. Adding earthenware clay into the mix would likely lower the melting temperature of the clay body, potentially causing warping, blistering and overfiring.

In addition to handbuilding and throwing, we also use parian slip to create casts of plaster moulds. The slip, or liquid clay, does not create an excessive amount of waste, but we began to keep offcuts and trimmings from the casts in a tub. With washing out jugs after casting we would add some water to wash out the remnants and add this to the dry trimmings. After collecting a significant amount, roughly 3-5 litres, a stick blender could be used to mix the offcuts and clay water into a smooth consistency. Water can be added to create the desired thickness of slip, and we didn't need to add any deflocculant to cast successfully.

Collection of tests, left to right: Micro waste clay blend, waste glaze blend, smoke fired surface.

A collection of test tiles, blending a mixture of glaze waste and clay waste in increments of 10%, up to 50%.

GLAZE

Glazes are an integral part of the studio ceramic process but many ceramicists, ourselves included, find the science behind the chemical reaction that takes place in kiln occasionally bewildering. This can lead to a disconnect between the potter and the glaze materials that they use. Understanding the ingredients that make up a glaze can allow a potter to source local materials, substituting one far flung material to one that is mined closer to their studio.

GLAZES HAVE A BASIC MAKE-UP OF 3 PARTS:

SILICA - The glass former - This is what makes a glaze glassy or glass like.

FLUX - The temperature control - This lowers the melting temperature of the silica, without this the silica would not melt at regular kiln temperature.

ALUMINA - The flow control - Alumina helps glazes keep their shape and controls the 'melt' helping glazes to not run.

After these basic ingredients are added colourants and modifiers can also be used for any given aesthetic effect.

HERE ARE 3 WAYS IN WHICH WE PROCESSED OUR GLAZE WASTE.

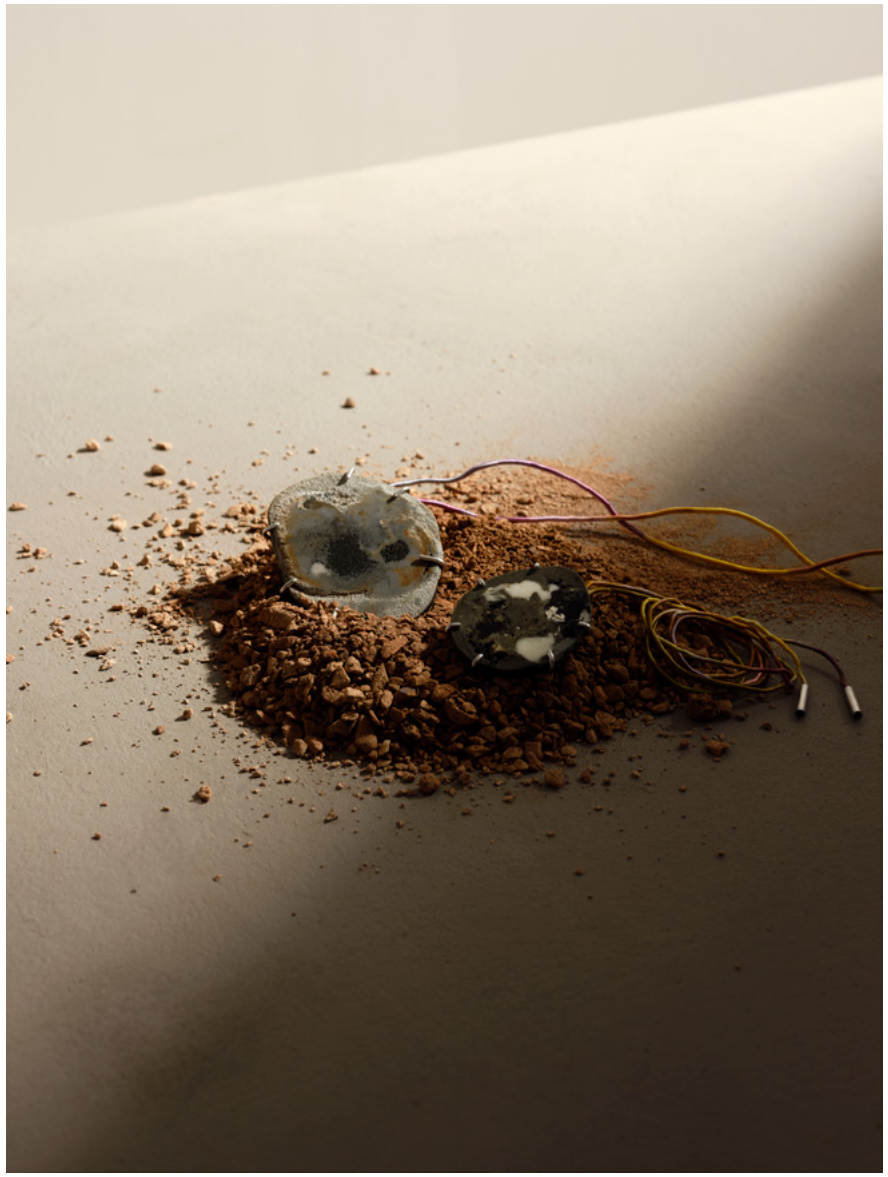
1. We let the glaze material hard-pan into an almost solid block. We then cut off small pieces and fired them on a bed of alumina hydrate. The alumina stops the glaze sticking to the kiln shelf. We also fired these items in small batches and inside of ceramic dishes to cut down on possible damage to the kiln. The fired glazes held their shape well and we called these items 'glaze rocks'. We then collaborated with two jewellers, **Kate Trouw** and **Stefanie Cheong** to see if this material could be a useful alternative to gemstones or other decorative materials.

2. We mixed the glaze into a liquid clay in increments of 10% up to 50%. This resulted in a surprisingly durable slip at 10-30% with 50% transforming into an almost volcanic clay surface. To turn our waste clay into a liquid we used a 5 gallon mixer and added water into our waste clay. This meant that we could use it as a decorating slip or to cast with. We were able to successfully cast a few pieces without adding deflocculant but more research would be needed to make a balanced, consistent recipe.

3. We tested it as a glaze. We simply collected our waste glaze material and kept it all together in a large bucket, when we wanted to glaze with it we would treat it as any other glaze, adding water till we had a milk/single cream consistency and sieving it through a 100 mesh sieve. If your glazes are similar in base and consistency then your waste glaze will be similar.

Not all glaze materials are toxic to the environment but if a glaze does contain toxic chemicals then it should not be disposed of down a drain.

Stefanie Cheong
Collaborative jewellery collection
using waste glaze material.



Kate Trouw
Collaborative jewellery collection
using waste glaze material.

Blended sphere, slip cast.
Combination of 20% glaze waste,
80% micro clay waste.

PLASTER

Plaster has been by far the most difficult material to deal with as our knowledge and understanding of plaster was very basic. For this we collaborated with **Chalk Plaster**. Chalk Plaster is a design studio that focuses on using traditional techniques to create contemporary designs for interiors. Their incredible knowledge of plaster led to the recycling and reuse of 34kg of plaster waste from our studio.

First the plaster was broken up into chunks then soaked in a solution of Alum (Potassium Aluminum Sulphate). This helped speed up the drying process of the plaster - the plaster was then placed in the kiln and fired to 650°C slowly over 8 hours. The slow firing was to facilitate the drying out of the plaster and reduce the risk of lime popping. After firing, the plaster was much more brittle and easily shaved down into a powder. Once in its powder form, water and other hardeners can be reintroduced to reform the plaster.

Chalk Plaster
Experimental object, created from
100% reprocessed plaster waste.

Studio bisqueware, mid processing.

BISQUE FIRED CERAMICS

After a year in the studio we found we had amassed boxes worth of ceramics that had broken during the first bisque firing. These materials couldn't be glazed, but equally as they'd already been fired, couldn't be reverted into a clay body again. We were stuck with them, but felt they could have use beyond being thrown into landfill.

Our first approach was to break down the bisque roughly and then put the pieces into a ball mill to finish the job of grinding it down into a fine usable consistency, with the idea that this could be added back into a clay body as a 'grog', which would bring strength to our clay bodies and also have interesting aesthetic qualities in terms of texture.

We found the ball mill to be lacking in overall information so we approached it by trial and error. Firstly we added our broken pieces of bisque into the milling jar, but our first problem was that the pieces were not breaking down quickly enough. We added water to the jar which helped to soften the pieces and resulted in a bisqueware slurry. To break down the ceramics even a little the ball mill had to run for hours, which was noisy and also had an added electricity usage which we felt was at odds with the original aim to reduce our emissions. Ultimately we had to abandon our experiments with the ball mill.

We found that using a sledgehammer and a bucket is a much quicker way to break down the fired pieces. We could then use different grades of sieve to separate the broken bisque pieces. We crushed the pieces down into small pieces around 1-3mm and then folded them back into the clay to use as a grog.

We added grog made from our stoneware bisque to our clay bodies in amounts up to 10%. It was best to spray the grog with water, this helped to manage any dust from the bisque and also prevented the clay from drying out as the grog was being added. Wedge the clay slowly, wearing gloves, as the crushed bisque can still have sharp points and edges.

We found that adding more than 10% grog made the clay difficult to build with as it reduces the plasticity of the body. The size of the grog pieces also affected the outcome, with larger pieces being more suitable for decorative work, as the grog has already been fired it does not shrink as much as the clay body, which causes cracking. This had interesting aesthetic qualities. Finer grog, which has a sand-like consistency, can be worked into the body more seamlessly.

Parianware grog added to
porcelain body, variety of tests.

Porcelain and parian blended sphere. Porcelain clay body with reprocessed parian grog.

Grog tests, blending fired bisque waste at 5% or 10% with clay body.

GLAZE FIRED CERAMICS

Ceramics that are fully fired can last for thousands of years, so it's hard to know what to do with a piece that fails at the last hurdle. Cracks can emerge in pieces during the glaze firing, kilns may overfire and cause a glaze to run, or general human error can mean a piece just does not work. These pieces can be sold as seconds if the defect is purely aesthetic. If they are truly unusable the pots can be broken down and used for drainage filler in planter bases, or used to create mosaic (remember broken glaze can be as sharp as broken glass and should be handled accordingly).

We collaborated with designer **Studio Emma** to use our glaze waste in her cement surfaces and products. Studio Emma used some of our waste to make countertops for a local salon. She adds the crushed ceramic pieces to the cement mix as an aggregate and once set she grinds them down to a smooth finish.

Studio Emma
Surface experimentations,
adding fully fired ceramics into
cement, then polishing.

CARBON OFFSETS

Our carbon subscription offsets 60 tonnes of CO_2e a year. It would take six pages of this booklet to show this circle to scale!

FACTS AND FIGURES

When we began this project we realised that we had made a lot of assumptions about the carbon impact of our practice. Digging into the facts and figures we started to challenge a lot of these preconceived notions. Firstly there is a commonly held belief that kilns must use tonnes of energy and as such ceramics is a high carbon usage practice, that lower temperature firings must use far less energy. Here is what we found out when we looked at the numbers behind our studio.

When firing to higher temperatures we found very little difference in the kw/h used. As we have two different styles of kiln in the studio we observed a difference in the energy used depending on the kiln style and insulation.

Our carbon subscription offsets 60 tonnes of CO_2e a year. We currently use **Carbon Neutral Britain,** whose projects are either Verified Carbon Standard (VCS), Gold Standard Voluntary Emission Reductions (VER) or Certified Emission Reductions (CER) certified. Carbon Neutral Britain spends 10% of our offsets on sustainable tree planting projects in Scotland and England.

Carbon offsets were not something we looked into lightly. We understand that they are a last resort for most and it can be hard to track their validity. For this reason after one year with Carbon Neutral Britain we are going to look into transitioning to more local charities such as Scottish Wildlife Trust and Trees for Life.

OUR WHEELS

run at an average of **0.4KW/H**

Based on an average use of 8 hours a week this amounts to **166.4KW/H PER YEAR**

38.27KG
CO_2e PER YEAR

BISQUE FIRING

to 1000°C used an average of **36.58KW/H** of electricity

8.4KG
CO_2e PER FIRING

GLAZE FIRING

to 1250°C used an average of **48.7KW/H** of electricity

11.2KG
CO_2e PER FIRING

ANNUAL FIRINGS

With an average of 60 firings a year, spread evenly between bisque and glaze firings, we estimate that we use

558KG
CO_2e PER YEAR

FINAL THOUGHTS

When we began this project, we were overwhelmed by the scope of the words ‘sustainability’ and ‘zero waste’. We wondered whether analysing our studio’s carbon output would ultimately lead us to the conclusion that the only way to improve would be to stop making altogether.

However, along the way we have been reminded of the value in being small makers. We are able to influence and work within our community. We have the power as small business owners to choose our materials carefully, and respond quickly to the information we have learned.

We also learned that we couldn’t be paralysed by wanting to achieve perfection, we needed to be open to challenging our assumptions, being dead wrong some of the time and accepting that this is only the beginning of our journey into sustainable ceramics. We will continuously need to stop and analyse our studio practices and not become complacent along the way.

Collection of experimental tests. From left to right: foraged clay and ash glaze, recycled paper added to porcelain body.

In the beginning of our project we were mostly concerned about the waste we were producing in the studio. This was perhaps because we had tangible material to deal with, and throwing it away into our rubbish bins twinged our consciences, leading us to want to minimise as much as possible. Research quickly led us to the fact the origin of our materials was of equal and probably greater importance. Understanding where our materials have come from and their overall impact is one of the most significant moves we can make. We wish for more easily accessible information from our suppliers about where and how our materials come to being.

Part of our ethos within our research has been complete transparency. We were particularly shocked to find in the beginning that not everyone shared in this belief, and some companies touting 100% zero waste were unwilling to share that knowledge in the community. This framed their sustainability claims as a marketing tool rather than a desire to reduce waste in a meaningful way. We hope that our information is transparent, practical and easy to understand to even the most novice potter, perhaps setting up their own home studio. As small businesses, the only way we can hope to have a meaningful impact is to be part of a larger movement.

There is a real growing movement between makers and artists of all disciplines, without this we would never have been able to collaborate with the amazing makers, who were able to take our rubbish and turn it into treasure and who could fill in the gaps of our knowledge. It is easy to become shortsighted and to be focused only on our own work, but through looking past our studio's four walls we can see the opportunity for change around us. We wish in the future to link up with more organisations, such as schools who may not have the requisite knowledge to make the most of their materials. This research project has given us a solid base of information to work from, but we recognise that this will be a lifelong journey and that there is plenty more still to learn.

Smoke fired object. Testing the surface finish on burnished clay as an alternative to glaze.

MATERIAL COLLABORATORS

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Creative Scotland

Test tiles, representing the blending of clay through wedging.

STUDIO FROST~WOOD

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