

How can traditional and modern pottery techniques be used to inform a circular, waste free economy for potters of the 21st century and beyond?

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Design Crafts

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Introduction

In this essay I am going to be looking at pottery techniques that can be used by potters to inform a circular and waste free economy. I will be looking at what a circular economy is and its importance to potters. I will be discussing a range of traditional techniques, in combination with modern techniques that potters can use to inform a circular and waste free practice. I will also be looking at changes potters can do so their practice is less wasteful. In addition, I will be comparing traditional consumption habits with today's consumerism. Ways of changing our way of thinking about consumption I will look at the Jugaad and Wabi Sabi ways of thinking. My thesis statement is 'how can traditional and modern pottery techniques be used to inform a circular, waste free economy for potters of the 21st century and beyond?' Key words and terms are circular economy, consumption, recycling, and clay. A summary of key literatures I have used are *Cradle to Cradle* by McDonough and Braungart, *The Complete Potters' Handbook* by Warshaw, and *Consumerism in World History* by Perer N. Stearns.

Chapter 1

In our current traditional linear economy products are made to be used, and then thrown away. Products are no longer designed to last, “everything is designed to reduce its value rapidly over time until we get to this stage where we have normalized and even praised excessive waste production” (Acaroglu, 2018). What happens to the product after its lifecycle is not important or thought of in its design process. We are currently in the age of consumerism and over consumption. People have always consumed resources because we need food, water, and shelter to survive. “Our era of human destruction has trained our eyes only on the immediate promises of power and profits” (Tsing *et al*, 2017, p. 2). Consumption is not inherently bad, but we have changed our consumption habits and are now over consuming resources. Before the 1800’s peoples consuming habits, even those of the wealthy, did not have the same consumerist issues we are currently having. They “Were part of cultures that did not operate in a consumerist direction, and extensive poverty was not the sole reason for this” (Stearns, 2001, p. 12).

As of 2021, we would need the equivalent of 1.7 Earths worth of resources to keep up with our current rate of consumption (Global Footprint Network, 2021). Changing our outlook on buying and consuming is important for creating a less wasteful economy. “Advertising exploits the idea that there is nothing we can’t be made to feel good about, no limit to how good we can feel, and nothing we will not do for those things” (Davidson, 1992, p. 25). As long as the aim of companies is to sell as much as possible, our current era of over

consumption will continue. There needs to be a change in how we think about production and products, and the Circular Economy model is an example of this.

A circular economy is where products are not designed to be used once and then thrown into landfills. The aim is to “keep resources in use for as long as possible” (Wrap, 2021), therefore making sure that all value has been extracted from the material. When a product has been used as much as it can be, then its components and materials are recycled and reused in other products. It is important that more businesses begin to adapt to a circular economy model because sticking to the ‘make, use, throw away’ model is not sustainable. Over 2 billion tons of waste is sent to landfill globally every year (The World Counts, 2021). Only 16% of this waste is recycled and only 46% of it is disposed of in an unsustainable way (Maplecroft, 2019). There is an obvious need for us to change how we approach products and change how we value them. The Earth's resources are not infinite, so it is important to find ways to not waste resources.

One way to achieve a circular economy is by re-imagining the design of a product. Recycling is a valuable resource that we have but can be made difficult by the design of the product, because few things are designed with recycling in mind. So, by reimagining a products design, you can design it to be made from different materials, or easier to take apart for recycling. I will be focussing on paper recycling first, then recycling clay, and finally using recycled materials to make new ceramic in my Granby Workshops case study.

Recycling paper is an old and traditional practice, the first recorded use of people recycling paper is in Japan in the 9th century (Northeast Recycling Council, 2019), and we are still recycling paper now. “Recovered fibre accounted for almost 60% of the worldwide manufacture of paper and paperboard in 2010” (Hubbe, 2014, p.1828). This means that paper manufacturing uses mostly recycled paper, so fewer trees need to be cut down. In 1985 the reported amount of recycled paper being used to make new paper was 45% (Porter and Roberts, 1985, p. 28), so there was an increase of 15% in 25 years. This is a slow rate of increase since it is only increasing by less than one percent a year. Work needs to be done to recycle more paper since 6 billion trees are still cut down every year to make paper and the amount of paper that people consume is expected to double by 2060 (The World Counts, 2021).

In the chapter *Eco effectiveness*, the design of three books is given to the reader as an example. The first book is the book that we are already familiar with, a paper book with a cover and ink text inside. A book as we know it does not last forever, so the question of what happened to the book after its lifecycle is posed. The paper of the pages is recyclable and can be combined with virgin paper to make new pages. The ink contains heavy metals, and the cover contains materials other than paper that means it cannot be recycled, composted, or burned (McDonough and Braungart, 2002, p. 68). The second book is one that product designers have attempted to make more eco-friendly. It has thin pages made from recycled paper printed with soy ink and no cover. But for the third book, the authors advise designers to reimagine the design process completely. The book does not need to be

made from the same materials we are used to and if the product designers think ahead then they can make sure that the smallest amount of resources are wasted.

The design and manufacturing processes of products contributes to the waste that is produced because of the products produced. So, when trying to make with minimal waste a maker needs to look at all points in the creation process. This includes thinking about where the materials you are using come from, what you waste while making and what happens when the lifecycle of what you are making finishes.



Fig 1. Well-Being and Future Generations (Wales) Act 2015 goals.

On the 10th of November 2021, the United Kingdom government approved legislation that aims to transition from a linear economy to a circular economy. This shows that transitioning into a more sustainable circular economy is becoming a critical issue. Through the act, there will be a push to make recycling more standardised for the public, and to do this the aim is to make recycling more accessible (Department for Environmental, Food, and Rural Affairs, 2021). This is a great start by the UK government to try and reduce the amount of waste the United Kingdom is producing, and “will protect and enhance our environment for future generations” (Department for Environmental, Food, and Rural Affairs, 2021). This was preceded by The Wellbeing and Future Generations Act (2015) which focuses on making sure that public bodies in Wales “think about the long-term impact of their decisions, to work better with people, communities and each other, and to prevent persistent problems such as poverty, health inequalities and climate change” (Future Generations, 2015). This act has seven goals for these public bodies to achieve and it is made clear that the aim is to reach all seven of the goals and not just some of them. Through achieving these goals, the aim is that future generations will be able to live in Wales with the same, or better quality of life than we do now (Welsh Government, 2021).



Fig 2. Bags of clay.

Pottery can be very resource intensive so when looking to have an eco-friendlier practice, there are different techniques that potters can use. Potters can look at different ways to reduce waste and resource consumption and can use the Circular Economy theory to inform their practice. The main and most important material that is used by potters is clay. Clay is mostly made from silica and alumina hydrated by water, Guggenheim and Martin define clay as “a naturally occurring material composed primarily of fine-grained minerals, which is generally plastic at appropriate water contents and will harden when dried or fired” (Guggenheim and Martin, 1995, p. 255). The variation of different impurities in clay gives it

different properties, and because of this there are different clay types (Chappell, 1991, p. 18). There are four different refined types of clay which are; Earthenware clay, Stoneware clay, Ball clay, and Porcelain (Warshaw, 2003, p. 14). Traditionally potters would only have access to the clay that is locally available to them but with modern transportation potters have access to all types of clay from all over the world. In the UK we mostly just have earthenware and stoneware clay that can be mined here, so UK potters need to transport other clay from other countries.

When working with clay a key factor is controlling its moisture content, "the nature of clay changes with its moisture content" (Blandino, 1997, p. 126). Clay has different uses depending on how dry it is. Liquid clay is used as a 'ceramic glue,' so that pieces of ceramic can be stuck together. "Moist clay's wonderful quality of flexibility is known as plasticity" (Davis, 1998, p. 22), plastic clay will hold its own shape but will change shape when force is applied. Clay that is wet enough to be soft and easily manipulated is best for making pots on the wheel. When it is slightly dryer, it is best for hand building clay because it holds its shape better than wet clay. Very dry clay, or bone-dry clay, is no longer usable but that does not mean it has to be thrown away. At any moisture level clay can be reclaimed back into usable clay. Clay is very recyclable in this way.

Reclaiming clay is a traditional technique that has been used by potters for an exceptionally long time. This is the first technique that potters can use to inform a circular and waste free economy. Reclaiming clay stops material from going to waste, and therefore less clay needs to be mined. Reclaimed clay is clay that has not been fired yet and can be recycled and

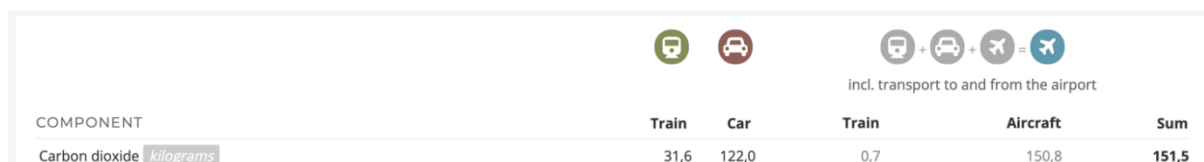
reused. Reclaiming clay is all about managing how much water is in the clay. In *The Complete Potters Handbook* (2003), Warshaw described the process of reclaiming clay. If the clay is too wet, then you put the wet clay on to a block of plaster and wait for it to dry. Once the clay has dried to a workable consistency then you can wedge it into a useable piece of clay. Wedging is when you knead the air bubbles out of clay (Fortnum, 2009). If the clay is too dry, then you need to add water to it. Once the clay has become a consistent thick slurry, then you repeat the steps as before. The clay is put to dry on a plaster block and wedged once it has dried to a workable consistency.

Recycling clay in this way means that very little clay is wasted. The clay can keep being reused until it is fired. This is extremely low waste since the only resource that is being consumed is water. So, if an item that is being made from clay has a mistake, it can be recycled. This helps ensure that only quality items get sold, and items last longer. If items last longer then fewer items are going to landfill. The more clay a potter reclaims instead of throwing away, the less a potter will need to buy. The less clay a potter needs to buy means less travel emissions for the clay. Recycling clay uses a lot of water, and most of that water is evaporated away, so a lot of water is wasted this way.

Controlling the moisture content in clay is key factor in pottery. Therefore, water is a heavily used resource in pottery. Only 2.5% of water on the planet is fit for human consumption, this is called fresh water (Smarter Business, 2020). Treated fresh water is what comes out of taps, so when potters use water, they are using drinking water. Fresh water is mined from

natural aquifers, and the aquifers are currently being drained faster than they can fill back up (Harvey, 2018).

Potters do not need to use drinking water when doing pottery. For pottery you only need water that does not have any large particles that could scratch or embed in the clay body, so tap water is not necessary. There is an opportunity to reduce wasting drinking water by collecting rainwater for pottery. If any large particles are strained out of the rainwater, there will not be any difference in use between the rainwater and the drinking water. Reducing the amount of drinking water used in their practice, potters can limit how many resources they are using. In addition to using excess resources by using tap water, potters can also use unnecessary resources by importing their clay from countries other than their own.



COMPONENT			 +  +  = 	Sum
	Train	Car	incl. transport to and from the airport Train Aircraft	
Carbon dioxide kilograms	31,6	122,0	0,7 150,8	151,5

Fig 3. Screenshot of carbon dioxide comparison of train and car.

Too much CO₂ in the atmosphere is affecting the planet negatively. It affects the planet by trapping heat from the sun by reflecting the heat back onto Earth and not letting the heat go back into space. This is causing global warming, which is causing extreme weather changes that are leading to animal extinctions, food supply issues and harsher living

conditions for all animals including humans (Nunez, 2019). Therefore, it is important that everyone puts in effort to reduce their CO₂ output as much as possible. For potters, the travel emissions generated from the import of materials and tools is a big contributor of CO₂ emissions. To reduce travel emissions, potters can buy clay from a local source. Travelling the same distance, aeroplanes produce more emissions than trains. Germany is one of the leading distributors of ball clay (Virta, 2006). So, on a journey from Germany to London a plane produces 151.5kg of carbon dioxide as seen in Fig 3. Doing the same journey from Germany to London a train produces 31.6kg of CO₂. So locally sourced clay is less likely to have been transported by plane so would have lower travel emissions attached.

Another way that potters can reduce their carbon dioxide emissions is by digging up and processing their own clay. Potters digging their own clay from somewhere near their workshop is a traditional practice, “to dig a single clean clay in the vicinity of the kilns was the habit of the old country potters” (Leach, 1940, p. 43). Today, clay is transported all over the world so that countries have access to clay types they would not normally have access to. However, this leaves particular areas with a negative impact on their environment, for example Ghana.

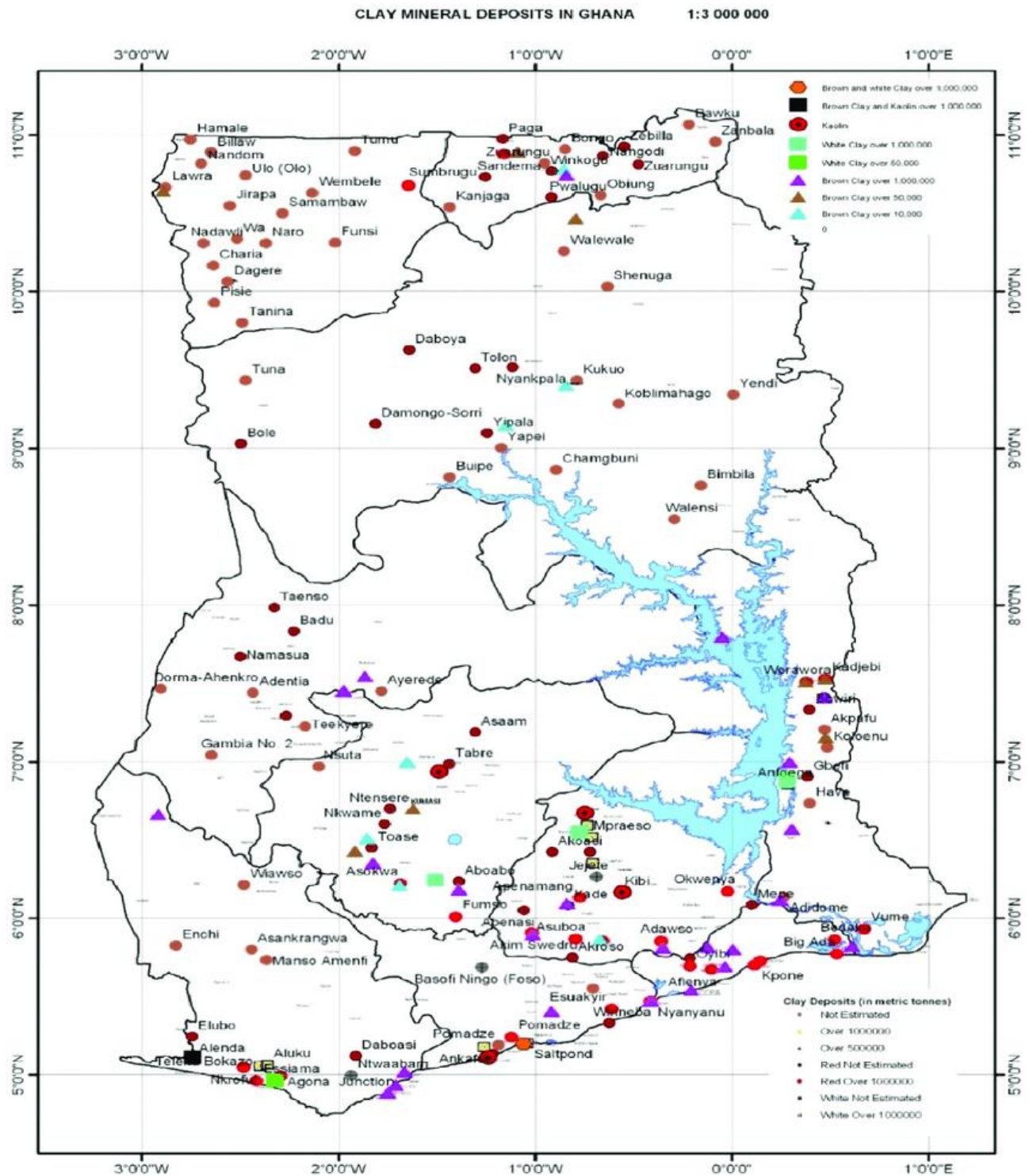


Fig 4. Map of clay deposits in Ghana.

One way clay is mined is through open pit mining. With this method of mining, a large hole is dug into the ground where there is a large natural clay deposit until all the clay is gone. Ghana is a country with lots of clay deposits as seen in figure 4, which is why clay mining is common there. In Ghana it is common for the miners to then abandon the pit when all the clay is harvested without returning the area to how they found it. The clay deposits that are being mined in Ghana are frequently next to rivers and the runoff is polluting the water. When the pits are left, water gathers in the pit and becomes a breeding ground for mosquitos and is trapping larger animals (Asante-Kyei and Addae, 2016, p. 120). To mitigate these effects, policies should be put in place to make sure that clay miners cannot do this anymore and efforts should be made to restore the area, so it does not fill with water and is not so steep animals get trapped in the pit. In Shama, a region of Ghana, they recently introduced a ban on clay mining in January because of illegal clay mining that had been happening there. They introduced this ban to repair the damage that had been done to the environment by illegal mining operations there (Annim, 2021). What has happened with the mining industry in Ghana is an example of the colonial impact that richer countries have done to poorer countries. Industry is moved to a country where labour is cheaper and then the local area where the industry is moved to suffers.

Larger deposits of clay are usually covered by topsoil so a good possible location to find decent sized deposits of clay is by streams or somewhere that has recently been dug up. To refine the clay, it first needs to be dried. Once dry, it needs to be broken into small pieces and saturated with water. When the clay has a thin liquid consistency it is passes through a sieve to remove large particles like stones and organic matter. The liquid clay is left for the

clay and water to separate, and the excess water removed. Then, like when reclaiming clay, it is dried on a plaster bat then wedged (Chappell, 1991, p. 22). Because potters will only be digging up lesser amounts of clay in comparison to pit mining, potters can mitigate the negative effects of pit mining.

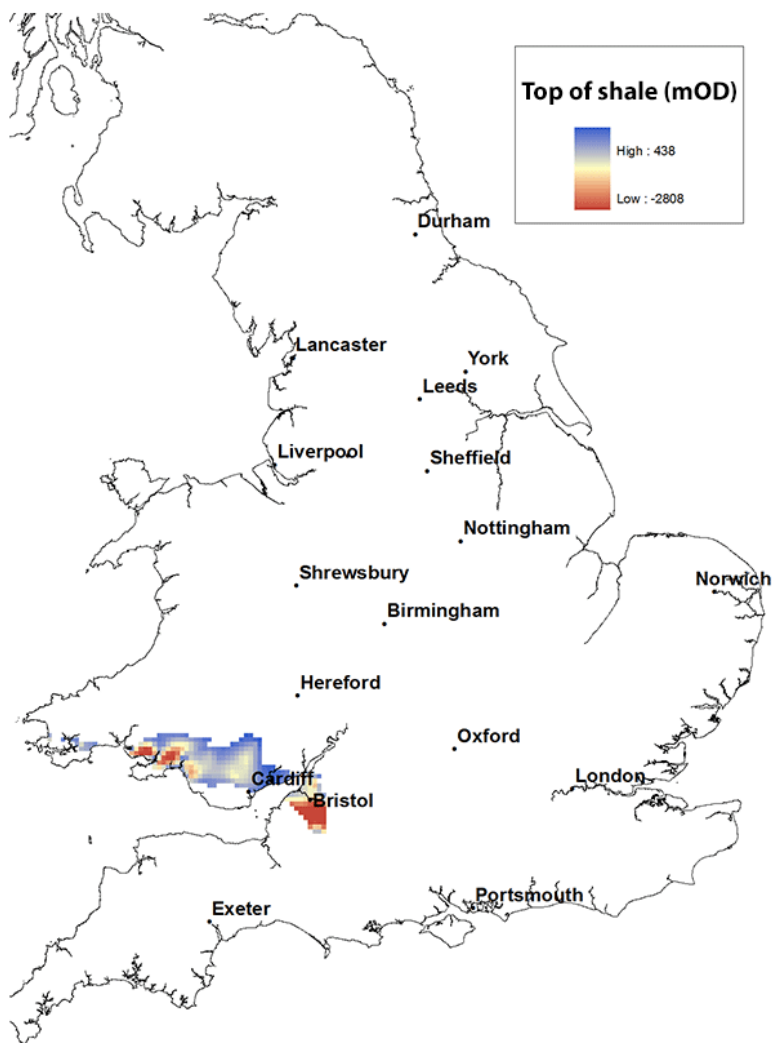


Fig 5. Map of clay deposits in Wales.

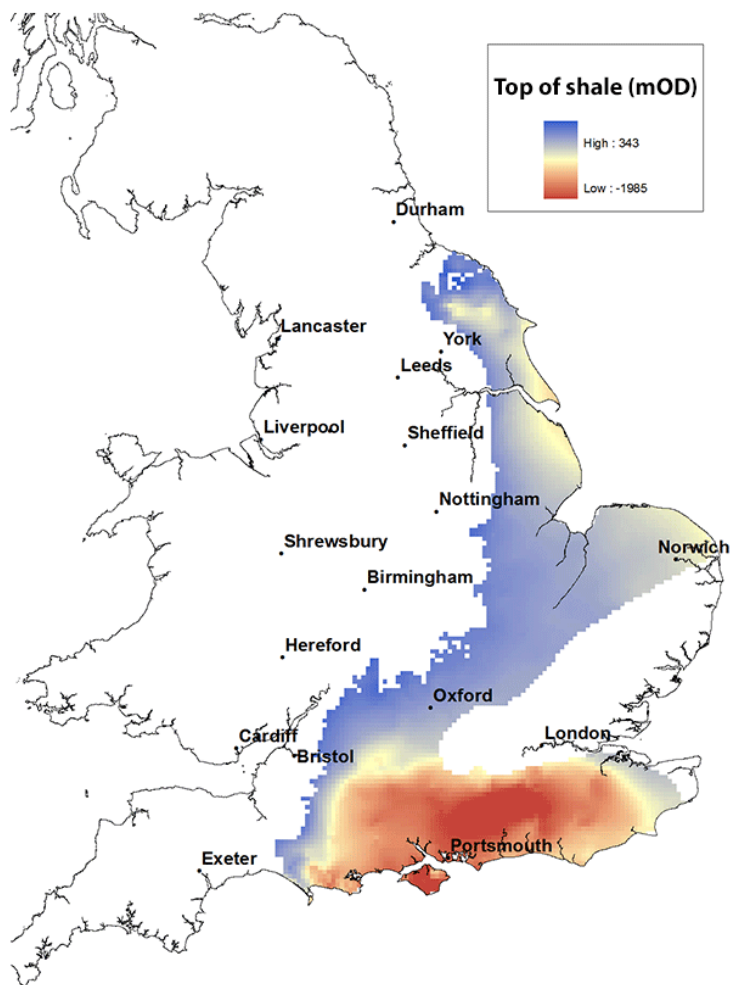


Fig 6. Map of clay deposits in England.

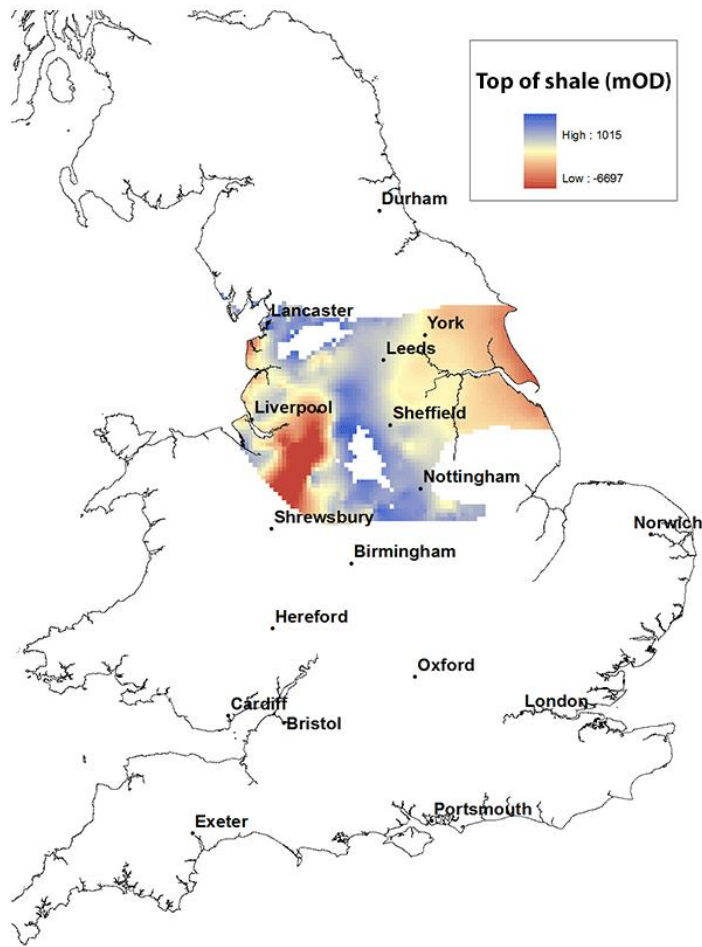


Fig 7. Map of clay deposits in England.

Figures 5, 6, and 7 show known large clay deposits in Wales and England. This indicates that there is enough clay in the UK that we could go back to mining clay locally. With vast amounts of clay available locally it is not necessarily environmentally valid to import as much clay anymore. Instead of buying clay that has already been mined, potters can mine their own clay since clay can be found in most places. Mining their own clay gives potters an opportunity to reduce their carbon footprint since the clay is going straight from the ground to the potter's studio. By digging their own clay potters are also reducing how much plastic they use. Commercially bought clay comes in plastic bags, so that is one less piece of plastic

for every equivalent bag of clay they dig up themselves. And to store the clay they have dug up themselves potters can reuse plastic bags, instead of sending plastic to landfill. Once clay has been extracted from the earth and been turned into usable clay, potters use tools to transform the clay into a form. One of the tools that potters can use is a pottery wheel.

A kick wheel is the traditional pottery wheel that has been used by potters for 5000 years (Warshaw, 2003, p. 112). A kick wheel is a turntable connected to a flywheel by a shaft and is spun by the potter kicking the fly wheel. This type of wheel does not use any electricity in comparison to the standard modern wheel. A modern electrical wheel has a motor and is run using electricity. With a traditional kick wheel, they rotate quite slowly, which can make it more difficult to throw on and it is common for the wheel to have a slight wobble which also makes it more difficult to throw on. Newer electric wheels are more likely to run smoothly and can usually rotate a lot faster than a kick wheel which makes for easier and faster throwing (Davis, 1998, p. 13). But they use electricity, and electricity can be very resource intensive to make if it made using fossil fuels. Modern potters can reduce how much fossil fuel they consume by switching to renewable energy in their pottery practice. Once a potter has made their piece out of clay, it needs to be put into a kiln to be fired.



Fig 8. Electric kiln.

A kiln is where a potter puts their clay pieces to be fired. Heating the clay to high enough temperatures for it to turn into ceramics is called firing the clay (BBC, 2021). Clay needs to be fired to 960 degrees Celsius to 1120 degrees Celsius for it to undergo the chemical change from clay to ceramic (Birks, 1993, p. 177). If a piece is glazed then it will need to be fired at least twice, and it takes a lot of energy to reach the temperatures needed for pottery (Milne, 2020). So, another way that potters can lower resource use is to switch to using renewable energy sources for their kiln. A potter switching to renewable energy for all their tools that require electricity is a wonderful way for them to consume less resources.

When the clay has been fired the properties of the clay changes, “a permanent bonding takes place then between clay particles, thus generating a waterproof material” (Santacreu, 2014, p. 91). The properties of ceramic have gone from plastic, soft, and water soluble, to being hard, durable, and waterproof. Once the clay has turned into ceramic it can no longer be reclaimed into usable clay because chemically it has been changed by the heat. Since the clay can no longer be reclaimed, it is important that potters fire pieces with intention because ceramic takes a long time to break down.

The oldest piece of pottery that has been found is dated 28,000 BCE (The American Ceramic Society, 2021). This indicates that it could potentially take longer than 30,000 years for ceramic to break down. The longevity of a piece of ceramic is strongly dependant on how high of a temperature the clay is fired to. Firing clay to a high temperature makes it “extremely durable, especially compared to both low-fire and mid-range ceramics” (Soul Ceramics, 2021). The lower a ceramic piece has been fired at, the faster it breaks down. The revival of the kulhad relies on this.

A kulhad is a reusable ceramic bowl that is mainly used in India and Pakistan that is used to serve food and drink. It is a traditional vessel that has been used for over 5000 years in India and Pakistan (Dhamija, 1992, p. 64). The Indian Government has been trying to bring back the kulhad for 17 years to replace single use plastics, particularly on trains (Dhillon, 2020). Since plastics never completely decompose (Plastic Soup Foundation, 2021), the change

from plastic to ceramic could have a significant impact in reducing how much waste is left by humans on the planet. The use of the kulhad in India follows their tradition of the Jugaad way of thinking.

Jugaad is an Indian word that cannot be directly translated to English but roughly means to use what you already have in a creative way. “Jugaad is a way for people to deal with whatever life throws at them, in ways you’d never expect” (*Untranslatable Words*, 2017), this way of thinking could be especially valuable if you do not have excess resources available to you. According to *Jugaad Innovation*, the main principles of jugaad are to “seek opportunity in adversity, do more with less, think and act flexibly, keep it simple, include the margin, and follow your heart” (Ahuja, Prabhu, and Radjou, 2012, p.19). The main principles of jugaad align with the Circular Economy method really well, and it could benefit potters to employ the jugged mindset in their practice.

Whilst it takes ceramic significantly less time than plastic to decompose and break down, it can still take hundreds to thousands of years depending on how it was fired. In the United Kingdom, 68 million tonnes of ceramic waste are sent to landfill every year (Lasseuguette *et al*, 2017). This is not sustainable since ceramic can take an exceptionally long time to break down, it will spend hundreds to thousands of years in landfill decomposing. Older pieces of ceramics frequently had elevated levels of lead because it made an attractive and reliable red colour, but lead is not used as frequently in pottery anymore because of the health risks (Princeton University, 2021). The lead in ceramic could leach out into the earth and affect the local ecosystem when put into landfill, but since less lead is used now, less lead is being

leached into the earth. Once a piece of pottery is broken, or not wanted anymore, it cannot be put in the recycling because ceramic cannot be recycled (Recycle Right, 2021). That does not mean it is completely useless though, it depends on how you view the broken object.



Fig 9. Ceramic bowl that has been repaired with Kintsugi.

Wabi Sabi is the Japanese art of finding beauty in imperfection, “the term Wabi Sabi suggests such qualities as impermanence, humility, asymmetry, and imperfection” (Juniper, 2003, p. 2). An example of this way of thinking is Kintsugi, the art of repairing broken ceramic with gold, silver or platinum (Witt and Nolte, 2018). By repairing something that is broken, you are making something beautiful out of something that would have gone to landfill. Techniques like this show us that what we view as discardable is dependent on our viewpoint.

There are many different techniques that potters can use to reduce their waste and inform a circular economy model in their practice. It is through a combination of modern and traditional techniques that potters can have an eco-friendly way of working. To have a greener practice potters can mine their own clay or buy locally, use collected water instead of tap water and reclaim all unused clay. Buying clay locally or digging up their own clay can also reduce their CO2 emissions. The other way they can reduce their CO2 emissions and resource consumption is to switch to renewable energy in their practice. Ceramic can take a really long time to breakdown, so it is important for potters to be mindful about what they fire. Big changes are unlikely to happen quickly, but all effort to be more environmentally friendly is valid. With government intervention, businesses will be forced to adopt a greener way of thinking as there will be many companies that have no desire to make their production processes greener without legislation. This would hopefully help avert situations like what has happened in Ghana. The Well-Being of Future Generations Act 2015 is ensuring that the beginnings of a change in mind-set are happening in Wales. By using the Jugaad and Wabi Sabi way of thinking we can change our mind-set to be less wasteful, and use what we already have. When it comes to over consumption, what we need to change the most is our outlook towards consumerism. Consumerism only happens for as long as we allow it to, and although buying stuff can give a sense of purpose and identity, it is entirely superficial (Stearns, 2001, p. 154).

Chapter 2: Case Studies

I will be doing an artist case study on Granby Workshop, a ceramic workshop that is based in Liverpool. Granby Workshop values the manufacturing processes when it comes to making their products. Granby Workshop produces unique pieces, and this is a result of them valuing the “creative potential of manufacturing” (Granby Workshop, 2021). In their products, they utilise randomness to get unique pieces. They have recently invented a new process of making ceramics where no virgin material is used and is made entirely of recycled material (Positive News, 2021). This new method uses materials from the ceramic industry, glass industry and waste from the quarrying industry such as slate, granite and marble. For their clay body they use industrial clay waste combined with crushed fired ceramics. Their glaze is made from recycled glass which gives them the base of their glaze. From the base, ground refractory bricks are used to strengthen the glaze. Crushed fired ceramics and recycled glass is what gives the clay its colours. This means each batch is unique due to the manufacturing process used (Kickstarter, 2020).



Fig 10. Granby Workshops' Recycled Ceramics.

By utilising waste from other industries to make their products, Granby Workshop has not only reduced waste from their own products, but utilised material that would have been sent to landfill by other manufacturers. This is an excellent example of a Circular Economy working, since these ceramic pieces are made from recycled ceramic. This is a notable example of a company working as waste free as possible, since their pieces are made from waste products. Granby Workshop is proving that there is a way that fired ceramic can be recycled. Granby Workshop has shown us that this kind of manufacturing can be done reliably and commercially. Hopefully, Granby Workshop's efforts at developing this new process will inspire other companies to do the same.

The second case study I will be doing is on Bernard Leach, an English potter that lived 1887 to 1979. He was born in Hong Kong, and returned to Japan as a young adult and was greatly influence by the pottery there. When he returned to England Leach set up Leach Pottery with Shoji Hamada in St Ives, Cornwall in 1920 (Ceramic Review, 2020). They encountered some problems when setting up the workshop, one of them being that there were not any large clay deposits in Cornwall. So, they travelled further to find clay for the workshop. For his pottery practice Leach dug up his own clay, "they found earthen ware clay near St. Erth and obtained stoneware from Dorset and Ball clay from Devon" (Leach Pottery, 2021).

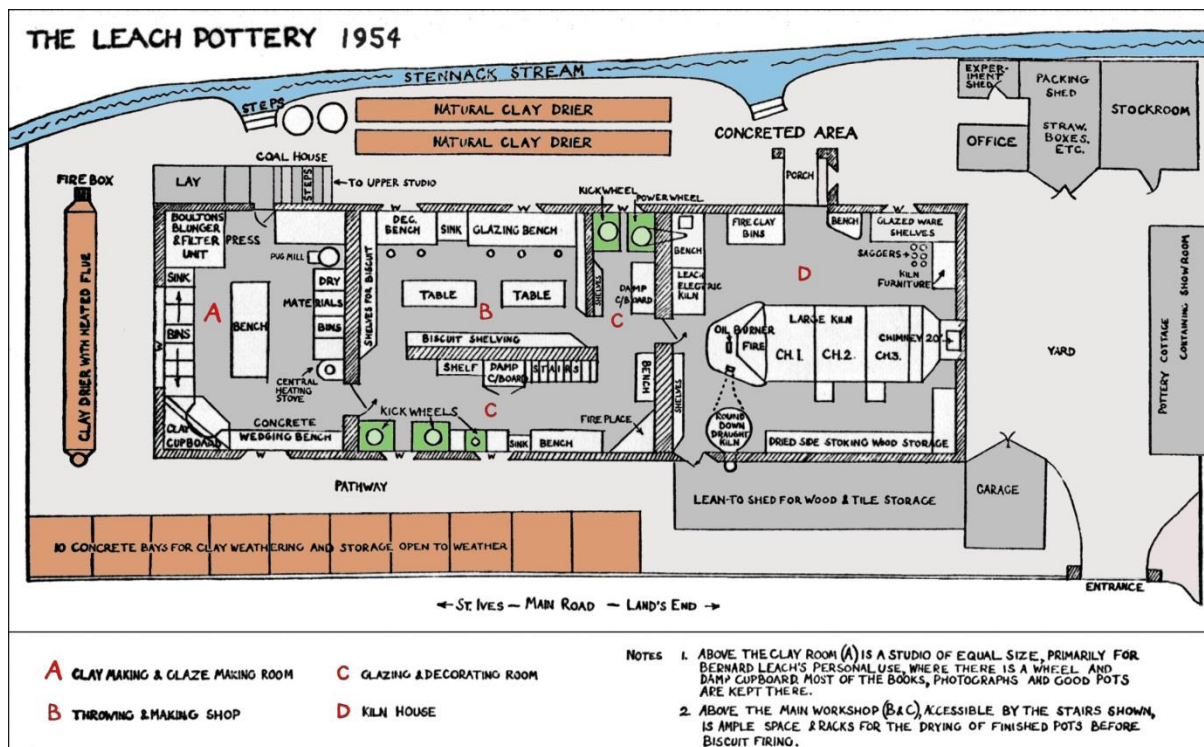


Fig 11. Map of Leach Pottery layout.



Fig 12. 3D model of Leach Pottery by Bernard Leach.

Leach planned the layout of his workshop meticulously; he created 3D paper models so that he could plan what would be on the walls as well as the layout. Fig 12 shows how detailed he planned the layout of the workshop. Each step in the pottery process had its own section, which can be seen in Fig 11. The layout of Leach pottery works really well (Marty Gross Film Productions, 2016), there is a flow to the layout so that the location of each step in the pottery process leads to the next step.



Fig 13. Bottle made by Bernard Leach.

He was a very influential potter in the 20th century, his work was a blend between English and Japanese style pottery which was considered very contemporary at the time. While he worked at Leach Pottery, Bernard Leach had many apprentices work with him (Antique Collecting, 2020), and this is one of the reasons he had such a big influence on potters at the time. When Leach started doing pottery, there were not any published books on how to start doing pottery (Smith, 2020). So, in 1940, he published *A Potter's Book* to make pottery more accessible.

Bibliography

Acaroglu, L. (2018) *Design for Disposability*. Available at: <https://medium.com/disruptive-design/design-for-disposability-962647cbcb0> (Accessed: 18 October 2021).

Ahuja, S. and Prabhu, J. and Radjou, N. (2012) *Jugaad Innovation*. San Francisco: Jossey-Bass.

Annim, A. (2021) 'Minerals Commission to prosecute 15 persons for defying clay mining ban at Shama', *City News Room*, 4th February. Available at: <https://citinewsroom.com/2021/02/minerals-commission-to-prosecute-15-persons-for-defying-clay-mining-ban-at-shama/> (Accessed: 02 December 2021).

Antique Collecting (2020) *Bernard Leach – a quick guide to his ceramics*. Available at: <https://antique-collecting.co.uk/2020/06/15/bernard-leach-a-quick-guide-to-his-ceramics/> (Accessed: 08 December).

BBC (2021) *Firing Process – Ceramics*. Available at: <https://www.bbc.co.uk/bitesize/guides/zsnbg82/revision/6> (Accessed: 01 December 2021).

Birks, T. (1993) *The Complete Potters Companion*. London: Conran Octopus.

Ceramic Review (2020) *The Leach Pottery: A Living Tradition*. Available at: <https://www.ceramicreview.com/articles/the-leach-pottery/> (Accessed: December 08 2021).

Chappell, J. (1991) *The Potters Complete Book of Clay and Glazes*. United States: Watson-Guptill Publications.

Davidson, M. (1992) *The Consumerist Manifesto*. London: Routledge.

Davis, D. (1998) *Wheel-Thrown Ceramics*. United States: Lark Books.

Department for Environmental, Food and Rural Affairs (2021) *World Leading Environmental Act becomes law*. Available at: <https://www.gov.uk/government/news/world-leading-environment-act-becomes-law> (Accessed: 14 November 2021).

Dhamija, J. (1992) *Indian Folk Arts and Crafts*. India: National Book Trust.

Dhillon, A. (2020) 'All change: India's railways bring back tea in clay cups in bid to banish plastics', *The Guardian*, 3rd November. Available at: <https://www.theguardian.com/global-development/2020/dec/03/all-change-indias-railways-bring-back-tea-in-clay-cups-in-bid-to-banish-plastics> (Accessed 07 December 2021).

Fortnum, K. (2019) *What is wedging*. Available at: <https://www.katherinefortnumceramics.com/post/what-is-wedging> (Accessed: 12 October 2021).

Future Generations (2015) *Well-Being of Future Generation (Wales) Act 2015*. Available at: <https://www.futuregenerations.wales/about-us/future-generations-act/> (Accessed: 28 November 2021).

Global Footprint Network (2021) *Ecological Footprint*. Available at: <https://www.footprintnetwork.org/our-work/ecological-footprint/> (Accessed: 14 November 2021).

Guggenheim, S. and Martin, R. T. (1995) *Clays and Clay Minerals*. United States: Clay Minerals Society.

Harvey, F. (2018) 'Are we running out of water?', *The Guardian*, 18th June. Available at: <https://www.theguardian.com/news/2018/jun/18/are-we-running-out-of-water> (Accessed: 02 December 2021).

Hubbe, M. (2014) 'Recycling Paper Recycling', *Bioresources*, 9(2), p1828-2829.

Juniper, A. (2003) *Wabi Sabi: The Japanese Art of Impermanence*. Hong Kong: Tuttle Publishing.

Kickstarter (2020) *Granby ware*. Available at: <https://www.kickstarter.com/projects/granbyworkshop/granbyware/comments> (Accessed: 18 November 2021).

Lasseuguette, E. *et al.* (2017) *Recycling Ceramic Waste to Produce Green Concrete*. Available at: <https://www.research.ed.ac.uk/en/publications/recycling-ceramic-waste-to-produce-green-concrete> (Accessed: 04 December 2021).

Leach, B. (1940) *A potter's Book*. England: Clays Ltd.

Leach Pottery (2021) *History*. Available at: <https://www.leachpottery.com/history> (Accessed: 08 December 2021).

Maplecroft, V. (2019) *Waste Generation and Recycling Indices 2019*. Available at: https://www.circularonline.co.uk/wp-content/uploads/2019/07/Verisk_Maplecroft_Waste_Generation_Index_Overview_2019.pdf (Accessed 26 October 2021).

Marty Gross Film Productions (2016) *The Leach Pottery 1952* [video]. Available at: <https://video.alexanderstreet.com/watch/the-leach-pottery-1952> (Accessed: 08 December 2021).

McDonough, W. and Braungart, M. (2002) *Cradle to Cradle*. New York: North Point Press.

Milne, L. (2020) *Is Pottery Eco-Friendly?* Available at: <https://thepotterywheel.com/pottery-clay-eco-friendly/> (Accessed: 28 November 2021).

North East Recycling Council (2019) *A Brief History of Recycling*. Available at: <https://nerc.org/news-and-updates/blog/nerc-blog/2019/11/19/a-brief-history-of-recycling> (Accessed: 14 November 2021).

Nunez, C. (2019) 'Carbon Dioxide Levels are at a Record High', *National Geographic*, 13th May. Available at: <https://www.nationalgeographic.com/environment/article/greenhouse-gases> (Accessed: 02 December 2021).

Plastic Soup Foundation (2021) *Plastic Production and Decomposition*. Available at: <https://www.plasticsoupfoundation.org/en/plastic-problem/plastic-environment/plastic-production-decomposition/> (Accessed: 07 December 2021).

Porter, R. and Roberts, T. (1985) *Energy Savings by Waste Recycling*. Amsterdam: Elsevier Applied Science.

Positive News (2021) *The Dinnerware Made from Recycled Ceramic*. Available at: <https://www.positive.news/lifestyle/smashing-the-dinnerware-made-from-recycled-waste/> (Accessed: 18 November 2021).

Princeton University (2021) *Ceramics*. Available at: <https://ehs.princeton.edu/health-safety-the-campus-community/art-theater-safety/art-safety/ceramics> (Accessed: 02 December 2021).

Recycle Right (2021) *Household Ceramics*. Available at: <https://recycleright.org.uk/item/household-ceramics/> (Accessed: 02 December 2021).

Smarter Business (2020) *Will We Ever Run Out of Fresh Water?* Available at:

<https://smarterbusiness.co.uk/blogs/will-we-ever-run-out-of-fresh-water-sources/>

(Accessed: 01 November 2021).

Smith, I. (2020) 'Wheel of fortune – the life and achievements of Bernard Leach', *Apollo*, 18th

July. Available at: <https://www.apollo-magazine.com/bernard-leach-centenary/> (Accessed:

09 December 2021).

Soul Ceramics (2021) *Guide to kiln temperature ranges for pottery*. Available at:

<https://www.soulceramics.com/pages/guide-to-kiln-temperature-ranges-for-pottery>

(Accessed 14 October 2021).

The American Ceramic Society (2021) *Brief History of Ceramics*. Available at:

[https://ceramics.org/about/what-are-engineered-ceramics-and-glass/brief-history-of-ceramics-and-](https://ceramics.org/about/what-are-engineered-ceramics-and-glass/brief-history-of-ceramics-and-glass#:~:text=The%20oldest%20known%20ceramic%20artifact,Brno%2C%20in%20the%20Czech%20Republic)

[glass#:~:text=The%20oldest%20known%20ceramic%20artifact,Brno%2C%20in%20the%20Czech%20Republic](https://ceramics.org/about/what-are-engineered-ceramics-and-glass#:~:text=The%20oldest%20known%20ceramic%20artifact,Brno%2C%20in%20the%20Czech%20Republic) (Accessed: 11 October 2021).

The World Counts (2021) *World Waste Facts*. Available at:

<https://www.theworldcounts.com/challenges/planet-earth/state-of-the-planet/world-waste-facts/story> (Accessed: 23 October 2021).

The World Counts (2021) *Paper Comes from Trees*. Available at:

<https://www.theworldcounts.com/stories/paper-waste-facts> (Accessed: 02 December 2021).

Tsing, A. (2017) *Arts of Living on a Damaged Planet*. USA: University of Minnesota Press.

Untranslatable Words (2017) BBC Culture, 14 December. Available at:

<https://www.bbc.com/culture/article/20171213-jugaad-an-untranslatable-word-for-winging-it> (Accessed: 8 May 2021).

Virta, R. L. (2006) 'Ball Clay', *Mining Engineering*, 14 December, p. 41.

Warshaw, J. (2003) *The Complete Potters Handbook*. London: South water.

Welsh Government (2021) *The Well-Being and Future Generations act*. Available at:

<https://gov.wales/well-being-of-future-generations-wales> (Accessed: 26 November 2021).

Witt, A. and Nolte, T. (2018) 'Kintsugi ++', *Issues in Science and Technology*, 34(4), p. 55.

Available at: [https://www-jstor-](https://www-jstor-org.ezproxy.uwtsd.ac.uk/stable/26597990?seq=1#metadata_info_tab_contents)

[org.ezproxy.uwtsd.ac.uk/stable/26597990?seq=1#metadata info tab contents](https://www-jstor-org.ezproxy.uwtsd.ac.uk/stable/26597990?seq=1#metadata_info_tab_contents) (Accessed: 09 December 2021).

Wrap (2021) *Wrap and the Circular Economy*. Available at: [https://wrap.org.uk/about-](https://wrap.org.uk/about-us/our-vision/wrap-and-circular-economy)

[us/our-vision/wrap-and-circular-economy](https://wrap.org.uk/about-us/our-vision/wrap-and-circular-economy) (Accessed: 18 October 2021).

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