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An exploration into the balance between culture and sustainability through Nigerian coral bead jewellery, and the creation of a sustainable alternative to the natural coral used for the beads.

By Oghenerume Egbeniyoko



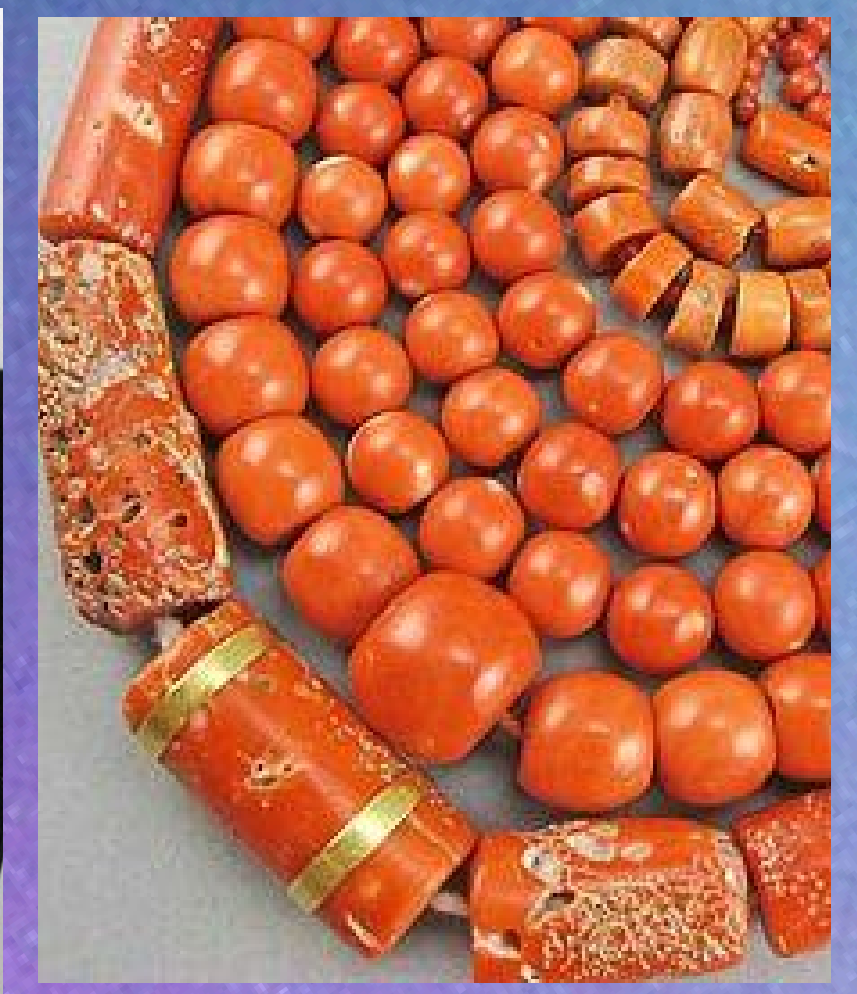
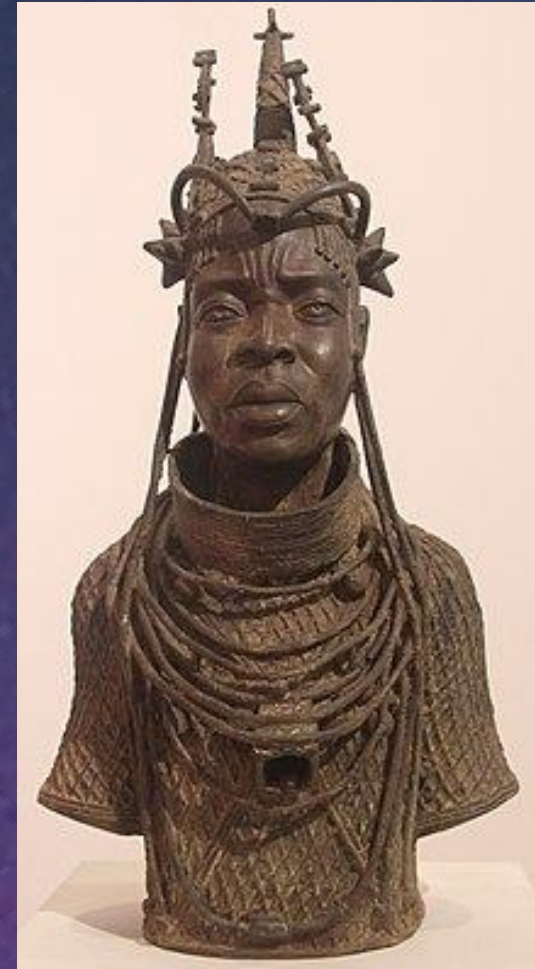
The History

Coral use in Nigerian jewellery dates back to the 15th century, when **Portuguese traders exchanged coral for spices, textiles, and other goods.**

Initially **used by Benin royalty**, before later spreading across other Nigerian tribes.

Now, they're **commonly used for special occasions such as weddings, coronations, and religious ceremonies.**

They **symbolize royalty, wealth, and spiritual protection.**



The Problem

Significant threat to marine biodiversity.

Coral reefs support
about 25% of all
marine species.

50% of coral reefs
already destroyed
or at risk.

110,000 lbs of coral
is extracted
annually for the
jewellery trade.

Coral jewellery
industry is valued at
\$168M annually.

"It's not something people think about often, there's less consciousness about the impact of coral harvesting."

~ Nigerian Elder

How can cultural preservation coexist with environmental protection?

The Stakeholders

Macro

Law Makers - Outlines initiatives for sustainability and sets regulations.

Department of Forestry - Controls supply of Pine Resin and promotes forest conservation.

Cultural Leaders - Those who control who receives beads and influence trends.

Waste Collectors - Participates in circular economy through waste eggshell contribution.

Meso

Tailors - Produce native attire that the beads are used with.

Farmers/bakeries - Those who have a chicken farm to harvest and sell on the bulk wasted eggshells.

Local Artisans / Makers - Commissioned to design and make the bead depending on the occasion.

Miso

Consumers:

Native residents - Those born and bred in Nigeria for most of their lives, experiencing the culture first hand.

Familiar Diaspora - Those familiar with the culture despite being disconnected from the source of it.

Unfamiliar diaspora - Those who are detached from their heritage due to disconnection from its source.

Creatives - Understand the methodology and reapply in different context.

Understanding the Value

Father and Son Interview

Profile: **61 Yr Old - Male - Father**

Place of Birth: **Nigeria**

Place of Upbringing: **Nigeria**

Connection to Nigerian Culture: **Strong due to upbringing**

Profile: **24 Yr Old - Male - Son**

Place of Birth: **UK**

Place of Upbringing: **UK - Nigerian Diaspora**

Connection to Nigerian Culture: **Strong due to family support**

- *"The less refined and more natural a coral bead is, the more valuable it becomes."*
~ Father
- *"The diaspora's inquisitive appreciation allows us to push design languages forward."*
~ Son
- *"It's about tying the alternative to history and culture, making it relatable and significant."*
~ Father

Coral beads value comes from their connection to cultural heritage, and their imperfections. Unlike pearls or gold, cracks, discolouring and warping in the brads increase their desirability.

"If it looked and felt like coral, and its story was tied to heritage, it could be an alternative." ~ Father

The Innovation

Where is the innovation?

The innovation is the creation of a biomaterial that authentically replicates the cultural and aesthetic value of Nigerian coral beads while supporting ecological preservation; through methods of design and experimental manufacturing techniques.

The Impact

What are the impact goals?

- To reduce ecological damage by offering a sustainable alternative that eliminates the need for natural coral harvesting.
- To repurpose organic waste materials, into high-value products, promoting a circular material economy.
- To preserve the symbolic and aesthetic integrity of Nigerian coral bead jewellery through material innovation.
- To promote new income generation through a scalable product ecosystem that benefits small-scale producers.
- To develop a versatile design methodology for designing sustainable solutions to issues in heritage rich contexts.

The Process

Phase 1: **Material Exploration**

~ 3 weeks

- New material compositions.
- Evaluate the internal structure, capabilities and constraints of the material.
- Replicate the distinctive hues and organic patterns of natural coral.

Phase 2: **Machinability Exploration**

~ 2 weeks

- Manufacturing processes that can be applied to the biomaterial.
- Refine processes for greater control over form.
- Optimise the successful processes for scalability.

Phase 3: **Enhancement Exploration**

~ 3 weeks

- Experiment with surface enhancement techniques.
- Explore the machining of structural linkages for more complex jewellery designs.
- Exploring the use of cultural references, techniques and materials.

The Material

Why Eggshells?

- Eggshells are made of Calcium Carbonate, same as Coral making it a genetic match
- Eggshells are an abundant waste material so using them is a good opportunity to support a circular economy as per Nigeria's goals.
- Eggshells can be processed without industrial machinery, making it an inclusive material.
- Eggshells accept pigment quite well which is crucial to replicating Coral beads iconic red, orange, and pink hues.

Why Pine Resin?

- Low melting point enables energy-efficient processing and moulding; ideal for off-grid or low-tech production environments.
- Colophony contains abietic acid, which allows it to form strong bonds with minerals like eggshells, ensuring mechanical stability.
- Naturally waterproof once cured, protecting the composite from moisture damage and increasing product longevity.
- Has historical use in Nigerian craft, incense, and wood finishing and feels authentic and earthy, aligning with traditional aesthetics.

Design 1: Aesthetic Replication – Standard Beads

Tackling the subject of an alternate material by replicating the appearance of the most common used style of beads.

“It looks like what you have for traditional weddings... we give [them to] husbands when they’re getting married... or if they’re being crowned like a Princess.”

I intended for these beads to replicate the hard and polished finish that seen in the most common, generally used coral beads. To make them, a mold had to be formed out of perfectly smooth cores which would produce these finishes, then to replicate the necessary density the compound had to be melted into a slurry before being poured into the molds; a process most similar to traditional casting.

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Example



Design 2: Material Replication - Flower Beads

Tackling the subject of an alternate material by recreating the raw appearance of unrefined coral used in more rare and valuable beads.

"Give me the roughness... not too perfect. It's worth more because there's a story behind it."

The second set of beads were designed to have a much more organic appearance to cater to the consumers research I conducted which stated that beads that look more natural hold greater value than those with a highly processed appearance. The key to making a more organic appearance was through replicating the powder metallurgy manufacturing process where variations in particle size would generate more imperfections on the bead.

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Example



Design 3: Material Enhancement - Electroforming

Tackling the subject of an alternate material by enhancing the appearance of the beads through experimental techniques.

"The diaspora's inquisitive appreciation allows us to push design languages forward with sensitivity."

Moving on to the 3rd set of beads, I thought it was important to not just show material replication but also material enhancement through the lens of the diaspora. This led me to experiment with the elctro-forming process in which current is passed through the material to transfer copper on to it's surface. It's a process used to plate gold jewellery however, I didn't want my take to have that polished, perfect look. Instead I wanted to imitate the natural growth pattern of coral in the ocean and make them look more organic in accordance with my research. To do that I coated the beads that were made out of a tree branch mould, with conductive ink and then left them in the electrolyte for 3 days for the copper to grow sporadically.

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Example



Design 4: Cultural Enhancement – Pattern Beads

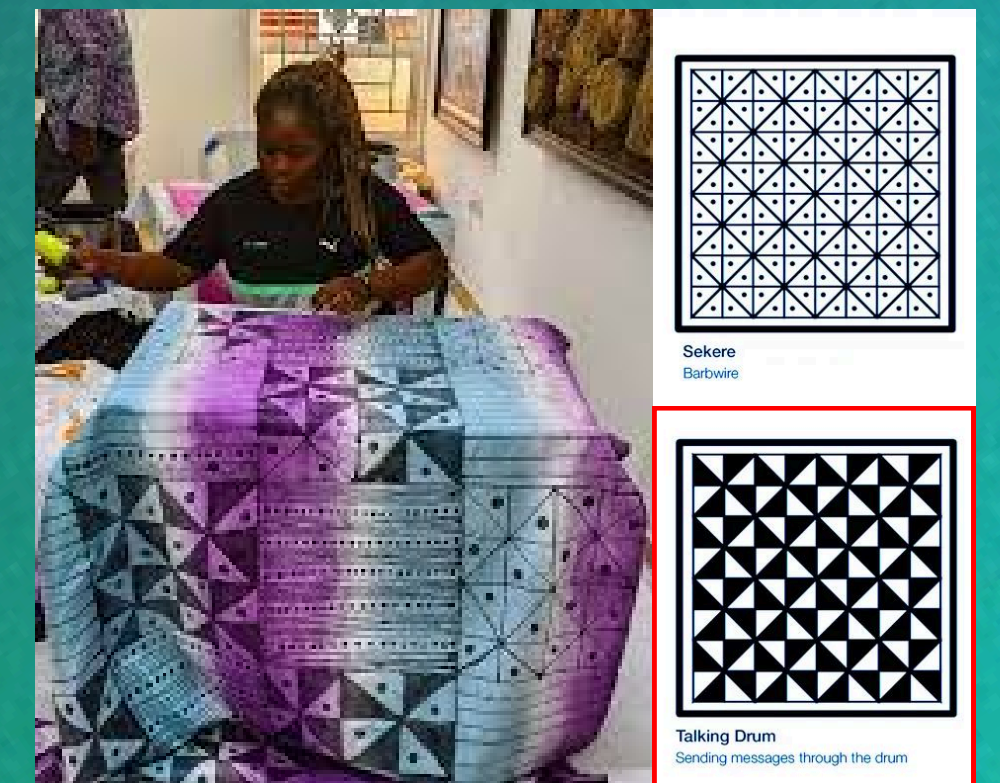
Tackling the subject of an alternate material by replicating the appearance of the most common used style of beads

“If I had beads with my initials, I’d keep them forever, it’s like carving your name into your culture.”

Staying on the theme of enhancement, the forth beads I created focused on cultural enhancement. When understanding the value of coral beads I found that a big part of it came from their heritage. So, for these beads I wanted to enhance their narrative by physically communicating that unseen value.

To do this I created a mould with an embossed pattern in it called 'Talking drum'; it's one of many patterns commonly used in Yoruba textiles, however I wanted to use them in the bead design to elicit a similar cultural feeling as the textiles would, in addition to showing the potential for even more patterns and messages being physically communicated through the beads; which could be very important considering Nigerian coral beads are commonly used for special occasions like weddings.

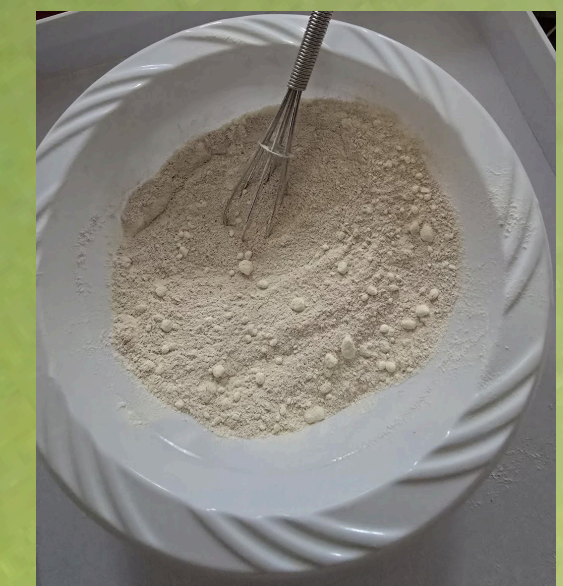
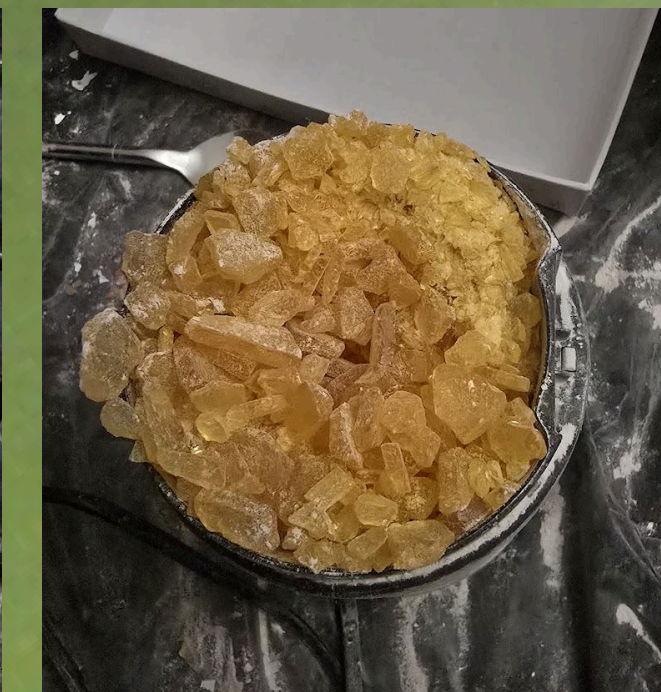
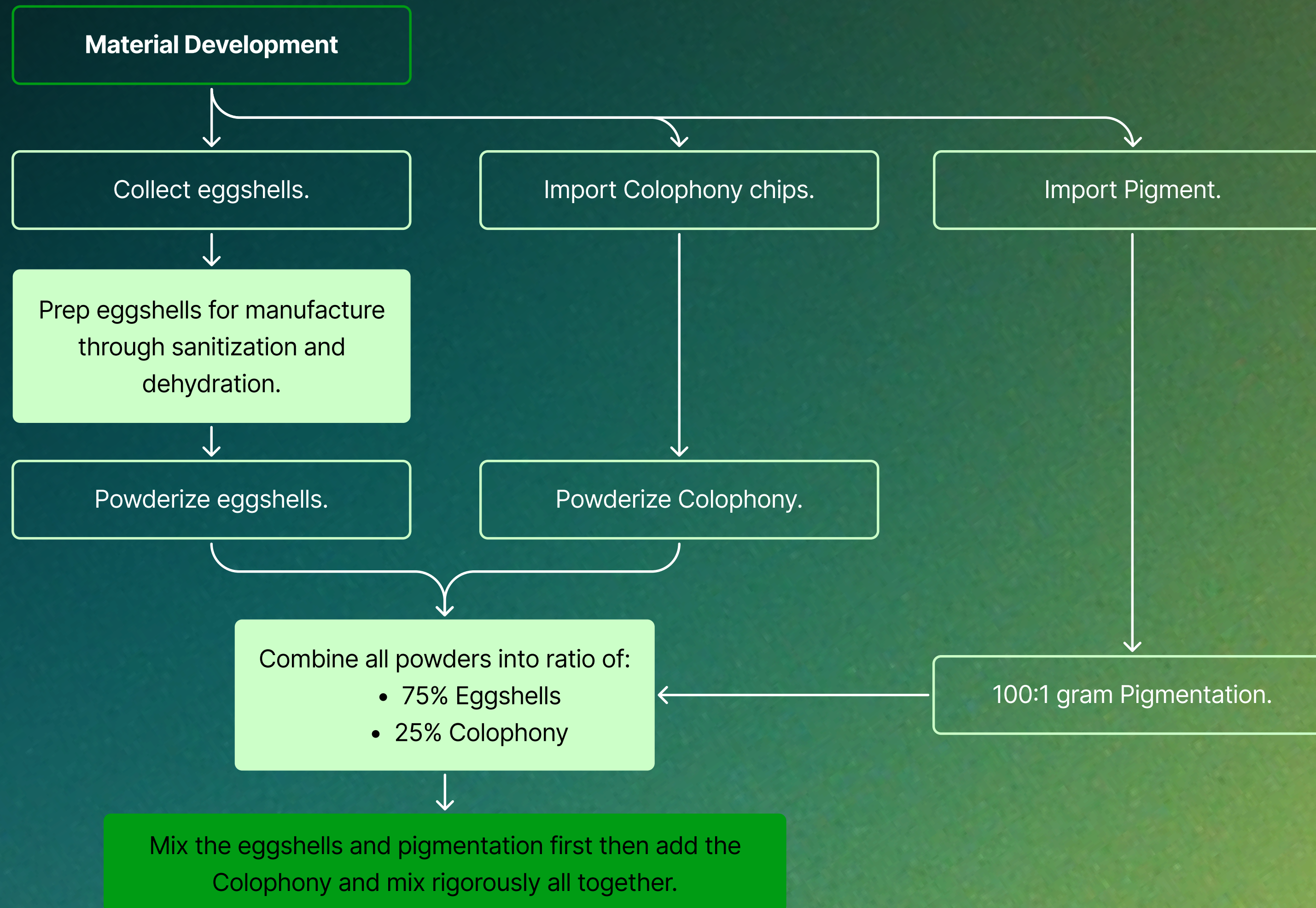
Example



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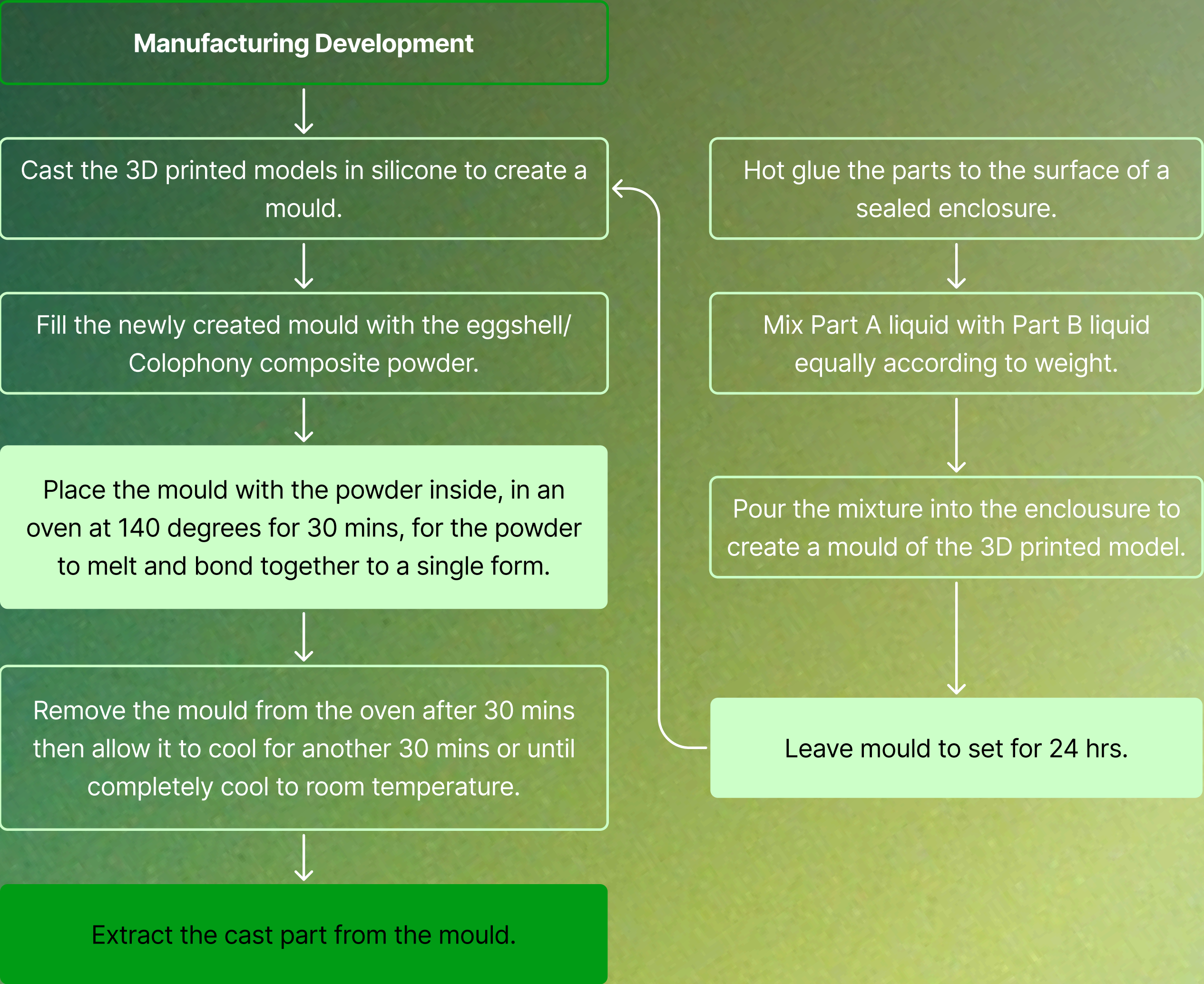
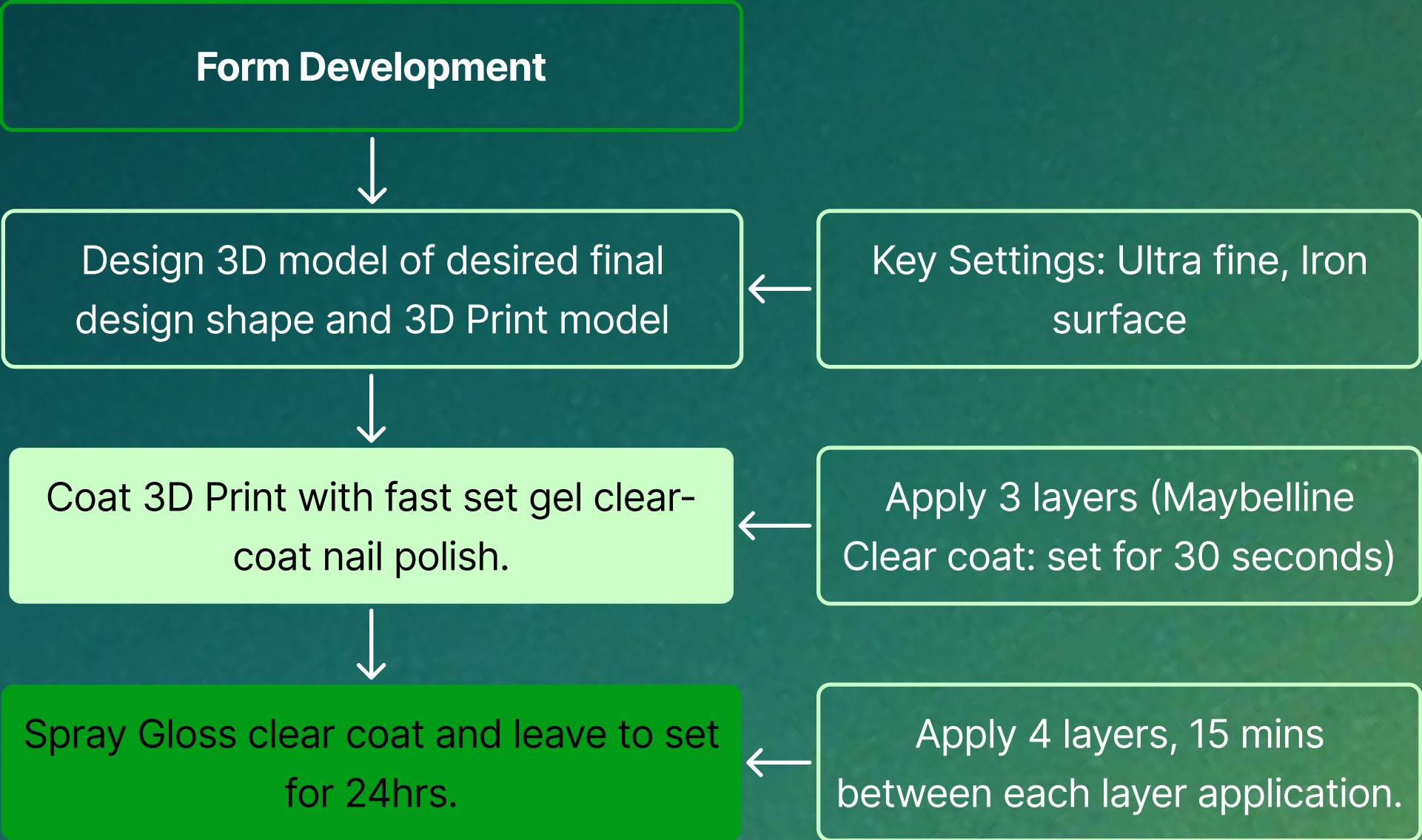


Raw Materials



Manufacturing

Properties	Result
Eggshells Chemical formula	Calcium Carbonate - CaCO_3
Colophony Chemical formula	Abietic acid - $\text{C}_{20}\text{H}_{30}\text{O}_2$
Hardness	19.05 HV
Density	2.30 g/cm^3 (Coral: 2.68 g/cm^3)
Composite Melting point:	80 degrees
Optimal bonding/molding temp:	140 degress
Shrinkage	-0.25
Cooling time to Room Temp	30 mins
Ratio - Filler/Binder	75/25
Waterproof: Yes/No	Yes



Validation - Interview style - Younger Gen

Interviewee 1

Profile: **29 Yr Old - Male - Creative**

Place of Birth: **UK**

Place of Upbringing: **UK - Nigerian Diaspora**

Connection to Nigerian Culture: **Weak due to disconnection**

Interviewee 2

Profile: **21 Yr Old - Female - Non Creative**

Place of Birth: **UK**

Place of Upbringing: **UK - Nigerian Diaspora**

Connection to Nigerian Culture: **Average due limited interest**

Interviewee 3

Profile: **25 Yr Old - Male - Creative**

Place of Birth: **UK**

Place of Upbringing: **Nigeria**

Connection to Nigerian Culture: **Strong due to family support**

Insight 1

There's potential beyond jewellery in sectors such as architect, due to the materials versatility.

~ "Honestly, I could see this in interior design, like tiles, or wall finishes, maybe even furniture accents."

Insight 2

Emotional significance is tied to how long an item is kept and passed down.

~ "The value for me lies in how long you carry it for... my dad's had his since he got his title."

Insight 3

Beads trigger intergenerational memories.

~ "My grandma, my mom, I see all of them wearing this. I can imagine them wearing this with their wedding attire."

Validation - Interview style - Older Gen

Interviewee 4

Profile: **52 Yr Old - Male - Non Creative**
Place of Birth: **Nigeria**
Place of Upbringing: **Nigeria**
Connection to Nigerian Culture: **Strong due to upbringing**

Insight 4

Beads are provide a more accessible higher quality alternative to mass-produced imports.

~ "The beads you have can made accessible to more people... your quality is way better than those ones people are buying."

Interviewee 5

Profile: **51 Yr Old - Female - Creative**
Place of Birth: **UK**
Place of Upbringing: **UK - Nigerian Diaspora**
Connection to Nigerian Culture: **Average due limited interest**

Insight 5

Finds storytelling-based design more impactful than literal replication.

~ "If you're able to story-tell it well, then that's all that matters."

Interviewee 6

Profile: **60 Yr Old - Male - Non Creative**
Place of Birth: **UK**
Place of Upbringing: **Nigeria**
Connection to Nigerian Culture: **Strong due to upbringing**

Insight 6

More labour intensive pieces are perceived as high value due to the intentionality behind them.

~ "If it looks like someone really had to put in effort, it feels more prestigious."

Cultural Value Proposition

Cultural Value

- Promotes the preservation of Nigerian coral beads in an increasingly environmentally responsible world through a sustainable alternative
- Enables the integration of oral and visual storytelling through customer designed beads to encourage the emotional and ancestral value.
- Material versatility allows replication of the full aesthetic spectrum of coral beads, from polished finishes to highly valued, imperfect textures.

Quote by Interviewee 6:

“Beads that look like they’ve been through generations of life are worth more than anything, it’s like passing on wisdom.”

Social Value Proposition

Social Value

- Encourages rural industrialization with minimal infrastructure, through the creation of income and opportunities for rural farmers and the local community through eggshell collection and resin tappers.
- Enables local manufacturing and artisan training, fostering community upskilling and allowing each region to adopt its own bead-making styles.
- Promotes intergenerational engagement by giving consumers design agency, allowing both elder and diaspora youth preferences to shape the final product.

Quote by Interviewee 4:

"If you're using the beads to help increase Nigeria's economy... it's better for everyone. It becomes a more sustainable way of living."

Environmental Value Proposition

Environmental Value

- Simplifies the supply chain and reduces emissions by using local biowaste and natural resins instead of harmful petroleum-based or mined materials like plastic beads and natural coral
- The manufacturing process minimizes energy-intensive production by operating below 150°C and lightweight raw material minimizes the carbon emission used for transport.
- All waste material can be re-melted and reforged to form another bead, making the manufacturing process truly waste-free.

Quote by Interviewee 1:

“As long as it’s not made in a way that’s damaging to the planet... it wouldn’t change my opinion.”

Ethical Value Proposition

Ethical Value

- By primarily using common waste material instead of extracting new resources, there's less dependency on resource rich regions and more on equitable economic growth.
- Local sourcing enables transparent, ethical supply chain that fosters accountability within communities.
- Encourages consumers to make informed, culturally-rooted choices that align with sustainability.

Quote by Interviewee 3:

"That's a full circle moment... we found a natural alternative that can be used and it's the same material."

Feasibility

Eggshells

- Approx **17 million farming households in Nigeria** raise birds, which consequently produce eggs.
- **1 hen lays 300 eggs per year**, therefore a farm of 20 could potentially produce 6,000 eggshells per year which is approx **30 kg**.
- **1kg of eggshells is enough to produce 15 necklace beads** therefore 1,000 participating farms could possibly produce over **15,000 necklaces beads' annually**.
- While theoretical, **Nigeria already produces 250,000 tonnes of eggshell waste annually**, now we just need to utilise them.

Pine Resin

- Despite **Nigeria having 732 million Pine trees**, they aren't typically tapped for resin so there's untapped potential within that sector.
- Tapping just 1% which equates to **6 million trees would yield thousands of tonnes of natural resin annually**.
- A single mature pine tree can produce 3 kg of resin per year so at least **1,000 trees could support small-batch production within a community**.

System Thinking

Material / Process	Function	Properties	Production Strategy	Additional Detail
Eggshells	Primary filler (CaCO ₃) in the biomaterial composite	Abundant food waste, high in calcium carbonate	Partner with bakeries, eateries, poultry farms, and hotels for consistent supply	Source mapping can begin with urban food districts in Lagos and farms in rural villages
Collection (Raw Shells)	Accumulation of eggshell waste	Bins, branded sacks, drying trays	Incentivise collection via waste pickers and buy-back programs	Leverage markets and farms as community hubs
Colophony (Pine Resin)	Natural binder, adds structure and durability	Melts at 150 degrees, hardens at room temp, aromatic	Establish sourcing through pine plantations in Jos, Taraba	Community resin tapping co-ops can be trained using models from India and Kenya
Pigment (Iron Oxide)	Adds cultural colour coding	Mineral-based, heat-stable, UV-resistant	Partner with local pigment traders and artisanal mines	Various natural dyes can also be trialled to offer the variety in colour plastic beads provide
Dehydration	Prepares eggshells for grinding	Sun-dry or low-heat dehydration	Replace electric ovens with passive solar dryers reducing energy usage	Solar dome dehydration units can be built from recycled metal and polycarbonate
Powderizing	Converts dried shells into fine granular filler	Millable, crushable, soft mineral	Use hammer mill or cassava-style grinder	Shared grinding stations can serve clusters of local producers
Ceramic (Terracotta)	Used to sculpt moulds or test shapes	Biodegradable, reusable, familiar in local craft	Source from Kwara, Benue, Ogun clay regions	Clay moulds can double as teaching tools for training
Metal Dies	For creating master bead forms	Long-lasting, mold-press compatible	Machine at fabrication hubs in Lagos	Pair dies with silicone casting trays for batch processing

System Thinking

Phase	Inputs	Processes / Activities	Stakeholders	Outputs	Impacts
Raw Material Sourcing	Eggshell waste, pine resin, natural pigments, water	Collection, tapping, drying, sorting, quality checks	Farmers, food vendors, resin tappers, cooperatives	Raw eggshells, pine resin, dye materials	Diverts waste, supports rural incomes, preserves forest resources
Raw Material Transport	Local vehicles, containers, fuel, labour	Aggregation and transportation from collection sites to workshops	Transporters, logistics co-ops, farmer associations	Raw materials delivered to processing hubs	Raw materials delivered to processing hubs
Material Preparation	Ground eggshells, resin, binders, energy	Mixing, low-temp heating (<150°C), molding	Local artisans, workshop technicians	Semi-finished bead blanks	Low energy use, decentralized production supports local ownership
Bead Finishing	Tools, water, pigments, finishing materials	Polishing, sanding, colouring, optional electroplating	Artisan producers, craft workers	Artisan producers, craft workers Finished individual beads	Imperfections as authenticity, increases cultural and market value
Jewellery Assembly	Threading cord, fabric, metal fasteners	Beads assembled into necklaces, sets, special occasion pieces	Assembly artisans, designers	Assembled jewelry (necklaces, bracelets, etc.)	Embeds cultural intention into form, enables product to match diverse events
Distribution & Sales	Retail channels, transport packaging	Selling through local retailers, pop-ups, exhibitions	Retailers, cultural curators, logistics firms	Jewellery reaches consumer markets	Product seen as cultural artefact, not just fashion item
End-of-Life / Reuse	Old beads, broken parts, heirloom designs	Re-melt and reforge into new designs	Consumers, recyclers, bead reworkers	Legacy items, recycled components	Recycled beads re-enter the supply chain or returned to the old owner.

Gallery







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