KARELIA UNIVERSITY OF APPLIED SCIENCES
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CREATING A RESIN REPLICA OF AN ORGANIC OBJECT

Thesis
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Nimike

Hartsimuovijäljennöksen tekeminen orgaanisesta objektista

Tiivistelmä

Tämä opinnäytetyön aiheena on muovijäljennöksen tekeminen asiakastyönä Botanialle, Joensuun kasvitieteelliselle puutarhalle. Projekti alkoi asiakkaan tarpeesta saada näyttelytuote kasvitieteellisille näyttelyille ja esitystarkoitukseen. Kaakaohedelmä valittiin mallinnettavaksi kohteeksi. Jäljennys toteutettiin hartsimuovivaluna silikonimuotteja käyttäen.

Selvitys muovi- ja hiekkavalun käytännöistä tehtiin selkeyttämään työtapoja, mutta tiukan aikataulun takia tämä jäi lyhyeksi ja ytimekkääksi. Nämä käytännöt toimivat ohjenuorana jäljennöksen tuottamisessa.

Raportoinnissa keskitytään kirjaamaan työn edistyminen kohtuullisen yksityiskohtaisesti alkaen hedelmän halkaisusta muovivalun tekemiseen ja päättyen hartsimuovijäljennöksen viimeistelyyn. Tämän pohjalta on mahdollista arvioida hartsimuovin muita mahdollisia käyttökohteita samantapaisia menetelmiä käyttäen.

Kieli Englanti	Sivuja 33

Avainsanat

Muovivalu, silikonimuotti, käsityöt, asiakastyö

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Title

Creating a resin replica of an organic object

Abstract

The following thesis describes customer work made for Joensuu's botanical garden Botania. The project began from the customer's need to have a product that they can use in botanical exhibitions and showcases. Cocoa fruit was chosen as the object to be replicated. Resin casting was chosen as the method of replication due to high accuracy silicone moulds offer.

Due to a tight schedule, resin and sandcasting methods were researched to establish a guideline to follow with an organic object. This thesis focuses on describing the working procedure in relatively high detail, starting from splitting the object, continuing to mould creation and casting procedures and ending in product finalization.

This thesis also touches on how the casting methods can be used to replicate other similar organic objects.

Language English	Pages 33

Keywords

Resin casting, silicone moulding, craftsmanship, customer work

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1 INTRODUCTION

Joensuu botanical garden and tropical butterfly garden Botania contacted Karelia University of Applied Sciences' design department in 2014 in order to revise their service design, facility outlook as well as have physical products designed which they could sell. Multiple students joined the project, and after an initial visit the project head devised various tasks for the students to realise for Botania.

These tasks ranged from creating a map of the region to interior design and so forth. One thing the customer wanted was to have a plastic replica of a flower. While this would have been possible, the university has no tools or materials to produce an exact replica of high quality needed for exhibition use. Instead, I suggested that I would take a fruit from one of their trees and make a replica by using resin casting. This was an idea they liked, and with cocoa fruit chosen due to its popularity, we began planning how it should be done.

The task was as follows; to use silicone to make negative moulds of a split cocoa fruit, and then cast crystal clear resin. The end result would be two halves of the same cocoa fruit. The beans from inside would be placed inside the halves, allowing the customer to see through the fruit and how it looks inside. To replicate the fruit more accurately, we agreed that one of the halves should be painted to resemble the fruit.

This thesis is a case study investigating not only whether or not it is possible to replicate an organic object such as a fruit by using silicone moulds and resin casting, but also how well it can be done.

2 FRAMEWORK AND METHOD

2.1 Action plan

The action plan in this thesis stands on two methods of casting: sandcasting and resin casting. Using the two methods as a framework, I have produced a negative silicone mould of two halves of a cocoa fruit, after which these moulds were used to cast a clear resin replica of the original fruit. One of the halves was painted afterwards.

However, in order to fully grasp the practical methods, some key vocabulary on materials and methods needs to be explained. These methods were employed to create a replica of a cocoa fruit for the customer to use.

This thesis' practical work is based on both researched knowledge and past experiences. Due to tight schedule, no proper practical research was done on the materials themselves outside a minor casting test to get acquainted with the resin as a material. While the approach in this thesis is explorative, the underlying question was not whether or not the resin replica could be made; the question was how well it could be made.

2.2 Framework

Rather than employing an existing academic framework and artificially forcing one to fit the thesis, I chose to use a framework I have gained through personal experience with customers. It contains three overlapping concepts; Provider, which is me; the customer, in this case Botania; and methods, which include all the knowledge realizing the end product. These three concepts are presented in Image 1.

The three overlap with each other to different extents. The Provider, be it in whatever field, has the most overlap with Methods. The Methods include all the knowledge and methods needed to provide the Customer with whatever they seek or need. The Methods in this thesis' case touch on casting and the required materials. The Customer's role is to provide the reason for a product to be made as well as values the product ends up carrying on the long run.

The overlapping regions have significance as well. In this framework, the Customer mostly needs to interact or be in contact with the Provider, whereas the Methods are left less touched. The Provider on the other hand needs to be in direct and large contact with both, and this overlap with both Customer and Methods creates the region where all sections overlap, producing the end product.

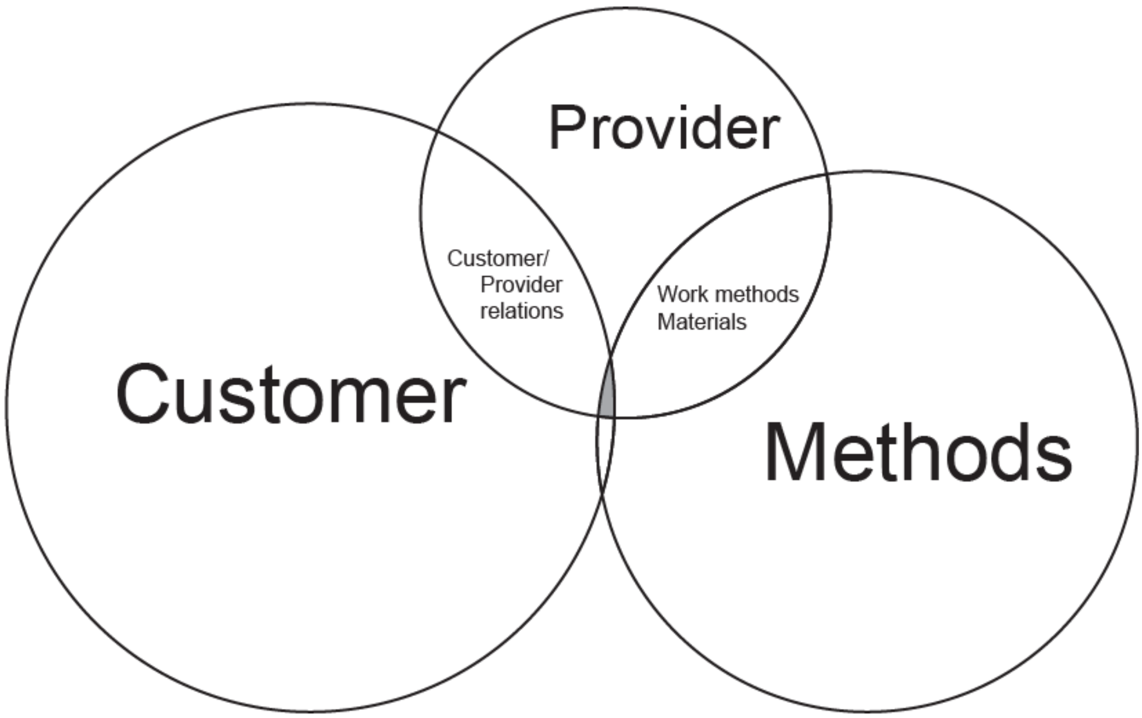


Image 1. Used framework

2.3 Casting

Casting, in this context, is when a mouldable material, e.g. molten metal, is poured into a shaped cavity and allowed to solidify. Casting also involves preparing the mould that is used to make the casting. (Rao 1996, 1.)

Sandcasting is the older of the two and the one I have extensive experience with. The second one is resin casting using a silicone mould. The description for the latter is largely used as a guideline for the work itself, and due to multiple sources giving a slightly different overview of the process, the description here is an amalgamation of various sources put together.

In addition, due to the practical nature of this thesis and a relatively tight schedule, time was of the essence and none could be wasted. There was no time to test the methods to any large extent and do repeated prototyping. This is admittedly the weakest point in this thesis and the final results do reflect this.

2.4 Materials

The main two materials in this project were clear resin and silicone. Resin used in this project was unsaturated polyester resin, which offers wide variety of applications depending on the mix used to produce the resin. Often one of the components is delivered in a separate vessel and fills the chemical makeup of the resin in order to solidify it. Unsaturated polyester is known to be used in electrical application, buildings, luggage and other consumer products despite being first introduced in military use. (The Plastics Industry Trade Association 2015.)

The silicone rubber used for the mould is a two-component rubber. Generally speaking, these sort of silicones can be used for seals, cable insulations, pacifiers and so on. Moulding silicone used in this thesis was a two-component silicone that is able to cure in room temperature. (Shin-Etsu. 2009.)

Both aforementioned materials require curing. Curing is either a chemical reaction or a physical action which turns the curing material into a more solid version. This can be caused by e.g. the chemical linkage turning more stable. (Businessdictionary 2015.)

2.5 Sandcasting

The theory of sandcasting can be described as a method of creating a negative mould using two blocks of oil based sand.

Preparation for sandcasting requires an oil based sand that can be tamped down and can withstand metal in its liquid form with temperatures roughly between 800°C to 2500°C (Uniweld Productions 2015) depending on the metal used, a separation agent to keep the two halves apart, and a model used to either vaporise within the mould or to create the shape of the negative mould. The latter is applied in this case.

The two halves are prepared separately. Both halves will be housed inside a frame specifically made for sandcasting. The first frame is filled with sand to the point where the object's middle section aligns with the top of the frame, after which the object is surrounded with further sand to the brim of the frame. With each added sand it is necessary to ensure the tamping is made well enough, as uncompressed casting sand will allow material to escape or will crumble inside the mould. After the first frame is filled and properly prepared, the second frame is attached atop the first frame.

A separation agent is spread across the sand and the object. A casting canal mould, usually shaped like a flat ended cone, is kept near the object as the second frame is filled with casting sand in the same manner. Extra sand is applied around the casting canal mould, usually shaped like a volcano, to ensure that the casting material finds its place.

After the two halves are prepared, the second half is lifted from the top. As the sand is oil based, it will hold its shape as long as needed as long as it is properly tamped. Nevertheless, carefulness is recommended in order to keep the second frame's mould from damaging. The object that now has given the sand its negative mould is removed, and escape canals are carved on the sand of the first frame.

The frames are attached to each other again at this point and locked down with e.g. clamps. The casting material is then poured into the casting canal with a steady pace to ensure complete spread of the material within the negative mould between the two frames.

After the material has cooled down and solidified, the frames are separated, and unburnt sand is stored for future use. Burnt sand is discarded. The cast object is then cleaned of sand and finalised with cutting excessive material and often polished. (Kauppila 1964, 172-174.)

Sandcasting does not suit objects with escape corners, and as such alternative moulding methods such as invasive casting should be considered. (CustomPartnet 2015.)

2.6 Silicone casting

Production of two-half silicone mould has many similarities with sandcasting. The object to form the shape of the mould is placed inside a frame, half encased in quick mould material. Clay or similar material can be used. Mould-keys are then formed on the material either by attaching separate shapes or by pressing impressions on the surface. After this, the silicone rubber is poured on top of the object. (ARTIDEE 2015.)

After curing the first half of the mould, the frame is removed alongside the clay and any other excessive material. After cleaning the mould, the frame is reconstructed around the now cleaned base mould. A separation agent is applied on the surface of the mould prior to pouring the second layer of silicone.

If applicable, it is optional to attach an object that would function as the pouring canal’s mould prior to the second mould pouring. However, if this cannot be made, pouring and escape canals are then produced by removing material from the silicone halves with a sharp tool, e.g. a surgeon’s knife.

After the two moulds are cured, the object is removed from them. Often a separate frame is needed to hold the two mould halves securely enough in order to ensure that they will have no escaping cast material. Casting itself works the same way as with sandcasting, with the material poured in at a steady pace to ensure total spread. (Livingston 2015.)

After the casted material has cured, it is removed from the mould and finalised. (Zalewksi 2015.)

3 PROCESS

3.1 Materials and preparations

Due to the nature of the object, the cocoa fruit, time was not to be wasted. Before the materials needed for the silicone managed to arrive, the fruit was preserved in an air sealed and dry box in a refrigerator. This was in order to preserve its shape, surface structure and overall shape. The colour was least important bit in regards of the moulding process, and as such the discoloration of the cocoa fruit had little to no impact. The cocoa fruit was photographed prior to its preservation to keep records of the cocoa fruit's phases during the process as well as to have proper point of comparison and to have a reference for the painting process (Picture 1.)

Picture 1. Freshly plucked cocoa fruit

After the moulding materials arrived, the cocoa fruit was removed from the refrigerator and moulding was done on the same day.

ARTIDEE Silcolan NV was selected as the moulding silicone due to its relatively good viscosity. This viscosity is needed in order to have the silicone pouring into every crevice on the cocoa fruit's surface and preserving those details. Other cheaper options were considered as well, but due to their inability to accurately replicate intricate details on a given surface, Silcolan NV offered a good middle ground between practical usage and price.

3.2 Mould creation

3.2.1 Base of the moulds

The process began with the cutting of the cocoa fruit. A sharp, thin kitchen knife was used to make the cut in order to prevent material expansion and disfiguration. An issue about the thickness of the cocoa fruit's shell had to be taken into consideration, as cocoa fruit was relatively unknown to the producer. Nevertheless, after the initial incision cutting became similar to any other relatively hard shelled fruit and proceeded to split without troubles (Picture 2.) At the top, where the stem protrudes from the cocoa fruit, the cut was slightly

Picture 2. Split cocoa fruit with beans visible

angled so that the stem could be used as a casting canal.

After the cocoa fruit was cut into two halves, the cocoa beans were removed with a Swiss army knife blade due to its relatively small size (Picture 3.) The cocoa beans were to be dried out and used in the final phase, where they would be set inside the two cast halves. Before that they would need to be dried of the membrane they were encased in. A small, sharp hook was produced out of a 2mm steel axel to serve purpose of hanging the beans in a ventilated open painter’s cabin.

Picture 3. Separated beans and tools used

Time became essential at this point, as all possibilities for the cocoa fruit halves to dry into a thin shell or begin to rot were relevant. Pieces of birch were used to build the frames. The walls of the frames were glued with a general glue, Eri Keeper, as it offers a good enough bond between the walls, which then can be easily be broken by manual labour. The main goal of these walls was simply to keep the silicone from escaping the targeted area. Generic red clay was used as the bottom for the first halves of the silicone moulds (Picture 4.) This was chosen due to its malleable nature and because it can be used to caulk any possible spots on the birch walls' seams.

Picture 4. Red clay bed with frames

Prior to pouring the silicone, indentations were made on the red clay bottom around the fruit halves. These indentations would then serve as the locking mechanism between the silicone mould halves (Picture 5).

Picture 5. A half set in the clay with indentations around it

3.2.2 First half of the moulds

Silcolan NV requires a hardener to be mixed with it. The amount of hardener used is 2-5% of the needed material. For example, in 100g of Silcolan NV, 2-5g of hardener is needed. Due to the lack of access to any sort of scale that would give an accurate enough result for the material, experience with other composite materials such as two component epoxy was exercised. As the hardener is blue in colour, the final mix of the two needed to have certain shade of light blue to itself (Picture 6.) Comparing the colour of the silicone to the prototype mould offered a good point of comparison.

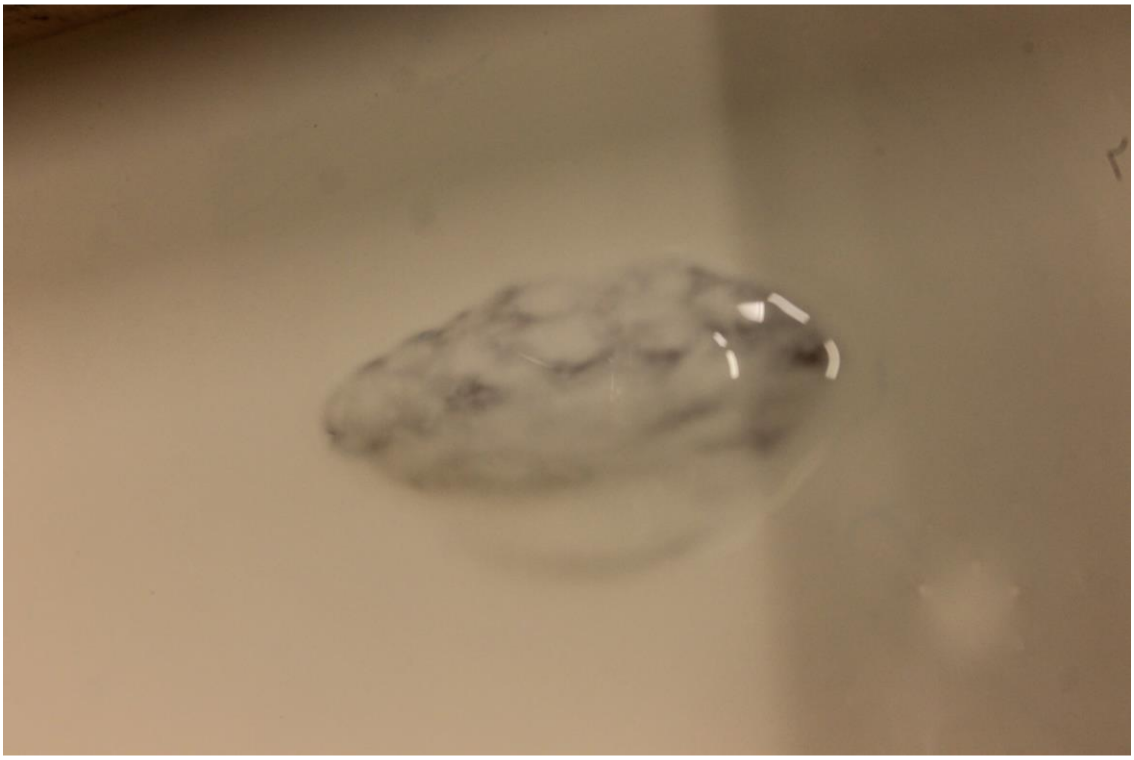
Picture 6. Batches of silicone were mixed in a transparent cup

After the silicone was mixed with the hardener and the colour was evenly light blue, the silicone was poured on top of the cocoa fruit halves. Pouring began from one corner to ensure even spread (Picture 7).

However, it soon became evident that one litre of silicone was not enough. The larger half of the cocoa shell was not completely encased in the silicone material, thus forcing a pause in the production until more materials could be secured (Picture 8).

A new can of Silcolan NV arrived four days later. The cocoa fruit halves were kept inside the mould in order to preserve them as closely to their original form as possible and to keep them from drying out. When the red clay was removed, it was noticed that the fruit halves were in a rotting state. The moisture from the red clay within the sealed environment had kept the overall shape and size similar when the first half was moulded but also caused the cocoa fruit halves to rot. For whatever reason, I had expected the halves to dry out and become thin as the moisture evaporated. In hindsight, this was a very stupid assumption. There was not enough silicone to completely produce the recommended wall thickness, and as such this was left in the mould untouched.

Picture 7. Pouring the silicone



Picture 8. Surface of the fruit visible through thing layer of silicone

A new batch of silicone was ordered and added. Despite the fact that the original layer had already cured, the new layer managed to attach itself onto the older layer without any problems.

The other mould was then prepared for the production of the second half. The mould was washed with warm water and soap to remove the remaining red clay and residues from the rotting process. The same pieces of birch were used, but positioned slightly differently. Prior to pouring, ARTIDEE silicone separation wax should have been applied to the surface of the mould. After the second half of the mould had been poured and hardened, it was realised that the silicone separating wax was not applied, thus making the two halves stick together to a large degree. However, due to the amount of red clay still present on the surface of the mould it was possible to separate the two. Nevertheless, a new top half was needed due to the complications, but parts of the previous mould top was used, namely the section which was poured into the cup formed by the cocoa fruit half.

3.2.3 Second halves of the moulds

With both cocoa fruit halves having the bottom of their mould trimmed, they were prepared for the production of the top half. Both saw careful application of the silicone separation wax, which was spread by using a cloth for overall area. A brush was used to apply it to corners where cloth could not properly spread the wax. The bottom halves were encased by the same birch walls, and red clay was used to seal the possible seams. A new silicone mix was prepared for pouring, and unfortunately there was not enough material to produce a minimum thickness of 4mm on the other mould. However, this posed little problems as the moulds were supported by wood from either side during the casting process.

The most difficult part with plastic casting was estimating the amount of the hardener needed without an accurate scale. Unlike with Silcolan NV, the hardener for ARTDEE XOR Crystal polyester resin is transparent and leaves no properly visible trace when mixed. The ratio in which the two materials need to be mixed is similar to the Silcolan NV, in the range of 2-5% of the overall weight (Picture 9).

Picture 9. Mixed resin. Notice the blue tint

Another problem that can only be solved with time is with the curing of the crystal resin. Within the instructions it is recommended to cast the crystal resin in three phases, which is not possible with the two half moulds. In addition, air curing is not recommended as it will leave the surface sticky. Thus, after the casting of the two halves were finished and they had been cured to the point of holding their shape properly, they were moved into a more a sealed environment where they were allowed to cure until their surface had reached level of hardness that could be worked with.

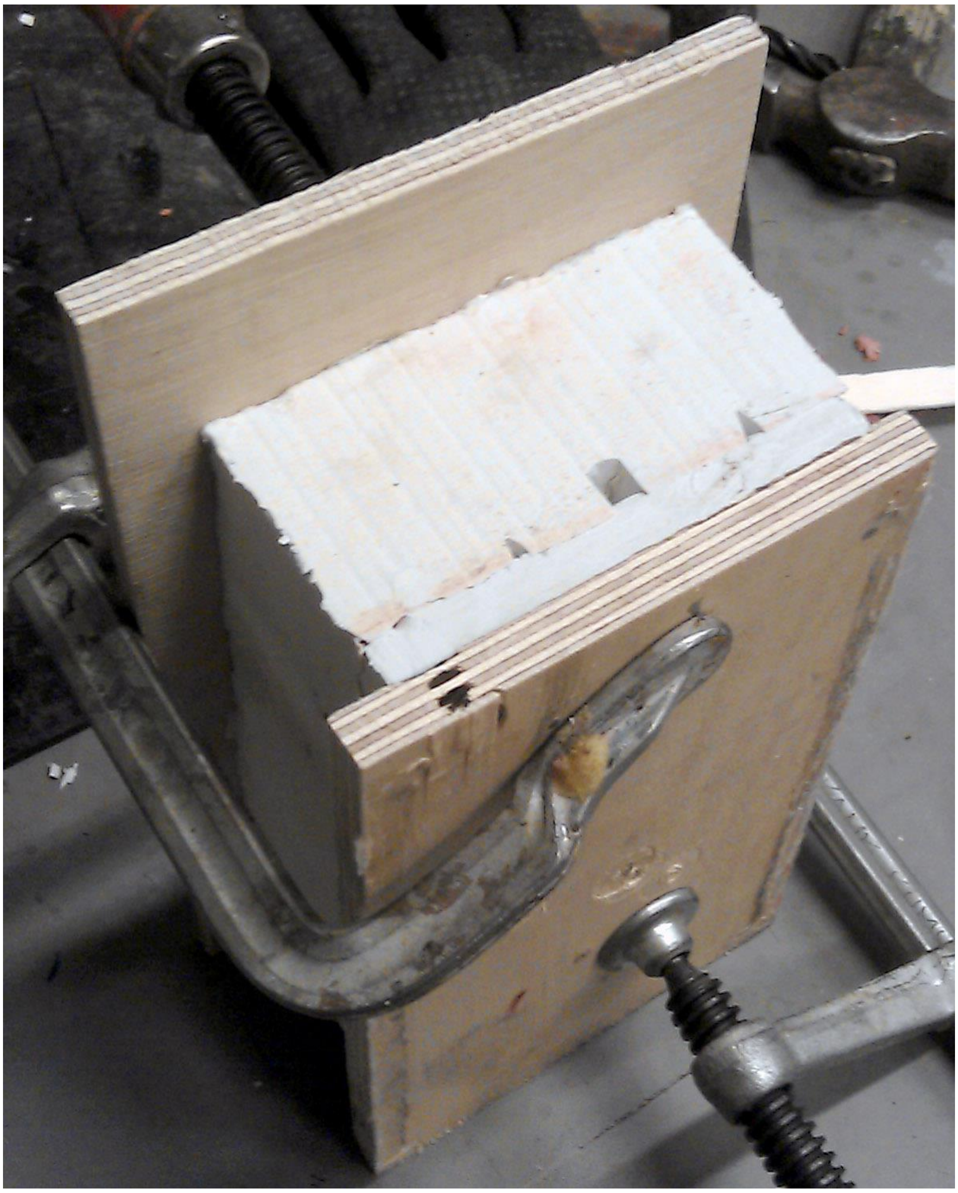
To prepare for casting, both halves of each mould were further trimmed. In addition, the necessary escape canals were carved in alongside the main pouring canal. These escape canals were not carved all the way to the surface, but left inside the mould to form a dead end (Picture 10). This is because, due to the crystal resin's relatively low viscosity and slow hardening time, the material would have escaped from the mould if such holes were made. At the very top the two escape canals were carved next to the main pouring canal to allow the air to escape from the mould during pouring.

Picture 10. Carved canals with open pouring canal at the top

Before the casting process the moulds were presented to the customer. The customer reaction was positive, which gave the green light for the next phase of the project.

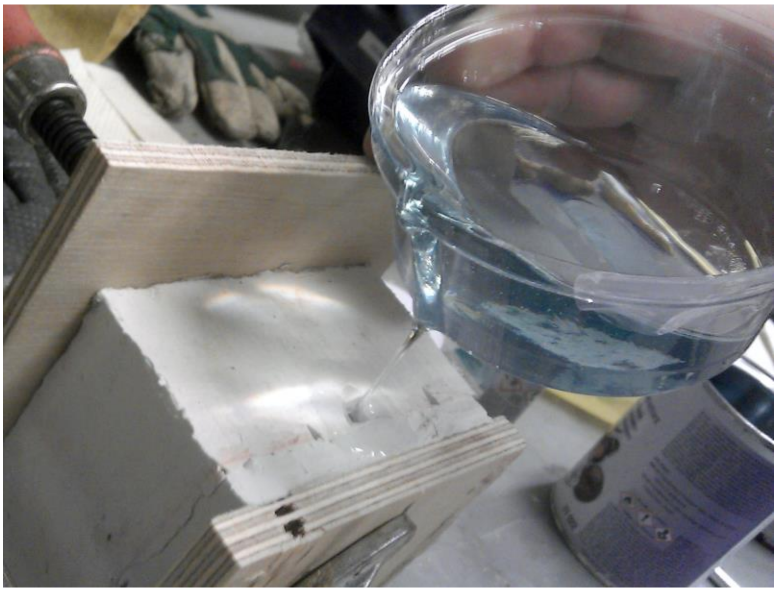
3.3 Casting procedure

The moulds were secured together with two pieces of wood and two clamps. The clamps were lightly secured in order not to disfigure the mould halves (Picture 11).



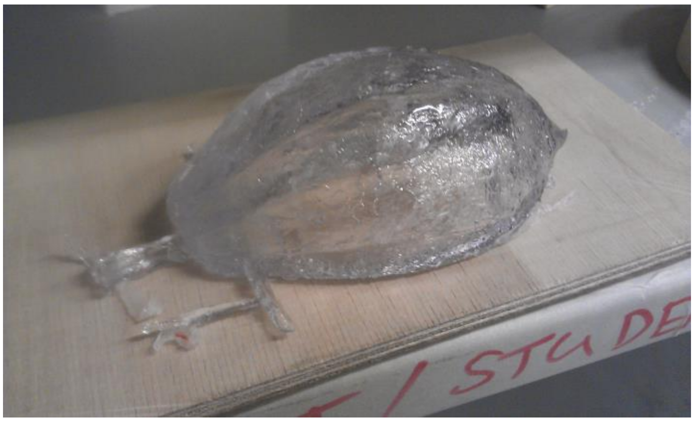
Picture 11. Mould secured by two pieces and clamps.

The pouring of the crystal resin took longer than estimated, about fifteen minutes per mould (Picture 12.) This is a stark contrast to bronze sand casting, where the molten material is comparable to tap water in viscosity and fills moulds at high speed. The main reason why casting took time was because air escaping through the crystal resin was slow. By tightening and loosening the clamps the air could be pumped out. Despite this, one of the moulds had enough trapped air to give an image of a filled mould while in reality the mould was only halfway filled. The mould was later filled to the brim and the seam where the two different casts met is only visible to those who are aware of it.



Picture 12. Casting the resin

When the cured halves were inspected, a handful of casting errors were detected. One of the halves trapped air bubbles inside itself, which cannot be removed without drilling holes to the half and then fill with crystal resin. The other half has an open cavity, where air had been trapped on the inner surface of the mould. The cavity was filled with crystal resin after the surface had cured otherwise.



Picture 13. Casted object straight from the mould

3.4 Curing

Before final curing, the halves were presented to the customer for further inspections. The customer was pleased with the current results, which raised the question of whether or not either of the halves should have been painted after they were fully cured.

The curing was done by moving the halves into plastic box with aluminium sheet functioning as sealing device. Aluminium foil was recommended by the instructions in that the cast models would be encased by it, but in this case some liberties were used to ensure no pieces of the aluminium foil would get trapped on the fully cured surfaces (Picture 14.)

Picture 14. Other half on aluminium foil bed

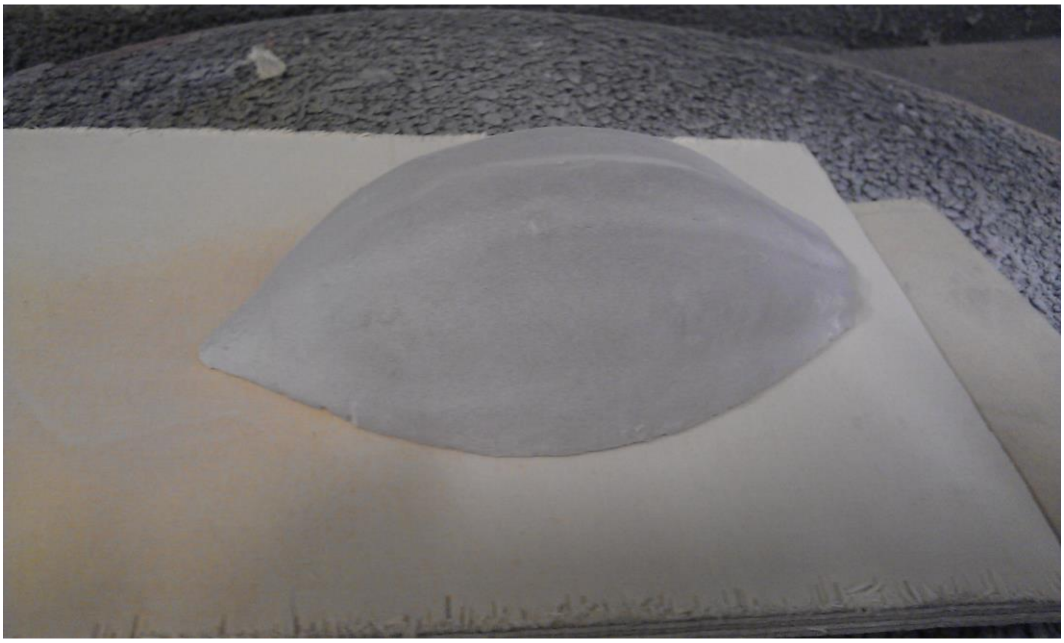
However, due to the nature of the crystal resin, the surface of the halves was not cured throughout. In order to prevent the surface from absorbing surrounding dust and general particles, it was decided that a layer of clear varnish could be applied in aerosol form on the surface. This should capture the uncured surface and allow it solidify without further contact with air. Before initial application, test models were used to see the effect the clear varnish would have, and initial test run showed good test results, where the surface stayed hard (Picture 15.)

Picture 15. Varnished surface

3.5 Paint operations

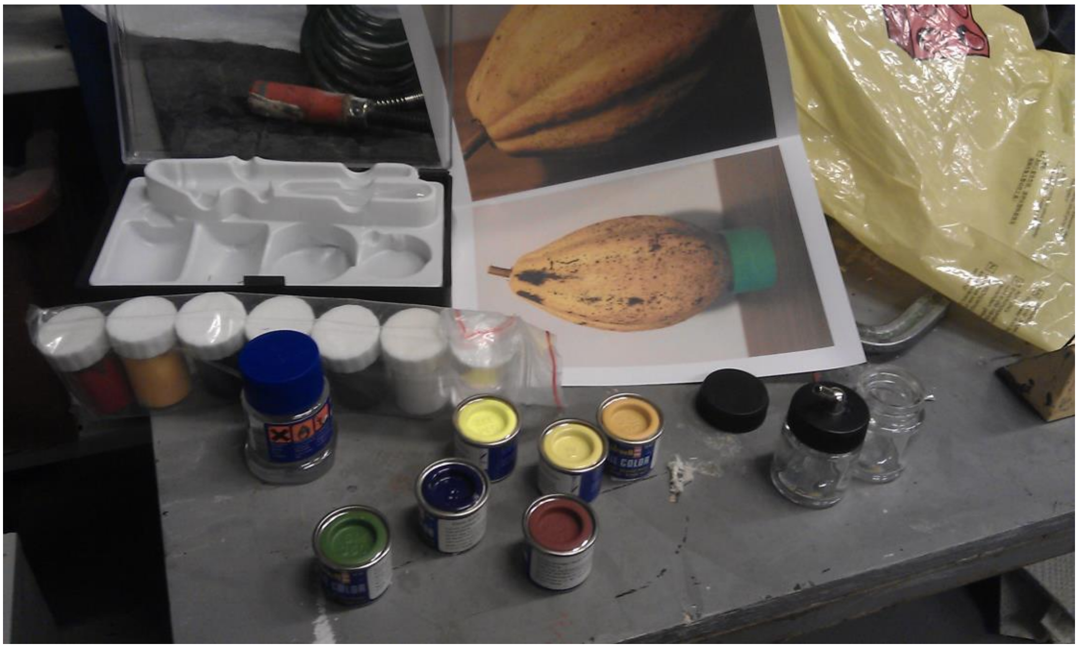
The initial look after applying the clear varnish on the shell halves they were allowed to completely cure for few days. Despite the initial tests showing good results, the actual results of the cocoa fruit model itself should be considered as a failure due to the resin surface still being slightly mouldable underneath the varnish. More time was allowed for the surfaces to cure within the varnish layer, but it seemed apparent that the final curing time for the crystal resin is one month in the environment the casting was produced in. At this point the results were showcased to the customer for inspection, and with the customer's agreement the project continued as planned.

For painting one of the halves was prepared with slight water sanding with 1000 grid sandpaper. After this, the surface was primed with Games Workshop's Skull White spray paint (Picture 16.)



Picture 16. The white primer was applied lightly

While the spray paint was drying, a mix of Revell enamel paints was produced. Printed photos of the cocoa fruit was used as general guideline. The ratio of the paints was not measured in any scientific fashion, but by basing it in direct side by side comparison between the paint colour and the photographs. In estimation, the ratio of the paints was as follows; 70% Matte Yellow, 10% Luminous Yellow and 8% green and 2% blue (Picture 17.)



Picture 17. Paints used

A large batch was produced for possible complications. The paint was then airbrushed on the half surface unevenly to mimic how the strength of colours were on the original cocoa fruit. The spots and other darker areas were painted on the surface with splattering technique, and the smallest spots were made individually by hand by using a sharpened stick. Afterwards, another clear surface of varnish was applied (Picture 18.)

A complication appeared with the last layer of clear varnish. For whatever reason, the surface of the varnish became wrinkled. Usually this happens if the varnish captures moisture inside it, which wasn't the case here.

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Picture 18. Preliminary painting with in its first phase

4 FINISHED PRODUCT

4.1 Customer reception

Product dimensions are 110 x 67 x 65.1 mm. Due to the shrinkage in the mould and in the resin, the finalised product has only approximately the same dimensions as the original fruit (Picture 18.) However, this was expected and had no overall effect on the product or its quality.

Picture 19. Both sides showcase the high detail on the resin models

To evaluate the finished product there are two approaches I have employed. The first and foremost is simple customer satisfaction on delivery, which can simply be described as positive. The customer liked the finished product and deemed the project a success. It was put into exhibition use week after the delivery was made.

The overall cost of this project was 162.50€. This includes two 1kg cans of Silcolan NV at 53€ per piece, a 500g can of same material at 31.50€, two 500ml cans of XOR Crystal resin, general form separation wax at 5.90€ and the rest were postage costs. All materials were secured from webstore Hobby Point.

4.2 Personal evaluation

The second approach to evaluate the finished product is what I as the producer see in the product. Personally I feel that the product has been a failure to some extent.

First of all, there were air bubbles trapped inside the resin cast, which cannot be masked with outside painting or drilling a hole to them and filling them. However, this would also cause a clear break where new resin was poured in. In order to prevent this from occurring in the future, the mould should have a different kind of casting, and more escape canals should probably be added. One possible solution would be to use a moving platform that cradles the mould back and forth during curing, as this could make the bubbles move towards the surface. However, due to the thick nature of resin the platform would need to move back and forth at a rather quick pace, which could pose all sorts of problems. Another workable solution could be to be have this platform vibrate at a reasonably high frequency, though that too may pose problems. The only way to know for sure would be to test these.

In addition, due to the cocoa fruit halves rotting and expanding during mould casting phase, the final product is only indicative of the real shape of the fruit. The only way to really prevent this is to produce the mould faster within a more controlled environment. The time the mould takes to cure can be controlled with the hardening agent. However, using too much hardener can cause the mould to cure too fast in different parts, causing crevices and breakdowns. In this project I did use more hardener than usually needed in order to save time, but the extra amounts were not all too large overall. It would seem that a malformed mould would require exceptionally large amounts of hardener. How the hardener would be affected by a cooler environment is an unknown factor. Room temperature is often the recommended temperature at which a mould should cure. As such, experimentation should be enacted on this as well.

Lastly, the main issue with the product was that the resin used in this project required far more experience and first hand knowhow than expected. Unlike metals, which have standardised consistencies and act the same way as long as they are properly produced, each label of resin is slightly different. While experience states that they all act the same way in general terms, each resin and their variants have their own quirks. ARTIDEE XOR Crystal had instructions to be cured in a sealed environment in order to cut the flow of air. Despite cutting the air circulation the best I could, the unfortunate result was that the surface remained sticky, almost as if it could not cure to the very end. This was remedied with a layer of clear varnish to capture the sticky surface inside. This proved to be only a temporary solution, as the real resin surface ended up being slightly mouldable even after everything had been tried.

Regarding the sticky surface, I enacted a simple experiment with the remaining resin. When the cherry blossoms were in their best bloom, I picked a few and cast resin on top of them inside a shot glass. The glass was filled about 8mm from the brim, and the resin was sealed by using thrice folded aluminium foil, specifically sanded piece of wood and strong rubber bands to prevent any air leaking in or out. The shot glass cast was allowed to cure three weeks in room temperature. Despite this, the surface was still left sticky as if had access to flowing air. It would seem that the nature of XOR Crystal resin is very peculiar and finding the best way to cure it is found through experimentation rather than sticking with guidelines giving in the provided manual. In the end, I ended up sealing the sticky surface with few millimetre layer of epoxy resin.

Interestingly, the amount of hardener used for this test casting showed an under laying danger in how the escaping air may cause peculiar effects in the resin itself. Both the Silcolan NV and XOR Crystal Resin came with more hardener than necessary, thus I ended up using vastly more hardener for the remaining resin than needed, almost 30% mix. The escaping air thus could not properly rise to the surface, but left long and thin leaf shaped formations in the hardened resin. The air between the glass and the resin couldn’t escape either, leaving a slightly foggy visage. This was surprising, as the resin was advertised as crystal clear.

The word for I would use for this project would be experience. Guides and instructions are only an indication of what should happen and how materials should react under described circumstances. Further experimentations with different exotic organic materials would be needed to fully write down a guideline on how to create a perfect resin cast based on similar organic materials. All the research needed already exists, I would only need more experience to realize the product in the highest possible quality.

5 DISCUSSION

5.1 Personal successes and failures

It is rather hard to estimate what I can regard as personal success or failure. What I described in the previous section can be also seen as my success and failures. However, I do feel that creation of the silicone moulds was a personal success as much as the casting was a personal failure. I am not entirely sure whether or not I should credit this on the chosen resin, XOR Crystal, or inexperience with overall procedure of resin casting and curing. In the future there needs to be further tests with the same moulds but with different resin brands. For example, using other polyurethane based resins with solid colours may provide better results, thou that would go against one of the project goals to have a transparent piece.

Allowing for the fruit to rot was a mistake I should have foreseen. While I was afraid that the fruit would dry out and wither, I did not take into account that the fruit would be sealed in a highly moist environment. Logic would dictate that a fruit would begin to rot relatively fast in such an environment. There is also a slight possibility that the red clay used to seal the wooden boxes encouraged further bacterial growth. It was my personal absent mind that allowed this to happen, but gladly this did not ruin the project as a whole.

5.2 Value of the project

From a personal point of view, the project’s value is as high as the customer gives to it. For them, a clear and visible model is valuable piece of equipment. A real fruit would turn bad within a week unless preserved in some sort of preservative or cast in clear resin. Having a 1:1 model of the fruit, especially one that can be split into two sections and showcase the insides where the beans would reside, allows the customer to have a broader showcase of the said fruit around the year.

Simply casting and preserving an organic product inside a resin casing is relatively easy, as long as the hardener is not abused. This project showed that organic matter is rather trickier to use as a model for mould making. Unlike a statue made of stone, the cocoa fruit was ultimately constantly changing in colour and size after the work had properly began. This constantly changing nature requires a fast working pace, and in hindsight the casting should be done on the very day the fruit has been plucked from the tree. There is a relatively large amount of documentation of how to cast a model kit part or similar with silicone mould and resin. However, the number of guides that touch on how to make a casting of an organic object are far less to a point that a normal search yielded zero results at the beginning of this project. As such, it is clear that this project has value in recording and outlining how to proceed with organic subjects when making a resin model out of them.

5.2.1 Value of 1:1 replica

A 1:1 replica is highly valuable in exhibition and teaching use. The more accurately something emulates an object, the better it illustrates the actual subject. With this resin model the customer is able to showcase a cocoa fruit at its prime even during off-season.

There is also a romanticised view on this from scale model world, where an accurate replication is one of the few things that keep certain things alive. For example, in 2006 all but the museum use Grumman F-14 Tomcat fighters were decommissioned and dismantled in order to prevent any spare parts from leaking to Iran’s air forces. (Theimer 2007.) In the eyes of a scale modeller, the models of the F-14 are one of the last things that keep the memory of those fighters alive, especially if the modeller models their piece accurately according to any individual fighter and their markings or a certain squadron like the famous VF-84 with their black and yellow colours combined with a jolly roger. In this sense, the replica is now the only physical memory of that one fruit.

5.2.2 Possible future uses of these methods

The methods described in this thesis to make an accurate replica of an organic object has its limits. Size and shape of the replicated object are perhaps the most important factors in whether or not it would be plausible to create a resin replica using silicone moulding. You also have the issue of either the mould or the resin capturing small parts of the object to itself, affecting its shape. For example, if a coconut’s shell would have been used in this thesis, there’s a high probability that hair from the coconut’s other shell would get stuck into both the mould and the resin. Smaller berries or fruits may be even harder to keep fresh during the mould curing process. As such, the replicated object dictates how challenging the process can be.

However, I do feel there is an inherent value in a high accuracy model and mould. For example, accurate replicas of human body parts could be used to represent e.g. a liver or a kidney to students rather than simply show an image. It would also be possible to represent something like a heart’s arteries by casting them silicone, thus producing a negative mould. Combining this negative mould with another negative mould of the outside of the heart, one could theoretically produce a fully accurate resin heart.

Despite the possibilities of creating long lasting replicas, it would seem that when it comes to organic objects, polyester resin is most often used to encase the object inside a plastic cube rather than replicate it.

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