pop.
BUBBLE MAKER

PROCESS REPORT

MSc04-ID9
June, 2020

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Abstract

DANSK

De globale klimaforandringer betyder at mange traditionelle vinregioner står overfor altødelæggende varme og tørke, dette tvinger vinproduktionen til at søge længere mod nord til lande med køligere klimaer. Mens fremtiden inden for vinproduktion i nordlige lande ser lovende ud, så er 'koldklima vine' begyndt at få stor opmærksomhed. Nordligt beliggende lande har en anden fordel; druer med en perfekt balance mellem syre og sødme der er ideelle til mousserende vin. Desværre er produktion af mousserende vin besværlig og meget af udstyret egner sig kun til masseproduktion i stor skala. Mindre vingårde må ofte ty til hjemmelavede løsninger, hvilket kan påvirke kvaliteten af vinen negativt. Mange vingårde er afhængige af turister for at øge deres profit, men her bliver de nødt til at gemme de hjemmelavede løsninger væk, da de ikke ser professionelle ud.

Resultatet af dette kandidatspeciale er **pop.** BUBBLE MAKER; et professionelt udstyr der kombinere processerne relateret til de sidste fire trin i mousserende vin produktion; frysning af flaskehals, degorgering, udjævning og sødning. Sammenlignet med at bruge hjemmelavede løsninger, får vinmageren en større faglig stolthed, både når vinen fremstilles alene og når det sker i samarbejde med turister. Eftersom alle processerne er placeret tæt på hinanden, kan vinmageren bruge sin tid mest effektivt og gør det nemmere at fremstille mousserende vin. Produktet ændre den måde hvorpå vingårde og vinerier interagerer med turister, ved at gøre det muligt for dem at skræddersy deres egen vin. Det følgende præsenterer produktudviklingen fra den første tår dejlig dansk vin, til et færdigt produkt forslag og en forretningsplan.
God fornøjelse!

ESPAÑOL

Con el aumento de la temperatura en el mundo, muchas regiones vinícolas tradicionales enfrentarán un calor devastador y sequías, lo que hará que la producción de vino migre hacia el norte a países con climas más fríos. Si bien el futuro de la vinificación en los países nórdicos es prometedor, en el presente, el vino de clima frío ha comenzado a llamar la atención. Esto se debe a que los países del norte tienen otra ventaja; uvas con un equilibrio perfecto entre acidez y dulzura, ideal para vinos espumosos. Sin embargo, la producción de este vino no es fácil y muchos de los equipos industriales sólo son adecuados para producciónes en masa en grandes instalaciones. Pequeños viñedos a menudo tienen que recurrir a soluciones caseras, lo que los hace más propensos a errores humanos, que pueden afectar la calidad del vino. Además, para aumentar sus ganancias, los viñedos confían en mostrar sus instalaciones a turistas, pero las soluciones caseras no lucen lo suficientemente profesionales como esto.

El resultado de esta tesis de maestría es **pop.** BUBBLE MAKER; equipamiento profesional que combina procesos relacionados con las últimas cuatro etapas de producción de vino espumoso; congelación del cuello de botella, descorche, nivelación y dosificación. Tener cerca los diferentes procesos significa que el tiempo del viticultor se usa de manera más efectiva y facilita la elaboración. El producto cambia la forma en que los viñedos y las bodegas interactúan con turistas, permitiéndoles participar activamente en la producción y personalizar su propio vino. En comparación con el uso de artefactos caseros, el viticultor disfruta tanto al hacer vino espumoso solo o en colaboración con turistas. A continuación se presentará el proceso de desarrollo desde el primer sorbo de un gran vino danés hasta una propuesta de producto terminado con un plan de negocios.
¡Chin Chin!

Preface

This master's thesis project is created by MSc04-ID9, Spring 2020. This project is a part of the Industrial Design at Aalborg University and the team has chosen the topic; production of sparkling wine. The project is presented through a process report, product report, technical documentation, and appendices.

Acknowledgments
This project would not have been possible without the knowledge and input from vineyards all over Denmark. Furthermore, a special thanks to our supervisors Louise Møller Haase and Mikael Larsen from Aalborg University for their help and guidance in the project.

Thanks to vineyards:
Guldbæk Vingård
Heden Vingård
Modavi
Årø Vingård
Glenholm Vingård

Reading Guide

This project consists of two reports; a process report with an appendix and a product report as well as a technical folder. It is recommended to read the process report first to get a better understanding of the development process before seeing the final result. To give an overview of the project, the process report is divided into; Understanding, Ideation & Experimentation, Detailing, Implementation, and finally the Epilogue. The product report presents the final design solution.
References are cited using Harvard (Author, year). Figures and tables are numbered according to the current phase (Ill. 3.1) and references to an appendix will be referred to by its number (Appendix 1). Throughout the process, needs and wishes were collected to give a direction to the project as well as things that needed to be further investigated. To make this clear, it will be indicated in the text as follows:

N | Need **W** | Wish **I** | Investigate

Ill. 0.1

Lucia Villaverde Puchcariov | *Lykke Rosenkilde Petersen* | *Stine Rønberg*

vino|studio

A wine enthusiastic design studio with focus on developing innovative solutions within the wine industry. Our ambition is to help the small wineries gain a completive advantage in the wine industry and gain even more professional pride.

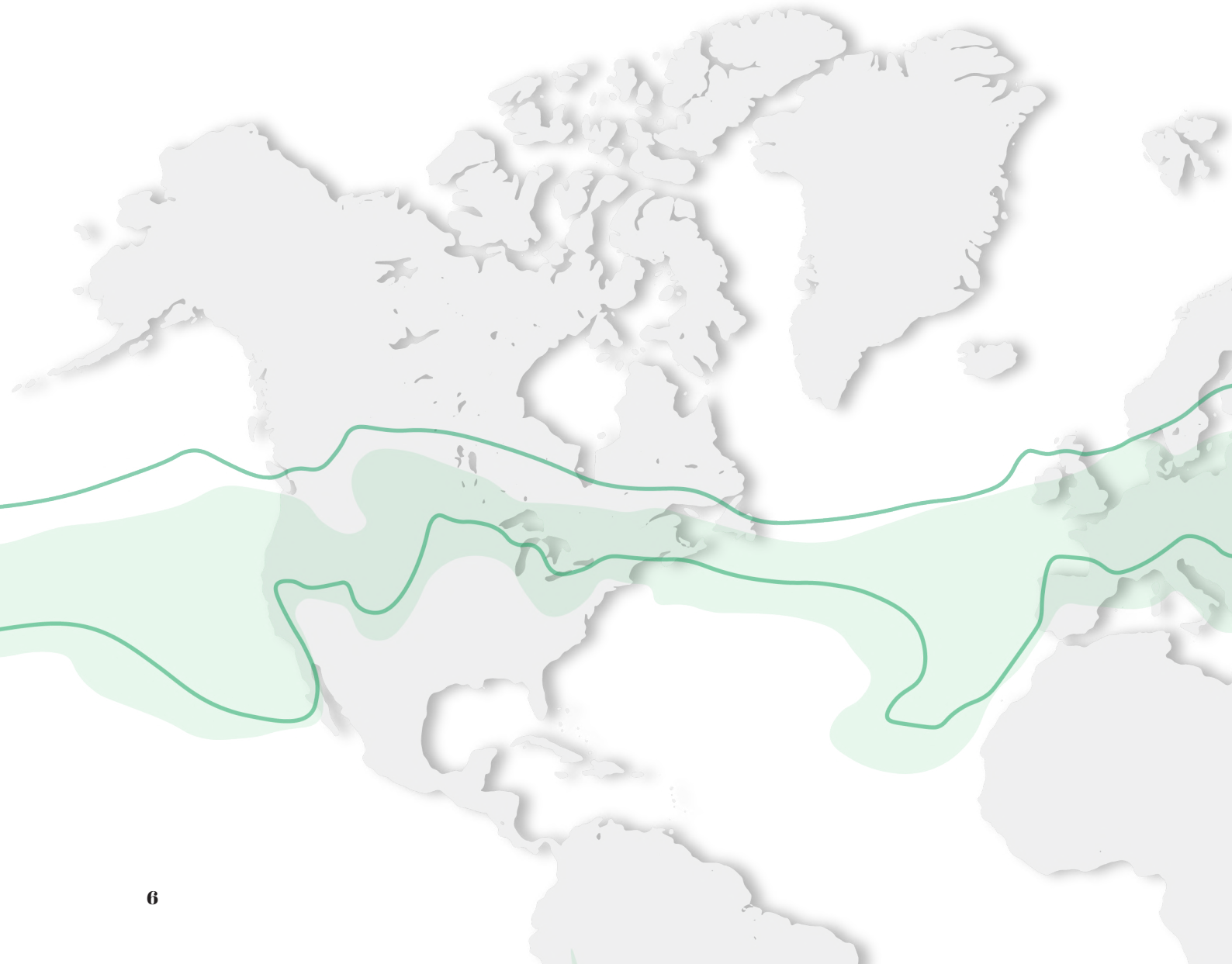
Table of content

Framing the project

SPARKLING WINE IN NORTHERN COUNTRIES

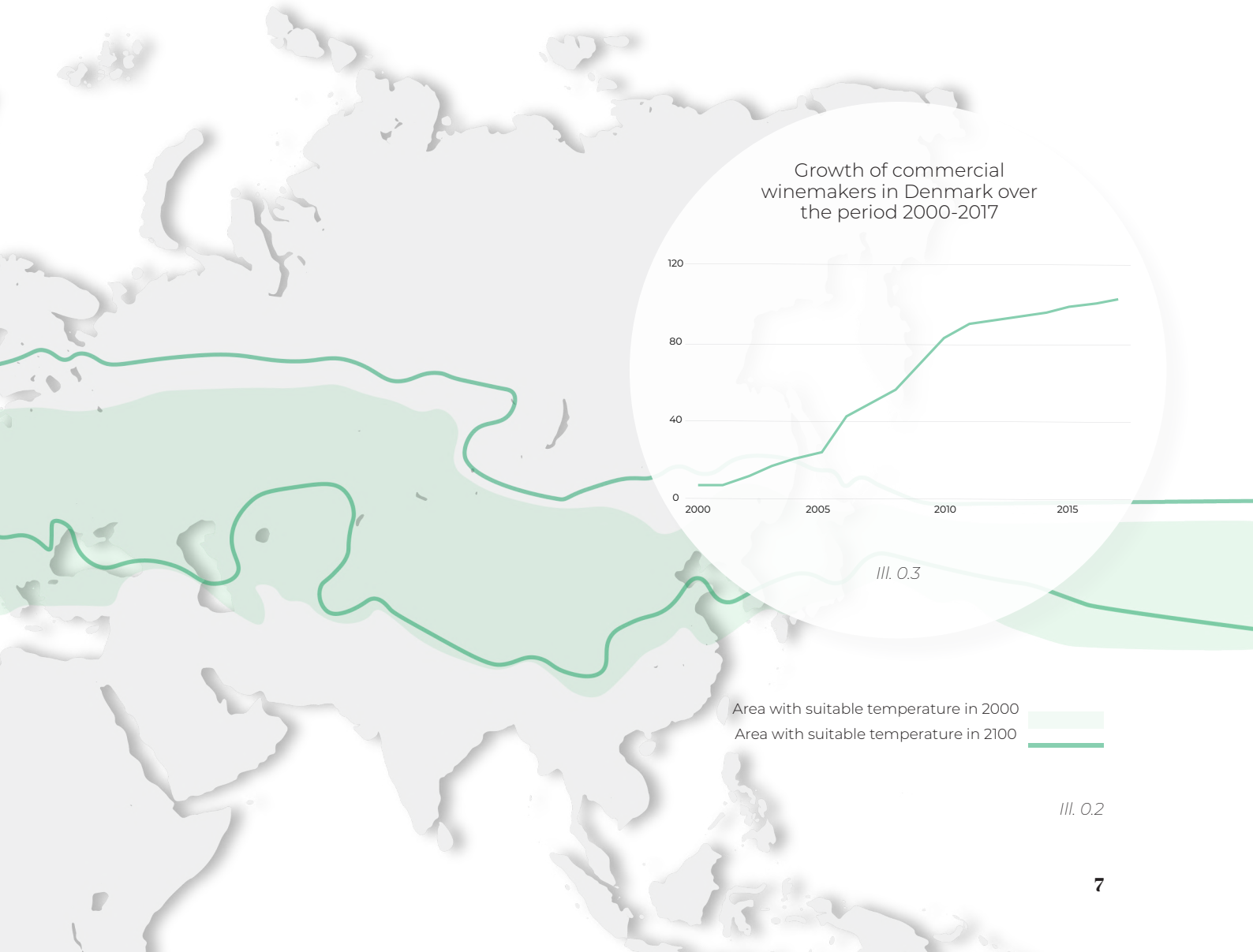
Climate changes have a big impact on wine production worldwide which means big changes will have to be made in the next few years to secure the produce. This means that traditional wine-producing countries no longer will have the appropriate climate, as seen in illustration 0.2. This is especially seen in the northern hemisphere but affects the southern hemisphere as well. As an example, areas in Spain are already affected by this as heatwaves, droughts, and excess sunshine have a devastating effect on the crops. If the tendency continues, a considerable part of the 7 billion Spanish wine industry is in danger. To cope with this, vineyards move their vines up in the mountains where it is possible. For regions where this is not an option the wine production will have to migrate further north. (Marques and Velazquez, 2019).

Northern countries, such as Denmark, might not be placed in a traditional wine region yet, but the colder climate has another advantage; fruits with a perfect balance between acidity and sweetness. This means that the grapes currently grown in North Europe are ideal for sparkling wine. (Alderman, 2019).



MARKET SIZE

According to the Market Research Future report (Sparkling Wine Market Research Report – Global Forecast to 2023, 2020), the sparkling wine market in general, is predicted to have a notable growth rate over the period from 2018 to 2023. Various factors are propelling growth such as; increase in the number of local wineries, demand for premium wines, and introduction of innovative products in the market such as limited edition, low-alcohol, and organic sparkling wines in different flavors.
This growth is not only seen in big wineries but also in smaller ones. As an example, in 2018 Britons drank a record amount of homegrown sparkling wine, according to The Guardian, becoming more popular than big sparkling wine industries from Australia, the US, and Germany combined. (Smithers, 2020)
This master thesis project will use sparkling wine production in Denmark as a case. Here the number of commercial winemakers doubled from around 50 to more than 100 in the last decade (Toldam-Andersen and Becker, 2018), as seen on illustration 0.3. It is assumed that the findings presented in this project can easily be applied to other northern regions.



Ill. 0.3

Ill. 0.2

Ill. 0.4

SMALL COMMERCIAL WINERIES NEED SMALL SCALE INDUSTRIAL EQUIPMENT

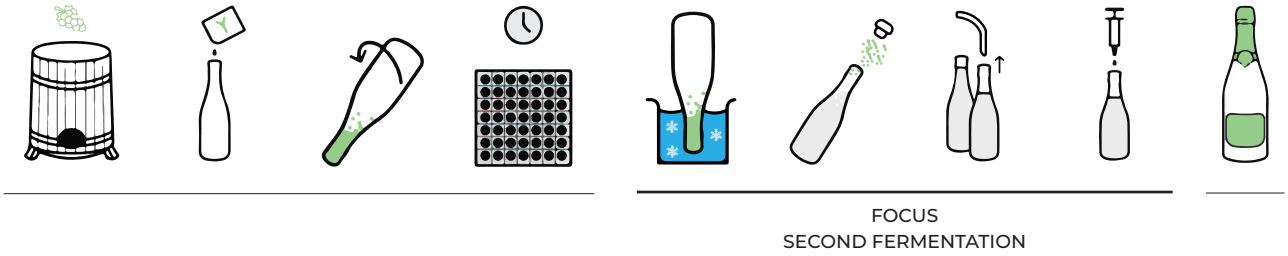
When new wineries are entering the sparkling wine market, they typically start with smaller batches while they experiment and perfect the recipes. Some will later expand while others will stay small. This creates a problem since a lot of the industrial equipment used in sparkling wine production is only suitable for mass production in big facilities.

Smaller vineyards do not have the money to invest in these or the high volume of grapes for it to make sense. Therefore they often have to resort to homemade solutions, also known as hacks. The small vineyards use a combination of manual processes and hack's to streamline production. This makes them more prone to human mistakes, and as a consequence, the quality of the wine is lower. Additionally, the profits of small commercial wineries rely on tourists visiting for wine tastings, seeing the vineyard, or just buying wine. Unfortunately, the winemakers are not able to show their visitors the production of sparkling wine because of the hacks. They look cheap and unprofessional compared to the price visitors would need to pay for a bottle.

Ill. 0.5

MAKING SPARKLING WINE

There are several methods for producing sparkling wine, this project focuses on the most popular one; Méthode Traditionnelle. Here the bubbles are created in the bottle by doing a second fermentation (Git.eclipse.org., 2020). The last four processes involved in this second fermentation are; freezing the neck of the bottle, disgorging, leveling the wine, and adding dosage (Ill. 0.6). These four processes are essential for developing a product for small vineyards and will be defined in detail later on.

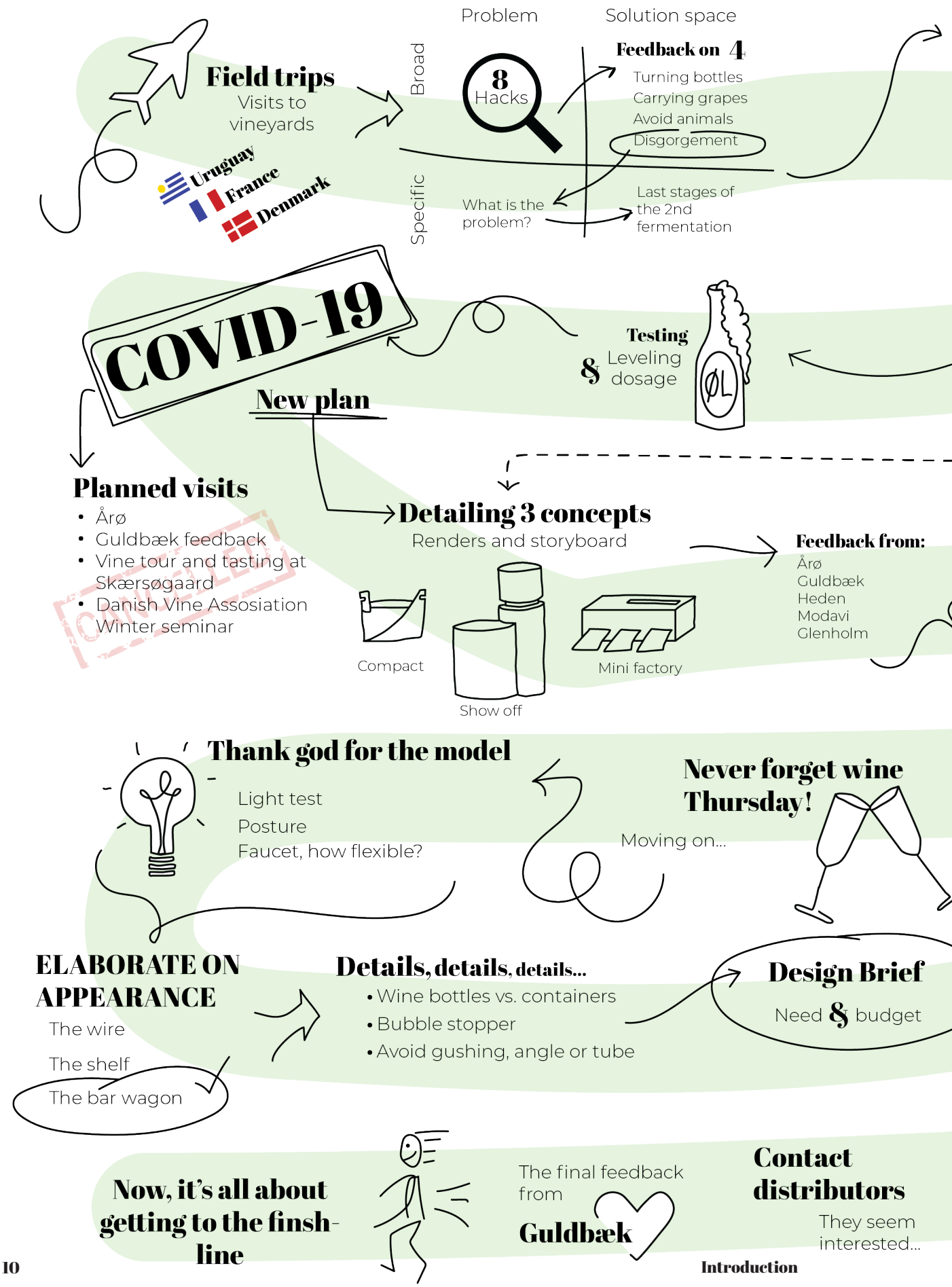


Ill. 0.6

Research and visits to small commercial vineyards made it clear, there was a gap in the market for a professional equipment to produce sparkling wine, using the Méthode Traditionnelle. Therefore, the aim of this project has been:

"How to develop professional equipment for sparkling wine production that focus on improving the quality while giving the tourists an experience?"

Process tracking

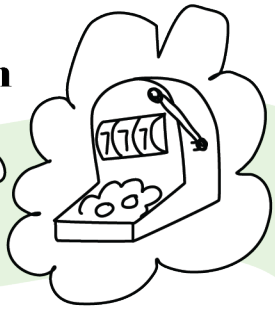


Understand!
Neck freezing
Disgorgement
Leveling
Dosage

Milestone 1
Keep up the good work!

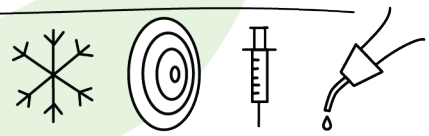
Start concept development

Striim

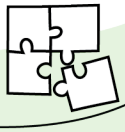


Does not work!
What to do?

Sketch on 4 processes:
Mapping solutions

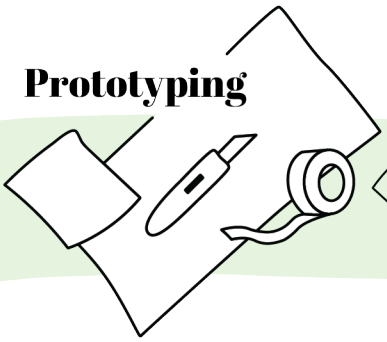


Next step....
Combine processes



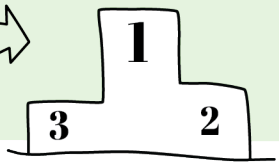
3 Concepts:
Mini factory
Manual
Show off

Prototyping



- and the winner is...

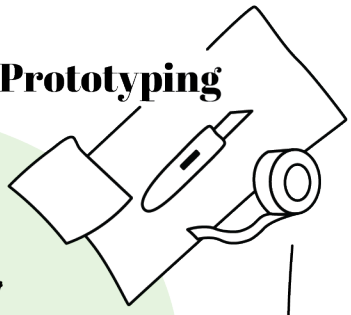
Show off



Excited winemakers

Milestone 2
Keep up the good work!

Prototyping



How many bottles?

Minimize material

How will the pump work?

Crisis...
Should freezer be included
- **Yes**

Turning mechanism
Motor or mechanical?

How will mechanical work?
Pedal

Milestone 3
Keep up the good work!

What material?
Ask China for prices

Adjusting leveling
Snap fit

How to add glucol?
Funnel

Bar mat

Getting the small details right

Placement of bottles on lid

Explore frame options

Disgorgement bowl
Opening in top or bottom?

Ill. 0.7

Ill. 1.1

Understanding

IDENTIFICATION OF THE PROBLEM

To identify a problem in wine making, several visits to Danish, French, and Uruguayan vineyards were made. Here eight problems were observed. After the market research, the eight problems were reduced to four, which was sketched upon. (Appendix 1) The sketches was then shown to the winemakers for feedback to finally go with one problem. The four problems presented were: Riddling the bottles, the last stages of the second fermentation, carrying grapes when harvesting, and avoiding animals in the vineyards. The ideation for the four problems was shown to Guldbæk Vingård and Heden Vingård to get feedback on each problem. (Appendix 2)

Sparkling wine

“Come quickly, I am tasting the stars!” Dom Perignon.

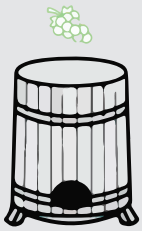
The first documentation of sparkling wine was as early as 1531 by French monks. However, it was not until the 17th century when another monk, named Dom Pierre Perignon, planted vines and subsequently started its popularity. (Schlack, 2019)

But what does it mean that a wine is sparkling? Sparkling wine refers to effervescent wine, a wine that is expected to be bubbly or fizzy, caused by naturally released carbon dioxide. Sparkling wine is made as any other wine with grapes being pressed and then fermented. What differs from still wine is the addition of a second fermentation to create and hold the carbon dioxide in the wine. (What is Sparkling Wine, n.d.). There are different methods for making sparkling wine, some methods don’t have a second fermentation but add the carbon dioxide artificially, others have the second fermentation in a tank or in the bottles. The second fermentation is also where the sweetness of the wine is defined as well as how bubbly it will be. (Schiessl, 2017)

This project will focus on sparkling wine made by the traditional method, also known as the champagne method, particular the last stages of the second fermentation: 5. freezing the neck, 6. disgorgement, 7. leveling, and 8. dosage.

To give a better understanding of how it is made, an overview of the processes can be seen below.

TRADITIONAL METHOD

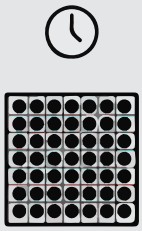


1

The first step in making sparkling wine is to have a finished base wine, also called still wine, and bottle it.

2

To start the second fermentation and create bubbles, it is necessary to add yeast and sugar. Afterward, the bottle will be sealed with a crown cap.



3

The wine are stored between 9 months and 5 years, depending on the desired quality. The process is called aging and during this time the yeast dies and become lees.

4

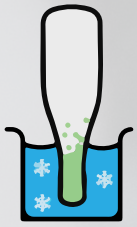
The bottles are rotated to gather the lees in the bottleneck this is called riddling. It is important to keep the bottleneck downward to avoid the lees mixing with the wine again.

FACT BOX

cold climate wines

Climate has one of the biggest impacts on the flavor of the wine. Sunshine is very important during the growing season for grapes, as it makes the grapes develop sugar which then converts into alcohol. Equally as important is coolness, as a low evening temperature preserves the malic acid in the grapes, which gives the overall balanced acidity in the finished wine. Wine regions that have “diurnal shifts”, which is where there is a significant difference between day and night temperatures, is where cold climate wines are growing (Signer, 2016). Cold climate wines are often known from regions like Champagne in France but countries like Sweden, Denmark, Poland and England are starting to produce great cool-climate wines as well (Puckette, 2019). Grapes that are growing in a cool climate take a longer time to ripen. This results in lower natural sugars and higher acidity which gives crisp and light wines, perfect for sparkling wine (Signer, 2016).

Growing wine in cold climates means the growing conditions can vary a lot from year to year, this variation increases the further to the north the vines are growing. Because of this, the micro climate in the field is of great importance and research has shown that small producers get the highest yield. The reason for this is that small producers have more vines placed in ideal conditions whereas the big producers have more open fields. For winemakers in Denmark and other northern countries, this means there is a benefit of staying small instead of continuing to expand. (Bentzen & Smith, 2009).



5

Most professional wine-makers freeze the neck of the bottle to make it easier to remove the lees, as it creates an “ice bullet”.

6

The crown cap is re-moved which causes the frozen lees to shoot out of the bottle with a pressure of around 6 bars.

7

For having the same level of liquid in all the bottles, wine might need to be removed or added. This step is im-portant for ensuring quality in the product.

8

A mixture of wine and sugar, called Exposi-tion liqueur is added to fill the bottle and de-fine the type of spar-kling wine; sec, brut, doux, etc.

Ill. 1.2

9

Then the bottle is corked and labeled. This is the final step before selling the wine.

(Puckette, 2016)

Last stages of the second fermentation

An investigation of the last four processes in the second fermentation was needed to gain a better understanding of the subject. This was essential to build a foundation of knowledge for creating and developing future concepts.

Ill. 1.3

FREEZING THE NECK

Before freezing the neck it is important to cool the bottle to lower the pressure inside. The bottles are placed with the neck down in a freezer, ice bath, or in a tub of ice cubes to freeze the lees at a recommended temperature between -20°C and -30°C (Neck freezers, n.d.). It takes between 2 to 60 minutes to freeze, depending on the freezing method, the thickness of the bottle and the ambient temperature (Champenoise method, n.d.). Often the first 25 mm of the neck is submerged in an antifreeze solution that will speed up the process. The neck freezing will allow the lees to create an “ice bullet” and reduce the amount of wine being lost when disgorging. (Karlsson, 2017)

Ill. 1.4

DISGORGEMENT

The lees is expelled from the bottle by opening it like a beer bottle since they are closed with crown caps. It is a messy process and it needs to be done correctly in order to take out all the lees without losing too much wine. There are many hacks in order to make this process less tedious, cleaner, and making it more practical for production, for instance, holding the bottle at a certain angle.

LEVELLING

Leveling the wine plays an important part in the production of sparkling wine, as the disgorgement is not a fully controlled process that leaves the bottles with an uneven amount of liquid inside. As the wine are sold commercially, it is crucial that the wine contains and tastes the same. This process can be done by adding or removing wine so all the bottles have an equal amount inside and there is space for adding sugar during dosage. There are several ways of doing this manually, from taking out liquid by inclining the bottle, using pumps, or syringes. Because different wine need different amounts of sugar, it varies from winery to winery how much they take out or add when leveling.

DOSAGE

The last process before corking the bottles is the dosage, which is prepared in a container. Basically, the dosage is a solution of sugar and preservatives that is dissolved in wine, preferably the same base wine that was used at the beginning of the sparkling wine process. The amount of sugar in the dosage needs to be very precise as it defines what type of wine it will be; sec, brut, etc. (Yeamans, 2018). The preservatives can be brandy or sulfites, to prevent spoilage and oxidation. (Dosage - Union Des Maisons De Champagne, u.d.). Gushing may occur when adding the dosage, this is an abundance of wine overflowing the bottle, resulting in a loss. To avoid this, it is necessary to make sure there are no sugar crystals in the mixture and the temperature is the same as the wine. (Sparkling Handbook 2018-2019, 2018)

Ill. 1.5

Ill. 1.6

The investigation of the last four stages of the second fermentation, helped gain better understanding of the considerations that needed to be included when developing a product for making wine with the traditional method. The product needed to embrace the making of quality wine. This can be done by avoiding gushing by cooling the bottle before freezing the neck or having a specific angle for disgorgement to avoid spillage. Besides, it is important that the winemakers can produce different types of sparkling wine, making it necessary for them to be able to change the amount of leveling and dosage. As the most common way of leveling was to remove wine, the project will not focus on adding wine.

N | *Possible to change the amount of leveling*
Possible to change the amount of dosage
Specific angle for taking off the cap

W | *Freezing should be at a temperature below -20°C*

FACT BOX

dosage

Sparkling wine used to contain much more dosage than it does today as taste has evolved and today's consumer prefers dry wines, particularly in Scandinavian countries, as they are least likely to favor the sweet. (Dosage - Union des Maisons de Champagne, 2020)

These days, the amount of sugar per liter of wine is regulated by law and the terms are the same for Champagne and all other sparkling wines in the EU. (Yeamans, 2018). Mentioned below are the sweetness categories, grams of sugar added per liter of wine.

- Brut nature 0 g/L - no added sugar.
- Extra brut 0-6 g/L
- Brut 0-12 g/L
- Extra dry 12-17 g/L
- Sec 17-32 g/L
- Demi sec 32-50 g/L
- Doux> 50 g/L (Karlsson, 2017)

As seen the amount of sugar does not vary drastically so the amount of dosage needs to be precise.

N | Enable precise dosage

Ill. 1.7

User

As there are different types and sizes of wine productions, they will not have the same needs for a product. The following presents an overview of the different types of users and how they will benefit from using a product that combines the last processes of the second fermentation. Representatives from each of the user groups were interviewed over the phone or in person. (Appendix 3) This helped gain personal insights to discover how the different users can benefit from the proposed product as well as which user group to direct attention to.

Ill. 1.8

HOBBY WINEMAKER

200-1.000 vines.
Less than 200 bottles of sparkling
Small budget.
Use easy hacks.
Does not mind spending time.
Production for own consumption.
Interested in new tech.

Ill. 1.9

SMALL COMMERCIAL WINERIES

1.000-20.000 vines.
200-2.000 bottles of sparkling
Most of DK winemakers.
Willing to invest if a product saves time.
Use hacks
Dont have money or capacity for mass production.

.

Ill. 1.10

BIG COMMERCIAL WINERIES

20.000+ vines.
More than 2.000 bottles of sparkling
Less frequent in DK.
Big wineries/cooperatives.
Automated production.
Disgorge small batches to test and experiments.
Big international market.

Ill. 1.11

CIDER PRODUCTION

Few DK commercial cider makers, many hobby
Not all disgorge.
Big international market, hobby and commercial.

The primary user is the small commercial wineries that will use the product for industrial production of sparkling wine. They have bigger budgets than the hobby makers but do not have the money or need for a big production facility for mass production. This group takes up the majority of commercial wineries in Denmark. A secondary user is the big commercial wineries who have a big production setup but need to be able to experiment and test small batches without changing the production setup. For hobby winemakers and cider makers, the price of the product will be of great significance, as they often have a limited budget and a small number of bottles.

Visits at vineyards

How small commercial wineries produce sparkling wine and what challenges they meet are investigated through interviews and observations from visits to the vineyards; Guldbæk and Heden. The visits especially focused on the last stages of the second fermentation. The vineyards vary greatly in size, where Heden is one of Denmark's smallest commercial vineyards with 1000 vines against Guldbæk's 15.000 vines. These vineyards are chosen to get a more nuanced picture of their challenges when producing sparkling wine, no matter the size of the production. Furthermore, is it planned to get comments on the initial concept from both vineyards

CONTEXT

At both vineyards, space was an issue because many of the processes when making wine was made in big containers or barrels which took up space all year round. At Guldbæk, the owner even had to include his son's garage for storing the bottles during the second fermentation, because he lacked space. Although they did not have much space, both vineyards was kept neat and tidy. This is because the wine industry is applauded with the smiley scheme from the Danish Veterinary and Food Administration. At the same time they had a lot of tourists coming to visit the vineyards for tours and wine tastings, this was a large part of their income, so they needed to keep their production facilities neat.

Ill. 1.12

Ill. 1.13

MAKING SPARKLING WINE

The equipment, the amount of bottles produced, and how they performed the last stages of the second fermentation varied between the vineyards. Where Guldbæk produced 100 bottles of sparkling wine in a day (two persons), Heden produced 12 bottles in a day (one person). Where Guldbæk did all four steps of the processes; freeze, disgorging, leveling, and dosage, Heden left out the step of leveling.

Illustration 1.14 to 1.16 show pictures from Heden where owner Hans showed how and what equipment he used for the last stages of the second fermentation. For freezing, he used an EPS-storage box with hole cut out for the bottles, inside was a mix of salt and ice. It took around one hour to freeze the necks this way.

For the next steps, he was wearing gloves. For disgorging he was using a standard bottle opener and a bucket. Because the bottle has a pressure of 6 bars the lees will explode when it hits a surface and make a lot of mess. That often happened at Heden because he used an open bucket that did not stop lees from splashing back at him. After disgorging, he went straight to dosage. Here he used a funnel that made it a bit difficult to put the dosage in slowly enough to avoid gushing over.

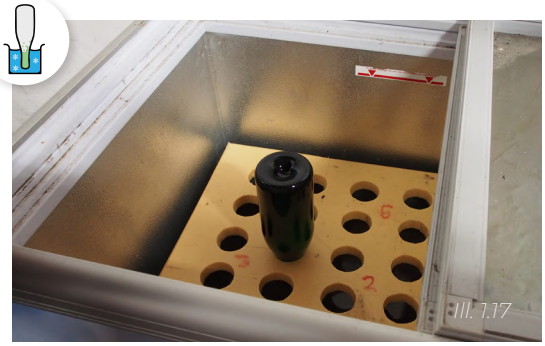
Because Heden used small simple hacks and equipment, it was easy for him to have a station for each step. When the bottle was disgorged, the other steps needed to happen fairly quickly, in order to lose as little carbon dioxide as possible, i.e. bubbles.

Ill. 1.14

Ill. 1.15

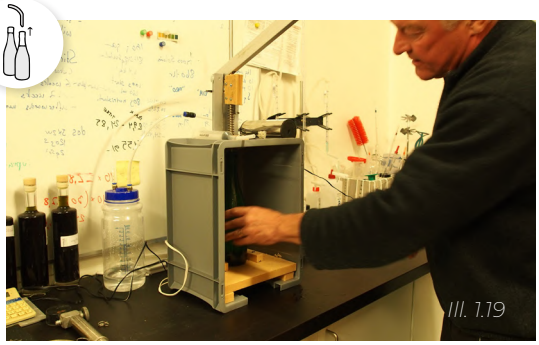
Ill. 1.16

At Guldbæk the owner Jan had optimized the processes compared to Heden. He had bought a freezer where he had put in a container suitable for containing anti freezing liquid and a fixture to hold the bottles similar to what is used in the industrial neck freezers. It freezes down to -30°C so the bottles only needed to be in the freezer for around 6 minutes. For the disgorgement he made his own product, as seen on illustration 1.18 He placed the bottle opener in an angle of 65 degrees to avoid gushing. He placed the opener on a bent tube to lead the lees and ice down in a container without making a mess. He then light the bottle with a flashlight to make sure all the lees was out. At Guldbæk leveling was an important step of the process, as it ensures the quality of the wine was the same. For leveling he made his own product by using an electrical pump and a tube (Ill. 1.19). Here a suction tube inside the bottle will remove the wine until it cannot suck more and hereby leaves the same amount of wine in each bottle. It is a simple product where he just needed to place the bottle correctly and then pull a handle. The challenge was to place

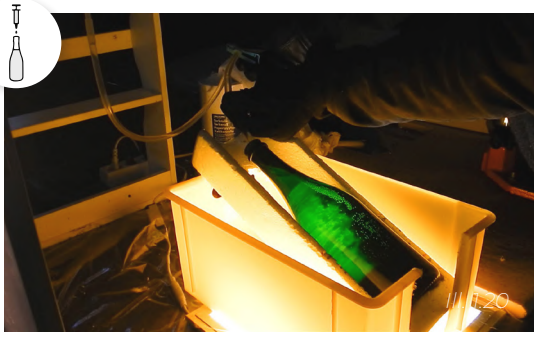


Ill. 1.17

Ill. 1.18



Ill. 1.19



Ill. 1.20

Ill. 1.21

the bottle without having a bad working posture, to check if the tube was inserted into the bottle correctly. For dosage, he used a tube and to avoid the wine gushing, he inclined the bottle. Today Jan is the only employee at the vineyard so when he is making sparkling wine he is including his wife in the production. This is to make the workflow go faster.

Although Guldbæk was proud of his homemade products, he did not think they looked professional enough to show them to tourists or on social media, especially since the bottle of sparkling wine costs 295 DKK. When he started making sparkling wines he started off with 1.500 bottles, this year he is making 1.200 bottles. Right now, he is not sure he is going to make as many next year, as it is a very time-consuming and inconvenient process. He does not know if he thinks it is worth it.

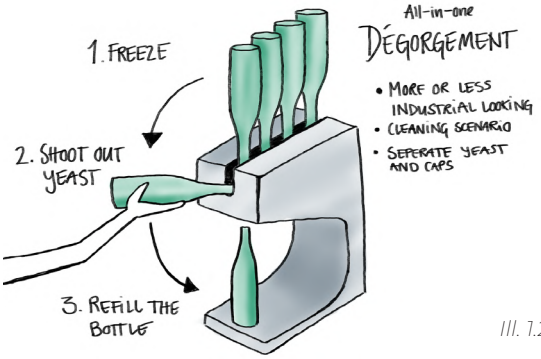
FEEDBACK FOR "ALL-IN-ONE"

Both vineyards were shown a concept idea to get feedback. Showing the sketch to the vineyards helped visualize opportunities and opened up a conversation about their needs for a future product.

The idea behind the initial concept "All-in-one" (illustration 1.22) was to have all four processes close by and to give the feeling of direction between each process. The concept is small and fits on a table to symbolize it is for small production.

Both vineyards could see a great opportunity in bringing all four processes together instead of having to buy four individual products. Guldbæk, in particular, could see the optimization of both the process and the time, as he had a production of more than 1.000 bottles. They both emphasized the lack of physical space at their vineyard and that it could be positive if the product did not take up space when it was not used or had wheels so it could be moved easily. All their equipment was washed and cleaned at the end of the day so the product should be able to withstand water and soap. In particular, Guldbæk emphasized the importance of the product being neat and professional, so he could show it to tourists and on social media.

Both vineyards were asked how much they were willing to pay for a product that combines the four processes into one. Heden would spend around 15.000 DKK whereas Guldbæk was under 100.000 DKK. (Appendix 2)



Ill. 1.22

Ill. 1.23

PRODUCTION SPACE

The illustration 1.23 shows how the production space was set up for making sparkling wine at Guldbæk. By observing the production being done, removing a bottle from the freezer took the longest as it was hard to see if the lees were frozen. Additionally was it hard to tell which bottle had been in the freezer the longest. At Guldbæk they also had cleaning stations for wiping the anti freezing solution off the bottle using a cloth. As mentioned earlier, after disgorging, the other steps needed to happen fairly quickly, in order to lose as little carbon dioxide as possible, which can be difficult to achieve due to the distance between the stations. The production setup took up a lot of space in Guldbæk's winery, therefore it was packed away and stored when not in use.

Challenges was seen at both vineyards when looking at the last stages of the second fermentation, no matter the size of their production. They both struggled with space and not having professional equipment. Because the wine industry are included in the smiley scheme from the Danish Veterinary and Food Administration, the product needed to be easy to clean. Bringing all four processes together into one product could have a great impact for the vineyards regarding optimizing the process of making sparkling wine. Guldbæk, in particular, could see the benefit of not having to include his wife in the production.

N
- Having the four processes close to each other
- Easy cleaning
- Minimize splashback when disgorging
- Able to withstand force of 6 bar
- Possible to operate the product with gloves on

W
- One man use
- The product should not take up space when not in use

Hacks

After the visits, it became clear that hacks was being used on the last stages of the second fermentation in small wineries. Therefore, Online research was conducted to identify the range of different hacks used for each step of the process. In this process, videos on youtube were especially important.

NECK FREEZING


Ill. 1.24


Ill. 1.25


Ill. 1.26

Ice Boxes and plastic buckets with salt and ice, or domestic freezers with a mixture of water and glycol can be seen as the most common hacks. A fixture to keep the bottles with the neck down is often used.

DISGORGMENT


Ill. 1.27


Ill. 1.28

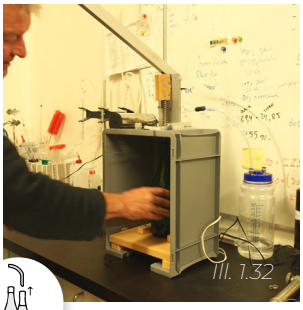

Ill. 1.29

This was the process with most "creative" hacks, probably due to the mess it creates doing it. Again, plastic buckets was popular due to their low price. As a more traditional approach, wine barrels with an opening was also used.

LEVELING


Ill. 1.30


Ill. 1.31


Ill. 1.32

Could be as simple as tilting the bottle to remove wine or using common elements such as a syringes, measurement cups, etc. In the images, a very developed hack can be seen, made out of a mechanical pump with a handle.

DOSAGE


Ill. 1.33


Ill. 1.34


Ill. 1.35

As with leveling, common tools was used to introduce the dosage into the bottles such as syringes, funnels and measuring cups.

FACTBOX

sparkling wine bottles

Wine bottle dimensions and shapes vary, especially sparkling wine bottles, which often come in containers of 750 ml which is the focus in the project. Unusual size bottles often don't use the traditional method for the second fermentation, therefore they will not be taken into consideration.

Sparkling wine bottles also have thicker glass, because they need to withstand the pressure from the bobbles. The thickest part of the bottle typically measures between 83 mm and 96 mm in diameter and are 279 mm to 315 mm in height. The hole of the bottleneck measures 17,5 mm in diameter and it is standard for every bottle. (Sparkling wine, n.d.).

N | Fit different bottles

Ill. 1.36

It was confirmed in the variety of hacks found Online that there was a market for a new product that fits the small producer of sparkling wine. Several problems were identified from the research, many of the hacks did not seem practical regarding; time management, working positions, storage, or cleaning. The hacks was often exposed to human mistakes, as their use was mainly manual. To cope with this, light was often used, to make sure all the lees was out and to have clear vision during leveling and dosage thereby reducing some human mistakes. In addition, wine tourism is an important part of vineyards' profits. For this reason, how their equipment looks matter, and these hacks did not have aesthetics that represent professional wine production.

W | Integrated light

Competitor analysis

An analysis of competitors was made to get an understanding of products available on the market, as well as the positives and negatives for each product. The analysis only contains products that can be bought, this means homemade hacks are excluded. Products for fully-automated large scale production were excluded as well, as it does not fit with the primary user: small commercial wineries. Some of the prices in the overview are including taxes, some are without.

Ill. 1.37

Disgorging key 470 DKK incl. VAT
Manual disgorging
This is the most simple product for removing the crown cap and nothing else.
Positives: The product is very simple, cheap, and easy to store when not in use.
Negatives: There is nothing to catch or shield from the lees. It could be used outside or pointed towards a container to catch the lees. It is low-tech and does not make the process faster than using a regular bottle opener. (Disgorging Key, n.d.)

Ill. 1.38

Disgorging Inox Pedestal 2.750 DKK incl. VAT
Manual disgorging
The pedestal head can have different angles and the curved tube functions as a guide to the lees.
Positives: The product is height adjustable and is easy to use.
Negatives: It does not seem to have an advantage in terms of added productivity compared to the homemade hacks. The product needs a container to collect the lees, this will often have a bucket hanging from it. (Disgorging Inox Pedestal, n.d.)

Ill. 1.39

DD Grilliat Machines – DDV1 32.945 DKK excl. VAT (Lelarge, 2020) Semi-automatic disgorging machine.
The product uses compressed air and does not need power to operate.
Positives: Has a closing mechanism that prevents wine spilling after removing the crown cap. It is very simple and easy to implement in production.
Negatives: Can only be used for disgorging, additional products need to be added to deal with the other processes. (DLV 1, n.d.)

Ill. 1.40

Vigo Ltd 46.000 DKK excl. VAT (Disgorging and topping up, n.d.) Semi-automatic disgorging, dosing, & topping-up machine
Has manual disgorging and semi-automatic dosage and topping up, also known as leveling. The product does not need power but a compressed air supply and has an output of 150 bottles/hour.
Positives: Easy to implement into production and is an easy "first-step" to a more automated production. While expensive, it is not unrealistic for smaller wineries to purchase the product.
Negatives: This product does not include neck freezing which will happen in an additional product. When disgorging, the operator has a bad posture, as seen on illustration 1.42. The process is less effective since the operator must stand and wait until dosage is finished. (Semi-automatic disgorging, dosing, & topping-up machine, n.d.)

Ill. 1.41

TDD Grilliat Machines - DDV ECO 206.200 DKK (Disgorging and topping up, n.d.) Semi-automatic disgorging, dosage, and leveling.
The machine runs on both power and compressed air with an output of 150-500 bottles/hour.
Positives: Has a large output of bottles with a small internal conveyor belt moving them. It has a closing mechanism to avoid spillage.
Negatives: The product is too expensive for most small wineries and needs a professional neck freezer with the same bottle output. As shown on illustration 1.43, the machine must be manually fed bottles in one end and manually taken out in the other end. Because of this, it either takes longer or is a two-person job. Furthermore, the height of the product seems to be too low for the operators. (DV Eco, n.d.)

Ill. 1.42

Ill. 1.43

NECK FREEZERS

As all the products above need an additional neck freezer, an analysis of those has been made. Again it is only products within the price range of the primary user that have been included.

Ill. 1.44

Vigo Ltd. 34.440 DKK ex VAT
Neck freezer for 32 bottles. Output: 150 bottles/hour.
The product freezes the first 25mm of the bottle in a container with an antifreeze liquid at a temperature of about -30°C.
Can be purchased in different sizes (Appendix 4).
Positives: Easy to operate and implement into a production. Has wheels that make it easy to move. It is possible to get different sizes of freezers so the size fits the winery's capacity.
Negatives: There does not seem to be a way of knowing which bottle has been in there the longest, which can potentially cause a not completely frozen bottle to be disgorged. (Neck freezers, n.d.)

Ill. 1.45

InVIA 1912 - PG60 TF 76.460 DKK excl. VAT (Winegrowers Supplies - Neck freezers, n.d.) Neck freezer for 60 bottles. Output: 400-450 bottles/hour The freezer rotates and keeps a temperature of -25°C to -28°C. The product freezes the neck also in a container with an antifreeze liquid.
Positives: Easy to operate and implement into production. The wheels make it easy to move.
Negatives: As with the product above, it seems to be difficult to know when the bottles are finished freezing, the fact that the product rotates, does not make it better. (Impianti Refrigerazione, n.d.)

The analysis of products available on the market shows a gap between the hacks and the equipment for industrial mass production. The biggest competitor was the Vigo Semi-automatic disgorging, dosing, and topping-up machine. This machine had some challenges in terms of ergonomics, especially when disgorging the bottle. Another issue was the waiting time between the operations, lowering the effectiveness. All of the products needed a professional neck freezer which greatly adds to the cost of the operation. The Vigo machine costs 46.000 DKK and the neck freezer suitable for its capacity cost 34.400 DKK ex VAT, this meant the overall price of the operation is 80.400 DKK.

N | Good physical working condition

Context moodboard

In order to start defining the appearance of our project, a mood board was created with different pictures of wine factories, which were corroborated by what were seen in the vineyard visits in France, Uruguay and Denmark. (Appendix 5) Two aesthetics were observed in wine production; the steel food industry look and the traditional warm vineyard look. Both of them were used in the ideation phase to later evaluate which one was preferred by the users.


Ill. 1.46


Ill. 1.49


Ill. 1.52


Ill. 1.47


Ill. 1.50


Ill. 1.53


Ill. 1.48

STEEL FOOD INDUSTRY LOOK


Ill. 1.51

TRADITIONAL WARM VINEYARD LOOK

A MIX BETWEEN BOTH STYLES

Ill. 2.1

Ideation & Experimentation

DEFINING A CONCEPT

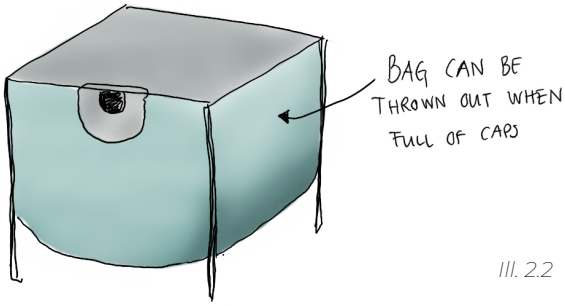
Having achieved a general understanding of the characteristics and context of the traditional method in sparkling wine production, the next step was to develop a product that could hold the processes of; neck freezing, disgorgement, leveling and dosage all in one. The phase consisted of several sketching rounds, fast prototyping and 3d modeling, and experimentations used to explore the solution space.

Initial sketching

To kick-start the sketching phase an association chain was used to expand the solution space and create blue-sky ideas (Striim, 2000). From the first word 'coffee machine' the team members took turns saying the first word that came to their mind based on the previous word. In the end, a list of 22 words was created. Subsequently, these words were concretized and sketched upon for 15 minutes. After finishing the sketches they were internally evaluated by writing the positives and negatives on post-its. (Appendix 6)

BAG

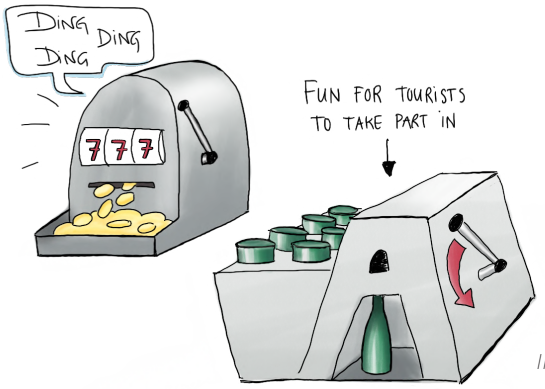
The concept was used for collecting crown caps when disgorging, as well as the lees.. After filling the bag with caps and lees, it is sealed and disposed of.
Evaluation: The overall idea is great, however, it would be beneficial to collect the crown caps without the lees, for correct garbage disposal. As the cap and lees sediment shoots out of the bottle with great power, more structure is needed for the concept to work.



Ill. 2.2

SLOT MACHINE

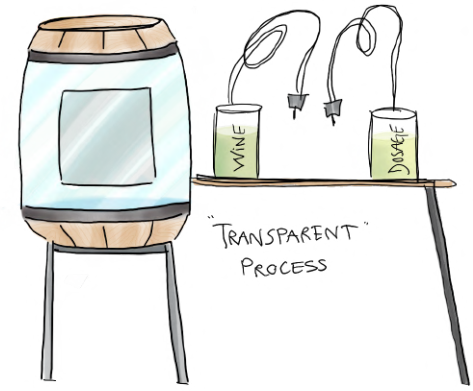
The focus of this concept was to make the Interaction very simple to make it possible for tourists to take part in and operate. The inspiration for this was a slot machine giving feedback for the operator. The concept has an integrated freezer, a disgorgement unit, and the dosage.
Evaluation: The simplicity of the interaction was positive no matter if the operator was a tourist or the winemaker. The show effect and the way of including tourists was something that could differentiate the product from competitors and was seen as having a lot of potential.



Ill. 2.3

TRANSPARENT BARREL

The barrel was used for disgorging and was transparent for making the process of disgorging visible for tourists. Leveling and dosage were placed on a table next to the barrel, freezing is not included in the product. It is easy to see what is happening in each step of the process.
Evaluation: Being transparent in the different processes was seen as positive and made it easier for the winemaker to explain the steps to tourists. On the negative side, the concept did not seem like one product but more a gathering of products for each of the processes.



Ill. 2.4

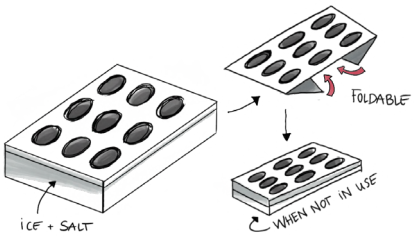
Ill. 2.5

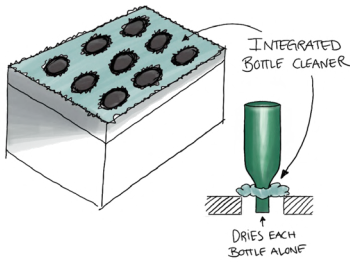
After evaluating the sketches it became clear that it had been difficult to draw with no overall direction. However, some interesting ideas emerged, such as disposable disgorgement container, fun for tourists, and a transparent process. These were elements that were included in future concepts. There were endless ways to construct each product and some sketches had focused on details while others were more overall. This meant they were difficult to evaluate and it was not possible to identify three concepts for further development. Because of this, it was decided to take a step back and focus on identifying different ways of solving each process to get a better overview.

The individual processes

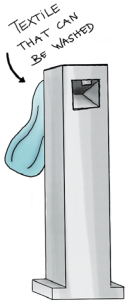
With a more specific focus, accompanied by a glass of sparkling wine, a brain pool was developed for sketching on each of the four processes. (Appendix 7) Each round was 15 minutes to sketch on one process, followed by a discussion. Initially, the idea was to place the results on a line from manual to automatic. However, after the first round, it was observed that the results showed many different solutions for each concept, going from very simple solutions to more complex in construction and technology, without necessarily meaning that they were manual or automatic. Therefore, the results were ordered from simple to complex solutions.

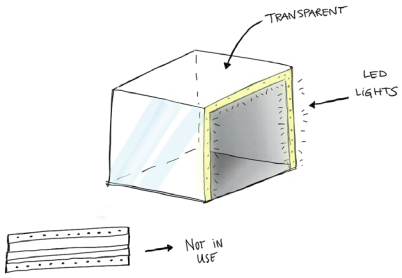
NECK FREEZER



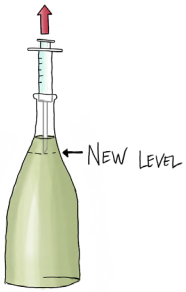


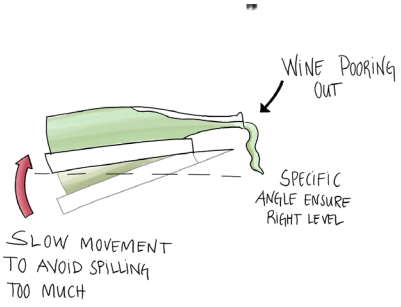
DISGORGEMENT



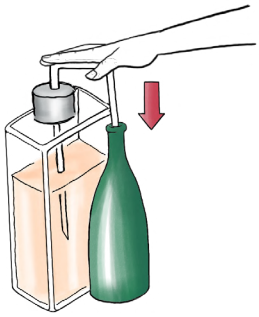


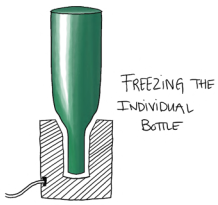
LEVELING

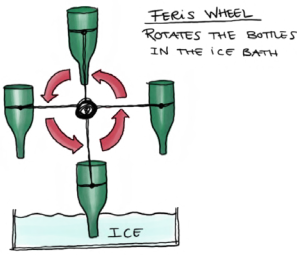


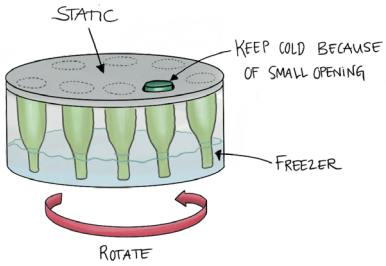


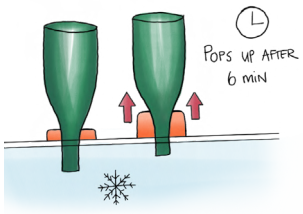
DOSAGE

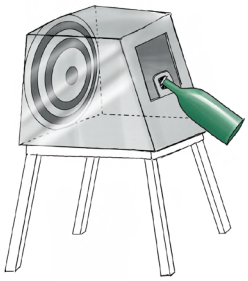


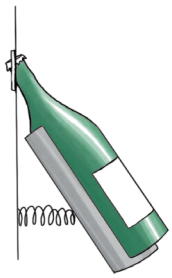


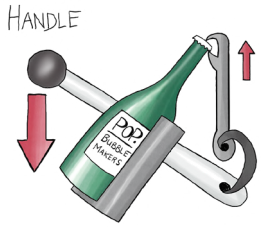


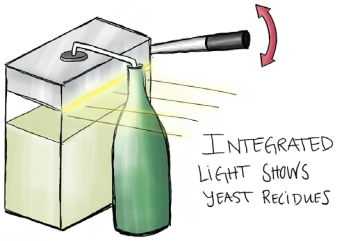


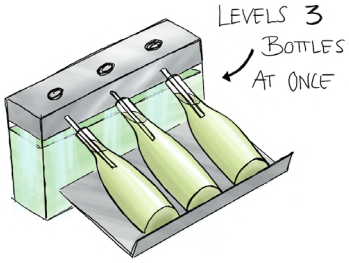


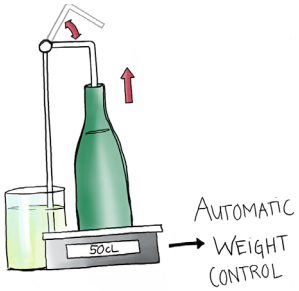


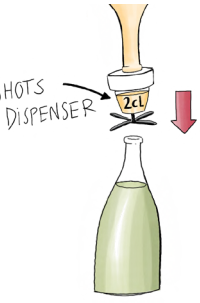


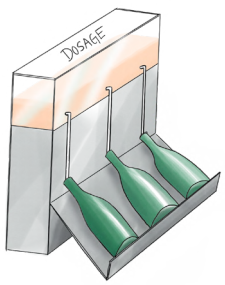












Sketching on the individual process allowed the different solutions to be mapped. It was possible to visualize which processes could go together in a concept, by looking at concepts with the same level of complexity. The next step was clear; combine the processes in full product concepts.

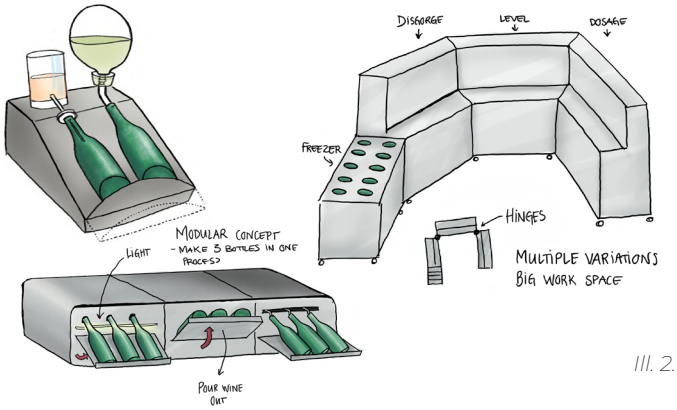
Ill. 2.6

Combine the four processes

With the process options mapped out, a sketching round to combine the four processes into three distinct directions was initiated. The goal was to include all four processes, however, this was still a challenge.

MINI FACTORY

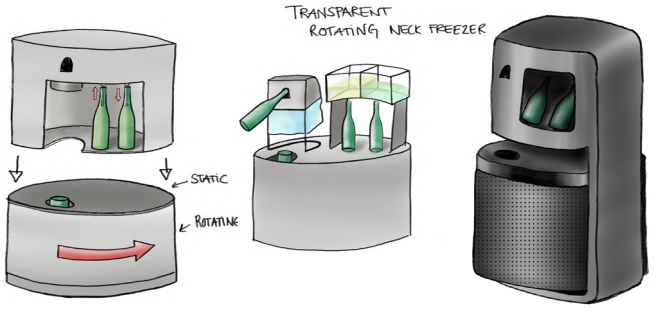
Inspired by a production line, the main idea was to produce as many bottles as possible in the shortest amount of time. The key feature was effective functionality and have all the processes placed next to each other, in the order, they were used. Aesthetically, it resembled machinery for the food industry, which often has a predominance of stainless steel. The desired outcome was a product with a clean and modern look.



Ill. 2.7

MANUAL - BUT WITH HELP

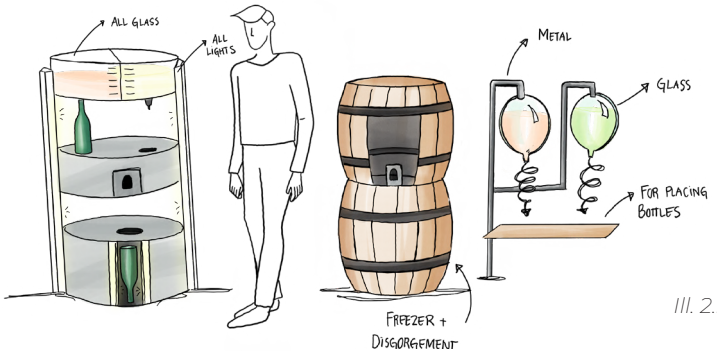
As the processes were only done one week a year, the main idea was to create a compact unit that could be handled manually. Because of this, simple one-hand use mechanisms were implemented. It also explored the possibility to hide or unfold the processes when not in use. The appearance was going to be inspired by a retro look, as old professional kitchen equipment.



Ill. 2.8

SHOW-OFF / FUN FOR TOURISTS

The process of making sparkling wine is very attractive to see, therefore this concept focuses on emphasizing each step, as part of a show. The idea was to make it transparent, so tourists could follow the processes. Every container should be see-through with light, in order to follow the process all the way. The aesthetics were inspired by old vineyard looks. Due to the see-through process idea, old chemistry laboratories were also an inspiration for the appearance.



Ill. 2.9

It was possible to define the three directions of the concepts, but not define the concepts themselves, instead, the outcome was clusters of ideas relating to each direction. It was difficult to choose between details and functions, because of this, it was clear that testing was needed to validate the solution in the sketches. As many of the ideas seem to work in theory, they needed to be proven in practice.

Test solutions for the four processes

From the previous sketches, there were different solutions on how to do the four processes. Now the solutions needed to be tested to see if they work, before developing further. The tests were divided into four, one for each process.

UPDATE! *The Corona lock-down happened right as testing had begun. This affected the test of the freezing techniques and disgorgement, as it had been planned but not yet executed.*

NECK FREEZING

Plan: Test how long it takes to freeze the bottle of the neck using different freezing techniques and investigate how the temperature in the "freezer" was affected over time, as a constant temperature was desired. As some of the techniques included temperatures below -20°C, a thermometer had to be borrowed from the Department of Mechanical and Manufacturing Engineering at Aalborg University. Testing with dry ice was supposed to take place in the Wet Lab located at AAU Create. Instead, user scenarios were used to evaluate the different techniques.

Dry ice: It can be dangerous to work with dry ice if the safety instructions are not followed. As the ice had to be ordered in advance, there was little flexibility for the winemaker. Although it was not possible to test the ability to stay cold, it will eventually melt and have to be replaced. Finally, it is relatively expensive to order and buy dry ice.

Ice cubes and salt: Ice melt fast so they need to be refilled continuously, meaning the wineries would need a lot of ice. Furthermore, it was questionable if the technique could get to the desired temperature and keep cool.

Regular freezer and anti-freeze liquid: This technique was already used in the vineyards with homemade fixtures. There is a cost of acquiring a freezer but it is a small investment compared to the gains in terms of ease of use and time.

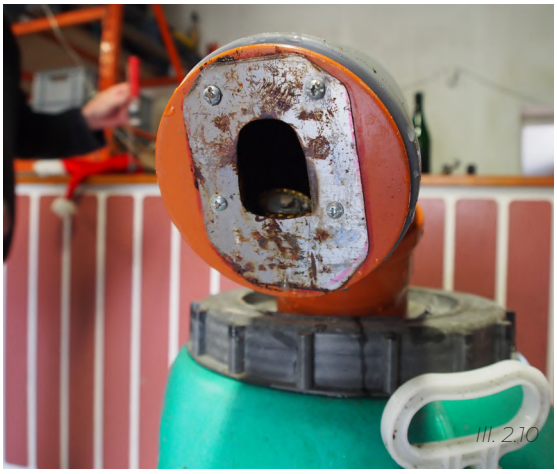
After looking at the different techniques, it was decided to work with a freezer, as it was the most convenient for the winemaker. Choosing one of the other options meant making it more complicated than the hacks many of the wineries were using today.

N | Use regular freezer

DISGORGEMENT

Plan: Test how the opening should be shaped to effectively remove the crown cap as well as test different opening principles and if it was possible to open several bottles at a time. For these tests, the wood and metal workshops were needed.

Instead of testing different shapes of holes and opening multiple bottles at once, existing products were used as a reference such as the one seen at Guldbæk, as they were known to work (illustration 2.10). The same goes for the angle, which was important to avoid gushing.

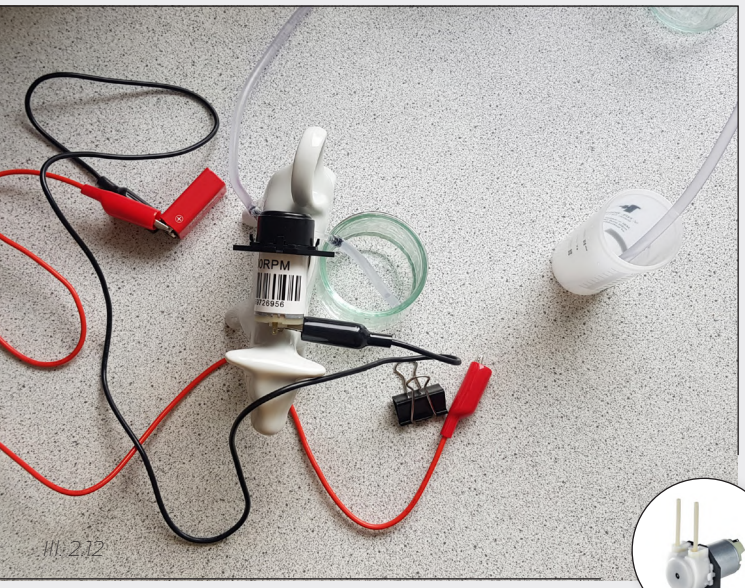


Ill. 2.10

LEVELLING

The evaluation criteria for leveling were how fast 20 ml of liquid could be removed, how easy it was to execute, and if it was possible to switch between different quantities. The full test can be seen in appendix 8.

Ill. 2.11



Ill. 2.12

Soap pump

Price: 80 DKK - Time: 13 second

Difficult to know when to stop and no more liquid was transferred. It took some pumps before the liquid replaced the air left in the pump. It hurt the hand after a while and did not feel professional when doing it. The tube had to be changed to adjust the amount of liquid removed.

Syringe

Price: 16 DKK - Time: 14 seconds

It hurt the hand after a while and it was necessary to use two hands. The syringes needed to be emptied in another container after each leveling. The tube had to be exchanged to adjust the amount of liquid removed. The syringe easily caused gushing.

Peristaltic pump

Price: 100 DKK - Time: 23 seconds

The pump was turned on by pressing a button. It was slower than the other solutions but it freed the winemaker's hands to do other things. An external structure was needed to adjust the length of the tubes depending on how much liquid should be removed

---

Although the peristaltic pump was the most expensive and the slowest of the solutions, it was seen as a great automatic way of solving the leveling. Besides, a larger pump would make the leveling faster. Furthermore, the pump gave the winemaker time to do other things, because he just starts the process and does not execute it. The big soap pump was still seen as a manual option, as it was quite fast and cheaper than the electrical pump. Having two different options, gave more flexibility when defining the three concept

DOSAGE

For dosage, the evaluation criteria were how fast 20 ml of liquid could be added, how easy it was to execute, how precise the dosage is, and if it was possible to switch between different quantities. It was also tested how the bubbles in beer reacted to the liquid being poured into them, with the different solutions. The full test of the dosages can be seen in appendix 8.

Soap pump

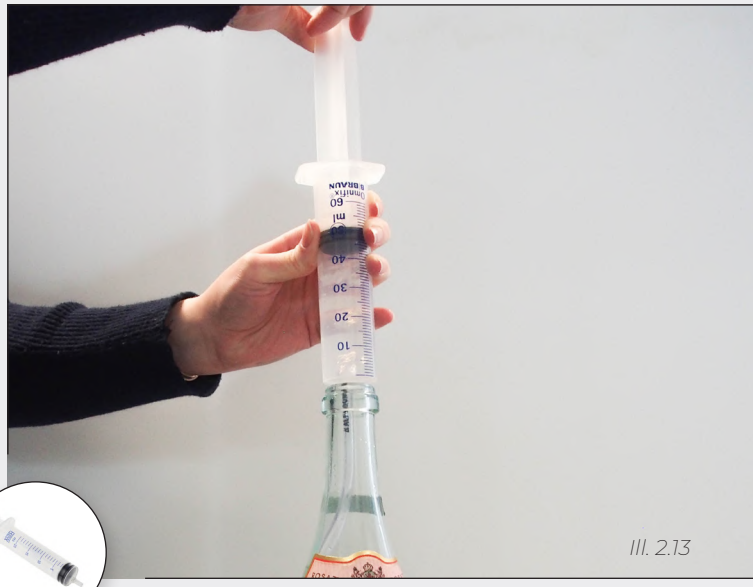
Price: 80 DKK - Time: Unclear

After many attempts, it was concluded that the amount of liquid transferred in each pump was too imprecise as it varied from 5 ml to 17 ml. Because of this, the soap pump was not approved for dosage.

Syringe

Price: 16 DKK - Time: 19 seconds

It hurt the hand after a while, two hands had to be used. It could be a challenge to fill the syringe, depending on the size of the container. The syringe was precise but depended on the time spent on measuring. It was observed that emptying in the bottle



Ill. 2.13

Peristaltic pump

Price: 100 DKK - Time: 23 seconds

The pump is turned on by pressing a button. It is slow but it frees the winemaker's hands to do other things. It is easy to change the amount of dosage by changing how long the pump is running.

Measurement cup

Price: 11 DKK - Time: 11 seconds

Risked having to go back and forward to get the right amount when measuring, which made the precision depend on who was doing it. The added liquid came in waves and was difficult to control and easy to spill. Pouring the liquid in the bottle easily caused gushing.

Ill. 2.14

Alcohol dispenser

Price: 80-200 DKK - Time: 7 seconds

It was easy to hit the bottle opening and it could be done with one hand. The dispenser was quite precise when done the right way. This could be because it was old and worn out. The beam of liquid did not cause gushing. There needed to be different dispensers to change the amount of sugar added.

Bottle pilot

Price: 60-100 DKK - Time: 7 seconds

The bottle pilot started again after a few seconds, so it needed to be removed immediately. It did not always work, this could be the individual pilot. Using a wine bottle as a container was tiring for the shoulder when using one hand, however, a smaller container could be used. The beam caused a small amount of gushing but stayed in the bottle and no liquid was lost

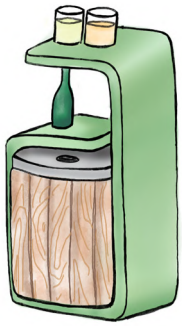
Ill. 2.15

Ill. 2.16

The peristaltic pump again did not prove to be the fastest, however, this would change with a larger pump. It has a big quality in being precise and easy to adjust in relation to the amount of dosage added to the wine. For that reason, the pump is a great automatic solution, furthermore, there was also great quality in using the same solution for leveling and dosage. The alcohol measurement dispenser was very easy to use, precise, and fast, because of that, it was a perfect manual solution.

Sketching, 3D, and cardboard

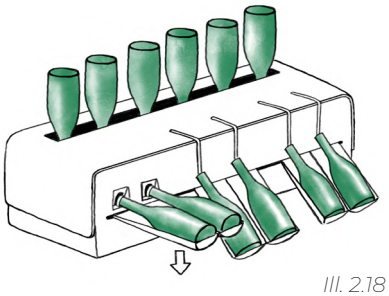
In order to gain a better understanding of concepts, sketches were made together. One led the pencil while all agreed on the major features of the concepts. Subsequently, the three concepts were elaborated in three different media: 3D, full-size cardboard model, and sketching. (Appendix 9) This was to provide a quick basis for discussing the three concepts more precisely in relation to the size and location of the processes.



Ill. 2.17

MANUAL BUT WITH HELP

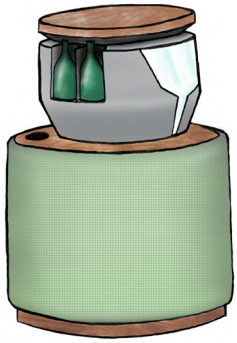
The concept had a round freezer, leveling and dosage were placed on the top, and disgorgement on the side.
Evaluation: The cardboard model made it clear that the product was larger than expected. Additionally, it was difficult to place the disgorgement in a place that felt natural.



Ill. 2.18

MINI FACTORY

The freezer was placed behind the rest of the processes. The disgorgement functions with the help of a spring and each process operates with two bottles at the time.
Evaluation: It is unclear how the interaction was going to be, especially when working with two bottles. The freezer might need to cover the whole bottle to give the full effect. The bottle has fixed places when leveling and dosage which enable it to be placed wrong.



Ill. 2.19

SHOW OFF

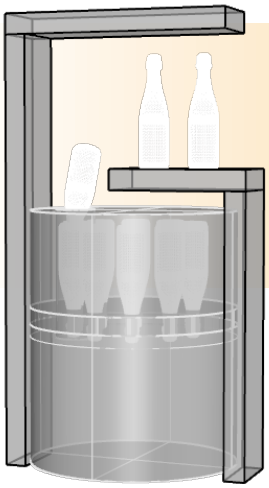
The disgorgement was placed on the top of a round freezer, on the opposite side of the glass. The glass made it possible to see the crown cap popping. The leveling and dosage were placed on a shelf under the top.
Evaluation: Again, the interaction was unclear. The 3D model made it clear that it was not easy to get the bottle out of the freezer because of the top of the product was in the way.

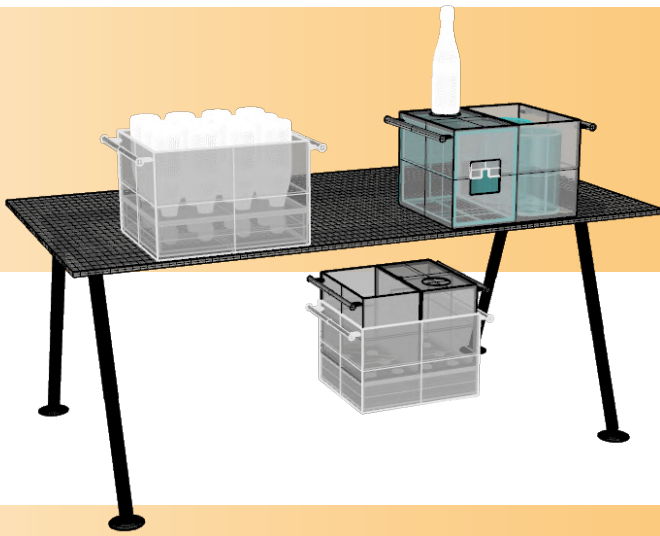
After evaluating the three concepts, it was clear, that they all lacked detail in terms of interaction and their expressions; they lacked personality. Another problem was the fact that the “show off” and “manual but with help “ was very much alike. Because of this, it was chosen that “manual but with help” should focus more on being a space optimizer and help with the vineyard’s lack of space. Going forward, that concept was known as “compact”. The following will give an overview of the further development of the three concepts.

N | Unable to place the bottle wrong when leveling and dosage

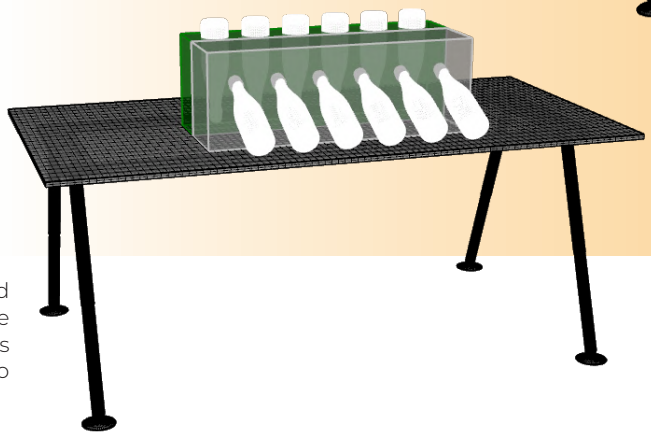
Evolution of concepts

At this point, the concepts needed to be more defined using the correct proportions, this was done by 3D modelling. Usually, every concept development process tends to go back and forth in an disorganized way. To give a better understanding of these processes, a time-line of how the 3D concept evolved with sketching inputs was created.



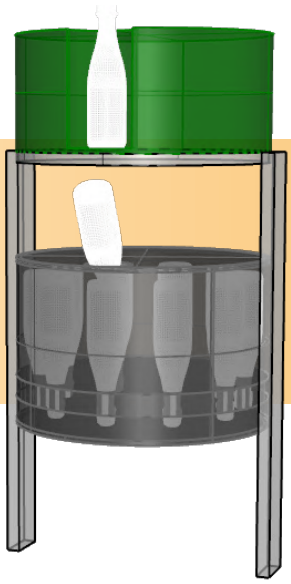


Initially, the concept was not entirely compact, as there was a lot of dead space inside the freezer.



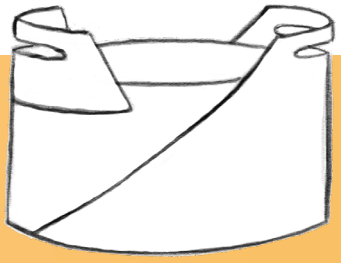
The production line idea did not evolve much since the sketching rounds. More details were added, such as light, to see the yeast and handles.

The shape was too complicated to picture a comfortable user scenario during wine production.



A simple construction was created. It lacked personality for what the concept “show off” meant.

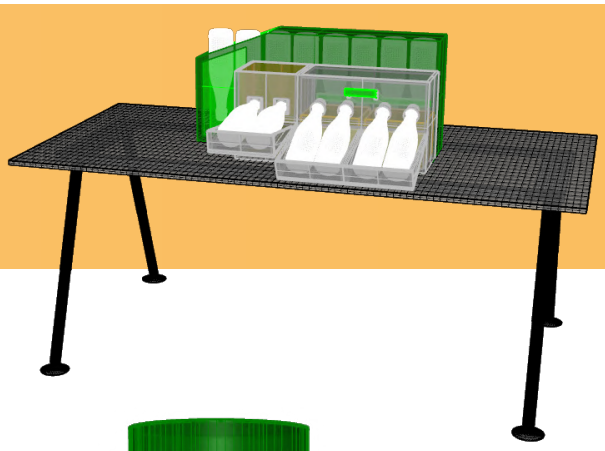
It seemed natural to go back to the round shape, but round edges made it awkward to place containers and mechanisms



It was needed to break the cylinder in two, making the product unfold once it needed to be used.

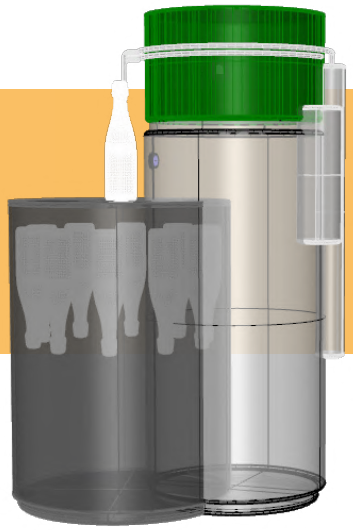
COMPACT

If the rest of the processes were stored inside the dead space of the freezer, it would become more compact.



MINI FACTORY

The focus was to have a 360 degrees view, so all the tourists could see the processes.



It was necessary to stop focusing on a compressed volume, reducing space was not relevant in this concept.

SHOW OFF

Ill. 2.20

With the overall shapes defined, the next step was to add materials and create three different aesthetics, as giving more ideas was going to open the feedback opportunities. Additionally, the documents with the concepts needed to be prepared to be sent to vineyards via email, including introduction and storyboards.

The three concepts

The three concepts were further detailed and shown to the vineyards. It wasn't possible to go to the vineyards and present the concepts, so storyboards and 3D models with materials were created to get a common understanding for discussing the concepts.

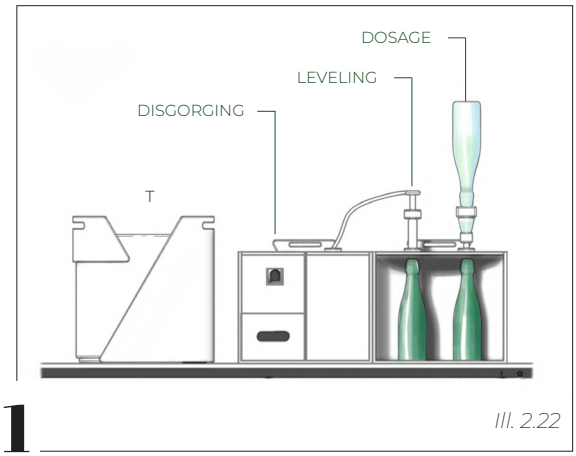
COMPACT

The compact concept was great for small wineries that have a lack of space. Since the product should only be used for about a week a year, it was important that it does not take up space when not in use.

The product was space-optimized by using the "dead" space in the freezer, when not in use, for storage for the rest of the product. The product had handles so it was easy for the winemaker to move. It was going to be used on an existing table. The device contained an electrical freezer and a manual pump for the leveling and an "alcohol measuring dispenser" for dosage.

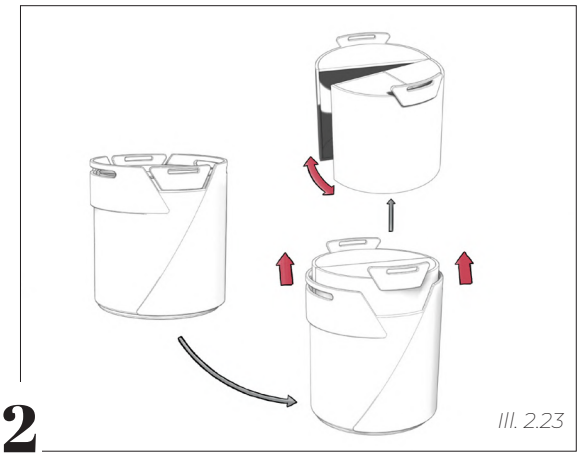
+ Space optimizing
+ Transportable

Ill. 2.21



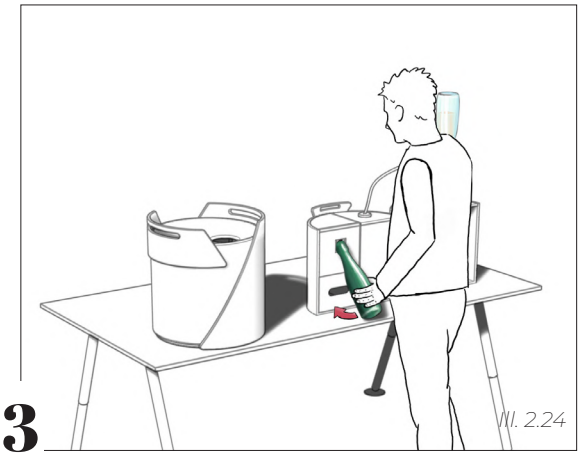
1 *Ill. 2.22*

Overview of unfolded product.



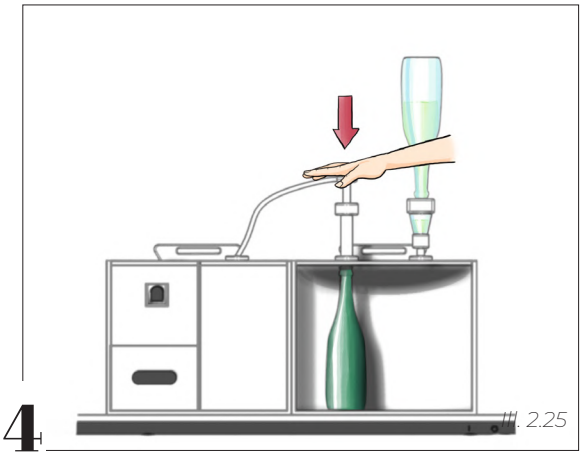
2 *Ill. 2.23*

Remove and open the inner container



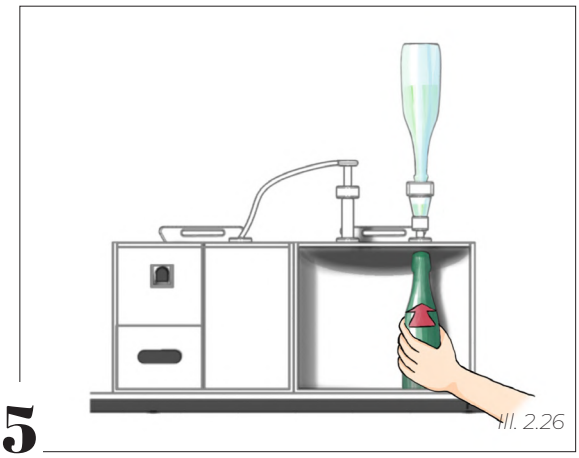
3 *Ill. 2.24*

Take out a bottle from the freezer and disgorge it.



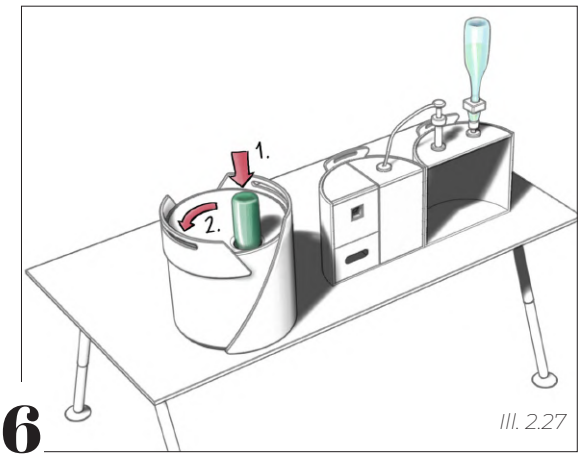
4 *Ill. 2.25*

For leveling place the bottle under the pump and press.



5 *Ill. 2.26*

Move the bottle to the dosage place and add the sugar.



6 *Ill. 2.27*

Place another bottle in the freezer and turn it to start the process again.

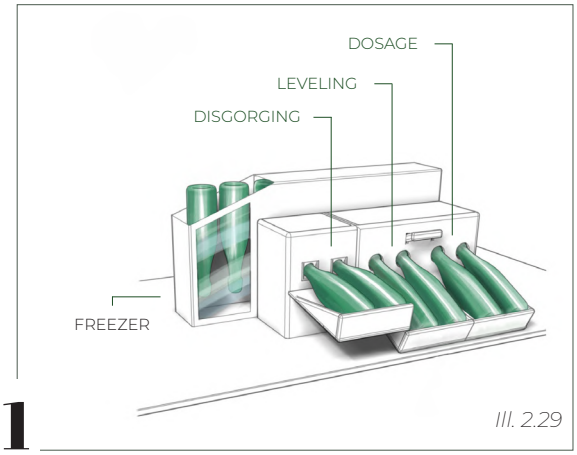
MINI FACTORY

Small commercial wineries do not have the finances or capacity to buy the large machines for mass-production used in the industry. However, they are still professionals and therefore want professional equipment.

The product had taken inspiration from a factory line, so each step in the production was placed right after another. Two bottles were produced at each step, this made production more efficient. The product was made in steel, known from the big machines in the industry. The product contained an electrical freezer and an electrical pump for the leveling and dosage. A light was placed behind the bottles in the freezer, so it was easy to see if the lees were completely frozen.

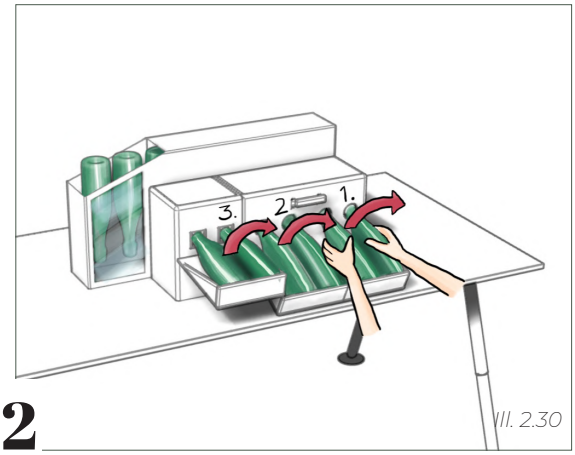
+ Professional industrial look
+ Time optimization

Ill. 2.28



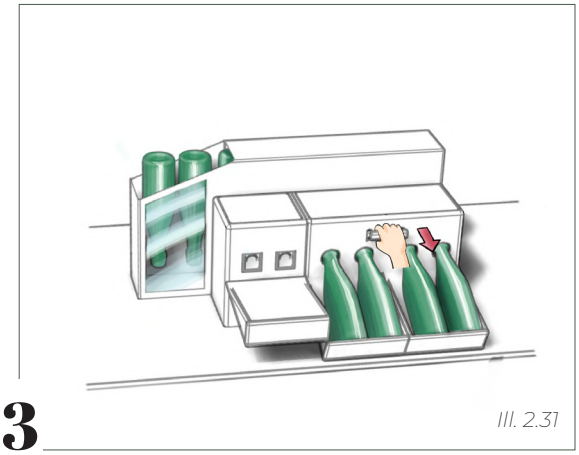
1 *Ill. 2.29*

Overview of mini factory.



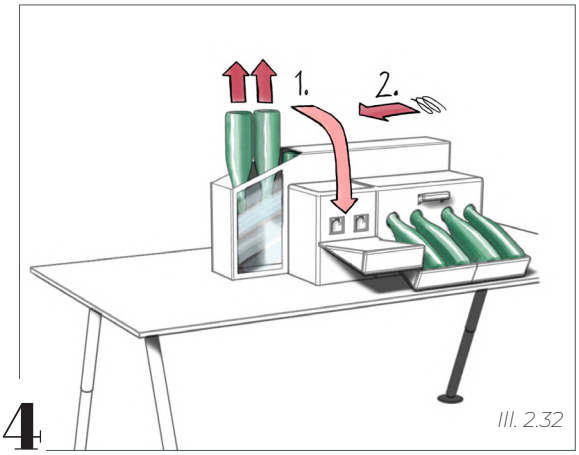
2 *Ill. 2.30*

1. Move from dosage to cork machine
2. Move from leveling to dosage
3. Move disgorged bottles to leveling



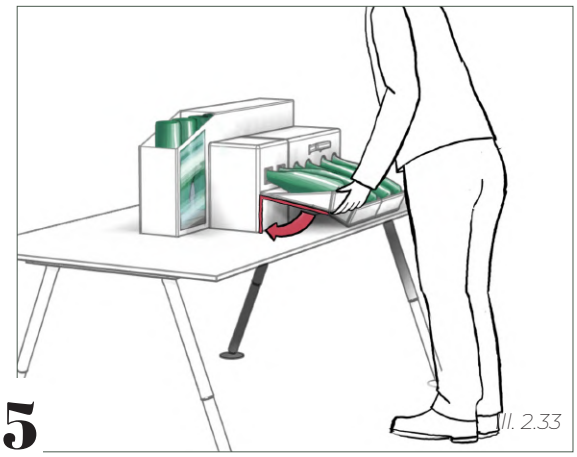
3 *Ill. 2.31*

Pull the handle to start process of leveling and dosage.



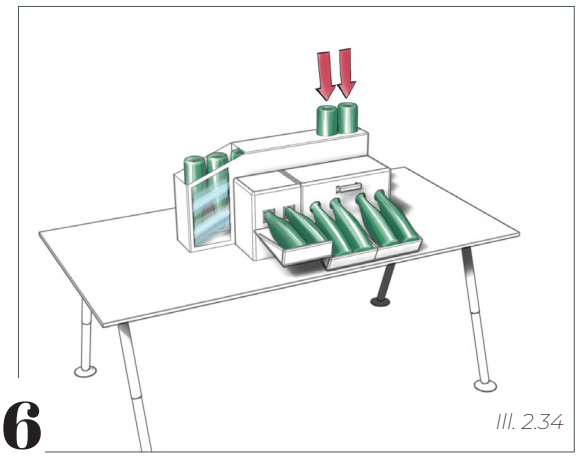
4 *Ill. 2.32*

1. Move bottles from freezer to disgorging.
2. The remaining bottles in the freezer will be automatically pushed to the left.



5 *Ill. 2.33*

Disgorge two bottles at the same time.



6 *Ill. 2.34*

Insert two new bottles into the freezer and start the process again.

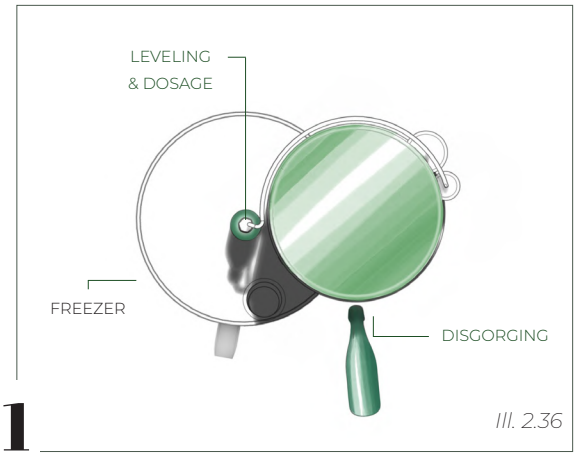
SHOW OFF

This concept was based on the fact that a large part of the vineyard's income comes from tourists.

The product was transparent and lights up, so the tourists could follow the processes as the winemaker makes sparkling wine. The round shapes allowed more people to see what was happening and the winemaker could keep eye contact with his visitors as he explained the steps. The product was still practical and all processes were close by for when there was no audience. The product contained an electrical freezer and an electrical pump for leveling and dosage. After adding a new bottle, the foot pedal was pressed down to turn the freezer. This ensured that the bottle removed from the freezer had been in there the longest.

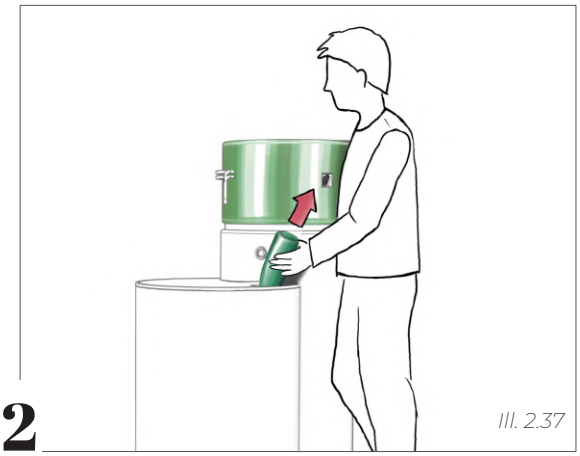
+ Transparent process, can see what happens.
+ 360 degrees visual for tourists.

Ill. 2.35



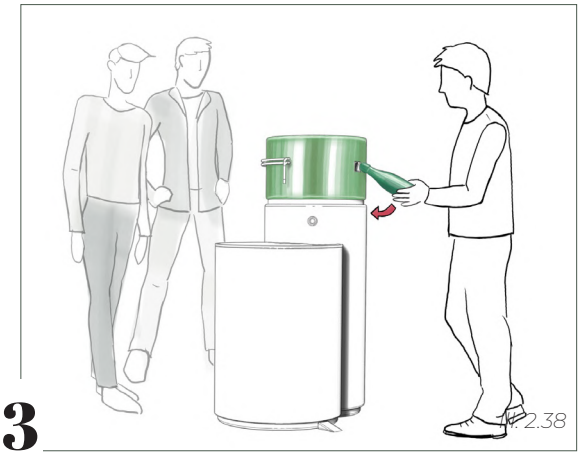
1 *Ill. 2.36*

Overview of show off



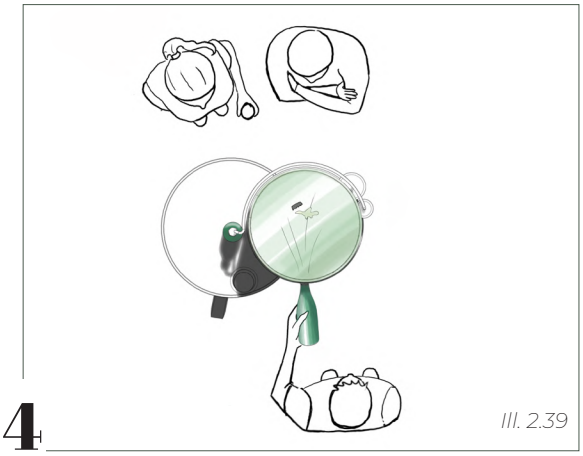
2 *Ill. 2.37*

Take out a bottle from the freezer.



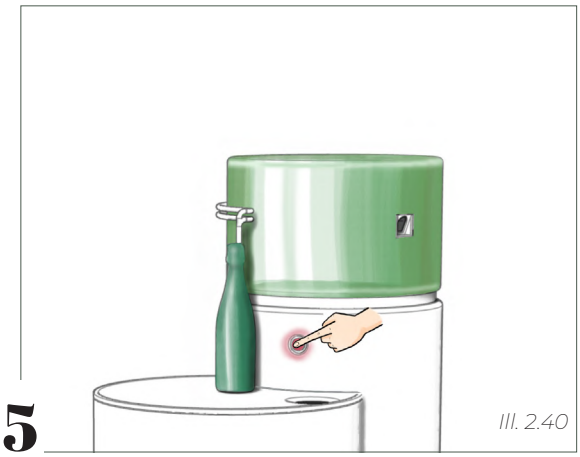
3 *Ill. 2.38*

Disgorge the bottle in the transparent container for all to see.



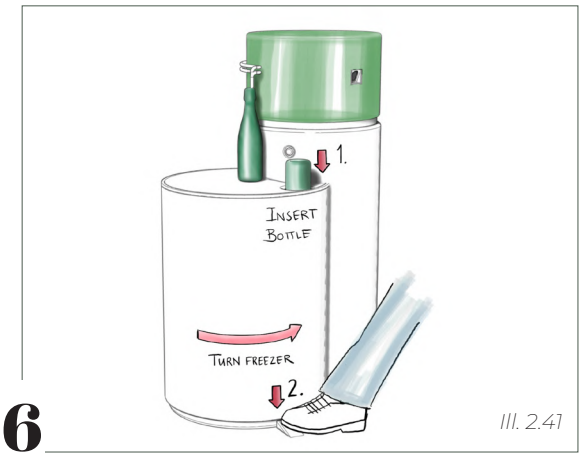
4 *Ill. 2.39*

The crown cap will fly straight towards the crowd.



5 *Ill. 2.40*

Place the bottle in the leveling and dosage platform. Pres the button and pump will start.



6 *Ill. 2.41*

1. Place new bottle in freezer
2. Press the pedal to turn the freezer

FEEDBACK FROM VINEYARDS

During the communication with the vineyards, many insights were gained as the concepts triggered ideas on how each process could be improved. Additionally, they were able to better explain the traditional method of making sparkling wine. This helped to create a better understanding of the future detailing of the product. The following table is a compilation of the main comments for each concept obtained via email and phone calls with the vineyards: Heden, Guldbæk, and Årø. (Appendix 10)

Show off

"Love the expression and colors. It would stand out at a wine fair"

"I like the 'show-off' element for tourist"

"If I had space, I would leave it out all the time"

"Wood would never be approved for the food industry"

"Genius idea with the turning freezer"

Compact

"I like the expression, it fits the context while standing out from competitors"

"Perfect for small productions"

"Great idea with the dosage storage in wine bottles. Is good to save over time, hence minimizing waste"

"I like that is easy to store"

Mini factory

"The expression is close to existing products. Looks boring in comparison with the other concepts".

"Two bottles at a time is good if it works. The corking machine is a bottleneck as it can only take 1 bottle at a time"

"I like the integrated light on the freezer, it would also be good with light under the leveling shelf"

"I expect less gushing when doing dosage because of the angled bottle"

After a positive reply from the winemakers on the three concepts, it was decided to go with the "Show-off" as it stood out from the current wine equipment, creating a great market opportunity. Furthermore, the tone of voice of the feedback, made it clear, that it was the majority favorite. Choosing "Show-off" also meant that the process of leveling and dosage would be automated using the peristaltic pumps, one for each process. However, some things needed to be changed, as it is not possible to use wood for food production. The positive elements of the other two concepts were still considered when developing further on "Show-off". The features taken into consideration were: the addition of light in all the processes, using wine bottles as dosage containers and incorporating wheels. Additionally, instead of being compact the product could have a second function such as a wine bar, when not used for production.

N
- Use material approved for food production
- Integrate light before and after disgorgement
- Wheels for moving easily

W
- Automated leveling and dosage
- Light in all four processes
- Aesthetically stand out compared to competitors

I
- Minimize gushing doing dosage
- Avoid losing bubbles during production
- Implement a second function in the product

Full-size mock-up

After it was decided to further develop on the concept " Show-off", a full-size mock-up was made. The model was made of cardboard and acrylic sheet, to get an understanding of the size.

In order to determine how large the freezer should be, the optimal amount of bottles for production had to be determined. This was defined by how long it took to freeze each bottleneck, which data was taken from the visit to the vineyards, and Internet research. Videos was used to time, how long it takes to do the disgorgement, leveling and dosage. The result was approximately 30 seconds. From this it was calculated, that if the expected freezing time was 3-5 minutes, the freezer needed to have space for 10 bottles. (Appendix 11) To fit 10 bottles, the freezer needed a minimum diameter of 500 mm.

From the 3D model, the freezer had a diameter of 600 mm, because that made the cylinders look more stable. In the cardboard mock-up the 600 mm looked massive and unnecessary (ill. 2.42), so the freezer was scaled down to a diameter of 500 mm (ill. 2.43). Doing the full-size mock-up, the question of how to eliminate unnecessary material, caused the model to lose the base of the small cylinder (ill. 2.44). Space for storage and a stable expression was not seen as reason enough to have so much extra material and the stable expression could be solved in another way using less material.

1 *Ill. 2.42*

2 *Ill. 2.43*

3 *Ill. 2.44*

The full-size mock-up gave a good perspective to the size of the concept, the freezer was initially intended to be 600mm but was now 500mm. The thought of eliminating material caused the concept to have a lighter expression that was positive for the otherwise heavy construction of the freezer. The full-size mock-up was used in most future ideation, experimentation, and detailing, for the placement of different components, etc.

N | Space for 10 bottles in the freezer

Avoid gushing

Gushing was a common problem for vineyards when doing dosage. They dealt with it by tilting the bottle during dosage, which caused the sugar to run down the sides of the bottle, thereby preventing gushing. It needed to be tested whether there were other ways to avoid gushing. The test was done with beers which also gush over when adding liquid. 20 ml was added to 300 ml of beer in four different scenarios. A previous test had shown that a syringe caused a lot of gushing, which created a good baseline and made it clear whether or not each solution worked. A syringe was used for all tests and a tube was used for the last test.

1

SYRINGE ALONE - BOTTLE VERTICAL

Ill. 2.45

The bottle was vertical as the liquid was added with a syringe alone. This created a lot of gushing, as expected.

2

SYRINGE ALONE - BOTTLE TITLED

Ill. 2.46

The bottle was tilted with a 60-degree angle, as the liquid was added with a syringe. This created a bit of gushing.

3

TUBE ADDITION - BOTTLE VERTICAL

Ill. 2.47

The bottle was vertical as the liquid was added with a syringe that had a tube going into the beer. No gushing occurred.

The syringe alone was better when the bottle was tilted compared to being in a vertical position. With the tube going into beer, there was no gushing at all. After the test, it was clear that using tubes for dosage worked best in terms of gushing. This gave the freedom of having the bottle vertical or tilted without gushing as long as the dosage was added into the wine.

N | Product should avoid gushing when doing dosage

Second function

The product was only going to be used one week once a year, but instead of tucking the product away, the opportunity for the product to have a second function was explored. A brainstorm of ideas was made and then four of the ideas were presented to the vineyards.

IDEAS FOR SECOND FUNCTION

Wine bar for wine tastings at the vineyards.
Shelf for selling wines at the vineyard.
Promotion-stand for wine fairs.
Making personalized wine with visitors.

In general, the feedback from the vineyards made it clear that designing a product with multiple functions was smart. Using the product for wine tasting had potential but Jacob from Årø Vingård was not sure if he would use the product this way. His winery was too cold for wine tasting and he would properly not move it into the wine tasting room. But he liked to have the opportunity to involve his guests in making their own sparkling wine, as it made it possible to use the product throughout the year.

After hearing the feedback from the vineyards and their enthusiasm for a second function, it was decided to keep working on that idea. Especially the opportunity to involve guests in making their own wine could have an influence on developing the rest of the product.

W | Possible to be included in tourist activities

Ill. 2.48

Adjustment of dosage

The amount of dosage added to the sparkling wine decide what type of wine it is. The amount can vary from year to year and batch to batch, therefore it had to be easy for the vineyard to change. If tourists were included in making their own wine, the amount of dosage would change many times a day, and by people who have not done it before. It should also be considered that the winemakers wear gloves when making sparkling wine, which rules out touch-screens. Different suggestions were discussed with the vineyards, but the overall objective was to choose between having a digital or analogue system for adjusting the amount of dosage.

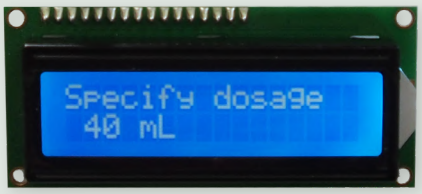
ANALOGUE

The analog solution could be a potentiometer, with big readable numbers on, as a turn knob is simple and well known. This option would also be easy to use with gloves depending on the size of it.

Ill. 2.49

DIGITAL

The digital solution could be an LCD screen, with plus and minus buttons to adjust the amount. Having a digital solution is a modern approach, but an unnecessary expense. One of the vineyards has the experience of screens breaking easily in the production site.



Ill. 2.50

The vineyards did not seem too concerned about the two options, they saw possibilities in both. Since the dosage was the only thing that needs to be adjusted, a screen seemed unnecessary and could be done just as easily with a button. The analogue solution is well known and cheap. It could easily be operated with gloves on and by guests trying it for the first time. Because of this, it was chosen to include an analogue solution for adjustment of dosage.

W | Use analog solution for adjustments

Bubble stopper

From the feedback, it was noticed that the vineyards found it very important not to leave the bottles open more than necessary, for instance, during leveling and dosage. Having the bottle open means losing the pressure inside as well as the bubbles, and it results in a lower quality wine. Today, the winemakers cover the bottle opening with their thumb in between the processes. To close the bottles doing leveling and dosage, existing products that were designed to fit sparkling wine bottles were tested. The desired outcome was finding the bubble stopper which was the easiest to use.

SILICONE STOPPER - PULLTEX
Price: 69 DKK incl. VAT
The Pulltex stopper was made of silicone, which had a lot of friction, and made the bubble stopper stay on and seal the bottle effectively. It was easy to put on but very hard to take off. It was necessary to use both hands and a lot of force. (Pulltex - Silikone Champagnestopper, n.d.)

1

Ill. 2.51

STEEL - BREDEMEIJER
Price: 121 DKK incl. VAT
This product was made of steel with an inner ring of rubber. The rubber closed the bottle and a steel clip around the neck made it stay in place and seal. The bubble stopper was easy to put on but hard to take off because the clip was so tight around the bottleneck. (Bredemeijer Champagneprop, n.d.)

2

Ill. 2.52

EASY-SEAL PLASTIC
Price: 14 DKK, less than 1 DKK when buying in bulk
The bubble stopper is made of plastic with an inner ring of rubber. The rubber is closing the bottle hole and two clips were fixing it to the bottleneck, making the bubble stopper seal. It was easy to put on and easy to take off using just one hand. It was by far the most economical option of the three and can have a lot of variation in color and finish. (Sapore: Champagne Stopper, n.d.)

3

Ill. 2.53

All three bubble stoppers sealed the bottle tightly and were easy to put on. Both the Pulltex and the Bredemeijer were hard to get off the bottle again. It was necessary to use both hands and a lot of force which caused a risk of spilling while doing it. The Easy-seal plastic was easy to put on and easy to take off, both things could be done with one hand. It was chosen to use the principle from the Easy-seal plastic bubble stopper.

N | Seal bottle during leveling and dosage

Tubes for leveling and dosage

Since it was chosen to work with pumps for leveling and dosage, it should be investigated where and how to place the tubes and the bottle during these processes. From the test "Avoid gushing" it was concluded that the tubes should be in the wine to avoid gushing. Furthermore, it was chosen to have a bubble stopper placed on the tubes to seal the bottle doing the processes. From this knowledge, inspiration pictures were found, especially of faucets. Afterward, concepts were drawn and simple mock-ups were used to act out on the 1:1 cardboard model. The concepts were: faucet with extender, semi-flexible, and flexible.

FAUCET WITH EXTENDER

The concept was inspired by a kitchen faucet with an extension, meaning the tubes will only be visible when used. The bottle needed to be placed close to the faucet.
Challenges: Limited bottle placement options and it took time to return the tubes into the faucet after each bottle.

Ill. 2.54

SEMI-FLEXIBLE

The concept was also inspired by a kitchen faucet but with a flexible structure giving more freedom of where to place the bottle. The structure had an extra "arm" so the tubes were not just hanging.
Challenges: Still limited bottle placement options.

Ill. 2.55

FLEXIBLE

The concept was inspired by a shower head with a flexible tube that could go wherever but still had a place to hang when not in use. This gave the winemaker the freedom to place the bottle wherever.
Challenges: Looked unprofessional, especially when not in use, as the long tube just hangs.

Ill. 2.56

Different scenarios with how and where the winemaker would place the bottle for leveling and dosage were tried out. It was concluded that the most likely scenario was moving the tubes directly from one bottle to the next. From acting out the three concepts, it was clear that flexibility was important. All three concepts had advantages and disadvantages, where "faucet with extender" was more neutral in its appearance and perhaps easier to incorporate into the product, it was less flexible than the others. It was decided not to choose between the three concepts as they were, but try to incorporate them into the product to see what fitted the best.

Containers for leveling and dosage

A container was needed for the wine that was pumped out during leveling and a container for mixing the dosage. One of the positive feedbacks from the concept "Compact" was that using the winemaker's pre-existing wine bottles was smart. Today they mix 3 - 5 liters of dosages and then throw away the leftovers. Using a wine bottle made it possible to make smaller batches but also to save it for later by sealing the bottle with a crown cap. To explore whether wine bottles should be used instead of developing containers designed for the product, a pros and cons list for both options was made.

Wine bottles pros

The vineyards will have a replacement
No limit in the amount of dosage prepared
Don't have to invest in developing containers
Fits the wine theme

Wine bottles cons

Often green, so the dosage can be hard to see
Different sizes may make attachment difficult
Has to throw out cap after opening bottle
Can look more unfinished

Bottles will have to determine some of the aesthetic in the product to make it coherent, this can be both good and bad.

Own container pros

The size of the containers have no limits
Same sizes make the attachment easier
Can include measurement lines to keep track
Can decide the color and material

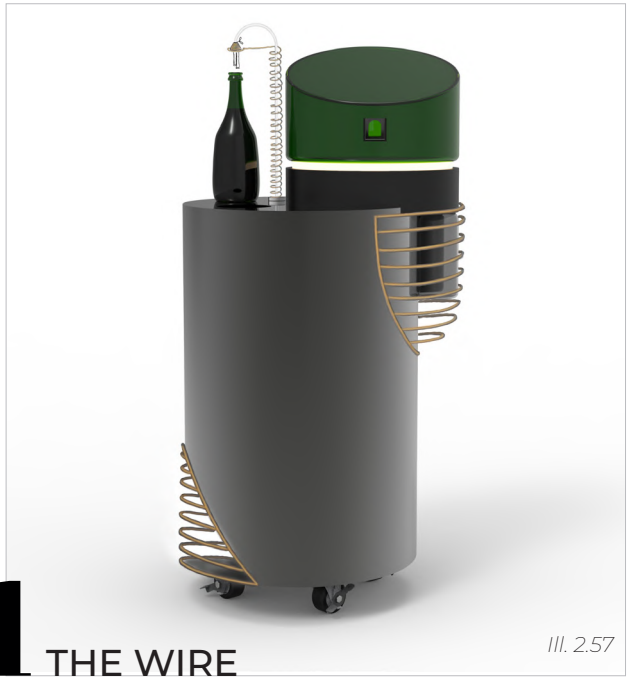
Own container cons

May need storage for the containers
More expensive to develop the containers
Not easy to replace

There were advantages and disadvantages to both options. The biggest advantage of having the wine bottle was the possibility of keeping the cost down, but that can be achieved by using a standard component as a jar. Doing the list, considerations about whether or not the containers should be hidden or displayed was discussed as well. The same goes for how and where to attach the containers. There was no demand for the size of the containers, but by having them small and easy to seal, it was possible for the winemakers to save the leftovers. It was decided that the containers should not be fixed but possible to take off for cleaning. No specific container was chosen after doing this list, but it is decided to incorporate different solutions of containers into the product to see if they fit the rest.

Elaborate the appearance

Since it was chosen to work with the concept "show-off", the identity of the concept had not evolved much. A brainstorming workshop was done to elaborate on the appearance and trying to incorporate all the previous details by sketching and using the cardboard model. Some of the details such as containers and tubes for leveling and dosage had different options that were not yet decided on. Incorporating them into different concepts, made the possibilities more clear. The result was three concepts: "The wire", "The shelf" and "The bar wagon".



Ill. 2.57

1 THE WIRE

The concept focused on making a support structure between the two cylinders while making it a detail that could become part of the concept's personality. This was done by making a structure of wires, which at the same time worked as a drawer where the containers for leveling and dosage were placed. The same structure with wires was used in the bottom of the freezer for ventilation purposes. The tubes for leveling and dosage were fixed in the lower part and flexible in the top. The disgorgement bowl had an angle to try out another appearance.

Evaluation:
Easy access to containers
Complex construction of containers
The wire had a function while being aesthetic
The angle in the bowl gave a nice overview
Faucet, flexible but still fixed place to store it

Ill. 2.58

2 THE SHELF

The shelf concept was not that different from the original concept "show off". It still contains the cylinders, but the base of the small cylinder had become slightly bigger to be able to place the two containers for dosages and leveling on top. By placing the containers there, it was easy to see the amount off dosage used and it gave a good working height when emptying the containers. The tubes for leveling and dosage were placed in a faucet. The tubes were pulled out when they were used.

Evaluation:
Easy access to the container
Lowest production cost
Minimalistic tube, look like it belongs there
The tube was the least flexible of the concepts
Least integrated shape

3 THE BAR WAGON

The concept was taking inspiration from an old fashioned bar wagon. With only two wheels for moving it, it needed a handle, which was placed on the right side of the small cylinder, so it was not interfering when using the product. The frame structure gave a fine detail and also held the two cylinders together. The tubes for leveling and dosage were hanging loose with a fixed hold spot when not in use. The two containers for leveling and dosage were placed below the base of the small cylinder. The containers was wine bottles so the vineyards can use their existing bottles

Evaluation:
Build-in handle was nice
Frame was good for stability in combining shapes
Foot pedal could be integrated in the structure
Containers were not as easy to access
A lot of flexibility in the tube

Ill. 2.59

Of the three concepts, “The bar wagon” had the most identity, with inspiration from an old fashioned bar wagon. Therefore it was decided to keep developing on that concept. However, the placement of the containers for leveling and dosage needed to be developed further as well as the placement of the tubes.

Design brief

PROJECT OVERVIEW

Smaller vineyards often have to resort to homemade solutions all so known as hacks, for the production of sparkling wine. As a consequence, the quality of the wine is lowered due to human mistakes. Additionally, these hacks do not look professional enough to be shown to tourists.

DELIMITATION

The concept is including a freezer, but this project is not focusing on developing the freezer in detailing, as that is an existing technology and it is the plan to outsource it. However, the focus has been on making the turning function work, while still having space for the main components needed in a freezer.

TAGET USER

The primary user is the small commercial wineries that will use the product for industrial production of sparkling wine.

A secondary user is the big commercial wineries who have a big production setup but need to be able to experiment and test small batches without changing the production setup.

BUDGET:

From talking to different vineyards, each had a maximum budget for purchasing a product to do the four processes;

Heden: 15.000 DKK
Årø: 60.000 DKK
Guldbæk: 100.000 DKK

Heden is one of the smallest commercial vineyards in Denmark and makes a little over 100 bottles of sparkling wine every couple of years. Even though Heden is in the category of a small commercial winery, his bottle output and budget is too low and will not be taken into consideration in this project. However, a budget of less than 60,000 will be aimed at to accommodate most vineyards.

Budget: 60.000 DKK

Project statement

How to develop professional equipment for sparkling wine production that focus on improving the quality while giving the tourists an experience?

The following needs and wishes were derived from the chapters '***Understanding***' and '***Ideation and Experimentation***'

No.	Page	Origin	Needs
1	17	Last stages of the second fermentation	Possible to change the amount of leveling
2	17	Last stages of the second fermentation	Possible to change the amount of dosage
3	17	Last stages of the second fermentation	Specific angle for taking off the cap
4	18	Fact box: Dosage	Enable precise dosage
5	23	Visits at vineyards	Having the four processes close to each other
6	23	Visits at vineyards	Easy cleaning
7	23	Visits at vineyards	Minimize splash back when disgorging
8	23	Visits at vineyards	Able to withstand force of 6 bar
9	23	Visits at vineyards	Possible to operate the product with gloves on
10	25	Fact box: Sparkling wine bottles	Fit different bottles
11	17	Competitor analysis	Good physical working condition
12	37	Test solutions for the four processes	Use regular freezer
13	41	Sketching, 3D, and cardboard	Unable to place bottle wrong for leveling and dosage
14	50	The three concepts	Use material approved for food production
15	50	The three concepts	Integrate light before and after disgorgement
16	50	The three concepts	Wheels for moving easily
17	51	Full-size mock-up	Space for 10 bottles in the freezer
18	52	Avoid gushing	Product should avoid gushing when doing dosage
19	55	Bubble stopper	Seal bottle during leveling and dosage

No.	Page	Origin	Wish
20	17	Last stages of the second fermentation	Freezing should be at a temperature below -20°C
21	23	Visits at vineyards	One man use
22	23	Visits at vineyards	The product should not take up space when not in use
23	25	Hacks	Integrated light
24	29	Context mood board	Aesthetic that fit with the wine industry look
25	50	The three concepts	Automated leveling and dosage
26	50	The three concepts	Light in all four processes
27	50	The three concepts	Aesthetically stand out compared to competitors
28	53	Second function	Possible to be included in tourist activities
29	54	Adjustment of dosage	Use analog solution for adjustments

Ill. 3.1

Detailing

HOW DO WE CONSTRUCT THIS?

The concept with its functionality and appearance was defined. However, taking the challenge of including four processes into a product involved the development of many details and inner mechanisms that were yet to be designed. The following chapter includes design considerations such as the product height, light features, cleaning aspect, placement of electronic components, user interaction, material, and production choice. All the final details make it possible to take this product into development.

Overview of Detailing

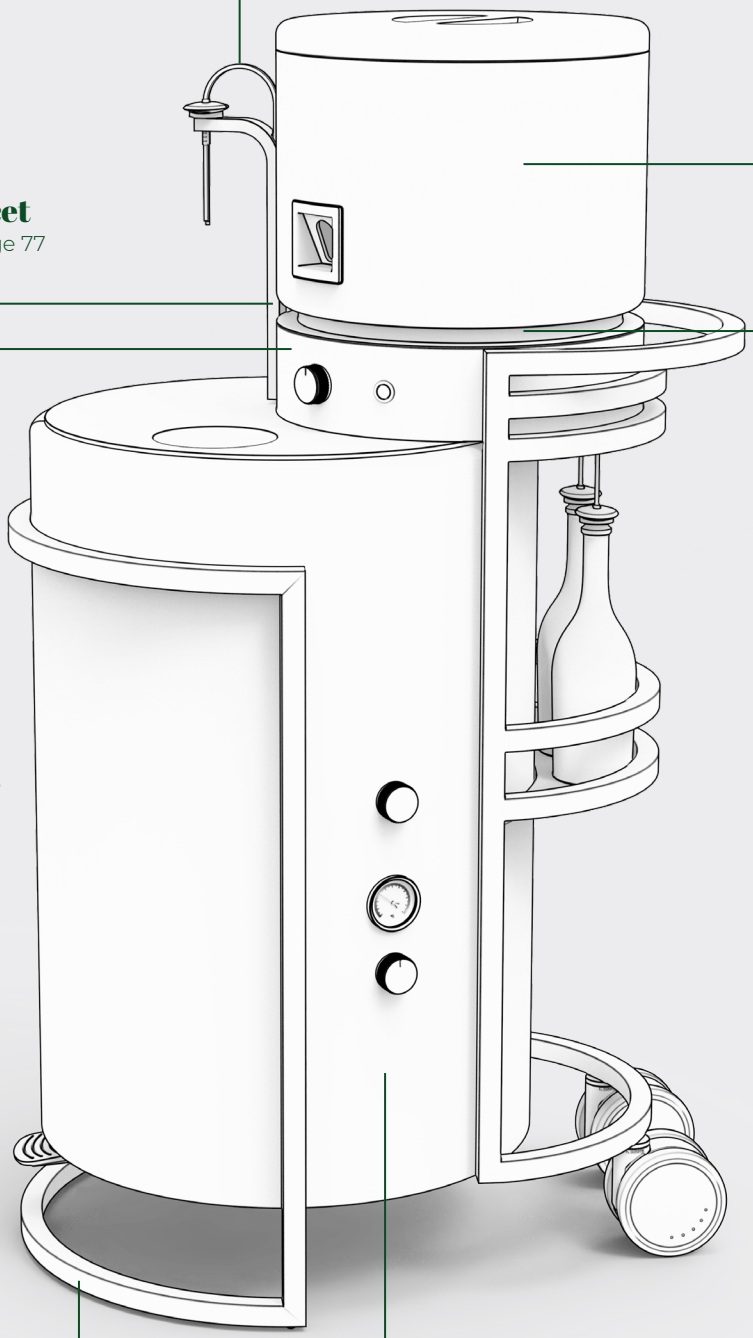
Tubes
See Page 76

Electronics
See Page 78

Disgorgement bowl
See Page 74

Faucet
See Page 77

Light
See Page 65



A good working posture
See Page 66

Materials & Production
See Page 80

Frame
See Page 72

Neck Freezer
See Page 68

Ill. 3.2

Light

The vineyard's feedback made it clear that light was a necessary factor to improve the quality of the wine. Adding light would help ensure that winemakers were able to see if there were any lees remaining during the different processes. Furthermore, a potential was seen in adding light to illuminate the disgorgement bowl, as it enabled the tourists to get a better view of the moment the lees were expelled from the bottle. Initially, online research was made to explore different lighting options (Appendix 12). A LED stripe was chosen due to its flexibility and because it could be made waterproof, which was very relevant in wine production equipment. A test was made to understand how the LED stripe would work, these findings will be described in the following.


Ill. 3.3


Ill. 3.4

DIFFUSER

The first observation was the need for a diffuser, as the individual LEDs were reflected on the wine bottle and it was bothering the view.

LIGHT RANGE


Ill. 3.5


Ill. 3.6


Ill. 3.7

It was confirmed that it was enough to have light going outside of the disgorgement bowl to check if there were lees remaining in the bottle. With extra Online research, the final solution was found: a standard waterproof two-sided LED stripe with diffuser included. This product would light outside as well as up in the bowl. As it was a standard component, it eliminated the need for a complex structure and simplified the assembly of the light feature.

N | Integrate to-sided light

A good working posture

When developing professional equipment, regulations regarding a good working posture must be investigated and taken into consideration. There are no specific rules related to the wine industry, therefore general recommendations have been included. (Appendix 13) Three different heights of the freezer were tested using the full-size mock-up, as well as the height of where the bottle opener for the disgorgement should be placed.

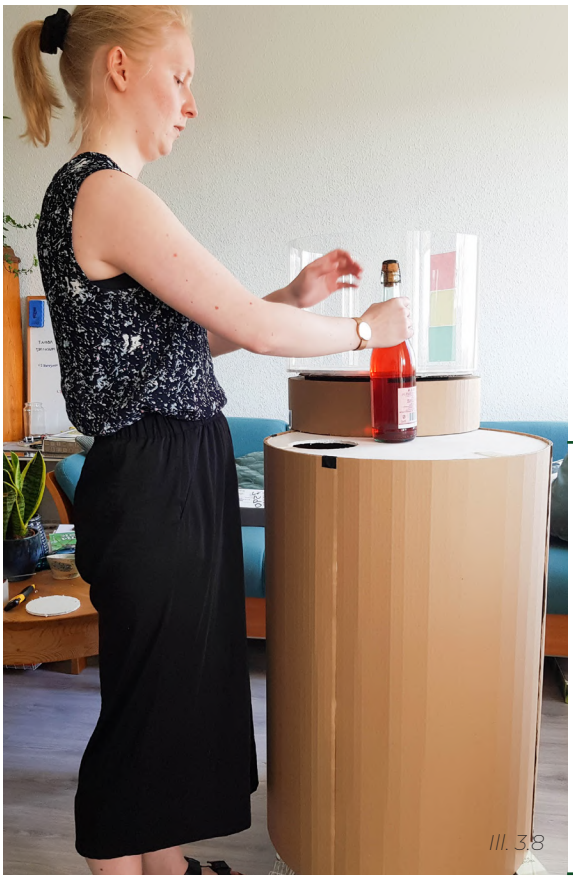
RECOMMENDATIONS

When doing manual work, it is important to follow the recommendations from the Work Environment in Denmark about lifting. This describes the distance allowed from the torso to carry a certain weight load. Because a bottle of sparkling wine rarely weighs more than 2 kilos, this regulation is omitted. (Andersen, 2005).

The recommendation for a good working height varies according to the person doing the work and what type of work it is. Therefore a height-adjustable workstation was the ideal solution but since the product is only to be used for a short time, this does not appear to be highly necessary. The height of the freezer was therefore taken from the existing recommended heights, such as the kitchen counter which is 900 - 950 mm (Pasternak and Dahl, 2018). In addition, the test is performed by two people with different heights of 166 cm and 180 cm. (Appendix 14)

THE HEIGHT OF THE FREEZER

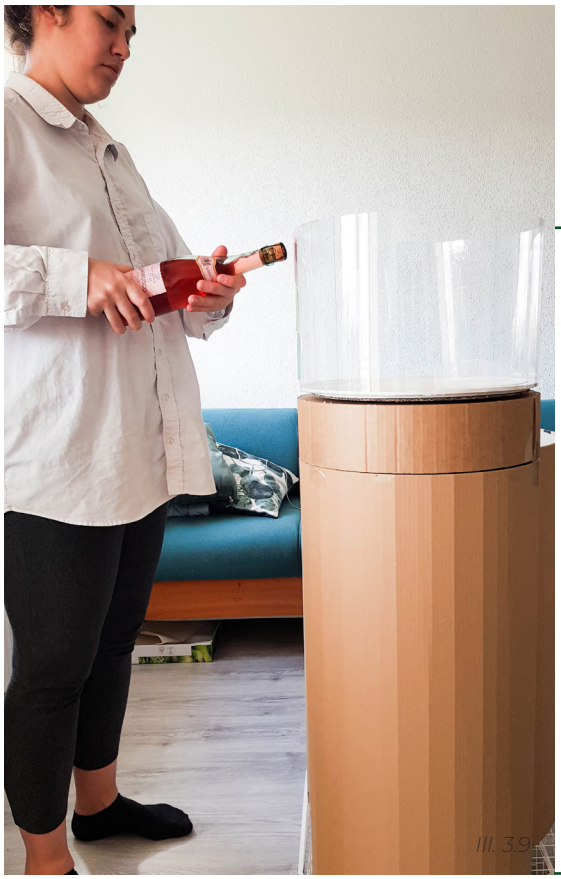
The plan: Take up a bottle of sparkling wine from the freezer and place it for leveling and dosage to see how it affects the posture. The tested heights were 900 mm, 950 mm and 1000 mm.
Evaluation: The lower the freezer was, the easier it was to take up the bottle. With the height of 1000 mm both participants felt that it hurt or was annoying for the shoulder after doing it a couple of times. On the contrary, the high freezer gave a better view when placing the bottle for leveling and dosage.



Ill. 38

PLACEMENT OF BOTTLE OPENER

The plan: "Disgorge" a bottle of sparkling wine with a bottle opener placed in three different heights of 1100 mm, 1180 mm, and 1260 mm from the floor.
Evaluation: When the bottle opener was placed at a height of 1100 mm, the participants felt the most relaxed in their shoulder and felt like having more force and control. Opposite when the bottle opener was placed at a height of 1260 mm it felt tiresome in the shoulder and it was hard to put in the force.



Ill. 39

The different freezer heights had different benefits. A freezer height of 1000 mm gave a better visual but hurt the shoulder, whereas it was easier to take up a bottle with a height of 900 mm. Therefore it was chosen to have a freezer with a height of 900 mm. With the disgorgement it was clear, that the lower the bottle opener was placed, the winemaker could use more force and have more control. Therefore it was decided to place the bottle opener at a height of 1100 mm.

N | The freezer lid should be in the height of 900 mm
The opener should be in the height of 1100 mm

Neck freezer

Freezing the neck is the first of the four last stages of second fermentation and is most effectively done at temperatures around. As the freezer was based on existing technology, the development in this project will only focus on aspects relating to the internal turning mechanism. The focus will be on how to hold the bottles when they turn around in the freezer and how to make them turn. In order to have a better overview, a section cut of the freezer was made, with only the developed features highlighted in colours, excluding standard components (ill. 3.10).

ADJUSTING TEMPERATURE

Like all other freezers, it must be possible to adjust the temperature of the freezer. This was done with a thermostat placed on the side of the freezer together with a thermometer to show the current temperature.

BOTTLE FIXTURE

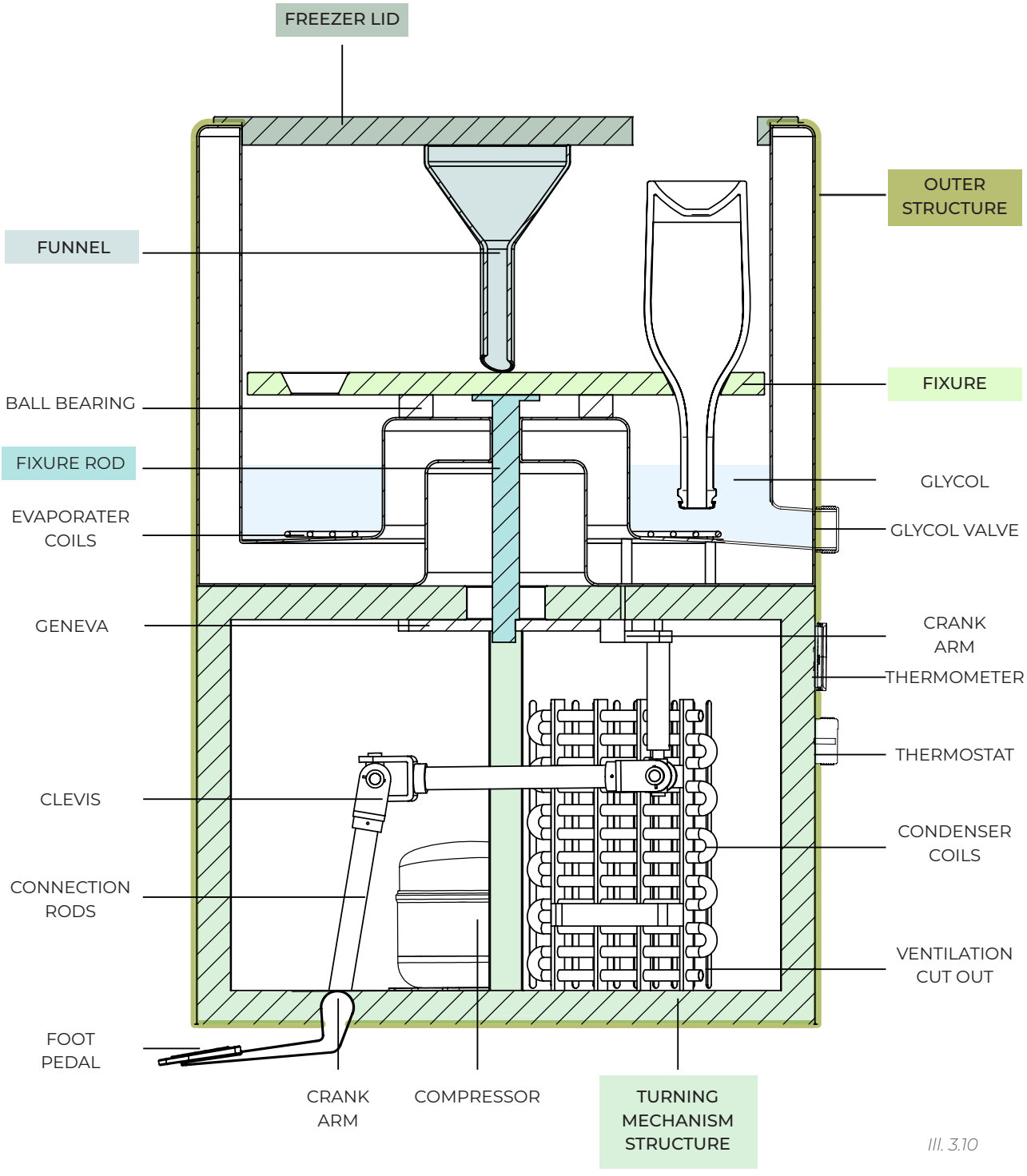
The fixture holds the bottle and turns around the center. The size of the fixture hole took inspiration from existing neck freezers, as they hold the bottles so they do not tip over. The fixture is a 20 mm thick plate with 10 holes, every hole tapers in to better hold the bottles. The fixture makes sure that only 25mm of the bottleneck is submerged in the antifreeze solution to speed up freezing the neck. (Appendix 15) The hole in the lid for adding and taking up bottles from the freezer is 13 cm diameter, big enough to fit a bottle and a big hand for placing the bottle in the fixture.

GLYCOL

Approximately 14 liters of food grade monopropylene glycol, is mixed with the same amount of water, which functions as an antifreeze solution. The mixture can be reused and stored in the freezer for several months, however it needs to be topped-up from time to time as there is a loss every time a bottle is taken out. The glycol is added through the hole in the lid. Initially, the idea was to pour the glycol through the hole in the freezer lid, over the fixture, and let it leak through the 10 holes in the fixture. This seemed very messy and as there was a lot of unused space in the middle of the freezer there was room for a long funnel. The funnel can be turned to fit the hole in the lid while concentric to the hole in the fixture, thereby making it easy to add the glycol without making a mess. To drain the freezer and for cleaning it, a valve is placed in the bottom of the freezer, by opening the valve, the mixture is emptied in a bucket placed underneath. When grabbing a bottle from the freezer, it is necessary to dry the neck, to remove remaining glycol before disgorging it. A hook with a hanging cloth is placed on the frame structure to have it close by.

TURNING PRINCIPLES

The idea of having a turning freezer came quite early in the development process. Turning neck freezers is not a new invention, however the existing ones make it even more difficult which bottle have been in the freezer the longest. The idea of making the whole bottle fit in the freezer and only use a single hole as an opening, was new.

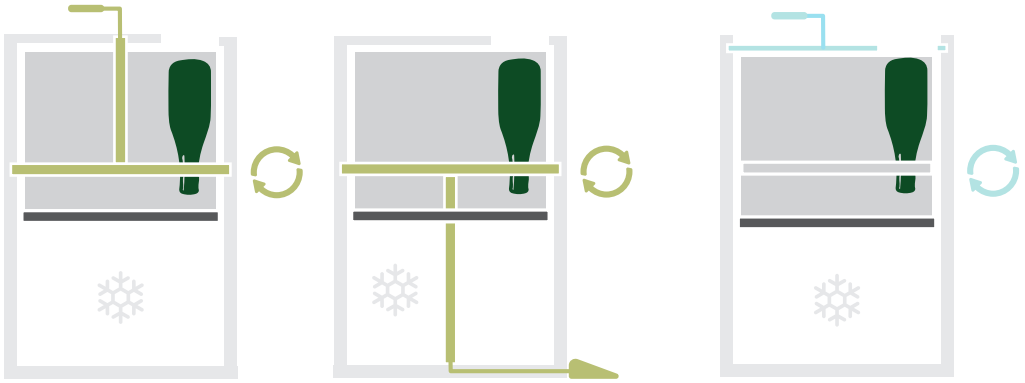

FREEZER LID
OUTER STRUCTURE
FUNNEL
FIXURE
BALL BEARING
FIXURE ROD
GLYCOL
EVAPORATER COILS
GLYCOL VALVE
GENEVA
CRANK ARM
THERMOMETER
THERMOSTAT
CLEVIS
CONDENSER COILS
CONNECTION RODS
VENTILATION CUT OUT
FOOT PEDAL
CRANK ARM
COMPRESSOR
TURNING MECHANISM STRUCTURE

Ill. 3.10

Both motorized and mechanical solutions were investigated, the different turning principles can be seen in illustration 3.11. The idea of using a foot pedal to turn the freezing was seen as a big advantage because it gives extra liberty to perform other actions with the hands. If tourists are on a visit, it gives a special “magic” movement, without the winemaker having to lose eye-contact with the visitors. This solution could be solved with a motor or a mechanical system, making the fixture with bottles turn every time the pedal was pressed. The simplicity of this mechanical solution fits well with the rest of the product and is easy to integrate with the rest of the freezer.

ALL FREEZER TURNS MOTORIZED

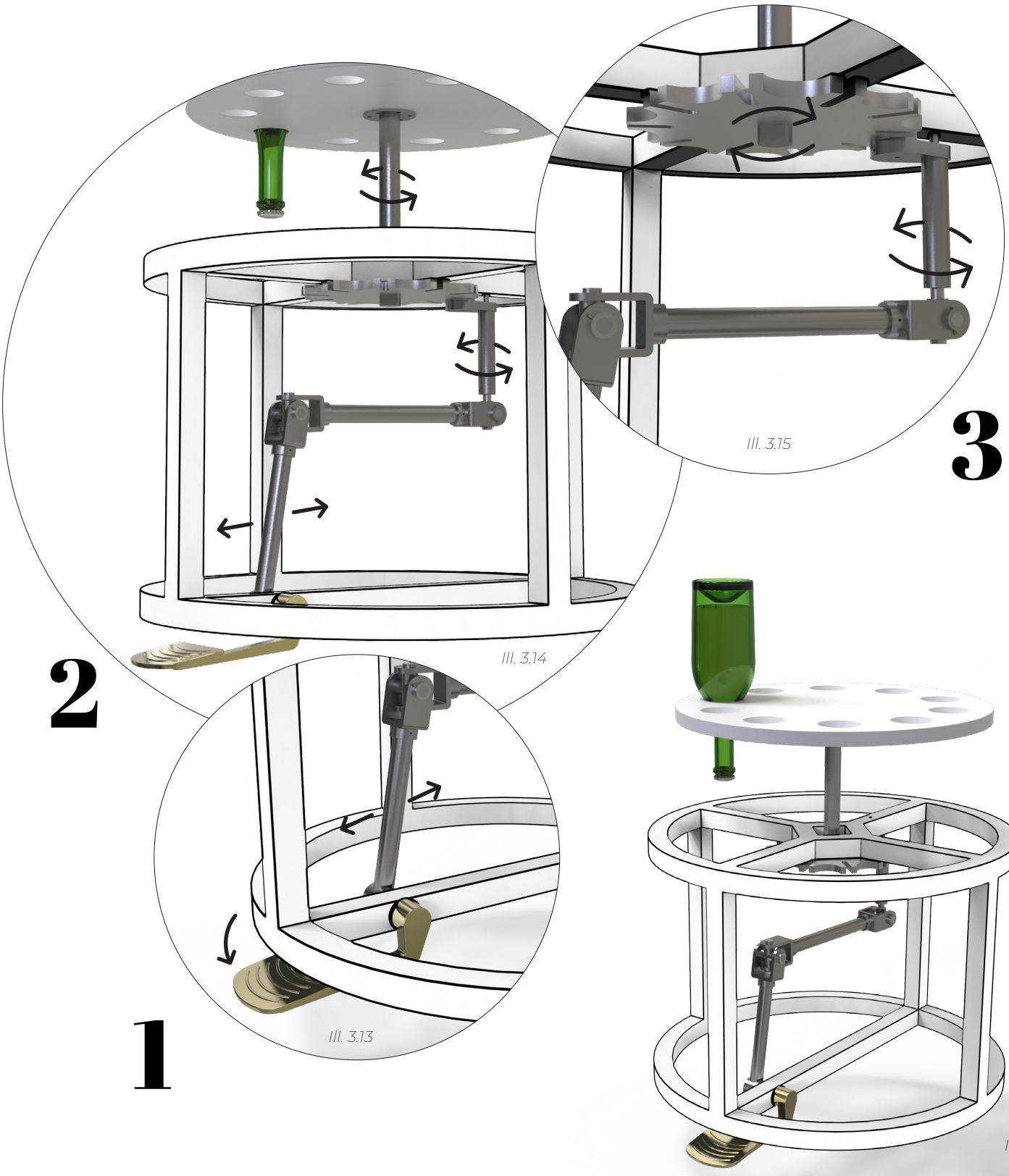
ONLY BOTTLE FIXTURE TURNS MOTORIZED



ONLY BOTTLE FIXTURE TURNS MECHANICAL OPTIONS

LID TURNS MANUALLY

Ill. 3.11



END SOLUTION

The foot pedal activates a system of crank arms, connection rods, and clevises (ill. 3.13-14), connected to a geneva wheel (Ill. 3.15). When the crank arm at the top rotates a full circle, the teeth in the wheel make the fixture turn one tenth of a round, which is equal to the number of bottles in the fixture (Ill. 3.12). As pushing the pedal only rotates the top crank arm half a circle, a spring will do the rest and give a controlled movement.

N | Secure bottles while turning with fixture

Frame

Ill. 3.16

The structural frame helps bring the different parts together and make it appear as one product. The frame also improves the stability and makes it easy to move because of the addition of two wheels and a handle. The functionality has mostly stayed the same since the ideation phase to the final frame, only aesthetic variations were evaluated.

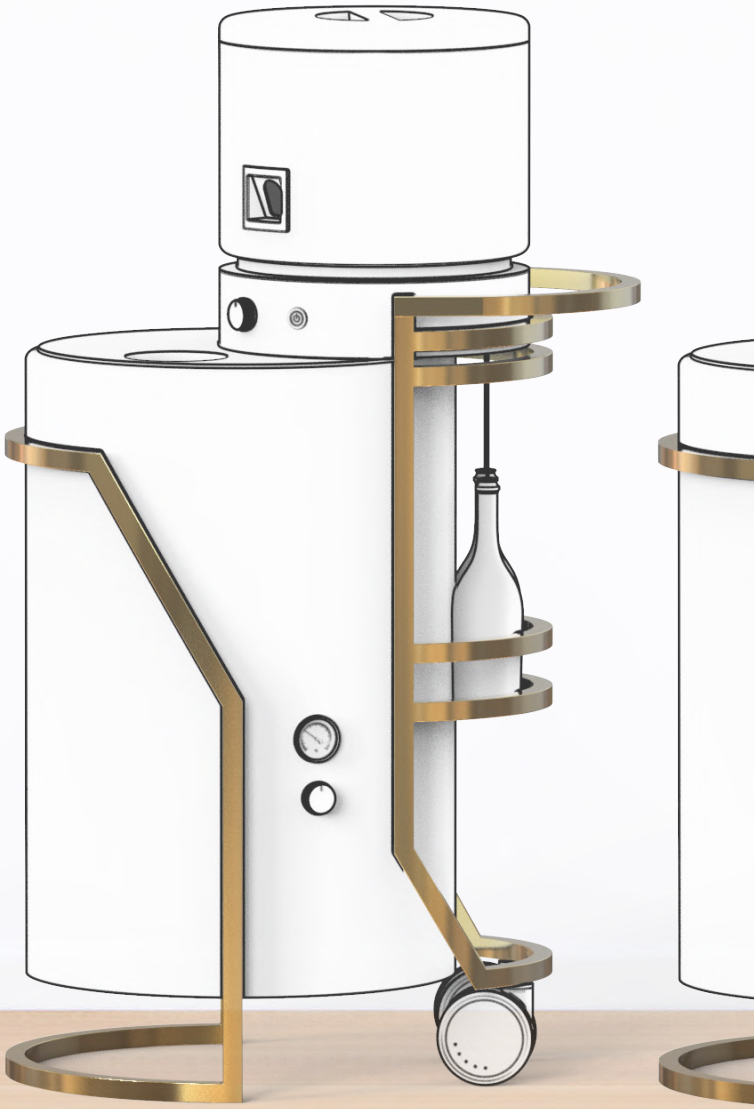
Different frames were explored by 2D sketches (Appendix 16) on top of the model (Ill. 3.16) and the most promising was made in 3D, which can be seen in the following.

KEEP IT SIMPLE

As the initial idea was very simple and stiff, tests with curved tubes were meant to soften the appearance of the freezer a little. Even though all of the frames could work, it was decided to go with something similar to the initial option, as it was the most optimal for production as well as having a plesant expression. A great fear was that the double curved bends would be both expensive and difficult to bend if at all possible.

APPEARANCE

As sparkling wine is viewed as something luxurious meant for celebrations, it is only fitting that equipment for producing sparkling wine is a bit luxurious in itself. The frame was always presented with brass color as it appears more luxurious and was something that would catch the eye of the tourists. The production facilities in vineyards are often very cold and not like what most people would expect from traditional wine production with wooden barrels. Because of this, it was important to have a product that fit the context while stands out from the monochromatic-only-stainless steel look of the competitors, especially if the tourists were to interact with the product.

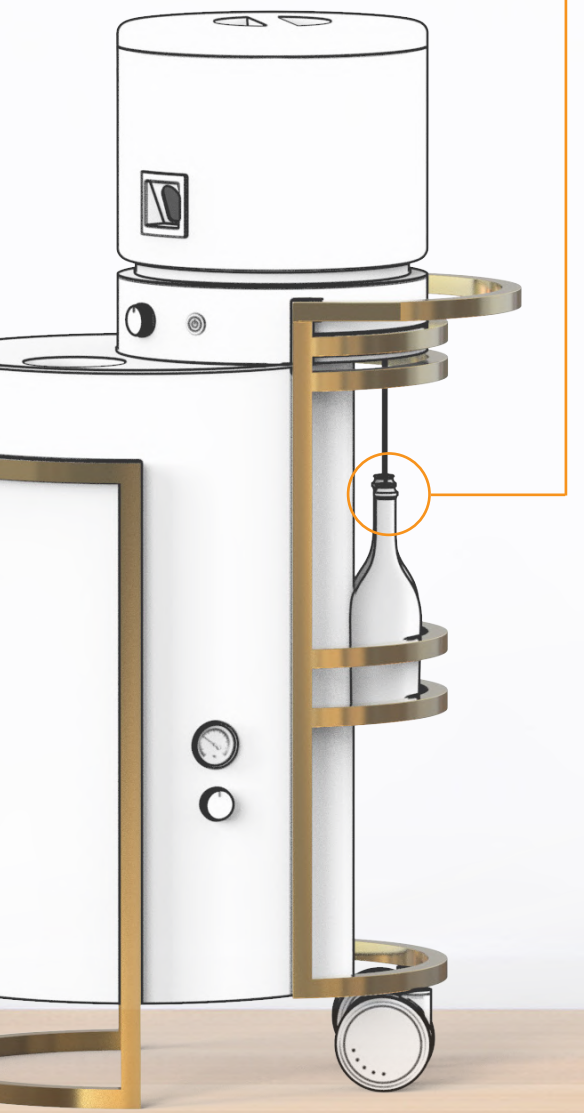


PLACEMENT CONTAINERS

After choosing the “Bar wagon” concept, it was fitting to use the wine bottles as leveling and dosage containers. The main concern with the containers was the practicality of placing and removing them for refilling the dosage and cleaning purpose. During ideation it was difficult to find a natural place for the bottles, the best was under the disgorgement base, but it didn't seem right or safe for them to simply hang.
The solution appeared while looking for bar wagon inspiration for the frame structure, where one of the wagons had the recognizable shelf to place the bottles. This feature fitted perfectly into the concept by being practical to place and to remove the bottles. Additionally, it also had a lower cost compared to a secure hanging feature.

In order to ensure that no dust or similar would get into the bottles during production, it was decided to use the bubble stopper again as it presented a very intuitive and practical closure, besides having a very low cost.

N | Use wine bottles as leveling and dosage containers
Use bubble stopper to prevent dust in wine bottels



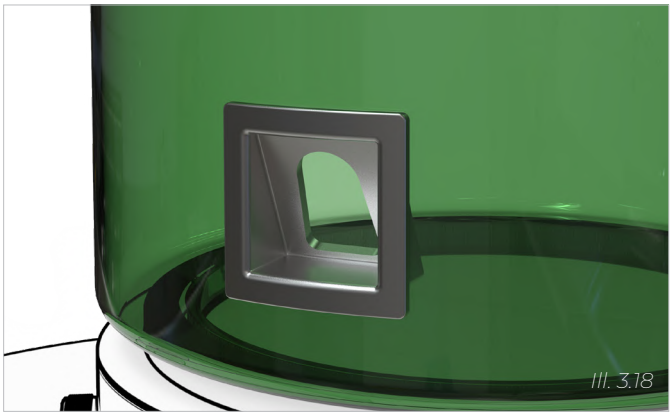
Ill. 3.17

Disgorgement bowl

Together with the disgorgement opener, the disgorgement bowl is one of the main elements of the concept and probably the most important in relation to the show-off aspect. The cylindrical transparent bowl will give the visitors a 360 degrees visual of the exploding frozen lees. Throughout the development of the bowl, cleaning considerations were widely discussed. Especially because it catches all the lees as well as the crown caps when disgorging a bottle and probably needs to be cleaned every day after production. Because of this, it should be easy to remove the bowl from the rest of the product as well as make it easy to clean.

DISGORGEMENT OPENER

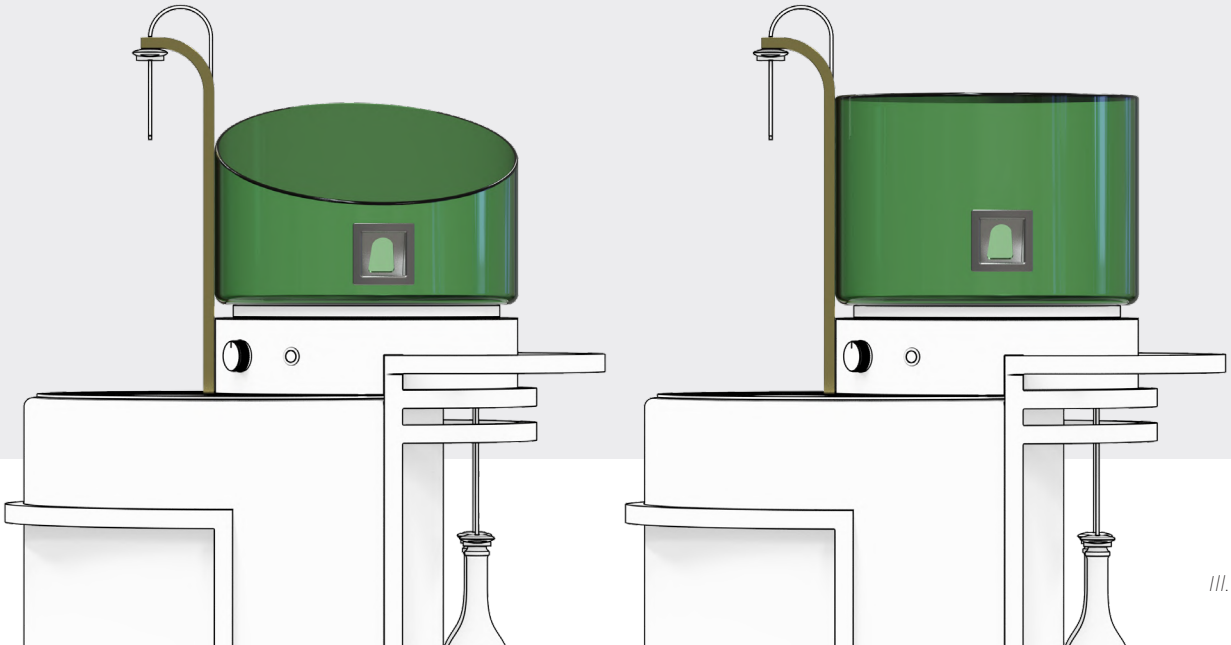
At the 'Visits to vineyards' it was clear that the bottle needed a certain angel when disgorging and which needed to be incorporated in the opener. From Online research and measurements from Guldbæk, an angle between 60 degree and 65 degrees was widely used (Appendix 17.). The disgorgement opener is placed with the angle going inwards, making it more coherent with the outer shape of the disgorgement bowl.



Ill. 3.18

FLAT OR ANGLED

The angled disgorgement bowl that was introduced earlier in concept 'The shelf' had the advantage of giving a better overview for the winemaker doing disgorgement. How that would look with the bar wagon needed to be explored. **Evaluation:** Although having an angle gives a better overview, it does not fit the rest of the product's appearance, especially with the faucet.



Ill. 3.19

TOP OR BOTTOM

At the end of each day of production, the bowl should be emptied and cleaned. To empty it, the winemaker should be able to open it either in the top or in the bottom.

TOP

Removing the lid in the top, results in all the lees gathering in the bowl.
Challenge: The structure that holds the lid must be strong so it does not fly off when the crown cap hits it with great force when disgorging.

BOTTOM

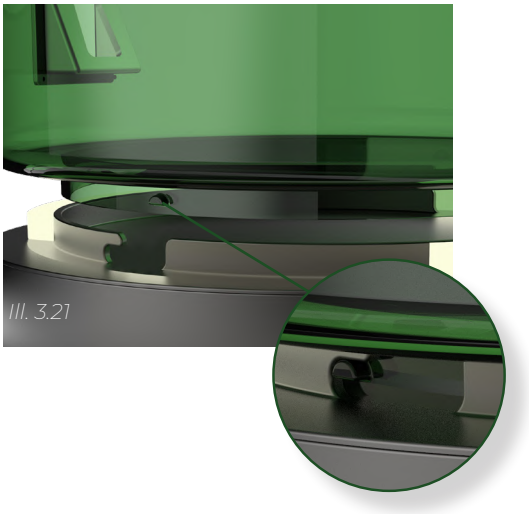
Removing the bowl would result in a tray holding all the lees.
Challenge: The tray must be large enough to contain all the crown caps and lees from a day's production. When dismantled, lees may run down the sides and create a mess.

Placing the opening in the top made the most sense in relation to not spilling any lees and minimizing extra cleaning. Research on different ways to attach the lid to the bowl was made (Appendix 18), this showed that using a rough tread, known from a jam jar, was a good option. The tread was easy to use and made the lid stay in place during disgorgement. The top of the lid has an indent, making it easy to grab the lid and twist for removal.


Ill. 3.20

ASSEMBLY WITH THE DISGORGEMENT BASE

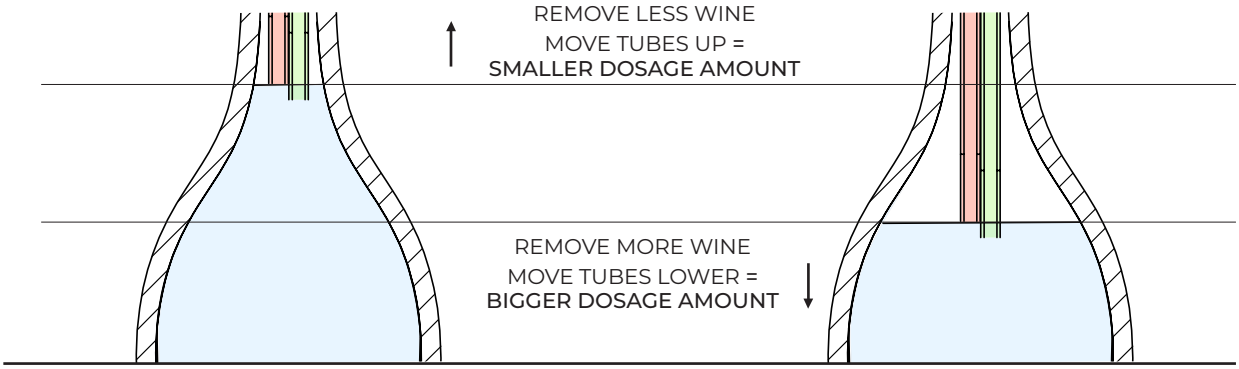
To remove the disgorgement bowl from the base, a slot locking mechanism, known from a lot of kitchen machines, was used. The user removes the disgorgement bowl by grabbing it underneath, then twisting it to unlock, and finally pull it up. After removing the disgorgement bowl and the lid from the base, they must be emptied for yeast and crown caps. To make it easy for the winemaker to clean, the bowl and lid both fit in the dishwasher, as the bowl is not higher than 30 cm.


Ill. 3.21

- Angle of 60 to 65 degree for the bottle opener
- The height of the disgorgement bowl should be < 30 cm
- Able to dismount the disgorgement bowl and lid

Tubes

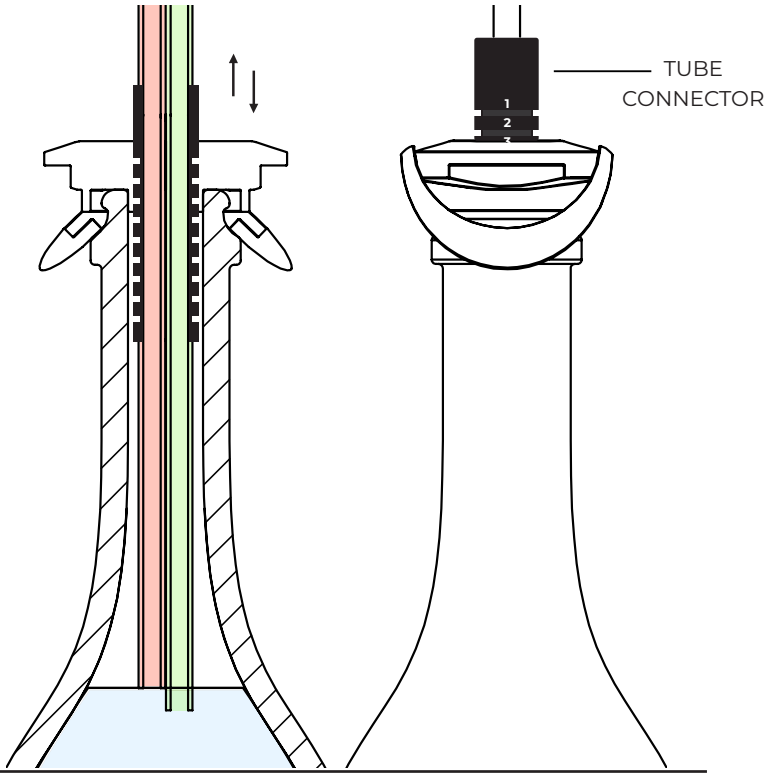
From the beginning the 4mm tube diameter were defined by the pump. However, a test was made in order to define the length of the tubes for two reasons. First, the length of the leveling tube inside the bottle was going to determine how much liquid would be removed from the bottle before adding the dosage. (Appendix 19) From the test, it was determined the tube length should vary between 100 and 120 mm. Secondly, to avoid gushing, the dosage tube needed to be longer than the leveling tube, as defined by the previous test: avoid gushing.



Ill. 3.24

Adjusting the length of tubes was so uncomplicated, that only a simple mechanism was needed. Several reference products were looked at in order to find a feature that was easy to move but firm enough to stop at the desired tube length. (Appendix 20)

Finally, it was decided to choose a modified existing bubble stopper, as it was a standard component and could be ordered with the requested cut. A tube connector was incorporated to hold the tubes together. Both tubes were to be moved at the same time, as the dosage tube (in green) is always 5 mm longer than the leveling (in red), gushing should never occur. This attachment has increments to mark the different levels of wine to remove.



Ill. 3.25

CLEANING

At the end of each day of usage, the leveling and dosage containers should be cleaned. A container filled with water and a mild detergent is placed on the shelf with both tubes going in. The other container is empty and placed on top of the freezer with the other end of the two tubes going in. The dosage button must be set to 'cleaning' and when the button is pressed, the both pumps will move the cleaning mixture from the container on the shelf to the bottle standing on the freezer. This cleans the tubes from inside and will take a little over 3 minutes.

N | Dosage tube should be 5 mm longer than leveling tube
Tubes length in bottles should be able to adjust from 10 - 12 cm

Faucet

One of the important details that had to be further developed after choosing to work with the "Bar wagon" was the placement of the tubes for leveling and dosage. The original idea was to take inspiration from the 'faucet with extender', as seen in 'The shelf' concept, as it fitted the expression of the concept the best. However, the way it was presented earlier was very simplified, so it needed to be further developed and incorporated with the chosen bubble stopper. This was done mainly with the use of 3D modeling, the following shows the evolution of the faucet.

EVOLUTION

The faucet was made of rectangular tube profile to fit the rest of the expression. It was as tall as a bottle plus the length of the tubes, making it quite tall. The tubes were fixed in the faucet and could only move vertically. Therefore the bottle needed to be placed directly under the faucet. A magnet was mounted on the bubble stopper to make it easy to attach it to the faucet when not placed on the bottle.

Evaluation: The expression of the faucet fitted the rest of the concept, but the tubes could only move vertically, so the placement of the bottle was important. This made the faucet tall and took unnecessary focus.

To give more freedom to place the bottle wherever the winemaker desired, the faucet was opened up at the top. This meant that the faucet did not have to be higher than the bottles. The bubble stopper was placed on top of the faucet with the use of a magnet, again, to make it easy to put back in place after use.

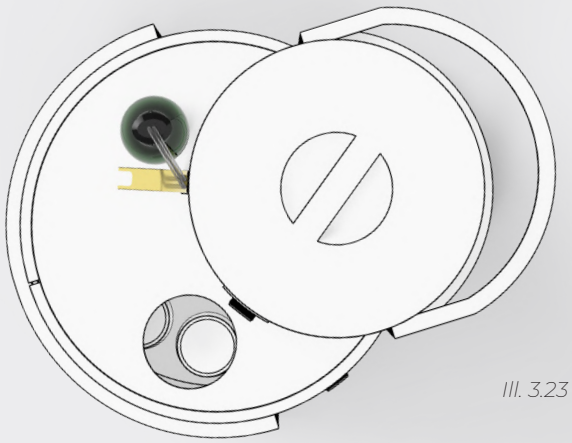
Evaluation: The new additions made the faucet look more as an integrated part of the product. Changing the directions the tubes could move in, making it much more flexible.

Ill. 3.22

PLACEMENT OF THE FAUCET

The previous investigations on good work posture recommendation helped in relation to how often and how far from the body it is good to reach for something. This can be used to determine where the faucet should be placed on the lid of the freezer. The freezer has a diameter of about 550 mm and to follow the recommendations the winemaker should not reach longer than 250-500 mm from the body (Production ergonomics, n.d.).

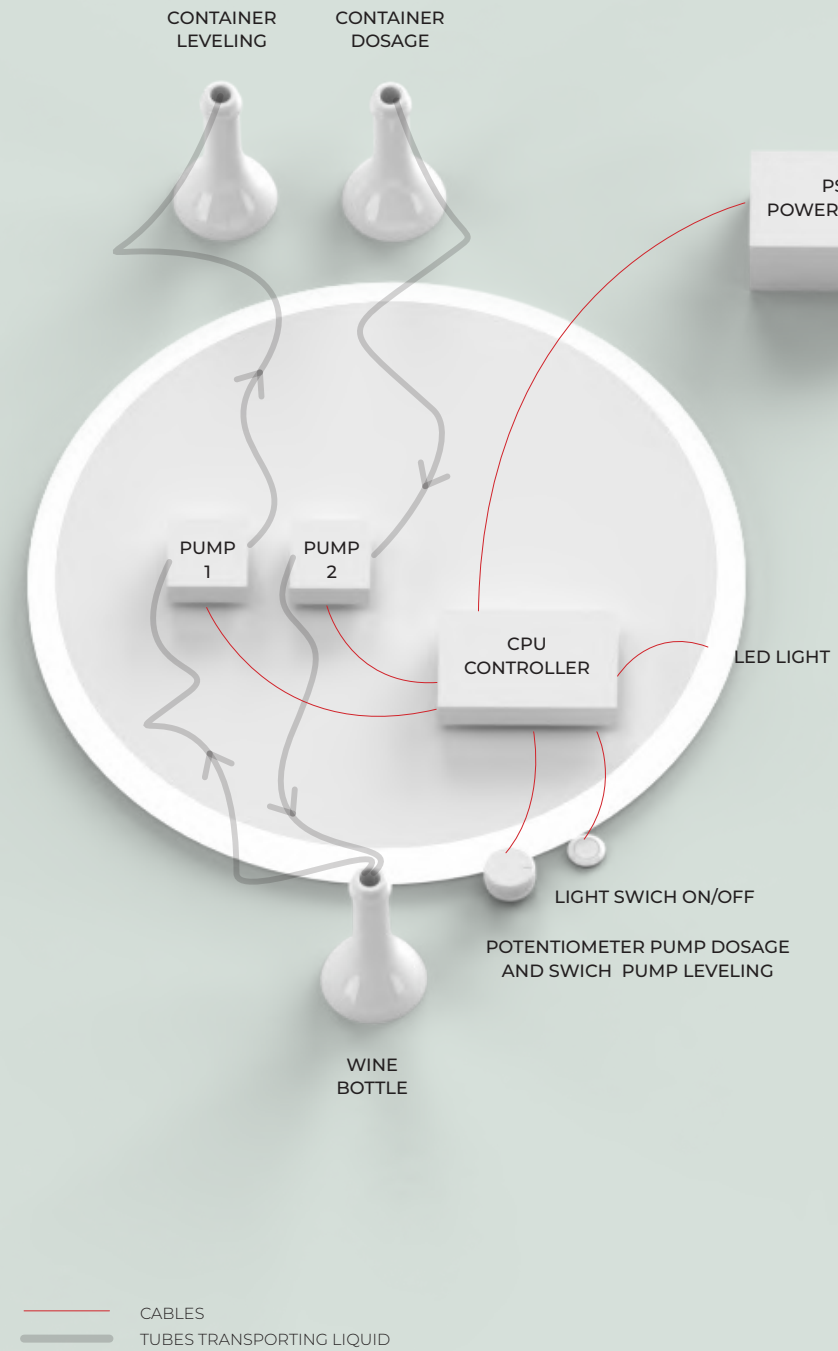
N
- Use magnet to fasten bubble stopper
- The faucet should be placed < 50 cm from the user
- Tubes able to move in every direction



Ill. 3.23

Electronics

Due to safety and maintenance reasons, all the mechanical and electronic components relating to the pump and light were placed inside the disgorgement base. The base had several benefits: sufficient space for all the electrical components , a simple construction with a lid to access it if needed, a good height for interaction with the dosage button, and light switch. A diagram of how the components will be connected can be found below (Ill. 3.26). Electrical engineer, Troels Mejer, gave feedback on the placement of the different components, to make sure it was realistic. To give an overview of the electrical processes, flowcharts were made to communicate how these will work (ill. 3.27), all flow charts can be seen in appendix 21. Because the processes will be semi-automated, the system will have input from a user, such as using the turn button to adjust the dosage.



CPU CONTROLLER

The product contains such a simple programing setup that the assembly could be outsource or in house without any difference in cost.

LED LIGHT

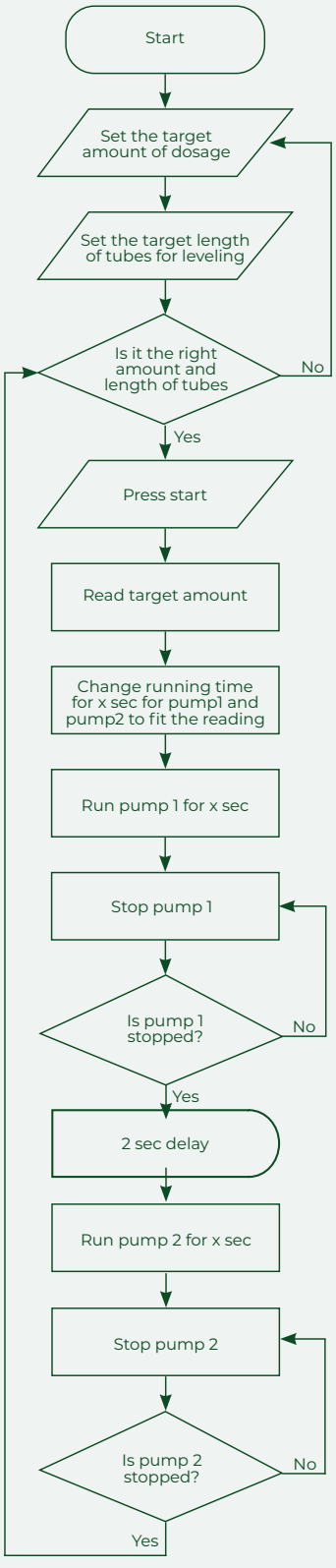
The light component will be connect with the CPU and then will be redirected to the power supply.

POWER SUPPLY

Component certified by CE (Europe) and UL (USA), not only reduce production cost, but it also reduce cost of certification as the electrical output is already certified.

Ill. 3.26

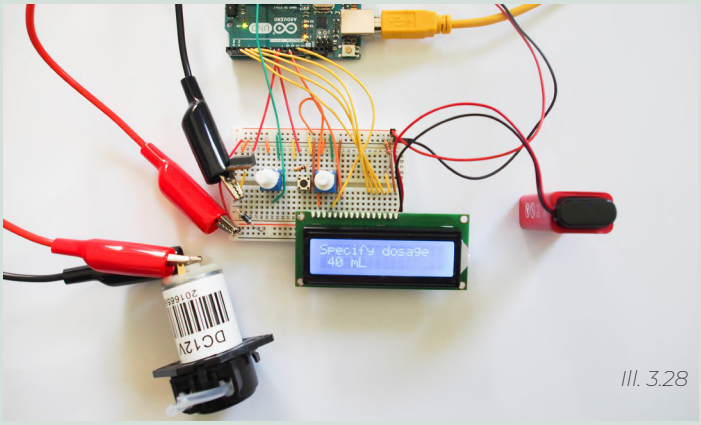
FLOWCHART



Ill. 3.27

The amount of dosage varies from 10 ml to 50 ml to fit the different sweetness categories of sparkling wine. The button has 5 ml increments to enable the need for precise dosage. The amount of leveling depends on the length of the tube, which means it can never take out more than specified. Therefore the pump for leveling runs for 2 seconds more than dosage to be sure the right amount is removed.

PUMP SYSTEM



Ill. 3.28

The system with the peristaltic pump was created using an Arduino to get a better understanding of what information the system needs in relation to coding (Appendix 22) and to make a proof of concepts.

The speed of the peristaltic pump is defined by the amount of liquid that is moved in seconds. The chosen pump has a flow rate of 120ml/60sec. The table below shows the relation between the ml and seconds.

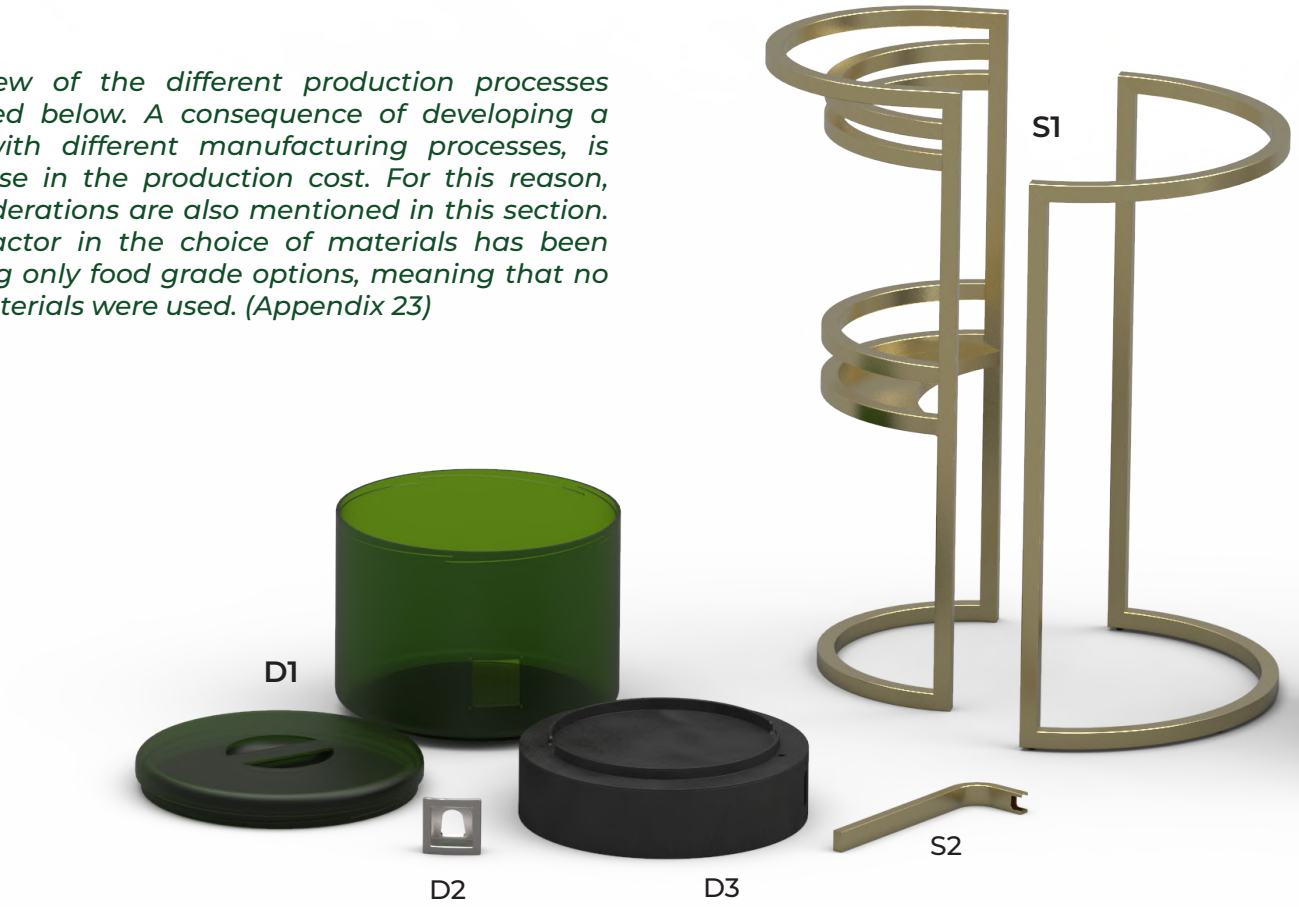
mL	10	15	20	25	30	35	40	45	50
Leveling Sec	7	9.5	12	14.5	17	19.5	22	24.5	26
Dosage Sec	5	7.5	10	12.5	15	17.5	20	22.5	25
Leveling + Dosage + delay	14	19	24	29	34	39	44	49	54

Ill. 3.29

N | The peristaltic should have a flow rate of 120ml/60sec.
Able to adjust amount of dosage from 10 ml to 50 ml

Materials and Production

An overview of the different production processes is described below. A consequence of developing a product with different manufacturing processes, is the increase in the production cost. For this reason, cost considerations are also mentioned in this section. Another factor in the choice of materials has been considering only food grade options, meaning that no porous materials were used. (Appendix 23)



D1 DISGORGEMENT BOWL

From the beginning, the disgorgement had been the main attraction for tourists. The material chosen was SMMA (Styrene methyl methacrylate) in transparent green resembling a wine bottle. SMMA is fairly new to the market, it is food approved, good for thick-walled injection molding, and has a bigger resistance to scratches than PMMA. (SMMA: An Alternative To Polycarbonate, 2017)

The material thickness is 5mm and is manufactured by injection molding in order to achieve all the necessary structures for attachment. Both the bowl and lid are manufactured by this process. CAD 3D models will be optimized with the necessary molding angles, fillets, and tolerances for a successful filling of the female mold and a successful de-molding of the male mold.

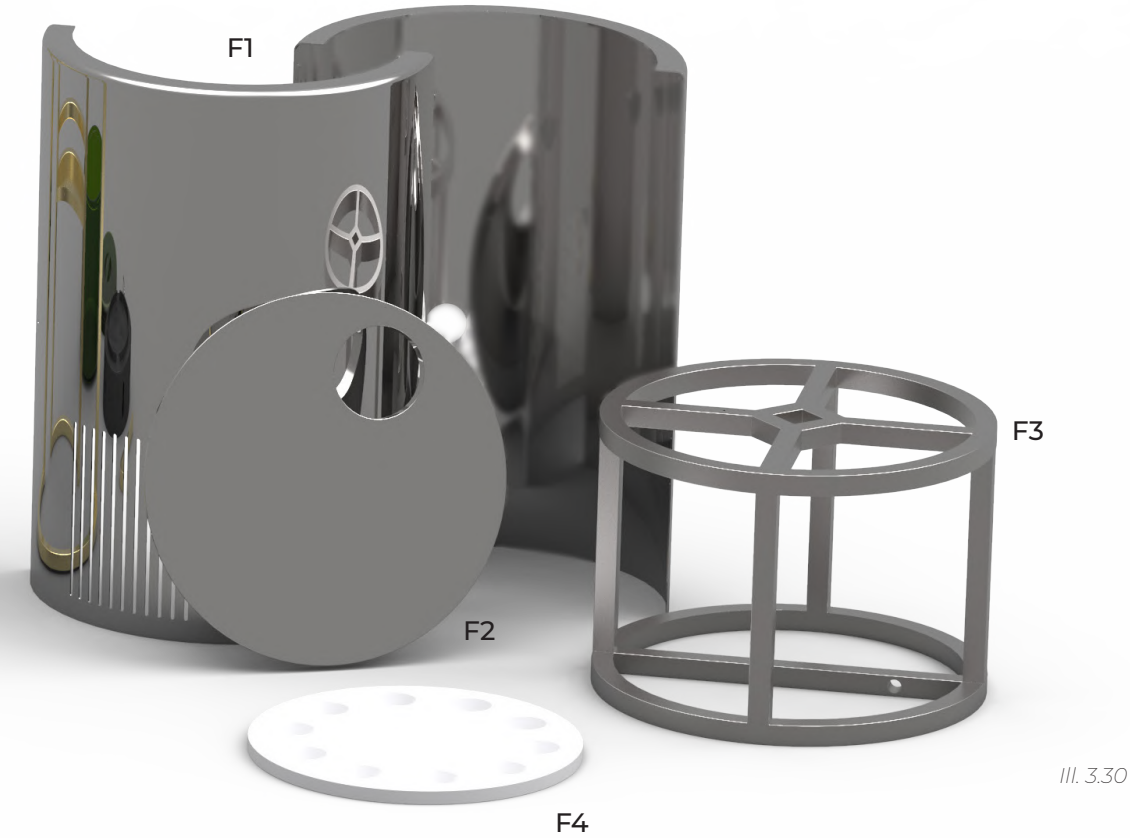
Other processes such as thermo molding and rotary molding was considered, but given the need for the disgorgement bowl to be flawless, as it will be illuminated and be in the front view of tourists, it has been discarded. However, they are open to being reconsidered in the future.

D2 DISGORGEMENT OPENER

As the opener is going to be in direct contact with liquid and will be prone to scratches from the crown caps, the opener is constructed in stainless steel grade 304 (Stainless Steel Investment Casting, u.d.). As the volume has several faces and angles it is processed by investment casting, also known as lost wax casting. This process offers an affordable production in stainless steel and it doesn't require a big molding investment. (6 Advantages Of Investment Castings, n.d.)

D3 DISGORGEMENT BASE

The base is very simple cylindrical container with a lid. Initially, the proposed material is a steel sheet with a 2 mm thickness, produced by laser cut, stamping and welding. The finish will be two layers of anti-corrosive paint and one layer of black paint. The lid and the base are attached by screws. If the production of the product reaches more than 5.000 units per year in the future, this component could be done in ABS or PET by thermoforming to reduce cost by mass production. All the disgorgement related components come second after the freezer in production cost due to the molding and assembly work.



Ill. 3.30

FREEZER

The freezer is an existing technology and it will be outsourced to a company specialized in freezers. For this reason is the most expensive component in of the product. Below the focus is the design of the components that are developed for this product and can't be bought as standard components.

F1 OUTER STRUCTURE

The outer structure consists of two stainless steel sheets grade 304, with a thickness of 2 mm. It is manufactured by guillotine cut, bent, and joined to the freezer frame to create a cylinder. Interior and exterior edges are also bent for avoiding having sharp edges. The steel is food grade and frequently used in the food industry. The product is going to be placed in a production facility and can benefit from the strength of stainless steel compared to other materials such as aluminum. (Stainless Steel Investment Casting, n.d.)

F2 LID

The lid is also constructed in sheets of stainless steel 304 with a thickness of 2 mm. Manufactured by laser cut and polished edges. The lid has isolation which is created by a shell in polyethylene attached with screws and filled with polyurethane. As the lid will be the most exposed component to liquids a bar mat (standard component) is incorporated in the top as an accessory.

F3 TURNING MECHANISM STRUCTURE

As this component will not be in contact with liquid or the user, its only function is structural, it will be produced in profiles of plain steel (mild carbon) 25x25x1,2 mm. Manufactured by guillotine cut, bent with a CNC rolling machine and point welded. The finish will be two layers of anti-corrosive paint and one layer of gray paint to avoid corrosion in the long run.

F4 FIXTURE

Developed in Nylon, as it can withstand more than -40°C and it performs well to being CNC milled. Diameter 460mm and 20mm thickness.

S1 STRUCTURAL FRAME

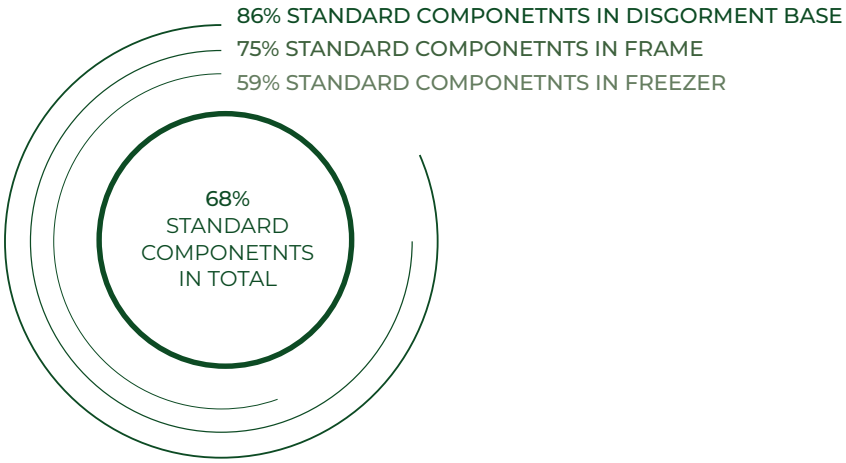
It was vital to keep the structure simple and keep the cost down, as the other main components were quite complex and relatively expensive. This was achievable, as the frame only has a stabilizing and aesthetic function to fulfill. For this reason, a square profile in plain steel of 25x25x1,2 mm was chosen. It is cut and bent by a CNC rolling machine and the pieces will be joined by MIG welding, as it is affordable and has a good precision for finish. Polish will be done after welding to have plane surfaces and a seamless weld. (McFadden et al, 2019) The brass finish is achieved by electroplating with an extra layer of coating for protection against corrosion or wear and tear.

S2 FAUCET

The faucet is constructed in 15x30x1,2 mm steel profiles, which are cut and manually bent. It has the same finish as the structural frame and is attached to the disgorgement base with screws. It was also considered to use a U profile, which reduces two cuts on the curve and end of the faucet. But the square profile worked better with the frame profile.

STANDARD COMPONENTS

A huge focus on the design of the product has been to incorporate as many standard components as possible, in order to reduce the cost of manufacture and the production time. The end result consists of approximately 68% standard components.



Ill. 3.31

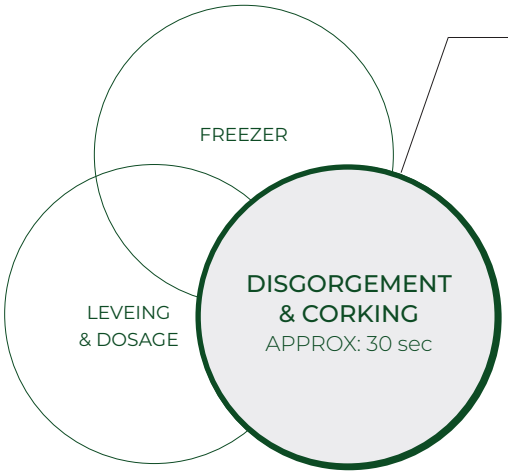
The journey of deciding the production of the product was very discontinuous, as it was necessary to go back and forward every time material or construction was colliding with each other. Once that the overview of all the processes was clear the product as a whole was accomplished. At this point the concept has been developed into a detail level that allows an estimation the manufacturing costs to be calculated. Many of the costs of the components have been reduced by incorporating standard components. However, to be ready for mass production, it would be necessary to reevaluate design decisions once working prototypes are developed, having in consideration the remaining steps of the DFM. Illustration 3.32, gives an overview of this based on DFM (design for manufacturing) (Ulrich and Eppinger, 2012).

STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
ESTIMATE MANUFACTURING COSTS	REDUCE THE COSTS OF COMPONENTS	REDUCE THE COST OF ASSEMBLY	REDUCE THE COST OF PRODUCTION	CONSIDER THE IMPACT OF DFM DECISIONS ON OTHER FACTORS

Ill. 3.32

Bottle output per hour

In order to have a product able to compete with existing solutions, it was necessary to calculate the bottle output per hour. This was done by calculating the time it took to perform each process. (Appendix 24)



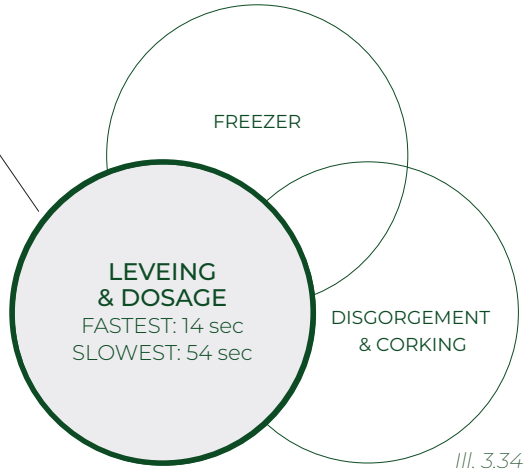
Ill. 3.33

THE MOST PROBABLE SCENARIO

At Guldbæk Vingård it was possible to see and time each process. It can be assumed that; removing the bottle from the freezer, disgorgement, corking, and adding a new bottle to freeze will be approximately the same time as in the developed product, which took 30 sec. The processes taking 30sec, creates an **OUTPUT OF 120 BOTTLES AN HOUR**

THE SLOWEST SCENARIO

If the winemaker is using the biggest amount of dosage, 50ml, the pump will run for 54 sec (See table page 79). Here, the leveling and dosage will be the bottleneck process, creating an **OUTPUT OF 66 BOTTLES AN HOUR**



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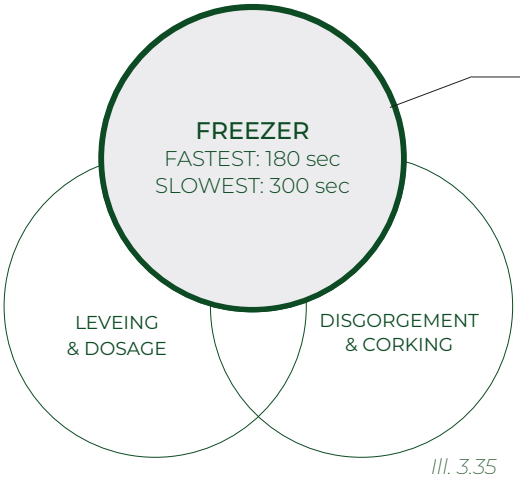

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THE FASTEST SCENARIO

If the temperature is at its lowest (-30°C), the fastest the freezer can go is 20 sec per bottle. Then theproduct would have an **OUTPUT OF 180 BOTTLES AN HOUR**

In order to be able to do all the other processes in 20 sec, there would need to be 2 winemakers at the same time. As the goal of the product is to be able to be used by one operator this output will not be taken in consideration.

N | Enable a bottle output of 120 bottles/hour

No.	Page	Origin	Needs
1	17	Last stages of the second fermentation	Possible to change the amount of leveling
2	17	Last stages of the second fermentation	Possible to change the amount of dosage
3	17	Last stages of the second fermentation	Specific angle for taking off the cap
4	18	Fact box: Dosage	Enable precise dosage
5	23	Visits at vineyards	Having the four processes close to each other
6	23	Visits at vineyards	Easy cleaning
7	23	Visits at vineyards	Minimize splash back when disgorging
8	23	Visits at vineyards	Able to withstand force of 6 bar
9	23	Visits at vineyards	Possible to operate the product with gloves on
10	25	Fact box: Sparkling wine bottles	Fit different bottles
11	17	Competitor analysis	Good physical working condition
12	37	Test solutions for the four processes	Use regular freezer
13	41	Sketching, 3D, and cardboard	Unable to place bottle wrong for leveling and dosage
14	50	The three concepts	Use material approved for food production
15	50	The three concepts	Integrate light before and after disgorgement
16	50	The three concepts	Wheels for moving easily
17	51	Full-size mock-up	Space for 10 bottles in the freezer
18	52	Avoid gushing	Product should avoid gushing when doing dosage
19	55	Bubble stopper	Seal bottle during leveling and dosage

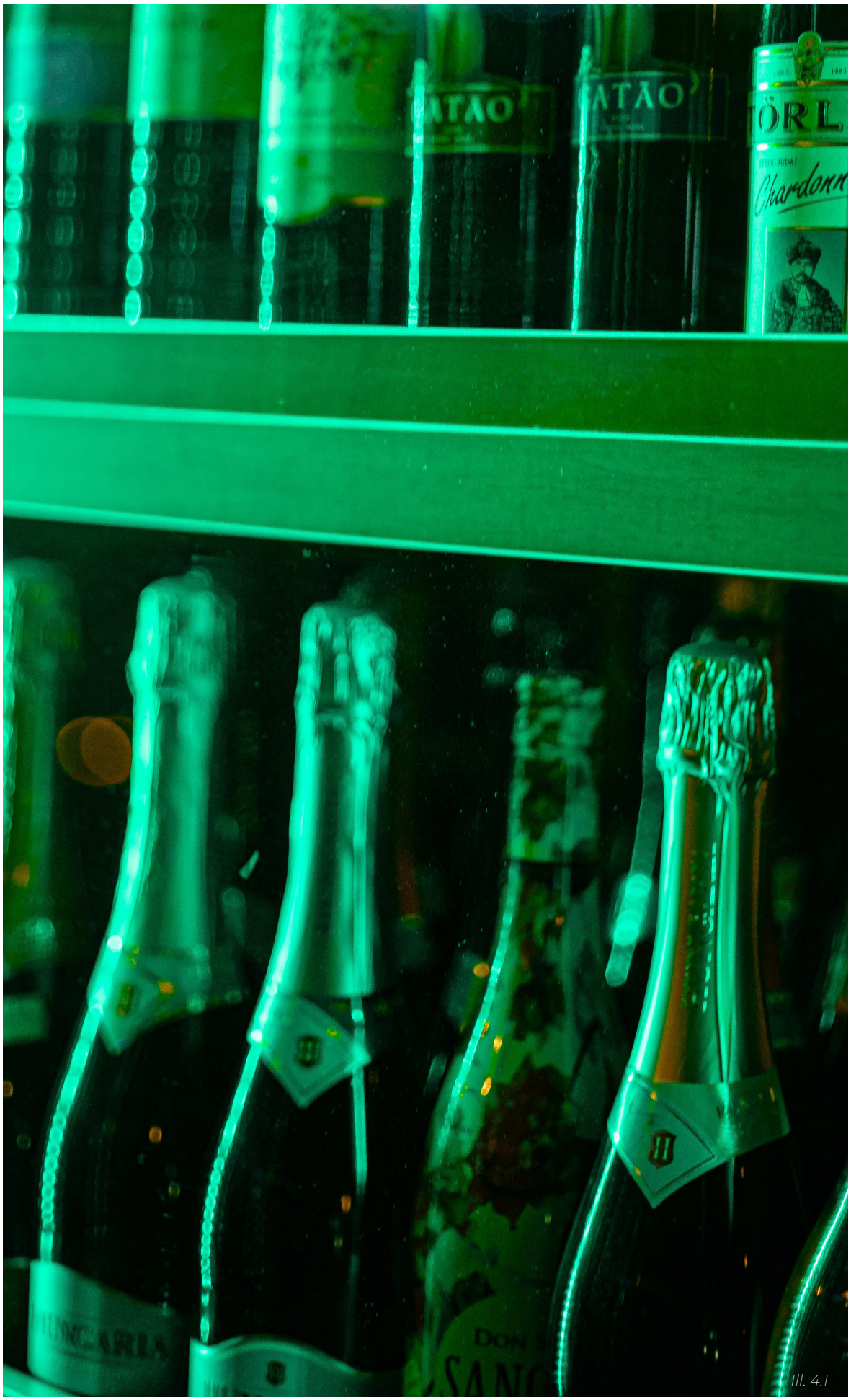
No.	Page	Origin	Wish
20	17	Last stages of the second fermentation	Freezing should be at a temperature below -20°C
21	23	Visits at vineyards	One man use
22	23	Visits at vineyards	The product should not take up space when not in use
23	25	Hacks	Integrated light
24	29	Context mood board	Aesthetic that fit with the wine industry look
25	50	The three concepts	Automated leveling and dosage
26	50	The three concepts	Light in all four processes
27	50	The three concepts	Aesthetically stand out compared to competitors
28	53	Second function	Possible to be included in tourist activities
29	54	Adjustment of dosage	Use analog solution for adjustments

No.	Page	Origin	Need
30	65	Light	Integrate to-sided light
31	67	A good working posture	The freezer lid should be in the height of 900 mm
32	67	A good working posture	The opener should be in the height of 1100 mm
33	71	Freezer	Secure bottles while turning with fixture
34	73	Frame	Use wine bottles as leveling and dosage containers
35	73	Frame	Use bubble stopper to prevent dust in wine bottles
36	75	Disgorgement bowl	Angle of 60 to 65 degree for the bottle opener
37	75	Disgorgement bowl	The height of the disgorgement bowl should be < 30 cm
38	75	Disgorgement bowl	Able to dismount the disgorgement bowl and lid
39	76	Tube	Dosage tube should be 5 mm longer than leveling tube
40	76	Tube	Tubes length in bottles should be able to adjust from 10 - 12 cm
41	77	Faucet	Use magnet to fasten bubble stopper
42	77	Faucet	The faucet should be placed < 50 cm from the user
43	77	Faucet	Tubes able to move in every direction
44	79	Electronics	The peristaltic should have a flow rate of 120ml/60sec.
45	79	Electronics	Able to adjust amount of dosage from 5 ml to 50 ml
46	83	Bottle output per hour	Enable a bottle output of 120 bottles/hour

Specifications

The product specification is an elaborated table, with defined values for the needs and wishes. The needs and wishes can be found on the previous page, which is referenced with numbers.

No.	Metric requirement	Unit	Value	References
1	Flow rate of peristaltic pump	ml / sec	120/60	4, 44, 46
2	Integrate to-sided light	Binary	Pass	15, 23, 26, 30
3	Angle of bottle opener	Degree	65	36
4	Freezer temperature	Degree	0 to - 30	20
5	Adjustable amount of leveling	Increments	9	1
7	Adjustable amount of dosage	ml	5 to 50	2, 4, 45
8	Length of dosage tube in the bottle	mm	100 to 120	42
9	Difference in length of tube for leveling and dosage	mm	5	18, 39
10	Rigid caster wheels	Binary	Pass	16
11	Disgorgement bowl fit in dishwasher (height)	mm	<300	6
12	Height of working surface	mm	900	11, 31
13	Closed container for expelled lees	Binary	Pass	7
14	Disgorgement bowl withstand force	Bar	6	8
15	Materials complied with food regulations	Binary	Pass	6, 14
16	Avoid loosing CO_2 during leveling and dosage	Binary	Pass	19
17	Working height of bottle opener	mm	1100	11, 32
18	Analog adjustment of dosage	Binary	Pass	2, 9
19	Possible to dismount the disgorgement unit	Binary	Pass	6, 38
20	Freezer capacity	Bottle	10	17, 46
21	Able to open up the disgorgement unit	Binary	Pass	6, 38
22	Fixture stabilized bottle while turning	Binary	Pass	33



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Implementation

HOW TO SELL IT?

At this stage the product has been defined in detail and it is ready for the first prototype to be produced. The following step is to create a business model of how to implement the product into the market and define a business plan in order to be a profitable business. Distribution channels, managing resources, marketing strategies, turnover time expectations, and other financial related factors are evaluated in this chapter.

Marketing potential

Internationally, the production of sparkling wine has been increasing and continues to see strong year-to-year growth. **vino|studio** *targets small wineries in Northern Europe, however, there are several other opportunities for expansion. (Graybill, 2020)*

POTENTIAL IN OTHER EUROPEAN REGIONS

The sparkling wine market in the United Kingdom has been increasing in the last decade and by 2018 there were 175 wineries operating in England. This was an increase of eleven wineries compared to the previous year. (Wunsch, 2019a) The amount of vineyards, on the other hand, was 672 in 2018 (Wunsch, 2019b), some of these could potentially start producing on their own if it became a good business case.

Germany offers great potential as well, as it is one of the biggest Central European wine producers with over 500 wineries. (German Wineries & German Wine, n.d.)

POTENTIAL IN OTHER CONTINENTAL REGIONS

Even though Europe holds the biggest market share, the remaining 22% of wine producers could also be potential buyers of the product, as seen on illustration 4.2 from 2016. (TechNavio, 2016)

Ill. 4.2

Ill. 43

POTENTIAL IN LARGER WINERIES

Big wineries around the world has the equipment to produce more than one million liters of wine a year. Nonetheless, as previously mentioned in 'Users', they have the demand for producing small batches for testing before initiating the big production settings. In this case, **pop.** BUBBLE MAKER has an opportunity to be very valuable. Additionally, the aspect of including tourists in the production could just as well be used in big wineries open to the public, as many wineries choose to add tourism services related to wine. This is done for several reasons, such as marketing, competitive advantage, strengthening of tourism, strengthening of the cultural identity of the product, sustainable development, local and economic development, as well as increasing the consumption of local wine.

Business model

To get an overview of the further business Business Model Canvas was used (Osterwalder and Pigneur, 2010). The model helped understand who the customers were, how to reach them as well as how they will benefit from the product.

CREATING VALUE

The customer segments are, as earlier mentioned, small commercial vineyards. However, there is an opportunity in expanding the market to mass producers as test equipment, to hobby winemakers or to cider production. Through the value proposition **vino|studio** focuses on creating equipment that optimizes time and space while giving the winemaker a feel of professionalism during the sparkling wine production.

CHANNELS AND CUSTOMER RELATIONSHIPS

Wineries, no matter the size, often buy their equipment from distributors such as Vigo or InVIA1912, therefore establishing sales channels through these companies is essential. The new generation of northern wine regions do not have centuries of experience like the traditional wine regions. Therefore, they are learning by doing and learning together. There is a willingness to share experiences between the small commercial vineyards which **vino|studio** can take advantage of, in order to create awareness of the product. By including brand ambassadors, **vino|studio** hopes to reach out to many small wineries, as well as vineyards that are not yet producing their own sparkling wine, thus increasing the distributors sales. Additionally, participating in relevant wine fairs such as Sitevinitech, helps to establish customer relationships and makes it possible for potential customers to see the product before buying.

PARTNERSHIPS AND REVENUE

The freezer is expected to be outsourced therefore is there a need for a key partnership with a freezer manufacturer. Other partners are needed for resources within software development and other sub-suppliers. **vino|studio** expects to produce the marketing material and continue development, prototyping, and testing, as well as optimizing the product for manufacturing.
The revenue is created when the product is sold at a fixed price depending on the quantity. The contribution margin for the distributor is negotiated by **vino|studio** and the distributors at the beginning of the partnerships.

Customer Segment

Small commercial wineries.
Mass production wineries - for testing.
Cider production.

Value Propositions

Time and space optimizing.
Feel professional.
Improve quality.

Channels

Distributors
Advertisement in wine magazines.
Wine equipment trade fairs
Brand ambassadors.

Customer Relationship

Personal assistance.
Phone call and online partnership through a distributor.

Revenue Streams

Product sale - Invoice orders by distributors.

Key Resources

Office space.
Storage space.
Design engineers.
Network.

Key Activities

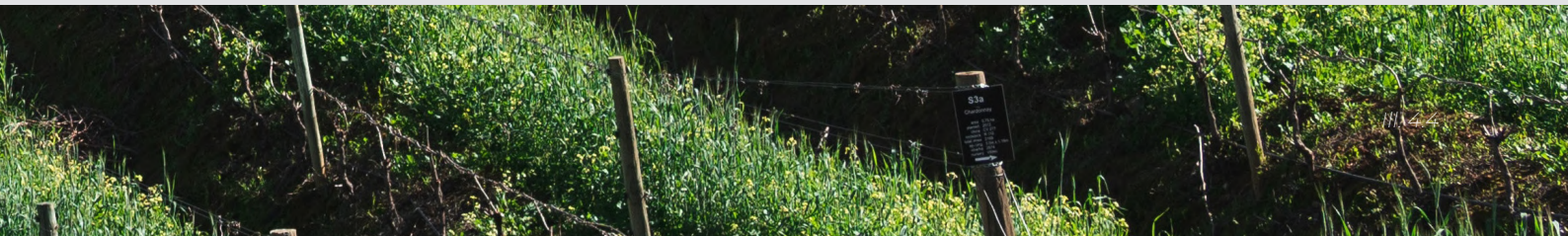
Continue development.
Prototyping and testing.
Marketing and distribution.
Production.

Key Partnerships

Freezer manufacturer.
Sub-suppliers.
Investors.

Cost Structure

Human resources.
Production.
Distribution.
Facilities.



Business plan

Wine has been produced for thousands of years, wine equipment has been evolving non-stop and as a consequence, it has created a very competitive market for introducing new products. Standing out from the crowd and having the correct selling point is therefore essential.

BUDGET OF SMALL WINERIES

As seen in the Design Brief the maximum budget is around 60.000 DKK. Because of this, it was highly relevant to keep the consumer price within this margin in order to assure the equipment will be accessible for small wineries.

COST AND SALE PRICE

An initial cost price of 14.259 DKK has been estimated considering; material price, production cost, and assembly workload. (Appendix 25) This cost estimation is expected to be reduced once a more thorough DFM is made, by reducing even more costs of assembly and production. Once defining the product cost, the contribution margin of **vino|studio** is added as well as the contribution margin for the distributor and sales taxes..

Sale price incl. VAT	**54.987**	**DKK**	**25%**
Sale price excl. VAT	43.990	DKK	
Distribution Margin %	8.342	DKK	39%
Contribution %	21.389	DKK	150%
Product Cost	14.259	DKK	

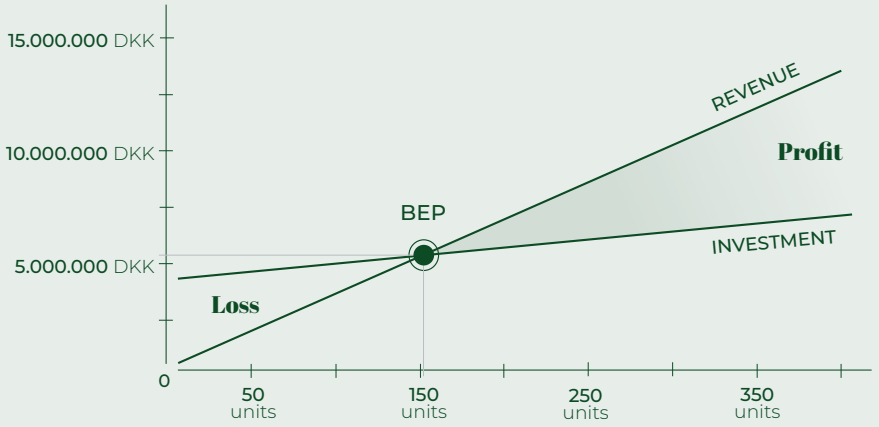
INVESTMENT

For the development of this project, an investment of approximately 4.490.000 DKK is needed. The investment will be obtained through a private investor, more specifically a venture capitalist. (McGowan, 2020)

Marketing	350.000	DKK
Development salary	2.160.000	DKK
Prototypes	750.000	DKK
Transportation/ Shipping	150.000	DKK
Tools	900.000	DKK
Miscellaneous	150.000	DKK
Software Developer	30.000	DKK
TOTAL INVESTMENT	**4.490.000**	**DKK**

BUDGET

The budget is based on the size of the investment, the fixed and variable cost, and the forecast of sales per year (see appendix 26). As shown below, it is expected to break even after selling 152 units (BEP).



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COMPETITOR PRICE ANALYSIS

As mentioned earlier, the closest competitor, Vigo *Semi-automatic disgorging, dosing, & topping-up machine* costs 46.000 DKK. The neck freezer suitable for its capacity costs 34.400 DKK ex. VAT. This means the overall price of the operation for the four processes is 80.400 DKK, with a bottle output of 150 bottles / hour.

pop. BUBBLE MAKER has a sales price of 54.987 DKK, with a bottle output of 120 bottles/hour, resulting in a highly competitive product against its closest competitor.

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Epilogue

FINAL THOUGHTS

“Too much of anything is bad, but too much champagne is just right.”
– F. Scott Fitzgerald, American novelist

Conclusion

The aim for this product has been to make a product for the professional winemaker that reduce time on the last stages of the second fermentation, ensures a consistent quality, and instills a feeling of professional pride. Through investigation of sparkling wine production, it was clear, that there is a market for a product targeting smaller wineries as well as the fact that the market will only increase in the future as the climate changes will push traditional wine production further to the north.

The project was initiated by visits to vineyards in three different countries as well as online videos of hacks from all over the world. This helped gain insights and relevant requirements that needed to be included in a product to cope with the observed issues. As the Corona pandemic hit early in the process, visits to wineries was no longer an option and feedback on concepts had to be obtained in alternative ways. Luckily, through renders and storyboards, it was possible to effectively communicate the concepts in a way, where the winemakers could give feedback on the different concepts over the phone. The feedback was of great importance in the development process and gave confirmation that the product solved the issues the winemakers were facing in the production of sparkling wine. It especially gave insights about the user scenarios, production and economic requirements. Initially, the product was placed in the middle of the scale between a hack and an industrial equipment, however, during the development process, it shifted towards a more industrial product in both appearance and price.

Integrating the last four processes of the second fermentation into one product has been ambitious and a bit of a challenge. The result is **pop.** BUBBLE MAKER, an equipment that has neck freezing, disgorgement, leveling, and dosage close to each other, with an additional show element that changes the way the winemaker interacts with visiting tourists. It opens for a completely different kind of wine tourism and allows the tourists to customize their wine in collaboration with the winemaker and hopefully help boost the sale of wine.

Aesthetically, it fits in the winery as well as in the more homely wine shop setting. All the materials are made in food grade materials, which is a significant improvement compared to the hacks they use today. All exposed surfaces can either easily be wiped off or put in the dishwasher. The product gains innovative height from the functionality of the turning freezer and inclusion of tourists, both when they are bystanders and when they actively participate. However, the most important thing is that it becomes easier for the winemaker to make sparkling wine and that the process is done with a feeling of professional pride. Additionally, **pop.** BUBBLE MAKER is a highly competitive product with a bottle output of 120 bottles/hour and a sales price affordable for small production wineries. Even though the product is designed with the small commercial wineries in mind, the product can also be used by big commercial wineries for testing small batches and for showing wine tourists.

It has been highly rewarding to immerse into the world of small commercial wineries. It is not common to meet such passionate people, who work hard every day because they love what they do, regardless of the economic benefit.

Reflection

PRODUCT

Further development

pop. BUBBLE MAKER is a proof of concept and the intention has been to make it plausible that the product can work in real life. When that is said, there are probably things that need to be optimized and constructed differently.

Materials and production

There is room for improvement in relation to the materials and production, as there were many insecurities, which made estimating the cost price a challenge. More experts should be consulted in each process, especially in the freezer, which would be the next step in the further development. After that, a dialogue should be initiated with the suppliers of the injection molded parts, to discuss price and optimizing the construction. As the frame structure has to withstand the load of the product, it is important to make sure that it can actually do so.

Prototype and testing

Making a working prototype for testing the user scenario and interaction is a big part of the further development, especially in this project where testing, along the development, has not been an option. Prototyping is needed to test many of the features in regards to the construction as well as the interaction, for instance the tube connector that helps to adjust the length of the tubes for leveling. This feature ended up being a semi-standard solution, so more tests should be developed with the corresponding production context to truly evaluate if this is the best solution.

Selling separately

During the understanding phase, a small portion of the interviewed vineyards already had a neck freezer in their production. Therefore, it would be convenient to explore the possibility of selling the equipment without the freezer.

PROJECT

Corona

In the middle of the concept development phase, the worldwide COVID-19 hit and it had a direct impact on the project. Several visits to vineyards, where it was expected to get more knowledge and inspiration for the project, were canceled. Despite this unfortunate situation, the team tried its best to gain knowledge in other ways by contacting the vineyards via phone calls, emphasizing the importance of receiving an answer. Most of the contacts were good to reply, however, the amount of information gathered was considerably reduced compared to what would have been achieved in a personal visit.

An advantage of the Corona situation, was the improvement of the graphic representation of the concepts. As they needed to be understood via email, an extra effort was put on them and it paid off. None of the contacted winemakers had trouble understanding the concepts and giving feedback. On the other hand, the renders limited their perception of the appearance, as it is hard to imagine something else once the representation looks realistic. The testing stage of the projects was also affected as it was supposed to take place the week the University workshops closed. It was hard to come up with a solution to replace them, however, all the tests where no external help was needed or which did not demand specific knowledge, got tested by the team itself. If the situation had been different, many of the interactions would have been tested by a winemaker, but luckily, the nature of the project made testing with an actual user not crucial.

Final thoughts

It was a challenge to develop such a complex product, and all team members were pushed out of their comfort zone. As a final master thesis project, it is believed that all aspects of the profession were accomplished. It gave great motivation to get such positive feedback from the vineyards throughout the process, including their interest in investing in what they called “a product that really stands out on the current market”.

Literature

Abitenda.it. (n.d.) *Champenoise Method.* [online] Available at: http://www.abitenda.it/SitoEnglish/boting.htm [Accessed 15 April 2020].

Andersen, J., (2005). *Lifting, Pulling, And Pushing.* [online] At.dk. Available at: https://at.dk/en/regulations/guidelines/lifting-pushing-and-pulling-d-3-1/ [Accessed 22 May 2020].

Becker, J. and Toldam-Andersen, T., (2018). *The wine industry in Denmark.* In: VitiNord2018. Copenhagen: Danish Vine Association.

Bentzen, Jan & Smith, Valdemar. (2009). *Wine production in Denmark Do the characteristics of the vineyards affect the chances for awards?.* University of Aarhus, Aarhus School of Business, Department of Economics, Working Papers.

Enonetexpo.com. (n.d.) *Impianti Refrigerazione.* [online] Available at: https://www.enonetexpo.com/?p=dettaglio-prod&id=749 [Accessed 16 February 2020].

Graybill, S., (2020). [online] *Bevindustry.com.* Available at: https://www.bevindustry.com/articles/92789-growth-driving-trends-impacting-wine-category [Accessed 21 May 2020].

INERIS, (2017). *SMMA: An Alternative To Polycarbonate.* [online] Substitution.ineris.fr. Available at: https://substitution.ineris.fr/en/news/smma-alternative-polycarbonate [Accessed 23 May 2020].

Karlsson, P., (2017). *Disgorging Sparkling Wine - How To Get The Yeast Out Of The Bottle.* [online] BKWine Magazine. Available at: https://www.bkwine.com/features/winemaking-viticulture/disgorging-sparkling-wine-get-yeast-bottle/ [Accessed 15 March 2020].

KitchenOne.dk. (n.d.) *Bredemeijer Champagneprop.* [online] Available at: https://www.kitchenone.dk/produkt/bredemeijer-champagneprop/ [Accessed 9 May 2020].

Lelarge, T., (2020). *Price Quotation Disgorging Machine Type DLV 1.* [email].

Linak.com. (n.d.) *Production Ergonomics.* [online] Available at: https://www.linak.com.au/segments/techline/tech-trends/production-ergonomics/ [Accessed 22 May 2020].

Lock, J., (2019). *Understanding Sparkling Wine Production Methods.* [online] Explore.flyingwinemaker.com. Available at: https://explore.flyingwinemaker.com.hk/wine-education/understanding-sparkling-wine-production-methods [Accessed 30 May 2020].

Maisons-champagne.com. (n.d.). *Dosage - Union Des Maisons De Champagne.* [online] Available at: https://maisons-champagne.com/en/appellation/stages-in-winemaking/preparation-for-shipment-many-years-later/article/dosage [Accessed 15 March 2020].

Marketresearchfuture.com. (2020). *Sparkling Wine Market Research Report –Global Forecast To 2023.* [online] Available at: https://www.marketresearchfuture.com/reports/sparkling-wine-market-6546 [Accessed 12 March 2020].

Marques, J. D. S., and Velazquez, J. (2019). *Why are wine producers in Spain moving their vineyards uphill?* [online] Euronews. Available at: https://www.euronews.com/2019/12/11/why-are-wine-producers-in-spain-moving-their-vineyards-uphill [Accessed 6 Mar. 2020].

Alderman, L. (2019). *Scandinavian Wine? A Warming Climate Tempts Entrepreneurs.* [online] Nytimes.com. Available at: https://www.nytimes.com/2019/11/09/business/wine-scandinavia-climate-change.html [Accessed 7 Mar. 2020].

McFadden, C., Lang, F., Shop, I. and Papadopoulos, L., (2019). *The Time-Tested Technique Of Welding, Its Types, Applications. [*online] Interestingengineering.com. Available at: https://interestingengineering.com/what-are-the-different-types-of-welding-and-which-is-best [Accessed 23 May 2020].

McGowan, E., (2018). *Private Investors For Startups: Everything You Need To Know.* [online] Startups.com. Available at: https://www.startups.com/library/expert-advice/private-investors [Accessed 23 May 2020].

Milwaukee Precision Casting, I., (n.d.). *6 Advantages Of Investment Castings* [online] Milwaukeeprec.com. Available at: https://www.milwaukeeprec.com/blog.html/2018/02/13/6-advantages-of-investment-castings/ [Accessed 23 May 2020].

Milwaukee Precision Casting, I., (n.d.). *Stainless Steel Investment Casting* [online] Milwaukeeprec.com. Available at: https://www.milwaukeeprec.com/stainless-steel-investment-casting.html [Accessed 23 May 2020].

Osterwalder, A. & Pigneur, Y. (2010) *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. Chichester: John Wiley.*

Pasternak, J. and Dahl, C., (2018). *Hvilken Højde Bør Køkkenbordet Have?.* [online] idenyt.dk. Available at: https://www.idenyt.dk/haven/blomsterhaven/kokkenbordshojde/ [Accessed 22 May 2020].

Patterson, T., (2011). [online] Available at: <https://winesvinesanalytics.com/features/article/83523/Succeeding-With-Sparkling> [Accessed 2 June 2020].

Puckette, M., (2016). *How Sparkling Wine Is Made. [online] Wine Folly.* Available at: https://winefolly.com/deep-dive/how-sparkling-wine-is-made/ [Accessed 15 March 2020].

Puckette, M., (2019). *What Are Cool Climate Wines?.* [online] winefolly.com. Available at: https://winefolly.com/tips/cool-climate-wine/ [Accessed 12 April 2020].

Saverglass.com. (n.d.) *Sparkling Wine.* [online] Available at: https://www.saverglass.com/en/catalog/sparkling-wines [Accessed 6 April 2020].

Schiessl, C., (2017). *All The Ways To Make Champagne And Sparkling Wine, Explained.* [online] VinePair. Available at: https://vinepair.com/articles/sparkling-wine-champagne-methods/ [Accessed 4 May 2020].

Schlack, L., (2019). *The History Of Sparkling Wine Includes Accidental Science And Exceptional Champagne.* [online] Wine Enthusiast. Available at: https://www.winemag.com/2019/12/02/history-sparkling-wine/ [Accessed 12 March 2020].

Signer, R., (2016). *Why Cool Climate Wines Should Be Your Go-To Bottles.* [online] VinePair.com. Available at: https://vinepair.com/wine-blog/why-cool-climate-wines-should-be-your-go-to-bottles/ [Accessed 12 April 2020].

Smithers, R., (2019). *Britons Drank Record Amount Of Homegrown Sparkling Wine In 2018.* [online] the Guardian. Available at: Sparkling Handbook 2018-2019. [ebook] Petaluma, CA: Scott Laboratories. Available at: https://scottlab.com/content/files/Documents/Handbooks/SparklingHandbook1819.pdf [Accessed 15 March 2020].

Striim, O. (2000). *Kreativ problemløsning og praktisk idéudvikling (2nd ed.).* Kbh: Gyldendal Uddannelse.

Tdd-grilliat.com. (n.d.) *DDV Eco.* [online] Available at: https://www.tdd-grilliat.com/en/2018/01/11/ddv-eco-2/ [Accessed 16 February 2020].

Tdd-grilliat.com. (n.d.) *DLV 1. [online]* Available at: https://www.tdd-grilliat.com/en/2018/01/11/dlv1-2/ [Accessed 16 February 2020].

TechNavio, (2016). [online] *Mms.businesswire.com.* Available at: https://mms.businesswire.com/media/20170614006068/en/592772/5/Sparkling-Wine-revised.jpg?download=1 [Accessed 23 May 2020].

Tiendainvia.com. (n.d.) *Disgorging Inox Pedestal*. [online] Available at: http://www.tiendainvia.com/en/disgorging/1930-pedestal-de-deguelle-inox.html [Accessed 16 February 2020].

Tiendainvia.com. (n.d.) *Disgorging Key*. [online] Available at: http://www.tiendainvia.com/en/disgorging/1931-llave-de-deguelle.html [Accessed 6 May 2020].

Ulrich, K. T. & Eppinger, S. D. (2012) *Product Design and Development*. 5. ed. London: McGraw Hill.

Vigoltd.com. (n.d.) *Neck Freezers*. [online] Available at: https://www.vigoltd.com/Catalogue/Disgorging-dosage/Neck-freezers [Accessed 16 February 2020].

Vigoltd.com. (n.d.) *Semi-Automatic Disgorging, Dosing, & Topping-Up Machine*. [online] Available at: https://www.vigoltd.com/Catalogue/Disgorging-dosage/Semi-automatic-disgorging-dosing-topping-up-machine [Accessed 16 February 2020].

Wineandbarrels.com. (n.d.) *Pulltex - Silicone Champagne Stopper. [online] Available at: https://www.wineandbarrels.com/shop/307-pulltex/3323-pulltex---blister---champagnestopper---silikone---sort/?gclid=EAIaIQobChMImLmJtPWm6QIVR8-yCh3WgACHEAQYByABEgK-FPD_BwE* [Accessed 9 May 2020].

WineFrog.com. (n.d.). *What Is Sparkling Wine?* [online] Available at: https://www.winefrog.com/definition/1138/sparkling-wine [Accessed 12 March 2020].

Winegrowers.info. (n.d.) *Disgorging And Topping Up*. [online] Available at: http://www.winegrowers.info/wine_equip/Sparkling%20wine/disgorging%20and%20topping%20up.htm [Accessed 16 February 2020].

Winegrowers.info. (n.d.) *Winegrowers Supplies - Neck Freezers*. [online] Available at: http://www.winegrowers.info/wine_equip/Sparkling%20wine/neck%20freezers.htm [Accessed 16 February 2020].

Winesolutionsunlimited.com. (n.d.) *Sapore: Champagne Stopper*. [online] Available at: https://www.winesolutionsunlimited.com/sapore-champagne-stopper [Accessed 9 May 2020].

Wineweb.com. (n.d.). *German Wineries & German Wine*. [online] Available at: https://www.wineweb.com/map_germany.cfm [Accessed 21 May 2020].

Wunsch, N., (2019 a). *Wineries In The UK 2000-2018*. [online] Statista.com. Available at: https://www.statista.com/statistics/302991/number-of-wineries-united-kingdom-uk/[Accessed 21 May 2020].

Wunsch, N., (2019 b). *Vineyard Numbers In The UK 2000-2018*. [online] Statista.com. Available at: https://www.statista.com/statistics/302981/number-of-vineyards-united-kingdom-uk/ [Accessed 23 May 2020].

Yeamans, B., (2018). *Understanding Disgorgement And Dosage*. [online] Alcoholprofessor.com. Available at: https://www.alcoholprofessor.com/blog-posts/2018/8/29/understanding-disgorgement-and-dosage [Accessed 15 March 2020].

Illustrations list

All illustrations not mentioned below is own illustrations. Illustrations found in Product Report are cited as PR Ill.

Ill. 0.4: https://www.archerysummit.com/visit/
Ill. 0.5: https://www.colourbox.com/
Ill. 1.1: https://unsplash.com/photos/cCVzi_mKovs
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AALBORG UNIVERSITY
DENMARK

pop.

BUBBLE MAKER

PRODUCT REPORT

MSc04-ID9
June, 2020

Ill. 1

Project title:	**pop.** BUBBLE MAKER
Team:	MSc04-ID9
Project period:	February - June 2020
Supervisor:	Louise Møller Haase
Technical supervisor:	Mikael Larsen
Number of pages:	25
Team members:	Lucia Villaverde Puchcariov Lykke Rosenkilde Petersen Stine Rønberg

Table of content

Sparkling wine

2

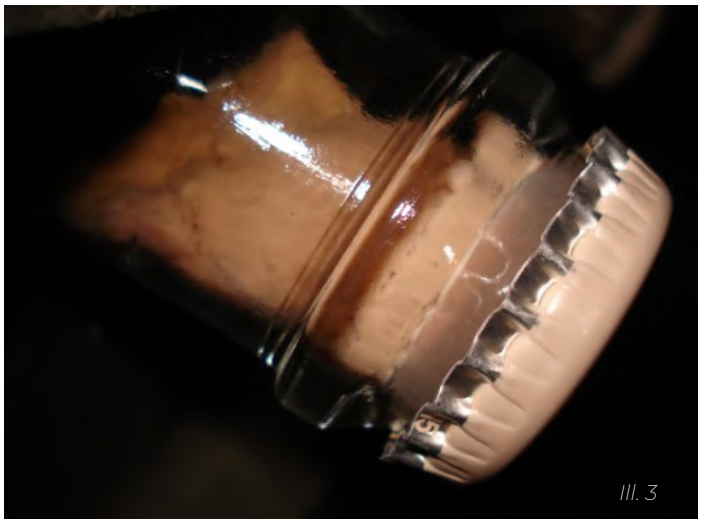
"Sparkling wines are a great addition to almost any winery's lineup of offerings for the tasting room, the wine club and beyond. But sparkling wine production is also a pain in the..."

Tim Patterson, award-winning wine maker and wine writer. (Patterson, 2011)

Sparkling wine production is not easy, specially for small and medium size winemakers. The second fermentation of the traditional method, which is the most common, is labor-intensive, require climbing a considerable learning curve and new equipment. However, the majority of the industrial equipment on the market is only suitable for mass production in big facilities. Smaller wineries often resort to homemade solutions, making them more prone to human mistakes, which can negatively affect the quality of the wine. To increase their profits, winemakers rely on showing their vineyards to tourists, but the homemade solutions do not look professional enough to do so, missing an opportunity to generate more sales.

All this is about to change, because **pop.** BUBBLE MAKER is here; a professional equipment designed for small and medium sized sparkling winemakers.

1



Ill. 3

Ill. 4

Ill. 5

3

Ill. 6

4

pop. BUBBLE MAKER allows you to develop the following crucial process of the second fermentation in a practical and professional approach. | **1.** Freezing the neck of the bottle: Makes it easier to remove the dead yeast, as it creates an “ice bullet”. | **2.** Disgorging: The crown cap is removed which causes the frozen lees to shoot out of the bottle with a pressure of around 6 bars. | **3.** Leveling, necessary for having the same amount of liquid in all the bottles. This is very important for ensuring quality in the wine. | **4.** Dosage: A mixture of wine and sugar is added to fill the bottle and define the type of sparkling wine, such as: sec, brut, doux, etc.

HOME MADE

hacks

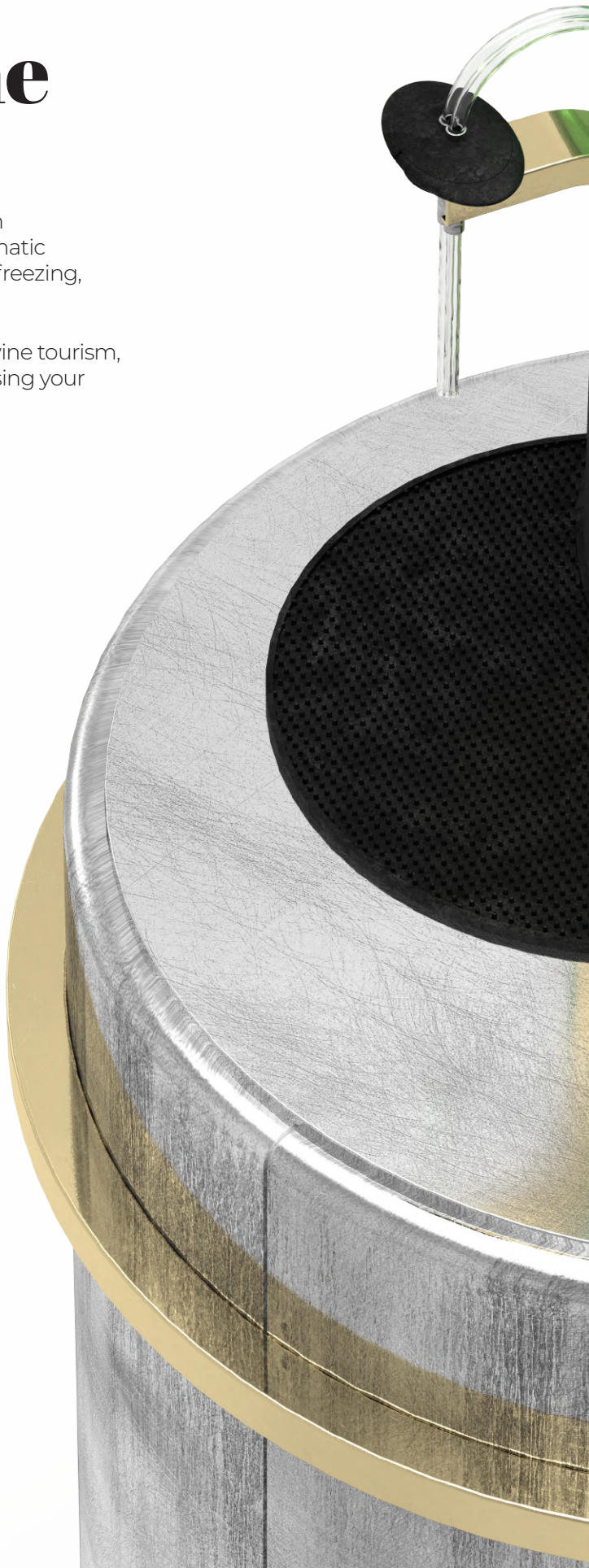
pop.

BUBBLE MAKER

The future of sparkling wine

pop. BUBBLE MAKER is the perfect equipment for an efficient sparkling wine production. With a semi automatic usage, it combines the four tedious processes of neck freezing, disgorgement, leveling and dosage.

If that wasn't enough, it also gives a new meaning to wine tourism, allowing your guest to produce their own wine, increasing your cellar-door sales and creating a great experience!

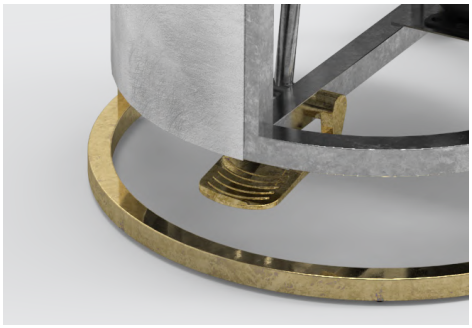


Design by vino|studio

Neck Freezing

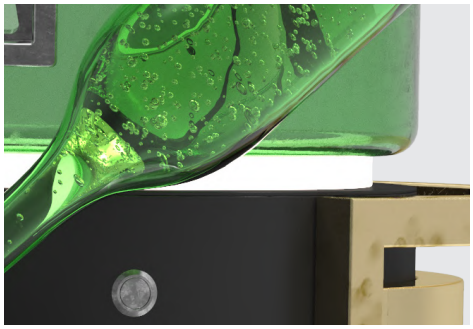
ADJUSTABLE TEMPERATURE

Freedom to adjust the temperature between 0 to -30°C.



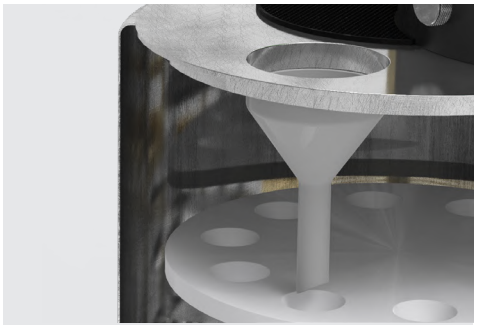
TURNING MECHANISM

Never forget which bottle is next. Hands free, foot pedal activated.



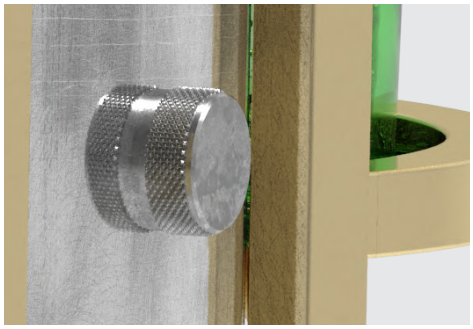
FAST CHECK

Ensure the lees are ready to be removed by using the light.



GLYCOL FUNNEL

Integrated funnel can be positioned for easy filling of glycol.



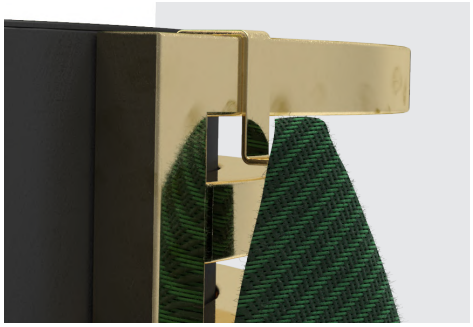
GLYCOL VALVE

Empty the gylcol tank by just opening the valve.

TRANSPORTABLE

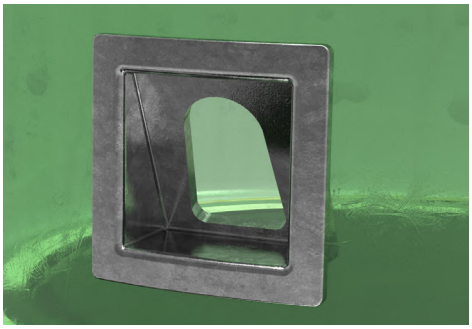
Just push it to an empty corner when not in use.

Disgorgement



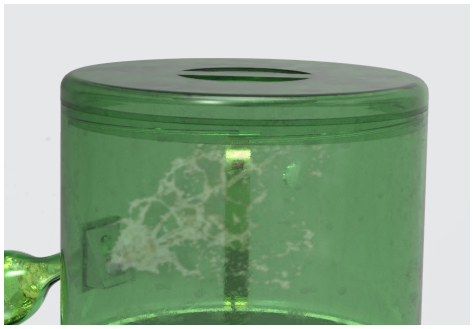
CLEANING CLOTH

Hook on frame allows the cloth to be close by for cleaning the neck.



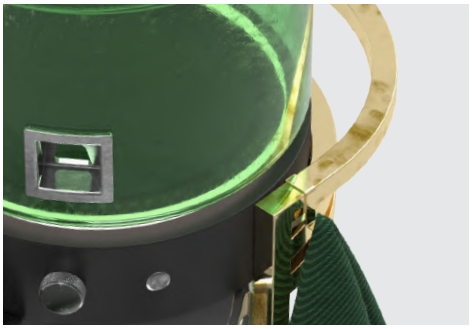
STAINLESS STEEL OPENER

Crown cap opener with integrated 65° angle to minimize spillage.



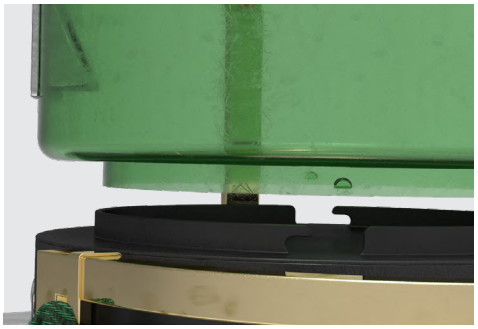
SHOW OFF

Tourists love to see the lees splashing! Every bottle disgorged will be sold!



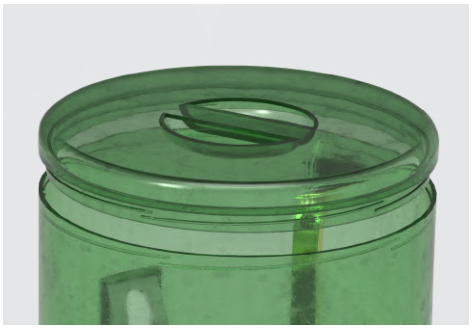
INTEGRATED LIGHT

Never miss out the splash by tuning on the light on the disgorgement bowl.



EFFORTLESS REMOVAL

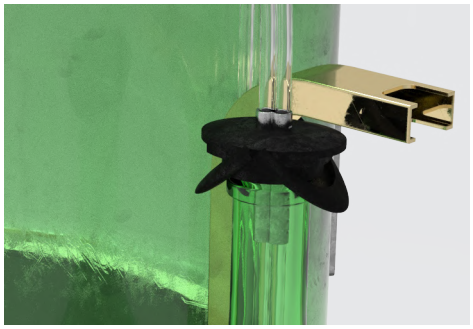
Turn the disgorgement bowl to unlock in it.



EASY CLEANING

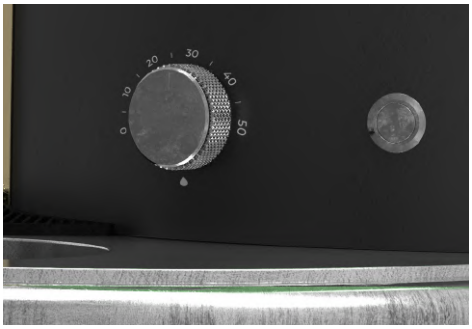
Do not worry about cleaning up the mess, remove the lid and put the bowl in the washing machine.

Leveling & Dosage



ADJUST LEVELING

Manual adjustment integrated in bubble stopper.



ADJUST DOSAGE

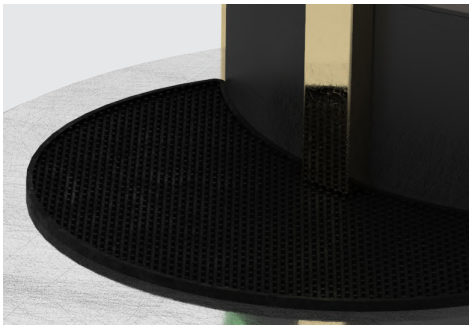
Are you a doux or a brut type? Set your dosage from 5 to 50 ml.

NO GUSHING

The dosage tube is always longer than the wine level to avoid gushing.

MULITASK

Be more effective by disgorging while leveling and dosage are running.



ANTI SLIDE SURFACE

Bar mat creates anti-slip surface and collect wine dripping from the tubes.

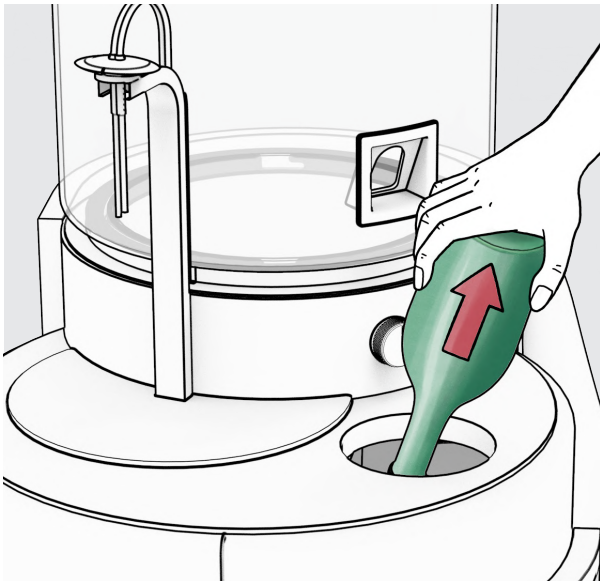
CONTAINERS

Store the dosage in your own bottles and avoid leftovers.

User scenario

| **1.** Take a bottle from the freezer and check if there is leftover lees using the light. | **2.** Clean the bottleneck with the cloth. You do not want to mix wine and the anti freeze liquid. | **3.** Disgorge and watch the lees explode. Quite cool, isn't it? | **4.** Place the open bottle on the bar mat at the top of the freezer. | **5.** Position the bottle stopper and adjust the leveling to the desired amount. This also seals the bottle, so no bubbles are lost.

1



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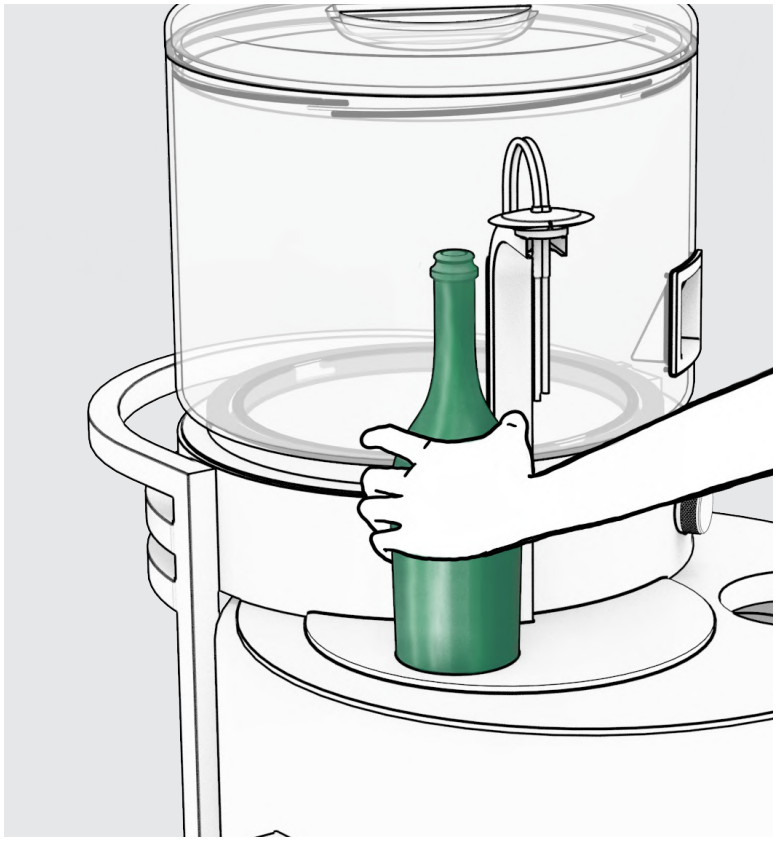

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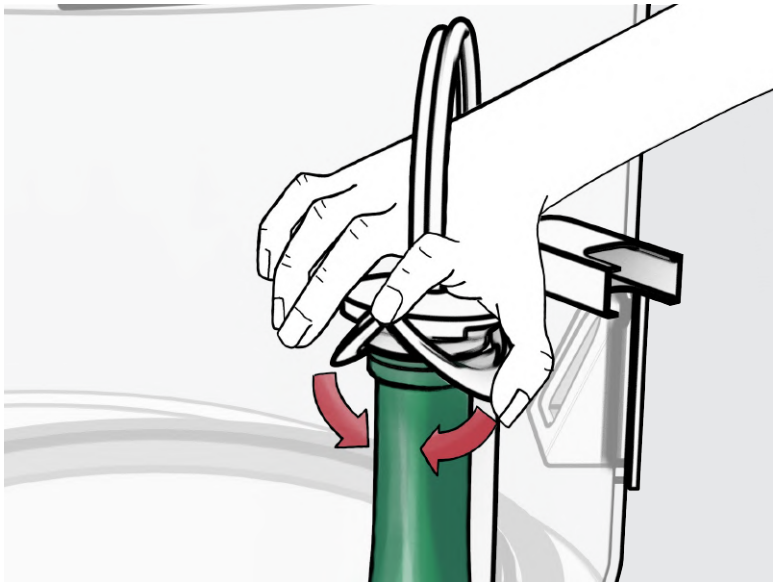

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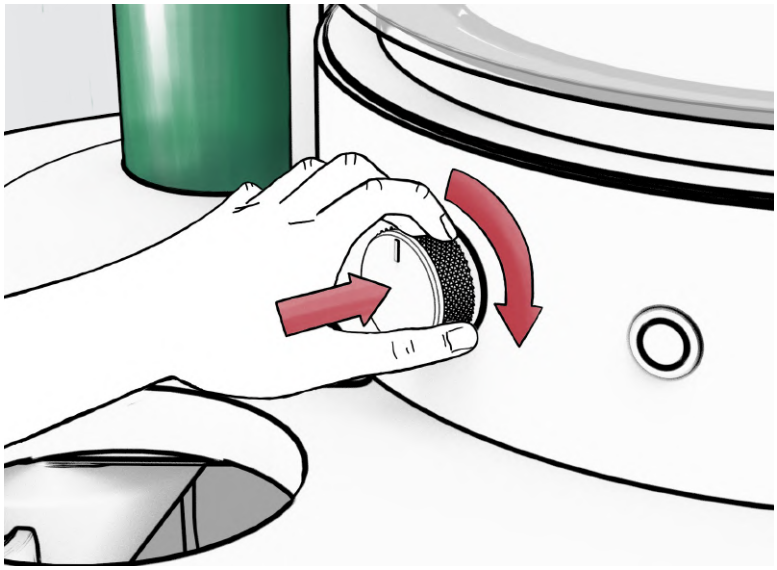

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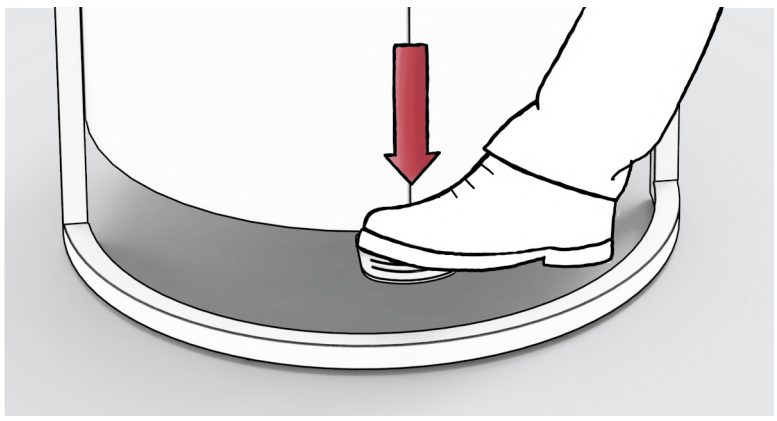
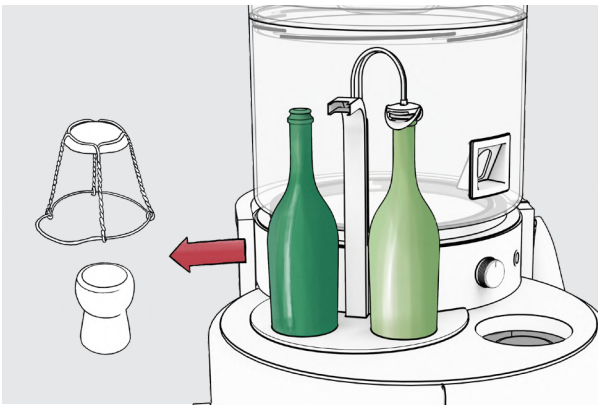


6. Adjust the desired amount of dosage and press the button to start the leveling & dosage processes. | **7.** You have time while this is happening, use it to place a new bottle in the freezer. Press the pedal to rotate the freezer, take up a bottle. | **8.** Repeat step 1, 2 and 3. | **9.** Switch around the bubble stopper from the finished bottle to the new bottle. The finished bottle is ready to be corked and stored. | **Repeat.**

8

9



Never before has a sparkling wine equipment had the opportunity to include tourist as in **pop.** BUBBLE MAKER. This will allow you to expand your sparkling wine production all year around every time you have guests.

Values

Having the different processes close by means the winemakers time is used more effectively and makes it easier to make sparkling wine. It also eliminates the dependency of an extra person helping.

pop. BUBBLE MAKER changes the way vineyards and wineries engage with tourists, by allowing them to actively take part in the production and customize their own wine.

The winemaker gains professional pride both when making sparkling wine alone or in collaboration with tourists.

Materials and Production

Only food grade materials are used, meaning that the equipment is approved to be used under authorities regulations. In addition, materials and processes were chosen in order to withstand the requirements of food production facilities.

The freezer is constructed in stainless steel and all the inner components are outsourced to a specialized freezer manufacturer company, which **vino|studio** has a key partnership with. 68% of **pop.** BUBBLE MAKER's components are standard in order to facilitate and reduce cost of maintenance.

Sparkling wine is enjoyed at the most meaningful events in life; a wedding, a new year, or at a graduation. It is viewed as something special, almost luxurious. Why not to have an equipment for producing sparkling wine that looks a bit luxurious in itself. For this reason, the frame is presented with brass color to catch the eye of the tourists. The cylindrical transparent bowl gives the visitors a 360 degrees visual of the exploding frozen lees in a bottle green see-through color.

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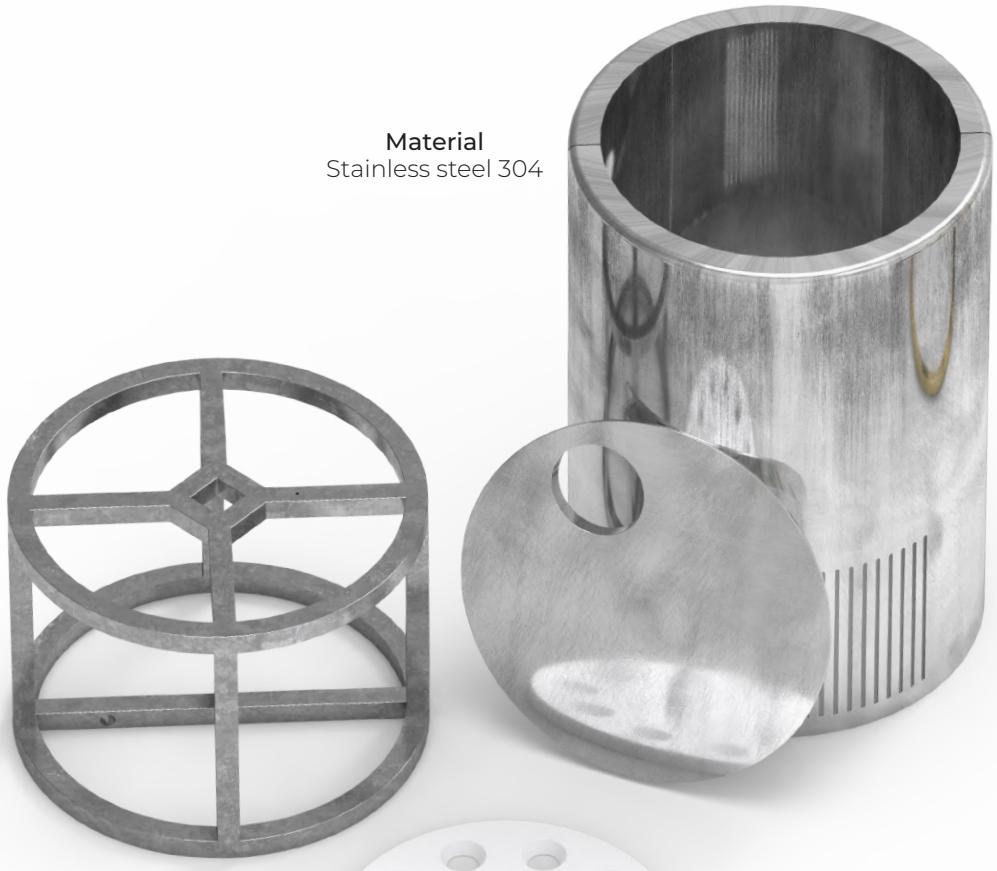
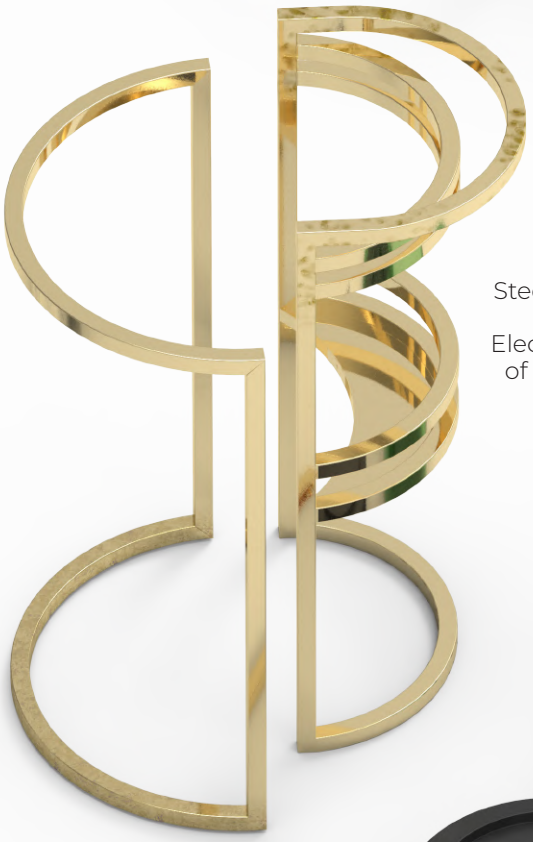
pop. BUBBLE MAKER has a product cost of
14.259 DKK per unit for the first batch



Material
Stainless steel 304

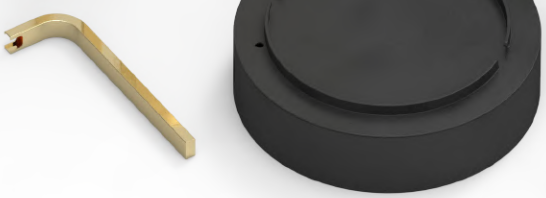
Material
Steel profile
25x25x1,2 mm
Finish
Two layers of anti-corrosive
paint and spray painted grey

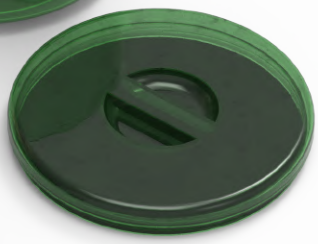
Material
Nylon
Production
CNC Milling



Material
Steel profile 25x25x1,2 mm
Finish
Electroplating + extra layer
of coating for protection
against corrosion

Material
SMMA
Production
Injection molding





Material
Steel sheet 0,8mm
Finish
Two layers of anti-corrosive
paint and spray painted black

Material
Stainless Steel grade 304
Production
Investment casting

UNDERSTANDING MARKET
Opportunity found

DESIGN
Product development

READY FOR PROTOTYPING
We are here

INVESTMENT
4.490.000 DKK

PROTOTYPE
Test phase
Evaluation and adjustments

FIRST YEAR
80 units sold

Ill. 6

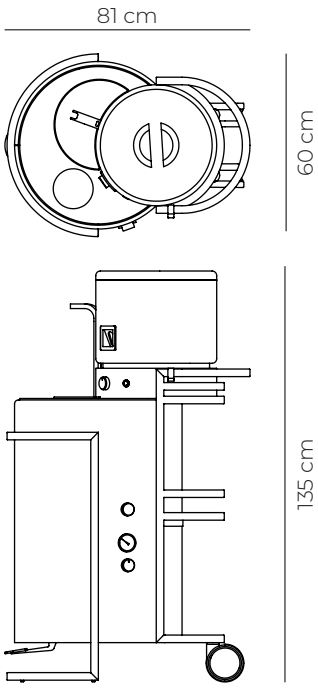
With the temperature increasing worldwide, the wine production is starting to migrate north, where countries have another advantage; grapes with a perfect balance between acidity and sweetness, ideal for sparkling wine. The new generation of northern wine regions do not have centuries of experience like the traditional ones. Therefore, they are learning by doing and learning together. There is a need for an equipment as **pop.** BUBBLE MAKER that allows new wineries to start on the right foot. There is also a willingness to share experiences between the small commercial vineyards which **vino|studio** supports, in order to create awareness of the best practices in sparkling wine. **vino|studio** creates a net of brand ambassadors, which reaches out to many small wineries, as well as vineyards that are not yet producing their own sparkling wine. Additionally, **pop.** BUBBLE MAKER will be participating in relevant wine fairs such as Sitevinitech, to establish customer relationships and make it possible for potential customers to see the product before buying.

pop. BUBBLE MAKER can be purchased at specialized wine distributors all over Europe. The distributor margin is negotiated by **vino|studio** and the distributors at the beginning of the partnerships.

An expected sales price starts at **43.990 DKK**
+ taxes with a 39% distribution margin

SECOND YEAR
Break even at 152 units sold

MARKET EXPANSION
UK and Germany =
+ 600 wineries
+ American market



1 : 25

Production method
Traditional / Champagne

Bottle type
750 ml

Bottle output
120 bottles an hour

Freezer capacity
10 bottles

Freezer range
0 to -30°C

Dosage range
5 ml to 50 ml
(5 ml increments)

PSU Certification
CE and UL (USA)

Pump flow rate
120ml/60sec

Working height
900 mm freezer
1100 mm disgorgement

Designers
Lucia Villaverde Puchcariov
Lykke Rosenkilde Petersen
Stine Rønberg


pop.
BUBBLE
MAKER