Analysis and economic viability plan for the substitution of plastic by residual organic material in packaging

Final Tesis

Student:
Juan Tomás Martínez Casasempere
Tutor:
George Horváth
José Vicente Tomás

Contents

1.Introduction

1.1 Keywords

Beer; Beer must; plastic; microbrewery; brewery; viability plan; brewing process; residual organic matter; reused barley.

1.2 Purpose of the project

Objective of the study: The present Final Grade Work aims to carry out an analysis and a detailed plan of the economic viability for the commercialization of a plastic substitute in which drinks are transported on the basis of reused barley from the brewing process. This project also aims to inform companies about the technique and advantages of using this product to close the material flow circle.

1.3 Motivation

This project seeks to analyze the possible implementation of a change in the packaging method of glass bottles or cans after the brewing process. The implementation of reusing the barley used will be studied, in order to eliminate the plastic from the production system, replacing the boxes with this material, in the case of glass bottles, and the packaging in the case of cans. Therefore, the viability of the project will be studied, economically with what initial investment and what are the steps to execute it.

Different beer producers will also be interviewed to find out their opinion and whether they are willing to undertake this investment.

The problem of pollution is well known, and within this great current and future problem for our planet one of the great factors is plastic. This material, most of which is obtained from the distillation of petroleum, is rarely recycled for different reasons that we will explain later. Plastic has caused, for example, the so-called "Pacific Islands" that, because of the ocean currents, all the waste that, for different reasons, has reached the sea, has formed a large amount of non-biodegradable garbage. The same is true of forests, cities, landfills....

Day by day you can see how the rivers, seas and land are with remains of this material. The motivation of this project is to alleviate these effects caused and showing how small changes can be made without the need for large investments. In this case the area of specialization for the reduction of plastic is in the beer sector, where the application of a

method to reduce the amount of use is feasible using a residual material obtained from the same production of beer.

The possible importance of the implementation of this method would cause positive externalities for the planet as well as possibly economic benefits through cost reduction, since it is no longer necessary to buy the packaging and a better brand image.

Alluding to this issue, there is a trend in which more and more companies try to change their methodology and get ahead of other companies obtaining a competitive advantage by offering a product to citizens with characteristics that are committed to their concerns about recycling and the use of plastic.

An example of this would be the Acciona brand, whose business lines are construction infrastructure, concessions, water, industrial... actively invests in promotions to reduce the use of polluting energies and asking for a climate change law from the government with the collection of signatures, diffusion in social networks...

The methodology of the project will be to observe the current problems of this sector focusing on the use of plastic and waste from the creation of beer, focusing on Spain and Europe. Subsequently, the analysis and debate on the viability of the method in the beverage industry will be carried out. Later, an analysis of the technology to be used and the hypothetical implantation in a microbrewery will be carried out. Finally, we will analyse the results obtained and reach conclusions about the method.

2. History and how it works today

2.1 History

Beer has existed for thousands of years and has ended up becoming the most popular and consumed alcoholic beverage in the world. This drink was born in the Middle East in the first settlements of Sumeria. From its creation it had a great importance since it is a great food source and a great source of sugar. Another factor was that when the water was heated and filtered it turned water into drinking water that was not.

For example, in ancient Egypt, the Pharaohs had access to wine, which at that time was the most prestigious drink, but the people without access to it drank beer, since it was a source of food and pure water. During this time beer was also used in funerary rituals and to accompany the deceased on their way to the divine.

The use of this drink spread towards the south of Russia and later towards the West and North of Europe being Armenia, Bohemia, Germany, Ireland and United Kingdom.

During this time beer was brewed in small quantities and was a household chore. It was this way since the beer could not be conserved and it was necessary to consume it soon after making it. Beer was also established in monasteries where it was drunk for its nutritional reasons and where the sugar in the drink helped to alleviate periods of fasting.

To begin to preserve the beer for a longer time was kept in caves with ice but even so occasionally bitter or spoiled.

In the next stage the glass began to appear. When the glass became the container where the beer was served, the color of the beer began to gain importance, the purity, the gas... Specifically at this time, in Europe, was important the light color of it, and the bubbles (type of beer Pilsen). In Ireland, on the other hand, the Guinness brand opted to stop brewing different types of beer and to brew a single type of black beer.

In 1860 a Frenchman named Pasteur realized that a lot of beer was wasted because it was bitter and he realized that yeast was a living organism and not a chemical as was believed at the time. He studied and observed that with a rapid boiling the bacteria were eliminated and a greater hygiene in the same one was gained. This is how pasteurized beer was born and it was easier to store it without risks.

2.2 National

In Spain the beer was not well seen since it was seen as a product of the Nordic people and the area of flandes, and the people of that region in Spain there was hatred. For example in the theatre beer was always put in ridiculous contexts and poets like Lope Félix de Vega Carpio referred to it as the urine of a sick horse, in the Spanish golden century in the play "Pobreza no es vileza" (Poverty is not vileness).

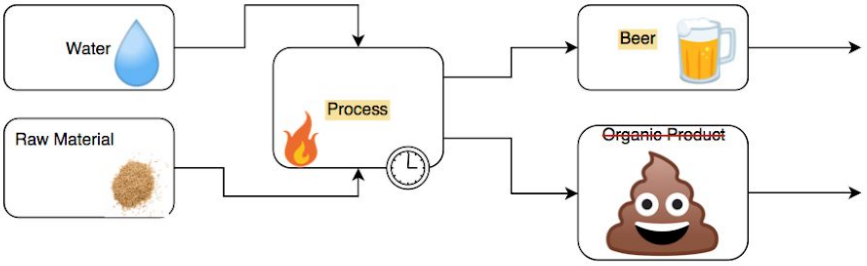
2.3 Current events

Today, the brewing industry is all over the world with a great variety of types of beers, brands, flavors ... Despite the large number of brands are mostly integrated in a few companies that have great power over the

market. With these brands live the so-called "microbrews" where thousands of breweries produce beer experimentally, with a high quality but lower volumes therefore with a higher cost per unit.

3 Problem explanation 1: Use of plastic packaging in the beverage industry.

3.1 Simplified manufacturing process



For many years in the alcoholic and non-alcoholic beverages industry it has been common to use plastic as a material both for packaging and for the packaging of bottles/cans. An increase in consumption would have a more serious environmental impact.

The reason why plastic is used is the low price of raw and secondary materials used to produce and store products. Plastic in particular has a very versatile use, because of this virtue it is used in many circumstances.

The low price of materials therefore means that producers do not pay the efficient price for the products. For this reason there are external costs that materialize in the form of plastic discharges, frequently discharged into oceans and landfills.

Focusing on packaging, we observe how, for example, the packs of units are used in order to keep them together. This single-use plastic causes a lot of contamination.

There is a method by which the amount of plastic in the rings for 6 can packs can be reduced. The method consists of using the barley used in the manufacturing process, adding the other parts of the cereal and other materials in smaller quantities, as we can see in your patent: US20180016750A1. In this way they manage to create rings resistant enough to keep the pack together. This product is also biodegradable and in the event that it reaches the sea decomposes and can be food for fish or fertilizer for the field given its properties rich in vitamins. This avoids the use of plastic in the distribution of packs of 6 of 0.33l each. The company Saltwater Brewery located in Delray Beach (Florida, USA), which holds the product patent, uses the method on the one hand as a marketing campaign, good brand image, cost savings because there is no need to buy raw materials for packaging ...

3.1 Process

Its manufacturing process is simple:

Step 1: When the beer is finished, the cereal residue is left to dry, in this way it loses moisture up to %.

Step 2: This waste is joined with the stems and parts of the cereal not used in the process. An oil-repellent chemical and a water-repellent chemical are also applied. Therefore the product remains approximately 87% of the weight is the pulp ground along with the others of the cereal. 2.7% by weight is alkyl ketene dimer. 0.8% is perfluoro alkyl ethyl phosphate.

Step 3 after joining everything is put into a press where it applies pressure and heat to leave it fixed with the desired shape.

Step 4 Then the edges are trimmed to make it aesthetic and perfectly functional.

Step 5 Disinfect the product.

The final result is, as can be seen in the image, a pack of 6 rings resistant and fully fulfilling its function.

Other companies have already started to change their 6-ring packs for other methods of joining the cans. The first company on a global level is the Mexican company Corona where it has replaced it with a pack very similar to the Saltwater brand being plant based. Another company is the Danish Carlsberg where he changes the method and manages to join the cans with a glue where when turning the cans is broken.

The problem with this method is that the waste produced by the creation of the beer is not recycled, in addition to adding a new material to the manufacturing process. Therefore this method used by the brand Carlsberg does not fit our purpose which is to combat both problems.

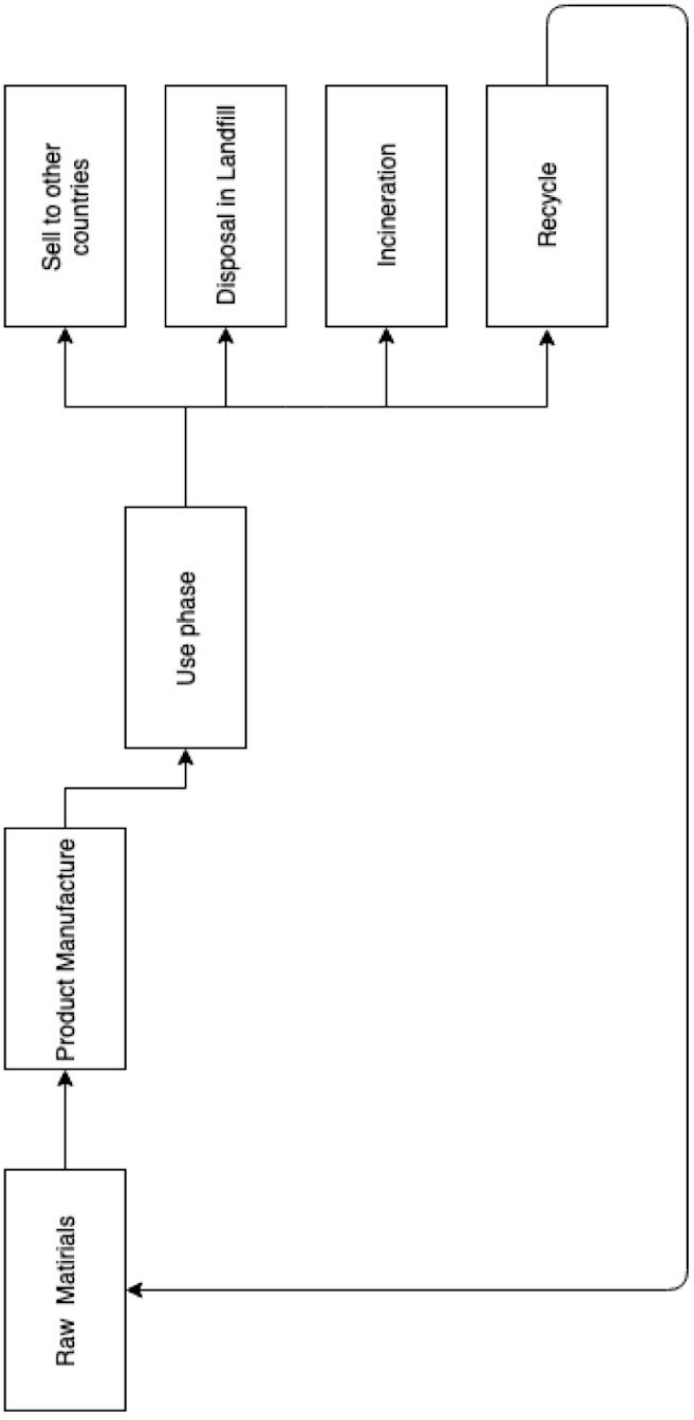
The idea of the project is to extend the usefulness of this idea and analyze its feasibility. The hypothesis of the project at this point is the possible application of this method for other types of substitute wrappers and for boxes in case of bottles or bottles.

For a better understanding of the reason/motivation for the creation of the product we will discuss how to treat waste in your economy:

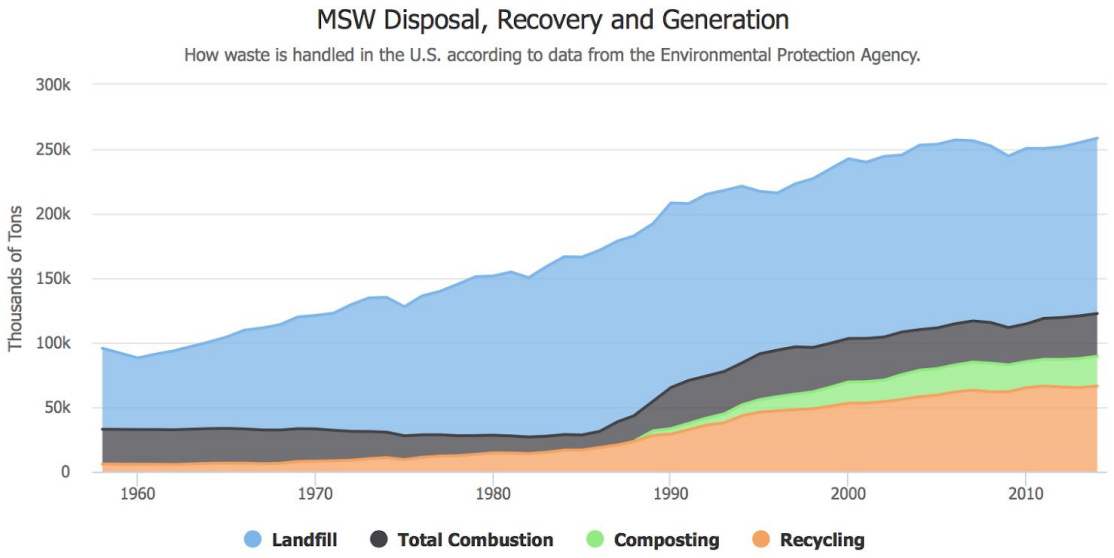
In the U.S. economy until the early 1970s, solid and liquid wastes were disposed of in the ocean, from residential and industrial sources as well, including heavy metals, industrial products and construction debris.

The following graph shows the life of plastic from how it is created to what happens to it after use.

3.2 Plastic Life Chart



The graph below shows the change in landfill composition with marine disposition, recovery and generation.



In the graph you can see 50% of the garbage goes to the many landfills they have. The problem with this method of accumulation is that it has a very high environmental effect, such as the impact on the landscape, land use, odours and gases that escape, and because of rain the heavy materials can be transferred to the soil and water of the region and contaminate them. Just as old landfills can also be dangerous (e.g. generation of methane and other flammable gases/explosives).

From the point of view of society, landfills in general carry an unknown risk. The main cause is the exact composition of the deposited discharges is not known. Although some of the problems and negative effects of landfills are already known today, and despite having seen the negative consequences of the different risks associated with landfills, the affected communities often choose to do nothing, because the costs of solving it can be prohibitively great.

The other half is divided between recycling (25%) which is a percentage with an upward trend and other methods.

The reason for this percentage is due to the different problems that recycling currently has: The cost of the process is high and the process of separating the different types of materials requires a high proportion of manual work. The lack of markets for secondary materials is also an important factor.

Other methods such as incineration, which is used due to the low cost of the process, have environmental consequences such as the release of chemical and harmful substances for both humans and the environment.

In any case, quantities of plastic and waste continue to reach the sea. There are three main reasons for this:

-When the garbage is transported, the plastic, given its lightweight, can fall in the wind and go to the sewage system where through it it it will go directly to the sea.

-Something similar happens with the garbage we throw in the street where rainwater and wind carry the plastic to rivers and sewers and therefore reach the sea without being treated and recycled.

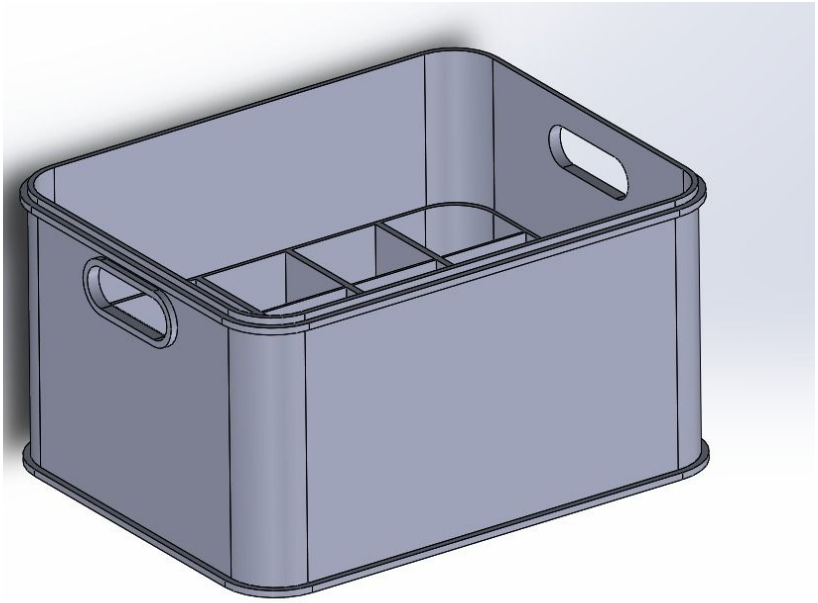
-In these cases, as they are too small to be filtered by sewage plants, they reach the sea and end up being food for small species that in some cases are in our food chain.

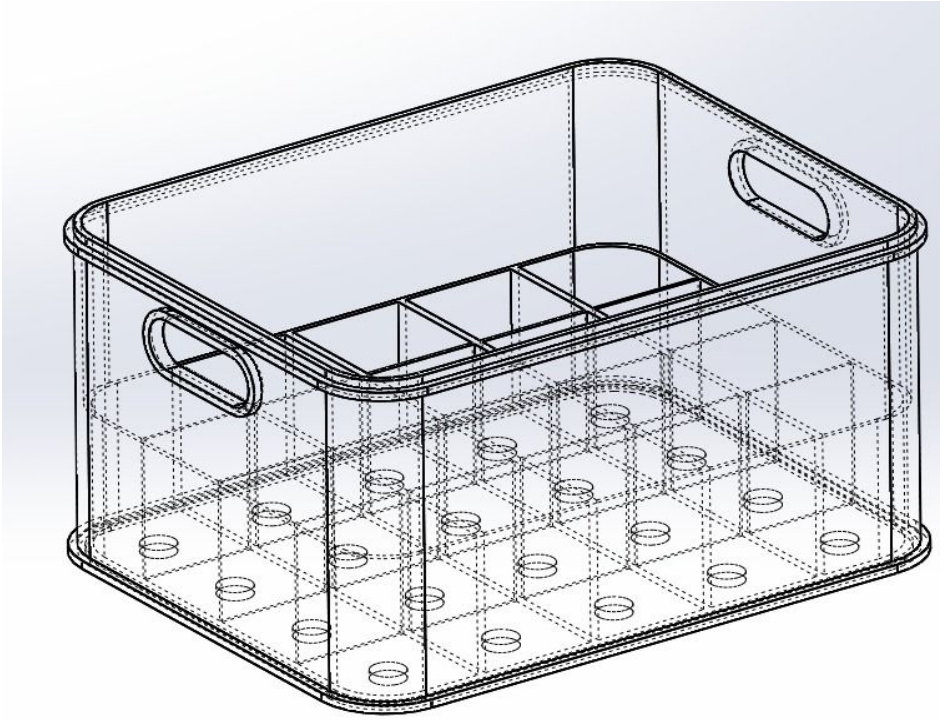
For the brewing sector, plastic is mainly used in the storage, packaging and distribution of beer. That is to say, it is the packs of rings, the boxes that transport the beers in the trucks, the plastic films that when heat is applied to them adhere to the containers keeping them united, in the case of glass bottles to avoid that they collide between them.

The use of this material previously mentioned in the case of rings would be applicable for all these types of packaging adapting the production process. Therefore we would apply the frontiers of use of the material giving it more utility.

The change in this section for the previous cases would be, the rings of 6 by rings of 6 with this material whose appearance would be as in the image in the point 3.1 process.

The boxes where the bottles of beer are transported by mountable boxes of this material, where after joining the different pieces it would be possible to use them and in the place of destination of the merchandise to discard them (or to sell them for food or fertilizer), this way we will avoid having to return the plastic boxes and to have them stored.

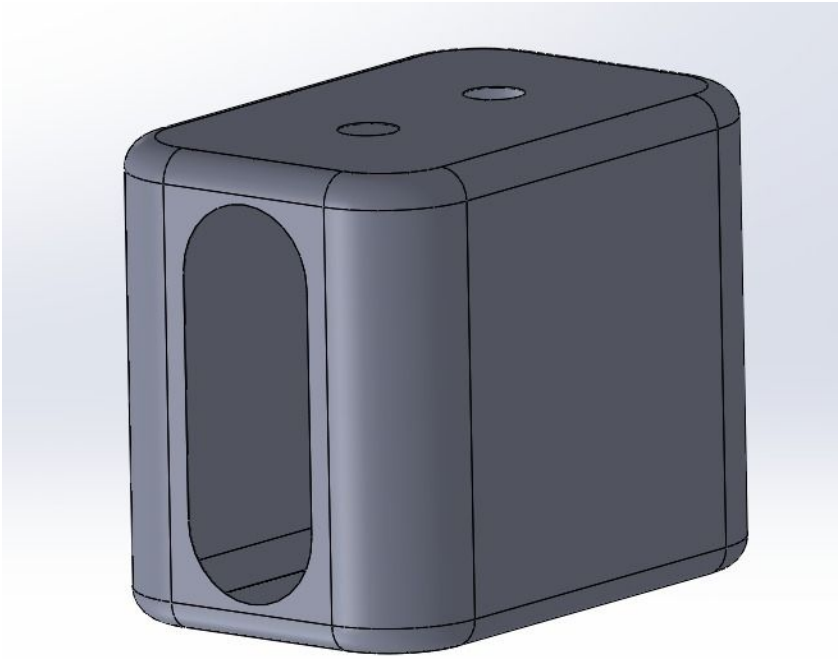




These boxes would be thicker than the current plastic, in addition to having a slot to fit on top of each other,(this simulation and all the others are carried out by a colleague of the valencia

polytechnic university of the degree of Industrial Design).Let's take an example for the previous case, a brewery exports its product to a country of the European Union, the plastic box bearing the name of the manufacturer printed on the side has to be stored, and in addition it can not be reused to transport other brands in addition to the price of the box. Since the glass that arrives and is consumed but not returned to the manufacturer for reuse but is treated in the country of destination, this box becomes a problem. In the case of applying the method the problem disappears either by simply throwing the box in the trash or using it for other purposes as fertilizer for the field given its properties.

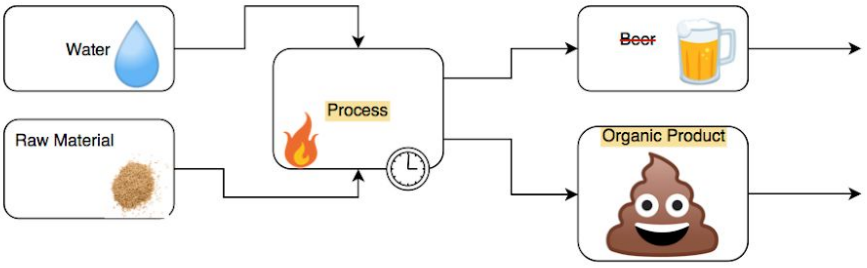
For the case of plastic films that wrap the cans through a process of applying heat, it would be to replace it in the form of a box with a structure more similar to cork or cardboard that would have the same function of subjection for transport and could also put the mark.



The glass bottles are transported in a method very similar to the bottles but adapted to the size but in the case that two bottles are sent will be sent for example a bottle opposite the other and with two rings adapted and joined to prevent mobility and impact between them.

4 Problem explanation 2: Use of production residues

4.1 Simplified matter flow diagram



In the following section we are going to study the flow of materials

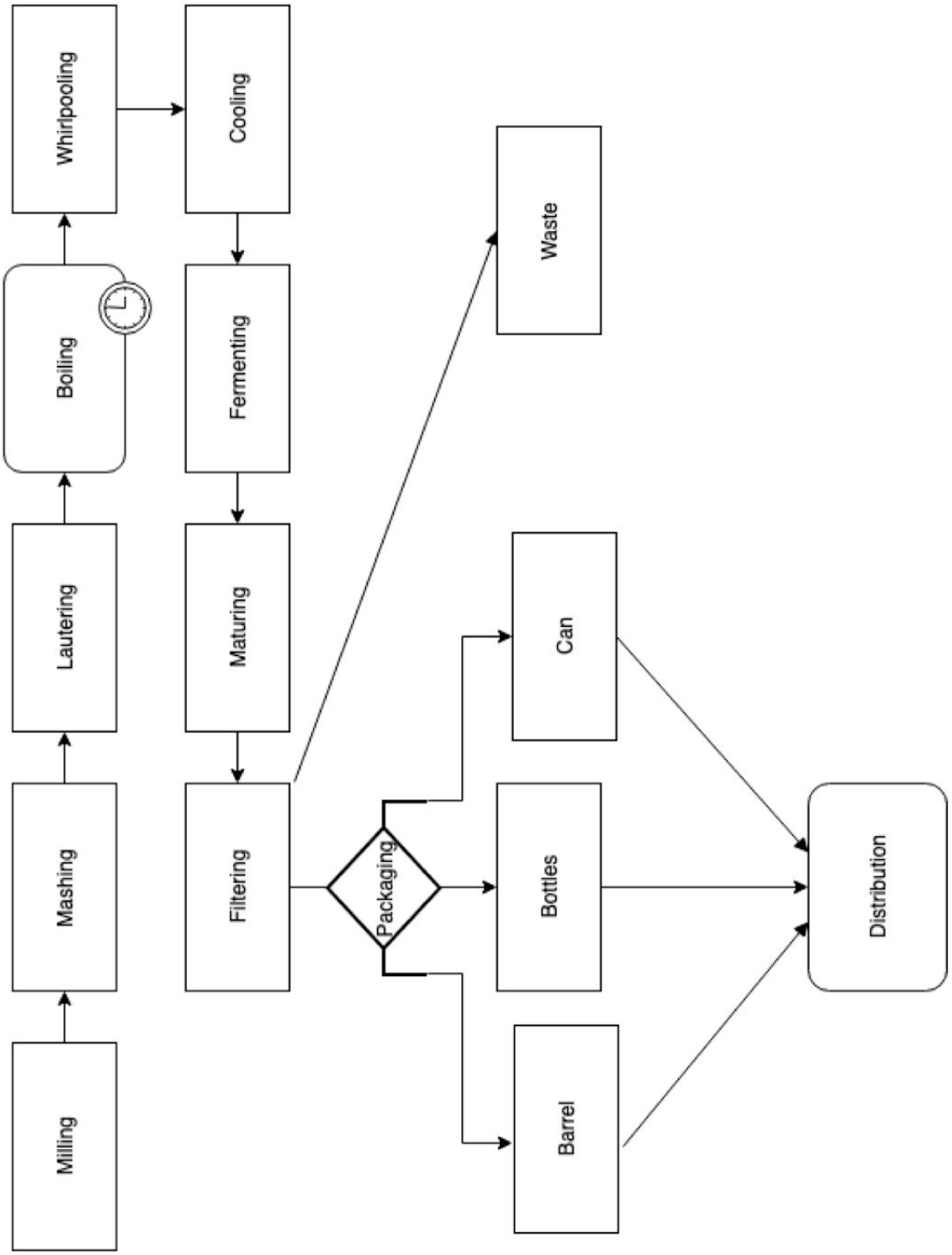
At this point of the project we are going to focus on waste taking into account where it comes from and how we act with it after processing it.

The flow of materials for the manufacture of beer where we will observe in which parts of the manufacturing process storage and transport exists.

Next we are going to observe in which parts of the process of creation, storage and transport there is use of the plastic to reduce it to the maximum or to eliminate it and thus substituting it for the barley giving him a second use.

The language we are going to use for the process production diagram is the BPMN language.

4.2 Materials Flow



1 Shredding: Malt grains pass through mills to reduce size

2. Mass Pot: Water is added to the malt grains, controlling time and temperature.

3. Must Filtration: The solids are separated from the must, such as the husks.

4. Boiling: The must is sterilized by means of high temperatures and the incorporation of hops and their bitterness is encouraged.

5. To let the Must rest: It is done with the purpose of that agglutinates in the bottom the substances

6. Cooling: Using cold water, in a heat exchanger, the must is passed through until a temperature close to 10 degrees C is reached.

7. Must Fermentation: for 7 days it is left to rest, allowing the yeast to transform the sugars into alcohol and carbonic gas. In this process is where the carbon dioxide gas is produced.

8. Maturation of the Beer: After removing the yeast and sending it to the dryer, the beer is left to rest for 15 days, at low temperatures, 0 degrees C approximately, achieving a chemical stabilization and a refinement of the flavor.

9. Beer Filtration: The beer is passed through pressure filters, using diatomaceous earth, in order to give it the brightness and transparency that characterize it.

10. Bottling: The beer is transferred to the different containers for its consumption as barrels, cans or bottles.

11. Use of the malt: After separating it from the beer is joined with the other parts of the cereal is joined with different chemicals as the case of saltwater brewery to create the biodegradable material in question

12. Factory storage: storage on pallets awaiting orders from suppliers.

13. Distribution by truck

14. Storage of suppliers for subsequent distribution or sale

15. Delivery to and storage in bars

16. Destruction of or sale of cash

As we observe in the steps of the creation of beer, there is the use of plastic in points 12, 13, 14 and 15.

At present, the resulting must is used in other functions due to its rich properties such as the high level of proteins.

Feed: this option consists of once the process is finished, the must is transported to a farm where it serves as food for animals that given its rich properties is highly recommended. The companies that make this option sell the amount of must in exchange for money or in exchange for another profit. In this way they close the flow circle of matter becoming fertilizer for the field.

The problem of this option is the short duration of bagasse in conditions for animal consumption.

Another problem for this way of treating bagasse is its transport.

Other cases are biofuel or prosthesis that in spite of being an expensive process, the use of this material can be used for dental prosthesis..... On the other hand also for broken bone prostheses....

5 Hypothesis to solve both problems

Having observed both problems and knowing the method used by the company Saltwater we will see the feasibility of the proposal. Observing the evidences and the common points of the problems in order to apply the possible optimal solution.

If we use the material resulting from the production process to replace the plastic packaging, the steps to follow would be:

1. Firstly, if the must resulting from the production process is greater than necessary, i.e. if there is a surplus.
2. The second step, and in the affirmative case to the first point, would be to observe if the technology and the current machinery allow to realize this product.
3. Estimate the cost of carrying out this methodology and compare it with the case of plastic.
4. Simulate a proof of concept and show the cost and benefit to the company in question.

Therefore, we will look for a joint solution to both problems and the hypothesis will be through the use of the material reused for manufacturing. A drying and moulding process will be applied in different ways to adapt to the different containers and in this way remove the plastic in a part of the production. The benefits will be economic by

saving the purchase of plastic, logistical savings by not having the need to accumulate plastic boxes and profit because the material can be resold as fertilizer or food.

In addition, other benefits can be achieved such as tax savings before possible future sanctions for pollution, even better positioning of the company in the market thanks to a better brand image aware of the environment.

6 Analysis and Exposure

To carry out the analysis of the research, we will first get to know the environment of the company, in this case the Spanish environment, but knowing that in today's society a company competes with companies not only national but also European and worldwide.

Therefore in analysis STEEPLE will be focused on Spain but always with a more global approach.

The STEEPLE analysis is a tool for analysing the macroeconomic environment in order to know the potential influence of various factors on the company. In this way we will know the weaknesses and strengths of the environment that can have a significant impact. Therefore, we will study the political, economic, social, technological and environmental factors. At the end we will analyze the possible scenarios.

In the first point, we will talk about how the issues of taxes, labour laws, environmental laws and political stability are dealt with.

The economic factors to be studied are permanent and temporary economic factors at national, European or global level. That is to say, economic development, wage levels, availability of materials, balance of payments, interest rates...

Social factors include the consumption habits of the population, their profile, beliefs, values, level of education, family structure. That is, the lifestyle and needs of the population.

The technological factors affect differently depending on the sector of the company. In our case we will value how important it is besides the automation of the sector and the changes and investment in R&D.

In the environmental factors we will study how it is gaining importance in this point for society and therefore for companies. In addition to the possible initiatives of the government or important associations capable of affecting the population.

Now that we know what each sector refers to, we are going to see how the Spanish national situation is and if in any case the international situation does.

6.1 Political Factors

In the Political dimension, after the elections of April 28, 2019 the situation in the congress is as follows:123 PSOE 66PP 57 Ciudadanos 42 Unidos Podemos 24 VOX and with less representation Catalan, Basque and Canarian parties. Therefore apparently a government with center-left ideology will be established.

The congress has also reflected the political problems with a part of society that seeks the independence of the autonomous community of Catalonia with the opposition of parties that defend the unity of the nation.

The formation of government in principle should not affect the stability of rates such as value-added tax which in the case of food stands at 4% for barley which is the main raw material of beer.

In addition, Spain belongs to the European Union where the food sector is protected by EU laws.

It would also be necessary to take into account the negative points regarding the Labor Reform of 2012 since it has led to short-term contracts and precarious employment.

6.2 Economic factors

In economic terms, the minimum interprofessional wage has risen to 900 euros per month (14 payments), a total of 12600 euros per year. This increase agreed by the government causes the disposable income to be higher and thus increasing consumption.

On a national level, Spain is in an economic expansion that also stimulates the population to feel more secure and therefore increase consumption. It is also one of the 15 main economies in the world.

The strength of Spanish banks increased after the crisis and the numerous mergers that took place. As a result, financial vulnerability has been reduced since 2009 and although it is now more stable, there are many problems, such as the numerous complaints made by the population to banks about the floor clauses.

The GDP is the economic growth measured by the rate at which increases the production of goods and services in Spain in this case for a year. The growth forecast for our economy is 2.2% in 2019. Therefore after several years of growth of more than 3% from 2014 and 2018 with a growth of 2.6% is estimated a growth of around 2% and 3% over the next few years.

6.3 EU Currency

The single currency for most of the euro area favourably affects the ability to compete in international markets. Given that a strong currency helps both imports and exports.

The negative points for the Spanish economy are:

We understand public debt as the obligation to repay the money to individuals or other countries, this debt belonging to the whole of society.

Spanish public debt in the first quarter stood at 1,199,773 million euros, representing 97.1% of GDP. Being one of the countries with the most debt in the world, given the possible need to issue public debt for some projects or give aid to its citizens will not be able to do so.

Another important point is the level of unemployment where the great concern is the precariousness of work and unemployment for those under 25. The latter is more than 50%.

6.4 Social and Ethical Factors

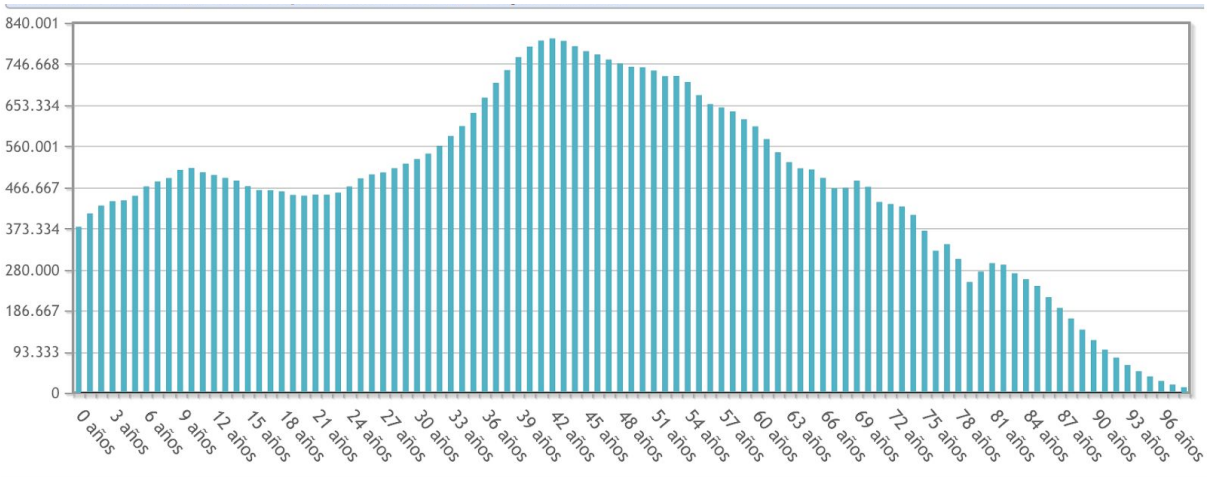
Spanish society stands out for having access to health care and education in general. Spain is also a secular country although the Catholic religion has certain privileges, being also the most practiced religion. Other minority religions that also coexist in Spain are Islam, Protestants and Orthodox.

Due to the climate that is a great attraction along with the gastronomy makes it a highly touristic country. In the same way that the national language (Spanish), which is the second most spoken on the planet, helps tourism.

In terms of birth rate and life expectancy, the birth rate is 8.4 per thousand inhabitants, or 393,181 births, the lowest since 1976. This case is due to the change in the way of life of society, the lack of economic stability, greater knowledge of contraceptive methods...

In addition, the average number of years a person would be expected to live at birth if the mortality pattern were maintained is 80.4 years for men and 85.7 years for women.

This data means that the population pyramid is inverse, the population is aged and spending on pensions is increasing, exceeding 40% of budgets. As we can see in the following table from the National Statistics Institute, the majority of the population is between 35 and 55 years of age. Therefore, in the future there will be a greater number of inhabitants who will have to receive benefits and a smaller number of inhabitants who contribute to the benefits.



In addition, the Spanish population, like the world trend, is heading and gaining more and more importance towards certain revolutions such as the feminist revolution, in which equal rights are defended, and the ecological revolution, in which the aim is to create a sustainable planet without damaging it.

6.5 Technological and Environmental Factors

The technological advances in the sector will not be very great given that it is a highly automated sector where there are production processes and advanced information systems.

On the other hand, there will be advances in logistics such as improved storage, transport and distribution of beer, such as new materials and new properties that better meet the needs.

In addition to the concern of citizens for the environment, which since the 80s has not stopped increasing, new technologies will be sought in

which they gain productivity, have more useful life time, save energy and reduce water consumption.

With the last two objectives they also seek to get the attention of a sector of the population that is ecologically responsible, seeks and demands advanced environmental legislation ...

Achieving the purpose can draw the attention of investors with an environmental behavior, savings on taxes and fees, savings on penalties for misuse and an image to achieve differentiation from the competition.

Due to the above and seeking customer loyalty are also being made "tastings" where the consumer is provided with the culture of beer and that the public or specialized in beer is for the case of artisanal beer.

7. Current and anticipated regulation

7.1 General regulation for breweries

We understand beers as: Beer: Food resulting from the fermentation, by means of selected yeasts, of a brewing must made from natural raw materials. Boe

Different types of beer must also be distinguished

-Cereal Beer: When the must resulting from the creation the content of beer barley is less than 50% of the total.

-Extra Beer: When the dry extract is equal to or greater than 15% by mass

-Special beer: When the dry extract is equal to or greater than 13% and less than 15% by mass.

-Black beer: When it exceeds 50 units of color, with the analytical method of European Brewery Convention.

-Beer with low alcohol content: When the alcohol content of the beer is between 1% and 3% by volume.

-Beer without alcohol: When the alcohol content of the beer is less than 1% by volume.

-Clara: Mixture of any type of beer with soda, soft drink or citrus juice only. At the same time the beer content has to be higher than 50% and the alcohol content has to be higher than 0.5% by volume.

The regulation covers from the creation to the placing on the market.

7.2 Quality standards: (Royal Decree 678/2016)

Food quality, in addition to hygiene and safety standards, must have the following characteristics:

-A pH not greater than 5.5

-A bitterness greater than 5 mg/l except for malt drinks

7.3 Taxes

Royal Decree 1165/1995,

Through the alcoholic graduation in the beer a scale of 6 levels is realized in which depending on the step in this located one pays a rate per hectoliter. In addition we understand degree plate like: Unit that measures the density of the must, to more density more fermentable sugars and therefore more alcohol. To understand it better we are going to put an example a beer with a degree plate of 14 means that if we take 100 gr of the must with which the beer has been made and evaporate the water it contains we have 14 gr of solids, most are fermentable sugars.

1 Alcoholic degree less than 1.2%:

2 Alcoholic degree less than 2.5% and greater than 1.2%: € 2.75 per hectoliter

3 Alcoholic strength greater than 2.5% and dish less than 11: € 7.48 per hectoliter

4 Beer with grade plate greater than 11 and less than 15 : 9,96€ per hectoliter

5 Beer with a major dish at 15 and less than 19: 13.56€ per hectoliter

6 Beer with degree plate greater than 19: 0.91€ per hectoliter and per degree plate.

7.4 Security and hygiene

EU Regulation 178/2002

In the process of creation, transport/handling and sale of the brewing process is prohibited:

-The transformation of starch into sugars by means of exclusively acid hydrolysis, i.e. accelerating the reaction of the chemical bond with the addition of water.

-Handle or transfer outside production facilities unless authorised.

-The addition of alcohol, other than that resulting from the fermentation of beer

-The substitution of hops by other bitter principles

- Any ingredient used for human consumption may be used provided it does not exceed 2% of the final product. This information does not apply to additives or flavourings used in the following processes

7.5 Anticipated legislation

At this point we will try to anticipate possible changes in order to be able to adapt with the necessary time and gain a competitive advantage with rivals.

In the short term and analysing the trends in the sector one could anticipate that, in principle, there will be no changes in the quality of the beer as it is a product that has been made for many years and no major changes have been made.

It is true that the sector is having a strong trend towards artisanal beer where innovation and experimentation with new flavors and where the consumer seeks a variety and superior quality.

In labelling, taxes and health and safety we cannot expect big changes just small adjustments without great relevance.

In terms of environment and packaging it is expected that both aluminum cans and glass bottles will be maintained since both containers are highly recyclable without losing their qualities, as well as being economical.

On the other hand, the EU is working to reduce single-use plastics from 2021. It could also be anticipated that work is being done towards the total elimination of plastic. This trend is caused by the fact that 85% of marine waste is plastic and that the vast majority of these plastics are single-use, such as cotton swabs, straws, plastic bags...

Another problem caused by plastic is that recycling it is more expensive than if we do not, for this reason only 30% of plastic is recycled.

8 Check Technology

In order to analyse the economic viability of this project, we will first have to check whether it is possible to carry it out with current technology.

In order to carry out the previously explained process, you will need a place to drain the barley and a heat and pressure machine. This heat machine will simply be applied a mold with the desired shape either rings, sheets, sides for the box ...

In addition to obtaining this heat, which would be approximately between 100 and 500 degrees Celsius, it would be necessary to exert pressure on the material in order to press it.

On the other hand, in order for the model to be viable, it would be necessary for the barley resulting from the process to be sufficient for the litres of beer it is going to transport. Therefore, the first step is to analyse whether there is a surplus or deficit in which case the model would not be viable.

8.1 Technical feasibility

The technical feasibility of the project would consist of knowing or estimating the quantity necessary for the product and thus knowing whether there is a surplus or deficit. If there is a surplus, we will also look for how to reuse the excess material.

Therefore for the manufacture of beer, suppose a liter of beer, this liter of beer is obtained between 0.1 kilograms and 0.3 kilograms of residual

matter. This variation is caused by the different types of beers that exist in the market and by the different processes that the different companies have at the time of realizing the beer, as it could be a microbrewery that realizes artisan beer or simply has a less efficient process or a multinational that makes thousands of liters of a Pilsen beer. Therefore, in the case of microbreweries it would be between 0.2 kilograms and 0.3 kilograms.

In the case of a pack of 6 cans (there is a market hypothesis that artisanal beer will tend in the future to cans) with a quantity inside each can of 0.33 liters means a total of 1.98 liters of beer. Therefore for this case the estimate of recycled material that we will obtain would be between 0.2 Kg and 0.4 Kg. The result of the material necessary for these rings is estimated at approximately 200 grams and the final result is similar to an egg carton pack. Therefore, the resulting quantity is sufficient in case of cans so there is a surplus. This is the example of the rings for the rings in the case of bottles there will be a greater surplus.

For the other cases as the boxes by modules there is also technical feasibility since there is sufficient material and with the remaining one could on the one hand sell to farmers or create more rings or boxes to sell them to other companies thus increasing profitability.

Another important factor is the pressure and heat necessary for the union of this material, this factor does not have major problem since the

common machinery already reaches the minimums for the creation of the product and no machine with special power is needed.

8.2 Economic viability

To analyze the economic feasibility of this idea we will translate it into numerical values. In this way we will be able to foresee the investment and the benefit that we will obtain with the use of this business model.

Therefore we will seek to know if the business project will generate sufficient profits.

After analysing the existing machinery in different sources such as pressure and heat brands and second-hand websites such as Alibaba among others.

Therefore after this analysis we obtain that the necessary machinery to realize the idea of business the average is between 1500€ - 6000 € depending on the antiquity of the machinery or if it is new, the different molds that can be applied to him for example if it is only for rings it will be more economic that if it is for rings and boxes. This price would be for the purchase of a single machine with a useful life of at least 100,000 uses.

The amount of machines needed will depend on the number of liters of beer per year and the type of container in which it is distributed.

The current business model that works through plastic where heat is applied and adheres to the container, the prices for plastic containers in the case of cans are around 10 euro cents per pack, so we exemplify numerically these data to see the result.

9 Hypothetical proof of concept

To check the viability of the project we are going to suppose the case of a microbrewery. This company would be considering a change in the way it packages and transports its products. Therefore we will calculate the necessary investment to undertake this mode of packaging.

The reason why we are going to suppose a microbrewery is that given its reduced size and its smaller number of employees it is easier to contact them to explain the different problems they have for the manufacture of beer and their greater knowledge about the process as they are in several functions at the same time. As well as being able to contact the owner directly in most cases.

On the other hand, microbreweries have a smaller infrastructure and it is easier to change to another model such as the one proposed.

Suppose an average production of 200,000 liters of beer per year of which 100,000 liters of beer are distributed in bottles, 80,000 liters of beer in kegs and 20,000 liters in cans of beer. (It is distributed this way because it is an average of how microbreweries sell their product).

A microbrewery of this size normally consists of 2 employees who do all the work and have a single place where it is manufactured and packaged. In this case, in the global calculation we would have a minimum of 40,000 kilograms and a maximum of 60,000 kilograms of residual material available for packaging. According to the study previously carried out, we use around 4,000 kilograms of them in the packaging of the cans. For the beer bottles, 32,000 kilograms of residual material will be used to pack them in boxes of 6 if, for example, two were

ordered, a method similar to that of rings could be used to avoid friction, with this method we use less material.

Therefore we observe that of the minimum 40,000 kilograms 36,000 kilograms would be used.

Assuming that all packs are 6 units, we establish that 1,100 units will be created for cans of 0.33 and 5,500 cases for beer bottles, i.e., if the company's sales were stable for years, the machinery in which it has been invested would last more than 15 years. The price per unit is between 4 euro cents and 10 euro cents bearing in mind that the raw material is not counted and only the energy used should be counted, the working time used plus the depreciation of the machinery used.

Another important factor is to know the opinion of the businessmen of microbreweries and their availability of investment. for this, we will carry out a survey asking them basic information, their problems of manufacture, distribution, use of the plastic, use of the residual material...

Later we conclude the work and we will observe if with the obtained results the project for a microbrewery is viable.

10 Interviews

In order to know the opinion on the project and the possible acceptance of the method, we are going to carry out a survey of 22 questions divided into 8 sections.

On the first page, we appreciate a brief introduction about myself, the purpose of the survey and what the data will be used for.

On the second page, we ask basic information about the company and about the entrepreneur, since it is a form intended for microbreweries, it will be answered by the entrepreneur himself.

The third page seeks to identify the quantity in litres of beer produced by the company, what is the size and quality of its packaging and what is its target market.

On the fourth page, we analyze more deeply the issue of the Final Grade Work, which is the way in which the barley is used once it has been used to brew beer.

In the fifth page, we explain our method, we give an example of the rings, we ask them to value the product from 1 to 6, in this way they must choose and they do not have the possibility of not answering neither affirmatively nor negatively. Just as they are asked for an approximate amount that they would be willing to invest.

Finally, they are given the real approximation of the price of the product asking if they were willing to do it and if the answer is negative if it is possible to give arguments about it and the future possibility of doing it.

We will now analyse the results of the survey:

For the first section of the survey there are several factors in common and other more differentiated factors. In the differentiated aspects appear the years of creation that will have a different impact on the current problems of the company. We have collected data from 2011 to March 2019.

In spite of carrying out the survey in different countries we have decided to limit the territory to only Spain given that due to possibly cultural factors it has not been possible to collect a significant number of surveys in other countries such as Germany, Hungary or the Czech Republic. Therefore, the microbreweries surveyed are a total of twenty-five companies from all over Spain.

As common factors we also appreciate that most beers are Ale, IPA and Lager. In a much smaller percentage of black beers. On the other hand, it also stands out that they are always micro-companies, that is to say, always less than 10 employees.

In the problems section I will attach different answers that exemplify the most common problems that microbreweries have:

-Obtaining the different types of malts and barley, especially the latter for their treatment in conservation. Bottles resistant to the pressure generated by the CO2 that is greater than usual due to its artisan recipe. Efficient transport method for the bottles once the product is elaborated.

-Distribution and market saturation

-Distribution does not meet delivery dates.

As a conclusion to the question we can observe how a problem is mostly at the end of the production process.

In the third section of the survey we obtain that the volume of production is very different and varies from 10,000 liters to 400,000 liters per year of beer.

As for the type of packaging used by companies against the trend of which we have written above, is still observed as a very primary trend since only two companies pack in cans and with few liters per year. The main form of packaging is the bottles of a quantity of 0.33l of glass followed by the barrel but being about 50% of the amount that is distributed in bottles.

As far as the company's target markets are concerned, restaurants and bars stand out in the foreground, followed by Spanish retailers.

In the background to supermarkets and establishments and also highlight Internet sales to individuals.

After studying the target markets of the companies we will study the countries where it is exported which are very varied from companies that distribute to 10 countries in Europe, companies that distribute to China or regional areas near the factories. We could highlight Germany, China, Portugal and France as the four countries where we export the most.

In the fourth phase of the survey where we focus on the content of the final grade work to the question: How is residual barley currently used after brewing?

100% of those surveyed use it for animal feed where farmers go to collect it for free, sell it or establish a barter.

We have also asked them if they think there is a better way to use it and if so, what is it.

In the case of this 20 % who have replied that if their answer has been:

-For human use. Prod packaged but the Spanish regulations do not allow it.

-Human food

-Fuel

-Manufacture of packaging, food and other animal species

-Credit memo

As a conclusion of both questions we can say on the one hand that the majority of entrepreneurs do not know other functions but that a part of

them do know their properties that have wide of utilities such as composting or manufacturing packaging which is our business idea.

After explaining our idea we ask them to value it in a number between 1 and 6 being a way of not being able to stay between yes and no.

We obtain that the great majority, 87.5% of those surveyed value it positively and 70% of them with the highest possible score.

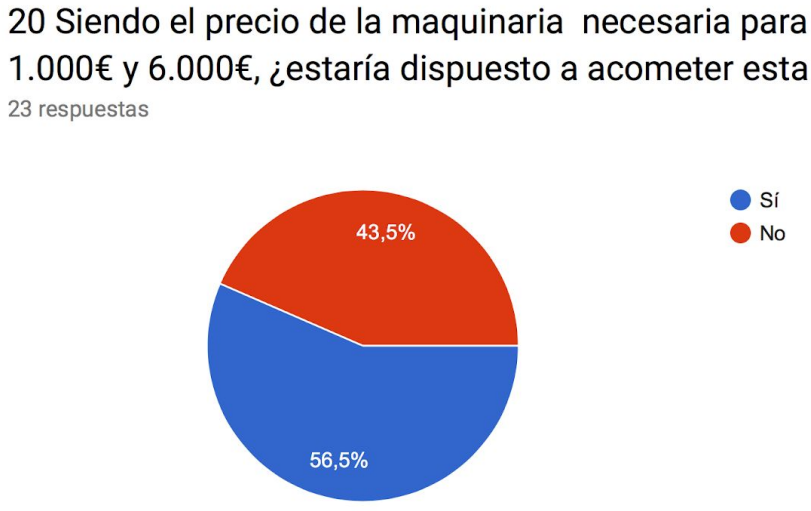
The next question was what they thought of the idea as a marketing strategy if it could be useful as a tool to sell more. At this point 95% of the answers obtained are positive, stating that it is a good idea today, favouring recycling, sustainability and the reuse of materials to respect the environment.

When asked how much they would be willing to invest in the necessary machinery, the answers were very varied, ranging from a price similar to that invested in plastic or a price not exceeding 12 cents, which is the

current cost of the way it is packaged. The reason for this answer to the question is given because the price of your product would cease to be competitive.

Finally we tell you the price that the machinery would have depending on the mold or molds that you want to put, ie how many types of packaging, if the machinery is new or second hand transforming it for the function we want to provide ...

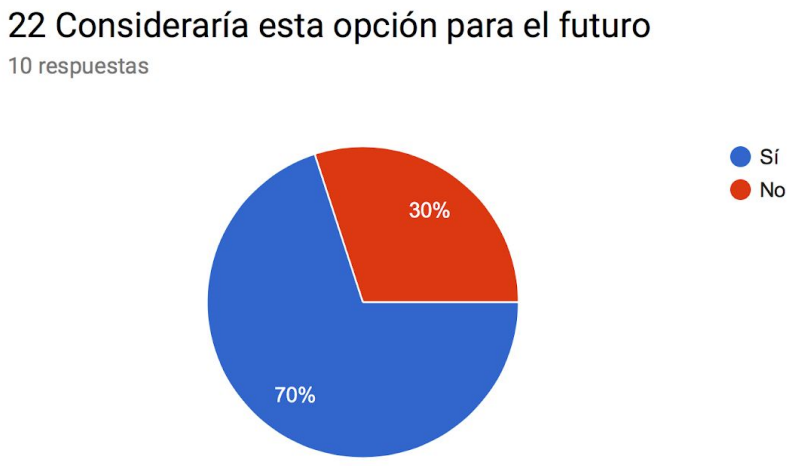
Therefore the final estimate is between 1000€ and 6000€ being the first quantity the minimum in the market with a second hand machine, a short useful life and a single mould, and the second figure being a completely new machine, with a minimum useful life of 100,000 uses and different moulds for different types of packaging either bottles, bottles or cans.



If the answer was affirmative, the survey was finished, but if the answer was negative, we wanted to know what they thought. 56.5% of the responses were affirmative, as can be seen in the previous graph. The

43.5% of negative answers were mainly because it is a higher cost than the current one, not to link beer and lack of funds for the investment.

As we foresee that there could be a lack of funds for investment given that they are small companies with a reduced financial capacity, the last question was whether they could be reconsidered in the future.



As we can see within that 43.5% 70% consider the option in the future when they have the capacity to face the investment.

11. Conclusions, limitations and future search

In this project we have studied the economic aspects that the company, in this case a microbrewery, must take into account for the execution of the change of model towards a model more involved with the conservation of the environment.

Comparing our business model with the plastic one we will be able to verify that it is profitable for different reasons.

As for the economic issue:
On the one hand in the model of the use of plastic has a cost to the company of about 12 euro cents per unit.The proposed model has a lower cost for the company. On the contrary, it would be necessary to make an initial investment where for a small company it is difficult to make an investment.

As we have observed in the economic analysis of the model it is profitable to use it and the use of this acquired material has a long useful life so no more short-term investments are needed.

In relation to the fiscal and strategic issue, as we have analyzed, the trend at both Spanish and European level tends towards the favoring of this type of materials providing tax savings, savings in possible fines for pollution and a very important factor that consists in achieving a competitive advantage over competitors. Given that it is a necessary change either towards this model or towards another model the elimination of plastic is a future reality and above all those of a single use.

Therefore, knowing that this business idea is more profitable than that currently used and may be a determining factor in the future, in addition to being a differential factor with other brands, the millennial generation and subsequent ones are able to change brands only because of their relationship with the environment as many reports prove.

Finally, after the work carried out and the verification by means of a survey of the acceptance of the business model, we can conclude by stating that this business model is viable, allows savings and expands both economic and brand image benefits.

As for the limitations of the final degree project carried out, it must be borne in mind that companies are not usually open to sharing their information and it is difficult to collect data for an analysis such as the one carried out. Likewise, in the case of the survey, the number of responses would have to be increased to make it clearer. Given that it is a project with a focus not only on the Spanish national level but also on Europe, it would be necessary to carry out the survey in other countries, where we have tried to carry it out but it has not been possible for different reasons.

Therefore, future searches or possible extensions to the project would be to know the opinion of entrepreneurs in other major beer producing countries such as Germany, Czech Republic or Hungary.
In the future it would be necessary to increase the number of answers at national level to know your product better and for example to carry out the project together with a company open to change its model.

12. Bibliography

Capó, J. (2012). Strategy and Design in the organization. Escola Politècnica Superior de Alcoy. Editorial Universitat Politècnica de València.

Procerveza (2009)/ Bodegadecervezas. Query “Beer Process”.
www.procerveza.blogspot.com
www.bodegadecervezas.wordpress.com

Smithsonianmag Company. Query “Saltwater Pattern”.
www.smithsonianmag.com

Google Patents. Query “Methodology for 6 pack ring”.
https://patents.google.com/patent/US20180016750A1

GNP (2019). Query “Gross National Product”.
http://www.pib.com.es

El Universal (2019). Query “Current and Future Regulation”.
www.eluniversal.com

Euro Parliament (2019). Query “Current and Future Regulation”.
www.europarl.europa.eu/news

Infogourmet (2017). Query “Recycled Glass”.
www.infogourmet.com

Curiosfera. Query “Beer´s History”.
www.curiosfera.com

Cerveceros Españoles. Query “Beer Regulation”.
www.cervecerosespañoles.com

INE (2019). Query “Demography”.
www.ine.es

Food New Slatan. Query “Process of Saltywater”.
https://foodnewslatam.com

13. Appendices

Questionnaire for the utilization of brewers' waste products

Questionnaire for the utilization of brewers' waste products

Dear Madam, Sir,

I am a student of the Polytechnic University of Valencia.I am doing the Final Project that deals with the use of residues from the production of beer.The aim of this survey is to broaden the knowledge about the methods of using organic solid residues in beer production. I would like to inform you that this survey is completely anonymous; no financial information or trade secrets of any kind will be asked for.

The questionnaire will only take 10 minutes of your time.

Thank you very much for your valuable contributions.

*Obligatorio

About your company
Please tell us a few things about your company
1 In which year did your company commence operations?

2 If different, since which year has your company been brewing beer?

3 Where is your company located? (Please specify city and country)

4 What types of beer do you brew?

5 Which production difficulties does your company currently face? (Consider: ingredients, packaging, distribution... Please specify.)

6 How many individuals are currently employed by your company?

Questions about the production processes at your company
In this section, some questions concerning the basic characteristics of

production at your brewery will be asked. Please help my research by responding to the questions below.

7 What is the volume of production per year (in liters of beer)

8 Volume of cans produced per year (in litres or number of cans)

9 Volume of bottles produced per year (in litres or number of bottles)

10 Volume of kegs produced per year (in litres of beer)

11 Company's target market(s)
select all that apply

- ○ Restaurants
- ○ Bars and taverns
- ○ Establishments or sporting events
- ○ Individuals (supermarket and similar establishments)
- ○ Individuals (Internet sales)
- ○ Retailer (in your own country)
- ○ Retailer (in another European country)
- ○ Retailer (international sales)
- ○ Wholesale (domestic sales in your own country)
- ○ Wholesaler (European sale)
- ○ Wholesaler (international sales)
- ○ Otro:

12 Where does the company export to? Please list.

13 Volume and type of containers processed by your company
select all that apply

- 0,33L (can)
- 0.33L (glass)
- 0,5L (can)
- 0.5L (glass)
- 1L (can)
- 1L (glass)
- 1L (plastic)
- 2L (plastic)

Information on the residual products of the production

In this section we seek to know how your company utilizes or treats the residual solid products of the production (as the barley and other materials).

14 How is residual barley currently used after brewing? *

15 Do you think there is a better way to use the solid residues mentioned above?
Only one

- Yes
- No
- Maybe

16 If the above answer is yes, could you specify which one

Another way may be possible.

Our idea is to replace the plastic as a packaging material and for holding containers together. Through a manufacturing process, barley is mixed with some other easily biodegradable materials, making a sturdy material for transporting cans and bottles. This product can be easily discarded, as it is biodegradable. With the use of this method, a solution is given to how to use beer waste and a plastic substitute for packaging. The machine to manufacture this product consists of a heated press, with which a barley pulp is shaped through a mold, into rings or boxes for packaging.The result of the product in the case of the rings of 6 would be...

The result of the product in the case of the rings of 6 would be the following: (Can be *adapted to other types of containers* such as glass bottles)

17 What is your opinion of the idea? *

Marca solo un óvalo.

	1	2	3	4	5	6	
Infeasible	◯	◯	◯	◯	◯	◯	Very Good

18 Would you consider it a good marketing strategy to use this substitute to eliminate plastic? Please explain your answer

19 How much would you be willing to invest in a solution that could reduce the plastic in packaging (e.g. rings from can packs or other packaging films)?

Willingness to undertake the investment

According to preliminary studies an estimate of the cost would be between 1000€-6000€ minimum. The life of the machinery is estimated at a minimum of 100,000 times of use.

20 Since the price of the machinery necessary for the process is between €1,000 and €6,000, would you be willing to undertake this investment?

Marca solo un óvalo.

- Yes *goes to "Thank you for your answers :)."*
- No *goes to question 21*

I wouldn't be willing to make this investment

21 Could explain your reason

22 Would consider this option for the future
Only one

- Yes
- No

Thank you for your answers :)