Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú

UNIVERSITAT POLITÈCNICA DE CATALUNYA

TREBALL FINAL DE GRAU

TÍTOL:

Creation, restyling and commercial application of a home biofuel production machine as a substitute of conventional methods

AUTOR: Clara Casademont Cavero i Núria Vendrell Ravetllat

TITULACIÓ: Grau en Enginyeria de Disseny Industrial i Desenvolupament del Producte

DIRECTOR: Juan Jose Aliau i Pons

DEPARTAMENT: Expressió Gràfica a l'Enginyeria

DATA: 02/07/2015

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QUALIFICACIÓ DEL PFC

TRIBUNAL

PRESIDENT **SECRETARI** **VOCAL**

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Aquest Projecte té en compte aspectes mediambientals: X Sí □ No

TREBALL FINAL DE GRAU

RESUM (màxim 50 línies)

El present treball es basa en la continuació, extensió i millora d'un treball final de grau d'enginyeria mecànica realitzat per les mateixes autores d'aquest. L'anterior treball es basava en optimitzar els recursos d'una fàbrica de mobles d'Indonesia creant una màquina que utilitzés la sobreproducció de serradures d'aquesta i la transformés en briquetes (bio-combustible) utilitzables en els propis forns de l'empresa per acabar tancant el cicle. El treball també constava d'una part d'adaptació d'aquesta màquina en el món occidental per haver així d'automatitzar-la, fer els diversos càlculs i plànols, seguir les normatives i directives vigents i acabar tenint una màquina completament funcional adaptada a les necessitats actuals del mercat europeu.

Per aquest treball, el de disseny industrial, el que s'ha volgut ha estat millorar la màquina anterior canviant els aspectes que no la feien viable o sostenible, incloent-hi altres de valor afegit i aplicant una idea de negoci per a fer-la totalment vendible i rentable.

La primera màquina occidental es basava en una màquina rotatòria de 4 estacions on en cada una hi passava una acció (càrrega de material, premsada, descàrrega i neteja). Aquesta màquina també constava d'elements externs que feien que tot el procés quedés automatitzat.

Per aconseguir el objectius marcats per l'actual treball el primer que s'ha fet ha estat estudiar el primer disseny de màquina i veure quin eren els canvis i millores que es podien aplicar tant a la màquina com al producte que fabricava (les briquetes). Els problemes i millores han sorgit gràcies a comentaris del tribunal del projecte anterior (en la presentació de mecànica), com de visions pròpies i d'un AMFE realitzat durant el desenvolupament d'aquest projecte.
Una vegada millorats tots els aspectes possibles s'han fet estudis comparatius per veure la diferència de la màquina anterior a l'actual i com ha millorat tant l'economia, la sostenibilitat, la facilitat de fabricació, etc.

Seguidament també s'han realitzat una sèrie de càlculs per arribar a la conclusió de si la màquina està ben dissenyada o no, per justificar quins elements comercials s'han d'escollir i per comparar-la amb l'anterior.

L'última etapa d'aquest projecte es basa en un extens model de negoci on, a part de crear una empresa per a fer-ho més realista, s'han fet diferents estudis de mercat per veure els països i clients potencials de la premsa i dels seus productes. També s'ha ideat una idea de negoci que dona una bona visió de la rendibilitat de la màquina i finalment s'ha dissenyat un màrqueting mix on es descriu tant el producte i el preu com la distribució i la promoció de la premsa per a que arribi a ser un èxit a vista dels clients.

Cal dir que totes les millores s'han fet seguint les normatives i directives vigents, així com tot el disseny de la màquina i que el pressupost ha estat detallat i contrastat amb els diferents proveïdors trobats.

Paraules clau (màxim 10):

Re-disseny	Briquetes	Fusta	Serradures
Bioenergia	Biomassa	Bio-combustibles	Reciclar
Reutilitzar	Transferència		

FINAL GRADE PROJECT

ABSTRACT (50 lines maximum)

This project is based on the continuation, extension and improvement of a mechanical engineering final grade written by the same authors of this. The previous project was based on optimizing the furniture factory resources located in Indonesia by creating a machine that uses the factory sawdust overproduction to make briquettes and transformed into bio-fuel usable in the company's own ovens to close the cycle. The project also consisted of a machine adaptation part in the occidental world for automatizing, making calculations and drawings, following the regulations and directives and end up with a fully functional machine adapted to European market current needs.

For this current project, the industrial design one, which has been tried to improve the previous machine; changing aspects that were not viable or sustainable, including other value-added and applying a business idea to do it fully marketable and profitable.

The first occidental machine was based on a transfer machine with 4 stations where an action was happening in each station (loading material, pressing, unloading and cleaning). This machine was supported by other external elements that made the process automatic.

To achieve the set goals current project, the first thing done is to study the first machine design and see what were the changes and improvements that could be applied to both the machine and the product manufactured (briquettes). Problems and improvements have come through the previous project presentation court reviews, own vision and an FMEA made during the development of this project.
Once improved all aspects, some comparative studies have been made to check the difference between the previous machine and the restyled one; how much the economy, the sustainability and the ease of manufacture has improved.

Then, some calculations have also made to conclude whether the machine is well designed or not, to justify what commercial elements should be chosen and to compare it with the previous one.

The last project step is based on an extensive business model which, apart from creating a company to make it more realistic, many market studies has been done to see the potential customers and countries to purchase the press or the briquettes. It has also devised a business idea that gives a good view of the machine profitability and finally has designed a marketing mix which describes both the product and the price as the press distribution and promotion for it to become a success in customers view.

It is important to say all improvements have been made following the current regulations and directives, as well as the entire design of the machine and that the budget has been detailed and contrasted with different providers found.

Keywords (10 maximum)

Restyling	Briquettes	Wood	Sawdust
Bioenergy	Biomass	Biofuel	Recycle
Reuse	Transfer		

ÍNDEX

IMAGES INDEX

TABLES INDEX

1. INTRODUCTION AND AIMS

The present project is an extension and improvement of a previous mechanical engineering one. This mechanical project had two different parts linked together. The first one was developed in Indonesia, in a furniture factory, the other one was developed in Catalonia. The main goals of that project pretended to be: search a problem, find a solution for this problem and set up this solution to can use it, for the first part. For the second part, the goal was simple; adapting this "Indonesian" solution to the occidental world, automated and following all regulations.

The problem found in the factory was the sawdust overproduction without any other utility and the found solution was to create, with this sawdust, a type of bio-fuel to use in the factory boiler (used to heat up the ovens). After different experimental studies were decided that the best way to make this bio-fuel was to create a press that (with water) converted the sawdust into sawdust briquettes. In Indonesia this press was built and now is being used, saving 1.300€ per year to the factory.

As mentioned, the second part was to adapt this press in the European factories with all the calculations, automations, regulations… Finally, this "European briquette press" was created but following the same line as the previous one; using the same materials, the same steps, the same times… The press designed was functional but did not be sustainable, well designed and neither had any business idea supporting it creation.

For this industrial design engineering project has been chosen to continue with that mechanical project but making it total sustainable, with a thought design and also with many studies before to create a great business idea to support that this press can become a success.

The main goals for this project are:

- Remove the water in all process. Search another material to make the briquettes.
- Remove some unnecessary machine steps.
- Perform different studies to improve other critical press parts.
- Make the machine more compact and aesthetic, to better selling.
- Carry out different market searches to know where the press has to be addressed, who are the potential customers and the profile of the potential by-customers.
- Create a business model with business idea and business examples that support the press selling.
- Try to improve all the press and briquettes characteristics making it cheaper.
- Continue following all the current regulations.

In the following sections are described all the steps to achieve all this objectives.

2. ANTECEDENTS

As mentioned above, this project arises from the idea of continuing a previous project made for the Mechanic Degree.

It was a project divided into two distinct parts with different objectives but linked between each other:

- The first part was to identify a problem in a factory situated on the east-asia and fix it in a period of 4 month finding the most sustainable and feasible solution with the available resources.

  This part was made entirely during four month in an Indonesian Factory (Otazen) which is allocated in wood manufacturing. This business is specialized on the creation of furniture from its design until the delivery to the last client.
- The second part had a clearly defined goal: ensure that the previous solution was viable in Europe making the necessary changes.

  In this case, the whole study was realized in Catalonia without the support of any particular company

2.1. INDONESIA

During the first stage of the project, the goal was watching the diary work on Otazen and finding the common problems that could be solved. One of this problems was that they had and overproduction of sawdust (small particles of wood coming of the furniture production) and, besides it expended a lot of space, the factory do not had any profit of it, even sometimes the factory had to pay to take it out.

Image 1. Sawdust space in the factory
Source: own source

When the CEO accepted the project of reuse the sawdust to the factory benefit, some restrictions were set for the design and fabrication process: everything has to be reused of the factory materials and causing no cost to it.

With these restrictions it was decided the solution. It was also detected during the observations that the factory was using old wood to throw it inside a boiler and sometimes more wood was needed to be bought. This boiler is used to avoid the fiber wood brake heating some water to moisten it during the drying process. Finally was decided to reach some combustible from the sawdust to replace the wood.

After this decision, some solutions were investigated and at the end were decided to do some tests using three methods: burn sawdust, produce charcoal and produce wood briquettes. These tests last three weeks and different types of briquettes were created by different types of sawdust and agglutinative. At the end the tests were burnt and verified some aspects: burnt efficiency, calorific value, manufacture difficulty, company acceptation…

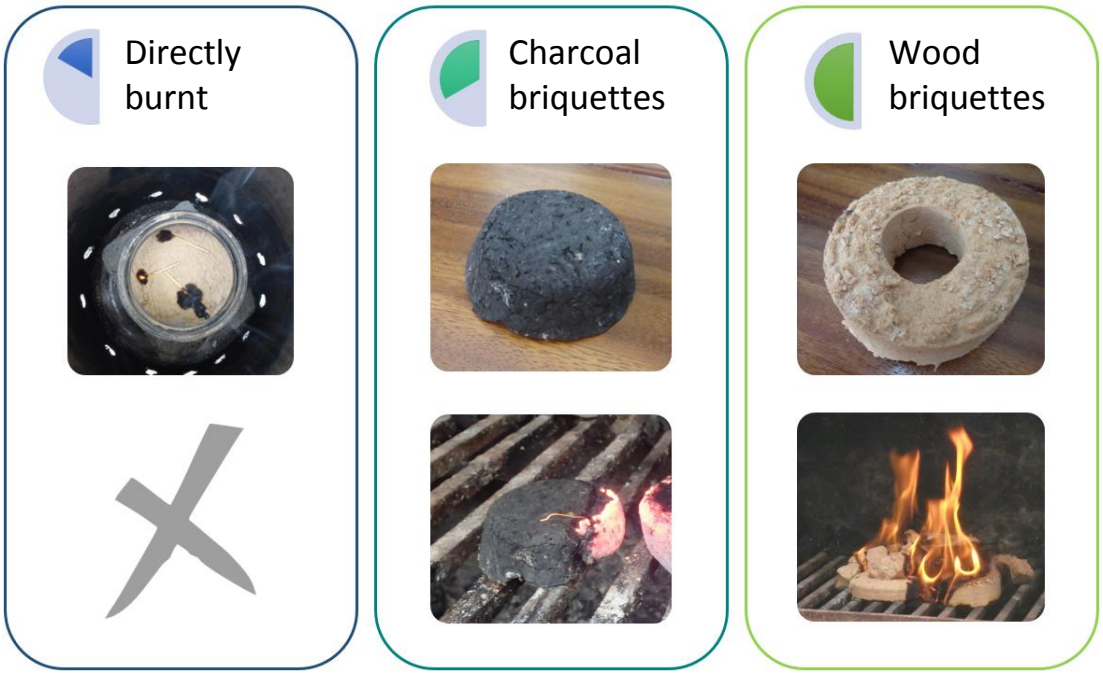


Image 2. Tests samples and combustions
Source: own source

After the results were compared, compacted wood briquettes were the chosen product. It is about a product that has a high calorific value, fewer yields than charcoal but good one, and it's manufactured at zero cost for the company.
The results were checked by the CEO and they give 48h to do a machine design which build briquettes as soon as possible. With this deadline a machine was designed and calculated its resistance and it was introduced to the technical team and production team to start the construction the next day. After one and a half month, some materials were found and recycled to build the machine. As it was building, it was also checked and some parts were modified during this process to reach the final machine.
On the images below are shown the followed steps to reach the machine and the working area that now is using.

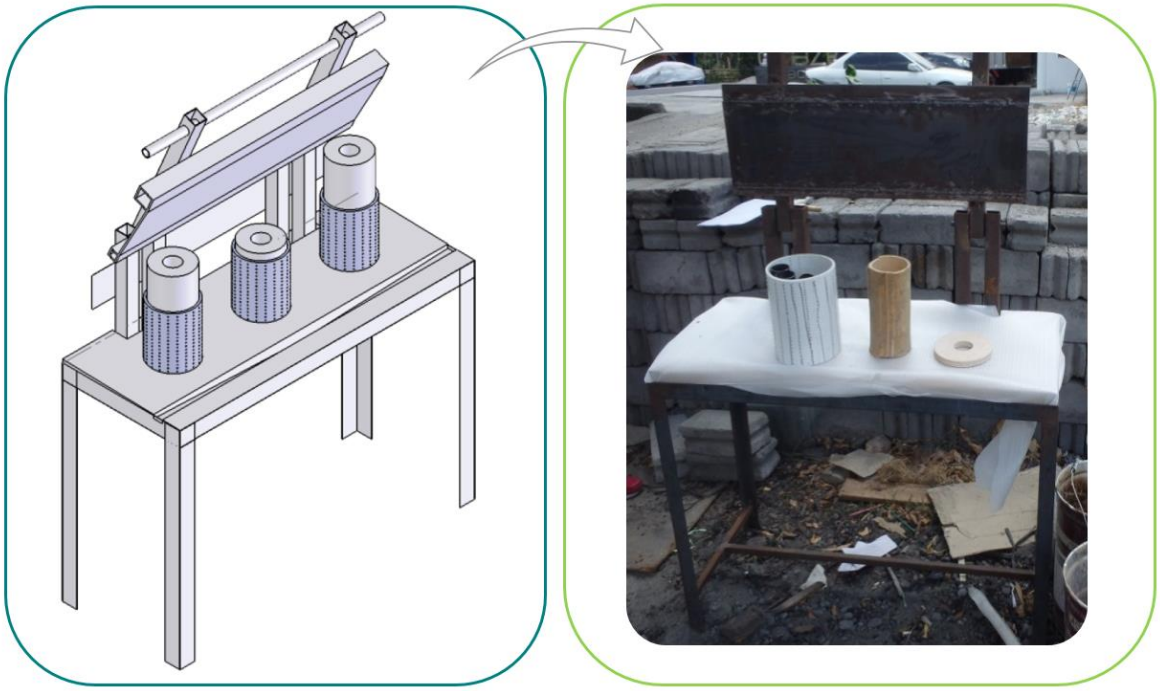


Image 3. Initial design
Source: own source

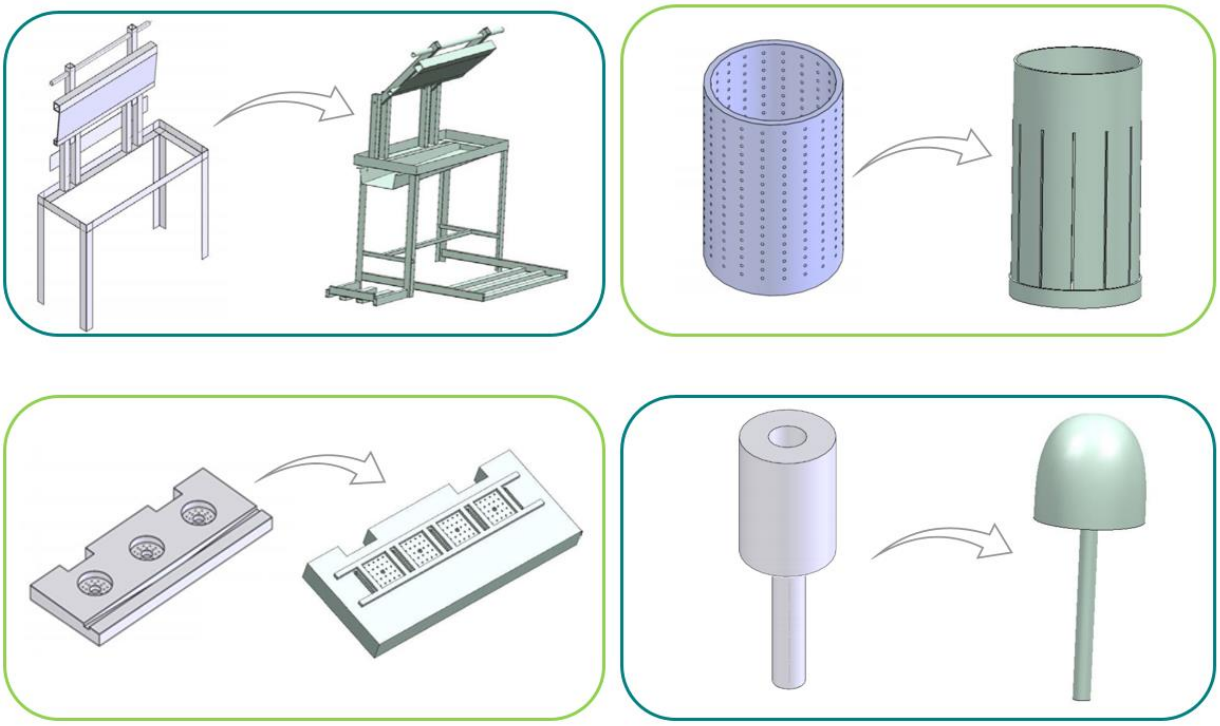


Image 4. Changes and modifications during the construction
Source: own source

Image 5. Final design after all modifications
Source: own source

Mixing area Make up area Unmold area Drying area

Image 6. Working area
Source: own source

This press was shown to the workers and also a practice lesson has teach to show how it works so it can be used in right now.
Thanks to this machine, the company got more space to other work and also has not to pay for the sawdust collection and the wood for the boiler.
These are some numbers to analyze the datum:

- Process numbers:
  - Mix preparation time → 20'/can
  - Cycle time (started process) → 6' 30" /pressing
  - Maximum drying time → 48 h
  - 12 briquettes/pressing → 8.280 briquettes/month

- Press numbers:
  - Weekly briquette volume → $36m^3$
  - Practical monthly briquettes → 87.168 briquettes

- Standard quantities
  - 1 sawdust can → 1 water can
  - Wet briquette weight: → 0.5kg

- Budget:
  - Theoretical machine construction cost → 91,75€
  - Real costs → 0€
  - Weekly savings → 27,08€
  - Annual savings → 1.300€

2.2. CATALONIA

Once the stay was end and coming back to Europe, it was seen that the realized work was positive for the personal development but the normative shortage of the country and the conditions imposed wasn't a strict engineering project.
Even though it was also seen a possibility to face tis project to the western world considering that the Europe society is becoming aware about sustainability and take care of the environment. Thanks to these items (which are increasing every day), it was seen a market opportunity of the machine built in Indonesia doing some changes. This way it could be sold in Europe.
Afterward visiting a power saw factory in Catalonia (Serradora Campamà) and commented the proposal ideas, its CEO saw a good project to implant this system in its factory.
After the project was accepted by the tutor, the second part of this project was started.
The goal, as it is said before, was adapt the Indonesia machine to Europe and make it viable here.

This adaptation goes through some points:

- Efficient and sustainable design
- Total automation of the machine
- Use of normalized parts
- Machine normative and directive
- Justify design and elements calculations
- Process design
- Do some blueprints to its fabrication
- Reasonable budget

As it has seen the modifying points of the initial design, it was decided that the designed machine has nothing to do with the designed before. It'll do the same purpose but it aspect and working method will be totally different.

Since the start, as the machine has different stages (there are a lot of stages on the briquette realization), it is seen that the new machine has to be a rotating transfer one. First step was thinking how many and which were the stages and then the task was design it as simple and fast as possible.

It was a 4 station transfer machine:

Image 7. Transfer machine (NX)
Source: own source

1. *Load Stage*: with a gravimetric dispenser

2. *Press stage*: activate with a linear actuator and pressed with an ejector system and springs

3. *Unload stage*: the briquette is knocked by the linear actuator and it falls on a conveyor belt.

4. *Cleaning stage:* a nozzle disassembles on the linear actuator and it is the responsible of eliminate the sawdust waste to block obstructions.

To automatize all the process, apart from the briquette machine, it also has to create the surroundings, meaning the after and before areas. This increase the creation complexity but at the same time increase the using simplicity.

Image 8. Working area with all the stages
Source: own source

Image 9. Mix area (big-bag + endless belt)
Source: own source

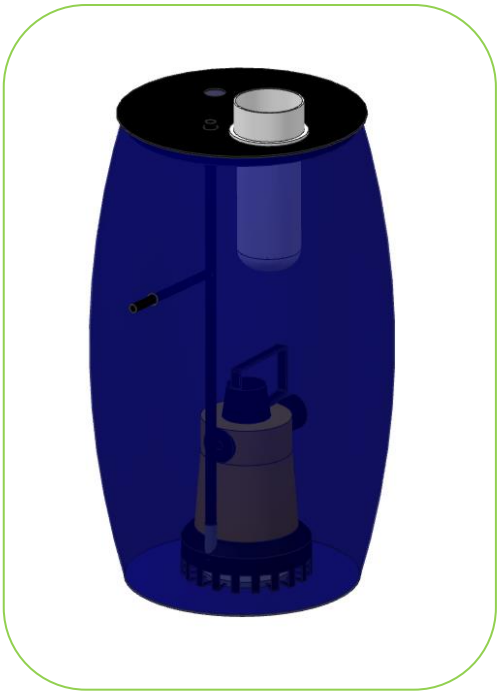


Image 10. Residue treatment (store + filter + waterproof pump)
Source: own source

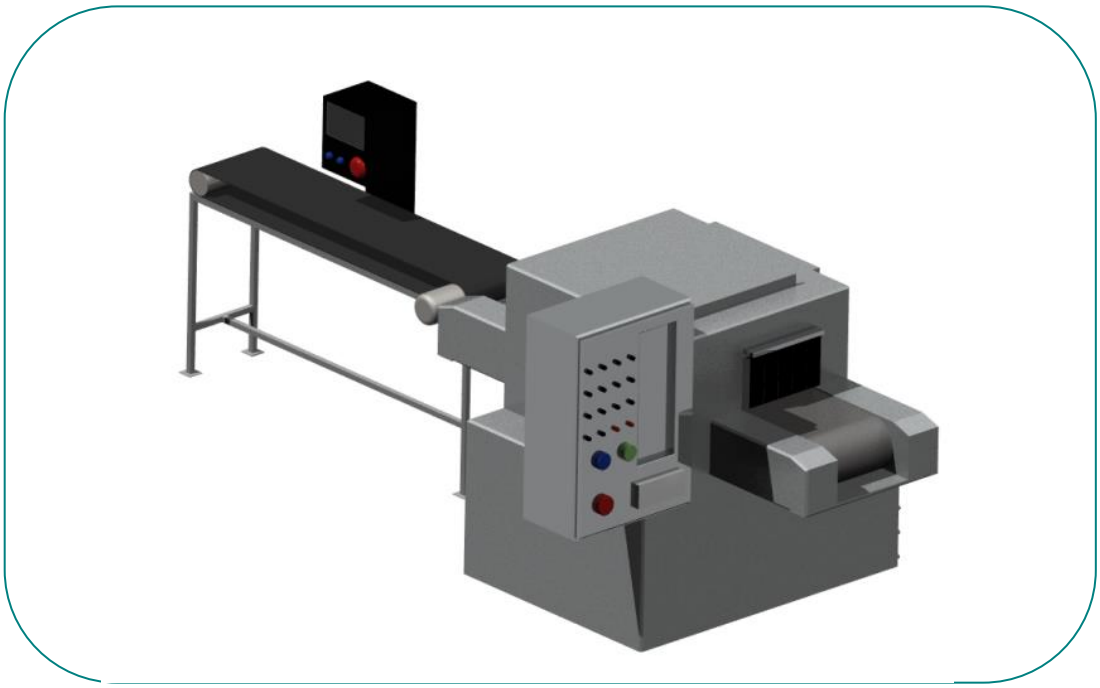


Image 11. Drying stage (conveyor belt + air oven)
Source: own source

Image 12. Final machine + security fence
Source: own source

These are some numbers to analyze the datum:

- Process numbers:
  - Mix preparation time → 30'/day
  - Cycle time (started process) → 9"
  - Daily manufacturing → 2.710 briquettes/day
  - Nº briquettes/bigbag (1 per day) → 2.700 briquettes

- Manual press vs automatic press:
  - Briquettes/month → 54.200 briquettes/month
  - Comparison → 555% more on a month

- Standard quantities
  - 1 kg sawdust → 3 liter water

- Budget:
  - Theoretical machine construction cost → 41.798€
    - Normalized parts → 19.801€
    - Engineering costs and parts → 21.997€

2.3. AND NOW…

Once the project was handed in and the oral presentation was done, the improvement comments of the tribunal were taken into account to continue with the following project modifying some aspects:

- Modify the product (briquettes) to reduce the drying time.
- Modify the press to become it sellable and modern and adapting it to the new product.
- Realize all the steps to simulate the process to create a business for selling it.

2. RESTYLING

2.1. BRIQUETTES

2.1.1. Current problems

In the past, when a solution was looked for the sawdust excess, producing a briquette pressing it with water was the fast and the effective one.

Once the machine has been adapted in the new conditions (Europe), has been discovered that it is not competitive with the other similar products on the market. These products have the same benefits but their prices are lower, as happen with wood, pellets or the briquettes made by hot pressure.
The attribute of the additional price begins on the use of water that it is added to compact the briquettes and the resulting recycle system of it. Furthermore, the use of this valued element, cause a high drying period. To decrease this period the process has been modified and becoming more complex using an extra strength for the press, a cleaning stage, a wasted treatment area and a drying stage with an oven causing an increase of the budget.
The first step of this new project will be finding an alternative solution to create a briquette without water and do this product a competitive one in the combustible market.

2.1.2. Tests and checks

For the mechanical project, several tests have been made using different types of sawdust and different ways to compact the briquettes. As wanted to have the same structure (only needed low pressure without heat to compress it) has been researched some other materials to behave as a glue to compact the sawdust.

To replace water, has been decided to use some element which accomplishes some features:

- Behave as a compact component
- 100% natural
- Low contaminate when burn
- Low ash producing
- Low cost or zero cost
- Recycled element
- Industrials quantitates

Only two elements were found which accomplishes these seven features: recycled cooked oil and cafe waste.
Although cafe waste are better because is not necessary to filter and last more without ferment, finally some recycled cooked oil briquettes were tests.
This decision was made in order to avoid cafe flavors in barbeques when using this kind of briquettes. It is a fact that cafe is an extremely aromatic product even when it has been used, so it is natural that this scent goes through the foodstuff when cooking.
To do the test has been followed the same process as in the project before:

1. Prepare tools:

Image 13. Tools for the test
Source: own source

- *Sawdust*: basic element
- *Cooked oil*: “glue element”
- *Mold*: plastic cup with holes
- *Press*: plastic cup with holes
- *Paper and pen:* necessary to write comments.

2. Mix elements and standardize quantities: as it is reduced sized test, the achieved results won’t be the lasts.

Image 14. Sawdust → Sawdust + oil
Source: own source

3. Press and readjust quantities: compress the mix to obtain a compact disc and analyze if the quantities are good. In this case, as can be seen on the paper, there was too much oil.

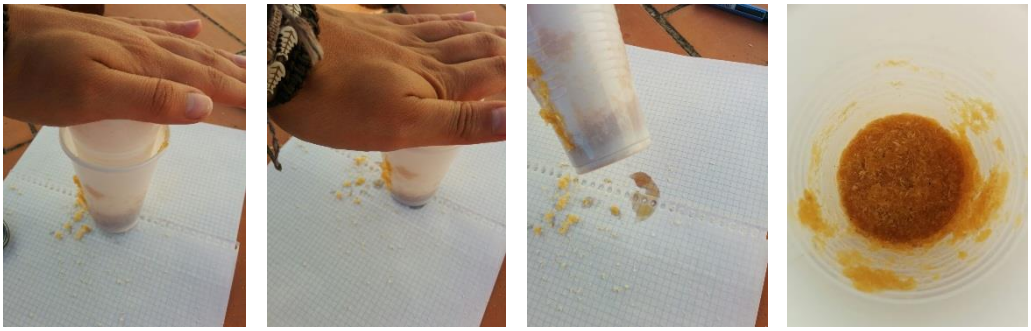


Image 15. Manual press
Source: own source

4. Unmold: pull out the compact sawdust and test its resistance, moisture and 'compactability'.

Image 16. Unmold briquette test
Source: own source

5. Burn the briquette and take some specific notes:

   - Burning time: 23 min approx.
   - Calorific power: 4,85 Kcal/kg
   - Leftover ash: none.
   - Smell: none.

Image 17. Burning briquettes
Source: own source

2.1.3. Conclusions

Afterward tests, some conclusions were made attending to the experimental results:

- Cafe compacted briquettes: cannot be used due to cafe aromatic spores which can effect on the barbecue flavors when cooking.
- Cooked oil compacted briquette:
    - No smell and leftover ash, same as water compacted briquettes.
    - Similar heat value than water compacted briquettes
    - Burning time increase in comparison with water ones.
    - Reduce water consume until zero
    - Entire sustainable product

2.2. PRESS

Besides the press redesign, to produce the new product, the compacted oil briquettes, if a profitable industrial sold machine wants to be done, this must accomplish some goals.

The press restyling is adapting it to achieve these goals without losing the functionality.

2.2.1. Goals

The stipulated goals that the machine must achieve to reach a better acceptation on the market are:

- *Compactness*: this is a various stages and areas machine that may employ a huge part of the factory space. As more compact, more easy will be to put it in any place.
- *Modularity*: tied on the compactness, if it is possible to reach a modular machine, it will be adaptable to all types of factories, optimizing this way the destination rooms. With this modular structure it will be possible to develop a machine suitable to small rooms, opening this way a new market line.
- *Simplicity*: although the fabricate company (EKOlogis) is the responsible of the assembly, one goal is reducing the parts or doing it less complex to prosper the assembly and also the transport. The goal is also simplify the parts to make an easy fabrication and its reparation could be more economic.
- *Lightness*: it will be modified for the previous proprieties and will imping on the assembly, the price of the self-fabrication parts, the transport method and the packaging.
- *Economy*: the target is reducing the sell price to aim all the types of companies doing all the applicable changes. This way it could get in the biomass combustible market as a strong competition.
- *Aesthetic*: this is the most difficult goal to aim. It has to combine the complete functionality with the wanted aesthetic :
    - Modernity
    - Simplicity
    - Lightness
    - Cleanliness

2.2.2. Changes and improvements

Before the studies, some changes were made to adapt the machine to the new method for doing briquettes (using oil instead of water):

- Dispenser: add → to insert oil on the mixture.
- Oven: eliminate → no need drying zone with oil briquettes
- Residues treatment area: eliminate → also as the process has changed, this area is not necessary anymore.
- Change the 4 stages transfer to 3 stages transfer → as the process and the material has changed, the last stage (cleaning stage) is not necessary.

Image 18. Briquette machine before changes
Source: own source

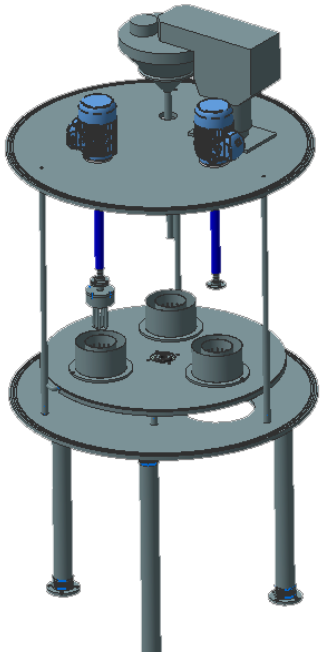


Image 20. Briquette machine after changes
Source: own source

Image 21. Molds before restyling
Source: own source

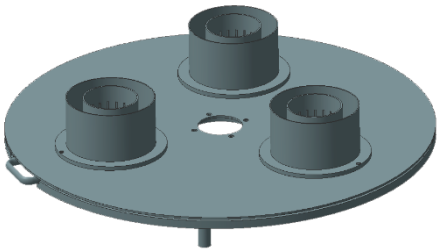


Image 19. Molds after restyling
Source: own source

2.2.2.1. FMEA

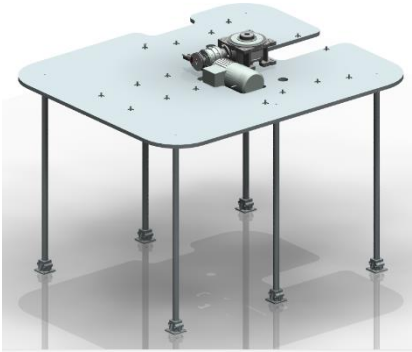
Failure mode and effects analysis (FMEA), is a systematic analytic technique which allow detecting possible failures before the next step or reach the costumer. It is an analytic tool to eliminate risks.

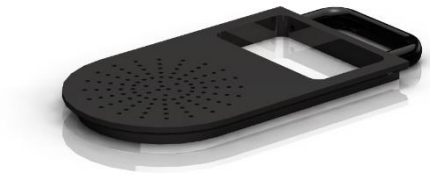
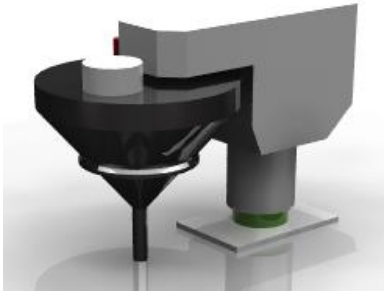
This technique may be employed on new designs or on existing ones which present some controversial parts as it's done in this project.

The table below show the followed process to redesign some parts with the objective to reduce producing costs, materials and a better visual aspect.

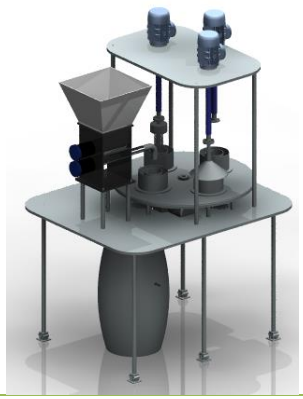
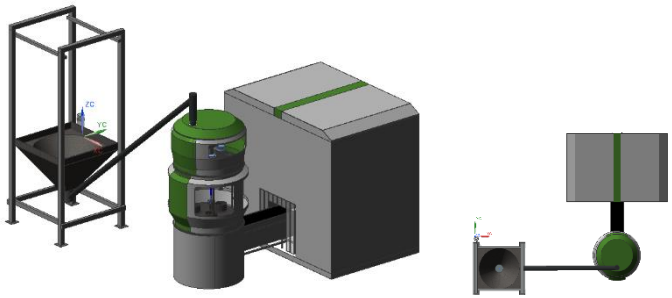
System Name:	Briquette Press	External suppliers:	UPC Vilanova	Engineer lead:	Clara Casademont / Núria Vendrell		
Model year:	2015	Production date:	NS	FMEA Date (original)	10/05/2015	Last Revision:	06/06/2015

Part Name	Part Function	Potential failure mode	▽	Potential effect(s) of failure	Potential failure cause	Present Conditions					Recommended action(s)	Responsible area/engineer	Results				
						Present Check(s)	Occurrence	Severity	Detection	(R.P.N.) Risk Priority Number			Action taken	Occurrence	Severity	Detection	(R.P.N.) Risk Priority Number
Bench legs and moorings	Machine support	Excess vibrations	1	Instability and excessive noise	Poorly chosen legs diameter	Finite elements studies	8	8	9	576	Different legs studies	Technic department	Change legs diameter	2	8	7	112
		Non security aspect	2	Loss of confidence in the company	Bad design	-	10	5	9	450	Design study	Design department	Design change	1	5	2	10
Bench table	Machine support	Difficult packaging	3	Transport costs raise	Different geometry from the rest of the machine	Packaging study	10	7	6	420	Different packaging studies	Design department	Geometry change	2	7	3	42
		Poorly visual aspect	4	Sales decrease	Different geometry from the rest of the machine	3D checks	10	5	8	400	Different geometries studies	Design department	Geometry change	3	5	2	30
Part drainage	Drainage oil	Not recollect the oil and expand it	5	Poorly running machine	Part missing	3D study	10	9	9	810	New parts studies	Design and techinch department	New part design	1	9	4	36
Upper support	Support little machines	Difficult packaging	6	Transport costs raise	Different geometry from the rest of the machine	Packaging study	9	7	6	378	Different packaging studies	Design department	Geometry change	2	7	3	42
		Poorly visual aspect	7	Sales decrease	Different geometry from the rest of the machine	3D checks	8	5	8	320	Different geometries studies	Design department	Geometry change	3	5	2	30
Dispenser	Dispenser the mixture	Block the system security	8	Do not fit in the assembly	Too big	Geometry checkings	10	9	6	540	Different dispensers (types and companies) research	Commercial department	Dispenser change	1	9	3	27
Bigbag structure	Sawdust transport	Low sawdust and oil mix	9	Bad briquettes compaction	Bad oil entrance	Mix fluids study	7	8	2	112	Study differents ways to mix the components	Technic department	Change the mixer method	3	8	2	48
		Do not achieve the dispenser	10	Do not enter the mix into the dispenser	Too short	Geometry checkings	10	10	9	900	Study differents ways to transport the mix	Technic and commercial department	Transport part change	2	10	3	60
Security system	Ensure the system	Low security to the user	11	Possibility of hurt to the user	Ensure the zone but not the machine	Expert feedback	5	9	7	315	Study different security methods	Technic department	Change the security system	2	9	7	126
		Space waste	12	Bad machine distribution	Ocupy too much space	Visual study	6	7	9	378	Study compact security methods	Technic department	Change the security layout	3	7	5	105

Potential Failure Mode	▽	Before FMEA	After FMEA
Excess vibration & Non security aspect	1 & 2	Skinny legs. Good resistance but fairly resistance to vibrations. 	Resistance vibration improvement besides save material (from six to three legs). 
Difficult packaging & Poorly visual aspect	3, 6 & 4, 7	Different geometries between the parts of the machine. 	Adjust this geometry to transform it like the others for a better packaging and better visual aspect. 

Potential Failure Mode	▽	Before FMEA	After FMEA
Not recollect the oil and expand it	5	Some remainig oil of the press process can be extrect and if it is not tecollected, it can damage the machine. 	Has been added some detachable component to recollect the remaining oil. 
Block the system security	8	Horizontal dispenser impede using a compact security system. 	Vertical dispenser allow to position this element inside the security system. 

Potential Failure Mode	▽	Before FMEA	After FMEA
Low sawdust and oil mix	9	 Oil entrance is on the last moment so the mix is not enough.	Oil entrance is now on the first stage of the process. 
Do not achieve the dispenser	10	 Short endless belt, do not achieve the dispenser.	 Extend endless belt to reach the dispenser.

Potential Failure Mode	▽	Before FMEA	After FMEA
Low security to the user	11	 The security system protect the area but not the press.	 Has been added a security system to the press to ensure the user. It also give a better visual aspect and compactability.
Space waste	12	The whole machine take up 6 x 4m. 	Has been reduced the taken up space to 5 x 3m and the parts are also modular, so the layout can be changed 

2.2.3. Final design

Once all the improvements has been implemented on the press, these are the final results:

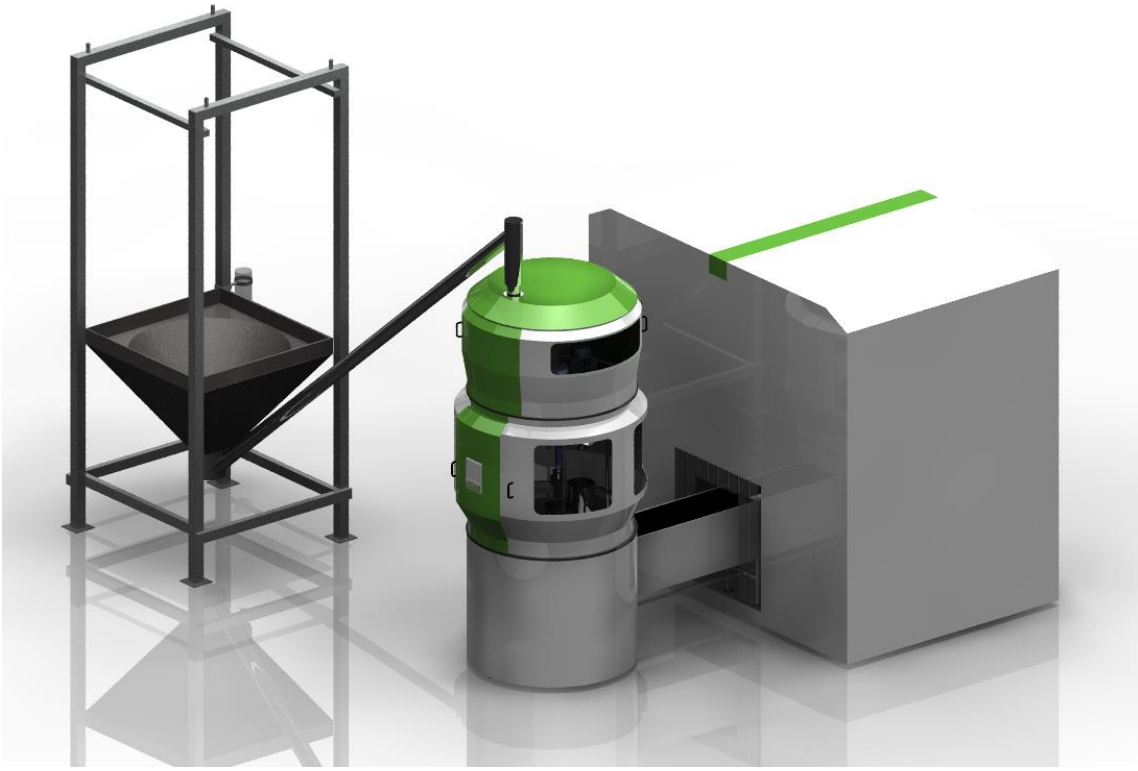


Image 22. Complete restyled press
Source: own source

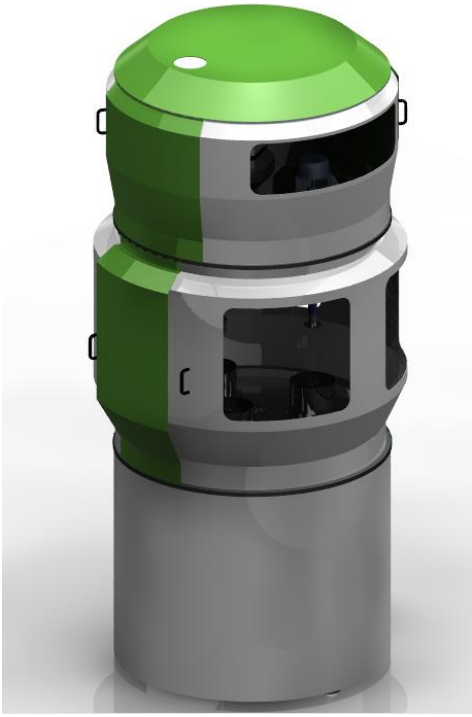
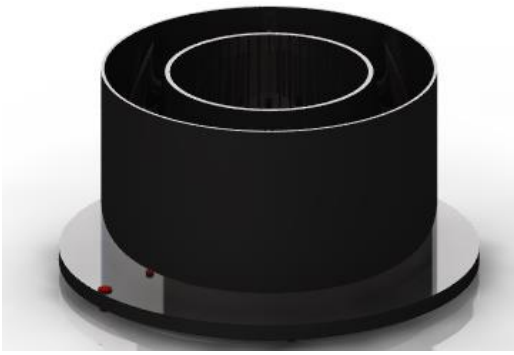


Image 23. Basic press part
Source: own source

- **Construction parts details:**

100 – Mold Function: briquette shape

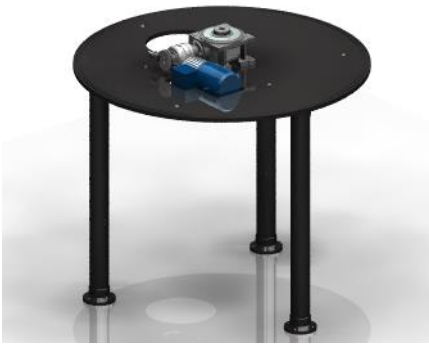


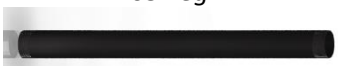
Part	***Production process***	***Geometry justification and function***
101 Neck 	AISI316 Circular profile Ø129	Top mold part.
102 Body 	AISI316 $Ø_{sup}$129	Lower mold part.
103 Base 	Mechanized AISI316 shape Ø260 x 20mm	Hold the mold and position it on the discs.
104 Stopper 	AISI316 Circular profile Ø208	Prevent oil remains damaging other parts

Standard elements

Part	***Brand***	***Use***
Dial 	Essentra	Mold positioning on the discs assembly.

200-Bench Function: elements support

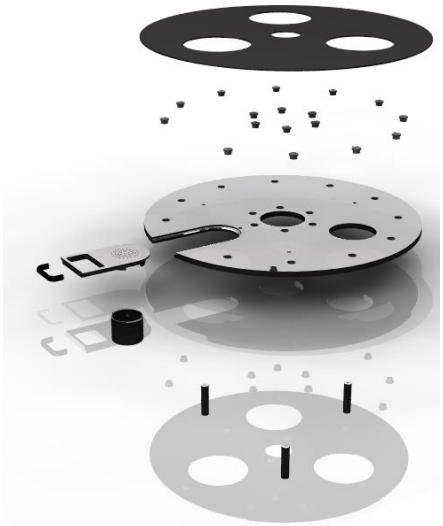


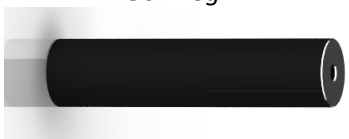
Part	***Production process***	***Geometry justification and function***
201 Table B 	Mechanized AISI316 shape Ø1260 x 20mm	Hold normalized elements and all the press machine. Circular geometry for a better assembly
202 Mooring 	Mechanized AISI316 Ø140 x 70 mm	Fasten the bench on the floor.
205 Leg B 	Mechanized AISI316 tube Ø83 x 1000mm	Hold, stabilize and position the bench table.

Standard elements

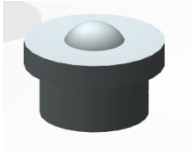
Part	***Brand***	***Use***
Turntable 	Goizper	Convert the machine into a 3 stage rotating one.
Screws 	Essentra	Join elements

300-Discs Function: mold rotate



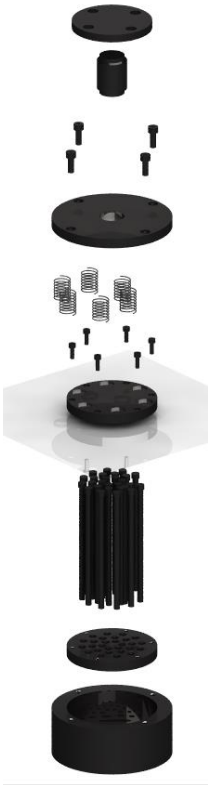
Part	***Production process***	***Geometry justification and function***
301 Disc Fix 	Mechanized AISI316 shape Ø1000 x 20mm	Mold hold and move them to the different stages
302 Leg D 	Mechanized AISI316 tube Ø20 x 130mm	Join hold on the bench
303 Removable part 	Mechanized AISI316 shape 284 x 168 x 35mm	Impede obstructions and machine getting dirty. Press helping.
304 Disc mobile 	Mechanized AISI316 shape Ø1000 x 5mm	Mold hold and move them to the different stages

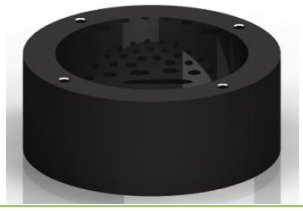
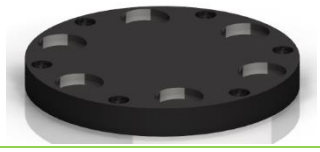
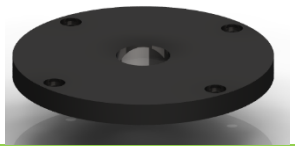
Standard elements

Part	***Brand***	***Use***
Screws 	Essentra	Join elements
Handle 	Elesa + ganter	Hand holding to extract the removable part.
Transp. balls 	Essentra	Movement helping

400-Ejectors press

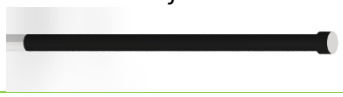
Function: briquette press



Part	***Production process***	***Geometry justification and function***
401 Bench E 	Mechanized AISI316 shape Ø90 x 10mm	Lower ejector holding
402 Housing 	Mechanized AISI316 tube Ø120 x 47,5mm	General ejector holding and elements cover.
405 Shoe 	Mechanized AISI316 shape Ø90 x 10mm	Top ejector and springs holding
406 Cover 	Mechanized AISI316 shape Ø120 x 10mm	Cover and top springs holder.
406-1 Support	Mechanized AISI316 tube Ø30 x 40mm	Linear actuator coupling

		
406-2 Coupler 	Mechanized AISI316 shape Ø80 x 8mm	Linear actuator coupling

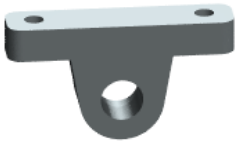
Standard elements

Part	***Brand***	***Use***
403 Ejectors 	DMEEU	Make wholes to favor the combustion
Springs 	INMACISA	Pressure and elasticizes the subset
Screws 	ESSENTRA	Join elements

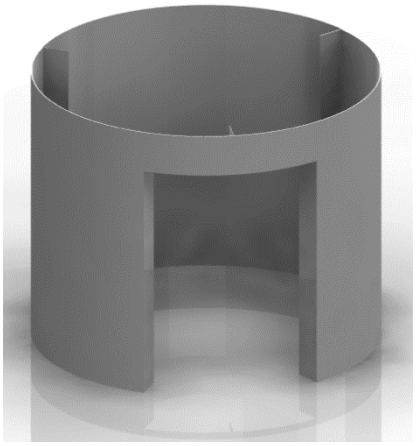
500-Elements bench Function: upper elements support

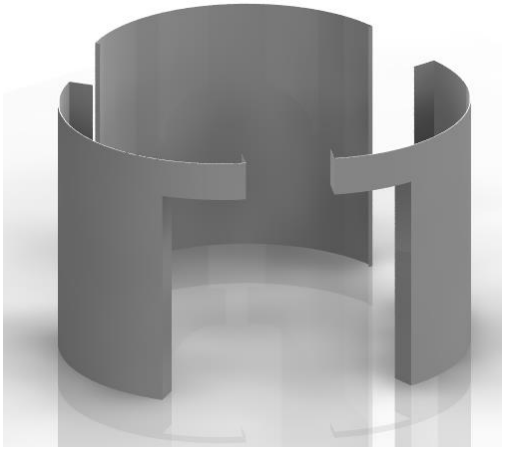
Part	Production process	Geometry justification and function
502 Leg A	Mechanized AISI316 tube Ø20 x 1000mm	Elements bench holding on the general bench
503 Table A 	Mechanized AISI316 shape Ø1260 x 20mm	Hold normalized elements Circular geometry for a better assembly

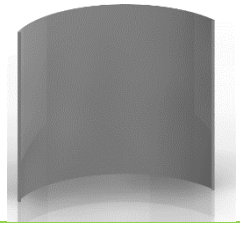
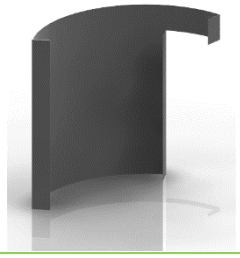
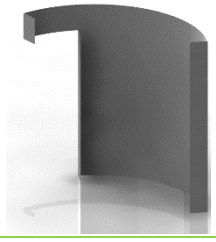
Standard elements

Part	Brand	Use
Screws 	ESSENTRA	Join elements
Bracket 	NIASA	Join elements

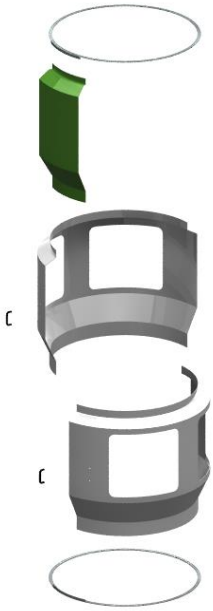
601-Security system (lower) Function: secure the machine and worker

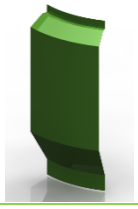
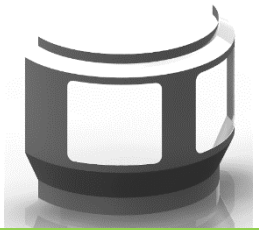
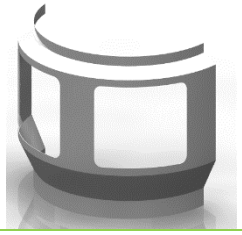




Part	***Production process***	***Geometry justification and function***
SS L1 	Bended steel shape Ø x 0,5mm	Avoid dirty entrance.
SS L2 	Bended steel shape Ø120 x 0,5mm	Avoid dirty entrance and let conveyor belt work.
SS L3 	Bended steel shape Ø120 x 0,5mm	Avoid dirty entrance and let conveyor belt work.

602-Security system (middle) Function: secure the machine and worker



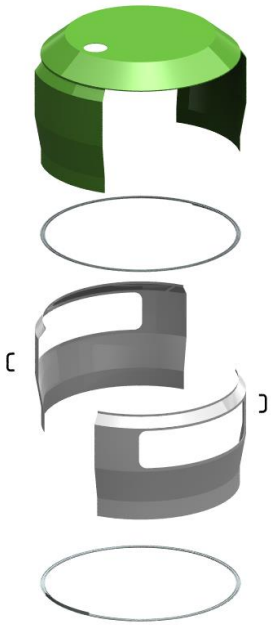
Part	***Production process***	***Geometry justification and function***
SS Fix M 	Bended + welded + laser cutting steel shape 10º x 1090mm	Security system holding
SS Rotary M1 	Bended + welded + laser cutting steel shape Ø 1388 x 1100mm	Rotary security system part. Manipulate elements allowing.
SS Rotary M2 	Bended + welded + laser cutting steel shape Ø 1425 x 1100mm	Rotary security system part. Manipulate elements allowing.

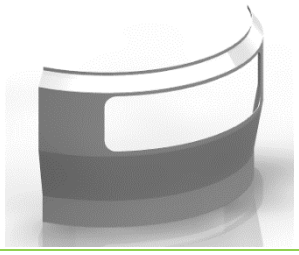
Standard elements

Part	***Brand***	***Use***
Rail 	DUCASSE	Rotate security system allowing.
Wheel system 	DUCASSE	Rotate security system allowing.
Handle 	ELSA + GANTER	Hand holding to rotate the security system.

603-Security system (top)

Function: secure the machine and worker



Part	***Production process***	***Geometry justification and function***
SS Fix T 	Bended + welded + laser cutting steel shape 70º x 1338mm	Security system holding
SS Rotary T 	Bended + welded + laser cutting steel shape 130º x 702mm	Rotary security system part. Manipulate elements allowing.

Standard elements

Part	***Brand***	***Use***
Rail 	DUCASSE	Rotate security system allowing.

Wheel system 	ELSA + GANTER	Rotate security system allowing.
Handle 	DUCASSE	Hand holding to rotate the security system.

2.3. ECO-DESIGN

The eco-design is an applied product and process design methodology, pointed to prevent and reduce the environmental impact. The eco-design practices stand out to add specific environment judgments to the other used variables on the valuation product performance studies lengthwise of its cycle life (production, distribution, use, recycling and final processing).
It is been analyzed the whole ensemble and the parts separately:

a) New concept development

- Dematerialization:
    a. *Briquette*: has been changed the production method, instead of using water is using recycled oil.
    b. *Machine*: order normalized parts on the same company to reduce transport resources.

- Share use and function integration:
    a. *Briquette*: it can be used on barbeques, fireplaces and boilers (particulars and industrials).
    b. *Machine*: the pressing stage has two functions: press the mix and do the holes for a better combustion on the same time.

b) Consume reduction and material diversity

- Minimization:
    a. *Briquette*: do not apply
    b. *Machine*: has been eliminated water consume and the residues treatment area.

- Thickness optimization:
    a. *Briquette*: do not apply
    b. *Machine*: has been reduced some thickness. Others are restricted for the parts.

- Part reuse:
    a. *Briquette*: do not apply.
    b. *Machine*: do not apply.

- Superficial treatments avoid:
    a. *Briquette*: packaging with ecological papers and punched branding.
    b. *Machine*: packaging with ecological papers, punched branding and minimization of the superficial treatments.

- Environmental impact:
    a. *Briquette*: has been selected wasted materials to create it.
    b. *Machine*: do not apply.

c) Less environmental impact materials.

- Natural by-products:
    a. *Briquette*: has been selected wasted materials to create it.
    b. *Machine*: do not apply.

- Recycled material:
    a. *Briquette*: 100% recycled material.
    b. *Machine*: build it with recycled stainless steel.

- Without dangerous substances:
    a. *Briquette*: do not use dangerous substances.
    b. *Machine*: do not use dangerous substances.

- Correct environmental production process:
    a. *Briquette*: do not apply.
    b. *Machine*: do not apply.

- Easy recyclability:
    a. *Briquette*: bio combustible. It cannot be recycled because there is no waste after use it.
    b. *Machine*: most parts are stainless steel, a 100% recycle material.

- Low energetic power:
    a. *Briquette*: do not apply.
    b. *Machine*: is an electrical machine (not pneumatic) and has been removed some stages which had high energetic consume (oven).

d) Reduce product process environmental impact

- Productive period reduce:
    a. *Briquette*: has been eliminate one stage.
    b. *Machine*: do not apply.

- Recycled production wasted:
    a. *Briquette*: the wasted can be processed equally.
    b. *Machine*: there is no wasting.

- Correct environmental production process:
    a. *Briquette*: do not use water anymore and do not produce wasting in its production.
    b. *Machine*: do not apply.

e) Distribution optimization

- Reduce pack using:
    a. *Briquette*: reuse packaging. It works as a fire initiator also.
    b. *Machine*: modular packaging which every part fits in another.

- Less environmental impact materials for the packaging:
    a. *Briquette*: do not use plastics and dangerous paints. Only cardboard sheet and bio-paintings.
    b. *Machine*: do not use plastics and dangerous paints. Only cardboard sheet and bio-paintings.

- Identify material with its symbol:
    a. *Briquette*: do not apply.
    b. *Machine*: do not apply.

- Maximize product contents:
    a. *Briquette*: different packaging for each use.
    b. *Machine*: disassembled transport and packaging to fit every part in each other.

- Reduce product weigh and packaging:
    a. *Briquette*: do not apply.
    b. *Machine*: disassembled transport and packaging to use less space.

f) Environmental impact reduce during its use.

- Reduce energy and water consume:
    a. *Briquette*: has been eliminate water use.
    b. *Machine*: has been changed some normalized parts to reduce energy consume.

- Add renewable energies use:
    a. *Briquette*: 100% recycled materials.
    b. *Machine*: do not apply.

g) Useful life increase

- Product reuse:
    a. *Briquette*: do not apply. After using there is no remain product.
    b. *Machine*: do not apply.

- Eliminate wake points:
    a. *Briquette*: do not apply.
    b. *Machine*: has been eliminated difficult edges. The majority of pieces are cylindrical in order to increase the resistance and the general aspect.

- Appropriate material thickness:
    a. *Briquette*: appropriate thickness according to the tests.
    b. *Machine*: the thickness of the walls has been defined for its resistance, durability and correct use.

- Modular product:
    a. *Briquette*: different packaging for each use.
    b. *Machine*: different layouts to fit in each factory or space.

- Maintenance and repair facilitate:
    a. *Briquette*: do not apply.
    b. *Machine*: vulnerable components are easy to unmold and replace.

- Replacements:
    a. *Briquette*: do not apply.
    b. *Machine*: replacements are provided on the website.

h) Waste management optimization

- Recyclable biodegradable materials:
    a. *Briquette*: totally biodegradable materials.
    b. *Machine*: the majority of parts are made in stainless steel, 100% recyclable material.

- Less number of different materials:
    a. *Briquette*: do not apply.
    b. *Machine*: the majority of parts are made in stainless steel.

- Compatible materials on its whole recyclability:
    a. *Briquette*: do not apply.
    b. *Machine*: do not apply. The machine has to be unmold for its recycling.

- Minimize paint use:
    a. *Briquette*: do not use painting and superficial treatments. All the packaging is made with perforated cardboard.
    b. *Machine*: only using painting for the external pieces (design strategy). Some superficial treatments are necessary for its well running.

- Simplify stripping down:
    a. Briquette: do not apply.
    b. *Machine:* all the machine is easy to strip down and assemble (accessible joining points, common tools…).

4. SUPPORTING NUMBERS

4.1. QUANTITIES STANDARDIZATION

For the quantities standardization the data has been provided by the experimental studies made for new briquettes type function test. As measures of tests molds are the same as press machine molds,

The known data are:

- Quantity of sawdust for 12 briquettes = 3 kg
- Sawdust density = 0.30 ton/m^3 = 300 kg/m^3

$$Sawdust\ volume = \frac{3kg \times 1m^3}{300\ \frac{kg}{m^3}} = \mathbf{0,01\ m^3}$$

Also, is easy to know how much sawdust is needed to produced 1 briquette:

$$Q = \frac{3kg}{12\ briquettes} = \mathbf{0,25\ kg\ of\ sawdust\ per\ briquette}$$

To know the needed quantity of oil or butter to produce one briquette, the calculations are:

The known data are:

- Quantity of oil for 12 briquettes = 1,5 liters

So, the quantity of water per briquette is:

$$Qoil = \frac{1{,}5l}{12\ briquettes} = \mathbf{0,125\ liters\ of\ oil\ per\ briquette}$$

Once all these unitary quantities of sawdust and oil are known, is the time to calculate the mix total weight per briquette because this quantity will be the quantity introduced inside the dispenser for a well dosage into the mold.
So,

Sawdust = 0,25 kg
Oil (density = 0,92Kg/dm^3) = 0,125 liters = 0,155 Kg

$$Total\ mescla = 0{,}25kg + 0{,}155kg = \mathbf{0,405\ kg\ of\ total\ mix}$$

Therefore, the dispenser let pass to each mold 0,405 kg of mixture to produce one briquette.

4.2. Process Design

Client:	UPC	**Briquette Press Reestyling**											**Production:**	4.901 U/ Day		**Project:**	TFG_2.0
Engineers	Clara Casademont / Nuria Vendrell												**Cycle time:**	5 seconds		**Data:**	06/06/2015
Comapny	EKOlogis	Cycle time											**Disponibility:**	87,50%			
		Time [s]	Start [s]	End [s]	Repetitions/ day												
Position	Concept		First briquette			...	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	...
	Sawdust charge	600	0	600	1												
	Sawdust transport - dispenser	60	600	660	continu	...											...
	Dispenser mix	20	660	680	continu	...											...
	Step change	1	680	681	677,5												
	Charging stage	**4**	681	685	2700												
1	Mold charging	3	681	684	2700												
	Waiting time	1	684	685	2700												
	Step change	1	685	686	677,5												
	Press stage	**4**	686	690	2700												
2	Press approximation	0,5	686	686,5	2700												
3	Press	2	686,5	688,5	2700												
4	Press retreat	0,5	688,5	689	2700												
5	Oil drainage	1	689	690	2700												
	Waiting time	0	690	690	2700												
	Step change	1	690	691	677,5												
	Unmold stage	**4**	691	695	2700												
6	Press approximation	0,5	691	691,5	2700												
7	Unmold	1	691,5	692,5	2700												
8	Press retreat	0,5	692,5	693	2700												
	Waiting time	2	693	695	2700												
	Packaging briquette transport	6	695	701	continu	...											...
	Packaging	30	701	731	continu	...											...
	Briquette pick up	1	731	732	continu	...											...

Diagram 1. Process design (Cycle time)

Source: Own source

4.2.1. Process design calculations

Knowing that the first briquette takes 695 seconds to go out finished but the rest only take five seconds (one cycle) and knowing that the machine is in operation seven hours per day, can be determined that:

Data:

- 1st briquette → 695 seconds
- Other briquettes → every 5 seconds
- Uptime → 7 daily hours = 25.200 daily seconds

$$Daily\ briquettes\ (teorical) = \frac{25.200s - 695s}{5s/briquette} + 1briquette\ (1st) = \mathbf{4.901\ briquettes}$$

If each briquette have 0,5Kg of sawdust, to achieve these 4.901 briquettes is needed:

$$sawdust\ Kg = 4.901\ briquettes \cdot 0{,}5\frac{kg}{briquette} = \mathbf{2.450{,}5\ kg\ serradures}$$

Once these theoretical data is known is easy to calculate what will be the real data:
Big Bag measures are standardized:

$$BigBag = 1{,}5\ x\ 1{,}5\ x\ 2\ m = 4{,}5m^3$$

With these data and the sawdust density known (d = 300 kg/m^3):

$$Sawdust\ Kg\ per\ BigBag = \frac{300kg}{m^3} \cdot 4{,}5\ m^3 = \mathbf{1350\ kg\ each\ Bigbag}$$

If each briquette have 0,5kg of sawdust, as mentioned before:

$$nº\ briquettes\ per\ BigBag = \frac{1350\ sawdust\ kg}{0{,}5\ kg/briquette} = \mathbf{2700\ briquettes\ per\ BigBag}$$

So, if the briquette press can produce 4.901 briquettes per day and one bigbag can give sawdust for 2700 briquettes. Daily, the machine will need 2 sawdust bigbags.

$$nº\ bigbags = \frac{4901\ briquettes/day}{2700\ briquettes/brigbag} = 1{,}82\ bigbags\ \approx \mathbf{2\ bigbags}$$

4.3. PRODUCTION DESIGN

Engineers:	Clara Casademont Nuria Vendrell	Briquette Press Restyling	Production total time:	19 weeks	Project:	TFG_2.0
Company:	EKOlogis	Production Organization			Date:	06/06/2015

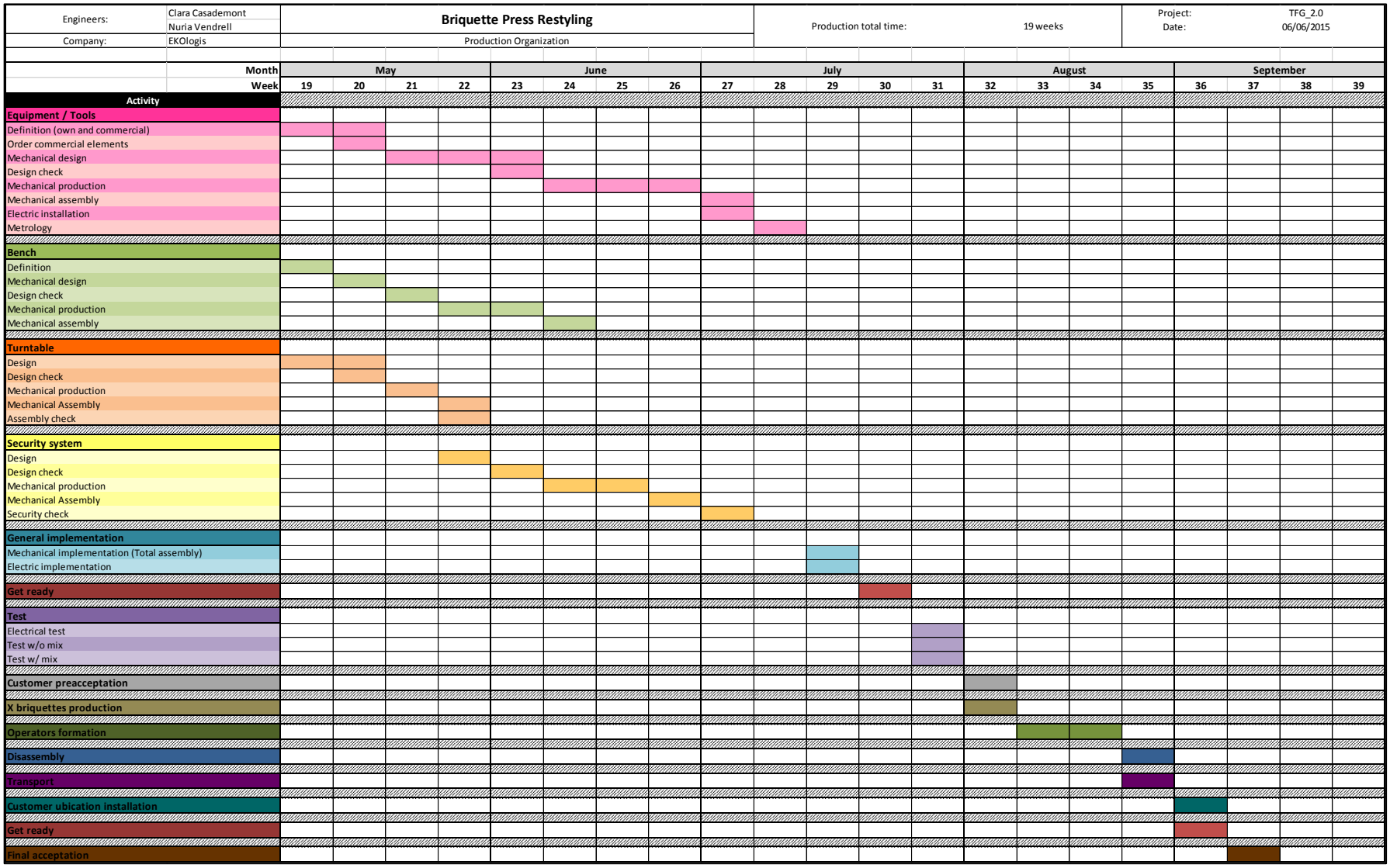


Diagram 2. Production Design

Source: Own source

4.3.1. Production design explanation

Apart of the process design, if the machine has to be sold, other type of calculations has to be made. These calculations are the production design. Everyone who wants to buy a product with these characteristics wants to know how much time has to spend until having the machine in his/her house or factory.

The previous production design shows all the production organization about the press from the definition and design (already completed) to the final acceptation. This organization is separated by the most important sub-assemblies as the general equipment and tools (commercial or not), the bench, the turntable and the security system. Later, another activity appears in the organization which joins all these sub-assemblies to create the final machine. The following activities are: tests, checks, formations, transports, installation and final acceptation which are faster to implement than the other ones described.

As can be seen, to execute all the production it takes 19 weeks (about 5 months) because is necessary to combine many activities, suppliers, workers… at the same time, and those things are very difficult to organize with a short time.

This production organization is only a guide to show, more or less, each process times, but it can vary depending on the incidentals during the production.

4.4. Maintenance Costs

To know the cost to maintain all this machine, is necessary to calculate the monthly cost of each electrical product and the other extra costs. This analysis is made bearing in mind that the person who purchases it has the opportunity to achieve all basic components (reused oil and sawdust) for free.
So, the extra components costs are only for packaging elements (bags, threads, boxes…).

Here are the different tables, separated by electrical costs and packaging costs. Finally appears the total maintenance cost:

Electrical maintenance costs					
Product	KW	Operating hours per month	KWh	€/KWh	Maintenance cost per month
Endless belt	0,5	154	77	0,148679	11,45 €
Dispenser	1,5	92,4	138,6		20,61 €
Rotary table	0,05	30,8	1,54		0,23 €
Linear actuator	0,55	92,4	50,82		7,56 €
Conveyor belt	1,1	154	169,4		25,19 €
Packaging machine	0,03	61,6	1,848		0,27 €
TOTAL					**65,30 €**

Table 1. Electrical maintenance costs €/KWh *Endesa One 2.1A rate. Powers over 10KW*
Source: multiple sources

Looking at these monthly electrical costs, it can be determined that this restyled machine is better than the other one because the electrical costs have reduced about 80%.

Packaging maintenance costs			
Product	Quantity per month	Unitary price [€]	Total cost per month [€]
Packaging bags	21565	0,05	1.078,25 €
Packaging thread	2 x 1000m	0,01 €/m	20,00 €
Packaging boxes	1798	0,23	413,54 €
TOTAL			**1.511,79 €**

Table 2. Packaging maintenance costs
Source: multiple sources

The packaging maintenance costs are the principal monthly costs. This is because the necessary bags to package the briquettes are special because of its absorbent capacity (to absorb the used oil) and are a little bit expensive and the high machine productivity required 21565 bags per month.

Total maintenance cost	
Type	Cost
Electrical cost	65,30 €
Packaging cost	1.511,79 €
TOTAL	**1577,1**

Table 3. Total maintenance cost
Source: own source

4.5. STANDARD ELEMENTS CALCULATIONS

4.5.1. Minimum pressed force

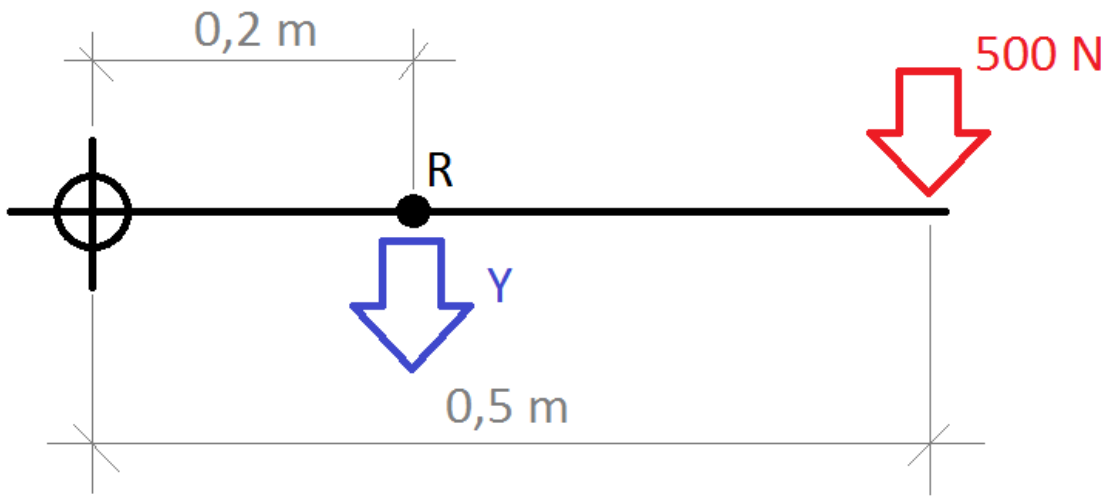
To determine the minimum press force that linear actuator has to do, different practical studies have been tested.
These practical studies proved on the manual machine which was produced in Indonesia. The test is based on place many elements, with the same weight (10 Kg), in the press zone until the press descend 70mm, the desired distance. Once the press achieve this descend, it is the time to account how many elements are necessary.

As mentioned, each element weighs 10 Kg and are need 5 elements to achieve the desired distance so the total weight is 50Kg.
To know the press force, the calculation is simple:

$$F = 50kg \cdot 9{,}8\, {}^{m}/_{s^2} = 490\ N\ \approx \mathbf{500\ N}$$

Once the press force is known, the press force that has to do the linear actuator is easy to calculate.
As the linear actuator force is directly to the briquette it is time to apply the lever rule:

Minimum press force for person = 500 N
Press distances:
Bench – center = 0,2 m
Bench – end = 0,5 m
So,



$$500 \cdot 0{,}5 = R \cdot 0{,}2$$
$$R = \frac{250}{0{,}2}$$

$$\boldsymbol{R = 1250\ N}$$

The minimum force that linear actuator has to do is 1,25 kN
Once this information is known, it can be determined what type of linear actuator is needed.

4.5.2. Linear actuator calculations

When the minimum actuator press force is known, is the time to determine the distance between mold and actuator to define all press geometry.
In this case, different calculations were made to know which distance is needed for this actuator.

Known data:

- Mold height = 120mm
- Distance to bench = 15 mm
- Press distance = 70mm
- Actuator separation = 50 mm

With these data, the distance that the actuator has to move to ideal pressed is known:

$$Distance = 120 + 15 + 70 + 50 = \mathbf{255\ mm}$$

Therefore, it can describe the minimum conditions that should have the chosen actuator:

- Minimum press force: **1250 N**
- Minimum axis distance: **255 mm**
- Possibility to add accessorize

Linear actuators are standardized elements so, we have to choose the most similar in the market and adjust it to apply the desired strength and make the required distance.

Finally, the chosen actuator has these technical characteristics:

- Maximum force = 3kN = **3000 N**→enough for the 1250 N necessaries.
- Distances: 100 mm, 200 mm, **300 mm** and 400 mm →where the 300mm distance has been chosen and adapted to the system
- Possibility to add accessorize

4.5.3. Turntable calculations

In this section, the purpose is to check that the turntable is well dimensioned for the plate and for all the forces located over it.

The turntable is the element which makes rotate all the structure for a well briquettes mass production. This turntable will have to do 3 stops, because in the press are 3 steps and for each spin it takes 1 second with a frequency of 50Hz.

GOIZPER turntable data (according to datasheet):

- Maximum axial load permissible: 6750N
- Maximum dumped moment permissible:265 Nm

AISI 316 plate data (own part):

- External diameter = 1000 mm
- Thick = 5 mm
- Plate weight= 60 kg
- Full tools weight (x4) = 25 · 4 = 100 kg

Applied forces data:

- Force ≈ 0 N
- Distance from center to press point = 275 mm = 0,275 m

$$Total\ axial\ load = 60 \cdot 9{,}8 + 100 \cdot 9{,}8 = 588 + 980$$

$$\boldsymbol{Total\ axial\ load = 1568\ N}$$

So, as total axial load are less than the permissible one, have been determinate the turntable is well dimensioned. Maybe is a little bit oversized but is the minimum turntable that the company offers.
In addition, being a perforated plate, the forces applied to it do not stop there, the dumped moment is minimal so, is also well sized for this part.

Here are the calculations made by the company from the data shown above:

GOIZPER **UNIDADES DE GIRO**

HOJA DE CÁLCULO - SISTEMAS DE GIRO INTERMITENTE GOIZPER

CLIENTE:	U P C	CONTACTO:	
N/REF:	18694/15 C1 U P C	18/03/2015	
S/REF:	Mesa 4 estaciones		

DATA

Tiempo de giro:	3,00 s	Ángulo de giro de la leva:	315 °
Número de paradas:	4	Frecuencia:	50 Hz

MASA e INERCIA A DESPLAZAR

Descripción	Cantidad	De (mm)	Di (mm)	Rr (mm)	L (mm)	a (mm)	b (mm)	M (kg)	J (kg·m^2)
Plato	1	1000	0	0	0	0	0	60,00	7,50
Utiles	4	400	0	280	0	0	0	25,00	9,84

		Radio equivalente:	329,20 mm
Masa total:	160,00 kg	Rs de los seguidores:	55 mm
Inercia total:	17,34 kg·m^2	Re/Rs real:	5,99

CÁLCULO y SELECCIÓN

Velocidad de entrada:	17,96 rpm	Tiempo total (giro + reposo):	3,34 s
Tiempo de giro propuesto:	2,92 s	Acel. Angular max.:	1,26 rad/s^2
		Tiempo de parada (reposo):	0,01 s
Par dinámico requerido:	21,94 Nm	Tiempo de parada (emerg.):	0,03 s
Par de fricción:	Nm	Par de frenado:	5,00 Nm
Par de gravedad:	Nm		
		Unidad:	**PGI-220/4-315-D-S33**
Par de trabajo necesario:	21,94 Nm	Reductor:	**RMI40 i49LF39,6**
Par de trabajo admisible:	90,00 Nm	Motor:	**AT 63C6 0,13kW**
Par de entrada necesario:	13,24 Nm	Función de movimiento:	S33
Par de entrada admisible:	23,89 Nm	Coef. de aceleración:	6,88
		Potencia motor necesaria:	0,05 kW
Vida de la unidad:	80000 h		
Precisión:	± 0,020 a 55 mm		

IMPORTANTE:

En caso de modificación de algún dato, por favor consulte para verificación y validación del producto

4.5.4. Endless belt calculations

The endless belt is the element which carries the sawdust from the bigbag to the dispenser (inside the press), this element is also commercial but it is necessary to calculate how much material has to carry every hour to adjust the speed to the ideal briquette production.

Known data:

- Briquette weight = 0,405 kg
- Sawdust density = 300 kg/m^3
- Quantity of sawdust for 1 briquette = 0,00135 m^3
- Cycle duration = 5 seconds

So if is required that in the dispenser will be always the enough quantity of mix for four briquettes (1 cycle), there must be:

$$Sawdust\ volume\ in\ the\ dispenser = 0{,}00135m^3 \cdot 3\ briquettes = \mathbf{0{,}00405m^3}$$

If a cycle lasts five seconds, the transporter must send 0.066 m^3 of sawdust every 5 seconds, so:

Each 5 seconds → 0,00405 m^3
Each 3600 seconds → ?

$$Quantitat\ a\ transportar = \frac{3600s \cdot 0{,}00405m^3}{5s} = \mathbf{2{,}916\ m^3\ per\ hour}$$

The standardization of endless belt is (Image 24):

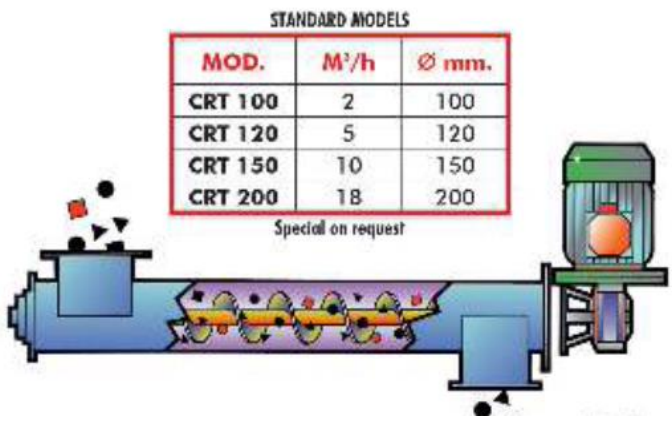


Image 24. Endless belt data
Source: Cavicchi

In this study case the standard items to choose are between CRT100 and CRT120. If 120 has chosen finally will be an excess sawdust in the dispenser, so it is preferable to choose the CRT100 that carries 2m^3/h, the dispenser always have material for three briquettes and as the transportation is continuous it never run out.

4.6. GEOMETRY SUPPORTING CALCULATIONS

Once all the standard elements calculations are executed, is necessary to study the geometry of non-commercial elements to check that are well dimensioned and to justify their geometry and their material.

In this press, the material cannot be chosen keeping in mind the total weight, the prices or the dimensions because the press has an important condition: all the system is continuously in contact with oil and with water when it is cleaned. For this reason the chosen material has to be oxidation resistant and also able to hold the different components weights and forces. So, the material is stainless steel, concretely AISI 316 because is a material with a high oxidation resistance and also has very good mechanical properties.

Then it goes on to justify the geometry of the most critical parts:

4.6.1. Disc Fix

The first element to study is the gyratory bench. This disc is called "Disc Fix" because is the element located below the rotary disc to support it and is fixing.
On this part is where all efforts fall at the first time. To check the well (or not) dimensioned has proven the von Misses strain applying all forces that has to support and this strain has been compared with the material elastic limit.
Another calculation made is to check the maximum disc shift.

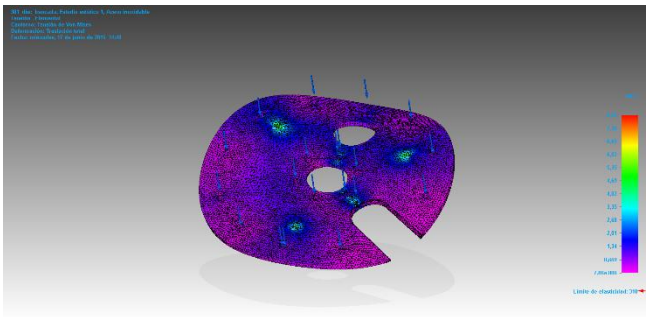


Image 26. Disc Fix Von Misses strain
Source: SE, own source

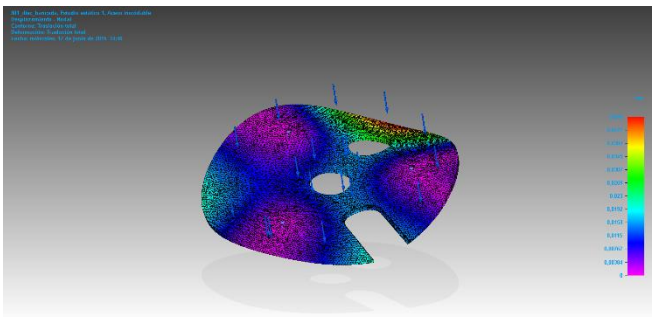


Image 25. Disc Fix maximum shift
Source: SE, own source

As can be seen in Image 25, the Von Misses strain in disc does not exceed the material elastic limit so, this part will not suffer any critic effort. The difference between the resultant strain and the elastic limit is so high and this sometimes means that the part is oversized but this oversized is not negative because it helps to avoid vibrations and noises when the machine will be running. Also, in this case the material reduction is not possible because inside this disc are incorporated the rotary balls and their need these measures.

Furthermore, the maximum disc deformation is insignificant (≅0,03mm), all the system are designed to support these small deformations.

4.6.2. Table B

Another critical part that needs study is the table which makes as all machine bench and has to support the rotary table weight, its forces and the actuator bench legs (part studied before).

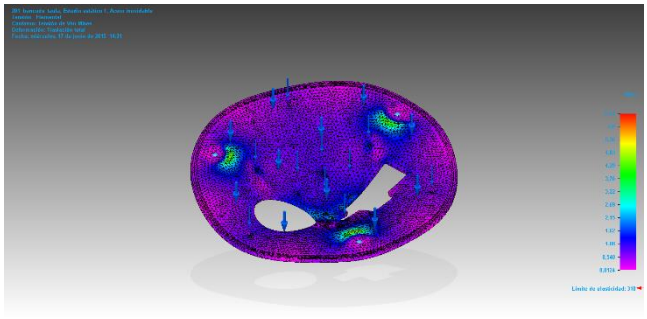


Image 28. Table B Von Misses strain
Source: SE, own source

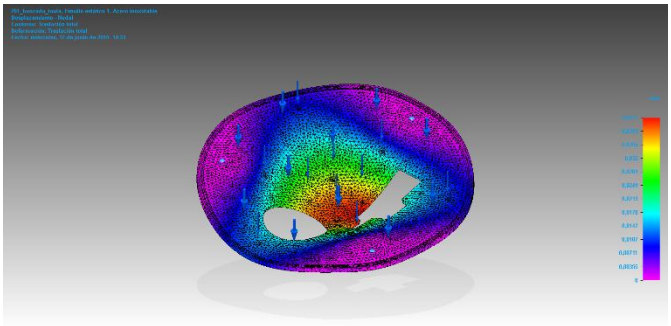


Image 27. Table B maximum shift
Source: SE, own source

As in the previous part, this is also oversized which gives more security in knowing that there will not be future problems. In this case, one option would be to reduce the table thickness and thus also would add lower costs but then other investments should be made to solve the problems of noise and vibration above.

Here, the maximum deformation is in the area with less material because also is the area with more forces applied. Despite this, this deformation does not cause any problem.

4.6.3. Table A

The sheet which works as an actuators bench is also studied to ensure the mechanism but knowing that will not cause any problem because is similar to the other bench and support less forces.
Here are its calculations:

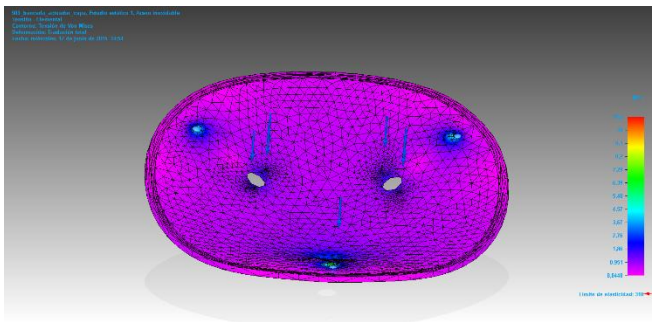


Image 29. Table A Von Misses strain
Source: SE, own source

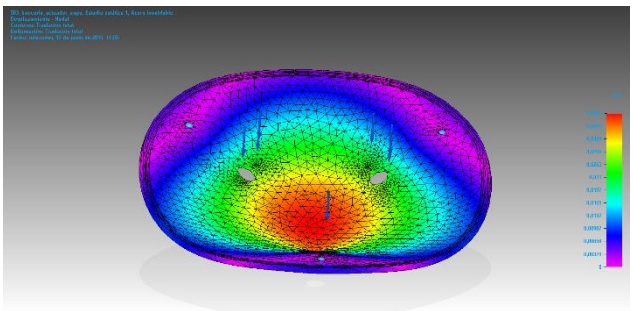


Image 30. Table A maximum shift
Source: SE, own source

4.6.4. Removable part

Another important part that is important to analyse is the removable one (of the press station). This part is located inside the bench disc and is where all the press forces are applied.
As the part is smaller than the other ones already studied and also has different parts without material, it is important to check how will be its changes when the maximum force will be applied.

Here are the results:

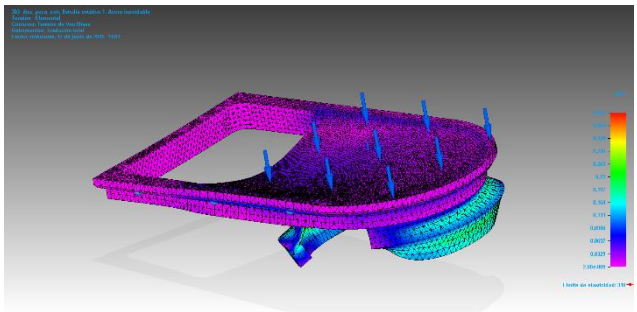


Image 32. Removable part Von Misses strain
Source: SE, own source

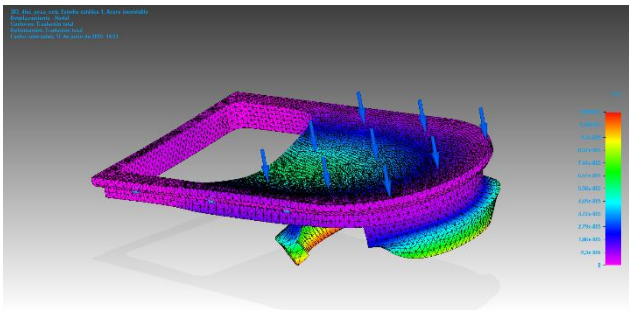


Image 31. Removable part maximum shift
Source: SE, own source

As can be seen in the Image 32 and Image 31, despite the fact that the part has a smaller dimensions does not have any problem with its limits.
It can be concluded that all own parts have been well designed with a positive oversized in terms of noise or vibrations.

4.6.5. Ejectors

Finally, the ejectors are also studies. The ejectors are the part which are located inside the press station, and which support the press force.

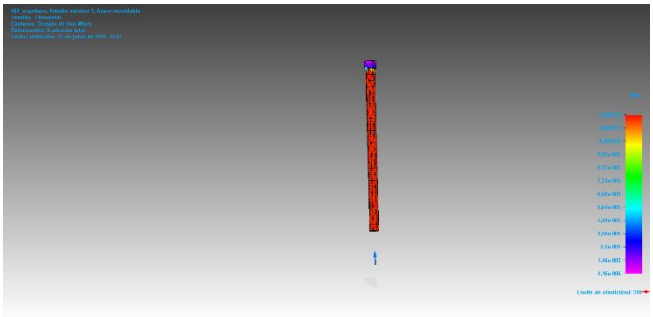


Image 34. Ejector Von Misses strain
Source: SE, own source

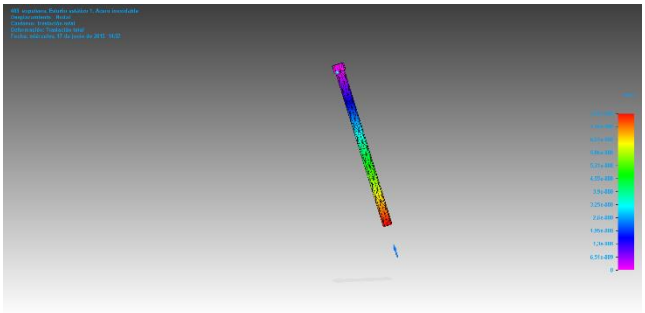


Image 33. Ejector maximum shift
Source: SE, own source

The ejectors neither have problems with the Von Misses strain (the maximum is about 0,010 MPa) or the maximum shift. So, this commercial part is well chosen.

4.7. Comparative numbers

To finish this calculations section it has been created a comparative table to compare the numbers results between the redesigned press and the press without restyling.
To make this comparison, different important characteristics have been chosen and compared.
Here are the results:

Comparative numbers				
	Before restyling	**After restyling**	**Observations**	**Comparison**
Quantity of material per briquette	Sawdust = 0,25 kg Water = 1,5 l	Sawdust = 0,25 kg Oil = 0,125 l	Less material used after restyling	✔
Briquette weight	1,75 Kg	0,405 Kg	Less weight per briquette after restyling. Packaging and transport easier.	✔
Calorific power per briquette	4.500 kcal/kg	4.850 kcal/kg	Higher calorific power after restyling. Conventional briquettes = 4.700 kcal/kg	✔
Burn time per briquette	15 min	23 min	Higher yield, more burning time after restyling.	✔
Nº of briquettes per day	3111 briquettes	4901 briquettes	A 57% more productivity after restyling.	✔
Electrical maintenance cost	350 €/month	65,3 €/month	Less maintenance cost for the restyling press. Less electrical components. Reduction of 80%	✔
Sustainable level (1 to 5)	3	4,5	Sustainable level is higher after press restyling. Change the materials, the stations, the components…	✔
Security level (1 to 5)	4	3	Change material, oil more inflamable.	✘
Adaptation level in different places (1 to 5)	1	4,5	After restyling better adaptation because have more uses	✔

Table 4. Comparative table
Source: own source

As can be seen in the Table 4, the restyling is better in every aspect except for the security level because of the material change.

5. BUSINESS MODEL

All the changes and improvements that have been made in the press are to be able to focus in a particular market with specific potential customers and to make it salable and profitable.
Once these changes have been implemented, the business model is the next part. This business model is based primarily on "creating" a company (fictitiously) in order to define all the processes to sell this machine in a reliable way; do some market research to define the business idea and to concrete the specific market that the press will be addressed and the potential customers that it may has. Also, this business model includes different studies of competitors and their prices as well as a SWOT analysis of the machine and all aspects of the marketing mix; the product, its price, the distribution (packaging and logistics) and promotion.

5.1. CREATING EKOLOGIS

As mentioned, the first thing done is to create the company that will sell the press. For this creation only have been given a name and have been defined the goals. Also, a logo has been created. This creation is simple because it is not an ADE project; it is only a way to show the product more realistic.

5.1.1. The company. Mission, vision and values

The company's name is: EKOlogis. Although it may seem very simple and random chosen name, it has a thought behind it. "Ekologis" is an Indonesian word to tell that something is ecological. This is the message the company wants to show, ecological and sustainable and for this the first part of the word (EKO) is written in capital letters.
Furthermore, although in English, Catalan or Spanish the word "ecological" has been written with C, the K in the Indonesian word gives it a youthful and dynamic touch, two great objectives for the company. The second part of the word "logis" is written in lowercase letters also wants to indicate the good corporate logistics to attract more attention of customers.

Once the company has a name, is the time to define the mission, vision and values:

- **Mission**: EKOlogis mission is basically promote and sale its flagship product, the press ZULFA. With it, the company wants to increase the advantages of people that use ecological systems as a substitute for conventional ones for the basic aspects in home. The public purpose of the company is both: the person who has to buy the press and the people who will benefit from its implementation. EKOlogis is intended for people with young spirit, wanting to improve the world, with awareness on the respect for the environment and enthusiasm to make changes in their lives. EKOlogis is different to all that surrounds it by its way of making and thinking and that's why can be a key company in a not too distance future.

- **Vision**: EKOlogis vision is try to extend the sustainable market throughout Europe and become the solution to the need of many people, providing facilities for daily life. EKOlogis also has vision to extend its market to other countries as EUA or Japan where the environment awareness is high.

- **Values**: EKOlogis values are direct and clear.
    - ✓ Environmentalism and sustainability
    - ✓ Cradle to cradle
    - ✓ Differentiation
    - ✓ Constant innovation

5.1.2. The logotype

The Image 35 shows the company logotype created.
This logotype wants to be more than a simple image for the company, it intended to convey the values of the company to all.
Also the logotype is the way for the enterprise to show itself in front of the world and this is the reason because there are a lot of studies behind its design.

Image 35. EKOlogis logotype
Source: Own source

There are the technic characteristics about the logotype:

Geometry
The principal geometry is a non-closed circle. The circle means that the company helps the world to finish the cycles (cradle to cradle) and also suggest that the company is familiar and closer to the customer. The opening part of the circle wants to show the open minded and innovations of the company.

Colours
The colours have also its meaning. The company have different corporative colours and there are two of them. The corporative colours are between green and orange-brown because are the colours that reflects better the values. With green colours people get the sensation about sustainability and environmentalism and the oranges colours are usually connected with the Earth and the recyclability.
The concrete used colours are:

[R: 91, G: 193, B: 5] [R: 209, G: 125, B: 3]

Fonts
Fonts are also important when the logotypes are created. In this logotypes in particular, are two type of font. One is for the “EKO” word and the other one for “logis” word.
EKO are written in capital and wide letters because is the most important word, the word that gives the principal adjective for the company: ecological.
LOGIS are simulating handwritten because with this type of letter the company gives more familiar sensations.

The concrete used fonts are:

- Font EKO: Fredericka the Great
- Font LOGIS: BlackJack

5.1.3. What EKOlogis provides

Until now, EKOlogis only offer one product; ZULFA machine. ZULFA machine is a press that produce sawdust briquettes with reused oil. It is about of an ecological and sustainable machine that makes ecological and sustainable product; the briquettes.

In the next sections, business idea and marketing mix, the product and sub-products are describe with all characteristics and technic details.

5.2. Business Idea

To raise a viable business idea, various market studies have to be made to justify that the product (and by-products) will be profitable, in which area they will be, who will be the potential customers…and ending with a solution focusing on a need required by a particular market.

The first step to start studying which is the potential sector for the press, is to depth knowledge of the by-product because is the part which will reach to the end user and which will add value (or not) to the machine.

As mentioned, the press is designed to produce briquettes; the briquettes are bio-fuel and are commonly used to generate heat. It is a 100% ecological and renewable product classified solid bio-energy.

Usually, these briquettes are cylindrical or brick shaped and have the principal function to substitute firewood and provide many advantages.

The briquettes can be made of different compacted materials as forest biomass, industrial waste biomass, urban waste biomass, charcoal or even a mix of all.

Image 36. Briquettes made from sawdust
Source: Own source

The press conceived is designed to produce briquettes with a mix of sawdust (as a base material) and reused oil or butter (as a levelling material). These two materials have been chosen because both are wastes that, separately, do not have another utility but compacting them appears the possibility of reuse them and closing a cycle “cradle to cradle”.

Once known the press’ by-product, it is time to start studying and concreting the priority utility and their customers (principals and potentials) and the ideal application zone.

5.2.1. Potential application

As previously stated, briquettes are made to generate heat. This heat can be generate in different ways; fireplaces, boilers, ovens… and this heat can be used in different aspects as heating, cooking…even in industrial uses.

After searching information about many possibilities to use briquettes, the desire is to focus to the most productive and profitable one. This possibility is: the briquettes used for domestic biomass boilers.
A biomass boiler is a heat exchanger where the energy is produced through a process of biomass internal combustion. These boilers are usually used for heating or to produce domestic hot water and also to generate industrial heat.

In the market are different types of biomass boilers:

- Pellets boiler
- Chip boiler
- Inverted flame boiler

As their names indicated, the first two boilers work with pellets (sawdust tubular compactions narrower and shorter than briquettes) or with chips (driftwood bigger than sawdust).
The inverted flame boilers usually work with firewood and are in this type where the application sector can be focus. The main desire is that the inverted flame boiler users replace the firewood and use briquettes for its price and for the comparative advantages.
Then, it explained in detail this type of boilers to understand its operation and where the briquettes can be used.

Inverted flame boilers

These boilers are the most common worldwide. Used (at first) firewood logs as biomass to burn and they are designed especially for domestic use (for their limitation on kW) in homes with one or flew floors.

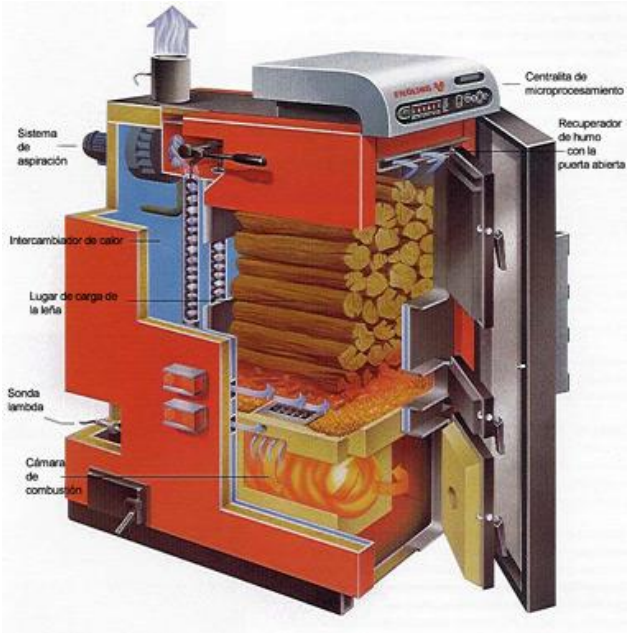


Image 37. Inverted flame boiler example
Source: www.cecu.es

The inverted flame boilers have this denomination for the combustion camera position, located below the firewood. Usually, these boilers have a rotor for the forced circulation of air.

A part of air (primary) is introduced into the boiler just above the grid which is supported the firewood. This part of air promotes the combustion (gasification phase), with the formations of embers in contact with the grid and the release of combustible gases from the wood pyrolysis (mainly carbon monoxide and hydrogen).

The liberated gases are drawn down through the grid and reach the bottom chamber, where the secondary air addition let the combustion finished. The key factors for optimum combustion are: an adequate amount of air, high temperature and high turbulences inside the combustion chamber and permanence, for enough time, of hot gases at home to complete thermochemical combustion reactions.

The flame inversion let to obtain a gradual combustion of firewood because it not completely burn in load, it burn only when the firewood reach the proximities of the grid. W

With this way, boiler dispensed power is more stable over time and let a better combustion control, increasing considerably yield and decreasing pollution emissions.

The most advanced models use regulation systems by microprocessors and achieve thermic yields about 90% and more.
One of the most new things are the air combustion regulation based in the oxygen need, calculated in the smokes with a special probe (lambda probe). The lambda regulation let regulate and optimize constantly the air quantity during the function cycle.
The briquettes application sector would be based in replace the firewood logs in the inverted flame boiler and using the briquettes. The briquettes give a lot of advantages in front of tradition firewood logs.
Although exist different flame inverted boiler types, with different measures and different biomass load type, in all the varieties the replacement for the briquettes is possible.
As mentioned before, these are the boiler types most used in the entire world. This indicates that is a good market to focus the business idea because the customer fleet is high.
Next is showed the results of a Europe study which are accounted approximately how many biomass boilers exist of each type:

Boiler type	Pellets boiler	Chips boiler	Flame inverted boiler
Quantity	279.398	283.707	4.372.140

Table 5. Study results: biomass boiler quantity of each type in UE
Source: own source

Flame inverted boilers are the 88,6% of total biomass boiler in Europe. So, this study supports the principal business idea.

Briquettes and flame inverted boilers

As already mentioned, the briquettes main use is to replace the firewood logs. The briquettes have many advantages (product and environmental advantages) besides the felling of trees decrease in front of the conventional firewood logs.

Product advantages	Environmental advantages
Higher calorific power	Clean energy. Not contaminant.
Easy and fast ignition	Renewable source
Low humidity	100% recycle
High density	Natural. Not toxic.
Takes up less space	No preservatives, chemicals or additives
Clean	Low smoke produced
Homogeneity	W/O bad smells
Easy manipulation	Less ash
No smells, smokes or sparks	Neutral CO_2 (no greenhouse effect)
Less ash	W/O environmental impact
100% ecological and naturals	Help to preserve the environment

Table 6. Product and environmental briquettes advantages vs. firewood logs

After studying all the advantages, the thinking about focus the business idea in the inverted flame boilers is consolidated. The conclusion is that the inverted flame boilers are a great potential application for briquettes because the briquettes can replace firewood logs without increasing the price and improving the environmental impact and their properties (a big added value for actual market).

5.2.2. Potential customers

To find correctly the press potential customers, it is necessary to do some market researches to know the countries which use more these sustainable technologies and the people profile that would use the briquettes in his/her home. Knowing this information it will be easier to concrete the potential customer for the designed press.

Potential countries

In the entire world are more developed countries than others and in the sustainable topic is the same. For that, a research have been made, to know the different Europe countries that use more the biomass inverted flame boilers (which the project will be focus) to know what are the potential countries in European continent to buy the briquettes press:

Table 7. Estimating stock flame inverted boilers in member states of the EU 2013

Member state	Flame inverted boiler
Austria	-
Belgium	34.270
Bulgaria	242.900
Cyprus	1.505
Czech Republic	296.450
Denmark	55.724
Estonia	28.698
Finland	183.888
France	217.323
Germany	321.860
Greece	27.193
Hungary	274.607
Ireland	19.058
Italy	136.077
Latvia	45.192
Lithuania	59.179
Luxemburg	1.226
Malta	613
Netherlands	48.368
Poland	765.477
Portugal	26.524
Romania	539.573
Slovakia	112.562
Slovenia	12.259
Spain	104.426
Sweden	194.476
England	288.370
EU27	**4.372.140**

As can be seen in the previous table, are many European countries that use this boiler type. The highlights countries as possible markets to focus are: Poland, Romania, Germany, England, Hungary and France.
If the attention is focused to notably countries, the majority are from the northern and eastern Europe, which have a large proportion of people living in isolated areas of the center, mostly in homes of one or few floors, and usually these countries have their own garden with enough space for these boiler type and also, these countries are very aware of respect for the environment as well as energy saving.
A part from in Europe, where have already proved that is a continent which can find a lot of potential countries, the company can also expand the market to other countries like EUA, Canada or Japan. These countries also have deep awareness with the ecological and sustainable culture and also have a similar lifestyle as European notably countries (isolated houses, apartments with few floors, space...).
So, the conclusion can be that the machine could focus to sale in different Europe countries (northern and eastern) and in EUA, Canada and Japan.

By-product customer profile

Once the potential countries have been described, it is time to determine the type of people who would buy the by-product, namely, the briquettes.

To determine this have been created a basic profile of potential by-customer:

- ✓ Biomass boiler owner (not essential)
- ✓ Resident in a potential countries
- ✓ Living in an isolated house with few floors
- ✓ Aged between 30 and 65
- ✓ Living with partner and / or children (the electrical cost is higher)
- ✓ Awareness to the environment

Although the concrete market for the business idea is biomass boilers, briquettes also can be used in other areas as ground fires or barbeques so, the biomass boiler owner requirement is not essential because other people can buy briquettes anyway.

Even though the product is not going to sell to these customers, it is good to know the by-product potential customer to determine correctly the potential specific product customer in order to make the appropriate advertising.

Potential press customer profile

Finally it is time to define the press customer profile. Starting from the product to sell and from all searches did previously, can be determinate the kind of person who it is addressed the press.

It has been defined different characteristics which the potential customer may have some or many of them. These characteristics are:

- ✓ Resident in previous mentioned countries.
- ✓ Owner of a factory where the waste produced is sawdust (sawmills, furniture factories, carpenters ...).
- ✓ Person with the possibility to get lots of sawdust without any cost (or very economically).
- ✓ Person wanting to expand their market and look for new business markets.
- ✓ Person concerned with the environment and sustainability.
- ✓ Person with initial investment capacity.

The press potential customer has to be a person who has the ability to buy the machine, with the possibility to get lots of sawdust and recycled oils or butters easily and without cost to have a manufacturing as economical as possible. In addition, the customer have to want to focus on new markets or expand their own market if he/she in already working is this subject.

As for the use of recycled oils or butters for the manufacture of briquettes, could be a good business idea that briquettes customers bring their recycled oils to owner press and thus ends up having a gain common: let the neighbors know where can leave their waste and they know that this waste will be well reused and the employer obtains the necessary equipment for free.

A good way to predict such as the success or failure of new product to market is studying the current market, the similar products, the companies and the prices to be able to compare them with the new product and determine the weaknesses and / or strengths of the new product.

Current market

In the current market are two types of machinery to produce briquettes. These types are:

- ✓ Domestic machines for manual manufacturing (sawdust with water)
- ✓ Industrial automated machines using two ways: mixing sawdust and water and only sawdust compacted under high pressure.

The current market sector most similar to the designed press is the second type, the industrial automated machines.

The difference with the current market is the use of different materials to create the same product. The designed press, as mentioned before, instead of using water as a compact material use reused oils and butters. This is the reason because of the machine is different from the others in the market, it has more sustainability and economical process and the final price is not so high as those made in high pressure machines because this press does not use much technology.

So, after the comparison with the current market we can conclude that, although there are similar machinery market, the new design provides differentiation and added value which could be an interesting point to highlight in its sale.

Image 38. Industrial automated briquette machine
Source: www.ostargi.com

Competitors

For the competitors study the information that has been searching are about different companies that sells this type of machinery to be able to study their business models and their publicity model.

Are different ways to get a briquettes press and the most difficult way is to find a company for the purchase.

Private sellers are most abundant. Whether they have the machine or if are second hand sold. It is the easiest way to find a briquette press as long as the buyer is an interested and look for one, do not exist the advertising outside the sector.

Chinese unnamed and no reference companies are also head of the list when someone is searching these type of products, although it does not give much confidence in being both a high inversion.

Finally has been found some companies that also offer such machines but not as a main element of the company. The two most important are:

- ✓ Ostargi

  Ostargi is a Spanish company located in the Basque country and is dedicated to all issues of alternative and renewable energy. Within its range of products are different types of briquettes presses made from all compacted sawdust under high pressure.
  Their presses have the prices ranging: 6.000 – 50.000 €
  Web page: www.ostargi.biz

- ✓ Felder

  Felder is a German company which is engaged in the manufacture and sale of all types of machines for woodworking. Within this range of products appear press briquettes although not the main element of their business.
  Their presses have the prices ranging: 8.500 – 100.000 €
  Web page: www.felder.at

After analyzing the competitors, it can be determined that the market is not very exploited and this is a plus for the proposed business idea. Although it must be done a great job in advertising to create a need for those who do not have it because surely someone who wants a briquette press, already could easily buy.

Prices

Finally, the prices of different types of machines on the market have been studied to see in which sector can be positioned the new product and if the price is consistent or not.

Because the difference on the price is very high depending on the machine type, a briquette press analysis has been made searching the prices separating them with characteristics:

- Manuals briquettes presses (mix of sawdust and water) and small (domestic)
    - The prices are ranging between 100€ and 1.000€
- Manuals briquettes presses (mix of sawdust and water) and big (industrial)
    - The prices are ranging between 1.500€ and 10.000€
- Automated briquette presses (mix of sawdust and water)
    - The prices are ranging between 15.000€ and 40.000€
- Automated briquette presses (sawdust compacting with high pressure)
    - The prices are ranging between 35.000€ and 120.000€

There are high fluctuations in prices because within the same sector are many machines with different technologies and characteristics each one (better materials, faster production, more sustainable...). This makes the price varies from one to another but the final product is the same.

5.2.3. SWOT analysis

In order to have a clearer view of the advantages and disadvantages that appear throughout the business idea has been designed a SWOT that summarizing them all and some new:

Intern Analysis	**Weaknesses**	**Threats**	**Extern Analysis**
	High initial inversion. Need large space to locate the machine. Big total measures. Difficult transport. Focused for people with poor experience about this subject. Little-known technique.	High competence with other products. Concrete market. It is not a standard commercial product. Entails enter to new markets and sectors. Need permits to apply in an industry.	
	Strengths	**Opportunities**	
	New way to manufacture briquettes: reusable materials (waste). Value added. Low cost of use. You just need one person in charge of the machine. Mostly automated process. Product & Service offer: competitive differentiation. It can be adapted to any country. Easy assembly	Untapped market. High business opportunity. Society increasingly aware on the environment (particularly in northern and eastern Europe). The crisis makes more people are enterprising and eager to expand their businesses to serve those seeking new sectors.	

Table 8. SWOT analysis

Source: own source

5.3. MARKETING MIX

The marketing mix is a business tool used in marketing and by marketers. The marketing mix is often crucial when determining a product or brand's offer, and is often associated with the four P's: price, product, promotion, and place.

In the following sections, these 4 P's are detailed:

5.3.1. Product

The product to promotion is the Zulfa press but also the by-product; the briquettes.

Zulfa press is a press that produces briquettes with reused and recycled materials to use as a firewood substitute. These briquettes are called bio-fuel and are more sustainable and ecological than others methods.

The press are full electric and it can operate with renewable energies, do not use any chemical material to produce the briquettes so is one of the most sustainable process.

The outer geometry, as can be seen in the Image 39, is like a tube, its general measures are approximately: 3 meter of height and 1,5 m of diameter and its colors are white and green, the company corporative colors. It is made by different materials especially with stainless steel. All mechanical parts of the machine are protected by a steel shell that also provides more aesthetic to the machine.

Zulfa press can operate in any factory; it only needs some electricity (preferably eco-electricity) and a mix with sawdust and reused oil or butter. If someone, with ecological mind, enthusiasm to invest in new markets and also can achieve these materials for free or very economical, it is a good business idea for him/her.

According to producers, Zulfa press has many possibilities to success in some European countries as well as in countries like EUA, Canada or Japan because of the ecological mindset of these countries. It is a business that does not need a very high initial investment, its maintenance are cheaper and its profitable, if the machine is well focused, can be high.

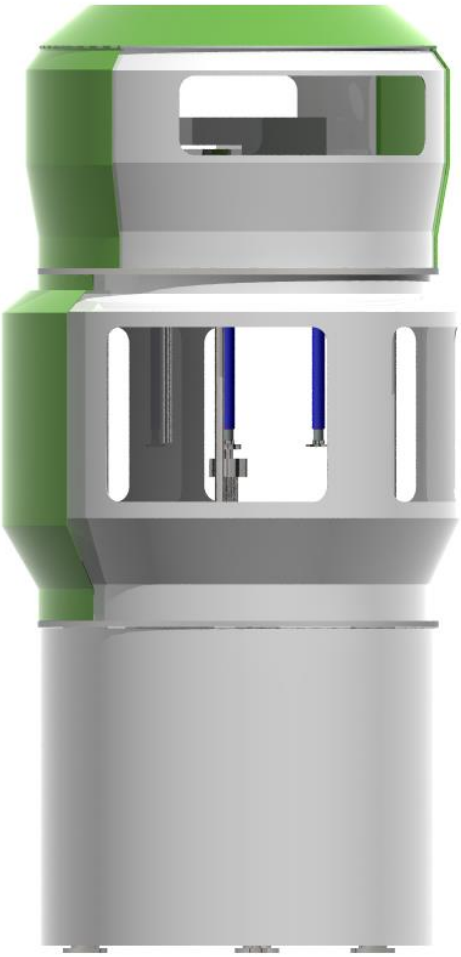


Image 39. ZULFA press
Source: Own source

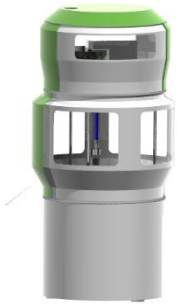
5.3.2. Price

Exist different press prices depending on extra elements that the customer wants to incorporate. The complete product has some elements that is possible the customer already has in his/her factory. So, the press is separated by packs with a combination on these extra items.

The price has been calculated adding all commercial products, all necessary material to make the own parts and also adding engineering costs (design, production, tests…).

Here have all press packs and prices:

- **ZULFA Basic Pack**



Basic pack includes only the press and oil dispenser. Do not include the bigbag structure, the conveyor belt and packaging pack. This pack is for people who already have all the extra elements and can integrate them with ZULFA press.

Retail price = **30.185 €**

- **ZULFA Added Pack**

For people who have some extra elements but not all, have been create the added pack. This pack includes the press with the oil dispenser and the customer can add the elements that he/she wants with a supplement in a price.

Add BigBag structure = **+ 992 €**

Add Conveyor Belt = **+ 1.141 €**

Add Packaging Area = **+ 909 €**

- **ZULFA Complete Pack**

Complete pack includes all elements, the press, the oil dispenser, the bigbag structure, the conveyor belt and the packaging pack.

"Complete Pack" Retail price = 33.227 €

*All prices are detailed in section 7, Budget.

*All packaging is made with standard elements, specified in previous sections.

4.3.4. Place

This section wants to explain all the product and by-product distribution. After creating the press and the company that sells it, it is necessary to determine how will be the distribution of the briquette press (for a better selling) and of the briquettes (for a better business idea). These distributions include the packaging and transport of both products.

- **ZULFA press. Packaging and branding.**

As it is mentioned before, Zulfa press is sold by packs, depending on the customers necessities. For this reason, Zulfa press packaging is also divided by packs. The first pack is the Basic Pack, this pack includes only the press and it is necessary only one box and the cover to package it. Here it is the packaging example:

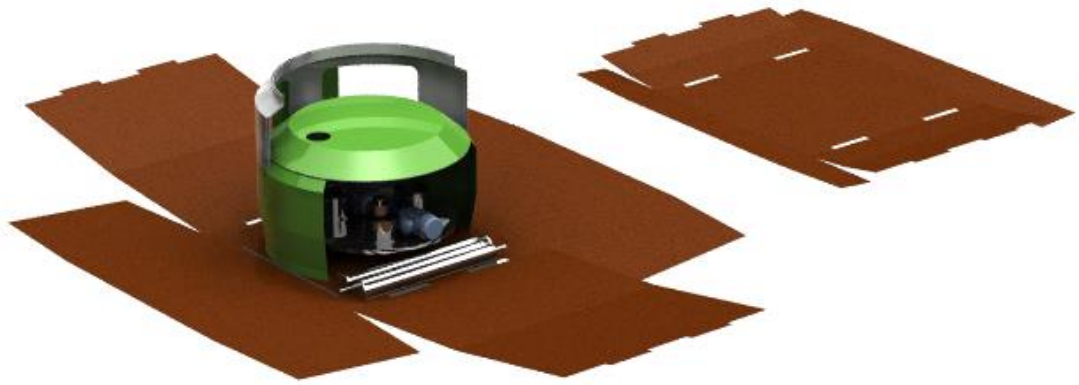


Image 40. Basic pack Zulfa press packaging
Source: own source

As can be seen, this packaging is also sustainable (as all products). The packaging is a paperboard box that does not need any extra element to close it. The box is made to close to its own paperboard. The closed box has a measures about 1500 x 1500 x 1000mm.

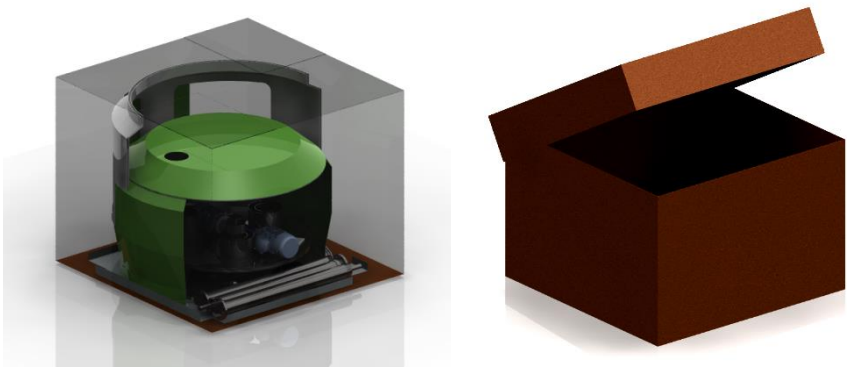


Image 41. Zulfa press closed pack
Source: own source

These are the samples of the opened box and cover:

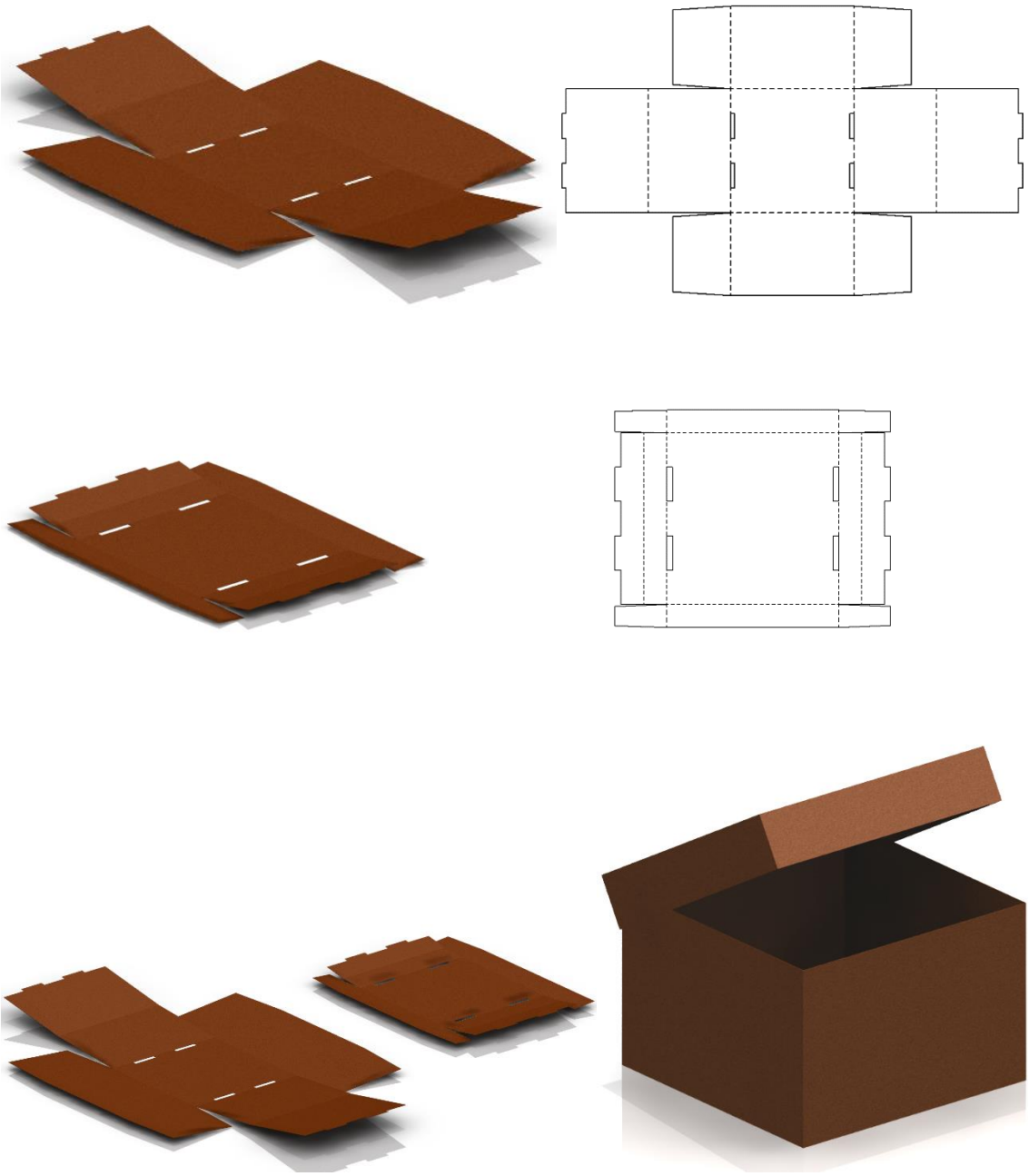


Image 42. Opened box samples
Source: own source

The other packs are commercial elements so; its packaging will be in separately boxes. Here are the examples:

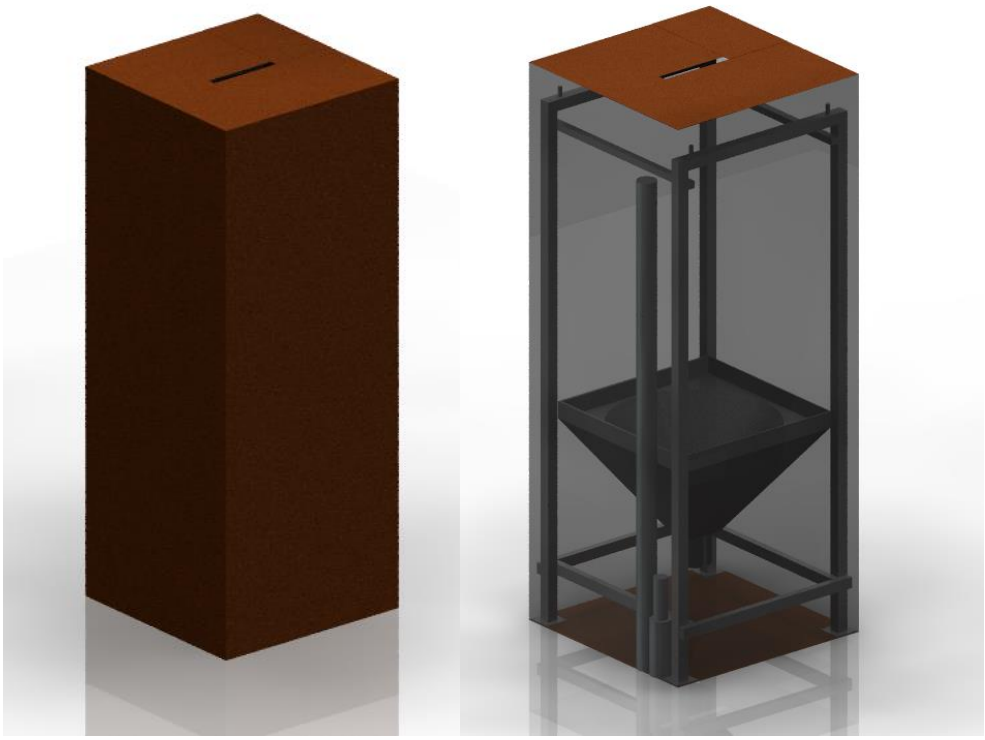


Image 43. Bigbag structure and endless belt box
Source: own source

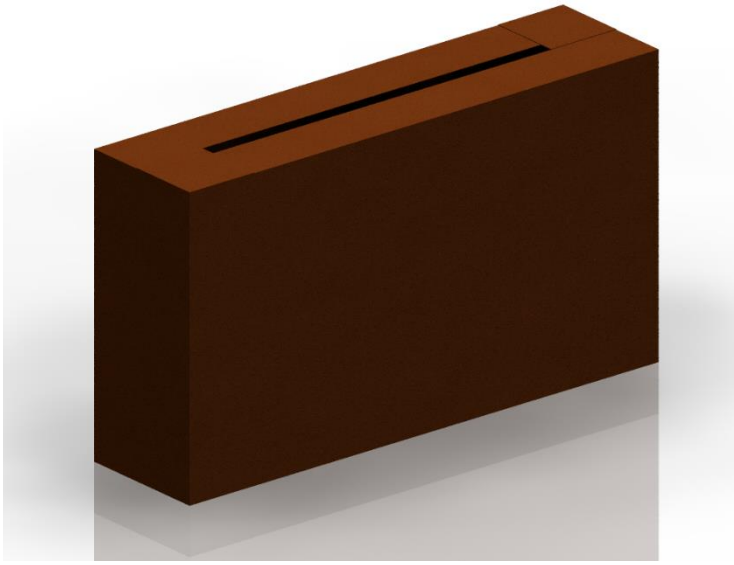


Image 44. Conveyor belt box
Source: own source

The press branding is in two box parts, in one part is only a label with all the press characteristics. This label will be made with recyclable materials.

Label data:

- ✓ Product name
- ✓ Product reference
- ✓ Company
- ✓ Barcode

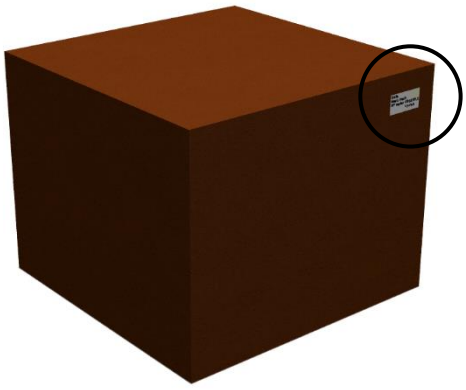


Image 45. Zulfa press branding
Source: own source

On the other part are different logotypes. In the top left corner is a company logotype (EKOlogis) and on the bottom are the ZULFA press logotype and the name of the pack that contains each box.
The Image 46 is an example:

Image 46. Zulfa press branding 2
Source: own source

- **ZULFA press. Transport logistics.**

The Zulfa press distribution will be also by packs, depending on the demands. The complete pack will be as the Image 47.
This distribution will need a non-standard pallet because its measures are 1500 x 1500 x 300 mm. So, for the distribution it is necessary to use a double pallet.

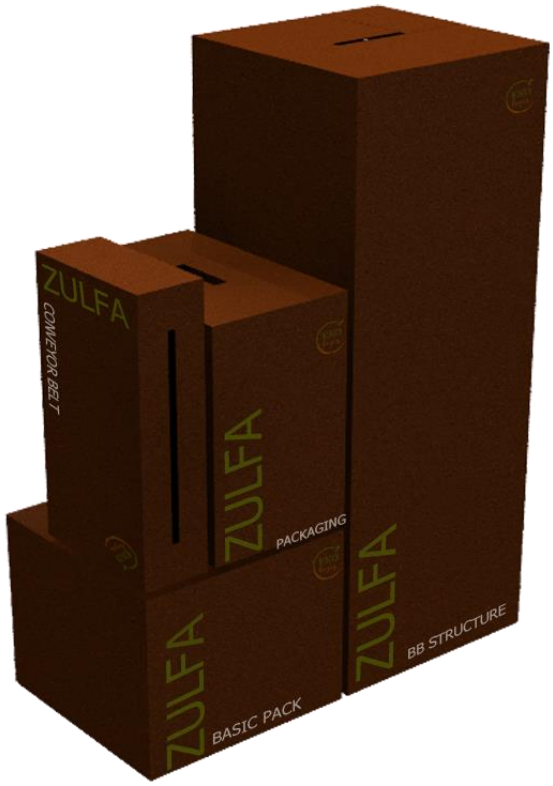


Image 47. Transport logistics
Source: own source

- **Briquettes packaging and branding**

For the briquettes packaging, has also been selected a kind of packaging without any toxic residues like paintings, glues or adhesives... There is only one kind of principal packaging which can be sold in different packs depending on the final costumer.

The main packaging is a cartoon sewing bag which contains 5 briquettes inside. It is the specific pack for barbecues and fireplaces. As the material is recycled cartoon and 100% cotton thread, all the pack can be burned without unwrapping it.

For the branding, has been selected the punching method in order to not use paintings, which mostly are toxic and unnecessary.

These packs can be sold separately on gas stations, supermarkets or specialized shops.

Here are some images that show how will be the briquettes packaging:

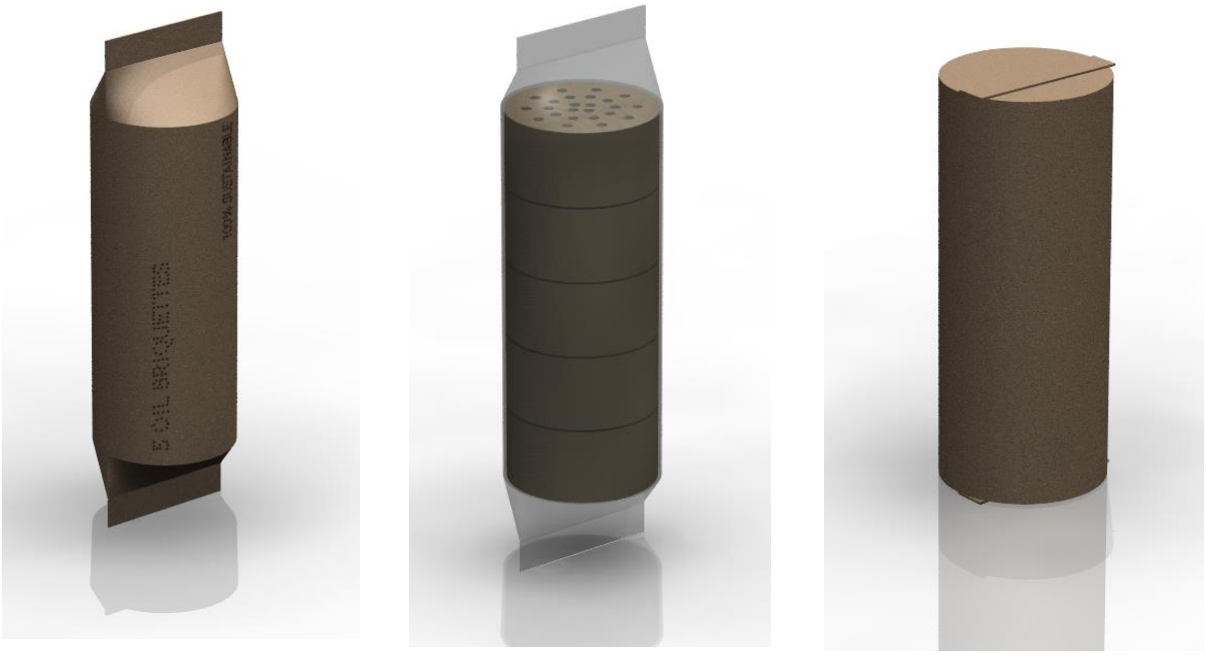


Image 48. Briquettes packaging: normal view, clear view and closed view.
Source: own source

These packs will be sold inside a box with 12 packs in each box. These boxes are also able to burn because do not have any other material except paperboard.
For the biomass boiler this is the best packaging because the customer can put inside his/her biomass boiler some briquettes boxes and they will burn slowly as the firewood logs.
In Image 49 it can be seen the packaging type:

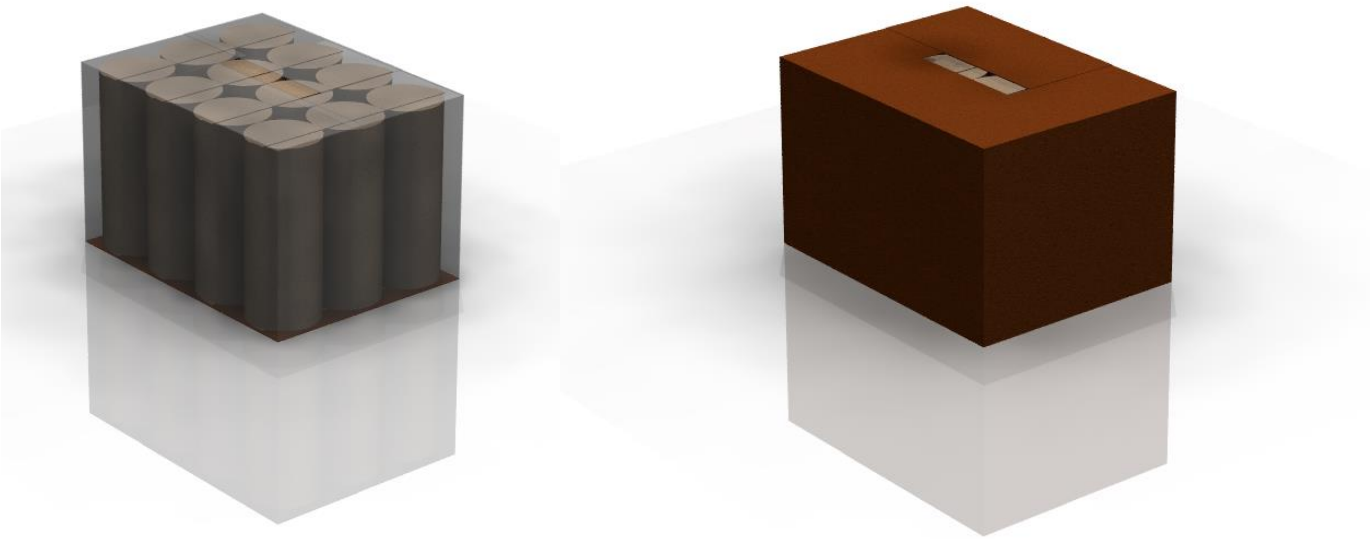


Image 49. Box briquette packs packaging: normal view and clear view
Source: own source

- **Briquettes transport logistics**

Finally, the briquette packs boxes are also transported by truck with standard pallets. In each pallet will be stowed 20 boxes with 12 packs each one; so in one pallet will be distributed 1.200 briquettes. If in one day the machine produces 4.901 briquettes, we will need almost 4 pallets per day.
Here is the example of a full pallet:

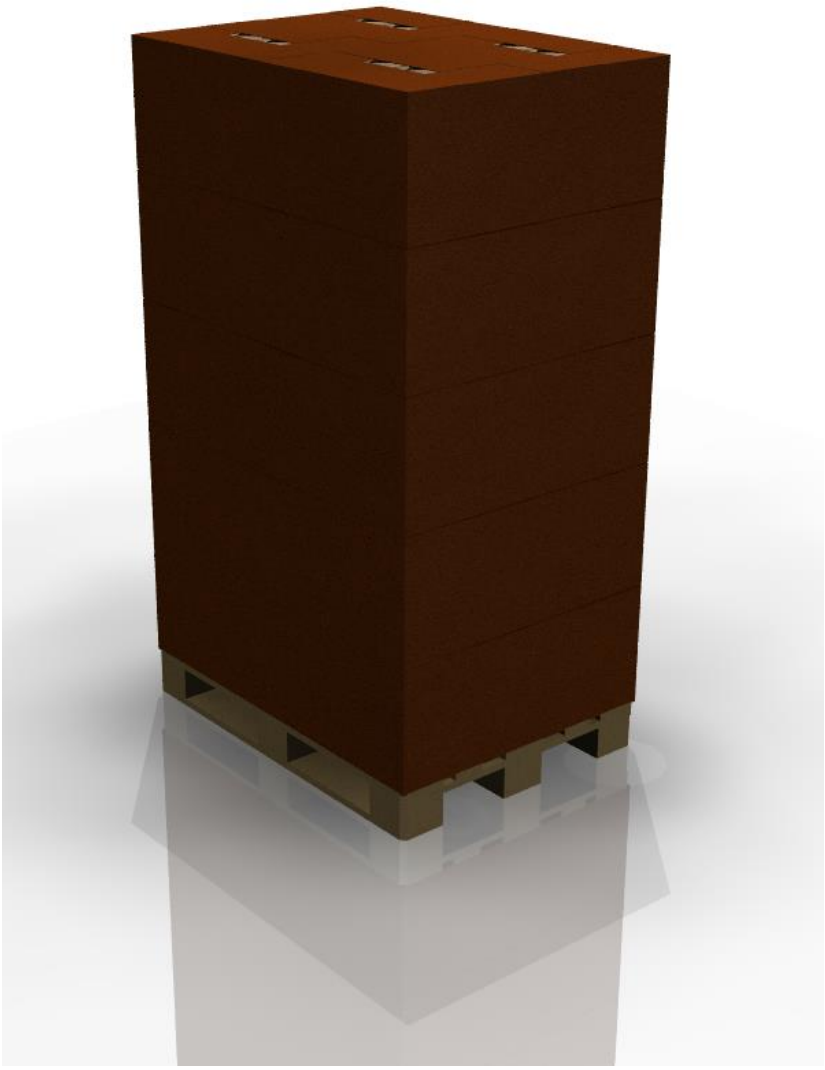


Image 50. Briquette packs boxes stowed in a standard pallet
Source: own source

4.3.5. Promotion

These are all of the methods of communication that a marketer may use to provide information to different parties about the product. Promotion comprises elements such as advertising, public relations, sales organization and sales promotion.

Has been considering that this is a very important point to start the business and have a good first impression to the costumers on the first months. Has been designed some promotional products: leaflet, datasheet, website, promotional videos and merchandising.

4.3.5.1. Leaflet

The first goal of the leaflet is get the possible costumers first attention and get something to spread around. As wanted something different, some designs were researched until reach the best choice to represent the company and the products.

Inside the leaflet must be simple information about the product (ZULFA machine) but also some information about the sub-product (the cooked oil compacted briquettes).

The chosen design is a funny playful one which makes people actually wants to handle it. Its workings are captivating and attention-grabber. The leaflet we are talking about is an infinite folding paper with four faces overlapped.

Image 51. Leaflet design
Source: own source

As it is known, touching new and unusual things makes the brain work faster and gets a better attention on it. It is easier to understand and remember the promotional message. It is designed to make the people like it and share it, that way the effect reaches further and lasts longer.

These are some characteristics about it:

- Tactile effect: the hands and the tactile perception incite the subconscious perception. When the brain perceive different senses (linguistic, visual and tactile) is easier to hold the information.
- Circular: the infinitive folding system it is perceived as a wish to continue playing with the flyer and cause positive sensations.
- Share effect: as it is a new and playful design, the people who has experienced on it

4.3.5.2. Datasheet

The datasheet is another promotional press plan that includes a description, some technical data and photographs. With this datasheet, the machine costumers which a quickly view can detect the most important features.

In the Image 52 it can be seen the datasheet design. In this design it is given much importance to the press photography, title and description, because are the things that the customer watch in a quickly view and captures his/her attention. In a smaller size are the press details, the technical data and its layouts, this information is important to the customer after his/her attention is captured.

The entire design follows the company line, simple, with the corporative colors and suggestion the sustainable life with leaves.

Here is the datasheet example:

Image 52. Zulfa press datasheet
Source: own source

4.3.5.3. Website

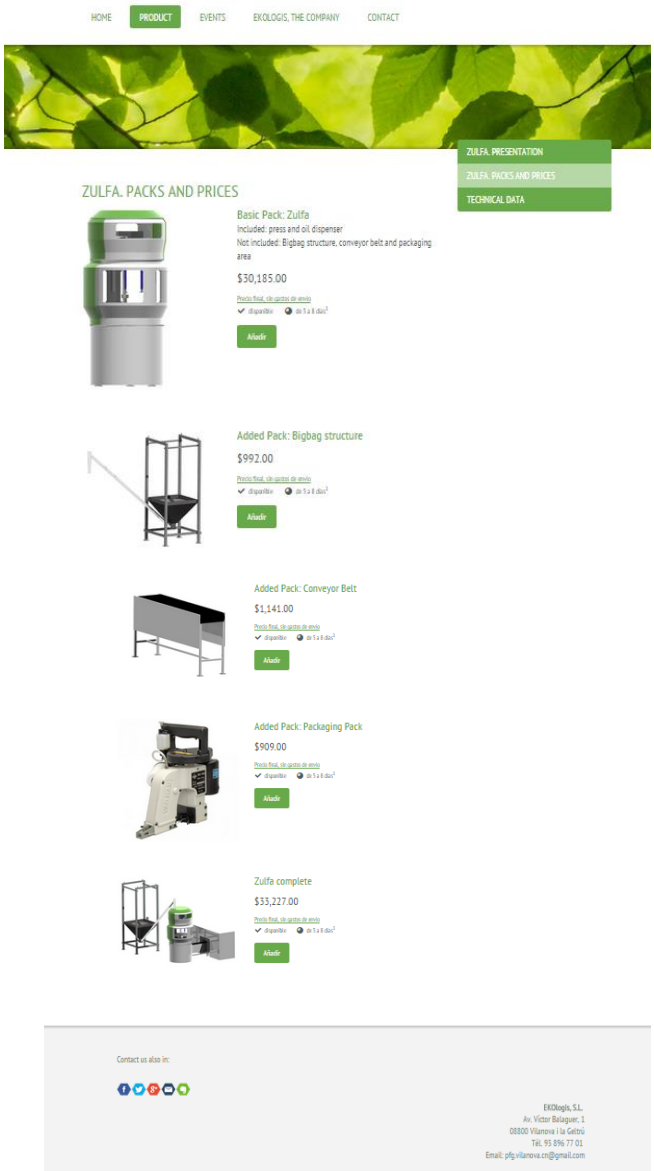
One of the best ways to promote something is to put in a website, and if you are the company the better is to create your own website and explain all product details, prices, company characteristics…

For this reason, EKOlogis has created a website with all company and Zulfa press details and with other things as upcoming events or ecological news.

As the other promotional documents the website has the corporate colors with a simple and intuitive design.

Here is the website link and some example images:

www.ekologis.jimdo.com



4.3.5.4. Promotional videos

The videos are another good way to promote some products because their help the potential customers to understand the product, its parts and the working process.

To promote Zulfa press, EKOlogis has edited different videos which show the press assembly with all commercial and non-commercial parts to understand how it is made and how its assembly and dismantling is and also show its function.

These videos will be showed in the project presentation but also it is uploaded in Youtube website:

- ZULFA Press Assembling

https://www.youtube.com/watch?v=LnZwmjd3d6U

- ZULFA Press Assembling details

https://www.youtube.com/watch?v=yH9jgFpxd_4
https://www.youtube.com/watch?v=DomeFlkBuXA

- ZULFA Press Working

https://www.youtube.com/watch?v=qEDFdmgSUvM

4.3.5.5. Merchandising

Finally, EKOlogis has also created some merchandising to promote the company in some events or meetings. This merchandising is included in cards, pens, folders, papers…and it is based on a company logotype.

Some merchandises examples:

5.4. BUSINESS EXAMPLE

After all calculations are done and the orientated price is indicated, the better for selling the Zulfa press is to create a business example. This business example is an imaginary situation that simulate when someone buys a Zulfa press. This simulation intended to be an ideal case, when the person who buys the machine can obtain the sawdust and the reused oil for free.

Here is the business example to promotion the Zulfa press:

Business example (ideal case)		
Action	**Value**	**Observations**
Daily briquettes [nº]	4901	Process design
Mensual briquettes [nº]	107822	
Retail price per briquette [€]	0,10 €	Currently price conventional briquettes = 0,12€
Gross profit per briquette [€]	10.782,20 €	Monthly
Maintenance costs [€]	1.577,09 €	Electrical and packaging. Oil and sawdust for free (ideal case)
Other monthly outgoings [€]	6.000,00 €	Rental, salaries,...
Total monthly outgoings [€]	7.577,09 €	Monthly
Net income [€]	3.205,11 €	Monthly
Press retail price (complete) [€]	33.227,00 €	Budget
Amortization [months]	**10,37**	**Months to be payed**

Table 9. Business example table
Source: own source

As can be seen, giving a lower retail price to briquettes than the currently briquettes in the market, the profit is so high. And with the ideal case the press would be amortized in about 11 months.

This business case is a good example to show for promoting the product, because the people can check that is a good deal.

6. ARTICLES AND CONDITIONS

The article and conditions is the document that indicates the general project laws as well as technical materials included in the machine.
Detailed in the sections below, are the both constrains: legal ones and the responsibility and obligation of each part. Also appear the property, the producer, the suppliers and all project participants. In addition, are also commented the legal terms in front of any discussion, doubt or requirement in all aspects mentioned before.

In this document are also showed the characteristics which have to be strictly enforced for the acceptance of all the materials that integrate the machine in general terms. Always, bearing in mind that in the last term of the materials lists for each assemblies, and in particular each blueprint, are the legal contracts for each part, determining the material, the processing, the coating and all final accepted part conditions to give it functionality and the specific requirements.

6.1. CE REGULATION

In 1989 EU approved a document to get unification criteria in all states to machines design, manufacture, and installation even the maintenance. This document is called "Machines Directive".

With this directive elaboration, the objective is to ensure the workers security and health, who can be subjected to risks from the machines uses. However, this document has been finally completed in different use cases with specific legal provisions on the prevention of workplace that may affect the workers during their work.

During the years, this directive has varied in different times from the first "Machines Directive (89/392/CEE) passing by the directives (91/368/CC, 93/4/CEE, 93/68/CE, 98/37/CE and 98/79/CE). The latter directive (2006/42/CE) is applied from December 29 2009, despite of there is a last modification (2009/127/CE), but it only affects the documents of the pesticides machines. The links of these standards can be seen in the Standards Applied (Annex B).

European directives are recommendations addressed to the states which belong to the CE and they have a certain time to incorporate them into their own legislation. Then it becomes a binding document.

These guidelines are designed to ensure that any new machinery marketed in Europe have the CE logo on them. This logo involves different aspects such as:

- Ensure that meets the essential safety requirements described in the directive.
- Ensure that the machine can have free movement within the internal European Union market.
- Member States cannot ban, restrict or impede the placing on the market and installation on its territory of all those machines that comply with the requirements set by the directive.

Spain has incorporated the Directive (2006/ 42 / EC) and all its amendments to national law by Royal Decree 1644/2008 (BOE no. 406 11/10/2008).

6.2. LEGAL CONDITIONS

The designer / manufacturer declares under its responsibility that the machine to which reference has been made in all the preceding paragraphs is intended to be incorporated into a set of machinery and cannot be put into operation until the set has been declared in accordance with the before mentioned directives which the machine complies with European directives and also meets the low voltage (73/23 / EEC and 2006 /95 / EC)

6.3. MACHINE CHARACTERISTICS

6.3.1. Machine description

The assembly machine is composed for:

- ✓ Base structure (bench). This will form a complete unit of machine.
- ✓ Rotary table with three stations with the same matrix on the top.
- ✓ Table set at the bottom of the rotary with different machining for each station.
- ✓ Tools to load the material for the press and for downloading (thus completing the three stages of the rotary table).
- ✓ External tooling for blending, transport and packaging of the product.
- ✓ Safeties fairing surrounding the whole press with different doors in the event of maintenance or repair.
- ✓ An electric cabinet that follows the standard written in section 8.5
- ✓ Control Unit, which will integrate all controls for proper operation of all buttons and manuals for better security control, situated outside the press.

6.3.2. Operations description

- ✓ The user, safely, because it is not in contact with any part of the press, with the help of a motorized trolley places a " bigbags " full of sawdust in their position within the structure of " bigbags " easily and intuitively.
- ✓ This sawdust are continuously dosing in external equipment (endless conveyor) where it also is adding the amount of oil required by an adjustable dispenser.
- ✓ The two raw materials are mixed during the transport to the dispenser
- ✓ The mixture is dosed into the mold on the first step (the load one) with the time and the amount defined in the dispenser characteristics. Once the defined time has passed, the table rotates 120 ° .
- ✓ Once the rotation is ended, the charging station mold starts again. In the second station the press tool is activated and in the third station the product is downloaded.
- ✓ The piece leaves the station 3 through a conveyor belt where it performs quality control, until the area where will be packaged in packs of 5.
- ✓ Once the briquette is properly packaged is placed in boxes of 12 packets to fill a pallet

If the security system is opened at any time that the machine is in operation , there is an emergency stop at all stations, including on the external devices .
All tools have been designed bearing in mind that there are forces applied (including station press).

All electrical equipment is standard normalized with current manufacturing references. The installation will be delivered certified with CE marking.
The non-commercial tools will be manufactured with compliance with safety regulations (ergonomics, visualization, smoke ...)
If it is necessary for the machine maintenance or to work inside, the individual protective equipment will be marked visibly on the outside and reflected in the documentation of the machine.

6.3.3. Production and capacity levels

The machine will be able to produce 7 hours a day, 220 days a year, provided it is performed preventive maintenance set by the supplier, except for wear or deterioration of parts.

6.3.4. Workstation

The workplace will be safe for the operator, it means, ergonomics, safety and environmental technology. It is designed so that the operator is not exposed to unnecessary risks and will avoid all potential risks given the current technology.

All the risks that can happen and be impossible to eliminate will be marked and the individual protective equipment will be identified if it is necessary to operate on the machine (both in production and maintenance).
All securities implanted in the installation will be standardized and clearly included in the documentation of the machine.

6.3.5. Construction rules

The supplier must ensure that the commercial elements used cannot be discontinued during the years following the delivery of the whole scheme, unless they are replaced by other equivalent elements and does not require important modification machine.

If a case the machine is delivered with discontinued elements and this is detected during the warranty period, these will be replaced by the machine supplier with updated elements without any cost for the customer.

6.4. MAINTENANCE

- ✓ Maintenance must be planned and programmed for commercial elements (indicated in each manual) as those of the machine. Start of having planned and programmed maintenance for both commercial elements (indicated in each manual) as those of the machine.
- ✓ The protection elements will be of quickly disassembly.
- ✓ Plugs on the inside and bottom of the installation for electrical items
- ✓ The elements of the machine should be able to be repaired outside the set.
- ✓ Safety instructions
- ✓ Nomenclature of components (specifics and commercials) and commercial components chips and specific components plans
- ✓ Attached drawings of the machine with its features.
- ✓ Attached nomenclature , plans and suppliers of commercial elements of wear
- ✓ Conformity guaranty
- ✓ Preventive maintenance file with frequency indicator
- ✓ A manual dismantling and assembling sensitive parts must have planned.
- ✓ Point products that can intervene in the set (lubricants, water , oil ...)

6.5. ELECTRICAL CABINETS

- ✓ With at least 15% of its free capacity will be installed in a integrated way the whole machine.
- ✓ Will have the protections necessary for the operator and the machine. Will be installed, if necessary, air conditioning and a thermostat.
- ✓ Will have a voltage limiter earthling
- ✓ The cables will join the cabinet by HARTING connectors type
- ✓ All the wires will be numbered and identified with permanent and indelible labels. As with the hoses, and will correspond properly with the scheme on paper.
- ✓ The junction boxes should be placed in accessible locations.
- ✓ The closet and all junction boxes be marked according to current regulations
- ✓ Outside a wardrobe will place a outlet 220v / 20A protected with a 0.030A differential for manual tools
- ✓ An internal prey for computers and control.
- ✓ The construction of the wardrobe will be realized according the actual normative.

It will take into account in its construction, the actual regulations and have as a reference to the following rules:

- ✓ UNE-EN 60439-1:2011: Sets of low voltage tools.
- ✓ UNE-EN 6007: 2005: Basic principles and safety for man-machine interfaces, marking and identification.
- ✓ UNE -EN 60204-1: 2007: Safety of machines. Electrical equipment on machines. Part 1: General requirements.
- ✓ UNE-EN 61000-6-4:2007: Electromagnetic compatibility (CEM). Part 6-4: Generic rules. Emission rule in industrials spaces (IEC 61000-6-4_2006).
- ✓ EN 60447:2004: Man-machine interface: Early maneuver.

6.6. TOOLS

All tools will be built with corrosion material resistant, to the wear and the dirt, being necessary the pipe and the cabling protection including all electrical change elements (detector, wires...). It should be able to be disassembling in a fast and simple way and once it is disassembled their good state must be warrantied.
The repeatability of the position of some components is warrantied in the way to secure a constant position of the welded elements.
the provider secures that all sets manufactured comply the plans specifications and have a dimensional repeatability. In any case, the references specifications in the plans ISO dimensioning are reflected in the tools to secure that the reference system of this corresponds to the plane defined subset and each component.

6.7. ENVIRONMENTAL REQUIREMENTS

6.7.1. Applicable to direct material suppliers

Sending a Statement documented that the products supplied do not contain: lead , mercury , cadmium or hexavalent chromium . The commercial materials must bring documents how should be recycled once it has completed its operational life. It will be the final owner of the machine responsible for this recycling.

6.7.2. Applicable to indirect material suppliers

Sending Security Cards and technical data supplied products. It will be the final owner of the machine that is responsible to carry out the recycling of materials that will be waste.

6.7.3. Machines refrigerants

The Regulation no. 1005/2009 concerning substances that deplete the ozone layer. Under this legislation, the points to consider when choosing the machine's cooling liquid is that all substances contained should have a limited time so it is appropriate to be use other refrigerants not included in the Annex I of this regulation

6.3.4. Fluid retention systems

All those systems that require oil or water for operation, have a retention basin capacity sufficient and accessible for cleaning to keep the possible leaks that may exist and thus prevent these liquids reach the ground , as indicated by the machinery Directive.

6.8. MACHINE SECURITY

After the installation of the machine in the factory and prior to use by the customer, must be verified in the presence of the supplier, the corresponding safety conditions:

- ✓ Acoustic límits that must be not exceeded: In the workplace and at all points located on a meter from the equipment
- ✓ LpAeqt: 70 db (A) → Sound pressure level weighted equivalent temporary.
- ✓ Lpc: 110 db (C) → Sound pressure level of emission peak weighted.

In the machine reception will be done a test to verify the safety of the machine as directed reflected in the RD 1644/2008:

- ✓ The machine is built and identified according to the current regulations and contains clear and precise information of their operations, as well as personal protective equipment , which if necessary , operators have to use for their security.
- ✓ When the danger of a machine or safety component are covered in whole or in part by provisions laid down in the application of specific directives , Royal Decree will not apply or cease to apply to these machines or components and will be reflected in the documentation of the machine.
- ✓ When an autonomous region checks that the marking "CE" has been placed inappropriately fall on the manufacturer or his legal representative established in the European Community the obligation to restore conformity of the product on what provisions are concerned about marking "CE " and to end the infringement under the conditions laid down in law.
- ✓ If the machine counts on several interchangeable equipment and manufacturing standard, these must be similarly identified with CE marking and declaration will be attached to the documentation of conformity for each one.

- ✓ When maintenance or production workers have to handle loads manually due to the characteristics of the machine, such as cleaning operations, material load... dismantling, these areas will supply machine fastening systems to make mobility a safely way .
- ✓ El provider will explain in its documentation, safety elements provided and the risk that eliminates or minimizes with these elements.
- ✓ The internal machine part will be completely unapproachable when it works
- ✓ The machine will have a visual and audible alarm.

Depending on its nature, the machine will also need to bring all indications that are essential for safe working. When an element of the machine must be handled during use with lifting devices, its mass must be recorded legibly, durable and unambiguous.

6.9. ERGONOMICS AND SECURITY

Workplace has been designed so that it complies with the regulations in force for the safety of the machine and its ergonomics.

- ✓ UNE-EN 614-1:2006+A1:2009: Machine safety. Ergonomic design principles. Part1: Terminology and general principles.
- ✓ UNE 81-425-91: Ergonomic principles to consider in the work system project.

As well as, all the regulations are applied to such facilities.

6.10. FINISHING AND MACHINE BRANDING

Each part of the press has a plaque identifying the useful, riveted or screwed to the frame or base plate in a visible place and preferably in an protected area from projections, grease and / or dirt.

The plate includes:

- ✓ Name, CIF, manufacturer address and telephone.
- ✓ Machine consumption power.
- ✓ Tool reference number, productive machine or productive element.
- ✓ Manufactured date.
- ✓ Machine owner.

6.11. TERMS OF DELIVERY

6.11.1. Documentation and drawings

The elements that accompany the machine in its delivery are:

- ✓ A plans game together with the views and sections necessary for proper interpretation. With the brands each component.
- ✓ A set of plans for cutting those components previously considered an agreement with the technical methods such as wear or risk all suitably dimensioned and referenced to their respective sets.
- ✓ References list of commercial elements used, having at least include the brand of the element, commercial reference, manufacturer's name and the quantity.
- ✓ Schemes pneumatic, electrical and hydraulic, if any. Minimum one copy on paper format and its delivery on informatics support.
- ✓ Disc PLC program.
- ✓ Conformity CE certificate under the established law.
- ✓ Manual machine operation according to regulations. Where indicated the basic instructions required for normal handling, use and handling of this.
- ✓ Preventive maintenance plan, indicating operations to do, the frequency of these and means for use (human and material).
- ✓ Instructions of handling and assembling for machine. Precautions to be taken into account and instructions for its care and maintenance.

6.11.2. Forecast preventive maintenance

In the machine documentation will see a section of needs preventive maintenance of Level 1 for operator performs and Level 2 for maintenance technicians. Finally, will be a summary of all transactions with the frequency, estimated time, etc.

6.12. GUARANTY

6.12.1. Global guaranty

The machine will be built with materials and commercial products as far as possible. Otherwise, it must observe the following:

- ✓ The provider ensures the existence of specific spares over the lifetime of the machine. Failure to ensure this, the vendor will deliver all the necessary documentation for manufacturing of the same with the documentation of the machine.

Purchased parts will have the same guarantees that the offered by the manufacturers of these components. If design and construction defects are registered within the warranty period, the supplier assumes the responsibility to redesign or rebuild them without charge. If these changes affect the production, the supplier will have to adjust to production schedules set by the customer and make changes when necessary.
The proposed changes may not be installed on the machine except in the following conditions:

- ✓ Acceptance, by the customer representative, of the modification sheet after control by experts appointed by him.
- ✓ Provider's commitment prolonging 6 months warranty items.

If, as a result of the intervention, the benefits achieved are not provided, the supplier will accept responsibility for the prejudice caused by it to the customer.
If, during the warranty period, an element of the installation has to be emergency changed because threatening production and if the supplier (already warned) could not intervene in time compatible with the imperatives of production, then client personnel involved in the installation, instead of the supplier. In this case, the costs of intervention are billed by the customer to the supplier based on the hourly rate for the service and retrieve by the shopping service.
Technical assistance after acceptance by the machine client is not included unless otherwise stated.
The provider agrees to make available to the client, technical assistance devices at a cost of defined schedule in your offer. The duration will be defined with a minimum of 6 months.
The technical staffs are sufficiently qualified, master installation and have participated in its set-up.
On these bases, technical assistance could be subject to a separate agreement between the customer and supplier.

The end of the guarantee is subject to the following conditions:

- ✓ Arrival at the end of the contractual guarantee made
- ✓ Written commitment of the provider in the case in which the warranty period has to be extended to certain organs or elements of the installation.
- ✓ Calculation basis of the guarantee; 1 year, 3 shifts to 8 hours. (220 working days).

6.12.2. Specific commercial elements guaranty

The guaranty will be given by the supplier or manufacturer. Never less than two years from receipt of the item or machine. In the event that verifies degradation of commercial elements of the machine due to its calculation deficient, throughout the warranty period, the supplier provides by their counts the necessary modifications negotiated before with the customer representative without damaging the manufacturing program .

7. BUDGET

7.1. FABRICATION COSTS

Once the machine design with all its elements are finished, is important to estimate how much it cost adding all elements, commercial or not.

Below are three tables of prices, on the first table is detailed the prices of commercial elements provided by the suppliers, these elements are the basic ones to produce the briquette press.
The second one shows the prices of non-standard parts and labor hour costs.
Finally, the third table detailed the prices of standard elements which are optional to buy for the customer, because are elements that some customers may have in his/her factory and they are not necessary to buy.

Commercial parts costs					
Element	**Reference**	**Supplier**	**Quantity**	**€ / unit**	**Total Price**
Dispenser	DV01	AXEL	1	1.838,45 €	1.838,45 €
Oil Dispenser	129.342.556	BEDRI	1	55,00 €	55,00 €
Ejectors	AH 6x125	DMEEU	40	0,35 €	14,00 €
Handle	GN 565.5	ELESA+GANTER	3	8,80 €	26,40 €
Intermitent index unit	PGI 220	GOIZPER	1	2.150,00 €	2.150,00 €
Springs	Danly	INMACISA	6	1,50 €	9,00 €
Ilumination	91.366	KAISER KRAFT	1	156,30 €	156,30 €
Linear actuator	M605	NIASA	2	1.697,00 €	3.394,00 €
Tilt support	Serie SB	NIASA	4	4,00 €	16,00 €
Actuator fixation	Serie BP	NIASA	2	6,00 €	12,00 €
Sensors	FCI	NIASA	4	52,00 €	208,00 €
Screen	CP 6315.200	RITTAL	1	89,90 €	89,90 €
Pipe fitting	3901 10 13	GAESTOPAS	6	2,86 €	17,16 €
Tubes (25m)	Various	GAESTOPAS	3	24,96 €	74,88 €
Rail	10100604620	DUCASSE	8	7,48 €	59,84 €
Rubber band (25m)	PERFIL-F	BLASI	2	3,70 €	7,40 €
Screws	Various	ESSENTRA	50	0,11 €	5,50 €
Fastering elements	Various	ESSENTRA	25	1,20 €	30,00 €
Subtotal					8.061 €
Incidentals 4%					322 €
TOTAL					**8.384 €**

Table 10. Commercial parts costs
Source: Multiple suppliers

Engineering costs and fabrication parts			
Component	**Quantity**	**€/unit**	**Total Price**
Fabrication parts [kg] - [€/Kg]			
AISI 316 (Sheet)	150	1,2 €	180,0 €
AISI 316 (Parts)	20	0,9 €	17,0 €
AISI 316 (Profiles)	100	1,2 €	120,0 €
Steel sheet	150	0,6 €	90,0 €
Methacrylate	10	0,3 €	3,0 €
Engineering hours [h] - [€/h]			
Engineering hours	175	25,0 €	4.375,0 €
Production hours	190	15,0 €	2.850,0 €
Assemble hours	168	15,0 €	2.520,0 €
Finishing hours	40	15,0 €	600,0 €
Finishing			
Thermic methods	1	150,0 €	150,0 €
Painting	1	255,0 €	255,0 €
Subtotal			11.160,0 €
Incidentals 4%			446,4 €
TOTAL			**11.606,4 €**

Table 11. Engineering and fabrication parts costs

Source: Multiple suppliers

Optional Elements Costs					
Element	**Reference**	**Supplier**	**Quantity**	**€ / unit**	**Total Price**
BigBag					
BigBag	AV	BIG-BAG	2	6,00 €	12,00 €
BigBag structure	BBV	CAVICCHI	1	220,00 €	220,00 €
Endless belt	Auger Feeding S	CAVICCHI	1	425,00 €	425,00 €
Subtotal					**657,00 €**
Conveyor belt					
Conveyor belt	L4545-52R	CAMPRODÓN	1	755,80 €	755,80 €
Subtotal					**755,80 €**
Packaging Area					
Back closer	GK26 1-A	REVO	1	475,90 €	475,90 €
Work table	AA321	RACTEM	1	65,95 €	65,95 €
Bag pack (500 units)	-	-	1	50,00 €	50,00 €
Thread (1000m)	-	-	1	10,00 €	10,00 €
Subtotal					**601,85 €**
TOTAL					**2.015 €**

Table 12. Optional elements costs

Source: Multiple suppliers

7.2. RETAIL PRICES

Another part of this budget is to calculate the machine retail price. This retail price includes VAT impost and the company profit. The profit, in this case, is for EKOlogis and it is a 30% of total price.

To calculate the retail price, have been created different packs to answer all customer requests. These packs are:

- **Basic Pack:** Includes only the press essential parts (press and oil dispenser). This pack is for people who already have the other components in his/her factory. The retail price of this pack is:

Retail price "Basic Pack"		
Total commercial parts		8.384 €
Total engineering costs and fabrication parts		11.606,4 €
SUBTOTAL		19.989,9 €
VAT	21%	4.198 €
Profit	30%	5.997 €
Retail price		**30.185 €**

Table 13. Basic pack retail price
Source: own source

- **Added pack:** This pack is for people who already buy the press (basic pack) but he/she need some components: bigbag structure, conveyor belt or packaging area. There are the retail prices of each component; this price has to be added to the basic pack price.

Retail price "BigBag"		
Bigbag		657 €
SUBTOTAL		657,0 €
VAT	21%	138 €
Profit	30%	197 €
Retail price		**992 €**

Retail price "Conveyor Belt"		
Conveyor belt		657 €
SUBTOTAL		755,8 €
VAT	21%	159 €
Profit	30%	227 €
Retail price		**1.141 €**

Retail price "Packaging Area"		
Total commercial parts		602 €
SUBTOTAL		601,9 €
VAT	21%	126 €
Profit	30%	181 €
Retail price		**909 €**

Table 14. Added pack prices
Source: own source

- **Complete pack**: For people, who do not have any extra component, also exist the complete pack. This complete pack includes all components mentioned in the other packs. This pack is probably the best-selling pack because it is difficult that the customers already have the extra components that fit in the ZULFA press.

Retail price "Complete Pack"	
Basic Pack	30.185 €
Bigbag	992,1 €
Conveyor Belt	1.141,3 €
Packaging Area	908,8 €
Retail price	**33.227 €**

Table 15. Complete pack retail price
Source: own source

7.3. Conclusions

Analyzing these retail prices, it can be concluded that, the press being a new methodology product, more sustainable and efficient and designed for everyone until the last detail (the product and the back service) has a very competitive price compared with the other similar briquette presses in the market. So, this press can be a successful product in the near future.

7.4. Comparison to previous press

After the restyling press budget analyze, is time to compare this cost to the press cost before the restyling to see if the applied changes are good for the budget or not.

Here have the comparative table:

PRESS MANUFACTURING COSTS COMPARISON		
	Before	**Now**
Commercial parts costs	19.801 €	8.384 €
Engineering costs and fabrication parts	21.997 €	11.606 €
Optional elements costs	(included in commercial parts costs)	2.015 €
TOTAL	**41.798 €**	**22.005 €**

Table 16. Comparative budget table of before and after restyling press
Source: own source

As can be seen in the Table 16, with the press restyling besides winning in design, sustainability and productivity, the profit is also in the budget. With this restyling, it has been achieved a saving of **47,36%**.

8. CONCLUSIONS

Once the project is finished, is the time to analyse if all the objectives, described in the introduction, have been achieved.

The main goal proposed was to convert the press process to the most sustainable industrial process in the current market and can be said that this objective is successfully reached. The restyled machine process is almost 100% sustainable because all the used raw material is reused and recyclable and the process to convert them in briquettes can be with renewable energy.

Other objectives were to make different studies to improve the entire machine; the steps, the design, the critical parts... and these objectives are also achieved. After realizing a FMEA study many press parts have been changed. The restyled press is more aesthetic, more compact, and more functional, with fewer steps and with more security.

Also, have been made many market studies to search the potential press customer and countries and has been created a business model to sell the press easier. These factors were as well in the beginning objectives.

The restyled press cost is more economical improving its characteristics and following all European regulations, the last objectives that the group was proposed for the project.

In conclusion, it can be said that all goals are reached and also have been achieved other objectives that initially are not expected.

With this project, a part of learning many engineering themes also have been learned the difficulty to design a product following all regulations and getting a great product, with the possibility to manufacture it and reaching all the objectives.

Despite this, working in this project has been a good experience for both of us, knowing the really mechanical parts, the busy schedules and ending with a great satisfaction with all the work done.

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