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

Writers: Clara Casademont Cavero & Núria Vendrell Ravetllat

This final project is based on the final thesis done for the degree on Mechanical Engineering, where the goal was to optimize the factory’s resources and turn waste into benefits. It was a factory established in Indonesia (Otazen) that makes wood furniture for several companies, such as Desigual or Massimo Dutti. Nevertheless, they also have their own line of products that they sell to the private sector and luxury hotels.

Due to the fact that the factory worked with wood, they had a big sawdust waste and the realization that it could be turned into fuel to dry the new raw material. Finally, a briquettes with sawdust compacted with water were created. After a drying period, they could be introduced into an oven to be burnt as if it were wood, achieving a similar result. In order to make these briquettes, a manual press had to be designed and built. It was a machine that created 12 briquettes at once.

*Image 1: Indonesian Press*
*Source: own source*

*Image 2: working area*
*Source: own source*
The second part of this project was to adapt this machine to the western world, thus dealing with regulation, automation and resistance numbers.

When this project was over, it was noticed that both, the machine and the briquettes, could have a follow up from the biofuel market’s point of view.

This industrial design thesis is divided into two separate but interconnected parts.

- The first goal was to redesign the briquettes and consequently the machine that produces them.

- The next goals were focused on the marketing and distribution of the briquettes and the machine. To do so, a company was created and a market research needs to be done.

Both parts of the thesis were carried out at the same time, since one was pointless without the other and sometimes one overlap the other.

Having set the bases of this thesis, it is easier to explain the main tasks for each of the parts of the project and their results.

The first observation was that using water during the creation process diminished the value of the briquettes as a biofuel. And hence, alternatives were sought to change its composition and remove water, which is a very valued element. Finally, it was decided to use recycled vegetal oil instead of water to compact the briquettes. In conclusion, this change of elements to compact the sawdust has led to a 100% sustainable briquette that only uses recycled materials that increase its value.

This change has also increased the performance and made easier the production of the final object.
Regarding the Mechanical Engineering project, the “European” machine (the automatic one), was divided into 4 different areas:

- **Mixing area**: where the elements (sawdust and water) were mixed and transported to the next stage.

- **Make up area**: a 4-station transfer machine was the responsible to move the mix over the stages needed to compact it properly.
  - Loading stage: its main function was to fill the molds, using a dispenser, with the exact quantity of the mix.
  - Pressing stage: here pressure was applied to the mix to give the right shape to the briquettes. It was triggered by a linear actuator and pressed with an ejector system and springs.
  - Unloading stage: the goal of this stage was to put the wet briquettes on a conveyor belt to carry them to the next area.
  - Cleaning stage: The remaining sawdust that might still be attached to the mold was removed to avoid future obstructions.

- **Drying area**: Due to the water added to better compact the sawdust, the briquettes came out of the molds too wet to be burnt in the oven. Therefore, in this area a circulating warm air oven dried the briquettes until they reached the right humidity level.

- **Residue treatment area**: this was an indispensable step regarding the water circulation that was used in the mix and came out of the press and cleaning stages.

*Image 4: areas and stages
Source: own source*
However, after modifying the briquette composition changing water to oil, some parts of the machine that are no longer necessary or have to do a different function need to be changed:

- Removing cleaning stage: Oil, being more viscous than water, makes the unmolding process easier and leaves less waste behind. Since, the 4-station transfer machine becomes a 3-station one.

- Removing drying area: oil has a positive effect on the briquette moisture because it is an inflammable element which favors its combustion.

- Removing residue treatment area: as oil has a higher density than water, some measurement could be standardized to use the necessary oil without it dripping during the pressing.

- Adding an element to incorporate oil into the mix.

Besides the changes in these parts, based on some improvement studies such as FMEA, some pieces could be optimized doing and easier production process, economizing materials and improving security (both for the machine and for the user who manipulates it).

In order to get a real vision of the project, some calculations were made to prove the chosen geometries of the parts (finite elements) and also to standardize quantities and making a good choice of the regulated elements.

The process design was also carried out together with the cycle time and the production design to know how much time will it take to develop the machine, the maintenance costs of it and its repayment.

To conclude, these numbers have been compared with the ones got on the previous project to understand the achieved improvements by the restyling.

This is a virtual image of the final design:
As it is mentioned before, the second part of the thesis is more focused on the selling and distribution of the briquettes and the machine.

To start working on it, the first step was to create the company responsible to manufacture the machines and the briquettes. It was named *EKOlogis*. This name was selected because it represents the values of the company. The mission (promoting and selling the product), the vision (expanding to the European sustainable market of biofuels) and the values (environment, sustainability, differentiation...) and the logotype were established.

To know if it is possible to sell the product, an important thing to do is to define a business idea, doing a market research to perceive its acceptance into the biofuel market. The conclusions obtained of the briquette usage are:

- In small quantities: it can be used as combustible for barbeques (replacing charcoal) or as a combustible for fireplaces (replacing wood).

- In big quantities: it can be used as combustible for inverted flame boilers (usually domestic ones).

Thanks to these studies the advantages of using the briquettes in other contexts has been seen. Furthermore, it could be seen who the potential costumers would be: mainly European countries, but also the United States of America, Canada or Japan.

Regarding the machine, possible locations to produce it were sought as well as what kind of costumers would buy it. It was concluded that clients would be from the aforementioned countries, owners of factories that produce sawdust or have access to it on a very low cost, with ideas od expanding their market and with environment awareness.

This is not a highly explored market, since there is only a similar high-pressure briquette machine, which uses high pressure and heat to compress them, therefore, not much competition. The goal is to produce and sell the compacted oil briquette press on a lower price than the other machines but also with a higher efficiency.

After the business SWOT analysis was made, it has shown that there are realistic goals that can be reached on the selected market. This company can also be a big competitor with the other ones in Europe, USA, Canada and Japan.
When the studies were finished, the business marketing mix has been designed (product, price, promotion and place):

- **Product definition:** the product is a compacted oil briquette press machine with its sub-product, the briquettes. In order to reach a bigger market, it has been designed as a modular machine to be easy to introduce in any factory, regardless of its free space.

- **Price:** with the purpose to reach all customer budgets, the machine can be sold as a whole pack, including all the accessories needed to mix the components, the conveyor belt and the packaging area. However, it can also be sold separately, taking into account that some wood factories might already have some of the components.

- **Place:** the standard European sizes and regulations have been adopted for the packaging and branding to distribute both, the machine and the briquettes.
Promotion: considering that it is a very important aspect to start a business and have a good first impression with the costumers, promotional products have been designed:

- Leaflet: strictly addressed to the machine and briquettes costumers and designed to communicate the business and product values.
- Datasheet: directed to the machine costumers, it includes a simple overview of its most important features. It is a technical promotion guide.
- Website: being Internet currently a much extended communication media, it is one of the easiest promotional tools and the one that will reach more possible buyers.
- Promotional videos: it will enable customers to see the machine working and its assembling process.
- Merchandising: a small sample will be produced to give away during promotional presentations, meetings, exhibitions or conventions.
Lastly, in order to make this thesis a realistic project that could be sold in Europe, Terms and Conditions were searched and followed. Besides, Rights and Obligations for the costumers as well as for the company selling the product have been included.

The main goal of this thesis was the study of a new 100% sustainable product implementation on the market from the start (when the first idea comes out and has to carry out all the tests and checks) until the end (the production and sell) going over all the steps such as the market researches, budgets, changes and improvements, conditions.