(B.A.M.) van Biesbergen, BSc Industrial Design Engineering, Thesis, August, 2023

The Development, Design, and Optimization of a briquette press for Twin Tech engineering

Thesis focus

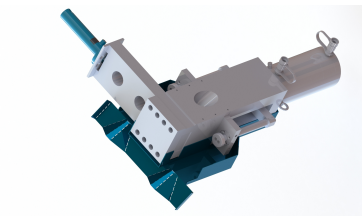
Metal is used in daily life, from the parts in your alarm clock, to the bikes in the bike rack and all things in between. However, the metal supply is not an endless supply we can use forever. For this reason and many more, it needs to be recycled. This thesis discusses the development of a briquette press to simplify and optimize the recycling of metal scraps and coolant.

(A) Current situation

(B) biquette

F. 1: Current situation and briquette

Background information and relevance



F. 2: Proposed ejection and collection mechanism

The company is developing a machine to press the metal scraps ejected by a CNC machine into briquettes. These scraps are currently stored in a bin below the output of the machine. However, the coolant from the CNC machine also leaks into this bin, as seen in figure 1.A. This leads to health hazards and unusable coolant [6]. Coolant is one of the more expensive components of the CNC process, therefore it should be reclaimed and reused [1]. Reusing coolant also has environmental benefits, such as less pollution. This adds to the sustainability of the industry, which is an enormous benefit [4, 2]. The machine that is developed in this thesis, will reclaim the used coolant, compress the swarf and store the briquettes. The pressing mechanism was predetermined and validated with research [5, 3]. Next to this, the outside of the machine is developed, to stand out in the current market.

Development

The process is split into 3 main parts that were developed. These 3 parts are the distribution into the bin, the reclaiming of the coolant and the design of the outer shell.

Briquette distribution

F. 3: Mechanism

When the briquettes are ejected out of the press mechanism, they descend to the same point. This leads to an uneven distribution of the briquettes in the bin. A mechanism was designed to solve this problem, as seen in figure 3. It is stationed below the ejection points and uses an angled plate to guide the pressed briquettes to different places in the bin.

Coolant reclaiming

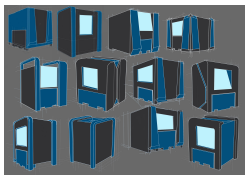
For the collection of the coolant. It needs to be done throughout the whole process. In figure 6 it can be seen that the designed mechanisms consists out of different parts. Reclaiming the coolant should be done in all of these parts. This means reclaiming starts when the scraps fall in the hopper. This part is designed with holes, so coolant can already leak through it and sent to the pump. The other main points of collection are around the press and before the briquettes fall into the bin. The reclaimed coolant goes to a pump that sends it back to the dirty coolant reservoir of the CNC machine. The CNC machine will do the rest of the cleaning, as long as there are no scraps bigger than 50 microns in the coolant [7].

(A) Inside (B) Front

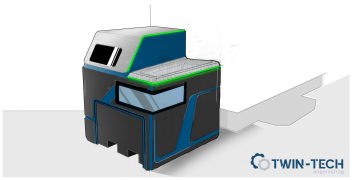
F. 4: Insides of the machine

Outer shell design

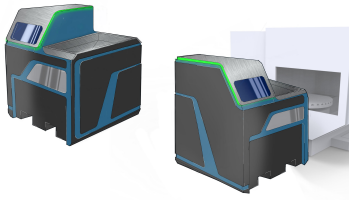
For the outer shell design, there was a start design for an electrically driven machine. The change to hydraulics led to the need for a new design. A glimpse of the design process is shown in figure 5. Part C is the final design in the style of Twin Tech engineering.



(A) Conceptualization



(B) Iteration

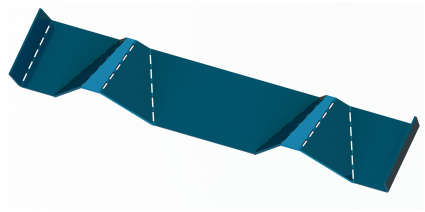


(C) Final design

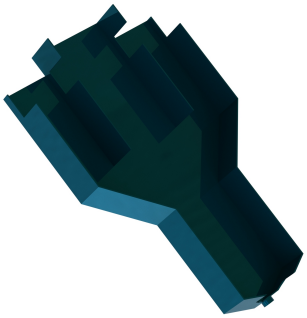
F. 5: Design process drawings

Results

The press is not finalized at the end of this thesis. There still needs to be further developments and alterations to make it a working and complete machine. The developed results are described below.



(A) Distribution mechanism



(B) Coolant reclaim

(C) Outer design

F. 6: Features of the machine

Briquette distribution

The briquette distribution, led to the angled plate in figure 3, after different designs and shapes were tested. The current design has an angular movement. It is placed below the ejection points. The pressed out briquettes slide over the plate and land in the bin. As each briquette is slightly different and with the movement of the distributor, they will all end up in a different spot.

Coolant reclaim

The coolant is collected in 2 parts. Around the hopper and below the ejection mechanism. This ensures the reclaiming of as much coolant as possible, throughout the whole process. Next, it goes to a pump that sends the coolant to the CNC, to handle it further. The more coolant is reclaimed, the faster the machine is earned back by the company. As it is a machine that saves money, rather than makes money.

Outer shell design

The outer shell is based around the mechanism that needs to fit inside it and the footprint below the CNC output. An added USP is the collection bin that fits within the design. The design is following the guidelines of Twin Tech engineering. The height difference is possible, because not the whole machine is stationed underneath the output.

Conclusion

In conclusion, the machine still needs to be finalized, as the designs that are created are proposals. Besides this, it is shown that there is a lot of potential en need for this machine. However, the machine is developed a lot since the start of this thesis, showing the contribution of this thesis to the project.

Bibliography

[1] Vimal Dhokia et al. “Effect of Cryogenic Cooling on the Surface Quality and Tool Wear in End Milling 6061-T6 Aluminium”. In: *22nd International Conference on Flexible Automation and Intelligent Manufacturing (FAIM 2012)* (Apr. 2012).

[2] M. Greeley and N. Rajagopalan. “Impact of environmental contaminants on machining properties of metalworking fluids”. In: *Tribology International* 37.4 (Apr. 2004), pp. 327–332. ISSN: 0301679X. DOI: 10.1016/J.TRIBOINT.2003.11.001.

[3] Bisrat Kebede and Hirpa G Lemu. “Design, Simulation and Production of Hydraulic Briquette Press for Metal Chips”. In: *Advances in Science and Technology Research Journal* 13.2 (Apr. 2019), pp. 24–30. DOI: 10.12913/22998624/105809. URL: http://www.astrj.com/pdf-105809-39858?filename=Design_%20Simulation%20and.pdf.

[4] M. Kobya et al. “Study on the treatment of waste metal cutting fluids using electrocoagulation”. In: *Separation and Purification Technology* 60.3 (May 2008), pp. 285–291. ISSN: 13835866. DOI: 10.1016/J.SEPPUR.2007.09.003.

[5] Arkadiusz Michał Kowalski, Przemyslaw Frankowski, and Agnieszka Tychoniuk. “Design of briquetting press - from idea to start of production”. In: Apr. 2018. DOI: 10.22616/erdev2018.17.n436. URL: https://doi.org/10.22616/erdev2018.17.n436.

[6] Choon Man Lee et al. “Eco-friendly technology for recycling of cutting fluids and metal chips: A review”. In: *International Journal of Precision Engineering and Manufacturing - Green Technology* 4.4 (Oct. 2017), pp. 457–468. ISSN: 21980810. DOI: 10.1007/S40684-017-0051-9.

[7] Plant Engineering. “Recycling machine tool coolants”. In: *Plant Engineering* (May 2003). URL: https://www.plantengineering.com/articles/recycling-machine-tool-coolants/.