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DESIGN AND CONSTRUCTION OF A WOOD POWDER PRESS MACHINE FOR MAKING PARTICLE BOARD AS A SUPPORTING MEANS FOR PRACTICAL ACTIVITIES

Rancang Bangun Mesin Press Serbuk Kayu Pembuatan Papan Partikel Sebagai Sarana Penunjang Kegiatan Praktikum

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ABSTRACT

This research activity studies the design of particle board press machines using iron plate materials and manual labor-based hydraulic presses. This research aims to produce a work tool that can facilitate the continuity of processing sawdust into particle boards so that practical activities can be carried out effectively and efficiently while still paying attention to the values determined in the practicum. The research method is carried out using the study of existing tools and will be made another tool with more straightforward work by analyzing the factors of weakness in existing tools. The working mechanism of the sawdust press machine to be made is manual, using human power, and the sawdust press machine is intended for practical student activities in the laboratory.

Keywords: Effective; Efficient; Manual; Particleboard; Practicum; Sawdust

ABSTRAK

Kegiatan penelitian ini merupakan kajian perancangan mesin press papan partikel dengan menggunakan material plat besi, dan press hidrolik berbasis tenaga kerja manual. Tujuan dari penelitian ini adalah untuk menghasilkan suatu alat kerja yang mampu memperlancar kelancaran pengolahan dan pengolahan serbuk gergaji menjadi papan partikel sehingga kegiatan praktikum dapat terlaksana secara efektif dan efisien dengan tetap memperhatikan nilai-nilai yang telah ditentukan. dalam praktikum. Metode penelitian dilakukan dengan cara mempelajari alat-alat yang sudah ada dan akan dibuat alat lain yang cara kerjanya lebih sederhana dengan menganalisis faktor-faktor kelemahan alat yang sudah ada. Mekanisme kerja mesin press serbuk gergaji yang akan dibuat adalah manual dengan menggunakan tenaga manusia dan mesin press serbuk gergaji ini ditujukan untuk kegiatan praktek mahasiswa di laboratorium.

Kata Kunci: Efektif; Efisien; Panduan; Papan partikel; Praktikum; Serbuk gergaji

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A. INTRODUCTION

Wood is an essential building material and never goes out of style. (Steiger & Erlangga, 2010). The wood processing process to fulfill needs apart from producing processed wood also produces waste (Rachman & Malik 2011). Sawmill waste is waste or remnants of processing at the sawmill location (Rianto, 2019). Residues from sawn wood processing are by-products of sawmills, such as sawdust side and end cuts, but can also be products that do not meet the specified quality criteria (Wahyudi, 2013). Wood waste can also be interpreted as leftover wood waste in various shapes and sizes that must be sacrificed in the production process (Wulandari, 2017). Sawmill waste in Indonesia reaches 1.4 million m^3 yearly, with a total wood production of 2.6 million m^3 yearly (Malik, 2012). Waste has become a significant problem as Indonesia's industry develops increasingly rapidly (Aisyah, 2013). Sawdust waste left to rot, stacked, and burned will negatively impact it, so it must be addressed (Maulana et al., 2020). The wood waste can be used for recycled products, providing economic benefits to the community (Wulandari, 2013). One of the efforts to utilize waste from sawmills is to use it as material for making particle boards because it is no stranger that waste is often used as raw material (Luthfianto & Nurkhanifah, 2020).

Particle board is one of the artificial board products widely used by the public as a substitute for wood, the availability of which is increasingly limited. (Ngadianto et al., 2019). Particleboard has several advantages compared to original wood: particleboard is free from knots, splits, and cracks. Apart from that, the size and density of particleboard can be adjusted to suit needs, has isotropic properties, and can regulate properties and quality. Particleboard is produced commercially using formaldehyde-based adhesives, namely urea formaldehyde for interior particleboard and phenol formaldehyde (PF) for exterior particleboard (Chaturvedi & Pappu, 2016). Formaldehyde-based adhesives are still an option for the industry because the price is relatively low, and particle boards with characteristics that meet standards can be produced (Zhang et al., 2018). In making particle board, the factors that influence the properties of particle board are the method of pressing the board, type, and size of particles, type and amount of adhesive, board density, water content, distribution and orientation of particles, quality of manufacture and final treatment (Sudiryanto, 2015). One of the stages of activity carried out in making particle boards is compression. For particle board that uses urea-formaldehyde adhesive, a compression pressure of 15 - 25 kg/cm is used (Kliwon & Iskandar, 2010). Economically, it is recommended to use a felt size of 15 kg/cm (Iskandar & Supriadi, 2011).

The pressing process in practicum activities in the Forest Products Technology department of the Samarinda State Agricultural Polytechnic uses a Cipta Karya Mandiri (CKM) Hot Press tool, which uses electrical power. Using this tool has the advantage of maximum compressive power. The weakness of using this tool is that its operation is very dependent on the availability of electricity, the use of electrical power tends to be significant. It is inadequate for practical activities, and maintenance is tricky and requires a high cost. The tools currently used in the forging process can be seen in Figure 1.

Figure 1. CKM hot press tool

This research aimed to create an alternative tool that can be used as a pressing tool. The concept of a new tool is operated manually, easy to operate, easy to maintain, has cheaper maintenance costs, and still has a maximum function, especially in terms of compressive power. It is hoped that new tools can increase the continuity of practicum activities more effectively and efficiently.

B. METHODS

Research Place

This research was carried out in two laboratories and included two activities. Production activities are carried out at the Forest Engineering Laboratory, and compression test activities are carried out at the Wood Products Engineering Laboratory. The Forest Engineering Laboratory and Wood Products Engineering Laboratory are in the Forest Products Technology Department of the Samarinda State Agricultural Polytechnic.

Stages of Research Implementation

1. Creation of Shape Concepts

The form concept applied is an open concept. The open image concept was chosen to ensure ease of cleaning and maintenance. The selected concept can be seen in Figure 2.

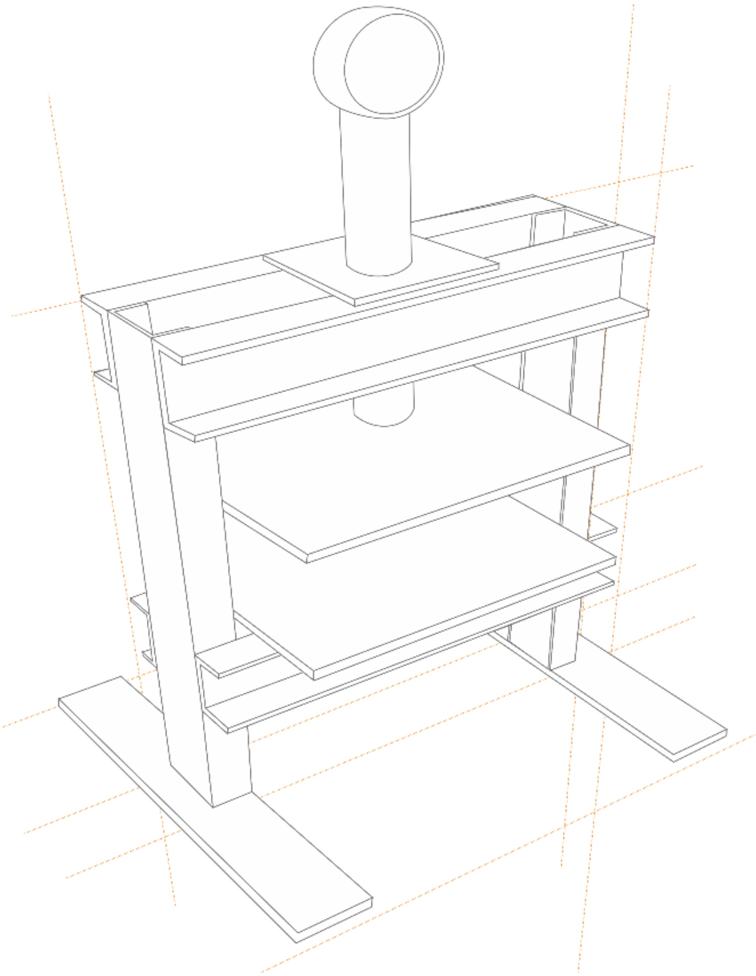

Figure 2. Selected design concept

2. Tool Working Concept

The working concept of this tool is compression using plate iron media. Two pieces of iron plate are used at the top and base. Forging uses the power of a hydraulic machine, which is pumped manually to produce pressure. The maximum pressure expected from this machine is 10 tons, and in units of newtons, it is as follows:

3. Tools and Materials

The tools used were a welding machine, grinding wheels, hand grinding, a sanding machine, and spray paint. The materials used were a 10-ton hydraulic press machine, a 10 mm iron plate, welding wire RB 260 mm, putty, base paint, iron paint, and thinner.

4. Tool Dimensions

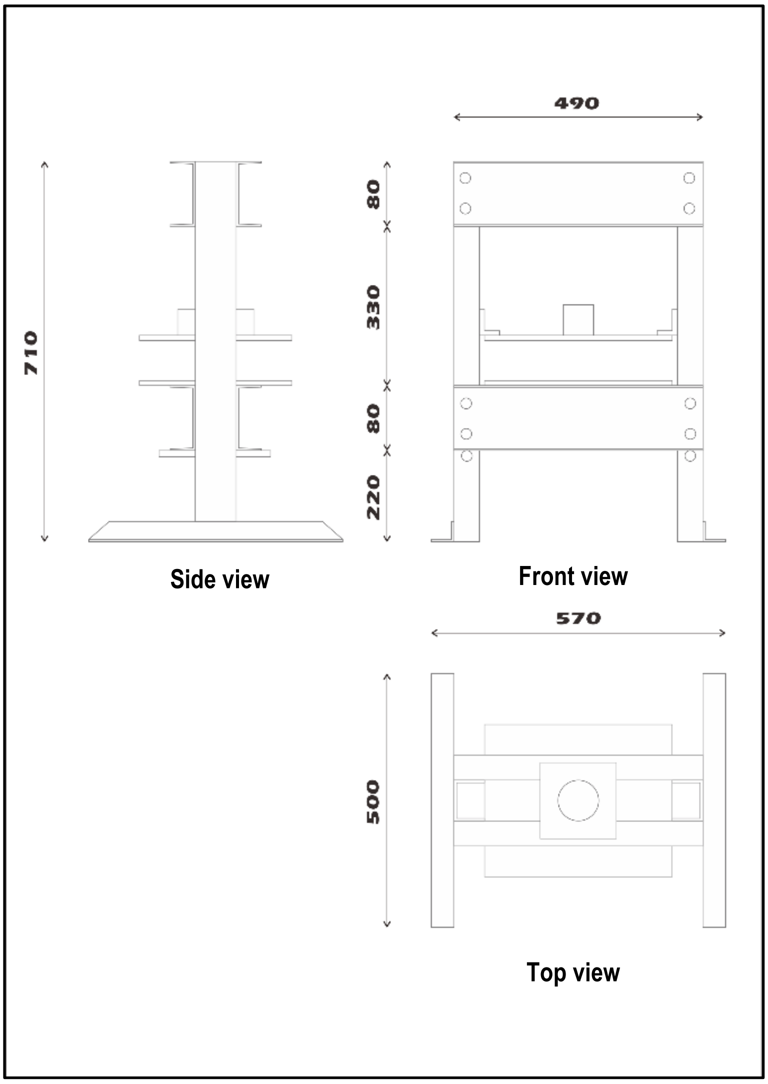

Figure 3. Tool dimensions in mm

5. Assembly Process

The assembly process, in this case, is the process of uniting the prepared parts. The joining of machine parts uses two types of connections: permanent and non-permanent. The permanent connection is an electric welding method, while the non-permanent connection uses bolts. The following is an illustration of the assembly. The choice of connection type in the assembly process is based on consideration of strength and function. An illustration of the tool assembly can be seen in Figure 4.

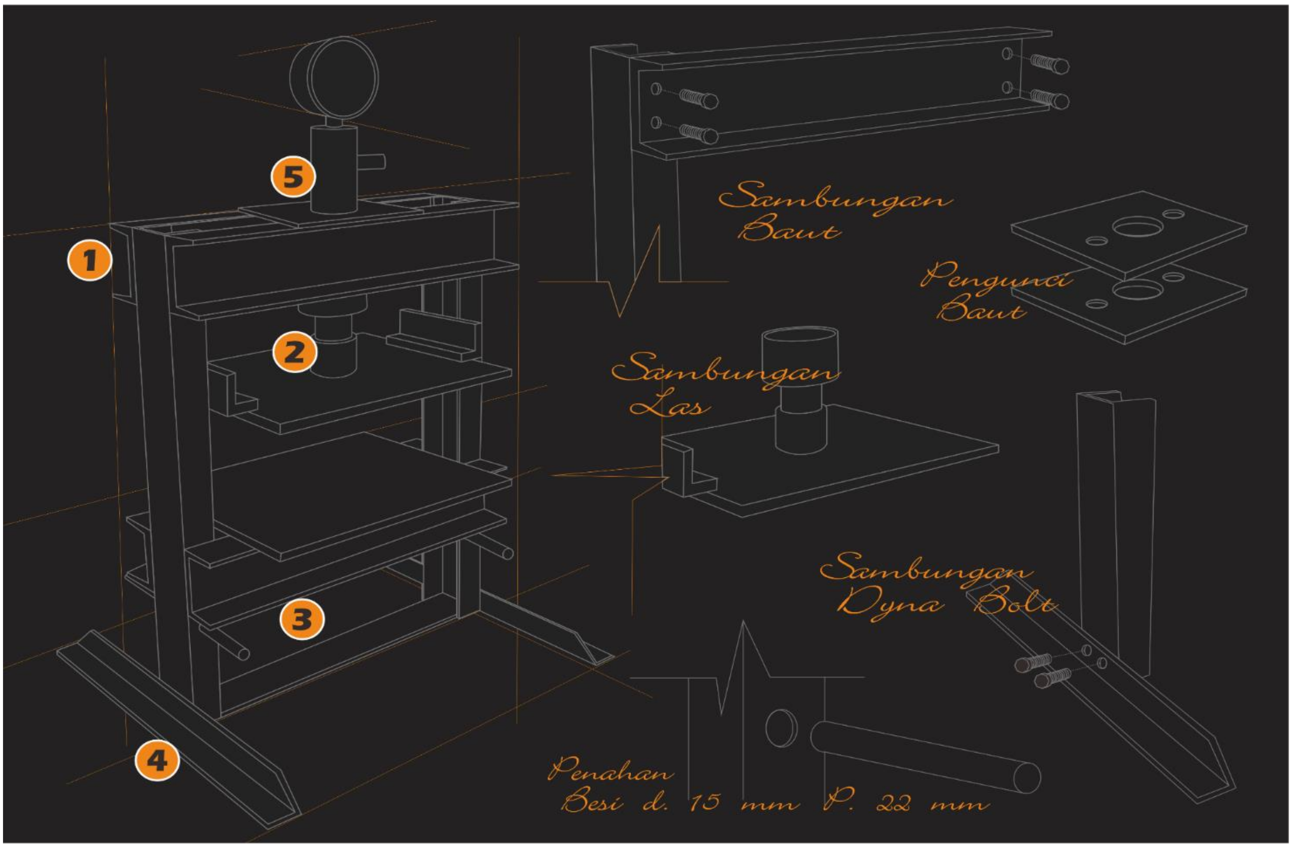

Figure 4. Assembly illustration

C. RESULTS AND DISCUSSION

Machine Generated

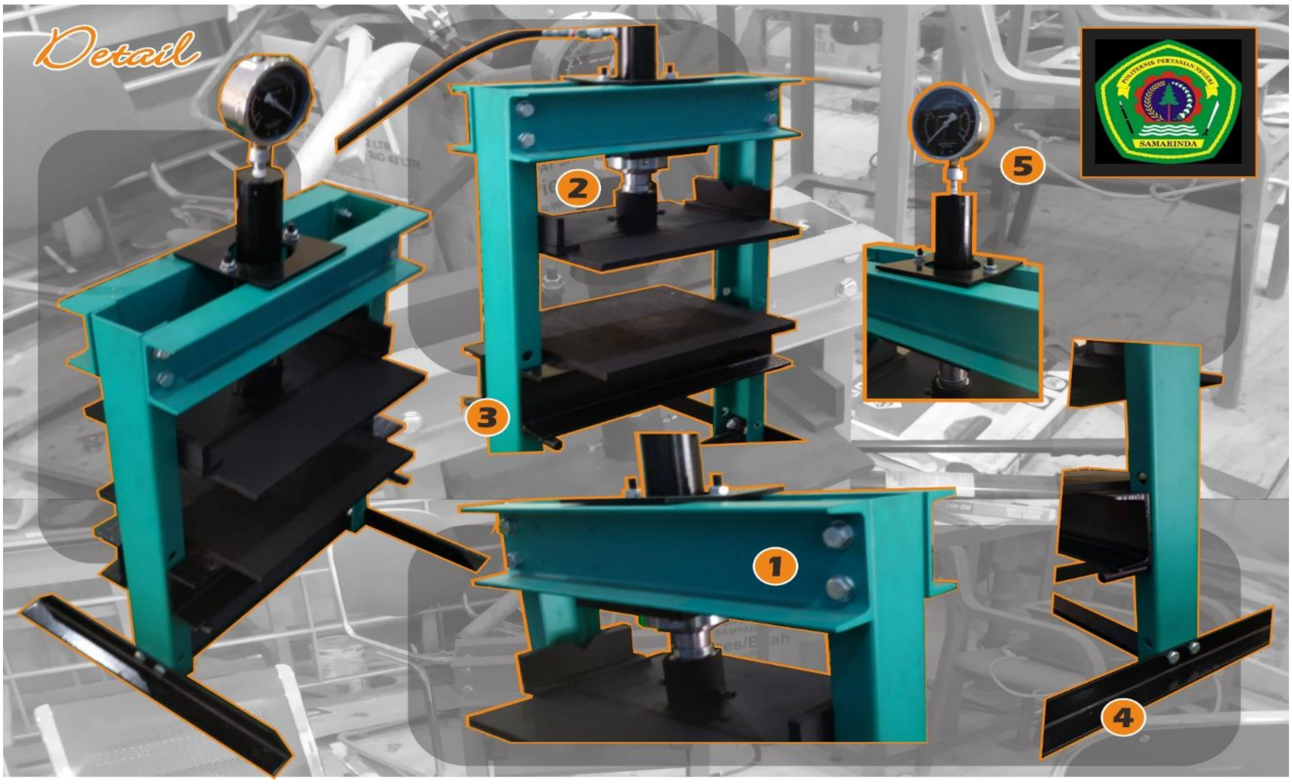

Figure 5. Illustration of assembly

Performance Testing

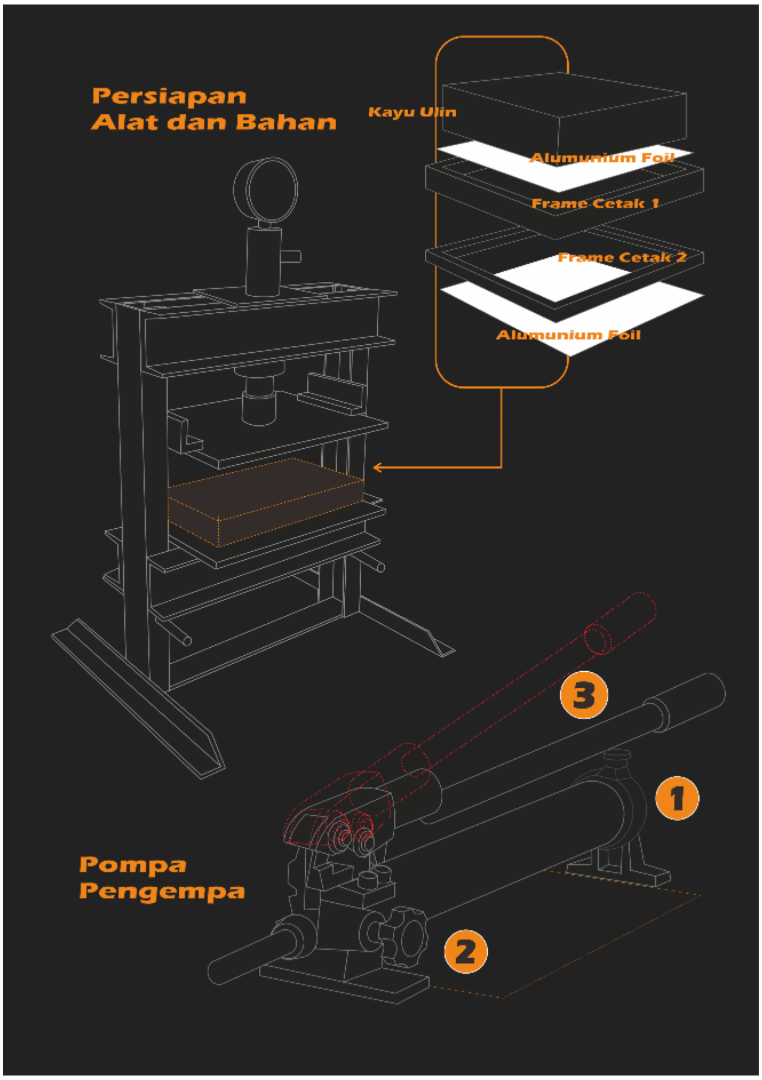

Figure 6. Illustration of tool operation

The steps in the working process of this tool are as follows:

1. The forging method is the cold forging method
2. Arrange the tools in the order specified
3. Preparation of dough consisting of sawdust, adhesive, and catalyst
4. The sawdust used is Meranti sawdust with a mess size of 100
5. The type of adhesive used is urea formaldehyde
6. The wood powder and adhesive ratio used is 60% wood powder and 40% adhesive.
7. Mix the mixture with the proportion according to the provisions
8. Place the mixture on printing frame one and printing frame two and compress it until it fills every part of the frame
9. Before pressing, the valves at number 1 and number 2 must be tightly closed by turning them clockwise
10. Note that the pointer on the pressure gauge should show the number "0"
11. Move the lever in an up-and-down direction to lower the pressure plate
12. Move the lever continuously until the maximum pressure is reached and the dough is compressed, or the dough thickness matches printing frame 2
13. When the compression process is complete, turn valve two counterclockwise to raise the pressure plate

The following data was obtained from the compression process (Table 1).

Table 1. Data from the compression process

Sample Number	Type Of Wood Powder	Mess Size	Ratio (%)		Initial Thickness (Cm)	End Thickness (Cm)	Pressing Weight In Pressure Gauge (Ton)	Time (Minutes)
			Wood Powder	Adhesive				
1	Meranti wood	100	60	40	2	1	9	40
2	Meranti wood	100	60	40	2	1	9	40
3	Meranti wood	100	60	40	4	1	9	40
4	Meranti wood	100	60	40	4	1	9	40
5	Meranti wood	100	60	40	5	1	9	45
6	Meranti wood	100	60	40	5	1	9	45

Press Force was calculated as follows:

F press = m x g
= 9000 x 9.81
= 88290

Where F press refers to compressive force in newton (N), m refers to the mass of capacity in kilogram (kg), and g refers to gravitational force in m/s^2.

D. CONCLUSION

It was concluded from this research that:
1. The forging method on this press machine is the cold forging method,
2. The compressive force resulting from the compression process is 88290 N or 7954 bars

It is suggested to:
1. This manual press tool is an initial prototype, so it requires further development to increase pressing power and production capacity,
2. To produce higher density and strength values for the compressed product, further development of the tool can increase the compressive power by adding a press tube or changing its capacity.

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