International Conference on Innovation and Engineering Technology (ICoIET) 2025
ISSN: XXX-XXX
Volume 1 Issue 01, 2025
https://icoiet.publikasi-untagcirebon.ac.id/

Design and Construction of Electric Hydraulic Coconut Milk Pressing Machine

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Abstract
This research aims to design an electric-based hydraulic coconut milk press machine that is capable of squeezing coconut milk effectively and consistently. This machine is designed with a processing capacity of 7 kg of grated coconut per cycle, using a hydraulic system driven by an electric motor as a pump driver. The system consists of a hydraulic cylinder, machine frame, squeezing container, and a manual button-based control system. Initial results show that the machine is able to speed up the squeezing process compared to conventional methods and increase the volume of coconut milk produced. This machine is expected to be an appropriate solution for home industries and SMEs in coconut processing, prioritizing efficiency, comfort, and hygiene.

Keywords: The first keyword: Extraction of Coconut Milk, Analysis of the efficiency of a three-phase induction motor due to voltage changes.

INTRODUCTION

The electric hydraulic coconut milk press is a mechanical technology innovation developed to overcome the limitations of conventional extraction processes by applying Pascal's principle to a hydraulic system. This technology integrates an electric motor to drive a hydraulic pump that generates high pressure of up to 200-300 bar to optimally squeeze grated coconut[4]. The theoretical basis of this system is based on the principle that "pressure applied to a fluid in a confined space will be transmitted equally in all directions" (Pascal's Law), allowing for an even distribution of force across the grated coconut material[5]. Recent research shows that mechanical extraction with hydraulic pressure can produce 25-30% higher coconut milk yields than traditional methods, with superior coconut milk quality in terms of fat and protein content.

The effectiveness of electric hydraulic presses in increasing productivity has been proven through various empirical studies showing an increase in production capacity of up to 300% compared to manual processes[7]. The hydraulic system offers advantages in terms of pressure consistency, precise process control, and the ability to extract coconut milk with an optimal water content of 50-60% according to industry standards[8]. However, the implementation of this technology still faces obstacles such as high initial investment, the need for regular maintenance of the hydraulic system, and dependence on a stable electricity supply[9]. Cost-benefit analysis studies show that although it requires an initial investment 15-20 times greater than manual methods, this technology is able to reach break-even point in 18-24 months of operation with optimal utilization rates.

RESEARCH METHOD

The experimental method is a research procedure carried out to reveal the causal relationship between two or more variables, by controlling the influence of other variables. This method is carried out by deliberately introducing an independent variable (inducing) to the research object to determine its effect on the dependent variable.

In research using experimental methods, there are three basic principles contained in experimental design, including the following:

1. Replication, is a repetition of the basic experiment.
2. Randomization: This principle is used in valid significance tests. A significance test will be valid if the observations are freely distributed, which is done by random sampling.
3. Blocking is a principle used to isolate treatment from the influence of other factors so that the experimental results are more accurate.

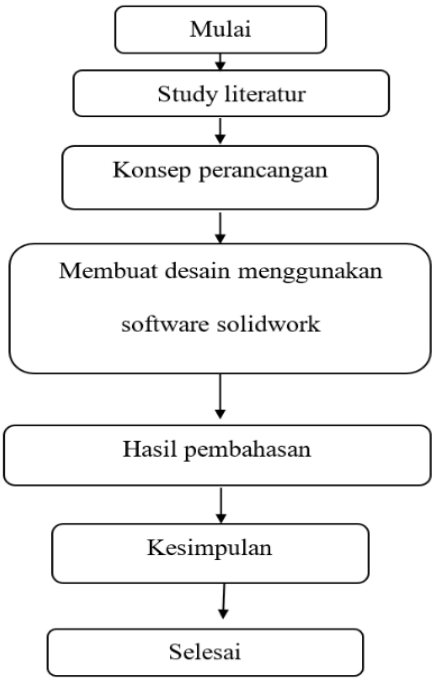


Figure 1. Flow Chart

RESULTS

1. Modeling of an electric hydraulic coconut milk press machine

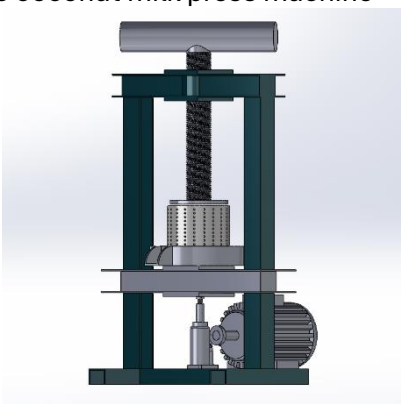


Figure 2. Electric hydraulic

The electric hydraulic coconut milk press is a mechanical technology innovation developed to overcome the limitations of conventional extraction processes by applying Pascal's principle to a hydraulic system. This technology integrates an electric motor to drive a hydraulic pump that generates high pressure of up to 200-300 bar to optimally squeeze grated coconut.

2. Prototype frame of electric hydraulic coconut milk press machine

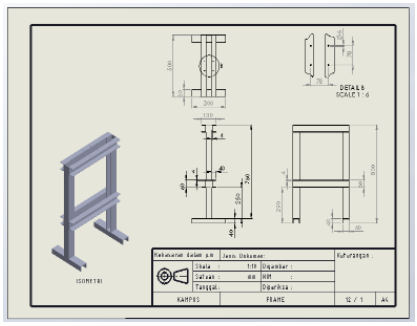


Figure 3. Prototype frame of electric hydraulic

The frame is the main supporting structure of all machine components, functioning as a load-bearing frame and a stable platform for the machine's working systems such as hydraulic cylinders, press tubes, electric motors, and control units. In an electric hydraulic coconut milk press system, the role of the frame is crucial because it must be able to withstand large compressive forces (up to hundreds of kilograms or several tons) generated by the hydraulic system repeatedly without experiencing deformation, vibration, or structural damage.

3. Electric motor

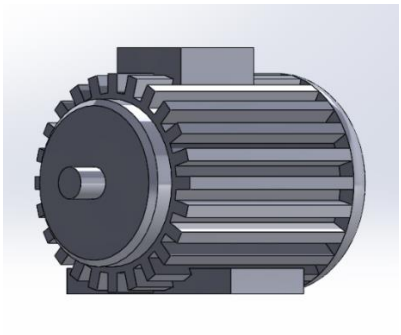


Figure 4. Electric motor

An electric motor is an electromagnetic machine that converts electrical energy into mechanical energy through the interaction of a magnetic field with an electric current that produces a motive force (torque) on the rotor[1]. In the context of modern technology, electric motors have become a fundamental component that drives various industrial and transportation applications, with operational efficiencies reaching 90-95% compared to internal combustion engines which only reach 25-35%[2]. This technology operates based on Faraday's law of electromagnetic induction and Ampère's law, where an electric current flowing through a coil in a magnetic field will produce a force proportional to the current strength and the intensity of the magnetic field. The specifications of the electric motor are 0.5HP or 1 phase.

4. Hydraulic jack



Figure 5. Hydraulic jack

A hydraulic jack is a mechanical device that operates on the principle of Pascal's law, where pressure applied to a fluid in a confined space is transmitted evenly in all directions. In the context of an electric hydraulic coconut milk press, the hydraulic jack acts as the main component, generating the large pressure used to compress the coconut pulp to maximize the coconut milk output.

5. Squeeze tube

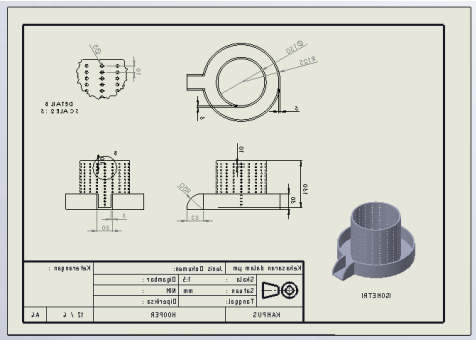


Figure 6. Squeeze tube

The squeezer tube functions as a static working cylinder that holds the grated wet coconut and channels the coconut milk to the outlet through a filtration system or small holes in the tube wall. At the top of the tube, there's usually a pressure plate driven by a hydraulic cylinder from above, exerting vertical pressure. At the base, the tube is equipped with a coconut milk outlet and a screen filter to separate the liquid from the pulp.

CONCLUSION

The conclusion of this design aims to design and develop an innovative and efficient electric hydraulic coconut milk press machine to increase the productivity of the coconut milk processing industry in Indonesia. This main objective is directed at creating technological solutions that can address fundamental challenges in the coconut processing industry, particularly in the aspects of extraction efficiency, product quality consistency, and operational sustainability. The development of an electric hydraulic coconut milk press machine is expected to be a catalyst for technological transformation in the coconut processing sector, from a conventional manual system to a more productive and sustainable automated mechanical system.

Recommendations

1. Capacity Development and Production Scale: Further research is recommended to design a variety of machine capacities, ranging from household to medium-scale industries, to meet broader needs.
2. Hydraulic System Optimization: Further testing is needed to determine variations in hydraulic pressure, cylinder diameter, and electric motor speed to find the most efficient combination for producing the best quality coconut milk.
3. Hygiene Improvement: It is recommended that all components that come into contact with raw materials be made of food-grade stainless steel meeting SNI or international standards to further ensure food safety and machine durability.
4. Automation and Intelligent Control: In the next development stage, the machine can be equipped with an automatic control system based on sensors or microcontrollers,

allowing the pressing process to be precisely regulated based on the volume of grated coconut and the desired coconut milk viscosity.

5. Ergonomics and Occupational Safety: The machine design should consider operator comfort, such as working height, control button position, and safety systems (safety valves and emergency stops) to prevent workplace accidents.
6. Economic and Durability Test Before mass production, it is necessary to analyze production costs, maintenance, and electrical energy consumption so that the machine is truly technically and economically efficient, as well as service life testing to ensure long-term reliability.

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