The Automatic Sliding Door Construction onEmpty Bunch Conveyor Using Pneumatic Actuator at Sungai Lilin Palm Oil Mill

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Abstract. The Empty Bunch Press is a pressing tool that processes empty fruit bunches from the threshing results, functioning to minimizeoil losses still attached to the empty bunches. The issue that occurs is the high current in the empty bunch press due to excessive feed of emptybunches, causing the pressing process to slow down and result in trips. The sliding door of the empty bunch conveyor is still manually operated by the operator, leading to uneven distribution of empty bunch feeds. Based on this issue, an automatic sliding door system for the empty bunch conveyor was designed using a pneumatic actuator. This researchaims to develop an automatic sliding door on the empty bunch con- veyor, evaluate the performance of the automatic sliding door system on the empty bunch conveyor, and determine the effect of the system instal- lation on the working amperage of the electromotor and oil losses in the fiber. The sliding door system was developed by constructing an actua- tor bracket, a limit switch bracket, and installing the electropneumatic system. The test results showed that the automatic sliding door system performed well in reducing the electromotor working amperage, with the average amperage before installation being 142 A and after installation dropping to 126 A, a decrease of 16 A. Additionally, it contributed to a reduction in oil losses in the fiber by 14.8%.

Keywords: Working Ampere, Oil Losses In Fiber, Automatic Sliding Door

1 Introduction

The Palm Oil Mill (PKS) industry is an agro-industrial sector that processes Fresh Fruit Bunches (FFB) of oil palm from plantations. The processing of FFByields two primary products: crude palm oil (CPO) and palm kernel (PK) [8].The empty bunch press station is a continuation of the threshing station, focusingon oil extraction from empty bunches using the empty bunch press machine [1].A challenge encountered in this process is the high amperage in the electric motor of the machine due to uneven reception of empty bunches, leading to a

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slower pressing process and frequent tripping of the machine [7]. The proposed solution is the installation of an automatic sliding door on the empty bunch conveyor, operated using a pneumatic actuator. This system will automatically open the sliding door when the motor's amperage is high, ensuring a more even feed of empty bunches into the empty bunch press machine [9].

Implementing this system is expected to reduce tripping and enhance the operational efficiency of the empty bunch press machine in PKS. Through the implementation of this system, the goals include achieving better operational efficiency, reducing high working amperage due to feed accumulation, and minimizing oil losses during the pressing process.

This study proposes an innovative approach to enhance the efficiency of the empty bunch press machine at PT Hindoli Mill. By integrating an automatic sliding door system, it is expected to significantly improve the operational dynamics of the PKS industry.

2 Method

In designing the automatic sliding door system for the empty bunch conveyor, a thorough design procedure is required to ensure optimal planning and execution. Initially, the control circuit for the pneumatic actuator-based automatic system was developed according to functional requirements using simulation software to evaluate the system's performance and determine component needs [10]. Thiswas followed by the preparation of tools and materials as per the established plans. Next, the actuator mounting design was created according to the position and dimensions and then fabricated with precise measurements, including the mounting for the limit switch. The actuator mounting was adjusted to the sliding door's distance.

After the mounting was completed, reinforcement bars were installed on the sliding door to connect the limit switch, ensuring the appropriate distance be- tween the components. The next step involved creating the control panel and assembling the automatic actuator system within it. Once the panel was assem-bled, air hoses were connected from the compressor to the actuator system. The final step included setting the upper and lower amperage limits on the electro- motor of the empty bunch press machine using the MT4W Autonics device [4]. After everything was installed, testing was conducted to ensure successful oper- ation.

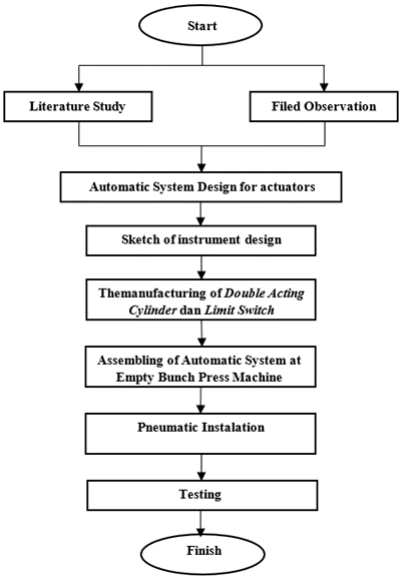
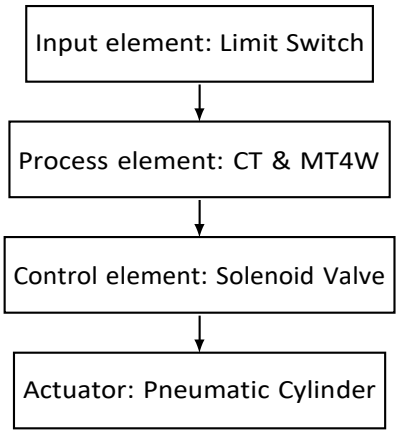


Fig. 1. The assembly procedure of automatic sliding door

3 Result and Discussion

Implementing this system is expected to reduce tripping and enhance the operational efficiency of the empty bunch press machine in PKS. Through the implementation of this system, the goals include achieving better operational efficiency, reducing high working amperage due to feed accumulation, and minimizing oil losses during the pressing process. This study proposes an innovative approach to enhance the efficiency of the empty bunch press machine at PT Hindoli Mill. By integrating an automatic sliding door system, it is expected to significantly improve the operational dynamics of the PKS industry.

Electropneumatic System Diagram



The system is powered by a delta start circuit, which is a common method to reduce the initial current drawn by induction motors [4]. Once the motor is operational, the current flowing through it is measured by a Current Transformer (CT). This CT monitors the incoming current and sends the measured value to the MT4W, a multifunction measuring instrument that processes the data [10]. Based on the current value received:

If the current exceeds 40 amperes, the MT4W sends a high (HI) signal, triggering the electropneumatic circuit to activate the pneumatic actuator. This results in the cylinder moving forward [9].
Conversely, if the current drops below 40 amperes, the CT detects this change and signals the MT4W to switch to a low (LO) state, which automatically commands the pneumatic cylinder to retract.

In summary, this system utilizes the delta start circuit to manage the motor's starting current effectively, monitors the current using a CT, and controls the movement of a pneumatic cylinder through an electropneumatic circuit basedon the measured current values [10].

3.1 Installation of the Front and Rear Mounting Brackets for the Double-Acting Cylinder

The rear and front mounting brackets for the double-acting cylinder, which feature four holes, are affixed to the actuator body bolts serving as the rear mount- ing point [6]. Subsequently, the brackets are secured to the actuator using bolts to hold them in place between the actuator and the bracket. Finally, the front piston cylinder is installed with the previously mounted brackets on the sliding door conveyor.

In image Fig 2 (a), it functions as a connector between the actuator piston and the mounting bracket installed on the sliding door. Image Fig 2(b) serves as a connector for the rear body part of the actuator that connects to the metal bracket. Fig 2 (c) shows the actuator with the front and rear mounts installed.

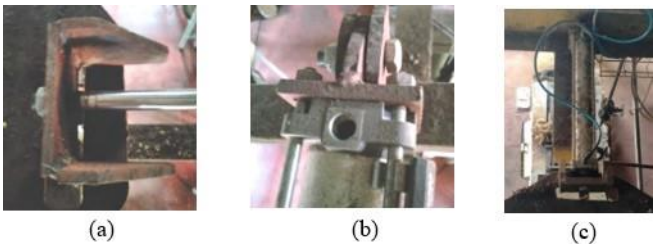


Fig. 2. (a) The front mounting bracket (b) The rear mounting bracket (c)The installed mounting bracket

3.2 Installation and Adjustment of Limit Switch Brackets

After the assembly of all mounting brackets is completed, the next step is to install the limit switches onto the brackets. The limit switch functions to adjust the distance with the actuator piston, halting its forward movement for Limit Switch 2, and to stop the piston cylinder when retracting for Limit Switch 1.On the sliding door conveyor, a metal tab is installed to make contact with the limit switch, as illustrated in Figure 3.

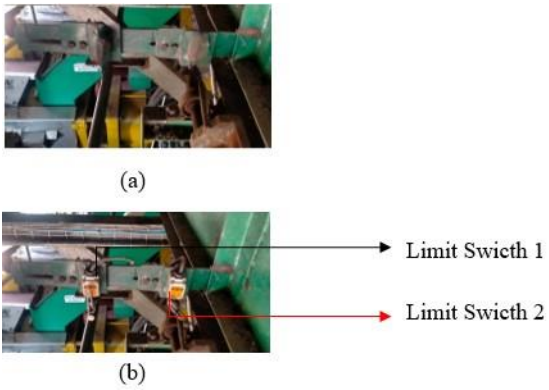


Fig. 3. (a) Adjustment of the limit switch bracket (b) After the installation of the limit switch

3.3 Electropneumatic System Installation

For the installation of the pneumatic actuator system, the pressurized air supply originates from the compressor pipe located at the empty bunch press station. The pipe is then connected to an air hose fitting that supplies input to the 5/2

solenoid valve. The hose of the double-acting cylinder is connected to the output of the 5/2 solenoid valve. This configuration is illustrated in Fig 4 below.

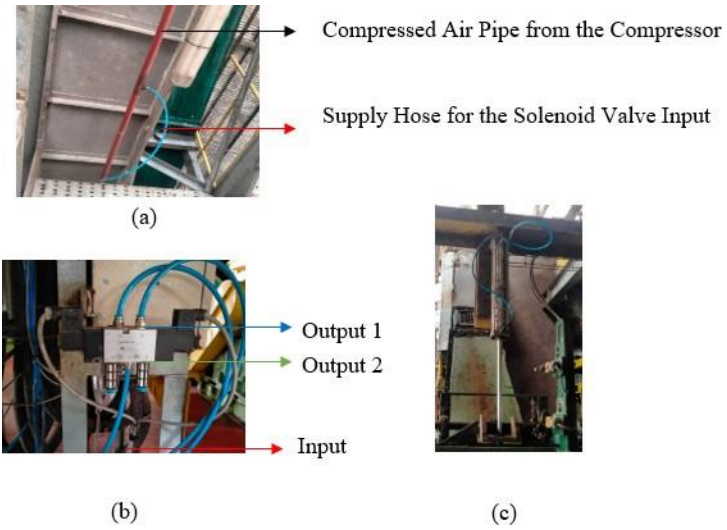


Fig. 4. (a) Compressed air pipe from the compressor (b) Installation on the 5/2 solenoid valve (c) Connection of the hose to the actuator

3.4 Control Panel Installation

The results of the wiring system installation for the automatic sliding door conveyor can be seen in Fig.5

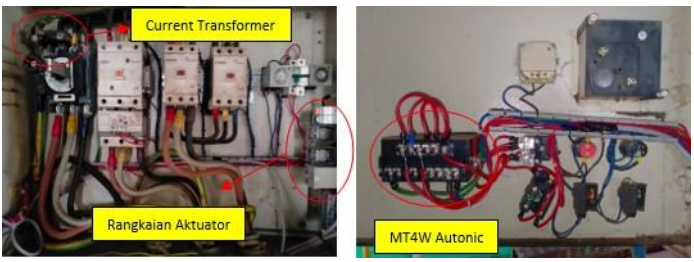


Fig. 5. MT4W Component Circuit

The automatic sliding door system is installed in the empty bunch press electromagnetic motor panel. Additional holes are made for the selector switch and MT4W Autonic is installed using an electric hand drill and hand grinder on the front cover. The control panel can be seen in Fig. 6

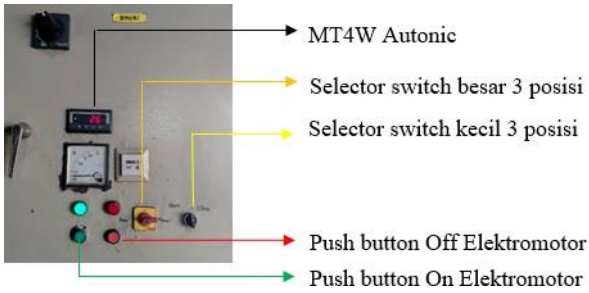


Fig. 6. The Panel of Automatic Sliding Door

The ”push button on” is used to activate the entire automatic sliding door system and the empty bunch press electromagnetic motor, while the ”push but- ton off” is used to turn off the electromagnetic motor [2]. The MT4W servesas the controller for the pneumatic actuator with an input signal from one ofthe single-phase wires on the three-phase electromagnetic motor [5]. The large selector switch is used to set the position to either automatic or manual for operating the pneumatic actuator. In the automatic position, it is connected to the MT4W, while in the manual position, it is connected to the relay solenoid valve circuit through the small selector switch [3]. The small selector switch is used to manually control the opening and closing of the pneumatic actuator by the operator.

3.5 Effect on Operating Current

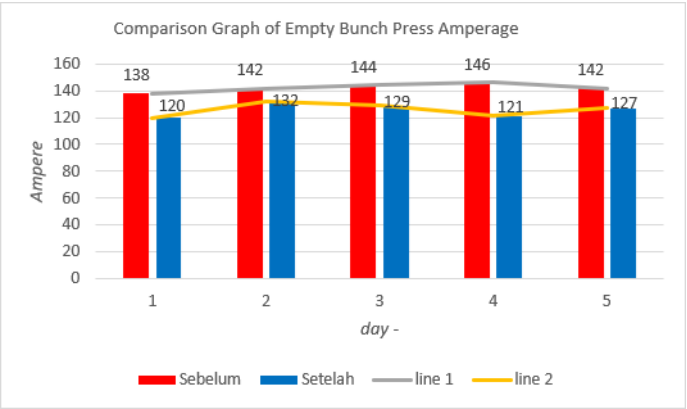


Fig. 7. Comparison Graph of Empty Bunch Press Amperage

The installation of an automatic sliding door on the empty bunch conveyor using a pneumatic actuator affects the operating current of the empty bunch press. The amperage of the electromagnetic motor is one of the parameters with a minimum of 100 A and a maximum of 150 A. The operating amperage range for the empty bunch press at PT Hindoli Mill Sungai Lilin is 130 – 140 amperes. If the amperage is at 110, it indicates a decrease in the number of empty bunches inside the press. The operating amperage being tested is for empty bunch press number 7. Data collection of amperage was carried out before and after the installation of the automatic equipment. The testing was done by observing the amperage on the panel when the sliding door of the empty bunch press was opened and the feed was in progress. The operating amperage data can be seen in Fig. 7

3.6 Effect on Oil Losses in Fiber

Based on Fig. 8 above, it shows that the average oil losses in fiber are above the maximum of 1% relative to the empty bunch. Fig 9 shows that the average oil losses in fiber are less than 1% relative to the empty bunch. From the graph of oil losses in fiber after the installation of the equipment from November 21to November 25, 2023, the percentage value decreased compared to before the installation of the equipment from November 7 to November 11, 2023. This indicates that the installation of the sliding door equipment has resulted in a reduction in oil losses.

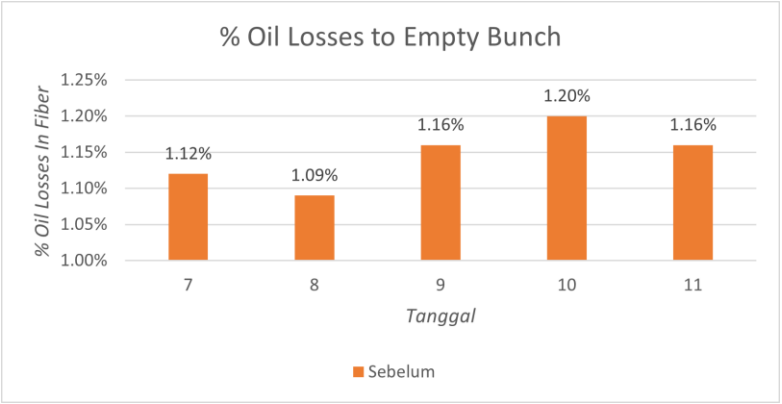


Fig. 8. November 2023 Oil Losses in Fiber Graph Before Installation of the AutomaticSliding Door on Empty Bunch Press

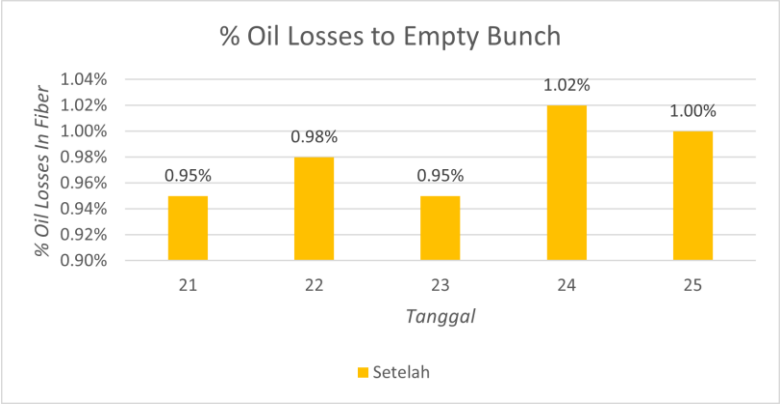


Fig. 9. November 2023 Oil Losses in Fiber Graph After Installation of the Automatic Sliding Door on Empty Bunch Press

4 Conclusion

In the development of an automatic sliding door for an empty bunch conveyor using an electropneumatic system connected with the working current of the elec- tromotor. The automatic sliding door provides excellent performance in termsof usage, speed, reliability, and safety. The development of the automatic slidingdoor can reduce the operating current of the electromotor by 16 A and help decrease oil losses in fiber by 14.8%."

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