JURNAL
Pendidikan, Sains, Sosial dan Agama
SEKOLAH TINGGI AGAMA BUDDHA NEGERI RADEN WIJAYA WONOGIRI

OPTIMIZATION OF BELT CONVEYOR SYSTEM PERFORMANCE AT LAMPUNG PACKING PLANT THROUGH APPLICATION OF BLOCKING INDICATION SENSOR

Sangkot Sabrina[1], Ahmad Dani[2], Amani Darma Tarigan[3]
[1]Teknik Elektro, Universitas Pembangunan Panca Budi, Medan, Indonesia
[2]Universitas Pembangunan Panca Budi, Medan, Indonesia
[3]Universitas Pembangunan Panca Budi, Medan, Indonesia
sangkotsabrina17@gmail.com, ahmad.kartasasmita@gmail.com, amanidarmatarigan@gmail.com

Article History:
Received: 26 November 2024 ***Revised: 30 Desember 2024*** *Published: 31 Desember 2024*

Abstract

In various industries, the use of belt conveyors as a means of transporting materials has become very common and crucial. Belt conveyor is a production process equipment used to transport large quantities of materials. However, there are often problems with blocking cement bags on the belt conveyor which causes downtime and reduces operational efficiency. This research aims to optimize the performance of the belt conveyor through the application of a blocking indication sensor system equipped with an interlock to stop the belt conveyor motor automatically when the blocking sensor is detected. The research method consists of the design and installation of limit switch sensors, the integration of indicator light systems, and PLC-based control using ladder diagrams. Testing is carried out for one month to measure its effectiveness. The results show that the application of this sensor has succeeded in reducing downtime by 33.6%. The implementation of this system provides early warning to operators and reduces the risk of further damage, thereby significantly improving operational efficiency. This study concludes that the application of blocking indication sensors on belt conveyors is able to optimize system performance by reducing downtime and accelerating response to operational problems.

Keywords: *Belt Conveyor, Blocking Indication Sensor, Downtime, Optimazation, PLC.*

INTRODUCTION

In various industries, the use of belt conveyors as a means of transporting materials is very common and crucial in supporting the production process (Priyambada, Finali, DY, Umar, & Utomo, 2024). Belt Conveyor (BC) is a tool designed to transport large volumes of material, either horizontally or forming an inclination angle from one operating system to another operating system in a series of production processes that use belts as their load carriers. At the Lampung Packing Plant, belt conveyors are used to transport cement bags that have been loaded from the Rotary Packer to the lorry loader and palletizer (Lubis, Pane, Lubis, Siregar, & Kusuma, 2021). However, as a mechanical device, belt conveyors are also susceptible to the risk of damage that can have significant negative impacts. Damage to the belt conveyor may result in a number of losses, including decreased productivity caused by the cessation of the production process (Toha, Juniah, & Yusuf, 2022). However, along with

the intensity of use, belt conveyors become susceptible to various damages that can have significant impacts. First of all, belt conveyors have a crucial role in ensuring the smooth and efficient operation of a production facility. Damage to the belt conveyor can cause the production process to stop, which in turn can result in decreased productivity and potentially substantial financial losses. High repair costs are also another negative impact, especially when the damage requires complex and expensive repair measures (Rosita, 2023). In its journey, the belt often faces several obstacles including the need for repairs, replacements, or maintenance triggered by damage or because of the tool's lifetime to improve the performance of the belt conveyor. If damage occurs to the belt conveyor, it can cause the main equipment to stop. Furthermore, the risk of work accidents increases due to damage to the belt conveyor, especially if it causes material to fall or be thrown that can endanger worker safety. Apart from the damage factor, blocking cement bags can also cause the belt conveyor to stop, thus inhibiting the loading process (loading time) of cement bags to trucks. In a competitive business world, optimizing loading time and production efficiency is the key to achieving competitive advantage. Increasingly tight industrial competition forces the industry to continuously improve the quantity and quality of its products in order to be able to compete in meeting consumer satisfaction. Likewise, rapid technological developments and increasing market demand are challenges for management, especially on the production floor (NANANG, 2023).

Loading time is the time available (availability) per day or per month minus the planned machine downtime (MUHAMMAD, 2022). Often there is blocking of cement bags and the number of bags entering the truck sometimes does not match the delivery order, so the operator must recalculate and this can trigger a delay time in the production process. This can cause major financial losses for the company. The more and more often the cement bags experience blocking, the longer the repair process will be, during the repair process the belt conveyor stops so that the loading process is delayed and the loading time is not optimal because loading is delayed. Therefore, it is necessary to optimize the performance of the belt conveyor. The PLC system allows operators to detect and fix problems in the automation system faster. This reduces downtime that can disrupt production and cause financial losses (Fadli, Yuliana, & Yanuartanti, 2024). Then there is no sensor system with interlock to stop the belt conveyor motor automatically if blocking is detected (AGUNG, 2023). Therefore, this Final Project will focus on optimizing the performance of the belt conveyor system through the application of blocking indication sensors at the Lampung Packing Plant by optimizing the loading time of cement bags to trucks as an improvement to the problem of high delay time in the loading process caused by cement blocking (Hazrina, Purwiyanto, & Gilang, 2024).

METHODS

Below is attached a flowchart of the application of blocking indication sensors as an optimization of the performance of the belt conveyor system. A flowchart is a diagram that uses a logical flow of data processed in a program from start to finish (Erivianto & Dani, 2024). Designing a flowchart on hardware is a design process to create a program that will later be run (Anggraini, Nugroho, Sakdillah, Trides, & Respati, 2023)..

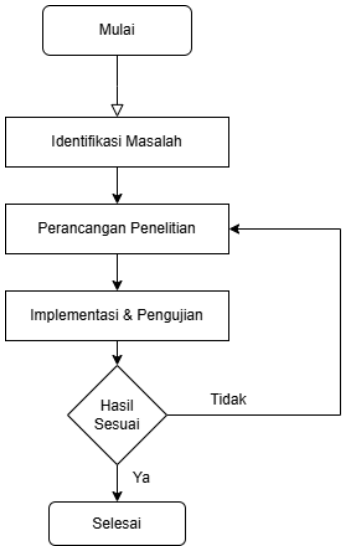

Figure 1Flowchart of Research Method for Implementing Blocking Indication Sensors

Problem Identification

There is no system that can detect cement bag blocking on the belt conveyor early on which causes delay time in operations and there is no sensor system with interlock to automatically stop the belt conveyor motor if cement bag blocking occurs on the belt conveyor (Prasetyo & Pramesti, 2024).

Research Design

Installation of Blocking Sensor & Indication Lamp

The application of blocking sensors uses a limit switch sensor type. The limit switch sensor is used to detect the presence or absence of cement bag blocking on the belt conveyor with the condition that the actuator of the limit switch detects or touches the surface of the cement bag piled up on the belt conveyor (Faizah & Widagdo, 2024). The position of the limit switch sensor is above the belt conveyor with a height of 1 approximately 20 cm above the belt conveyor. A limit switch is a tool that functions to disconnect and connect electric current in a circuit, based on the mechanical structure of the limit switch itself (Febrianto, Umbara, & Safaruddin, 2022). The type of limit switch used is the Telemecanique XCKJ Limit Switch with support installed on the top of the belt conveyor cover (Dwilaga, 2023).

Figure 2Installation Of Limit Switch Sensor

Indicator lights that provide signs or signals whether a circuit is operating or not. [19] Blocking indication lights will be installed at 2 points, the first point will be installed in the packer machine area with the aim that the operator can detect early if blocking occurs. Then the next point will be installed above the cover belt conveyor (Fachri & Alwathani, 2023). The LED indicator light system device is one of the important components of the control system that functions to inform the operator that the supporting parameters are in operating/normal or interlock/trip conditions (Perdana, 2019).

Figure 3Installation Of Blocking Indication Sensor Lamp

System configuration on PLC

Programmable Logic Controller (PLC) based control system is becoming a solution that is increasingly applied in various industries because of its ability to regulate and control various devices in one integrated system (Wijaya & Riananditasari, 2022). Software design in this study is needed so that the planned system can work properly. The program design in this project uses Siemens software with the type simatic S7. The most commonly used PLC programming language is Ladder Logic Diagram. Relay Logic Diagram is very similar to Ladder Logic Diagram. In the application of this blocking indication sensor, a ladder diagram is used as the programming

language. The relationship between input and output represents the causal relationship that occurs in the process, which ultimately represents a process of processing input signals to produce varying output signals (Baskoro, 2023). Input Device is a control component that is connected to the PLC input terminal (Lestari, 2021). The main components of the system start from the input. Generally in the form of sensor components or set point components (Fadylla & Azizah, 2023). Where the limit switch will be used as input (I46.6) which has NC contacts. Then added after that the running signal from the belt conveyor motor (Q6.8) and the running signal from the belt discharge group (Q19.3). If the sensor is active then the sensor will disconnect the input signal and the condition of the belt conveyor motor will stop/trip.

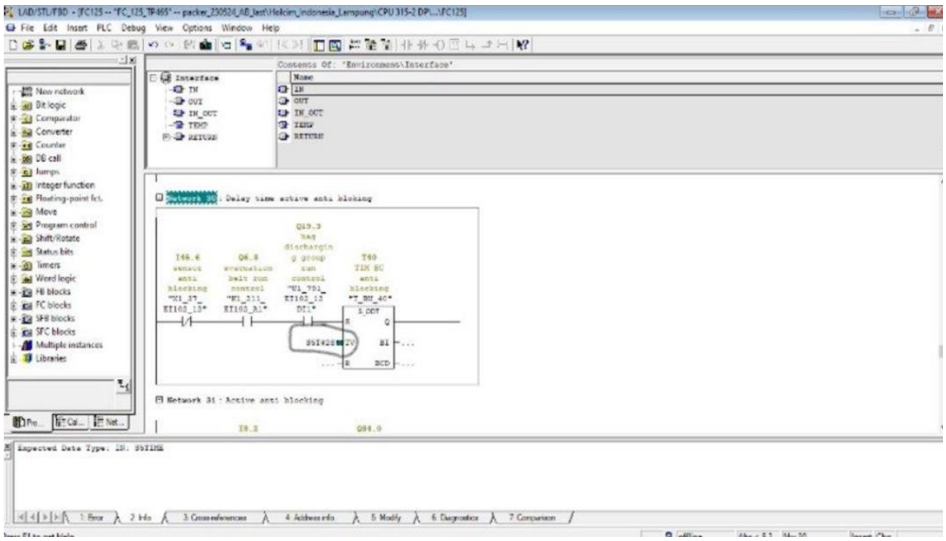

Figure 4Ladder Diagram On Siemens PLC

Implementation and Testing

In this study, the system used is an interlock system on the belt conveyor. In principle, interlock prevents errors in the operation of each equipment system [6]. The main purpose of a control system is to obtain optimization in this case can be obtained from the function of the system itself (Munandar & Yani, n.d.). When the cement bag passes through the belt conveyor without touching the sensor, it can be interpreted that the operational conditions are running smoothly, but if the cement bag experiences blocking so that the sensor detects a pile of cement bags, the sensor will send a signal to the indicator light so that the indicator light will turn on. In addition, the sensor also sends a signal to the belt conveyor motor in the interlock system so that the motor on the belt conveyor stops or is in a stop state (Safitri, Devi, & Nugrahadi, 2024).

The addition of a limit switch sensor to the belt conveyor is expected to overcome the delay time that occurs due to frequent blocking on the belt conveyor. In this case, the sensor will provide an early warning so that the operator can take quick action to overcome the blocking and stop the conveyor automatically if blocking occurs. In this study, commissioning and testing of the tool were carried out for some time on the belt conveyor to determine whether the blocking indication sensor was working properly as expected. The limit switch successfully sent a signal when it detected a cement bag blocking and sent a signal to stop the belt conveyor motor as shown below. The commissioning system needs to be implemented with the aim that the system is made to achieve

the output goals that are desired by an improvement, a system stage that summarizes all efforts made in the previous system steps (Firdaus et al., 2022).

Figure 5Commissioning Sensor Blocking Indication

RESULTS AND DISCUSSION

The application of blocking indication sensors on belt conveyors was tested for 1 month to determine whether this system is effective in reducing the number of equipment stops on belt conveyors by detecting blocking early (Tumpa, Fahim, Rahman, & Newaz, 2023). The following is data before the sensor was installed. From the period of February 6, 2024 to March 6, 2024, bag blocking contributed 66 minutes resulting in downtime as production stoppage time due to machine damage until the time needed for repairs and the machine is ready to be reused in bag cement production [15]

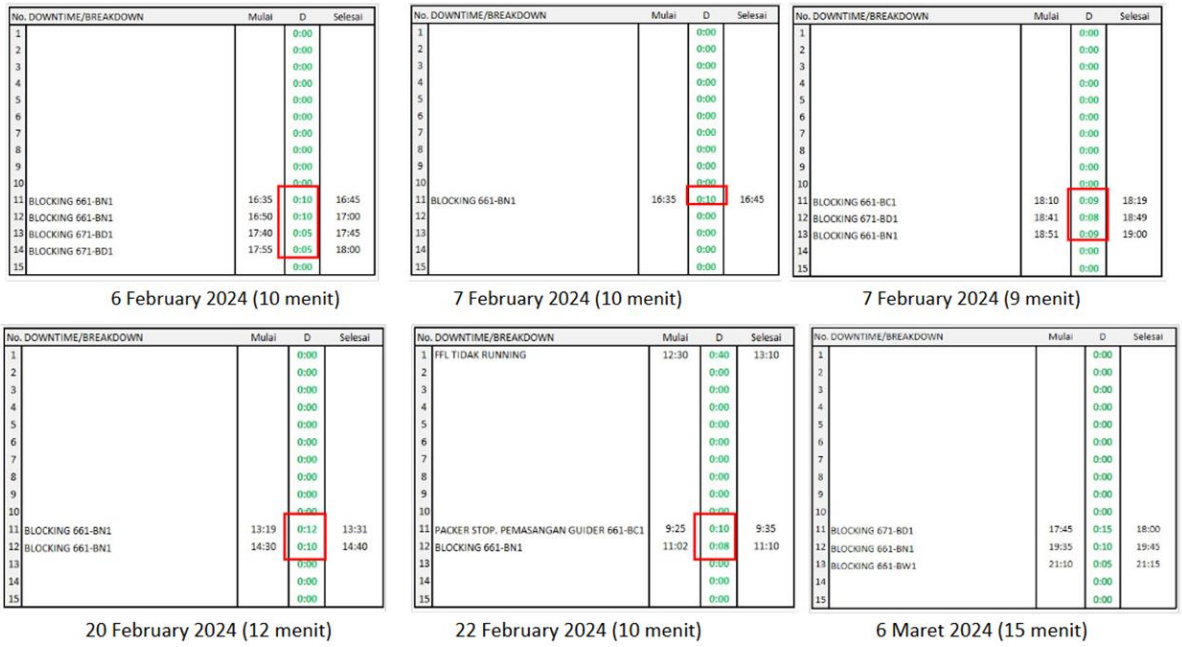

Figure 6.Downtime figures caused by blocking before installation of the blocking indication system

From the data above, an idea emerged to add a blocking indication sensor so that the belt conveyor can work optimally. After being installed for 1 month (period 27 July 2024 to 27 August 2024) the downtime figure has decreased by 33.7% from the previous 66 hours to 44 hours. With a sensor indication system that interlocks with the belt conveyor motor, the operator can immediately stop the conveyor to avoid further damage (SINGH, 2022). The implementation of this system reduces downtime by 36% and significantly increases operational efficiency.

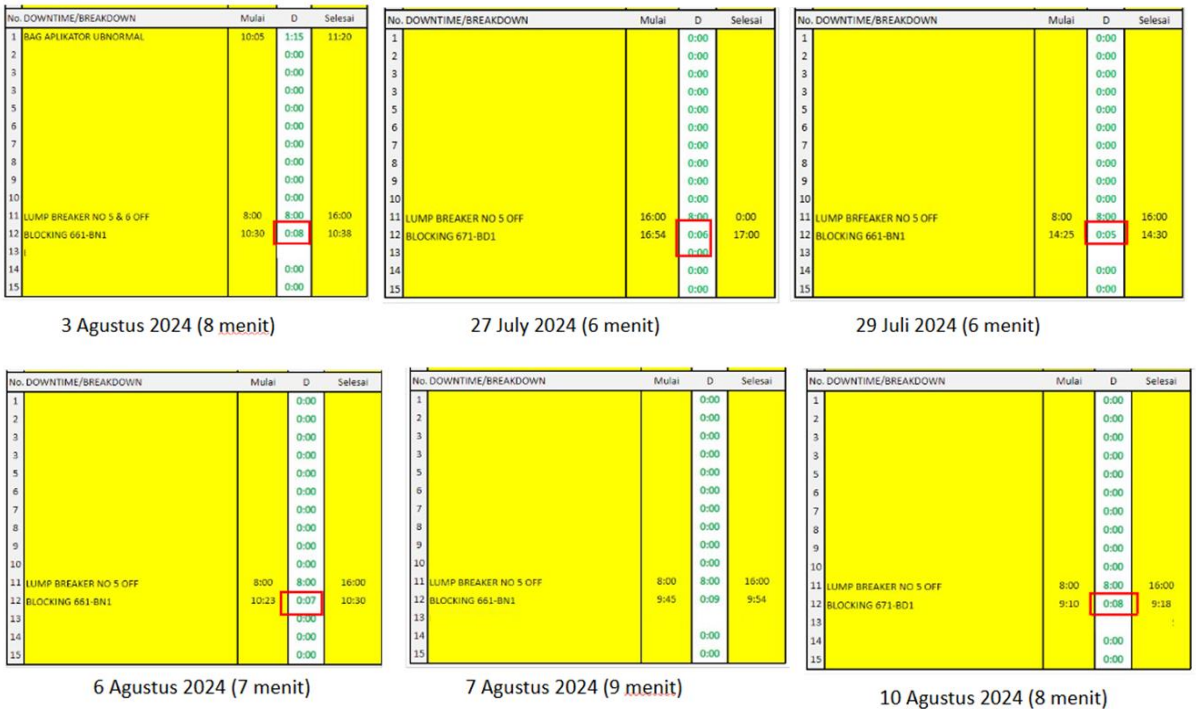

Figure 7Downtime figures caused by blocking before installation of the blocking indication system

CONCLUSION

The application of blocking indication sensors on belt conveyors can optimize belt conveyor performance so that it can reduce the number of equipment downtimes caused by cement bag blocking which results in delays in the loading process. The downtime rate decreased by 33.6% by providing a signal in the form of a blocking indication that can be quickly identified by the operator.

Words of thanks

The author would like to thank all parties involved, namely the Supervisor from Pancabudi Development University and the PT. Solusi Bangun Indonesia Packing Plant Lampung team who were involved in the process of implementing blocking indication sensors in the field & this article which is submitted as a form of publication.

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