

Optimizing Temperature And Humidity Monitoring Of Cold Storage Using The Elitech Rc4 Hc Data Logger: A Case Analysis At Pt. Delta Mina Perkasa

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Abstract

Cold storage is an important facility in the fishing industry to extend the shelf life of products, especially frozen fish, while maintaining their quality. This research analyzes the performance of the Elitech RC4 HC Data Logger in monitoring temperature and humidity in a 400-ton capacity cold storage at PT Delta Mina Perkasa, Sidoarjo, East Java. Research methods include surveys, direct observation, interviews, and internships, with descriptive and quantitative data analysis approaches. Data loggers were placed at three points: near the door, the middle section with load, and the back section without load, to record temperature and humidity conditions for 78 days. The results showed that the best temperature and humidity stability was recorded in the center of the cold storage, while the largest temperature fluctuations occurred near the door, caused by door opening and closing activities. In June, the cold storage conditions were considered good, but the quality of frozen fish decreased during July to September due to machine repairs. Overall, the Elitech RC4 HC Data Logger proved effective in monitoring real-time temperature and humidity conditions. However, to maintain the quality of frozen fish consistently, it is recommended that the company adds specialized humidity monitors, improves cold storage management, and conducts regular monitoring.

Keywords: Performance Analysis, Cold Storage, Data Logger, Frozen Fish, Humidity, Temperature

INTRODUCTION

Indonesia, as a country with an extensive marine territory, has great potential in the fisheries industry. However, major challenges have also emerged in recent years, namely the practice of overfishing. Overfishing refers to catching fish in large quantities in areas not far from the coast, which can cause damage to marine ecosystems [1]. To support the sustainability of the fisheries sector, fish catch storage technologies, such as cold storage, have become an important part of the solution. Cold storage keeps fish fresh and preserves its quality for a longer period, thereby increasing the added value of fishery products.

Cold storage is a storage facility that precisely controls temperature and humidity to maintain the quality of frozen fish. This technology provides various significant benefits, including extending shelf life, preserving the texture, aroma, and nutritional value of fish, and ensuring that products meet food safety standards [2]. In addition, cold storage also plays an important role in supporting the activities of fishers and fishing companies, such as in the handling of tuna, mackerel tuna, hairtail, and reef fish, which is also one of the sources of revenue for the Ministry of Marine Affairs and Fisheries [3].

Fish is one of the most perishable food commodities. Improper handling of marine products and poor sanitation can accelerate the deterioration of fish quality. The application of the cold chain through chilling and freezing techniques has been proven effective in preventing such spoilage [4]. This is where monitoring the temperature and humidity in cold storage rooms becomes important, which is carried out using devices such as data loggers. A data logger is an electronic device designed to record and monitor environmental parameters accurately and in real time. This device enables cold storage managers to detect undesired temperature changes so that corrective actions can be taken immediately to prevent product damage [5].

The use of data loggers not only helps maintain the quality and safety of fish but also supports the operational sustainability of cold storage. Through the analysis of the collected data, managers can improve operational efficiency, recognize temperature change patterns, and make decisions based on objective data [6]. For example, data loggers enable temperature and humidity monitoring in large-capacity cold storage, such as 400 tons, to ensure that all stored products are kept under optimal conditions.

In this context, temperature and humidity monitoring practices using data loggers have become a key element in maintaining the quality of fishery products in Indonesia. This article aims to analyze the performance of the Elitech RC4 data logger in monitoring the temperature and humidity of cold storage, as well as to examine its effectiveness in supporting the sustainability of the fisheries industry in the future..



RESEARCH METHODOLOGY

This study adopted survey and internship methods as the main approaches. The survey was conducted through direct field observation to understand the research location, the available facilities and infrastructure, and the production process flow at PT. Delta Mina Perkasa Sidoarjo. These observations were complemented by interviews with the quality control department, aimed at obtaining information related to equipment performance and cold storage mechanisms. Documentation of work processes was also included as part of data collection. According to Putra and Patmaningrum (2018), the survey method is used to collect quantitative data describing beliefs, behaviors, and relationships among variables, which is highly relevant for testing hypotheses in this context [7]. Internship, on the other hand, according to Azwar (n.d.), is a process of learning from real experience and applying knowledge to solve practical problems [8].

The data collected in this study included temperature, humidity, storage time, and the quantity of products stored in the cold storage. The analysis focused on the placement of data loggers at several strategic locations inside the cold storage, namely the middle section with load, the rear section without load, and the area near the door. The objective was to understand the optimal temperature and humidity distribution patterns for various types of fish, such as scad, skipjack tuna, and mackerel tuna, as well as other products such as squid and pangasius fillets. The quantitative data obtained were processed using a descriptive statistical approach, including the calculation of the mean, median, and standard deviation to evaluate data logger performance and temperature stability.

In addition, correlation analysis was applied to understand the relationship between temperature and humidity, as well as its impact on the quality of the stored products. The data logger was used to record temperature changes continuously, which were visualized in time-series graphs using software such as Microsoft Excel. This analysis enables the identification of temperature and humidity change patterns over time, as well as verification of consistency with cold storage operational standards.

Data processing involved steps such as editing, tabulating, and analyzing. Editing was carried out by gathering information from various sources, including related journals and reports. Tabulating was used to compile data tables based on frequency, while analyzing was applied to interpret the verified data. This study also used important formulas for the analysis, such as the calculation of relative humidity (RH) and standard deviation. The RH value is calculated by comparing the actual water vapor pressure with the saturation vapor pressure, while the standard deviation is calculated to evaluate temperature stability based on the mean and the difference between each data point and that mean [9].

With this approach, this study aims to evaluate the performance of the Elitech RC4 data logger in monitoring temperature and humidity in real time over 24 hours. This monitoring is expected to provide practical guidance for cold storage managers to maintain product quality and freshness optimally. The results are expected to serve as a basis for improving cold storage operations, particularly in the frozen fish industry.

RESULTS AND DISCUSSION

This study focuses on analyzing the performance of the Elitech RC4 HC data logger in monitoring temperature and humidity in a 400-ton capacity cold storage at PT. Delta Mina Perkasa Sidoarjo. The observations showed that temperature and humidity varied depending on the position of the data logger inside the cold storage. The three main positions tested were beside the door, the middle section with load, and the rear section without load.

Comparison of Cold Storage Temperature: Thermometer and Data Logger

Thermometers and data loggers have different but complementary functions in monitoring cold storage temperature. The thermometer, installed above the cold storage door, provides a direct reading of the ambient temperature. This device is useful for monitoring the performance of the cooling system and maintaining the quality of products such as frozen fish, which require a stable temperature [10]. Thermometers provide simple measurements but are less capable of recording temperature data continuously or detecting small fluctuations that occur over time [11].

On the other hand, a data logger is an electronic device that records temperature and humidity in real time. In this study, data loggers were placed at three strategic positions inside the cold storage: beside the door, the



middle section with load, and the rear section without load. The device is able to record data continuously, enabling a more in-depth analysis of temperature and humidity patterns. In addition, data loggers are an important tool for auditing and evaluating the efficiency of the cooling system [12]. The measurement results showed variations in temperature and humidity at each position. Beside the door, the average temperature was recorded at -14.3°C with a humidity of 86.9%, indicating large fluctuations due to the opening and closing of the door. In the middle section with load, the average temperature was -15.1°C with a lower humidity of 59.8%, reflecting better temperature stability. In the rear section without load, the average temperature was -15.0°C and the humidity was 88%, indicating a consistent temperature distribution.

The data logger proved its advantage in monitoring temperature and humidity continuously, enabling managers to detect undesired fluctuations in temperature and humidity. With this information, corrective measures can be taken promptly to maintain product quality in the cold storage, making the data logger an essential tool in cold chain management.

Efficiency of Using Data Loggers for Temperature and Humidity Monitoring

The use of data loggers makes it easier to record parameters such as temperature, humidity, light intensity, and solar panel data (voltage and electric current). The recorded data are stored on an SD card and uploaded to a cloud system, enabling real-time monitoring [13]. In the temperature analysis using data loggers compared with the cold storage thermometer, average temperature data per 2 hours over the period of 10 June – 10 September 2024 were used. The analysis process included trend visualization, descriptive statistical calculations, and comparison of parameters such as the mean, range, and standard deviation.

Descriptive statistics showed that the median thermometer temperature in all months was -19°C (Table 1). In addition, the temperature measurements showed that the most frequent temperature in June was -21°C with a relative humidity (RH) of 91%. Meanwhile, from July to September, the most frequent temperature was -18°C with an RH of 78% (Table 2).

Table 1. Median Thermometer Temperature

No	Month	Median Temperature ($^{\circ}\text{C}$)
1.	June	-19
2.	July	-19
3.	August	-19
4.	September	-19

Table 2. Thermometer Temperature and Relative Humidity

No	Month	Temperature ($^{\circ}\text{C}$)	RH (%)
1	June	-21	91
2	July	-18	78
3	August	-18	78
4	September	-18	78

In the data logger measurements, the average temperature varied by location inside the cold storage. For example, in the area beside the door, the average temperature in June was -14.3°C with an RH of 86.9%, whereas in the unloaded area at the rear, the average temperature was -15°C with an RH of 88% (Table 3).

Table 3. Temperature and Humidity of the Data Logger and Thermometer

Month	Location	Data Logger Temp ($^{\circ}\text{C}$)	RH (%)	Thermometer Temp ($^{\circ}\text{C}$)	RH (%)
June	Beside the Door	-14,3	86,9	-21	91
	Middle with Load	-15,1	59,8		
	Rear without Load	-15	88		
July	Beside the Door	-14,3	86,9	-18	78
	Middle with Load	-15,1	59,8		
	Rear without Load	-15	88		

Standard deviation analysis showed a temperature that tended to be stable, with an average standard deviation of 0.75°C. This indicates that the cooling system in the cold storage worked well in maintaining temperature stability. The error coefficient was also calculated to measure the uncertainty of the estimates. A small standard error indicates that the sample mean estimate is close to the population mean.

Thus, the use of data loggers provides greater efficiency in monitoring temperature and humidity compared with manual thermometers. Data loggers are able to provide more detailed and real-time data, thereby supporting better analysis and decision-making in cold storage management..

CONCLUSION

This study shows that the Elitech RC4 HC data logger is effective in monitoring temperature and humidity continuously in a 400-ton capacity cold storage at PT. Delta Mina Perkasa. The analysis results show that the cooling system worked well overall, although temperature fluctuations occurred in certain areas, such as beside the door, caused by the frequency of door opening and closing and the accumulation of frost. The average temperatures recorded ranged from -14.3°C to -15.1°C at various points, with the lowest standard deviation of 0.18, indicating good stability in most areas. The use of data loggers not only helps maintain the quality of frozen fish products but also improves operational efficiency by reducing the need for manual checks.

As a recommendation, the company is advised to continue using and optimizing temperature monitoring devices such as data loggers to detect normal and critical temperatures in real time. This step can prevent product damage due to undesired temperature changes. In addition, special attention should be given to frost accumulation, especially around the expansion valve and the cold storage door, to ensure that the cooling system runs optimally and that product quality is maintained. Routine maintenance and monitoring of the vapor coming out of the evaporator are also required to avoid product damage and improve energy efficiency.

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