# TEMPERATURE WORKING REFRIGERATED SEA WATER (RSW) USE REFRIGERANT R314A AT ALUMINIUM TUBE FOR PACKAGING FRESH FISH

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# TEMPERATURE WORKING REFRIGERATED SEA WATER (RSW) USE REFRIGERANT R314A AT ALUMINIUM TUBE FOR PACKAGING FRESH FISH

Budi Utomo, Bambang Sri Waluyo, Solichin Djazuli Said

**Abstract**— Energy consumption, cooling rates, temperature rate, and fish quality was evaluated. Using a computational method, trade-offs between cooling average rate and energy consumption rate were captured on this. Some experiments were conducted to similar conditions successfully verify computations and get the additional insights idea. In investigating the fouling of enhanced aluminum tubes, a continuous fouling test on eight enhanced tubes and one plain tube was conducted use optional time , using a medium fouling potential water as the test sea water velocity. These models serve to optimize design and thermal energy efficiency. We used parameter to summarize the most commonly, which allows us to directly compare the cooling performance of various packaging designs. The heat transfer model to map the entire temperature distribution inside the Refrigerated Sea Water was simulated measurements and was then used by heat transfer coefficient. Temperature monitoring and sensory evaluation was evaluated by means of the performance of the boxes. The thermal insulation of the new boxes was significantly better compared to the old boxes. Storage in the new boxes resulted in approximately 7 days longer storage life, according to sensory evaluation. Numerical results and experimental results was obtained. These optimize packaging of design needed and cooling efficiency serve by models . And summarize the all commonly used parameters by the performance of working, which allows us to directly compare the cooling performance of many packaging designs.

**Keywords** — temperature working, refrigerated sea water, refrigerant r314a, packaging, fresh fish.

## 1 INTRODUCTION

INTRODUCTION very often due to the resulting high cost of ice, the new fish handling methods cannot always has been successful. Usually practical rule of 60% fish + 30% ice, usually found in technical , cannot be applied to tropical and semitropical sea water conditions (Sainsbury, 1982), see figure 1. The natural convention use transfer process. When test of many kind the box storage and can give valuable indications for other heat transfering conditions, it can be used (Boeri et al., 1985). The temperature was should be measured for the some estimation calcaulation of the heat transfer coefficiently and quantify of the accuracy from the temperature distribution predicted from the heat transfer of coefficient estimate, so this work were to identify the proper position inside the box storage. It should be measured by an accurate calculatoin estimation of the heat transfering coefficient was identified from the analysis of the sensitivities and profile , where the position inside the pallet correctly. The prediction accuracy to try of the temperature distribution using the heat transfer model calculated was quantified can make impact of the heat transfer coefficient uncertainty (Mercier et al., 2017).


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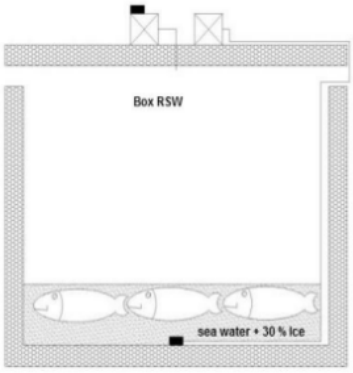
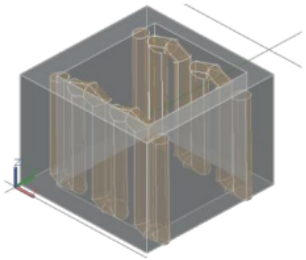
Figure 1. packaging fresh fish




Temperature monitoring make the performance of the boxes has evaluated by means. The numerical heat transfer modeling and sensory evaluation use to understand about the effect of the fish position in the wholesale fish package (like position on the corner with middle) was investigated by means of the afforementioned methods (Margeirsson et al., 2012). The thermal performance of two types of wholesale fresh fish boxes present study was to investigate, one made of expanded polystyrene and the other made of corrugated plastic (polypropylene) use applied aluminum tube for installation (Margeirsson et al., 2011), see figure 2. From the figure 2 show concept design of refrigerated sea water for packaging fresh fish.

Figure 2. concept design of RSW



The purpose of the model development needed was to get effectively cost improving the design of packaging type with regard to some case for thermal insulation since using methode of numerical modelling can be cheaper than by conducting a number of experiments to try and eror. The affected that thermal insulation, which all the focus is on the present study,for the goal of characteristic packaging. Design of models include conduction of thermal for the food product, air and packaging materials behaviour and radiation of outside and inside from the boxes. The Calculation can get effective thermal properties of the structured CP box. So the numerical of heat transfer models can be utilized to predicted where the temperature evolution in fresh fish packaged in boxes under dynamic temperature conditions (Margeirsson et al., 2011).

Corection of design was noted at that long-term fouling data was a big gap in modeling of fouling in enhanced tubes used in the actual cooling (Shen et al., 2019). We was summarized here in the most commonly used parameters of performance, which in we try to quantitatively compare of existing packaging with regard to each same function corectly or for multiple functions at the time , Because the new design of packaging can be evaluated from viewpoints serveral (Zhao et al., 2016). Fluid and air circulation systems have several disadvantages: like as higher initial cost and than must read a manual defrosting and frost removal include a substantial labour cost for this operation process so requires of coordination between the machinery operating personnel forces must better; and then, these systems require a larger refrigerant charge and in some cases this is so great as to use refrigerants from consideration unless a secondary (Sainsbury, 1982).

The concept of definition and measurement of shelf life. Determination of storage conditions can using time temperature integrators. And then used methods of extending shelf life including modified atmosphere packaging (M A P) and irradiation Sensory assessment (Mackie, 1986). The cooling performance and package-related energy consumtable can show in the design of box were evaluated in terms of overall process. For example like the experiments were conducted to verify computations and to evaluated the impact by using this methode on chilling injury as a measure for fresh fish quality, as this is available or food quality (Gruyters et al., 2019). This study shows the importance of conduction, radiation and the role of frozen packs at the centre of the box to preserve fresh fish.This study was carried out in order to optimize product transportation in an insulated box with an ice pack and fish . Two numerical model display approaches were developed in order to predict the product temperature change with the fungtion of time (Laguerre et al., 2019).

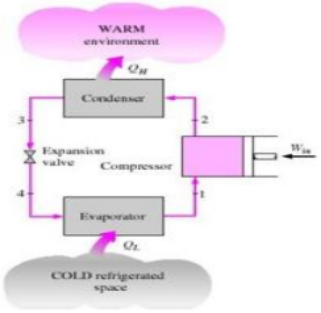
## 2 MATERIAL & METHODE

### 2.1 Refrigerated Compressed.

The vapor compression refrigeration cycle is the most used cycle in the refrigeration cycle. In this cycle the air is pressed and then condensed into a liquid, then the pressure is lowered so that the liquid can evaporate again.

To cool a chamber, the chamber shall be subjected to a fluid colder than the desired ambient temperature. Thus energy as heat can be moved from a cold space to a cooler fluid, and this will preserve the cold room temperature to energy transfer as heat escapes from a warm environment through the walls of isolated space. The vapor compression cycle cycle is shown in figure 3. following the flow of the vapor compression cycle.

Figure 3. Ideal Cycle of Steam Compression Refrigeration



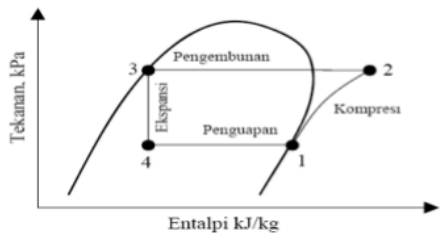

### 2.2 Coefficient of Performance (COP)

COP is a measure of the working effectiveness of a refrigeration system obtained from the comparison between the useful refrigeration in the evaporator unit with the net work performed on the compressor unit. A high COP value is desirable because it shows that a certain amount of refrigeration requires only a small amount of work.

The coefficient of carnot cycle achievement as a whole is a function of temperature limits, and can vary from zero to infinity.

The P-h graph in Figure 4, can be used to express the nature of the refrigerant operating in a refrigeration system. because with this graph can be determined the value of enthalpy at each point which is an important parameter for the calculation of the value of the performance of the system.

Figure 4. Cycle P-h diagram Vapour Refrigerated




### 2.3

**Cooling System Components**

Evaporator, is one of the refrigeration system unit where in this unit there is a change of refrigerant phase from steam to saturated vapor resulting from the absorption of heat in the environment (high temperature) by refrigerant (low temperature). Judging from the construction of evaprorator is divided into 3 (three) namely: bare-tube, plate surface, finned (Mercier et al., 2017) Condenser, is one unit of refrigeration system where in this unit there is change of phase of refrigerant from unsaturated vapor to liquid due to release of heat in environment (low temperature) by refrigerant (high temperature). Viewed from the construction by cooling the condenser water is divided into 3 (three) namely: Shell and tube, shell and coil, double tube.Compressor, is the heart of a refrigeration system because in this unit the compressor does work to drain the refrigerant in the cooling system circuit. Based on how the compressor works is divided into 3 (three) types of compressors, namely: Compressor piston (reciprocating), screw compressor (screw / rotary), and centrifugal compressor. The expansion valve maintains a constant pressure on the exit side that will enter the evaporator unit. If the pressure falls below the control limit then the valve opens wider, and vice versa if the pressure is above the control limit then the valve will close. in this unit the refrigerant undergoes pressure reduction treatment resulting in a decrease in temperature with a constant entropy value (isentropic).

### 2.4 Refrigerant

Refrigerant is a working fluid refrigeration system that serves to absorb, move, release the heat from one media to another media. there are 2 kinds of refrigerant that is;

1. Primary Refrigerant: Refrigerant that plays directly on the vapor compression cycle and undergoes phase change during the refrigeration process.
2. Secondary Refrigereran: The refrigerant that carries the heat from the cooled object to the evaporator and the heat transfer process only changes the temperature and there is no phase change.

### 2.5 Causes Factors of Failed Fish

The main causes of fish damage seen from the source include the cause of the fish itself when captured and peyebeb from outside the body of the fish. The cause of damage by the fish itself includes the physical condition and chemical composition of the fish. While the damage from outside the fish body caused by contamination of pressure mapun physical impact experienced by the fish during handling done. By knowing the mechanisms causing the damage can be attempted preventive measures to inhibit the deterioration of fish quality.

### 2.6 Thermal properties for multi-layered CP

Multi-layered CP walls show in Equivalent thermal properties. takes into account conductive heat transfer through the CP box walls, which are multi-layered, by estimating equivalent thermal parameters for each wall (top,bottom, long side, short side) by the model for the CP box. As noted, this information show the estimation is a difficult task because of the complexity of the heat transfer process through the air spaces in such structures. The estimated wall thickness and equivalent thermal properties for the CP walls.The equivalent thermal properties for the CP box walls were calculated according to the following equations.

$$\rho cp = \frac{\rho_{pp} . S_1 + \rho_{Air} . S_2}{S_1 + S_2} \quad (1)$$

$$Cp.CP = \frac{\rho_{pp} . CP_{pp} . S_1 + \rho_{Air} . CP_{Air} . S_2}{\rho_{pp} . S_1 + \rho_{Air} . S_2} \quad (2)$$

## 3 RESULT AND DISCUSSION

Box Packaging Fresh Fish made from box container which have small cost and eficiency to get it, by fisher man, see figure 5.

Figure 5. fabricated box of refrigerated sea water

The making of this RSW uses aluminum tube which is designed in such a way as to get good thermal performance. This design requires experts in their fields, the design of the pipe is made in such a winding way to get an even distribution of cooling temperatures, see figure 6.

Figure 6. box of refrigerated sea water.

The dimensions of the box greatly affect the length of the aluminum pipe, so that it also influences the thermal performance of the evaporator included in the fish storage box. As for the results of previous tests, it was found that some data showing the position of the thickness of the box turned out to affect thermal performance. These conditions answer the previous hypothesis that the storage media and thermal

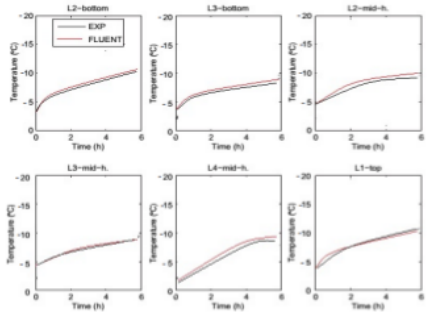
conditions given to a food can affect the quality level of the fish, see tabel 1.

TABLE 1
EQUIVALENT THERMAL PROPERTIES OF CP, $\rho$, K (MARGEIRSSON ET AL., 2011)

| Wall Type | $t$ ( mm) | $\rho\ (kg.m^{-3})$ | $Cp\ (kj\,kg^{-1}K^{-1})$ | $k\ (W\,m^{-1}K^{-1})$ |
|---|---|---|---|---|
| Top , Botton , Long Side Short Side | 0.6 ; 1,4 ; 0,6 ; 0,6 | 164.4 ; 116.4 ; 134.5; 130.2 | 1.895 ; 1.896 ; 1.893 ; 1.893 | 0.0350 ; 0.0316 ; 0.0216 ; 0.0184 |

This is shown in table 1, where the thicker the wall used for packing, the higher the thermal coefficient value and the thermal conductivity. In contrast to thin wall thickness will result in loss of thermal energy generated so that the temperature can change into ambient temperature and affect the storage. If viewed from the storage box data sampling location, then it can be described in the form of a curve where the most critical location if given this RSW system is over 2 hours. The comparison value is obtained from two types of places where the variable is in the aluminum pipe shape design as a source of cooling in the fish storage box, see figure 7.

Figure 7. box of refrigerated sea water.




Based on the results of calculations and data that has been reviewed the discussion is obtained if the use of this RSW can improve the quality of a product. For this reason the application of this system can be applied to small fishermen and has a level of performance that tends to increase.

Figure 8. box of refrigerated sea water.

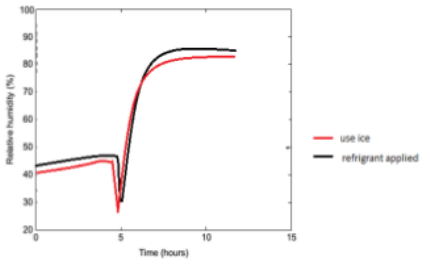



Figure 8 shows the use of ice can indeed maintain the durability of fish, but only in the initial phase, then the ice will melt and make fish can be contaminated with bacteria that can develop. for that the use of this RSW can maintain freshness and provide margins above quality by using ice by 10%. That is comparable to the level of planning of this fish storage box. However, efforts to patent and produce on a mass basis are still in the process of reviewing the study literature.

## 4 CONCLUSION

The fish product requires an adjustment of the thermal properties, and different packaging may can be affect the description of the mechanic heat transfer involved, such as in the presencetage of forced convection inside the boxt for packaging with significant areas. Finned their best use in where size of the refrigerant charge in the plant has become a matter of concern and requires carefully designed and a supply of refrigerant gas greater than is normal for most applications.To get best maximum performance the usefulness of the numerical modelling analysis, the mode packaging use ice packs or other phase make change materials should be considered in future of work like refrigerant insert in alumunium tube for evaporator inside refrigerated sea water system.Have not consistent relationship between any or two parameters use heat transfer work performance , the fouling potentialy and the increase of water-side pressure found some condition droped.Finally, the main idea of contribution the research is a reliable theoretical and basis experimental from improving use the design of box packaging system, and so that they provide rapid and cooling with uniformly of produce minimalize energy consumption process.

## ACKNOWLEDGEMENTS

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