IMPROVEMENT OF DRYING PROCESS IN FISH CRACKER PRODUCTION

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ABSTRACT

Fish cracker industry is one of the products from fish processing industry which is included in East Coast Economic Region (ECER). This project is focused on the productivity improvement in fish cracker processing, specifically of the drying process. Drying process involves process of removing water from the fish cracker from boiling stage. This project is proposed as an alternative to workstation rearrangement and also introduces better technology into this small medium industry. Currently, fish cracker is dried under the sun for few hours or put in drying compartment for 1 to 2hours. This study is proposed to develop better performance drying system with lower energy consumption and higher heating efficiency. In order to make this project happen, there are few things need to be considered, first the hygiene aspect, drying time, space, quality and ergonomic value. This research is based on the observation of a small fish cracker factory at Tanjung Lumpur, Kilang Keropok Mak Teh which already runs around 33 years. Most of the equipment at the factory are outdated and need to improve so that the productivity of the factory could be increase. Drying process is one of the workstation that consume most of the time, so if the drying time can be decrease, the productivity can be increase. Based on the objtive of this rojet, the new design of the drying system has been done. The analysis using numerical method software ANSYS (CFX) shows how the heat distributed inside the drying system and the air flow inside it.

ABSTRAK

Keropok industri ikan adalah salah satu produk dari industri pemprosesan ikan yang dimasukkan ke dalam Wilayah Ekonomi Pantai Timur (ECER). Projek ini tertumpu kepada peningkatan produktiviti dalam pemprosesan keropok ikan, khususnya proses pengeringan. Proses pengeringan melibatkan proses mengeluarkan air dari ikan keropok dari peringkat mendidih. Projek ini dicadangkan sebagai alternatif kepada penyusunan semula stesen kerja dan juga memperkenalkan teknologi yang lebih baik ke dalam industri sederhana kecil ini. Pada masa ini, keropok ikan kering di bawah matahari untuk beberapa jam atau dimasukkan ke dalam petak pengeringan selama 1 hingga 2 jam. Kajian ini adalah dicadangkan untuk membangunkan prestasi yang lebih baik sistem pengeringan dengan penggunaan tenaga rendah dan pemanasan yang lebih tinggi kecekapan. Dalam usaha untuk membuat projek ini berlaku, ada beberapa perkara yang perlu dipertimbangkan, pertama aspek kebersihan, pengeringan nilai masa, ruang, kualiti dan ergonomik. Penyelidikan ini adalah berdasarkan pemerhatian kilang keropok ikan kecil di Tanjung Lumpur, Kilang Keropok Mak Teh yang sudah berjalan selama 33 tahun. Kebanyakan peralatan di kilang adalah lama dan perlu untuk diperbaiki supaya produktiviti kilang boleh menjadi peningkatan. Proses pengeringan adalah salah satu stesen kerja yang mengambil masa yag panjang, jadi jika masa pengeringan boleh diturunkan, produktiviti boleh menjadi bertambah.dari objectif kajian ini, rekaan baru untuk system engeringan telah direka. Berdasarkan rekaan tersebut, analisis dengan menggunakan perisian kaedah numerikal iaitu ANSYS (CFX) telah menunjukkan bagaimana haba tersebar di dalam system pengeringan tersebut serta bagaimana udara mengalir di dalamnya.

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CFD	Computational fluid dynamic
ECER	East Coast Economic Region

NOMENCLATURES

A	Cross section area
h	Heat transfer coefficient
k	Thermal conductivity of material
L	Length
Q	Rate of heat transfer
T1	Temperature before transfer
T2	Temperature after transfer
ΔT	Temperature difference between solid and liquid
σ	The Stefan-Boltzmann constant
T_s^4	Uniform temperature
T_{surr}^4	The absolute temperature of the surrounding surface

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This chapter provides the description of the project background, problem statements, objective and scopes of study.

1.2 OVERVIEW ON FISH PROCESSING INDUSTRY

Fish is important in the diet of Malaysians and most ASEAN countries; it provides approximately 49 percent of the total animal protein consumed and 12 percent of the total protein intake. The availability of fish depends on the number of boats and quantity of fish caught per boat. However, the losses due to poor handling, transportation, storage and related facilities could easily amount to approximately 30 percent of the total landing.

Fishery products and methods of processing are considered. The status of existing technology is also assessed, although this is difficult due to the rapid expansion and development of certain sectors of the industry. The growth of the processing and utilization industry has increased the need for improved technology and consequently research and development is needed to support the growth of the industry

1.3 FISH PROCESSING INDUSTRY IN EAST COAST ECONOMIC REGION PLAN

East Coast Economic Region (ECER) is the way of government to expand every small industry at this region. This industry has caught the eye of our government because of that it's included into ECER. The fish industry is put under food and halal product initiatives. The table below shows what are ECER focusing for food and halal products. The bolded are for the fish processing industry.

Table 1.1: The focus of the ECER and the main location

Location	**Project Focus**
Pasir Mas	Halal Park (Food based) Incubator Centre for Micro Traditional & Specialty Food Processors
Gambang	Halal Park (Food and non-food based) Incubator Centre for Micro Traditional & Specialty Food Processors
Bachok	Fish Processing
Tok Bali	Integrated Fisheries Park Fish Processing
Kuala Krai	Food Processing (beef & poultry based)
Gua Musang	Food Processing (beef & poultry based), Herbal Biotech Industry
Chendering	Food Processing (fish & poultry based)
Kuala Kemaman	Food Processing (fish based)
Tanjung Api	Fish Processing

Figure 1.1: The location of ECER

For the above map in Figure 1.1, shows the distribution or the main places that become the hub for the ECER in order the planning going on track.

From this, we can see that the government gives focus on this area of industry because they could see prospect in economical aspect. Moreover this will give a lot of job opportunities for our citizen so that the rate of jobless citizen in our country can be reduced greatly.

Fish cracker is one of the products from fish processing industry, so this research is mainly on the development of the fish cracker industry. The improvement for the rate of productivity is the reason behind this research. Next we will discuss on the problem statement for this fish cracker productivity.

1.4 PROBLEM STATEMENT

The study is setup to identify the problems and propose improvements for fish cracker production based on the basic quality improvement to increase productivity that will contribute to development of local food processing industry. So, with this research this is based on observation to identify the problems and solutions so that the factory could thrive into the future. The bottleneck or problem that will be focused is the improvement in the drying system for fish cracker.

1.5 OBJECTIVE

Every research or project there will be the main focus or objective. So for this research the objectives are:

1) To identify the problem in fish cracker processing.
2) To design suitable drying system for fish cracker.
3) To analyses the air flows inside the drying system using computational fluid dynamic (CFD).

1.6 SCOPE OF STUDY

The scopes of this study are to collect sufficient data so that the drying process can be compared from the original (which is based on the current technique) with later improvement. This made by visiting the site to collect that data. Besides, this study also covered on the design process which is designing a better drying system for dry the fish cracker more efficiently thus help to improve productivity. Lastly, the analysis of the air flow inside the drying system using computational fluid dynamics (CFD) software.

CHAPTER 2

LITRETURE REVIEW

2.1 INTRODUCTION

This chapter will explain about fish cracker, the drying process, the basic consideration of system, on the concept of heat transfer, and simulation related to the study which is the ANSYS software and the SolidWork software. All of it gives the information needed to complete this project.

2.2 FISH CRACKER

Fish cracker snack is a favorite with residents from various groups in the country are also in neighboring countries. In Malaysia there are fish cracker operators who run their enterprises on the coast, especially in Kelantan, Terengganu, Pahang, Johor and Kedah. Fish cracker is a famous snack food which is originated from East-Coast of Malaysia Peninsular. It is a specialty of Terengganu and now has been widely commercialized to entire country. Generally, cracker can be categorized as a type of snack which is made of flavored with fish or shrimp. The mixture is being hand-rolled into a sausage form. Ingredients of the mixture are fish (mackerel), sago flour, salt, water, ice cubes, and pandan leaves.

Fish crackers are a favorite snack of many by people in Malaysia. Crackers typically processed from fish, shrimp or octopus mixed with starch and / or corn starch as main material, salt, sugar and MSG as condiments. The types of fish that are commonly used to process the fish cracker are herring, sardines, bream, howl embers, jackfruit seeds and others.

Under the Food Regulations 1985, fish cracker shall be prepared from starch and protein content of not less than 15 percent. Fish cracker quality determined by freshness of the fish, type of fish used, ratio of primary substance and process used. Fish cracker quality can also be evaluated in terms of flavor, crunchiness and fluffy when they are fried in hot oil. There are some fish crackers produced by local manufacturers such as keropok kering and keropok basah.

There are two methods to eat fish cracker which are eat freshly after it has been boiled or by deep frying it. Usually, the huge and long sausages are cut into smaller pieces and thrown into the pan to be deep-fried until they turn crispy gold. Another option to take fish cracker is to just steam it. This gives it a fishier flavor but tastes as good as the crispy ones according to some people. A completely different kind of fish cracker is keropok keping and it comes in different flavors: fish, squid, and prawn.

Here, the fish cracker is shaped into even bigger tubes and cut into thin slices to let it dry in the sun. Fish cracker ready to be served with their chili sauce, or with own home-made chili sauce if one prefers or shrimp-based sauce is also common. The best way to eat the fish cracker is by take it right after frying when it is still hot, crispy on the outside and tender at the inside.

This industry needs some development especially in the production rate because this industry shows prospects for economic gain. One of the bottleneck issues for this industry is the drying process.

Figure 2.1: The keropok petak before being boiled

2.3 DRYING PROCESS

So far, there is no development of drying system had been made for fish cracker. The traditional way is the fish cracker that have been tweaked in the row above the carpet and then drained to the sun. In good weather conditions crackers can be dry within 6 to 7 hours.

Research on this particular station also not being enhanced before, so this research hopefully could help others to improve this small industry into more bigger and greater influence toward country's economy.

In order for this process to be enhanced research is done by improvement of the current process that being implement. There is some development that had been made for this process.

Figure 2.2: The typical way of drying, drying under sun

From the above Figure 2.2, which is the typical way of the drying under sun? There are several things that need to be considering by using this method. The most important issue is hygiene issue. This process requires at least one day for drying and also needs a lot of space for the process. The quality of product might be jeopardized by hygiene issue [1]. Another issue that need to be considered is weather, this is because at East Coast region have about few months of raining season (due to monsoon wind transition) so it will affect this industry very badly.

Figure 2.3: Drying process inside using rack

From the Figure 2.3, the method that being implement is the usage of rack for drying purpose. Actually this process being done inside the factory itself, but the process is very slow, it would take around 6-8 hours to dry the fish cracker. This is not very good in production aspect. This method is better in hygiene aspect but having problem in the time aspect which the process is quite slow. Another consideration that need to be concern of this method usage is the amount of moisture left inside the fish cracker. For a typical fish cracker that dried under the sun, the amount of moisture left inside the fish cracker is around 15-16 percent [2]. But from this method the value maybe higher because there is less heat energy that transmitted by heat radiation towards the fish cracker.

Heat radiation is the energy emitted by matter in the form of electromagnetic waves [3]. The concept is applied for the current process but like being discussed earlier this method does not guarantee in the hygiene aspect due to dust around the air cause by pollution.

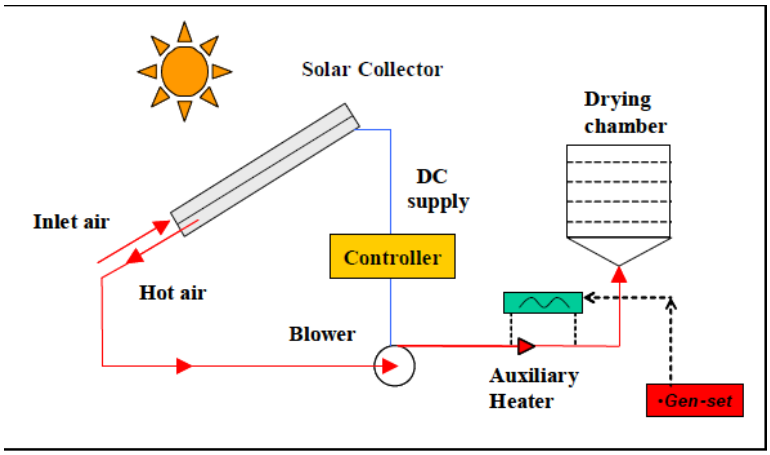

Figure 2.4: Improvement proposed (SIRIM)

From the Figure 2.4 above, SIRIM (Standards and Industrial Research Institute of Malaysia) had proposed the system that could help to improve the hygiene and production of the fish cracker. This is the basic concept that can be applied for this project.

Drying process can be improved by adapting a solar drying system which offers more efficient in drying, better quality, less space requirement and furthermore increasing the productivity of the company [4].

Besides there are also few examples of drying system that used on foods but still can be applied for this research. First, bin driers which are large, cylindrical or rectangular containers fitted with a mesh base. Hot air passes up through a bed of food at relatively low velocities. High capacity; low capital & running costs; & are mainly used for 'finishing' after initial drying in other types of driers. Improve the operating capacity of initial driers by removing the food when it is in the falling-rate period, when moisture removal is most time consuming.

Deep bed of food permits variations in moisture content to be equalized & acts as a store to smooth out fluctuations in the product flow. Foods should be strong to compression & retain spaces between the pieces to permit the passage of hot air through the bed. Secondly, Tunnel driers which layers of food are dried on trays; stacked on trucks move semi continuously through an insulated tunnel, having one or more types of air flow Food is finished in bin driers. Dry large quantities of food in a relatively short time. Third, the Conveyor driers (belt driers) where the Food is dried on a mesh belt in beds 5–15 cm deep. The air flow is initially directed upwards through the bed of food & then downwards in later stages to prevent dried food from blowing out of the bed [5].

Next we will discuss on the one of the major concept for the drying system which is the heat transfer perceptive for this research.

2.4 HEAT TRANSFER FOR DRYING PROCESS

Heat and mass transfer modeling in the air drying of solids is considered as a two stage procedure. The former aims to discover the dominant heat and mass transfer phenomena (heat versus mass, internal versus external); the latter aims to formulate empirical equations for the calculation of the corresponding heat and mass transport properties (mass diffusivity, thermal conductivity, boundary heat and mass transfer coefficients).

Basically heat transfer is much related for this research because drying process of fish cracker is applying the basic concept of heat transfer. So far, the drying system used for the industry is drying under sun, which is applying one of the heat transfer concept, heat radiation.

The fundamental of heat transfer like had been disused on previous paragraph ore convection, conduction and radiation. All these three concepts can be assumed as steady-state and expressed as follows:

For conduction

$$Q = \frac{kA(T1-T2)}{L} \qquad (1)$$

For convection

$$Q = hA\Delta T \qquad (2)$$

For radiation

$$Q = \sigma A(\, T_s^4 - T_{surr}^4) \qquad (3)$$

For this research the improvement of that need to be considered is decreasing the drying time of fish cracker. Besides this system is applied inside the factory so there are no sun used for the system but yet still related to heat transfer. In this section, we will discuss food drying process that had been done in research.

When warm dry air flows around a cold moist food sample, simultaneous heat and mass (water) transfer occurs, leading to, both, a decrease in food water content and an increase in its temperature [4]. In a convective drier, two different transport mechanisms simultaneously occur, heat is transferred from air to the material; water is transported from the core of the material to its surface and, eventually, to air. The rates of heat and mass transfer certainly depend on both temperature and concentration differences, but also on air velocity field which any model has to properly predict.

Heat and mass transfer modeling in the air drying of solids is considered as a two stage procedure. The former aims to discover the dominant heat and mass transfer phenomena (heat versus mass, internal versus external); the latter aims to formulate empirical equations for the calculation of the corresponding heat and mass transport properties (mass diffusivity, thermal conductivity, boundary heat and mass transfer coefficients). A model discrimination procedure was proposed in the first stage, and a model building procedure was examined in the second stage. The proposed procedures were applied to a wide set of experimental data in potato drying. The resulting model takes into account moisture diffusion and convective heat and mass transfer in the air boundary layer. Moisture diffusivity is dependent on material moisture content and temperature, while heat and mass transfer coefficients can be considered as constants [5].

The basic principle of food dehydration is the removal of water from food, the process of removing water causes quality changes which can be categorized as physical, chemical, and nutritional. These changes often have adverse effects on the quality of the resulting dehydrated food. In this work, the types of physical and chemical changes common in food drying [6].

The drying mechanism works when hot air is blown over a wet food, water vapor .Diffuses through a boundary film of air surrounding the food and carried away by the moving air. The factors that need to be controlled for the drying process are air temperature, humidity, and air velocity.