Energy and cost saving in pickled fish factory of Rai Chul Group

Atikorn Wongsatanawarid†
Mechanical Engineering Department,
King Mongkut's University of Technology Thonburi
126 Prachautid Rd. Bangmod Thungkru 10140 THAILAND
+662-470-9265, Email: atikorn.won@kmutt.ac.th

Jongsarid Cunvong
Managing Director of Chul Group
442 Moo 3 Samakkeechai Rd. WangChompoo Mueng Phetchabun 67210 THAILAND
+665-677-1101-4, Email: chul_energy@hotmail.com

Abstract

The case study of developing project in energy and cost reduction is carried out obeying on policies of the company. The pickled fish is one of best selling products of Chul group which is helping out people in the province to have more work and revenue. However, production capability is eventually increased in a few years, therefore, the cost and energy usage could not be realized by the factory. The processes start from fish ponds that fresh fishes are delivered in the tank buried with ice, then at the front line of the factory all fishes have to be cleaned out with room temperature water before it is moved in the scale removing machine. All fished are then cut to split off the entrails and fins. During the process, all fish pieces must be kept at below 10°C with ice buried, however, we noticed that the temperature distribution is widely non-uniform. In this study, we introduced an idea that could chilled the fish pieces during process by using ice-water slurry that could reduce the amount of ice cube used and crushing process for a half of the conventional method. The temperature distribution inside the fish pieces were measured to keep the target temperature of 10°C. The results showed that the target temperature could be reached at about 15 minutes with ice-water mixing 1:1 by mass. The cost of ice could be cut about 40 percent in a month. Totally, the reduction use of ice leads to saving of about 330,000 baht per year based on the last year annual data. The new idea could be implemented throughout the production process with already justification that is no impact to quality, and without any problem issues.

Keywords: Pickled Fish, Cost saving, Energy saving, ice-water slurry chilling

† Corresponding author

1. Introduction

The Thai pickled fish so called "Pla-som" is made by mixing raw fishes with ingredients mainly consisted of steam rice, garlics, salts and peppers. It is a kind of preserving food that can keep fish meat in the fridge some times longer than fresh fishes. The pickled fish is not only exist in Thailand, in fact, the pickled fish is a kind of classical fermented foods digested by lactobacilli bacteria which is naturally fermented in controlling of temperature so it tastes of a little sour, soft and mild (Steinkraus 1997). In Phetchabun, a lower northern province of Thailand, here people lives with agricultural tradition. Chul group is established local company since 1963 to support work and develop people living for over 70 years. Chul company handles several business such as, silkworm farming, silk spun, orange farming, mulberry farming and also fish farming. In few years ago, fish farming grew drastically then fresh fishes came out in several tons per day. The pickled fish production has to be commercialized in massive production; therefore high standard food grade factory was invested in place of in-house preservation. Thereafter, the Chul's pickled fish debuted to market, it was very good respond from the people not only in the province but also many tourists who passed by the shop.

The pickled fish production starts from catching fishes from farming ponds where else is away from the factory about 20-40 kilometers. Then the fresh fishes have to be buried with ice to keep its quality. Arriving at the factory, at the front line of production all fishes have to be divided by sizes, types and quality before weighting and clean out by water. Process batch would be directed to scale out by rotary drum machine for most of the scale, after that, it was finished by hand again for totally remove. Then all fishes have proceeded to cutting, fin and entrails removing, and slicing. During the process all fish meat are moving along the continuous process all work by human then the fish meat are buried with ice flaked all the time. Normally, the ice using in keeping chilled temperature are crushed from ice cube of about 10 kg. The ice is monthly use of about 70-80 ton per month. In the area, the ice cost about 1 baht/kg which means the factory have to pay about 70,000-80,000 baht/month for the ice excluding electrical use for crushing machine by working hours.

In this study, we introduced a chilling method of using ice-water slurry cooling instead of ice buried which aims to reduce the process cost, energy use for crushing machine and process time.

2. Methodology

A simple idea of improvement started from observing the production process, we had seen that the chilling of work in process by ice buried was obviously not uniform. Although, the ice and meat were mixed layer by layer however, the contact points of the small ice in lump size of 2-4 cm distributed over the fish meat were not sufficient. The cooling method by using ice buried is heat transferred by only in conduction mode which melt down liquid is not significantly used due to the buckets of WIP are likely the basket box.

We then change the chilling process of WIP by using ice mixed with water in the ratio of 1:1 by mass. Merts et al. (2007) had been studied that the chilling a kind of fish using ice-water slurry could reduce the chilling times significantly comparison to the ice flaked. One kilogram of ice mixed with a liter of water then all WIP meat are submerged in the ice-water slurry, however, we need a stifling bucket instead of the old basket box. In our experiment, we measure the temperature inside of the piece in three points by the time. The target temperature is keeping at 7-10°C during the production.

The quality impact will work by quality assurance team that they measure the pH value and laboratory sampling throughout the process. Finally the products would not impact in any change of taste.

3. Results

The chilling method using ice-water was expected to implement throughout the production process that would reduce the ice cost and crushing process without effect to products quality. The measuring temperature at inner of fish pieces is resulted in the table 1.

Table 1: The inner piece temperature chilling by ice-water slurry of WIP in production.

Time (min)	Inner temp.(°C)			Average(°C)
	1	2	3	
0	26.6	26.6	27.5	26.9
2	17.1	20.7	17.9	18.6
4	22.2	20.8	19.4	20.8
6	13.7	20.4	20.8	18.3
8	12.6	18.8	18.6	16.7
10	13.7	17.2	18.4	16.4
12	5.8	11.7	14.8	10.8
14	7.7	14.7	12.4	11.6
16	8.4	11.7	11.5	10.5
18	7.3	10.7	9.9	9.3
20	6.4	8.9	9.6	8.3
25	8.2	13.7	11.1	11.0
30	5.8	9.9	8.7	8.1
35	4.9	5.2	4.0	4.7
40	4.1	4.6	3.5	4.1

We can clearly see that the target temperature could be reached at roughly about 15 minutes in an average temperature. The average temperature could be plotted to show the chilling temperature with time as seen in figure 1.

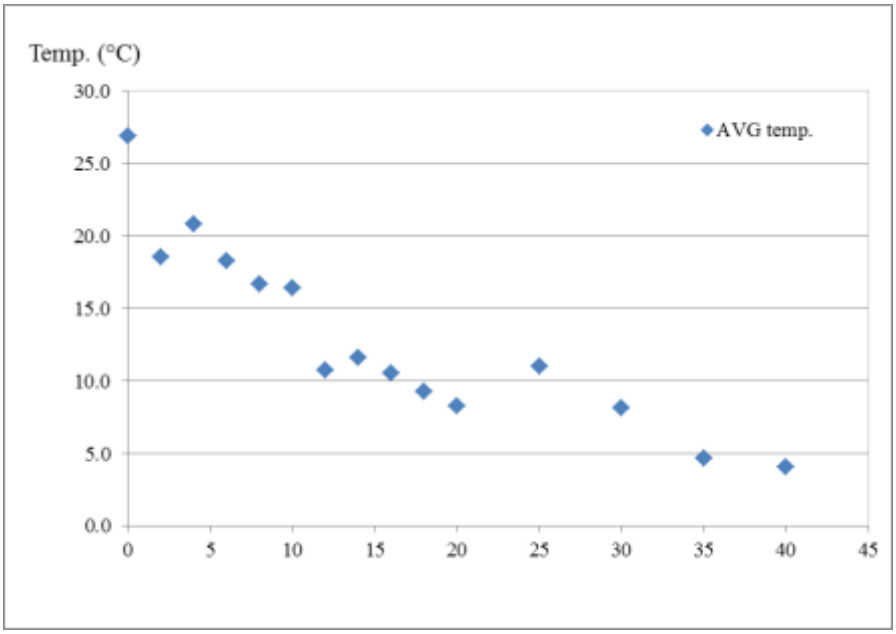

Figure 1: The average temperature plots with time of measuring by chilling with ice-water slurry.

The temperature reducing trends in good agreement with Skjervold et al. (2002) worked by using the same chilling method. The results proved that we could adapt the chilling method using ice-water slurry in the real scenario. Then the production team decided to implement in the mass production and study the difference use of kilogram of ice for two methods between ice buried and ice-water slurry chilling. The real scenario could be shown in figure 2.

(a) (b)

Figure 2: The chilling with ice-water slurry was implemented in the mass production of the factory for (a) preparation process (b) in the guts removal process

The data collected by two latest month of May and June in 2013 exhibits that ice-water chilling could save totally about 1-1.99 kg of ice used per kg of fish production. According to the last year annual data, total production of pickled fish was about 220 ton/year which means that applying ice-water chilling method will save averagely ice using by 330 ton of ice per year. The average cost of ice in the local area is about 1 baht per kilogram which is 330,000 baht of ice cost saving per year.

4. Conclusion

An idea of using ice-water slurry in chilling of fish pieces of pickled production demonstrated very promising way of keeping temperature during process. The target temperature of 10°C could be reached within about 15 minutes with a half of ice flaked use in weight comparison to the ice buried method. The heat transfer of using ice-water is benefit of liquid that could flow inside the fish pieces cavity lead to better uniformity of temperature in the pieces. The cost saving could be then calculate based on the last year annual data, it shows that the reduction of ice used could reduce the payment by 330,000 baht per year. The idea of chilling with ice-water could be then implement throughout the production process.

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