

A Study on a Model of Anchovy Solar

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Abstract— In central and southern coastal areas of Vietnam, annual yield of anchovy is enormous that leads the high demand for anchovy drying. Moreover, seafood in generally and anchovy in particularly brings more benefit for fishermen, especially dried anchovy as an exporting product is one of the main their income. The market requires that anchovy product has to be dried before packaging to export. There are many drying methods to process the anchovy but some problems might need to be solved such as the drying efficiency, the low product quality and sanitation, and the environmental annihilation. In order to using the profuse solar energy, a model for experiment investigation the anchovy dryer has been conducted in ThuDuc district, Hochiminh city with the anchovy caught from Kien giang and Baria-Vung tau province, southern Vietnam. The results indicate that solar energy is one of renewable energy which can be completely used for anchovy drying with high drying efficiency. The dried anchovy has good color, high quality, and especially it passes the requirements of food hygiene and environment protecting.

Keywords— anchovy; seafood processing; solar energy; solar dryer.

I. INTRODUCTION

In Vietnam, anchovy is one of the main seafood products and main income of many fishermen families. According to the statistics of General Statistic Bureau, the yield of catching is 1,802.6 tons in 2002; 1,856.1 tons in 2003, preliminarily 1,922.9 tons in 2004 in which floating fish consists of 50% mainly is anchovy [1]. For anchovy processing, most of them is treated by exposing in the sun or drying. In the world, there is about 50% of seafood yield is processed by similarly approach [1]. Seafood drying is favourite and it has also high exporting value. Therefore, it plays an important role in the economy of many countries such as China, India, Korea, New Zealand, ASEAN countries and also in Vietnam. There are many approaches might be applied for anchovy drying such as chamber dryer, tunnel dryer, conveyor belt dryer, heat pump dryer, solar dryer, and so on. In chamber dryer, the fish might be dried under high temperature up to 800C. The drying process is divided into two stages: in the 1st stage the temperature is about 40 ÷ 45°C and it is increased up to 70 ÷ 80°C in the 2nd stage and kept until completely drying. The tunnel dryer has many advantages including continuous operation, easiness to handle but it still has some weaknesses like difficult evaporation, long-drying time, long tunnel and high

investment cost. The conveyor belt dryer might be suited to drying small fish or fish fillet with high efficiency. These approaches have used high temperature for drying and the heat is supported by burning oil, electrical energy, coal, wood, and so on. The other approach is toward the low temperature as heat pump dryer. In recent years, people are interested much in heat pump drying system and it seem to be the substitution of sublimating dryer. However, in order to reduce the using fossil energy used in dryers, one of the cheapest energy is solar energy has been focused and developed. This might take in some advantages like making the best of endless source of solar energy, not contaminating environment, meeting the quality demand, operating easily, and working durably. Within the high radiation in southern Vietnam, the catching season of anchovy is summer, and focusing on how to apply and use solar energy to drying the anchovy, the model of solar dryer for anchovy has been conducted and investigated in Hochiminh city, southern Vietnam. This paper presents some results of the present study.



Fig. 1 Exposing anchovy in the sun after steaming at Ninh Thuan province, central coastal Vietnam [1]

II. MATERIAL AND EXPERIMENTAL MODEL

A. Material:

The anchovy used for investigation is caught from Ninh Thuan and Kien Giang province, Vietnam. Their scientific and English name is *Stolephorus commersonii* and Commerson's anchovy, respectively. It is noted that the anchovy have been pre-processing before drying. The clean anchovy are cooked in boiled salt water within two or three per thousand of salt in order to make sure the hardness of anchovy.

B. Experimental dryer model:

The dryer model for investigation is designed and manufactured that includes solar collector, fans, drying chamber, and trays. The calculating, designing and testing are follow some processes in Refs. [2-6].

1) *Solar collector*, The solar collector is designed and manufactured with two glass covers as a transparency for maximum radiation through and one black absorber panel for highest assorted radiation with its dimension is presented in Fig. 2. It is located with a slope angle of 30 degree in order to receive best solar radiation energy.

2) *Fans*: it needs forced convection so six electric fans have been installed with total power is 120 watts. These fans flow heated air from collector to drying chamber.

3) *Drying chamber*: the dimension is shown in Fig. 3a.

4) *Tray dimensions*: width: 1010 mm; length: 600 mm; height: 450-650 mm, one tray in drying chamber which can dry the fresh anchovy is about 2 kg per catch.

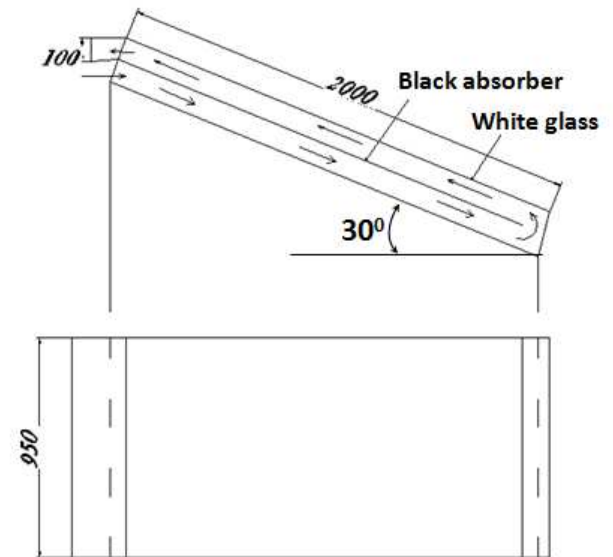
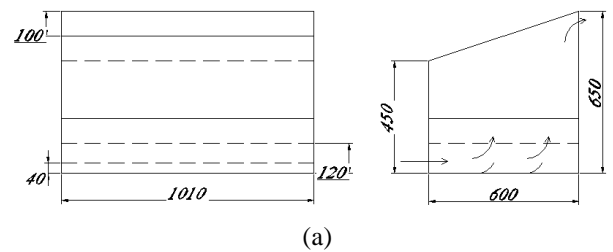


Fig. 2 The solar collector



(a)



(b)

Fig. 3 Drying chamber (a) and the model for experimental investigation (b)

The experimental model is illustrated in Fig.3b.

III. RESULTS AND DISCUSSION

The investigation is conducted during the catching anchovy in southern Vietnam with high radiation in the year. Figure 4 presents the investigation results for solar radiation, relative humidity (RH) of air, RH of hot air (after aborted solar radiation) and the air temperature into and output of from collector of the dryer model in many different days. It is interesting to see the increase of air temperature after flow through the collector. The experiment results indicate that the highest temperature might be enhanced up to 600C. This might lead the different temperature between in and out can be reached to nearly 300C which is very useful for drying. Moreover, it might confirm that using solar energy to make hot air for drying is available and possible.

Figure 5 shows the drying speed of anchovy between solar drying and exposing in the sun (exposed sun) method. It can be seen that solar energy drying might reduce quickly the RH of anchovy which is from over 90% to below 20% in 6 to 8 hours. The drying time of anchovy dried by solar dryer (test 1) is shorter than those is used the exposed sun directly (test 2). Moreover, the color and smell of anchovy dried by solar dryer are also very good comparing to one in the exposed sun directly method which shown in Fig. 6.

The other characteristics of dried anchovy in the exposed sun directly and solar dryer are presented in table 1. It shows that color, smell, and the shape of dried anchovy pass requirement standards for export when they are dried by solar dryer model. It is also to mention that the dried anchovy product used the exposed sun directly method absolutely is polluted by many ants and flies so that the sanitation standards of dried anchovy should be rechecked.

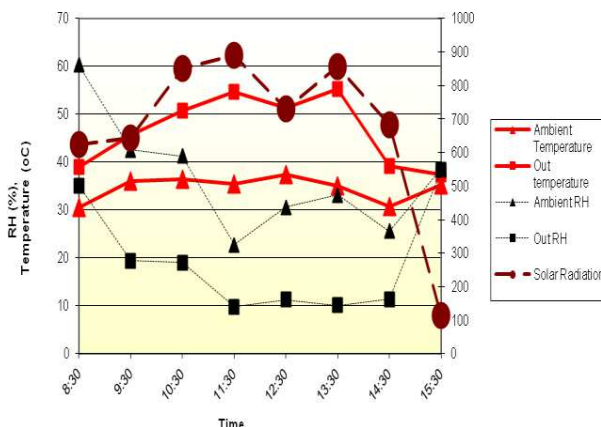
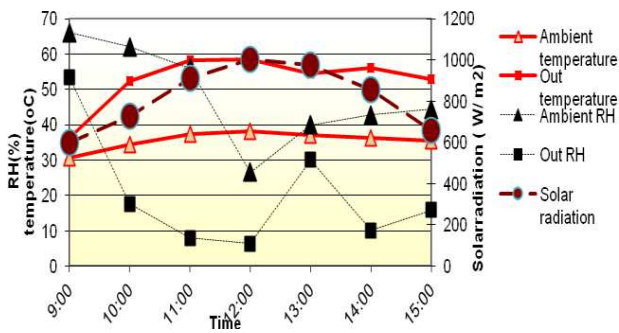


Fig. 4 The ambient and output of temperature and RH with solar radiation at different time in two different days

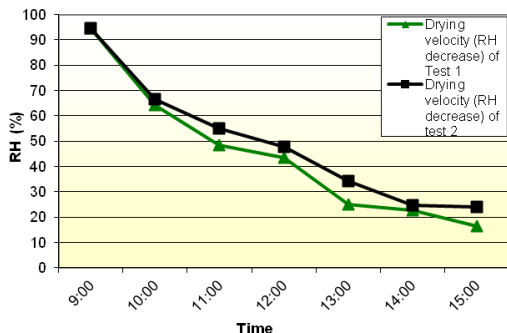


Fig. 5 The drying speed for anchovy in two approaches: solar dryer (test 1) and exposed sun directly (test 2)



Fig. 6a Anchovy before dried by solar dryer



Fig. 6b Anchovy after dried by solar dryer

TABLE I
SOME ANCHOVY CHARACTERISTICS IN TWO DIFFERENT DRYING METHODS

Anchovy Characteristics	Exposed Sun directly	Solar dryer
Color	Dark, dirty with many ants, flies, dust...	Bright, no effect with insect
Smell	A little salt	A little salt
Dried anchovy shape	Crushing, shape is not perfect	Dry, uncrushed, shape keeps the same before drying, looking good.

IV. CONCLUSIONS

A model of solar energy dryer for drying the anchovy has been developed successfully. The sun radiation, RH and temperature of air into and output of dryer have been investigated. The results demonstrate that solar energy is one of renewable energy which can be completely used for anchovy drying with high drying efficiency and shorter drying time. The dried anchovy has good color, high quality, keep the initial shape, and especially it passes the requirements of food hygiene and environment protecting. The expenditure for the model is very low which might prove that anchovy dryer with large capacity can be developed for saving time and improving high quality of dried anchovy.

NOMENCLATURE

RH relative humidity %

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