
韓・日 技術士合同심포지움

Research and Investigation on solar drying Systems of Food

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We would like to report on the results of our research and investigation which was performed in Bangladesh from October 1979 to march 1982.

The research and investigation was performed as ASCA (Association for Science Co-operation in Asia) project, and Japanese and Bangladesh government promoted it in co-operation.

We went to Bangladesh 5 times during about 3 years, and performed experimental work in co-operation with Bangladesh experts.

1. Background of the Research

1-1. Progress of the Former Research

At Canberra meeting of ASCA (Association for Science Co-operation in Asia) in 1975, the problem of solar drying systems of food was discussed and this experimental work was performed at Bangladesh in 1976.

The traditional method of solar drying of food has many problems such as lots of product loss and many kinds of contamination.

To solve these problems, co-operation in research was performed between Australia and Bangladesh by using polyethylene tent dryer.

Details of the results of this experimental work were discribed in the Dr. P. E. Doe's progress report. So, only its summary will be given below.

As the result of the test, it has become clear that the polyethylene tent dryer has many merits that follow. In polyethylene tent dryer the inside temperature rises and the air flow is accelerated according to its draft effect. As the air temperature rises, relative humidity inside tent decreases. This effect is not only to accelerate the drying speed but also to control the feeding of micro-organism. It is well known that, in case of food, micro-organism can increase under condition with the water activity of 0.7 or more. To avoid this effect, it is proven better that the relative humidity in side the tent dryer would be kept under 60%. The anti-weathering character of polyethylene film leads to a disagreeable problem for this project. The polyetheylene film used in Bangladesh has begun to brittle in about 2 months. This is the problem that must be solved for the economical performance of this project.

The solar drying system with polyethylene tent dryer was studied in Papua New Guinea, Malaysia, the Philippines and Thailand too, and improvement was proceeded for the system so as to be adjusted with weather condition in each country.

1-2. Significance of this Project in Bangladesh and its Present Situation

Bangladesh has 144,000km² of area and 85.4 million people. The density of population is the highest in this region except a city state like Singapore.

Bangladesh people usually feed on rice. Protein sources for them are chicken, mutton, beef, goat, fish, shrimp and bean.

Fish and shrimp are caught mainly in fresh water rivers, and a little sea fish caught in the sea in Bangladesh. Various storage methods of food are known in Bangladesh, but any of these are not of wide use there.

Bangladesh has two main seasons, i.e., dry season and wet one. Dry season is from October to March, and wet season from April to September. In dry season, relative humidity is about 40%, when the sun shines very brightly. So the solar drying system using polyethylene tent dryer is considered a very profitable process for Bangladesh. So it is proposed that in dry season fish is dried and stored and that in wet season dried fish will be consumed little by little. To Bangladesh people, the development program of a simple storage method is a very important problem because the transport and distribution mechanism within the country has not yet been well developed.

This project has three objects as follow, (1) the improvement of the solar drying system of fish using polyethylene tent, (2) the improvement of the quality of polyethylene film and (3) the establishment of the storage method of dried fish.

If the project has been completed with success, the result will be very profitable to Bangladesh people.

1-3. Evaluation of Solar Drying System of Food Social Appropriate Technology

As for technology based on market needs, considerations on economic use of local resources, environmental protection, the disposal of wastes, and so forth tend to be neglected. Moreover, as a matter of appropriate technology, it is undesirable such technology lead to enlarging regional discrepancies in economic and cultural life, causing the unemployment in the region, threatening the safety of life, sanitary conditions, and so forth.

This project is proposed rather with a consideration of much broader political level for improving the future dietary life of Asian people than with the direct commercial and market interest in mind. So, we can not expect this system as it is to diffuse immediately on industrial market. Therefore we should continue our effort to develop the appropriate method under realistic conditions from a broader political point of view.

There are some problems to be solved in connection with the environmental protection. These are the treatment of gut of fish and the waste of plastic film of tent. The problem of the treatment of fish gut can be solved by utilizing it with fodder if waste has amounted to a large quantity. According to our experience in Japan, we consider that polyethylene film but not polyvinyl chloride one should be selected for this purpose.

As a matter of regional condition, if we use sea fish only, the seaside area is more profitable. However if we can apply this system to fresh water fish and agricultural products by utilizing solar heat as energy source, there will be few problems due to regional discrepancies. So, this technology is much feasible and has a possibility as community technology in Asia.

For the effect of increasing local employment opportunities desired as one of conditions for social acceptance, we can expect it of this technology, because it has not probability to serve mass production industries, but possibility to do with labor-intensive industries.

As for this technology, there is no worry about threatening its safety, sanitation and freedom from accident.

The most important problem today is how to maintain a constant supply of fish in dry season. It will be possible by promoting fishery. But in future it is necessary to develop the culture of fish with marine ranch.

This system is the most fitted field, to the utilization of solar energy, because the drying temperature is 55°C or under.

If polyethylene tent can be improved for anti-weathering and economical character, this system will be very useful for Asian people.

As seen above, the "Solar Drying System of Food" is considered as social appropriate technology and is acceptable to Asian countries. Therefore, we consider it very important that it will be developed as quickly as possible.

2. Summary of Experimental Results

The experimental work to dry fish was performed using polyethylene tent dryer at Cox's bazar where is the beach of south Bangladesh.

The main objects of the research are as follow, (1) the study of the structure of polyethylene tent dryer for fish drying, (2) the study of the physical and chemical property of polyethylene film as tent dryer, (3) the study of the storage method of the dried fish, (4) the confirmation of points to be improved for its application to Bangladesh.

2-1. Structure of Polyethylene tent dryer

Three types of polyethylene dryer were studied. They are the triangular tent dryer, the semicircular tent dryer and the tent dryer attached solar collector, as shown Fig. 1, 2, 3.

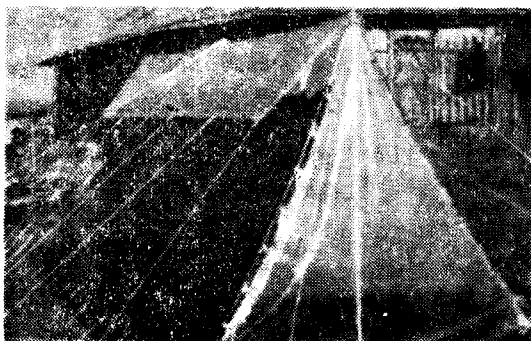


Fig. 1. Triangular Tent Dryer

There are many different character of three type dryer.

Finally, according our experimental results, we recommend the semicircular type tent dryer because it is most simple of three and it can be constructed with local materials as bamboo, crushed stone and rice straw, and the semicircular type dryer has effective drying ability.

2-2. Physical and Chemical Properties of Polyethylene Film

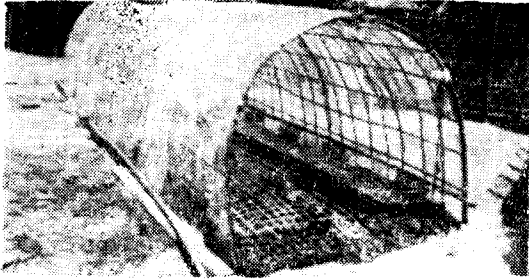


Fig. 2. Semicircular Tent Dryer

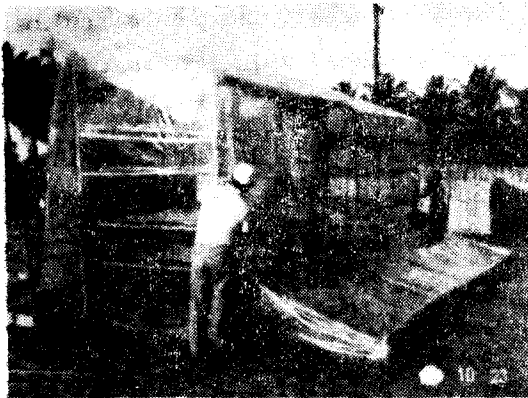


Fig. 3. Tent Dryer attached Solar Collector

There had been a doubt for polyethylen film which made in Bangladesh become brittle soon.

We performed ultraviolet ray irradiated test for tow types of polyethylen film which are made in Japan and made in Bangladesh. The test method is as follow that the ultraviolet ray irradiate to polyethylen film along 80 hours with ultraviolet ray fademeter and measure the tensile strength with Shimazu auto-graph. The strength of the ultraviolet ray of fade meter in one hour is equivalent to the natural irradiation of outdoor in 2.4 days, so the irradiation of 80 hours is equivalent to the irradiation of 192 days.

According the experimental results, there are no difference in tensile strength between the no irradiated film and the 80 hours irradiated film of two type. But the mean value of tensile strength of the Bangladesh film is lower than the Japanese film.

Scatter of film thickness and small crack cause the low tensile strength of the Bangladesh film.

2-3. Study of Storage Method

The problem for storage method is re-absorption of humidity of dried fish.

We studied several method to solve the problem. The storage method must be considered with the circulation system, but the future circulation system of dried fish in Bangladesh is not clear today, so we can not solve it completly.

We recommend the Fogla bag as packing material.

Fogla is plant growing near the water's edge in Bangladesh. Bangladesh people make mat with Fogla and use as floor mat.

Fogla bag are shown as Fig. 4.

2-4. Confirmation of Points to be improved for its Application to Bangladesh.

We can obtain some results about above problem with questionnaire and interview.

In Bangladesh the public relation with a letter is limited. So, this system must be diffused with man-to-man method by JOVC (Japan Overseas Volunteer Co-operation) or others.

We would like to performe this project in second step soon.

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Fig. 4. Fogla Bag