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SOLAR AND ELECTRICAL COPRA DRYERS

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INTRODUCTION

India produces about 6000 million coconuts of which about 40% is converted into copra for oil extraction. The wet coconut kernel which contains 45–55% moisture has to be dried to 6% moisture level to obtain the copra.

The common practice of making copra is by drying the split coconuts under the open sun on cement or mud floor for 7 to 10 days. Copra obtained by this method is generally of poor quality because prolonged exposure under open conditions results in microbial infestation and contamination from dirt and dust make the copra inferior in quality. The microbial infestation can be effectively reduced if drying is done more quickly in suitable dryers. Using the abundant solar energy prevalent in tropical countries, such dryers can be devised.

Copra drying in the sun becomes impossible during the rainy season and hence artificial drying has to be resorted to. The existing artificial kiln dryers are of direct types and the copra obtained is of inferior quality. To obtain good quality copra during rainy season, a suitable dryer using indirect method of artificial drying is essential.

The Central Plantation Crops Research Institute, Kasaragod has developed two different dryers to suit the above conditions for the benefit of small farmers and copra processors.

i) A solar cabinet dryer for drying copra during sunny days.

ii) An electrical dryer for drying copra during monsoon season.

I SOLAR CABINET DRYER

This dryer is of chamber type having direct heating and natural air convection arrangements. The dryer is mainly comprised of (A) A cabinet frame made of jackwood with castor wheels for mobility (B) Transparent covers on the four sides of the frame with 3 mm glass pane; and on the top with 3 mm acrylic plastic sheet (C) Drying surface inside the cabinet frame of area 1.06m^2 (D) Insulation between the drying surface and wooden frame (E) Reflectors on the three sides outside the frame (F) Suntracking arrangement (G) air inlet on the front side at the bottom (H) Exhaust outlet at the rear side on the top. (Figures 1 and 2).

The top cover made of acrylic plastic sheet is provided with hinges to facilitate opening of the dryer. The drying surface is made of 22 gauge corrugated GI sheet to obtain 10% more area per unit space. It is kept at an inclination of 12.5° (equal to the latitude of Kasaragod) and is painted

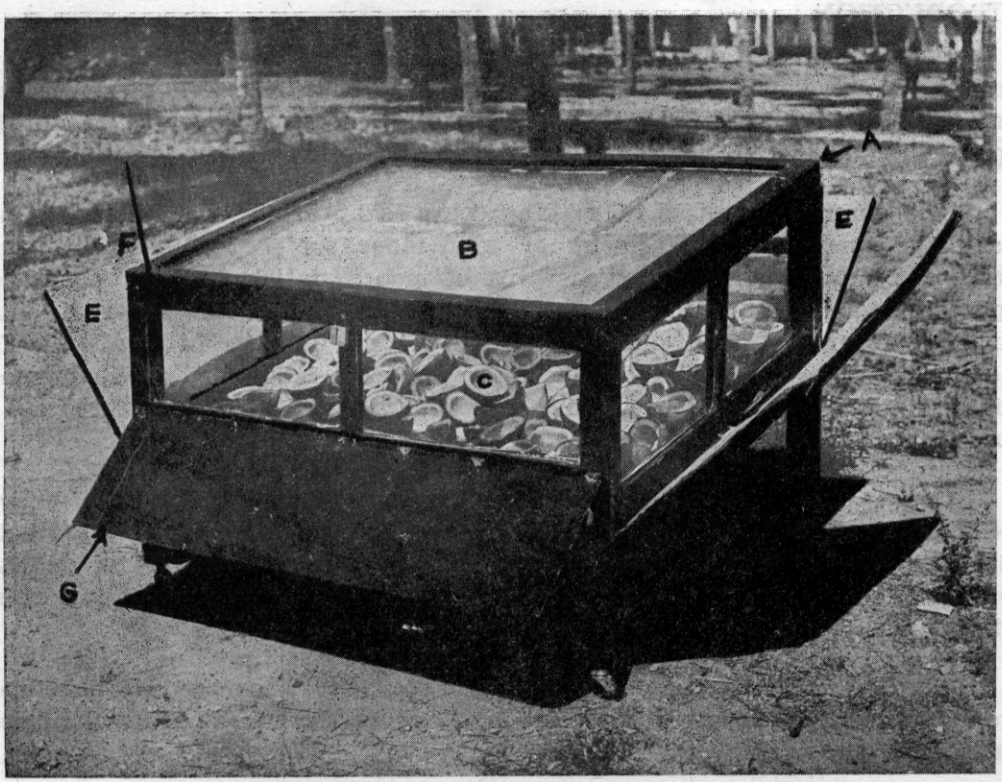

Fig. 1. Solar cabinet dryer
A. Cabinet frame, B. Transparent cover, C. Drying surface
E. Reflector, F. Sun tracking arrangement, G. Air inlet

black. Coir fibre insulation of about 5 cm thickness (2 kg) is provided between the corrugated GI sheet and wooden planks for preventing heat loss. The reflectors are made of 24 gauge aluminium foil and mounted on wooden reaper frame hinged to the three sides of the frame. This helps in concentrating the solar radiation on the drying surface itself. The drying surface is always made to face the sun with the help of the castor wheels and an indicator rod on top of the frame.

For air inlet, 10 cm wide opening covered with wiremesh is provided at the bottom on the front side of the dryer. A black painted GI sheet hood is provided to the opening at an angle of 45° to avoid the direct effect of air draught and to provide preheating to the incoming air. The exhaust opening provided at rear top is also covered with wiremesh.

1. Processing of coconuts

Fully matured (12 months old) coconuts are selected for copra making. After harvesting, the whole nuts are stored for 4 to 6 weeks. The husk is

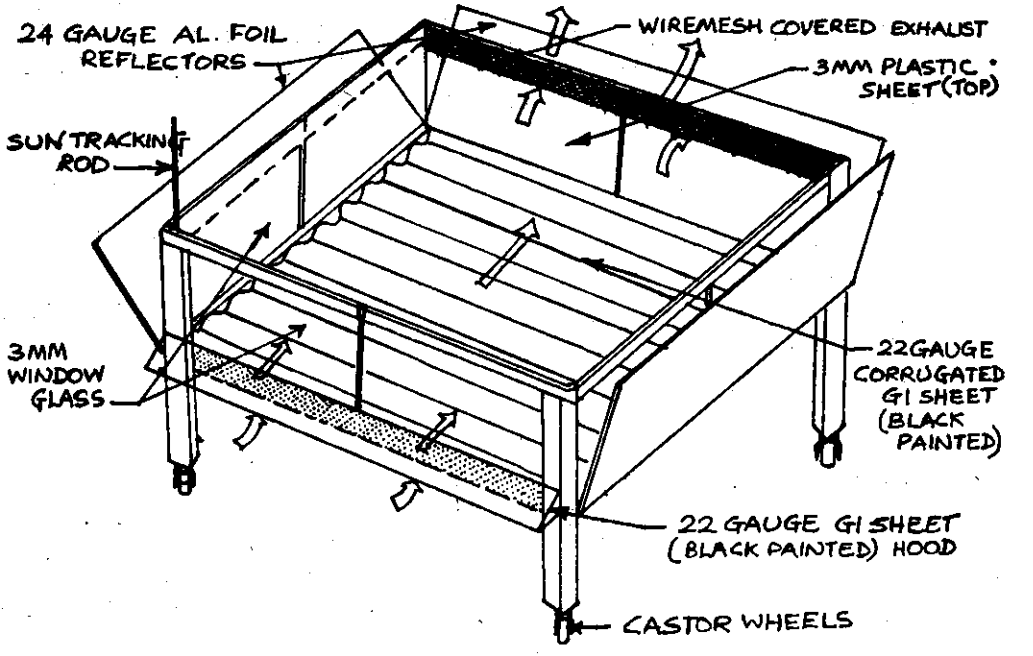

Fig. 2. Solar cabinet dryer (Scale 1=10 cm)

removed and the nut split into two halves. The split nuts are kept inverted for 15 minutes to completely drain the adhering water. Then the cups are transferred to the dryer.

2. Operation of the dryer

The split nuts are loaded on the drying surface with the cups facing up. The dryer is positioned to face the sun with the help of the indicator rod. The dryer is moved to track the sun twice during the day at 3 hr intervals for effective trapping of solar energy. Heat is generated inside the cabinet due to absorption of solar radiation and this helps the moisture in the copra to evaporate quickly. The moisture-laden air escapes through the exhaust vent. At the close of the day, the cups are covered with gunny cloth and the dryer is closed. At the beginning of the second day, the kernel are detached from the shells and they are kept for further drying. The drying is continued every day from morning till evening to reduce the moisture content to less than 6%.

3. Performance

The capacity of the dryer is 90 coconuts per batch (14 kg of copra). The drying is accomplished in 3½ to 4 days thereby reducing the drying time by 50%

as compared to the conventional method. The temperature and relative humidity inside the dryer during drying was found 17°C more and 22% less respectively compared to the respective ambient factors. The dryer costs about Rs. 2200/- and the cost of drying is 0.85 ps. per kg.

4. Advantages

1. Drying time is reduced by 50% compared to the open sun drying.
2. The quality of copra obtained is superior to the copra obtained by open sun drying.
3. The dryer is versatile in design and can be adopted for other plantation crop produces also.
4. It is easy to fabricate locally.
5. It can be easily transported.
6. It is within the reach of small farmers.
7. It is very easy to operate and the maintenance cost is low.

ELECTRICAL DRYER

It is a tray type dryer with mixed flow and forced hot air circulation, devised for drying 1000 coconuts. The dryer mainly comprises (A) drying chamber (B) plenum chamber (C) heating unit (D) blower unit (Fig. 3).

Drying chamber is made of jackwood planks lined with 22 gauge GI sheet inside. The air distribution chamber located vertically at the centre is made of GI sheet with perforations on both the sides. The drying chamber can accommodate 10 trays of 92 × 45 cm size and made of welded wire mesh. The trays are kept on aluminium angle runners on both sides of the air distribution unit. The top of the drying chamber is open with an adjustable lid to serve as exhaust.

Plenum chamber is connected to the botom of the air distribution unit at one end and to the heating unit at the other. It is made of GI sheet and covered with asbestos cloth and partially by asbestos rope. Coating with plaster of paris, is given over this for insulation purposes.

There are 20 air heaters of 400 watts each arranged in a box of MS sheet 3mm thick. The heaters are controlled by switches and energy regulators. A valve to regulate the inlet air flow is provided at the end connecting to the plenum chamber.

Blower unit consists of a 1.5 HP, 2880 rpm motor which is used as prime mover with a capacity of 60m^3/min. The air blown over the heaters gets heated up and distributed in the drying chamber by the air distribution unit. The motor operation is controlled by a direct on line starter.

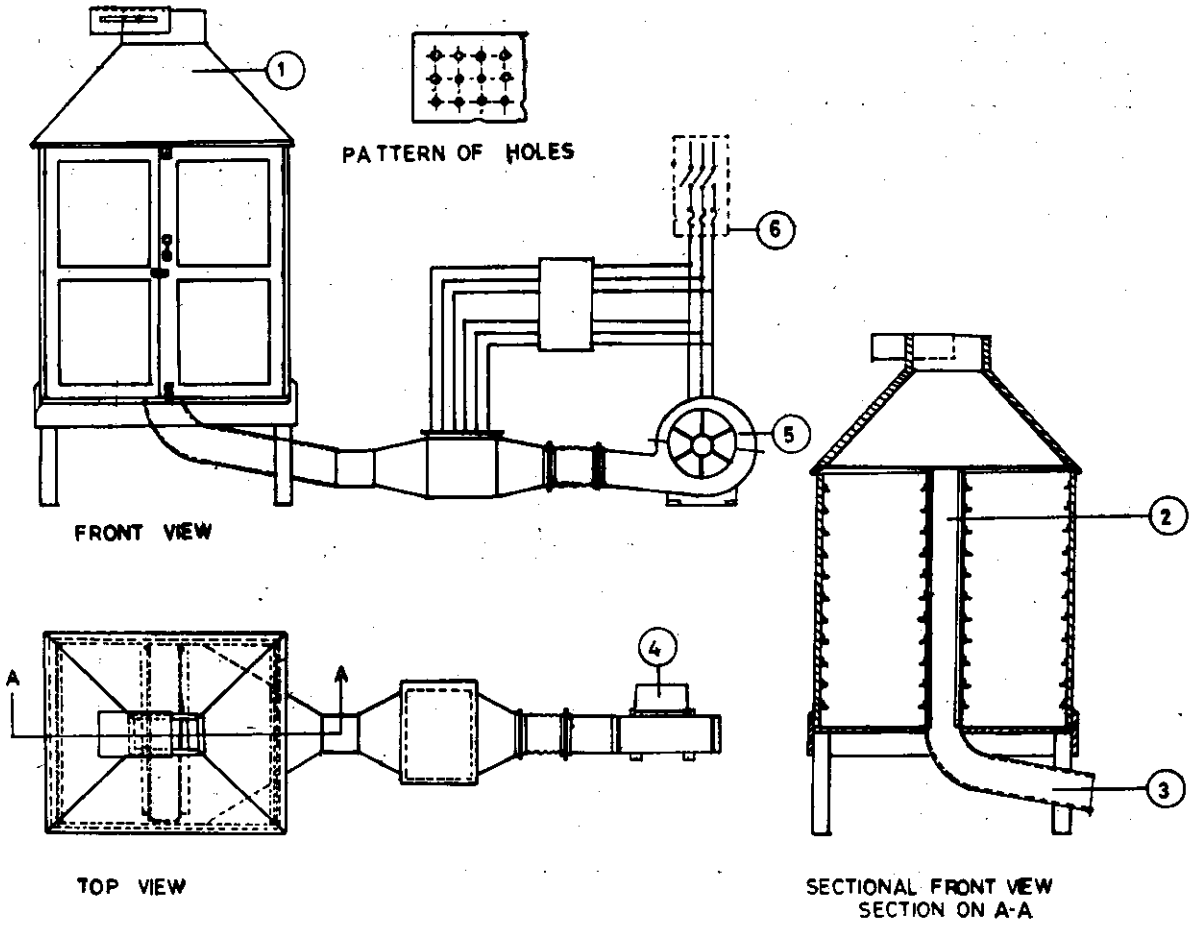

Fig. 3. Electrical dryer

1. Drying chamber, 2. Air distribution unit, 3. Plenum chamber, 4. Motor, 5. Blower, 6. Control panel

1. Operation of the dryer

Hundred split nuts are loaded on each tray with the cups facing sideways. During loading, the blower is switched on with the exhaust lid partially opened. After loading, the heaters are switched on. Desired temperature of the hot air is achieved with the energy regulator and by adjusting the inlet valve and exhaust lid openings. The temperature of inlet air is ket at 60°C for copra. The air velocity parallel to and through the material was 25m/min. and 10m/min. respectively.

The dryer is operated continuosly for 12 hours initially and is switched off. The trays are taken out and the shells separated from the kernel. Then

the trays with the cups are reloaded into the dryer with cups facing up and the dryer is switched on again. The drying is continued till the desired moisture level of 6% is attained.

2. Performance

The capacity of the dryer is 1000 coconuts per batch (160 kg of copra) and drying is accomplished in 30 hours in this dryer. The rate of hot air flow through the material is 6m³/min. The energy utilisation efficiency was found to be 42% in this dryer. The cost of dryer is Rs. 12000/- and the cost of drying works out to 98 paise per kg.

3. Advantages of the dryer

1. This dryer could be a feasible proposition for cooperatives, medium growers and copra processors.

2. The dryer can be used in rainy season also when the sun drying is not possible.

3. The quality of copra is good, white and mould free.

4. Dryer design is simple and can be got fabricated locally.

5. Location of the heating unit outside the drying chamber makes it free from fire hazards and it is possible to use locally available material like wood for drying chamber, thereby reducing the cost of construction.

6. It can be operated by a semi-skilled person.

7. Mixed type air flow provides uniform drying of the produce and hence no need for mixing.

SPECIFICATION AND LIST OF MATERIALS

A. Description

		Solar cabinet dryer	Electrical dryer
1.	Type	Chamber type	Tray type
2.	Heating mode	Direct solar radiation	Electrical energy
3.	Air circulation	Natural air convection	Mixed flow forced hot air circulation
4.	Capacity	90 coconuts	1000 coconuts
5.	Area for housing	1.1 m²	6 m²

B. Materials required

1.	Jackwood	0.075 m³	1.	Jackwood	0.239 m³
2.	Corrugated GI Sheet 22 g	1.25 m²	2.	GI sheet 22 g	9.375 m²
3.	GI Sheet 22 g	0.35 m²	3.	Aluminium angles 25×25×3 mm	49.20 m
4.	3mm window glass	1.40 m²	4.	Welded wiremesh 50×25 mm	10m²

	Solar cabinet dryer			Electrical dryer	
5.	3mm acrylic plastic sheet	1.25 m^2	5.	MS sheet 3 mm	1.0 m
6.	Coir fibre insulation	2 kg	6.	Plaster of paris	5.0 kg
7.	Aluminium foil 24g	1.65 m^2	7.	Asbestos cloth	2.0 m^2
8.	Hard board	2.71 m^2	8.	Asbestos rope	15.0 kg
9.	Wooden reapers	15 m	9.	Electrical room heater 400W	20 nos.
10.	Castor wheels	4 nos.	10.	30cm, 6 blade blower unit	1 no.
			11.	3 phase 1.5 HP 2880 rpm motor	1 no.
			12.	Starter for motor	1 no.
			13.	Heater switches	3 nos.
			14.	15 A Main switch	1 no.
			15.	Energy regulator	1 no.

COST ANALYSIS OF DRYING

Item	Solar Cabinet dryer	Electrical dryer
Basic details		
1. Cost of the unit (Rs)	2200.00	12,000.00
2. Expected life	10 yrs.	10 yrs.
3. Use of dryer in an year	200 days	200 days
4. Time required for a batch	4 days	2.5 days
5. Quantity of copra/batch	14 kg	160 kg
6. Labour requirement for operation of the dryer including dehusking, splitting, deshelling etc.	0.2 man days	3.5 mandays
Fixed cost		
Annual depreciation (Rs)	220.00	1200.00
Annual interest on half new cost 10% (Rs)	110.00	600.00
Annual maintenance @ 10% annual depreciation (Rs)	22.00	120.00
	Rs. 352.00	Rs. 1920.00
Fixed cost/batch	Rs. 7.00	Rs. 24.00

OPERATING COST			
1. Labour charges @ Rs. 25/- per day (Rs)	5.00		87.50
2. Cost of energy @ 0.17 ps. per unit for 270 units (Rs)	—		45.90
3. Operating cost/batch (Rs)	5.00		133.40
Total cost/batch (Rs 5+7)	12.00	(133.40+24.00)	157.40
Cost of drying per kg of dried copra (Rs)	0.85		0.98