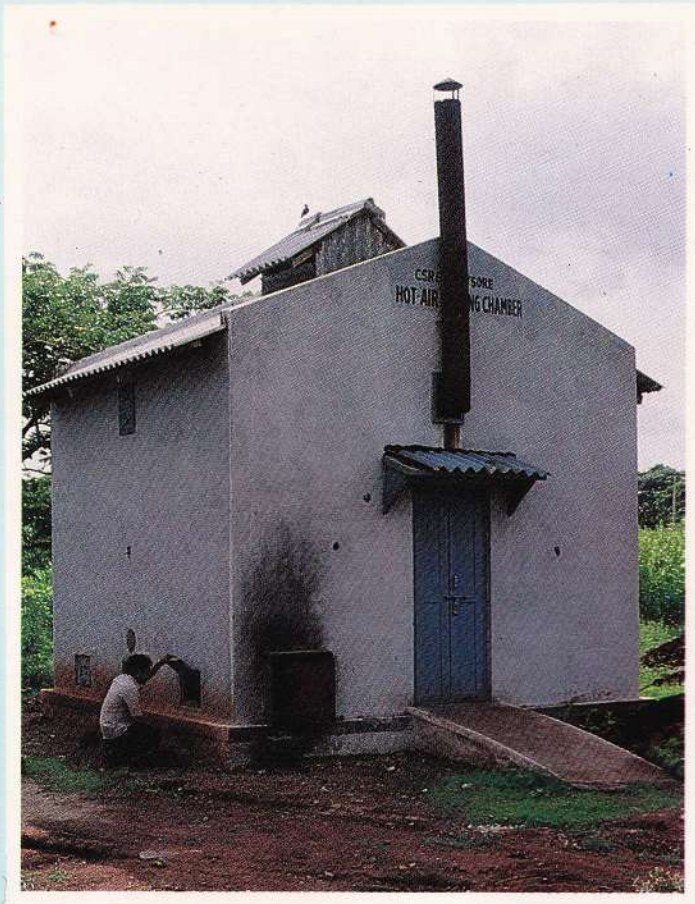


USHNA KOTHI

AN APPROPRIATE RURAL APPLIANCE FOR
STIFLING REELING COCOONS



CENTRAL SERICULTURAL RESEARCH & TRAINING INSTITUTE

MYSORE - 570 008 INDIA

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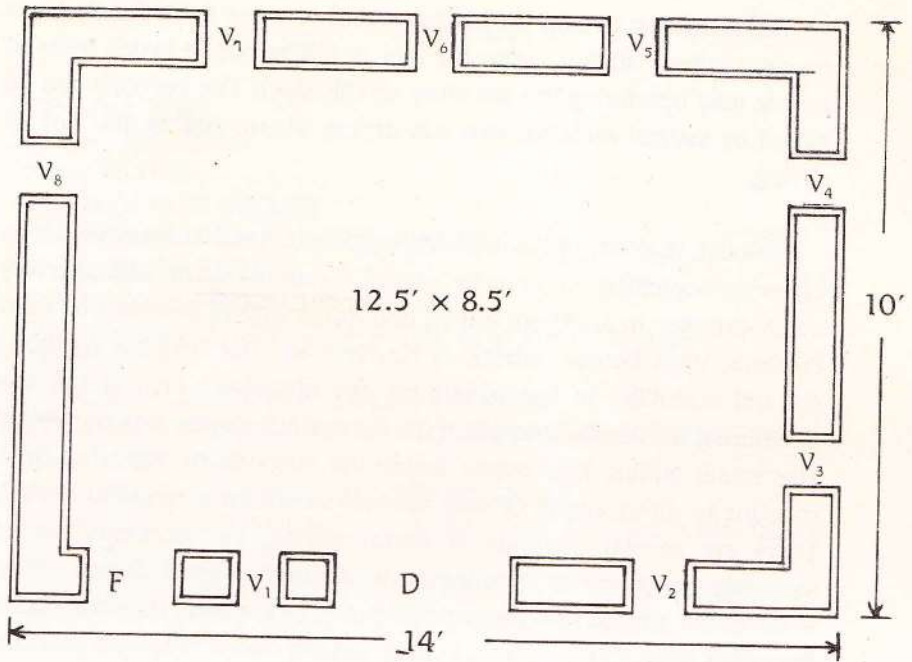
INTRODUCTION

For extraction of silk, freshly harvested cocoons are subjected to a process called "stifling" with the aim of killing pupae inside without in any way interfering the structure of silk shell. The cocoons can be stifled by several methods like sun drying, steam stifling and hot air drying.

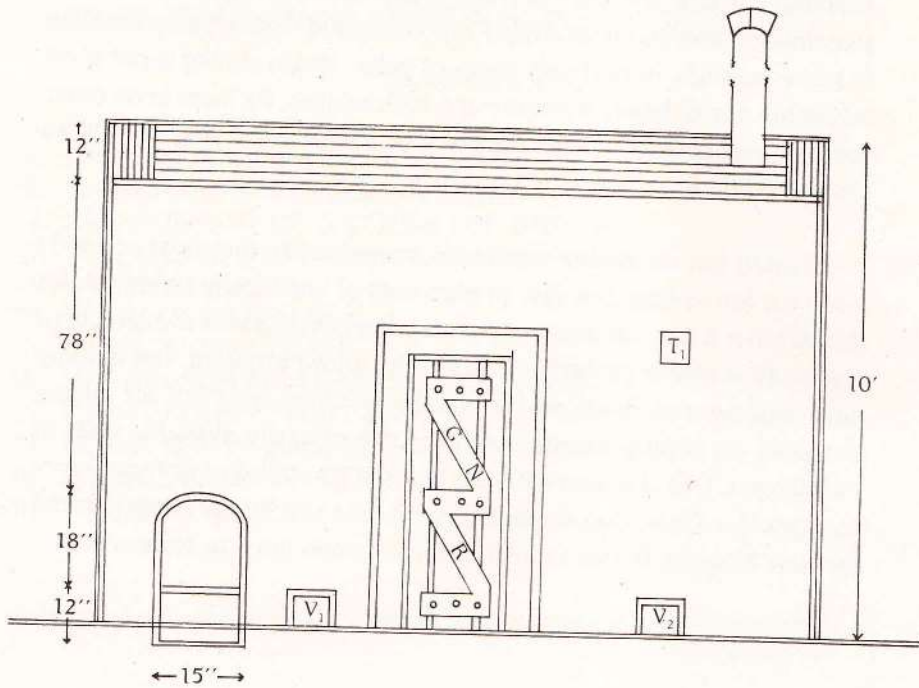
In India, majority of the mulberry cocoons are stifled either by drying under the scorching sun or by hot steam. Generally steam stifling is very much popular in southern states and sundrying is followed in Uttar Pradesh, West Bengal, Jammu & Kashmir etc. But both the methods are not scientific. In the sundrying, the ultraviolet rays of the sun deteriorate the tensile strength of the fibre which results in poor reeling. The steam stifling kills pupae inside the cocoons by exposing fresh cocoons to direct action of very hot wet steam for a required period. There are several methods of steam stifling, but generally basket steaming and chamber steaming are in common practice. Steam stifling is no doubt simple and economical but it has several disadvantages. Steaming only kills pupae but does not dry them. The wet cocoons cannot be stored immediately as they are attacked by fungus. Freshly steamed cocoons are also not fit for immediate reeling because sericin remains soft and dissolves readily in cooking and reeling baths resulting in more wastage. In northern states of India, steam stifling is not at all advisable due to heavy humidity and high rainfall. As there is no other method available for village reelers they follow sundrying as well as steam stifling for stifling the cocoons.

Though hot air stifling method is proved to be the most scientific and best for reeling, but due to high cost of electrically operated hot air chamber it has not become popular. Moreover, scarce availability of electricity is also a problem. To solve the above problem, the authors have studied and developed a suitable country type hot air stifling chamber, for stifling cocoons with the use of easily available fuels in the villages. This chamber can also be used for stifling of non-mulberry cocoons like Tasar, Oak-tasar, Muga etc. and will be very much useful for Raw Material Banks in stifling the cocoons prior to transaction.

PLAN OF USHNA KOTHI



FRONT ELEVATION OF USHNA KOTHI



USHNA KOTHI

SALIENT FEATURES:

1. Cost of investment is less.
2. Suitable for village reelers.
3. Electric power is not required.
4. Suitable for mulberry and non-mulberry cocoons.
5. All kinds of fuels can be used.
6. Stifling cost per kg of cocoons is lowest.
7. 250 to 300 kg of cocoons can be stifled at a time.
8. Construction is simple.

PHYSICAL DATA:

- | | | |
|--|---|--|
| 1. Object | : | To stifle cocoons by hot air method by making use of easily available fuels. |
| 2. Size | : | 14' × 10' × 10' (425cm × 305cm × 305cm) |
| 3. Materials required | : | Bricks, fine sand, red soil, asbestos sheets, wooden door, M.S. sheets, refractory bricks. |
| 4. Capacity | : | To stifle about 250 to 300 kg of green cocoons at a time. |
| 5. Duration | : | About 4 hours. |
| 6. Driage | : | 30 to 40%. |
| 7. Fuel | : | Firewood, coal, charcoal or husk. |
| 8. Quantity of fuel per charge | : | Firewood 60 kg approximately. |
| 9. Time required to raise the temperature to 60°C. | : | 30 minutes. |
| 10. Time required to raise the temperature to 100°C. | : | 60 minutes. |

CONSTRUCTIONAL DETAILS:

The 'USHNA KOTHI'-a hot air cocoon stifling chamber is having the dimension of 14' length, 10' width and 10' height. This is constructed over a foundation of cement-concrete bed on size-stone masonry with cement mortar. The super structure consists of burnt brick masonry and mud joints. Its outside walls are plastered with cement for protection from rain and inside walls with mud for insulation. Roofing is made with corrugated asbestos sheets on wooden frame.

It has eight ventilators at the bottom and four at the top of size 9'' × 6'' with adjustable window pan made of plain asbestos sheet supported by wooden framings. One wooden door of size 6' × 3' is fixed in front of the chamber. Four glass windows of size 6'' × 6'' are fixed on all four walls of the chamber to record the temperature at a height of about 6' from the bottom. In left corner of the front side, one oven of size 1½' × 1½' is constructed on the ground keeping the fuel feeding part outside. The oven is made of refractory bricks to prevent heat loss. This is connected to flue gas pipes running all around the chamber and finally connected

to the chimney for smokelet. This oven is suitable for feeding firewood as fuel. This can be suitably modified for other fuels also. The floor is made of soil with $\frac{1}{2}$ " thick sand bed over it.

ARRANGEMENT OF COCOONS FOR STIFLING:

The cocoons are filled in perforated trays of size $2' \times 2\frac{1}{2}'$, each has a capacity to accommodate 2 to 2.5 kg of green cocoons. These trays are placed one above the other in parallel rows on specially designed cocoon racks of size $4'2'' \times 2' \times 7'$ made of iron. The above cocoon rack consists of 20 parallel rows which can accommodate 40 perforated aluminium trays, overall 80 to 100 kg green cocoons can be easily accommodated in one rack. The chamber can conveniently hold three such racks. Thus, 250 to 300 kg of green cocoons can be stifled per batch in this chamber.

WORKING PRINCIPLE:

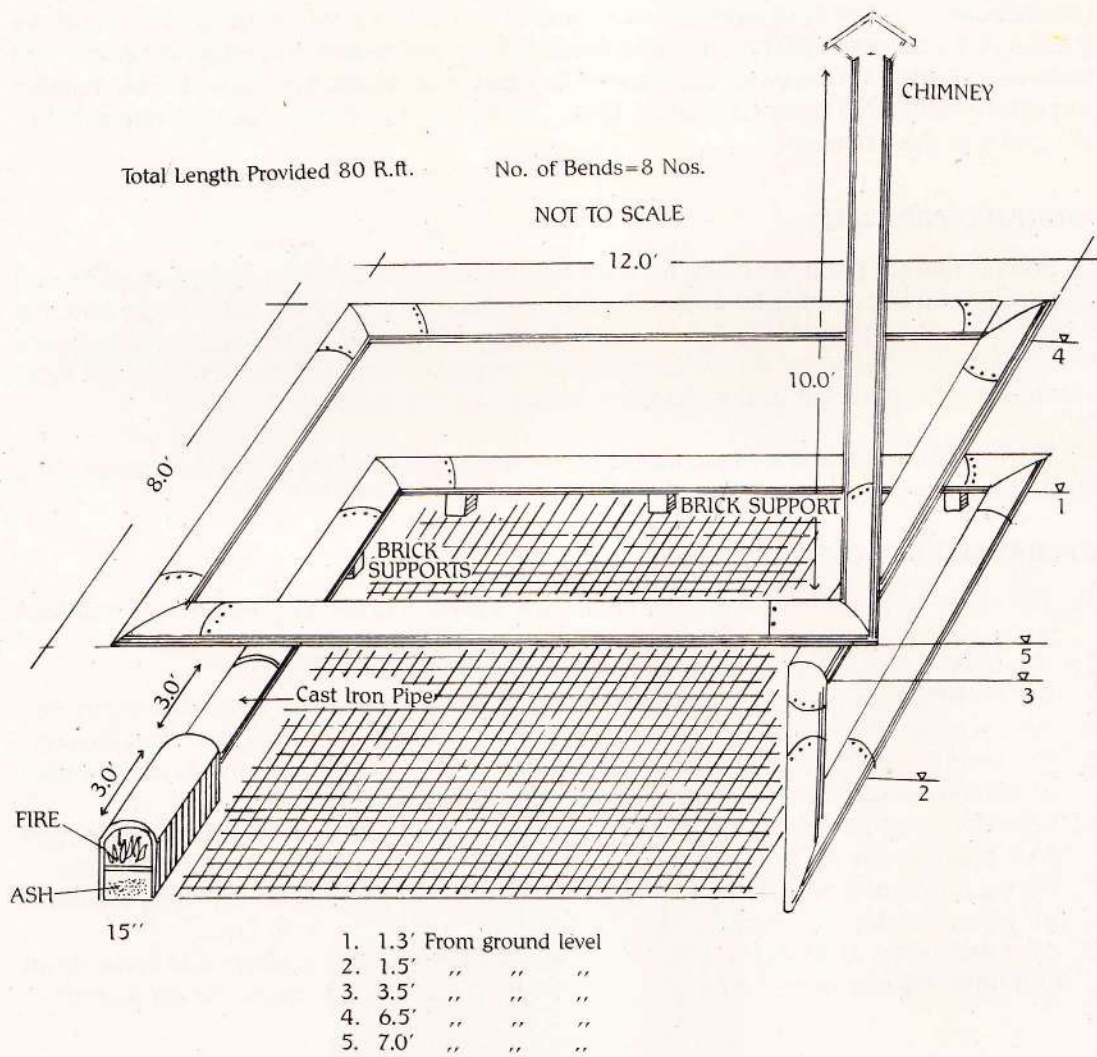
The hot flue gas produced inside the oven is circulated through the flue-gas pipes all around inside the chamber at different angles. As the flue gas pipe is thin, the heat energy from the flue gas is easily radiated inside the room and heats up the surrounding air. The pupae inside the cocoons are first killed by hot air and start drying by evaporation of pupal body fluid. The moist air expels out of the chamber through the top ventilators.

The bottom ventilators are responsible for controlling the air-flow inside the chamber and create an automatic air draft.

OPERATIONAL PROCEDURE:

1. The green cocoons which are to be stifled are first filled in the aluminium trays and kept ready outside the chamber for loading.
2. Now, the fire is set on in the oven and tested for any smoke leakage.
3. After testing, the trays with the cocoons are placed on the racks inside the chamber.
4. After loading of cocoons the door is closed and care is taken to avoid any heat leakage.
5. Fire is continued even after the closure of the door. The temperature inside the chamber at different places is recorded with the help of dial thermometers.
6. When temperature reaches 100°c , the time is recorded. Fire is continued further for atleast four hours to get 30 to 40% weight loss, maintaining around 100°c temperature.
7. During this period both bottom and top ventilators are regulated for expelling the moist air formed inside the chamber, due to evaporation of pupal body fluid.
8. After four hours of stifling, the fire is stopped and temperature is allowed to come down to normal for one more hour. Later on, the dried cocoons are taken out for storage.

FLUE GAS PIPE LINE ARRANGEMENTS

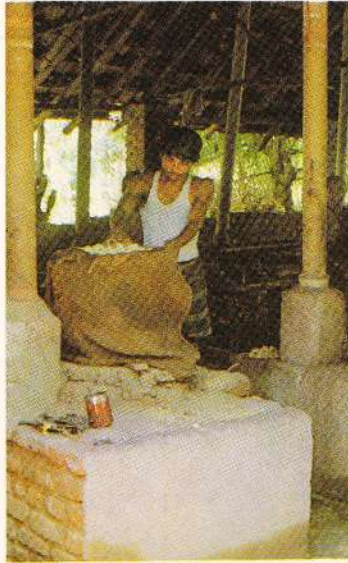


MATERIAL REQUIREMENT FOR THE CONSTRUCTION OF USHNA KOTHI
SIZE: 14'×10'×10' (425 cm × 305 cm × 305 cm)

Sl. No.	Name of the Item	Quantity	Amount (approx.) Rs. Ps.
1.	Burnt bricks (9'' × 4'' × 3'')	4000 Nos.	1,600.00
2.	Granite jelly (Size 40 mm)	¼ lorry load	200.00
3.	Size stones	550 Nos.	1,000.00
4.	Sand	1 lorry load	300.00
5.	Granite stone lintels (3'' or 4'' thick)	i) 4' length-1 } ii) 3' length-1 }	200.00
6.	Cement	15 bags	1,200.00
7.	A.C sheets (corrugated) size 10'×3'	8 Nos.	2,400.00
8.	a) wooden door of size 3'×6' with wooden side framing (4''×3'')	1 No.	1,200.00
	b) Wooden reepers of size 4''×3'' for A.C. roof support	15' length	200.00
9.	M.S. sheets - 20 gauge (8'×3')	12 Nos.	3,000.00
10.	C.I circular pipe-1/4'' thick × 10'' dia (3' to 6' length)	1 No.	400.00
11.	Fire clay or refractory bricks:		
	a) curved shape: }		
	b) regular shape: }	30 Nos. each	300.00
12.	Iron gratings of size 2½'×2' (Heavy duty)	1 No.	250.00
13.	Plain glass sheets of size ½'×½'	4 Nos.	30.00
14.	J-Bolts	12 Nos.	20.00
15.	Wire mesh of size 1'×1'	12 Nos.	100.00
16.	A.C lid of size 1'×1' for ventilators	12 Nos.	300.00
17.	Labour charges:		
	a) Civil works	—	2,000.00
	b) Carpentry	—	200.00
	c) Tinkering	—	600.00
		Total Rs:	15,500.00
18.	Add: 10% extra being area weightage for Mysore. (1989)	—	1,500.00
19.	Iron cocoon racks of size 4'2''×2'×7'	3 Nos.	3,000.00
20.	Perforated aluminium trays of size 2'×2½'	120 Nos.	15,000.00
		Grand Total Rs:	35,000.00

(RUPEES THIRTY FIVE THOUSAND ONLY)

BASKET STEAMING



This is a traditional method of stifling. Most of the charkha reelers practice basket steaming. Here pupae inside the cocoons are killed but not dried. Steam stifled cocoons should be immediately reeled, otherwise there is a chance of fungus attack.

CHAMBER STEAMING



In large reeling establishments stifling of cocoons is done by 'chamber steaming' method. Here the cocoons are loaded on bamboo trays over a trolley with racks and pushed inside the chamber. Hot and wet steam is injected inside the chamber for a required period for stifling.

ECONOMICS OF STIFLING GREEN MULBERRY COCOONS IN USHNA KOTHI

Sl. No.	Particulars	Materials/Expenditure
1.	Electric power	Not required
2.	Capacity	250 kg
3.	Duration	4 hours
4.	Fuel	60 kg firewood
5.	Fuel charges per batch	Rs. 42.00 @ Rs. 700.00 per tonne
6.	Labour charges per batch	Rs. 15.00
7.	Miscellaneous charges, (Kerosene, cotton balls, etc)	Rs. 0.50
8.	*Depreciation @ 10% per annum on total cost	Rs. 5.00
9.	Total expenditure incurred	Rs. 62.50
10.	Cost of stifling per kg of green cocoons	Rs. 0.25
11.	Drying loss of cocoons in 2 hours (%)	15 to 20
12.	Drying loss of cocoons in 4 hours (%)	30 to 40

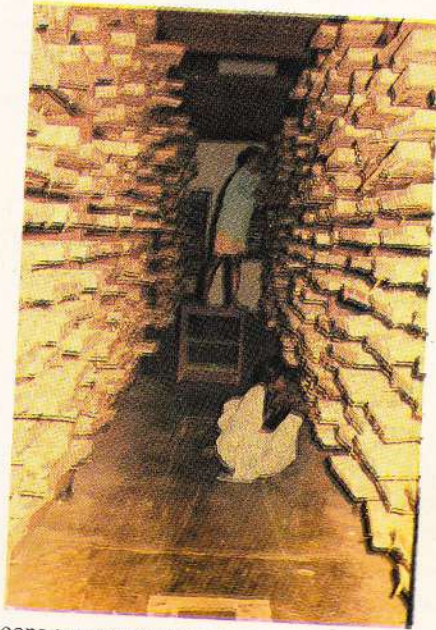
*Depreciation of the plant is calculated @ 10% on total expenditure of Rs. 35,000 considering stifling of two batches per day.

COMPARATIVE ECONOMICS OF STIFLING GREEN COCOONS BY HOT AIR METHODS

Sl. No.	Particulars	Hot air stifling chamber	
		Electrical (lab model)	USHNA KOTHI
1.	Electrical supply required (3 phase)	Yes	No
2.	Capacity (kg)	36.000	250.000
3.	Duration (hrs)	6	4
4.	Power consumption (35 Kwh/hr)	21 Kwh	60 kg. Firewood
5.	Electricity/fuel charges/batch (Rs)	15.75 @Rs. 0.75/unit	42.00 @Rs. 700.00/tonne
6.	Labour charges per batch (Rs)	5.00	15.0
7.	Miscellaneous charges	Nil	Rs. 0.50 (Kerosene, cotton balls etc)
8.	Depreciation @ 10%/batch/annum (Rs)	4.00	5.00
9.	Total expenditure incurred/batch (Rs)	24.75	62.50
10.	Cost of stifling per kg of green cocoons (Rs)	0.68	0.25

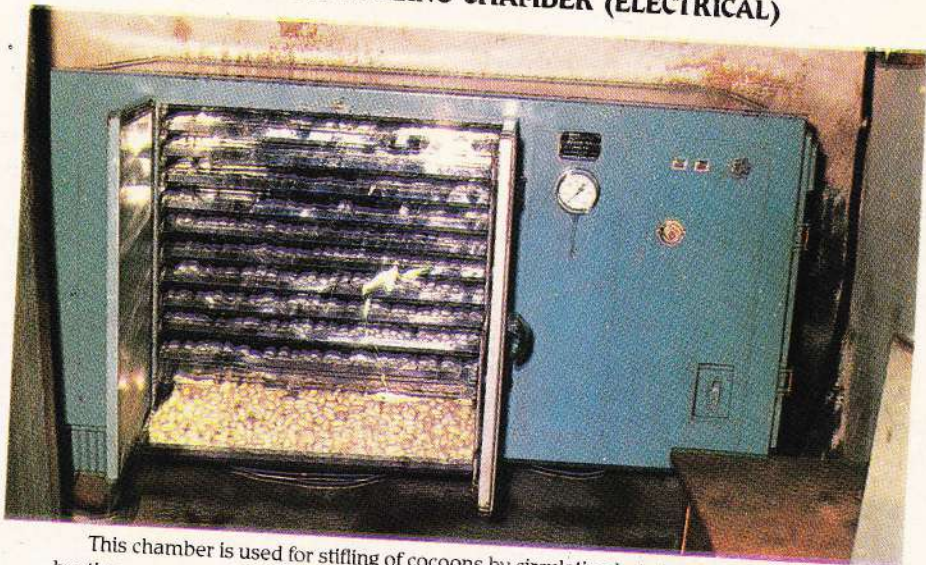
From the above table it can be seen that quantity of firewood required for 'Ushna Kothi' to stifle one batch of cocoons (250 kg) for four hours is 60 Kg approximately. The stifling cost per kg of cocoons in 'Ushna Kothi' works out to be only Rs.0.25 which is almost three times cheaper as compared to electric hot air stifling chamber. This type of hot air drying

STORAGE OF COCOONS



Steam stifled cocoons are stored in the store room on the racks in bamboo trays. In spite of many preventive measures, cocoons get fungus attack if not used immediately for reeling. This is a great disadvantage of steam stifling. Whereas hot air stifled cocoons can be stored easily for a long duration.

HOT AIR STIFLING CHAMBER (ELECTRICAL)



This chamber is used for stifling of cocoons by circulating hot air produced by electrical heating arrangements. Fans provided are responsible for circulation of hot air inside. This method of stifling is most scientific. The temperature inside the chamber can be controlled by thermostat arrangements.

oven will be very much convenient for the village reelers to stifle the reeling cocoons using easily available fuels in the villages.

LARGE SCALE STIFLING AND REELING TRIALS

Large scale stifling trials were conducted on USHNA KOTHI as per the method described earlier. Steam stifling was also conducted for equal quantity of cocoons by "chamber steaming" as followed in silk filatures. Both the lots were reeled on cottage basins following open pan cooking system at Govt. Silk Filature, Chamarajanagar.

The above study was initiated by State Sericulture Department, Government of Karnataka with the aim to find out the feasibility of 'USHNA KOTHI' for commercial application.

The physical/commercial characters of cocoons taken for the above study are given below:

1. Source	Govt. Cocoon Market, Vijayapura.
2. Race	Multi X Bivoltine
3. Quantity purchased (Kg)	300.00
4. Average rate per Kg (Rs)	87.88
5. Average Single cocoon weight (gm)	1.57
6. Average Single shell weight (gm)	0.28
7. Shell ratio (%)	17.83
8. Average filament length (m)	713.00
9. Average filament denier	2.67
10. Defective cocoon (%)	6.00

COMPARATIVE MASS REELING PERFORMANCES OF COCOONS STIFLED IN USHNA KOTHI AND BY CHAMBER STEAMING ON COTTAGE BASINS AT GOVERNMENT SILK FILATURE, CHAMARAJANAGAR

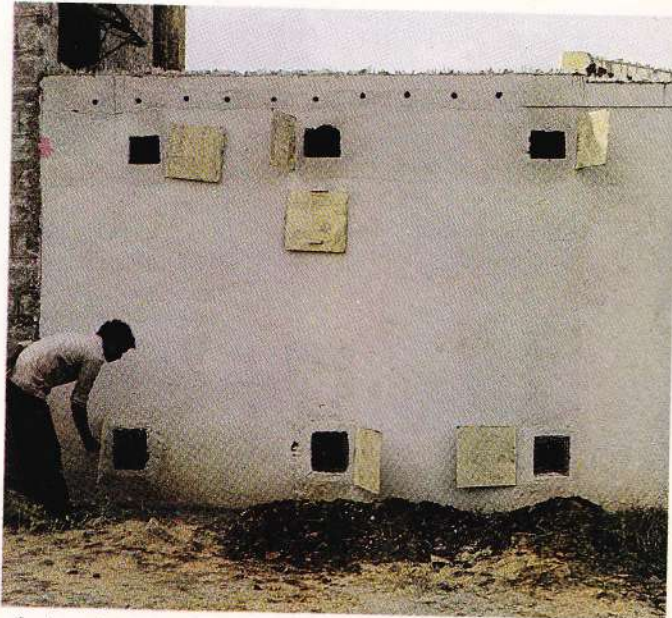
Sl. No.	Particulars	Hot air stifling	Steam stifling
1.	Quantity of cocoons taken for reeling (Kg)	150.00	150.00
2.	Total number of cocoons reeled	91,800	92,200
3.	Driage percentage after stifling	25.00
4.	Number of basins worked	21	21
5.	Type of reeling machine	Cottage basin	Cottage basin
6.	Driage percent on reeling day	60.8	61.5
7.	Total production obtained (Kg)	16.920	17.170
8.	Renditta	8.86	8.74
9.	Average production/basin (Kg)	0.805	0.817
10.	Denier of raw silk reeled	20/22	20/22
11.	Reeling waste % on silk weight	25.8	23.2
12.	Rereeling waste % on silk weight	0.07	0.06
13.	Stifling : Fuel charges/Kg (Rs)	0.17	1.93

USHNA KOTHI – FRONT VIEW



The front view of 'Ushna Kothi' shows firewood type oven, front door, bottom ventilator, temperature recording place and chimney.

USHNA KOTHI – BACK VIEW



The back view of 'Ushna Kothi' shows top and bottom ventilators. The ventilators are used to control the air draft inside the chamber in addition to maintaining of required temperature inside the chamber.

From these results it is clear that practically there is no difference in the reeling performance of two cocoon stifling methods. However, average renditta in case of hot air stifled cocoons appears to be similar. For hot air stifled cocoons little adjustment is required in cooking technique, for higher efficiency and output.

COMPARATIVE TECHNOLOGICAL CHARACTERS OF RAW SILK PRODUCED FROM COCOONS STIFLED BY USHNA KOTHI & STEAMING CHAMBER TESTED AT SILK CONDITIONING AND TESTING HOUSE, BANGALORE

Sl. No.	Particulars	Hot air stifling	Steam stifling
1.	Winding breaks/5 skeins/hour	4.0	5.0
2.	Size deviation (denier)	1.37	1.44
3.	Maximum deviation (denier)	1.80	2.30
4.	Average size (denier)	20.50	22.00
5.	Tenacity (g/d)	3.00	3.10
6.	Elongation (%)	20.00	19.00
7.	Cohesion (number of strokes)	67	64
8.	Evenness (%)	80.00	78.00
9.	Low evenness (%)	73.00	70.00
10.	Cleanness (%)	82.00	84.00
11.	Neatness (%)	82.00	82.00
12.	Low neatness (%)	75.00	75.00
13.	Uniformity	Fair	Fair
14.	General finish	Good	Good
15.	Colour : i) Shade	Yellow	Yellow
	ii) Degree	Light	Light
16.	Lustre : i) Kind	Moderate	Moderate
	ii) Degree	Medium	Medium
17.	Hand : i) Nature	Hard	Hard
	ii) Smoothness	Smooth	Smooth

The above table indicates that there is no significant difference in raw silk characters between the two systems of stifling viz., hot air and steaming. However, winding performance as well as evenness and cohesion characters are better in case of hot air stifled cocoons as compared to steam stifling.

In addition 'USHNA KOTHI' is having the following major advantages in filature reeling :

1. The stifling expenditure is reduced to 30 to 40% as compared to steam stifling.
2. The reeling cocoons can be seasonally purchased, hot air stifled and stored for longer period. This will facilitate purchase of cocoons at lower prices.
3. In rainy season the hot air stifling will remove all fears of fungus attack and reduce the cost of maintenance of cocoons.
4. The cocoons can be either partially or fully dried to a desired degree of drriage.

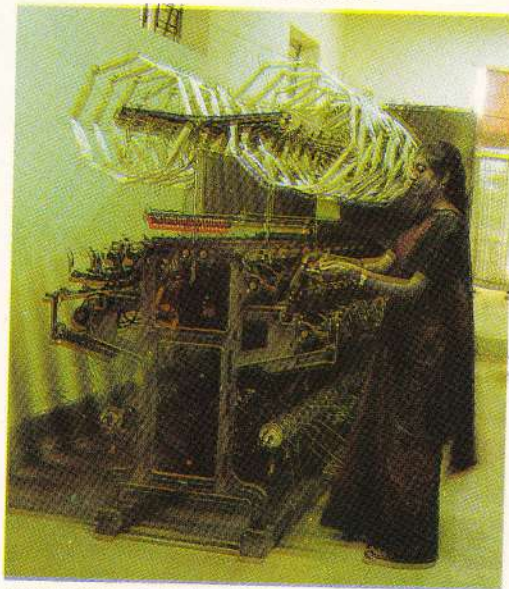
*Study made by Department of Sericulture, Government of Karnataka, in collaboration with CSRTI, Mysore.

COTTAGE BASIN



Cocoons stifled in 'Ushna Kothi' were reeled on cottage basin for large scale reeling trials. It was observed that reeling performances of hot air stifled cocoons in 'Ushna Kothi' is at par with that of steam stifled cocoons.

WINDING FRAME



The raw silk obtained from hot air stifled cocoons is subjected to winding and other technological tests. Better winding performances were observed for the raw silk of hot air stifled cocoons in comparison with that of steam stifled one.