BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
SOUTHERN ZONE, CHENNAI

APPLICATION NO. 85 OF 2023

Sri. Raveendran Babu	:	Applicant
Vs		
Union of India & Others	:	Respondents

REPLY AFFIDAVIT FILED BY RESPONDENTS, 12, 13, 14, 16,18,19,20 &22 IN THE ORIGINAL APPLICATION NO. 85 OF 2023

COUNSEL FOR THE 12, 13, 14, 16,18,19,
20 & 22 RESPONDENTS

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Dated this the 15th day of September, 2023

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I **Iby Babu,** aged 53 years, W/o Babu, residing at Kandathil, Koottar P.O., Idukki-685552, do hereby solemnly affirm and State as follows:

1) That I am the 13th respondent in the above Original Application. I am filing this affidavit for and behalf of Respondents Nos. 12,14,16,18,19,20& 22 as duly authorized by them.
2) That all the facts stated, averments made and proposition of law raised in the Original Application except to the extent that are specifically admitted hereunder are false and hence denied. The Original Application is not maintainable either in law or on facts.
3) At the outset, it is humbly submitted that, the Original Application is not maintainable as the petitioner approached this Hon'ble Court without having a cause of action as contemplated under the provisions of the National Green Tribunal Act 2010. The Petitioner has not disclosed the facts in toto relating to the true facts and affairs of the case.

4) That it is respectfully submitted that more than 80% of the Small Indian Cardamom is being produced in the four Talukas of Idukki District in Kerala namely Udumbanchola, Devikulam, Peermedu and Idukki. More than 5 lakhs of people are directly or indirectly involved in this agrarian industry predominantly as farm Labours, marginal & small scale farmers having land holding less than one hector.

5) Small Indian Cardamom which is an endemic species of the Western Ghats is being grown under the shades of large and thick canopy. In a way the cardamom cultivation is promoting the growth of green cover by preserving or planting trees. Decreased productivity and loss of crops due to the climate change issues and price fluctuations are the major factors adversely affecting the farmers who are solely depending on the Small Indian Cardamom cultivation. Despite all these odds, the farmers are sticking on good agricultural practices to protect the environment and ecology as the Small Indian Cardamom being an endemic species of the terrain can be grown only in a particular tropical and ecological condition. Therefore the answering respondents and others who are depending on the agricultural prospects of the Small Indian Cardamom are more concerned about the ecological protection and issues related to the climate change arising out of global warming and thus do not indulge in any activities which may adversely affect the initiatives to fight global warming.

6) The agricultural process of Small Indian Cardamom starting from the planting of saplings to the drying of fresh cardamom

capsules harvested from the farms. Fresh cardamom has moisture content of more than 80%. For reducing the moisture content to 10% for the purpose of making the spice as a commodity, the raw cardamom capsules need to be dried continuously. Conventionally the raw cardamom were being dried in the traditional dryer houses using wood as fuel. After having conducted a lot of research with the support of the Spices Board of India and other agencies, modern electricity enabled dryers with Biomass Gasifier Technology have been introduced for curing the raw cardamom using wood chips, dried bio wastes, coconut shells, coconut husk or wood based briquettes as fuel. The modern dryers are more fuel efficient and functioning with the aid of electricity.

7) That it is respectfully submitted that the modern cardamom dryers are using the Biomass Gasifier technology, which is having the following features.

- The gas is compressed down with the help of main blower motor.
- The heat generated by burning of gas is passed through the heat exchangers.
- This heat is blown inside the fuelling chamber to dry the raw cardamom.
- The automatic shutters are interlinked with temperature controllers and the operator can set the desired temperature. Increasing the temperature at periodic interval can be made automatic with the help of additional fittings.

- In the gasification process, carbonaceous materials are converted into combustible gas under controlled amount of oxygen.
- The gas thus generated is used as a fuel in the gasifier.
- The combustible gas generated is more efficient than direct combustion of the original fuel.
- The fuel unit is compact and is kept outside the chamber room.
- There is no heat loss as the flue pipes are packed inside a chamber.

From the above features of the Biomass Gasifier Technology, it can be seen that the modern cardamom dryers are more scientific, more fuel efficient and eco-friendly.

8) That it is respectfully submitted that the modern cardamom dryers with Biomass Gasifier Technology are having the following salient features:

- The fuel materials can be briquettes, coconut shell, coconut husk, wood chips or any dried agricultural wastes.
- It helps to prevent deforestation and helps in disposal of agricultural waste in a meaningful way.
- The process ensures good colour to the capsules due to temperature controller attached with the device.
- The time required for drying raw cardamom capsules is less compared to the conventional method of drying.
- The drying process is less cumbersome for the operator and is less risky as the fuel feeding is required once in six hours and the temperature control is fully automated.

- The dryer is very operator friendly and requires less man power.
- The fuel efficiency is high as the fuel wastage is minimal.
- Due to the compact design, less plinth area is required for loading the dryer.
- Cost of fuel is much less compared to the conventional system of drying or electric dryers.

On a perusal of the above features of the modern cardamom dryer with the biomass gasifier technology, it can be seen that the dryers are more environment friendly, cost effective and user friendly. These dryers are more cost effective and fuel efficient compared to the other methods of conventional dryers as well as newly introduced electrical dryers. The answering respondents are using the modern cardamom dryers with the Biomass Gasifier Technology.

9) It is respectfully submitted that the Farm Machinery and Post-Harvest Machinery and Equipment Testing Centre, ICAR-CIAE regional centre Coimbatore, a Govt. of India undertaking is an approved agency for testing and issuing certificates to the farm machineries and equipments. A copy of the report no. PH 123/2021 in respect of the agricultural dryers-PECD500(Cardamom) manufactured by M/s Popular Engineering Works, Puliyanmala road, Parakadvu, Kattappana, Idukki District- 685508, Kerala is produced herewith and marked as Annexure R13(a). The answering respondents are using the dryers purchased from the empanelled manufactures of

the Spices Board of India, the Industries Department – State of Kerala and the Department of Agricultural Development and Farmers Welfare - State of Kerala. All these Government agencies are empanelling the manufactures of the farm machineries and equipments after conducting detailed enquiry and verifying the various certificates and documents including the report from the Farm Machinery and Post-Harvest Machinery and Equipment Testing Centre.

10) On a perusal of Exhibit R13(a) report, it can be seen that the modern cardamom dryers which are installed and operating by the Answering respondents are more scientific , fuel efficient, cost effective and less hazardous to human lives and environment compare to conventional dryer houses and newly introduced electric dryers.

11) That it is respectfully submitted that, the Spices Board of India, the Agriculture Development and Farmers Welfare Department of the Government of Kerala and Industrial department, Government of Kerala are giving subsidies for purchasing and installing the cardamom dryers with biomass gasifier technology from the empanelled manufactures. The answering respondents are using the cardamom dryers using the biomass gasifier technology purchased from the manufactures empanelled by the Spices Board of India or the Department of Agriculture and Department of Industries- Govt. of Kerala. All the Answering respondents and the similarly situated persons have been operating the dryers with the support and assistance of the Spices Board of India which is the agency mandated to deal with the development, both pre-harvest and post-harvest

activities of Small Indian Cardamom. Therefore there is no merit in the case of the petitioner that the Cardamom dryers are being operated unscientifically, causing pollution and contributing to global warming. On the other hand it can be seen from the preceding paragraphs that the cardamom dryers with Biomass Gacifier Technology are being manufactured, installed and operated scientifically taking into account of the parameters like fuel efficiency, abating environmental pollution , cost effectiveness etc.

12) That it is respectfully submitted that, the Statements and averments contained in paragraph 5 of the Original Application are false and hence denied. The Answering respondents and the similarly situated persons are cultivating Small Indian Cardamom. The big cardamom is not being grown in Idukki district as the species is endemic to the Sub Himalayan region of North Eastern India. There has been no practice of drying Small Indian Cardamom in sunlight or other methods as stated in the Original Application. Annexure A1 study published in the journal is in respect of the drying of large cardamom mainly grown in Sub Himalayan regions, which has no application in the case of Small Indian Cardamom which is being grown in the Western Ghats region and the agricultural practices are entirely distinct. The averments to the effect that the electric dryers are more cost effective and efficient is denied as contrary to truth. The electric driers are more costly - installation as well as operational coast wise - compared to the dryers with the biomass gasifier technology. Furthermore, due to the paucity of regular uninterrupted power supply the electric dryers are not feasible for the region. In the event of electric failure, diesel generators

have to be operated and which will lead to more environmental pollution. Therefore the attempt of the petitioner to promote the electric dryers is without any basis and only for the purpose of promoting the interest of the manufactures of the electric dryers who are believed to be behind the filing of the instant Original Application.

13) In reply to paragraphs 6,7&8 of the application, it is respectfully submitted that the dryers used by the petitioners are not causing water or air pollution as alleged. On the other hand, due to the scientific design of the dryers and the technology used therein, the air pollution is minimal well within the prescribed limits as per the National Ambient Air Quality Standards. Since the agro based fuel is being used in cardamom dryers the possible air pollutant from the dryer is particulate matter (PM10). The ambient air quality with respect to particulate matter was found to be 38.0034 micro gram per M^3 by an inspection conducted by the officials of the 3rd respondent Pollution Control Board in one of the units. This is well within the limit of 100 micro grams per M^3 as per the National Ambient Air Quality Standards. Since the modern dryers are scientifically designed and using the Biomas Gasifier Technology, the emission of smoke is very minimal and exhausted through a Chiminy there by abating the remote chances of health hazards due to the inhaling of smoke. All other averments contrary to this is unfounded and made with ulterior motives to protect the interest of the petitioner to promote the interest of the manufactures of the newly introduced electric dryers.

14) In reply to paragraph 9, it is respectfully submitted that the statement to the effect that plastic briquettes are used in the cardamom dryers is stoutly denied as contrary to truth. The answering respondents have never ever used plastic briquettes in their dryers. It is important to mention here that the plastic briquettes cannot be used as fuel in the cardamom dryers with Biomass Gasifier technology as it will cause damage to the dryer. Since dried bio waste, coconut shells, coconut husk, wood chips and wood based briquettes are the fuels used in the dryers, there is no scope for deforestation for collecting fuel for the dryers for drying the fresh cardamom. On the other hand the modern dryers are checking the possible chance of deforestation for collecting wood as fuel for the dryers for drying fresh cardamom. It is also not true to say that the dryers of the answering respondents are situated in thickly populated areas.

15) It is respectfully submitted that drying is an essential part of the agricultural process of producing the Small Indian Cardamom. Preserving the colour, aroma and flavour is very much essential to ensure the quality while drying the small cardamom. Even in the conventional system of drying the Small India Cardamom in the dryer houses, the green colour and aroma were being preserved. The preservation of green colour of the Small Indian Cardamom is very much essential for ensuring its marketability and fetching reasonable price. Therefore the drying of cardamom in a scientifically designed and developed dryer is an inevitable part of the agricultural production process of small Indian cardamom.

16) That is respectfully submitted the curing/drying of cardamom being an inevitable part of the agricultural process, it is not required to obtain licence from the Local Self Government Institutions as per section 233(B)(b) of the Kerala Panchayat Raj Act 1994 for the installation and establishment of a cardamom dryer unit. Section 233(B) (b) of the Kerala Panchayat Raj Act 1994 reads as follows:

"233B. Exemptions.- Notwithstanding anything contained in section 233, no permission of Village Panchayat shall be required for the installation of establishment of the following machinery or manufacturing plants or industrial units, as the case may be, namely:-

(a) xxx xxx xxx

(b) Electrical and non-electrical installation installed for agriculture purposes;"

As per this section, the electrical and non electrical installations installed for the agricultural purposes need not obtain a licence from the Local Self Government Institution to operate. Therefore some of the answering respondents did not obtain the licences from the local Self Government Institutions as it is not mandatory in view of section 233 B(b) of the Kerala Panchayat raj Act 1994. Similarly, since the drying units are operating as part of Agriculture processing of Small Indian Cardamom and not causing pollution, some of the answering respondents have

not obtained consent to operate from the 3rd respondent, the pollution Control Board on the bonafide belief that the consent of the Pollution Control Board was not mandatory.

17) That it is respectfully submitted that after having conducted inspections in the drying units of the answering respondents by the officials of the 3rd respondent Pollution Control Board, show cause notices were issued to the respondents who have not obtained the consent to operate. On receipt of the show cause notices so issued, the respondents who received such notices filed their reply along with an application for getting the consent to operate from the 4th respondent. All the answering respondents are entitled to get consent to operate from the Pollution Control Board as their dryers are installed and functioning fully in conformity with the provisions of the Act and Rules applicable to them.

18) It is respectfully submitted that, the answering respondents are law abiding citizens and having great regard and respect to the laws of the land. The answering respondents have never intended to operate their units in violation of the rules and regulation, if any, applicable. If this honourable Tribunal is found that the answering respondents need to obtain licence /consent from any competent agency, the respondents will act in accordance with the directions pleased to be issued by this Honourable Tribunal. There is no wilful latches or negligence on the part of the Answering respondents to follow or comply with any of the mandatory provisions of law as applicable to the dryer used for drying the fresh small cardamom harvested from the farms.

19) In view of the facts stated above, the Original Application is devoid of merits and liable to be dismissed by this Hon'ble Tribunal.

For these reasons and other reasons to be urged at the time of argument, it is humbly prayed that this Hon'ble Tribunal be pleased to dismiss the Original Application with orders of costs.

All the above stated facts are true to the best of my knowledge, information and belief.

Dated this the 15th day of September, 2023

Deponent

Solemnly affirmed and signed before me by the deponent, who is personally known to me on this the 15th day of September, 2023 in my office at Ernakulam

Joice George
Advocate

MANUFACTURER : M/s. Popular Engineering Works,
Puliyanmala Road,
Parakadavu, Kattappana,
Idukki (Dist)- 685 508,
Kerala.

APPLICANT : M/s. Popular Engineering Works,
Puliyanmala Road,
Parakadavu, Kattappana,
Idukki (Dist)- 685 508,
Kerala.

M/s. Popular Engineering Works
Agricultural Dryer-PECD-500 (Cardamom)

Report No.: PH-43/123/2021	Month: May	Year: 2021

सत्यमेव जयते
Government of India

भाकृअनुप
ICAR

FARM MACHINERY AND POST-HARVEST MACHINERY & EQUIPMENT TESTING CENTRE
ICAR - CENTRAL INSTITUTE OF AGRICULTURAL ENGINEERING
REGIONAL CENTRE, COIMBATORE - 641 007, TAMIL NADU
(An ISO 9001:2015 Certified Institute)
Telephone: 0422 2472624

Type of test	Commercial		
Name of the machine	Agricultural Dryer-PECD-500 (Cardamom)		
Test Code referred	IS 8108 (Part 1) (1984)	:	Test Code for Grain Dryers- Part-1 Selection and Preparation for Test
	IS 8108 (Part 3) (1985)	:	Test Code for Grain Dryers- Part-3 Methods of Tests for In-Silo Dryers
	IS 8420 (2000)	:	Grain Dryers- Glossary of Terms
	IS 9555 (1999)	:	Rice Polisher
Test requested by	M/s. Popular Engineering Works, Puliyanmala Road, Parakadavu, Kattappana, Idukki (Dist)- 685 508, Kerala.		
Testing Authority	Farm Machinery and Post-Harvest Machinery & Equipment Testing Centre ICAR-Central Institute of Agricultural Engineering Regional Centre, Coimbatore - 641 007, Tamil Nadu.		
Period of test	February, 2021		

1. This Test Report should not be reproduced in part or full without prior permission of the Testing Authority, Farm Machinery and Post-Harvest machinery & Equipment Testing Centre, ICAR-Central Institute of Agricultural Engineering, Regional Centre, Coimbatore - 641 007. Tamil Nadu.
2. The data given in the Test Report pertain to particular machine submitted for test by the applicant.
3. The data collected during the test do not in any way attribute to the durability of the machine.
4. The results reported in this report are observed values and no corrections have been applied for atmospheric and site conditions.
5. **This report is valid till 12/May/2028** as per OM 13-24/2018-M&T(I&P) dt 19.9.18.

SELECTED CONVERSIONS

S. No.	Units	Conversion factor
1	Force	
	1 kgf	9.80665 N
		2.20462 lbf
2	Power	
	1 hp	1.01387 metric hp (Ps)
		745.7 W
	1Ps	735.5 W
	1 kW	1.35962 Ps
3	Pressure	
	1 psi	6.895 kPa
	1 kgf/cm^2	98.067 kPa=735.55 mm of Hg
	1 bar	100 kPa/10 N/cm^2
	1 mm of Hg	1.3332 m bar

CONTENTS

1. SCOPE OF TEST

To check and assess the following.

1.3. LABORATORY TEST

- Checking of specifications
- Wear analysis of critical components
- Hardness of materials
- Chemical analysis of materials

1.2. FIELD TEST

- Rate of work
- Quality of work
- Ease of operations and adjustments
- Labour requirement
- Defects, Breakdowns and Repairs

2. TEST PROCEDURE

The sample was tested as per the procedure described in the test codes.

3. METHOD OF SELECTION

The machine was submitted by the manufacturer for testing. Exemption from random selection of test samples as per office orders OM 13-13/2020-M&T (I&P) dt 24.04.2020 and OM 13-13/2020-M&T (I&P) dt 10.09.2020 from M&T Division, DAC&FW, Ministry of Agriculture and Farmers Welfare, New Delhi.

4. SPECIFICATIONS

4.1. GENERAL		
Name of manufacturer	:	M/s. Popular Engineering Works, Puliyanmala Road, Parakadavu, Kattappana, Idukki (Dist)- 685 508, Kerala.
Email	:	populardryers@gmail.com
Telephone	:	+91 4868 252278/ +91 96051 85391
Name of Machine/Equipment	:	Agricultural Dryer (Cardamom)
Type	:	Power operated
Source of heat	:	Wood & Biomass briquette
Make	:	M/s. Popular Engineering Works
Model & S. No.	:	PECD-500 & CD-2019-12
Year of manufacture	:	2020
Dryer dimension (L×W×H), mm	:	3650 × 3057 × 2059
Furnace dimension (L×W×H), mm	:	2454 × 1603 × 2100

Drying capacity, kg/batch	:	500 (as specified by manufacturer)
Weight of the Machine, kg	:	1400
Colour of the dryer	:	Green with white
Colour of the fire chamber		Black with red
4.2 POWER UNIT		
4.2.1 Dryer Blower Motor		
Provision & Type	:	Electrically/ Power/ Motor operated & Direct coupling
Type of prime mover	:	Electrically operated 2 hp AC induction motor with capacitor starter
Motor power, hp	:	2
Motor phase	:	Single phase
Type of drive	:	Direct coupling with motor
4.2.2 Furnace Blower Motor		
Provision & Type	:	Electrically/ Power/ Motor operated & Direct coupling
Type of prime mover	:	Electrically operated 1 hp AC induction motor with capacitor starter
Motor power, hp	:	1
Motor phase	:	Single phase
Type of drive	:	Direct coupling with motor

4.3 MAIN PARTS OF AGRICULTURAL DRYER

4.3.1 Drying Unit		
Dryer chamber size (L×W×H), mm	:	1665×1660×475
Dryer top cover fixing sheets size (L×W), mm	:	1580×730
Dryer top cover fixing frame size (L×W×T), mm	:	1695×1680
Dryer top cover inspection window size (L×W), mm	:	300×193
Dryer chamber fixing sheets size (L×W), mm	:	1650×590
Dryer chamber fixing corner frame size (L×W×H), mm	:	510×100×100
Dryer chamber fixing frame size (L×W), mm	:	1665×1665
Dryer chamber inspection glass window size (L×W×T), mm	:	280×165×5
Dryer bottom cover fixing sheets size (L×W), mm	:	1595×715
Dryer bottom cover inspection window size (L×W), mm	:	540×345
Dryer bottom sheet size (L×W), mm	:	885×885

Dryer legs length, mm		:	730
Dryer legs chamber fixing side size (L×W), mm		:	180×180
Dryer legs floor resting side size (L×W), mm		:	90×90
Thickness of dryer sheet material, mm		:	1.8
Dryer top cover sliding roller size (D×W), mm		:	50×40
Dryer top cover sliding pipe size (D×L), mm		:	41.5×1980
Dryer control panel box size (L×W×H), mm		:	320×200×400
Dryer exhaust duct size (L×W×H), mm		:	2060×400×400
Dryer exhaust duct closing sheet size (L×W), mm		:	380×380
Dryer exhaust duct resting frame size (L×W), mm		:	1320×463
Thickness of exhaust duct sheet material, mm		:	0.9
Dryer chamber floor wire mesh size, mm	Aperture size	:	4.4×4.4
	Wire diameter	:	0.8
Dryer chamber floor wire mesh grill frame (L×W), mm		:	1590×1590
Dryer exhaust recirculation duct size (L×W×H), mm		:	1400×300×300
Dryer exhaust recirculation duct closing sheet size (L×W), mm		:	367×295
Construction details		:	Dryer unit is made up of MS sheet (1.8 mm thickness). Top, bottom and chamber sheets are fixed to form a diamond shaped structure mounted on MS sheet legs. The dryer chamber floor is fixed with grill frame made up of MS flat (40×6 mm) covered by MS wire mesh. Top cover is fixed on a frame made of MS sheet (2.5 mm thickness). It tightly seals the dryer chamber with the box frame made up of MS 'L' (40×40×2.5 mm). Top cover of dryer is a slide opening type provided with bearings and rollers for easy opening and closing. Dryer exhaust is connected with duct made up of GI (Galvanized Iron) sheet (0.9 mm thickness) which is mounted on the frame made up of MS square (50×50×1.5 mm) pipe. Dryer exhaust duct is fixed with air recirculation duct for reuse of hot air for higher thermal efficiency. Dryer comprises of control panel box with temperature and

		air supply control systems. Dryer is provided with inspection windows for supervision during operation.
4.3.2 Dryer Blower		
Blower casing size (D×W), mm	:	940×355
Impeller size (D×W), mm	:	500×254
Blower suction chute size (L×W×H), mm	:	260×405×405
Blower suction chute inspection window size (L×W), mm	:	285×175
Blower outlet opening size (L×W), mm	:	355×355
Thickness of sheet material, mm	:	2.3
Blower frame size (L×W×H), mm	:	610×400×560
Construction details	:	Dryer blower made of MS sheet (2.3 mm thickness) receives heated air from the furnace and delivers it to the dryer box from the bottom (Plenum chamber). Blower uses 2 hp electric motor directly coupled with an impeller. Blower frame made up of MS 'L' angle (35×35×5 mm) is welded to form a rectangle frame.
4.3.3 Furnace Blower		
Blower casing size (D×W), mm	:	360×80
Thickness of casing, mm	:	8
Impeller fan size (L×W), mm	:	119.2×55.6
Overall impeller diameter, mm	:	310
No. of fan blade	:	6
Thickness of fan blade, mm	:	5.2
Air supplying pipe diameter, mm	:	74.2
Briquette firing air supplying pipe diameter, mm	:	58.3
Air supply diversion connector size (L×W), mm	:	200×80
Air supply diversion control sheet size (L×W×T), mm	:	140×71×2.5
Blower base frame size (L×W×T), mm	:	285×255×21.5
Construction details	:	Furnace blower is made up of Aluminium casting which supplies the air to be heated to the furnace. Blower uses 1 hp electric motor directly coupled with an impeller. Air supply can be directed to both wood firing /briquette firing, wherever necessary.

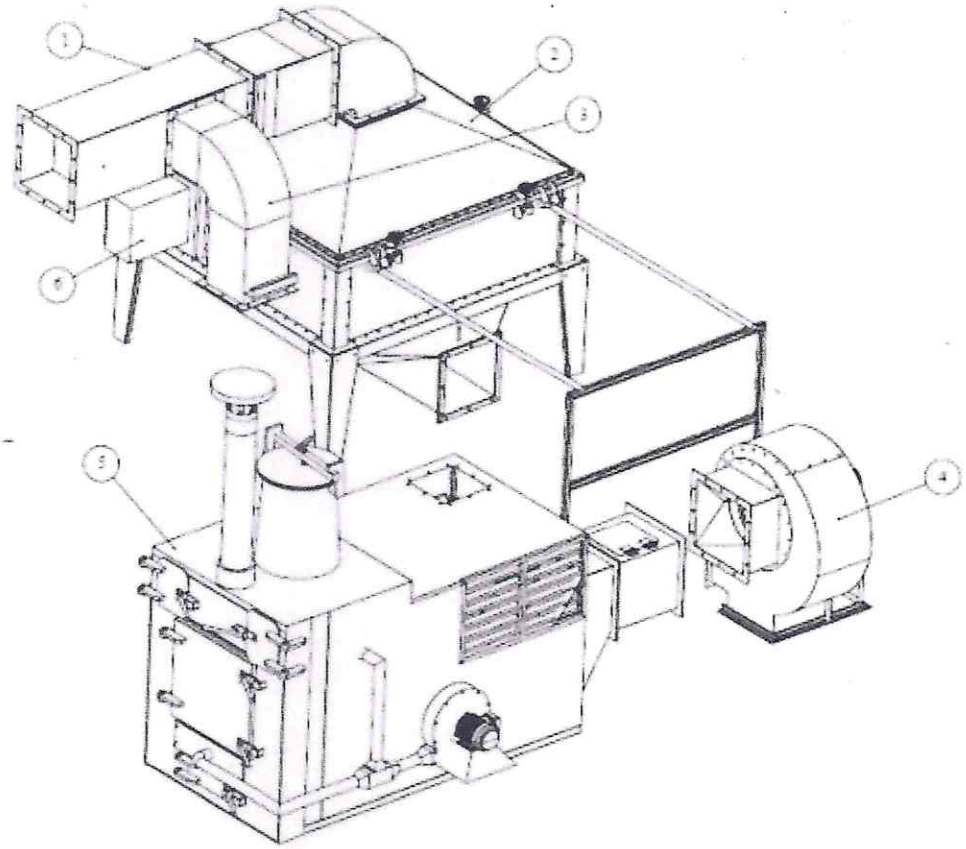
4.3.4 Furnace		
Wood loading opening size (L×W), mm	:	415×405
Wood loading door size (L×W×T), mm	:	634×585×6
Wood door handle size (D×L), mm	:	20×225
Firing pit size (L×W), mm	:	865×320
Firing tunnel size (D×L), mm	:	610×760
Firing tunnel wall thickness, mm	:	8
Firing wood grill size (L×W), mm	:	885×305
Air supplying pipe size (D×L), mm	:	60.5×900
Air supplying pipe hole diameter, mm	:	12
No. of holes	:	13
Smoke pipe diameter, mm	:	155
Smoke pipe inspection door size (L×W×T), mm	:	295×250×6
Ash pit opening size (L×W), mm	:	315×130
Ash pit size (L×W×H), mm	:	845×130×250
Ash pit opening door size (L×W×T), mm	:	380×172×6
Smoke exhaust chimney size (D×L), mm	:	165×570
Smoke distributing cone size (D×H), mm	:	477×90
Biomass briquette loading tunnel size (D×L), mm	:	385×1000
Briquette firing grill size (L×W), mm	:	175×175
Briquette firing tunnel closing cover size (D×T), mm	:	410×32
Heated air outlet chute size (L×W×H), mm	:	260×405×405
Furnace front plate thickness, mm	:	6
Furnace frame size (L×W×H), mm	:	2400×1205×1990
Furnace cover sheet thickness, mm	:	0.9
Construction details	:	Furnace front plate, doors and firing tunnel, chimney, and biomass briquette loading tunnel are made up of MS. Front plate (6 mm thickness) comprises of openings for wood loading , ash pit opening and smoke pipe inspection openings welded with the firing tunnel (8 mm thickness) and firing pit walls. Air supplied from blower reaches bottom from a GI pipe. Wood firing ash grill is made up of MS 'L' angle (35×35×5 mm). Briquette ash grill is made up of MS square (25×25 mm) rod. Supplied air gets heated up in the firing tunnel and reaches

		the dryer blower. Furnace frame is made up of GI square (25×25×1 mm) pipe and MS 'L' angle (35×35×5 mm) welded to form a rectangular frame. Furnace frame is fully covered by GI sheet (0.9 mm thickness).
4.3.5 Overall dimension of Dryer		
Length, mm	:	3680
Width, mm	:	3190
Height, mm	:	2085
4.3.6 Overall Dimensions of Furnace		
Length, mm	:	2485
Width, mm	:	1600
Height, mm	:	2100
4.3.7 Other Items		
Bearing type	:	6205
No. of bearings	:	2

5. CONFORMITY TO INDIAN STANDARDS

Clause	Requirements as per IS 9555 (1999)	Observations	Remarks
5.1	**MARKING AND PACKING**		
5.1.1	**Marking:** Each polisher shall be marked with the following particulars		
	a) Manufacturer's name and his recognized trade-mark, if any.	Marked	Conforms
	b) Batch or code number.	Marked	Conforms
	c) Power rating and capacity.	Marked	Conforms
	d) Model No.	Marked	Conforms
	e) Year of manufacturing.	Marked	Conforms
	f) Direction of rotating parts and rated speed.	Marked	Conforms
5.1.2	A minimum cautionary notice worded as follows shall be-written in *vernacular* language legibly and prominently on the main body of the machine:		
	a) Do not wear loose dress, bangles, watch etc., while working.	Written	Conforms
	b) Do not work under the influence of intoxicants like liquor, opium etc.	Written	Conforms
	c) Children and aged persons should be discouraged for working on the machine.	Written	Conforms
	d) Do not operate machine without guards and safety devices.	Written	Conforms

6. MACHINE DRAWING



1.Dryer exhaust air duct; 2.Dryer chamber; 3.Exhaust air recirculation duct; 4.Dryer blower; 5.Furnace; 6.Control panel

Fig.1. Agricultural Dryer-PECD-500 (Cardamom)

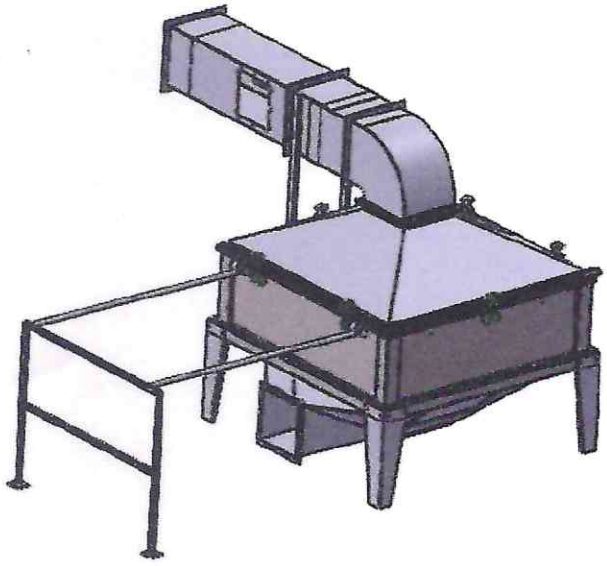
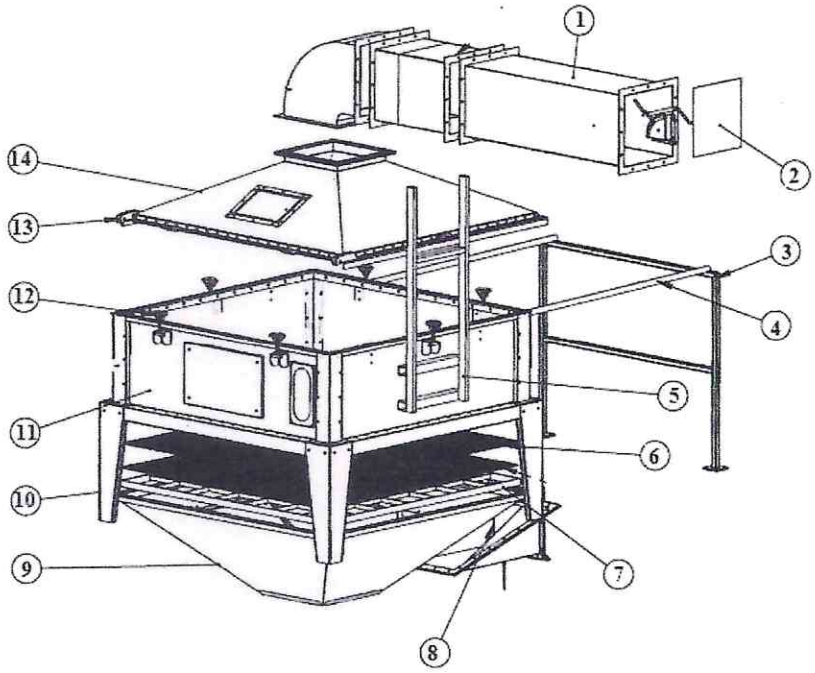
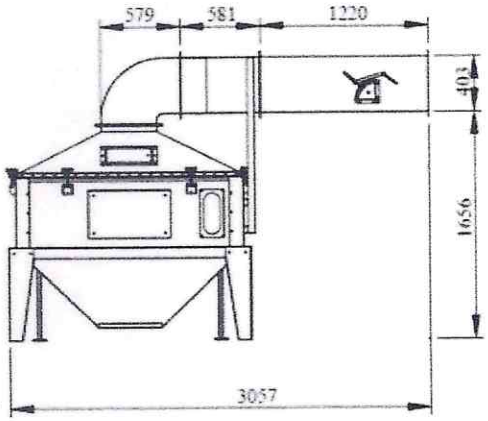


Fig.2. Drying Unit of Agricultural Dryer (Cardamom)



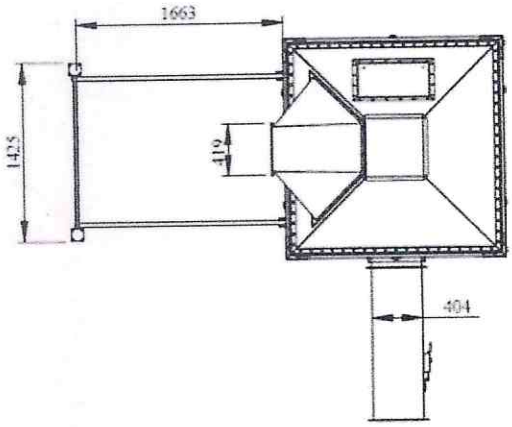
1.Exhaust air outlet duct; 2.Outlet duct closing sheet; 3.Top cover resting frame; 4.Top cover sliding pipe; 5.Outlet duct resting frame; 6.Dryer chamber floor wire mesh sheet; 7.Dryer chamber grill frame; 8.Dryer blower connecting chute; 9.Dryer bottom cover; 10.Dryer leg; 11.Dryer chamber; 12. Dryer chamber frame; 13.Top cover sliding roller;14.Dryer top cover

Fig.3. Exploded view of Drying Unit



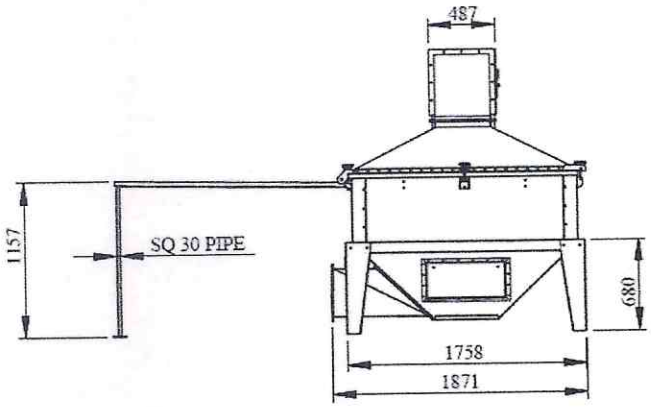
All dimensions in mm

Fig.4. Front view of Drying Unit



All dimensions in mm

Fig.5. Top view of Drying Unit



All dimensions in mm

Fig.6. Side view of Drying Unit

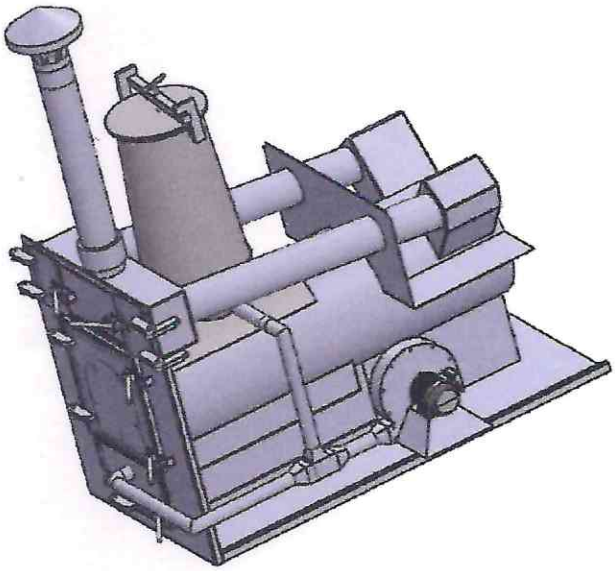
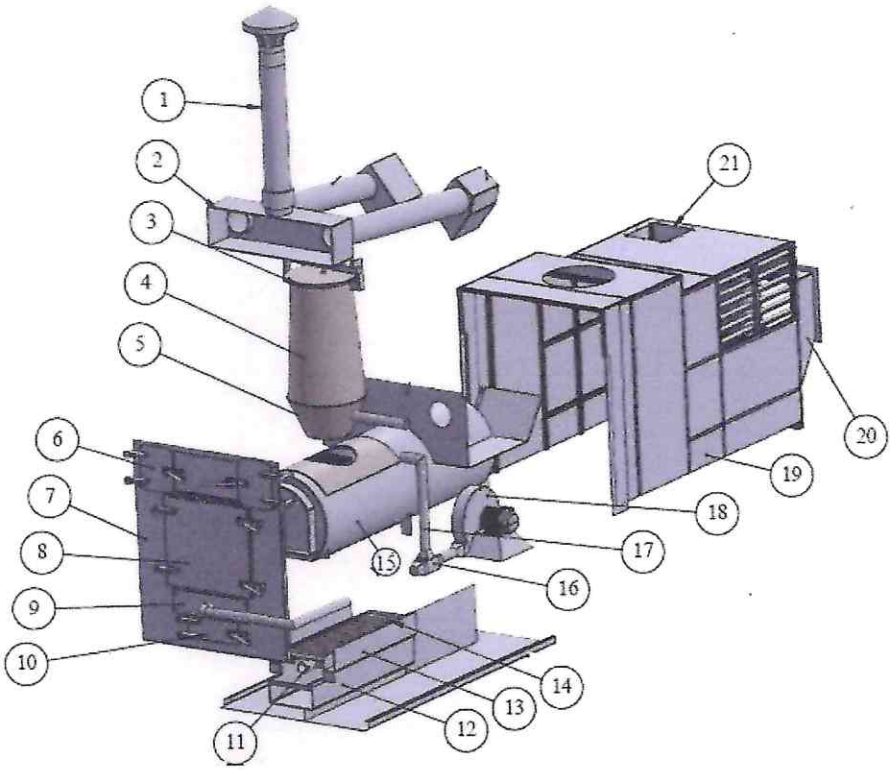
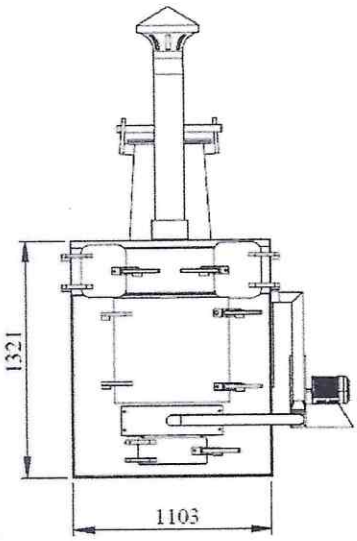


Fig.7. Furnace of Agricultural Dryer (Cardamom)



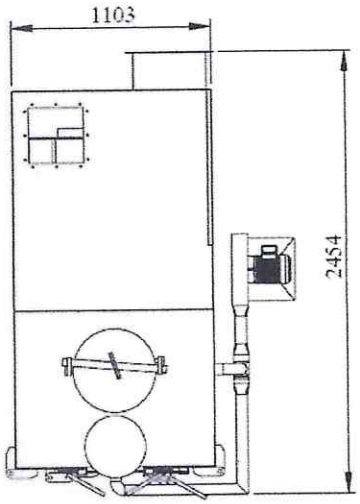
1.Exhaust smoke chimney; 2.Smoke pipes connector; 3.Briquette loader closing plate; 4.Briquette loading tunnel; 5.Briquette firing zone; 6.Smoke pipe inspection door; 7.Furnace front plate; 8.Firing tunnel door; 9.Air supplying pipe door; 10.Ash pit door; 11.Air supplying pipe; 12. Ash pit; 13.Firing side wall; 14.Firing wood grill; 15.Firing tunnel; 16.Air diversion connector; 17.Briquette firing air supplying pipe; 18.Furnace blower; 19.Furnace frame; 20. Dryer blower connecting chute; 21.Exhaust air recirculation opening

Fig.8. Exploded view of Furnace



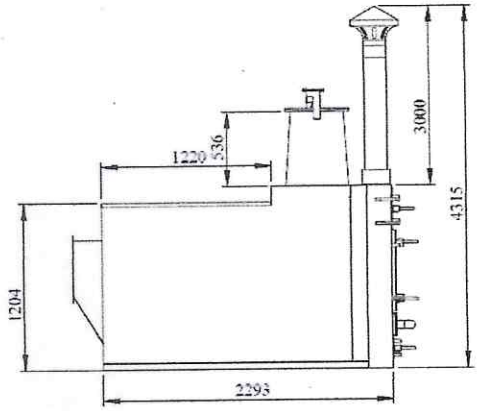
All dimensions in mm

Fig.9. Front view of Furnace



All dimensions in mm

Fig.10. Top view of Furnace



All dimensions in mm

Fig.11. Side view of Furnace

7. LABORATORY TEST

7.1 HARDNESS TEST

Table 1. Results of hardness test of different parts of Agricultural Dryer– PECD-500 (Cardamom)

S.No	Part of Agricultural Dryer	Hardness as observed	Material of construction
1	Dryer chamber/ Top cover/ Bottom cover sheet	128.8-141.7 HV (MICRO VICKERS HARDNESS)	Mild steel
2	Dryer top cover/ chamber frame	154.3-159.2 HV (MICRO VICKERS HARDNESS)	Mild steel
3	Dryer chamber floor grill frame	87.7-91.5 HRB	Mild steel

4	Dryer blower impeller sheet	125.2-126.6 HV (MICRO VICKERS HARDNESS)	Mild steel
5	Furnace cover sheet/ Exhaust duct sheet	108.6-112.8 HV (MICRO VICKERS HARDNESS)	Galvanized iron
6	Furnace frame	142.3-150.6 HV (MICRO VICKERS HARDNESS)	Galvanized iron
7	Firing tunnel sheet	87.5-90.3 HRB	Mild steel
8	Furnace front plate	85.3-88.2 HRB	Mild steel
9	Furnace doors plate	84.2-87.8 HRB	Mild steel
10	Briquette grill	90.0-92.0 HRB	Mild steel
11	Firing wood grill	94.3-96.6 HRB	Mild steel

7.2 CHEMICAL COMPOSITION

Table 2. The chemical composition of different parts of Agricultural Dryer-PECD-500 (Cardamom)

S.No	Part of Agricultural Dryer	Chemical composition	% by weight	Material of construction
1	Dryer chamber/ Top cover/ Bottom cover sheet	Carbon (C) Silicon (Si) Manganese (Mn) Phosphorous (P) Sulphur (S) Carbon Equivalent (CE)	0.061 0.114 0.555 0.027 0.004 0.184	Mild steel
2	Dryer top cover/ chamber frame	Carbon (C) Silicon (Si) Manganese (Mn) Phosphorous (P) Sulphur (S) Carbon Equivalent (CE)	0.148 0.142 0.573 0.015 0.009 0.270	Mild steel
3	Dryer chamber floor grill frame	Carbon (C) Silicon (Si) Manganese (Mn) Phosphorous (P) Sulphur (S)	0.166 0.223 0.542 0.057 0.036	Mild steel
4	Dryer blower impeller sheet	Carbon (C) Silicon (Si) Manganese (Mn) Phosphorous (P) Sulphur (S)	0.031 0.072 0.181 0.014 0.005	Mild steel
5	Furnace cover sheet/ Exhaust duct sheet	Carbon (C) Silicon (Si) Manganese (Mn) Phosphorous (P)	0.039 0.073 0.193 0.017	Galvanized iron

		Sulphur (S)	0.006	
6	Furnace frame	Carbon (C) Silicon (Si) Manganese (Mn) Phosphorous (P) Sulphur (S)	0.076 0.087 0.179 0.006 0.007	Galvanized iron
7	Firing tunnel sheet	Carbon (C) Silicon (Si) Manganese (Mn) Phosphorous (P) Sulphur (S) Carbon Equivalent (CE)	0.135 0.141 0.577 0.017 0.011 0.258	Mild steel
8	Furnace front plate	Carbon (C) Silicon (Si) Manganese (Mn) Phosphorous (P) Sulphur (S) Carbon Equivalent (CE)	0.119 0.109 0.534 0.017 0.005 0.233	Mild steel
9	Furnace doors plate	Carbon (C) Silicon (Si) Manganese (Mn) Phosphorous (P) Sulphur (S) Carbon Equivalent (CE)	0.064 0.128 0.778 0.016 0.004 0.222	Mild steel
10	Briquette grill	Carbon (C) Silicon (Si) Manganese (Mn) Phosphorous (P) Sulphur (S)	0.230 0.252 0.643 0.071 0.051	Mild steel
11	Firing wood grill	Carbon (C) Silicon (Si) Manganese (Mn) Phosphorous (P) Sulphur (S)	0.096 0.119 0.375 0.071 0.040	Mild steel

8. PERFORMANCE TEST

The Agricultural Dryer (Cardamom) was operated for 22 hours. Out of 22 hours, machine was operated continuously for 5 hours at no-load condition, during the beginning of the test. Same machine was used and operated for drying cardamom for 17 hours. Wood is used for heating air in the furnace, used for drying. All these test runs were carried out to assess the performance of the machine regarding its drying rate, thermal efficiency, coefficient of performance, heat utilisation factor, power consumption, fuel consumption and soundness of construction. The summary of the performance test is given in the following Tables:

8.1 NO-LOAD CONDITION

Table 4. Summary of Performance Test at No-Load Condition

(Details given in Annexure II)

S.No	Parameters		Observation
1	Total time of operation, h		5
2	Power consumption, kWh		2.07
3	Fuel consumption, kg/h		11.8
4	Speed of furnace blower motor, rpm		2880
5	Speed of dryer blower motor, rpm		1440
6	Outlet air velocity from firing chamber, m/s		13.2
7	Outlet air velocity of dryer exhaust, m/s		20.3
8	Average sound/noise level of machine during operation, dB	Max Min	65.4 63.1

8.2 *LOAD CONDITION*

Table 5. Summary of Performance Test at Load Condition

(Details given in Annexure III)

S.No	Parameters		Observation
1	Total time of operation, h		17
2	Power consumption, kWh		2.27
3	Speed of furnace blower motor, rpm		2880
4	Speed of dryer blower motor, rpm		1440
5	Outlet air velocity from firing chamber, m/s		10.5
6	Outlet air velocity of dryer exhaust, m/s		7.6
7	Average sound/noise level of machine during operation, dB	Max Min	71.9 68.7
8	Feed per batch, kg		500
9	Initial moisture content (mc), % wb		82.6-84.0
10	Final moisture content (mc), % wb		2.91-3.50
11	Total fuel consumption, kg/batch (Wood)		230.5
12	Thermal efficiency, %		38.23
13	Coefficient of performance (COP)		0.42
14	Heat utilisation factor (HUF)		0.58
15	Dried cardamom output, kg/batch		92
16	Drying rate, kg/h		0.36-0.41
17	Ambient Air Conditions i) Temperature, °C ii) Relative Humidity, %		 25.0-32.5 46-70
18	Temperature readings of inlet air and inside dryer at different time		
	i) Time, h		0-17
	ii) Inlet hot air temperature, °C		34-76
	iii) Air temperature inside dryer, °C		26.9-75
	iv) Dryer exhaust air temperature, °C		25.4-56.1

8.3 DRYING CAPACITY OF MACHINE

Dryer input capacity is found to be 500 kg per batch.

8.4 QUALITY OF WORK

Quality of work is determined by drying rate, thermal efficiency, coefficient of performance, heat utilisation factor, power consumption, fuel consumption and soundness of construction. Drying rate was found to be 0.36 to 0.41 kg/h. Thermal efficiency of the machine is observed as 38.23%. The coefficient of performance was observed as 0.42 and heat utilisation factor was found to be 0.58. The total fuel consumption is observed as 230.5 kg of wood per batch and power consumption is found to be 2.27 kWh.

8.5 LABOUR REQUIREMENT

Two labourers cum skilled operators are required for the continuous operation of the machine.

9. EASE OF OPERATION, ADJUSTMENTS AND SAFETY

The Agricultural Dryer (Cardamom) was easy to operate and no problem was observed in handling the machine during the operation. Guards and safety covers are provided on all rotating parts.

10. DEFECTS, BREAKDOWN AND REPAIRS

The Agricultural Dryer (Cardamom) was operated for 17 hours long run tests continuously to assess the performance of the machine. No breakdown occurred during the long run tests. There were no defects and repairs during the test.

11. SUMMARY OF OBSERVATIONS, COMMENTS AND RECOMMENDATIONS

11.1 Dryer input capacity was observed as 500 kg per batch.

11.2 Drying rate is found to be 0.36-0.41 kg/h.

11.3 The thermal efficiency of the machine is observed as 38.23%.

11.4 The coefficient of performance was observed as 0.42 and heat utilization factor was found to be 0.58

11.5 Total fuel consumption is observed as 230.5 kg/batch of wood and power consumption is found to be 2.27 kWh.

11.6 Adequacy of Literature: The manufacturer has provided Operator's manual and Service manual to users in English.

Date of Mailing to Director, SRFMTTI, Tractor Nagar, Garladinne, Ananthapur, AP	**05.05.2021**
Remarks received, if any	**Nil**

TESTING AUTHORITY

Dr.R.H.Sadvatha	Scientist & Test Engineer	12/5/2021 Scientist & Test Engineer Farm Machinery and Post Harvest Machinery & Equipment Testing Centre ICAR - CIAE, Regional Centre Coimbatore - 641 007
Dr.Ravindra Naik	Principal Scientist & Senior Test Engineer	12/05/2021 Principal Scientist & Senior Test Engineer Farm Machinery and Post Harvest Machinery & Equipment Testing Centre ICAR - CIAE, Regional Centre Coimbatore - 641 007
Dr.T.Senthilkumar	Principal Scientist & Testing Authority	12/05/2021 Dr.T.Senthilkumar Principal Scientist & Incharge Farm Machinery and Post Harvest Machinery & Equipment Testing Centre ICAR - CIAE, Regional Centre Coimbatore - 641 007
Dr.S.Balasubramanian	Head (I/c) ICAR – CIAE Regional Centre Coimbatore	12/5/21 प्रभारी / Head केन्द्रीय कृषि अभियांत्रिकी संस्थान (भा.कृ.अ.प.) आंचलिक केंद्र, कोयम्बत्तूर - 641 007 ICAR - CENTRAL INSTITUTE OF AGRICULTURAL ENGINEERING REGIONAL CENTRE Sugarcane Breeding Institute Post Veerapanam Road, Coimbatore - 641 007

12. APPLICANT'S COMMENTS

Satisfied with the report.

ICAR - CIAE FMPHTC CBE-07

13. ANNEXURE-I

Views of Equipment and Various Components

Fig.12. Agricultural Dryer-PECD-500 (Cardamom)

Fig.13. Drying Unit

Fig.14. Dryer chamber

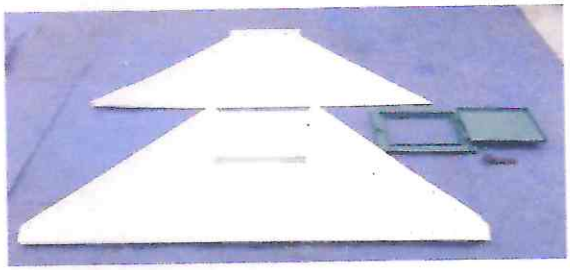


Fig.15. Dryer top cover sheets

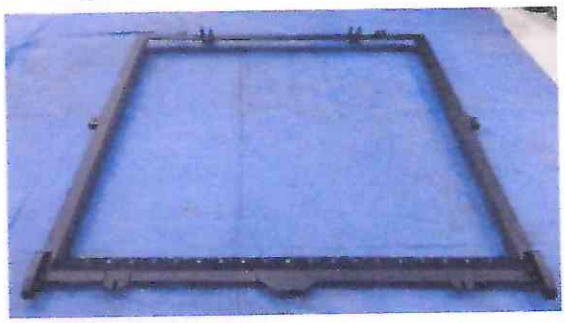


Fig.16. Dryer top cover sliding frame

Fig.17. Dryer chamber sheets

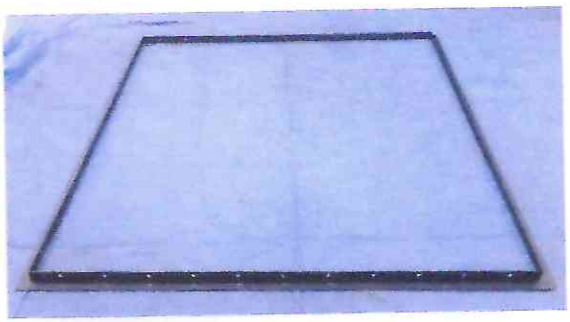


Fig.18. Dryer chamber frame

Fig.19. Dryer bottom cover sheets

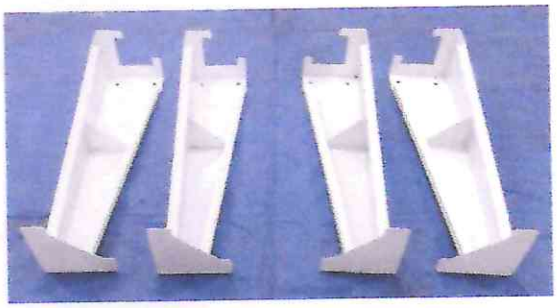


Fig.20. Dryer legs

Fig.21. Dryer chamber wire mesh

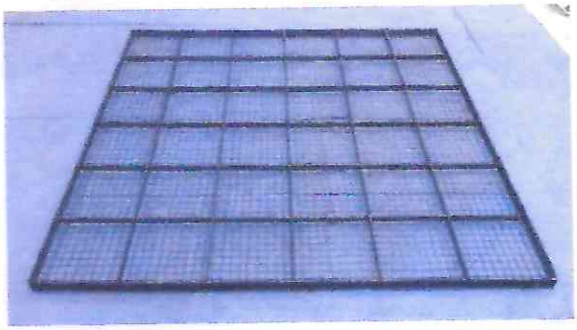


Fig.22. Dryer chamber wire mesh grill frame

Fig.23. Dryer exhaust duct assembly

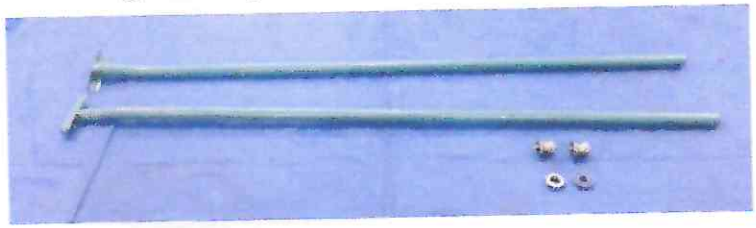


Fig.24. Dryer top cover sliding pipe and rollers

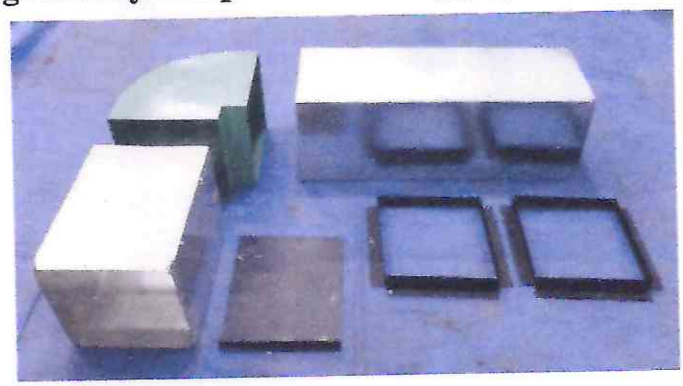


Fig.25. Dryer exhaust air recirculation duct

Fig.26. Control panel

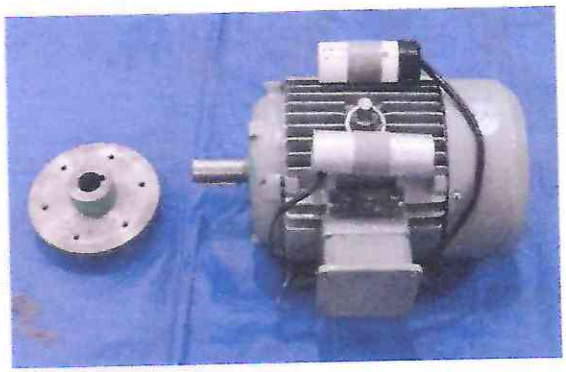


Fig.27. Dryer blower electric motor (2 Hp)

Fig.28. Dryer blower assembly

Fig.29. Furnace

Fig.30. Furnace blower electric motor (1 Hp)

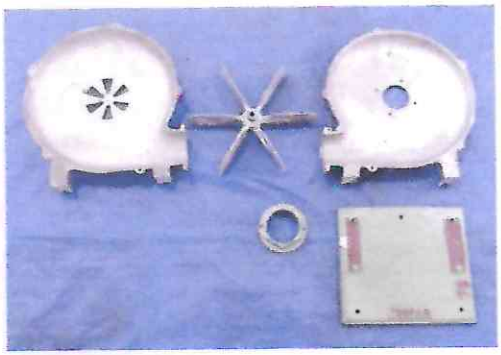


Fig.31. Furnace blower assembly

Fig.32. Furnace air supplying pipes

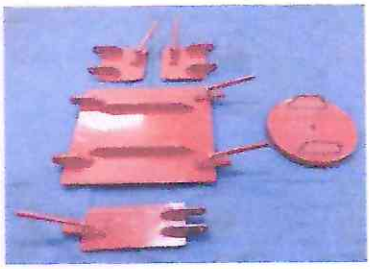


Fig.33. Furnace doors

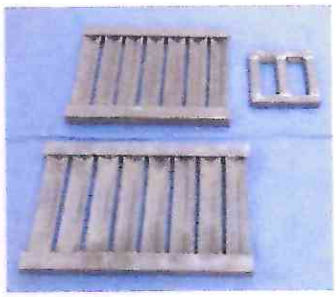


Fig.34. Wood grill & Briquette grill plates

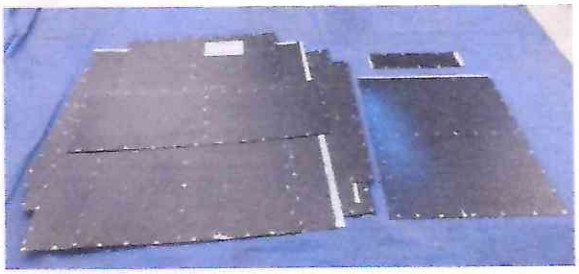


Fig.35. Furnace cover sheets

Fig.36. Smoke exhaust chimney

Fig.37. Furnace frame front view

Fig.38. Furnace frame side view

14. ANNEXURE–II

Datasheet on No-Load Condition- Agricultural Dryer-PECD-500 (Cardamom

Agricultural Dryer-PECD-500 (Cardamom)- No-Load Condition							
Parameters		**Test trials (h)**					
		1st	**2nd**	**3rd**	**4th**	**5th**	**Average**
Furnace outlet air temperature, °C		45	51	54	54	58	52.4
Temperature inside dryer box, °C		44	50	55	55	55	51.8
Dryer outlet air velocity, m/s		20.6	20.4	20.3	20.1	20.2	20.3
Furnace outlet air velocity, m/s		13.3	13	13.3	13.2	13.3	13.2
Power consumption, kWh		2.15	2.00	2.10	1.95	2.15	2.07
Fuel consumption (Wood), kg/h		11.8					11.8
Sound/ Noise level during operation of the dryer, dB	Max	65.6	65.8	65.4	65.0	65.1	65.4
	Min	63.1	63.3	63.0	63.0	63.2	63.1

15. ANNEXURE-III

15.1. Datasheet on Load Conditions – Agricultural Dryer-PECD-500 (Cardamom)

Time, hrs	Temp set at control unit, °C	Weight of samples, g			Dryer chamber air		Furnace outlet air		Dryer outlet air		Ambient air		Air velocity, m/s		Sound/Noise level during operation of the dryer, dB	
		Sample-45 (Bottom)	Sample-66 (Middle)	Sample-116 (Top)	Temp, °C	RH, %	Temp, °C (t2)	RH, %	Temp, °C (t3)	RH, %	Temp, °C (t1)	RH, %	Dryer outlet	Heating chamber outlet	Max	Min
0	47	600	600	610	26.9	54	34	53	25.3	87	26.9	55	8.2	11.1	68.2	65.6
1		560	600	610	47	84	48	31	25.4	86	27.0	53	8.2	10.6	69.4	66.6
2		490	580	605	47	85	49	30	28.5	88	27.0	52	8.3	10.6	70.0	67.1
3		435	555	585	47	83	47	30	28.0	95	27.1	50	8.2	10.5	70.1	67.9
5	49	325	435	525	49	84	49	29	28.4	86	27.5	49	8.4	10.2	71.2	67.2
7		240	330	450	49	62	49	28	35.4	51	31.0	48	8.5	11.1	70.6	67.1
9	51	180	240	335	51	61	52	23	38.1	45	31.5	46	8.7	10.0	71.0	67.5
11		145	190	245	53	50	54	14	43.5	34	32.5	46	9.9	10.3	71.1	67.4
13	53	125	160	195	53	31	53	12	42.3	34	25.0	70	10.3	10.2	71.0	67.0
15	57	115	145	170	57	24	56	11	47.0	24	26.0	68	9.3	10.4	72.1	67.3
16	60-65	95	125	140	65	18	66	11	56.1	18	27.0	63	1.8	10.6	79.0	76.9
17	75-78	95	125	140	75	16	76	11	55.5	17	27.0	63	1.6	10.7	79.1	76.8
Average													7.6	10.5	71.9	68.7

15.2. Calculation on Drying Rate

Time, h	% M.C (wb)	% M.C (db)	Drying rate, kg/ h
1	83.37	501.5	23.55
3	81.48	439.9	20.53
5	77.56	345.7	18.84
7	70.48	238.8	15.27
9	58.81	142.8	10.67
11	44.24	79.4	5.76
13	30.13	43.1	2.79
15	20.00	25.0	1.21
16	8.91	9.8	0.95
17	3.50	3.6	0.36

15.3. Cardamom Drying Rate

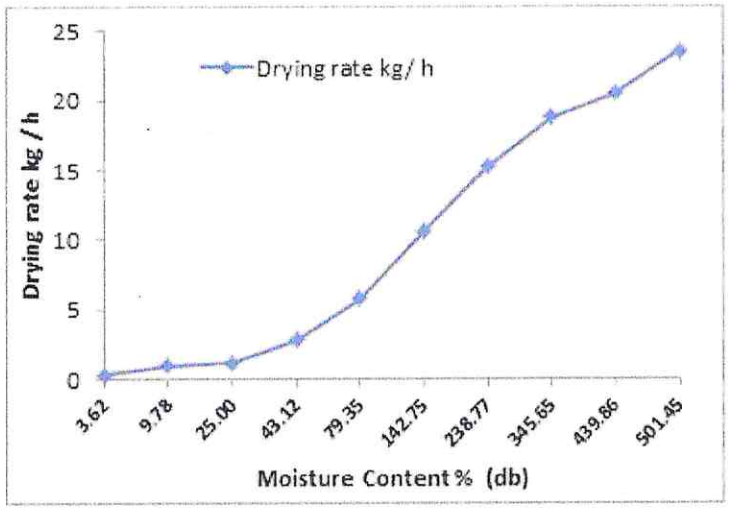


Fig.39. Drying rate of cardamom

15.4. Drying Characteristics of Cardamom

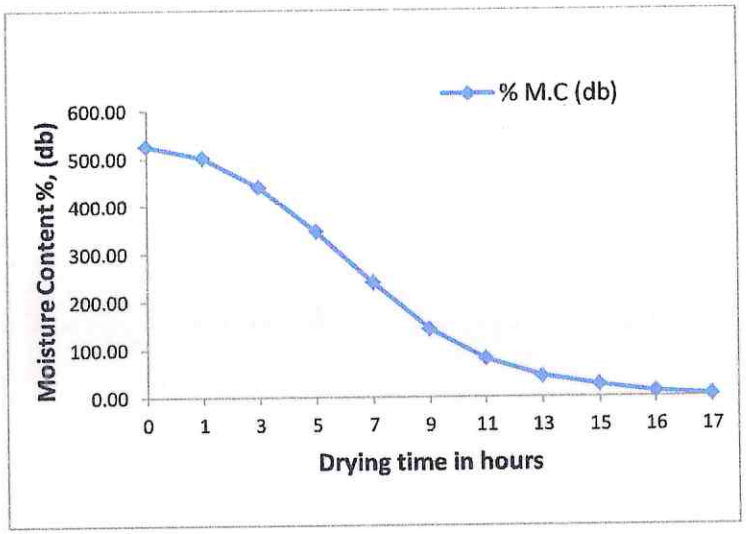


Fig.40. Drying characteristics of cardamom

/ The End of the Test Report /