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EXPERIMENTAL SETUP FOR HEAT TREATMENT CHAMBER TO GET UNIFORM TEMPRATURE WITH MINIMUM TIME

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ABSTRACT

The process of inducing evaporation of the moisture contained in wood; a type of hydrothermal treatment of wood is known as wood seasoning. The main purpose of the seasoning is to reduce the moisture content in the wood to a level appropriate to the use of the articles made from the wood. This prevents changes in the dimensions and shape of the articles, eliminates wood rot, increases the strength of the wood, reduces the weight of the articles, strengthens glued joints, and improves the quality of finishing. Wood is seasoned in various forms: lumber, peeled or planed veneers, crushed wood particles, and semi-finished articles. The simplest method of seasoning lumber is open-air seasoning, in which the lumber is stacked in the open air or under canopies for a period of two or three weeks to several months. The principal industrial method, kiln drying, uses kilns fed with hot air, a mixture of air and fuel gases, or superheated steam. Kilns with steam are the most commonly used type. Continuously operating kilns are used primarily for large-scale seasoning of umber prior to shipping; moisture content is reduced to 18–22 percent. Batch kilns are used to season wood to a moisture content of 7–10 percent.[1] On the basis of the research we made seasoning kiln we are using the heat exchanger to generate proper heat and the same generated heat will be blow inside the well-insulated canopies with high velocity and the our plant CFM will be sufficient to maintain the desire temperature for good result and it reduce the seasoning time as well. Safety precautions also has been taken by using different sensor for maintain even temperature for seasoning purpose. In our experiment we have done the experiment to remove moisture by uniform temperature. Experiment done in 20 Lx18 Wx10 H size insulated chamber and got good result of uniform temperature with minimum

time.

KEYWORD: Seasoning Chamber, Cfm, Zero Maintanance.

LITRATURE SURVEY

Rajesh Kumar Et al. investigated basic theory for the wood seasoning process which gave general idea for the process for wood seasoning. Which also mentioned the purpose for the wood seasoning to prevent injury by insects and decay before the timber is placed in service, To increase the durability of timber in service, To prevent shrinking and checking of the wood in service, To increase the strength of the wood, To decrease the weight of the wood and hence reduce shipping charges, To prepare the wood for its injection with preservatives and for other industrial uses. P. L. A. M. C. Wijewarnasuriya et al. was carried out study to investigate the applicability of sawdust operated kiln developed by Senadheera (2009), by investigating the factors affecting its operation such as burner and cost efficiencies. Most efficient sawdust feeding rate for the burner was found to be 60 g min-1 having particle diameter greater than 1 mm. Kiln was tested by seasoning Rubber (Hevea brasiliensis), Mahogany (Swietenia macrophylla), Lunumidella (Melia dubia) and Albizia (Paraserianthes falcataria). Albizia showed the highest drying rate, followed by Rubber, Lunumidella and Mahogany. This sawdust operated kiln consumed 144 hours to dry 25 ft3 of 25 mm thick rubber wood from green conditions to 13% of moisture content. The sawdust operated kiln in the present study showed the lowest cost efficiency compared with two other industrially operating kilns in the country. The highest cost efficiency was observed in the kiln at Rowood Lanka Pvt Ltd. However, according to cost – benefit analysis carried out for three kilns, kiln at State Timber Corporation showed its ability for a long run enterprise. Each kiln contributed approximately 25% of cost on energy out of total seasoning cost. It was found that sawdust operated kiln in the present study will not be sustained as an enterprise due to higher cost of seasoning.[2], R. S. Sujith Rathnayake et al. experimented Most of the limber in Sri Lanka is used in unseasoned state or seasoned using conventional kilns which use fuel wood boilers or open fires as a heating source. A study has been conducted to introduce dehumidification drying kiln. which is easy to fabricate and consumes less energy hence ideal for small scale timber industries. Experiments were conducted to investigate drying behaviour. to develop kiln schedules and to evaluate the developed kiln schedules for Pine timber. The dehumidification kiln used in the present study is locally fabricated and it has 25 cubic feet capacity. The temperature of the kiln can be increased to 50flC and relative humidity

can he reduced to 16%. It is concluded that higher quality II. brasiliensis and P. cardiac dried timber can be obtained at a faster rate by drying them using these schedules ill the dehumidification drying kiln compared with conventional drying.[3] Akhmedyanova E.N et al. The article dwells upon the peculiarities of using granulated sawdust (pellets) and identifies the ways to improve the efficiency of plants by applying unsteady modes of drying granulated sawdust with thermal units (pumps).[4] Rajesh Kumar Mishra et al. The process of inducing evaporation of the moisture contained in wood; a type of hydrothermal treatment of wood is known as wood seasoning. The purpose of seasoning is to reduce the moisture content in the wood to a level appropriate to the use of the articles made from the wood. This prevents changes in the dimensions and shape of the articles, eliminates wood rot, increases the strength of the wood, reduces the weight of the articles, strengthens glued joints, and improves the quality of finishing. Wood is seasoned in various forms: lumber, peeled or planed veneers, crushed wood particles, and semi-finished articles.[5]

Experimental Setup

Instrument and Material Requirement for this Experimental Setup.

Sr.no	Name of Instruments/ Material	Qty
1	Temperature Sensors Sensor type: RTD (PT-100) Diameter: 4mm Temperature range: 0- 4000C Length: variable (95 mm to 230 mm)	08
2	PID Temperature Controller with Sensor	01
3	Paper less Temperature Recorder (Data logger)	01
4	Blowers, Capacity: 12000 CFM Motor:	As per Req.
5	Moisture Meter	01
6	Thermometer (Calibrated) 100 deg. C	01
7	Pine wood (4 x 4 inch)	As per Req.

Experimental setup has arranged based on NSPM- 9 Guideline. And for that Three basic parameters are necessary and which are

1 calibrating the portable sensors.

2 calibrating the permanent sensors installed in the FHAT chamber; and 3 conducting an actual test treatment.

(1) Calibrating the portable sensors

As per NSPM-9 Govt. guideline Using a factory (calibrated) certified glass-mercury thermometer (readable in one tenth of a degree in Celsius) as the standard, compare the readings from each portable sensor to the standard and record any deviation. The calibration process is carried out using a swirling hot water bath at or near required treatment temperature. Any

sensor that deviates by +/0.30 C from the standard should not be used for calibration of permanent sensors. If cordless factory calibrated portable sensors are used, they require no further calibration At least a minimum of three portable sensors would be required to be calibrated for the test.

(2) Calibrating the permanent sensors installed in the FHAT chamber

The calibration of permanent sensors installed in the chamber or used to measure core temperature is done in similar way using the calibrated portable sensors. For this purpose, the portable sensors with a zero-correction factor may be used instead of certified glass mercury thermometer as standard against which permanent sensors are compared. The permanent sensors tested should pass the same level of accuracy as that of portable sensors.

(3) Conducting actual test treatment

The officers nominated by in-charges of NPQS/RPQS shall carry out actual test treatment by inserting portable sensors into holes drilled in different solid wood blocks up to a depth of 6 cm and positioned at different heights in the chamber loaded with pallets. The exact placement of sensors should be indicated in three-dimensional diagram. The chamber should be closed and turn on the heating system. The readings of sensors should be taken at least once every five minutes during warm-up and every 2 minutes during dwell-time. From the readings determine the warm-up time and run the dwell-time portion of treatment and hold for the minimum time specified by the approved treatment schedule i.e. 56 o C for 30 minutes.

If the test treatment successful, the nominated officers should initial the log sheet and remove all the portable sensors after the chamber cools down to ambient temperature and submit a report in prescribed format.

So Experimental setup was based on NSPM-9 Guideline as per above mentioned parameters and location of 8 sensors position has also given in the below layout.

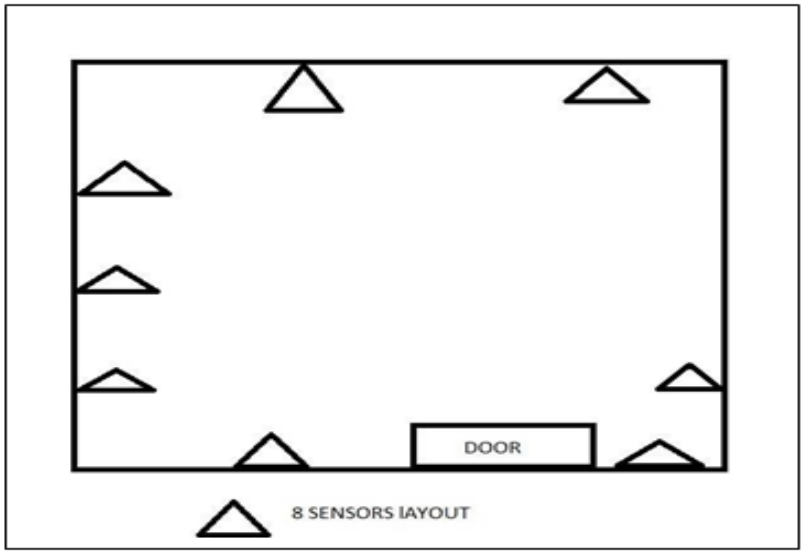


Fig 1: Layout for 8 Temp. Sensors.

This given layout indicating the position for Temp Sensors, among these 8 sensors two sensors has placed in wood core by piercing 2-inch hole and that two points consider coolest point of whole chamber. Now after calibration all sensors as per NSPM-9 guideline track the all 8sensors data at 2 min gap and generate the graph. In this Experiment Warm up time and dwell time is also important to know the health of heat treatment plant.

For this experiment we have built a chamber with 20 Lx18 Wx10 H, chamber fabricated with 18 gauge galvanised sheet and thickness of the box is 80 mm and in that we have packed insulation material to protect heat loss during experiment, this chamber loaded with all safety accessories to prevent the accident and it fully operated over the control panel so all temperature vs time data can be monitored over the panel through PC. Each temp variation after two minutes has been noted.

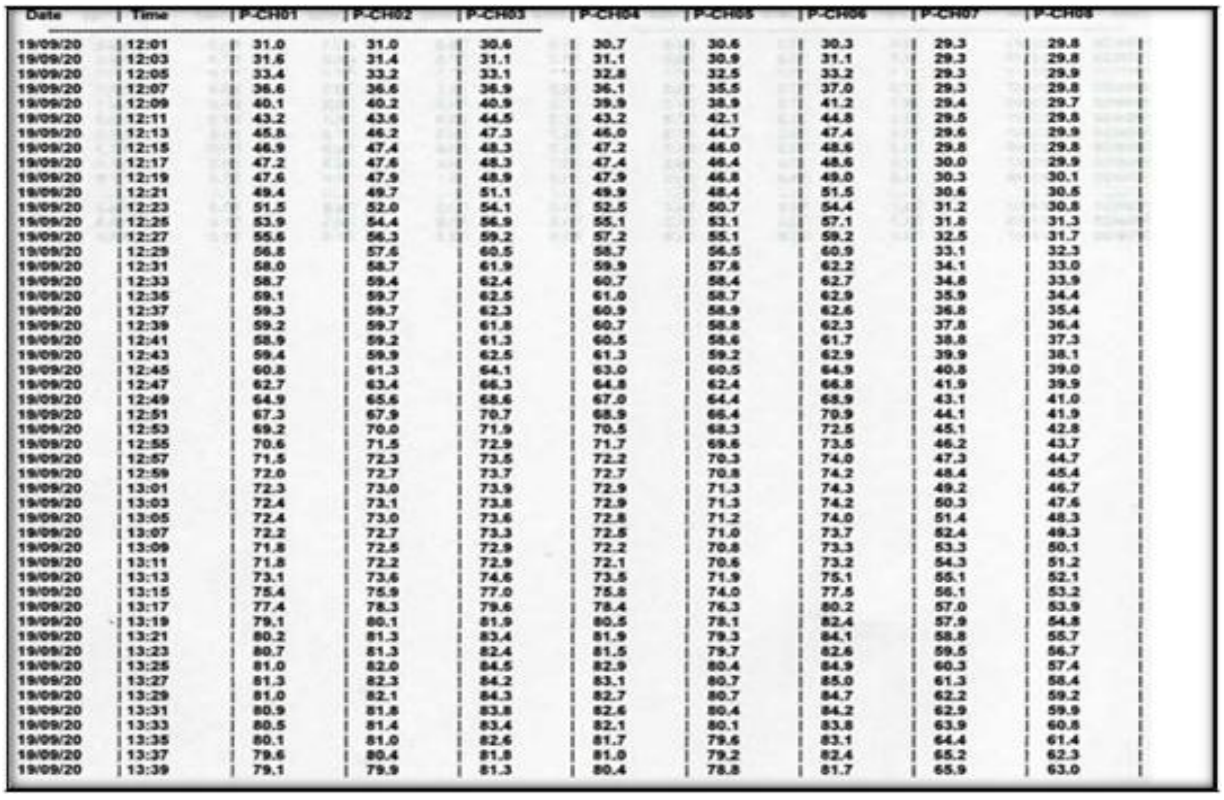
Fig.2: Experimental setup.

Wood is used as a fuel in the furnace and after burning fuel hot gases produce that hot gas path has given below.

Furnace – junction – heat exchanger – chimney

When heat exchanger pipe getting heat it give their heat to chamber by using high CFM fan and moisture remove can be fast.

When experiment has started hot gases passes to chamber by exchanger through fan and chamber start heat up which can show over temperature scanner. Objective is to get 56 degree Celsius and it should be remained for 30 minutes to approve the treatment process. So as start the plant heating inside the chamber continuously gaining and each temperature increment can be monitor on temp scanner.[6]



Date	Time	P-CH01	P-CH02	P-CH03	P-CH04	P-CH05	P-CH06	P-CH07	P-CH08
19/09/20	12:01	31.0	31.0	30.6	30.7	30.6	30.3	29.3	29.8
19/09/20	12:03	31.6	31.4	31.1	31.1	30.9	31.1	29.3	29.8
19/09/20	12:05	33.4	33.2	33.1	32.8	32.5	33.2	29.3	29.9
19/09/20	12:07	36.6	36.6	36.9	36.1	35.5	37.0	29.3	29.8
19/09/20	12:09	40.1	40.2	40.9	39.9	38.9	41.2	29.4	29.7
19/09/20	12:11	43.2	43.6	44.5	43.2	42.1	44.8	29.5	29.8
19/09/20	12:13	45.8	46.2	47.3	46.0	44.7	47.4	29.6	29.9
19/09/20	12:15	46.9	47.4	48.3	47.2	46.0	48.6	29.8	29.8
19/09/20	12:17	47.2	47.6	48.3	47.4	46.4	48.6	30.0	29.9
19/09/20	12:19	47.6	47.9	48.9	47.9	46.8	49.0	30.3	30.1
19/09/20	12:21	49.4	49.7	51.1	49.9	48.4	51.5	30.6	30.5
19/09/20	12:23	51.5	52.0	54.1	52.5	50.7	54.4	31.2	30.8
19/09/20	12:25	53.9	54.4	56.9	55.1	53.1	57.1	31.8	31.3
19/09/20	12:27	55.6	56.3	59.2	57.2	55.1	59.2	32.5	31.7
19/09/20	12:29	56.8	57.6	60.5	58.7	56.5	60.9	33.1	32.3
19/09/20	12:31	58.0	58.7	61.9	59.9	57.8	62.2	34.1	33.0
19/09/20	12:33	58.7	59.4	62.4	60.7	58.4	62.7	34.8	33.9
19/09/20	12:35	59.1	59.7	62.5	61.0	58.7	62.9	35.9	34.4
19/09/20	12:37	59.3	59.7	62.3	60.9	58.9	62.6	36.8	35.4
19/09/20	12:39	59.2	59.7	61.8	60.7	58.8	62.3	37.8	36.4
19/09/20	12:41	58.9	59.2	61.3	60.5	58.6	61.7	38.8	37.3
19/09/20	12:43	59.4	59.9	62.5	61.3	59.2	62.9	39.9	38.1
19/09/20	12:45	60.8	61.3	64.1	63.0	60.5	64.9	40.8	39.0
19/09/20	12:47	62.7	63.4	66.3	64.8	62.4	66.8	41.9	39.9
19/09/20	12:49	64.9	65.6	68.6	67.0	64.4	68.9	43.1	41.0
19/09/20	12:51	67.3	67.9	70.7	68.9	66.4	70.9	44.1	41.9
19/09/20	12:53	69.2	70.0	71.9	70.5	68.3	72.5	45.1	42.8
19/09/20	12:55	70.6	71.5	72.9	71.7	69.6	73.5	46.2	43.7
19/09/20	12:57	71.5	72.3	73.6	72.2	70.3	74.0	47.3	44.7
19/09/20	12:59	72.0	72.7	73.7	72.7	70.8	74.2	48.4	45.4
19/09/20	13:01	72.3	73.0	73.9	72.9	71.3	74.3	49.2	46.7
19/09/20	13:03	72.4	73.1	73.8	72.9	71.3	74.2	50.3	47.6
19/09/20	13:05	72.4	73.0	73.6	72.8	71.2	74.0	51.4	48.3
19/09/20	13:07	72.2	72.7	73.3	72.5	71.0	73.7	52.4	49.3
19/09/20	13:09	71.8	72.5	72.9	72.2	70.8	73.3	53.3	50.1
19/09/20	13:11	71.8	72.2	72.9	72.1	70.6	73.2	54.3	51.2
19/09/20	13:13	73.1	73.6	74.6	73.5	71.9	75.1	55.1	52.1
19/09/20	13:15	75.4	75.9	77.0	75.3	74.0	77.5	56.1	53.2
19/09/20	13:17	77.4	78.3	79.6	78.4	76.3	80.2	57.0	53.9
19/09/20	13:19	79.1	80.1	81.9	80.5	78.1	82.4	57.9	54.8
19/09/20	13:21	80.2	81.3	83.4	81.9	79.3	84.1	58.8	55.7
19/09/20	13:23	80.7	81.3	82.4	81.5	79.7	82.6	59.5	56.7
19/09/20	13:25	81.0	82.0	84.5	82.9	80.4	84.9	60.3	57.4
19/09/20	13:27	81.3	82.3	84.2	83.1	80.7	85.0	61.3	58.4
19/09/20	13:29	81.0	82.1	84.3	82.7	80.7	84.7	62.2	59.2
19/09/20	13:31	80.9	81.8	83.8	82.6	80.4	84.2	62.9	59.9
19/09/20	13:33	80.5	81.4	83.4	82.1	80.1	83.8	63.9	60.8
19/09/20	13:35	80.1	81.0	82.6	81.7	79.6	83.1	64.4	61.4
19/09/20	13:37	79.6	80.4	81.8	81.0	79.2	82.4	65.2	62.3
19/09/20	13:39	79.1	79.9	81.3	80.4	78.8	81.7	65.9	63.0

Fig.3: Experimental data from software WPS-20.

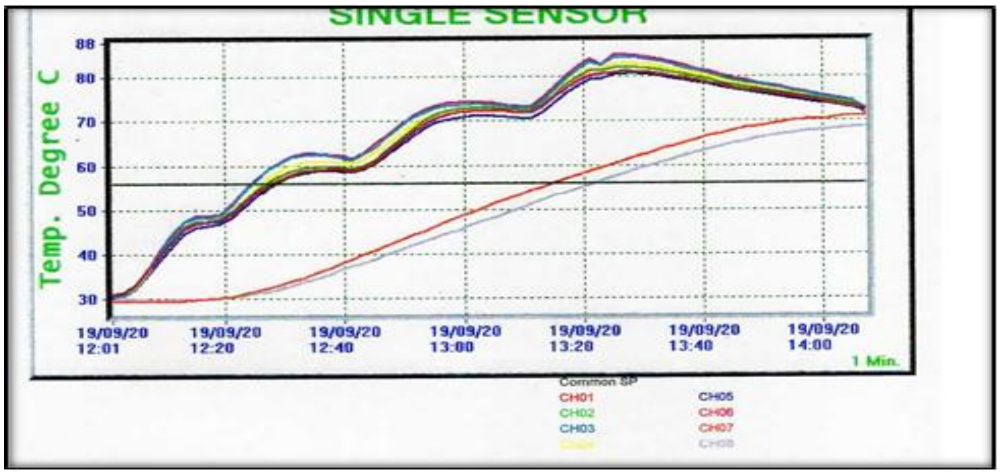


Fig.4: Experimental data graph from software WPS-15.

It can be show from the data and graph that attending time of 56 degree Celsius was very fast in wood core where sensor was fitted. And performance chart and graph show the good result. Hence wood treatment time was very less.

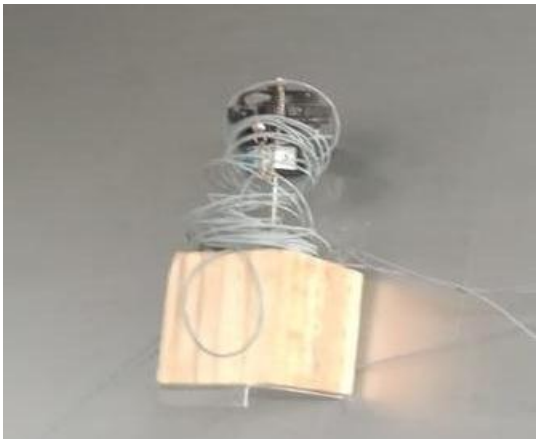


Fig.5. RTD PT 100 sensor fitted in wood core.

Fig.6: Ispm-15 Wood Fire Panel.

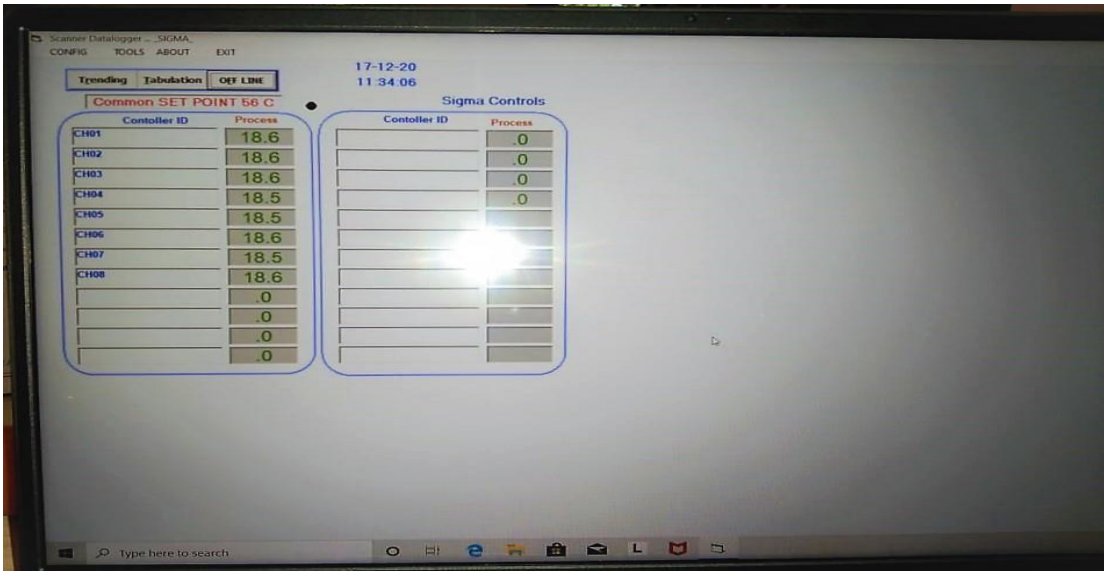


Fig.7 Wps 15 Software.

In fig.7 WPS 15 software given which can use to get 8 sensors reading on PC/ laptop after 2 minutes interval times and their graph also can be generated in same software.

Fig 8: Window dampers.

In fig 8 window dampers are given for the safety concern in experiment and hooter was also use in safety concern.

CONCLUDING REMARKS

We have performed the number of experiments in WPS heat treatment plant and as per the data it can be concluded the time between starting time and attending time is minimum. Due to effective heat exchanger and higher fan cfm (13 blades fan) the temperature can be gain

effectively and rapidly. As 75 mm insulation was use with high density so heat loss was minimum.

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