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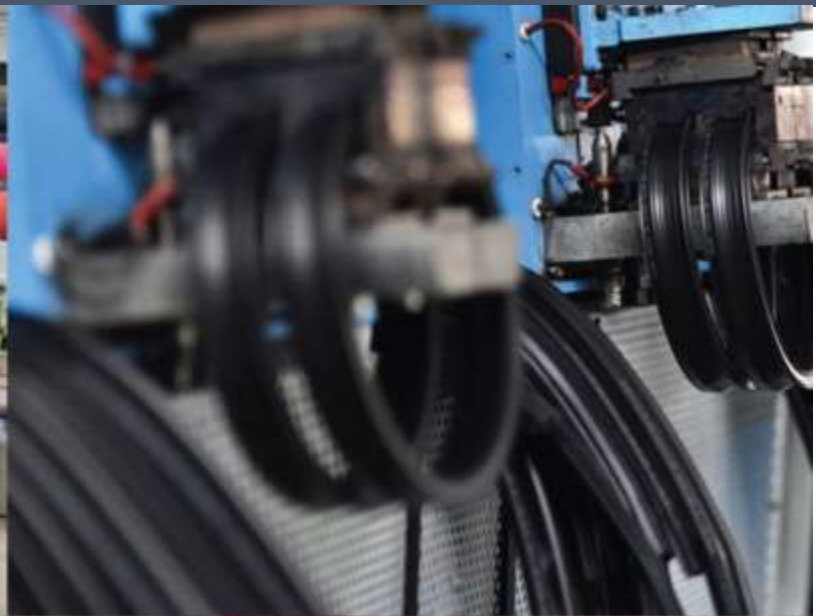
In Association With



ELECTRO-MAGNETIC Innovative Technologies

Kerone Research & Development Centre (KRDC)

B/47, Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India  
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com



**Continuous Infra-Red Heat Treatment  
for Drying of Barley Husk**

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Customer :	M/s. Hindustan Unilever Ltd.
Process :	Continuous Infra-red Heat Treatment for Drying of Barley Husk

**Test Report No: 187/KRDC/LAB/17 Mum 24/10/2023**

Date Sample reception : 21/02/2023  
ID : 187/LAB/24

**Sample Description:**

Sampling : As Requested  
Sample Condition : Acceptable  
Sampling date : 23/02/2023  
Product : Barley Husk  
Start Date test : 23/02/2023  
End Date test : 23/02/2023

**Laboratory Experimental System –**





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### System Specifications –

<b>IR Power</b>	5 kW
<b>Type of IR Emitters</b>	Quartz Infrared
<b>Rotary Drum Size</b>	Φ324 mm x 800 mm long x 3mm Thick.
<b>Thermal Monitoring System</b>	Single Channel Fiber Optic: Range -40 to 250°C
<b>Exhaust</b>	Exhaust port with manual damper
<b>Air Circulation Fan</b>	Radial Fan FHP 0.5HP

### Laboratory's Environmental Conditions –

<b>Temperature (degree C)</b>	29.4°C (±5°C)
<b>Humidity (%)</b>	≤50% RH
<b>Pressure (kN/m<sup>2</sup> or kPa)</b>	Not recorded




**Note for recommendation:** Environmental conditions have a direct impact on test results. Accuracy and consistency of test data are affected by the laboratory conditions



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### Equipment Used -

Name of Equipment	Picture of Equipment	Specifications
<b>Compact Thermal Imaging Camera</b>		<b>Model: FLIR E-30</b> <b>Resolution: 160x 120IR Thermal sensitivity of 0.10°C</b>
<b>Thermo Hygrometer</b>		<b>Model No: HTC-2</b> <b>Temperature accuracy: ±°C (1.8°F)</b> <b>Temperature resolution: 0.1°C (0.2°F)</b>  <b>Humidity range: 10%~99% RH</b> <b>Humidity accuracy: ±5% RH</b> <b>Humidity resolution: 1% RH</b>
<b>Moisture Analyzer</b>		<b>Make: Axis Balance</b> <b>Description:</b> <b>Moisture range: 1% (sample 0.02/0.05g), 0.1% (Sample 0.5/5g), 0.01% (Sample &gt;5g)</b>

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### Procedure of the Experiment -

- The experiment was performed on Barley Husk to speed up the heating rate.
- For this experimental run, the given sample was taken and then passed in the Continuous IR heating system with suitable parameters.
- After the heating treatment, the sample was analyzed.

### Analytical Results:

#### **Trials 1 -**

Initial Weight - 1000g

Initial Moisture - 70.9%

Moisture after screw press - 53.3%

<b>Trials</b>	<b>Cycle time</b>	<b>Initial Moisture</b>	<b>System Specifications</b>	<b>Final Moisture</b>	<b>On product temp</b>	<b>Remark</b>
C1	After 30 mins.	53.3%	Set temp:120°C; Drum speed: 0.2rpm	21.9%	(55-63)	Drying Started
C2	After 60 mins.	21.9%	Set temp:120°C; Drum speed: 0.2rpm	15.8%	(55-65)	Drying continuous
C3	After 90 mins.	15.8%	Set temp:120°C; Drum speed: 0.2rpm	8.7%	(65-74)	Dried as desired

Final Weight - 223g

Final Moisture - 8.7%

No. of Cycles - 3

Total Cycle time - 90 mins.



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**Trials 2 –**

Initial Weight – 1000g

Initial Moisture – 70.9%

Moisture after screw press – 53.3%

Trials	Cycle time	Initial Moisture	System Specifications	Final Moisture	On product temp	Remark
C1	After 40 mins.	53.3%	Set temp:150°C; Drum speed: 0.1rpm	16%	(75-80)	Drying Started
C2	After 80 mins.	16%	Set temp:150°C; Drum speed: 0.1rpm	7.2%	(85-97)	Dried as desired

Final Weight – 211g

Final Moisture – 7.2%

No. of Cycles – 2

Total Cycle time – 1 hours 20 mins.

**Trials 3–**

Initial Weight – 1000g

Initial Moisture – 70.9%

Moisture after screw press – 53.3%

Trials	Cycle time	Initial Moisture	System Specifications	Final Moisture	On product temp	Remark
C1	After 40 mins.	53.3%	Set temp:200°C; Drum speed: 0.1rpm	7.5%	(93-104)	Dried as desired

Final Weight – 214g

Final Moisture – 7.5%

No. of Cycles – 2

Total Cycle time – 40 mins.

**Format: F/R&D/01**

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**Trials Images:**



**Untreated Sample (Initial sample, Screw pressed sample)**



**Treated Sample (Trial 1, Trial 2, Trial 3)**

**Format: F/R&D/01**

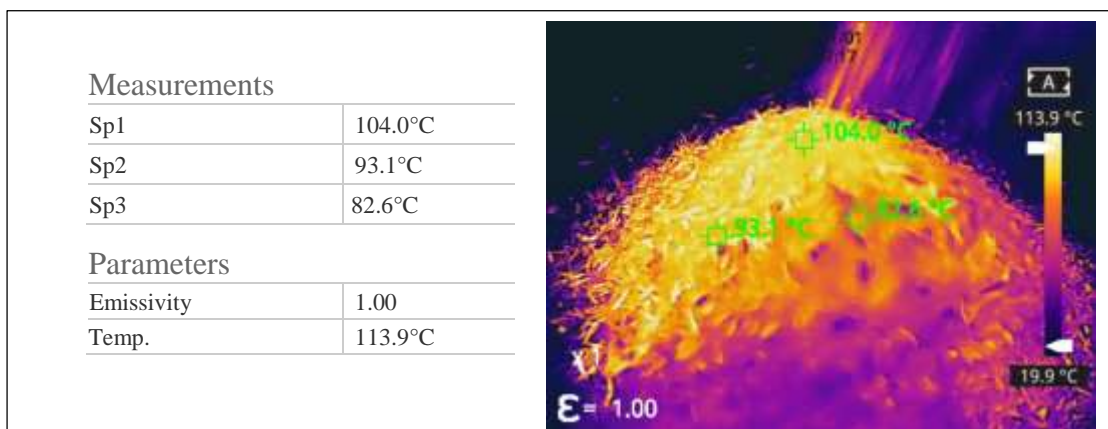
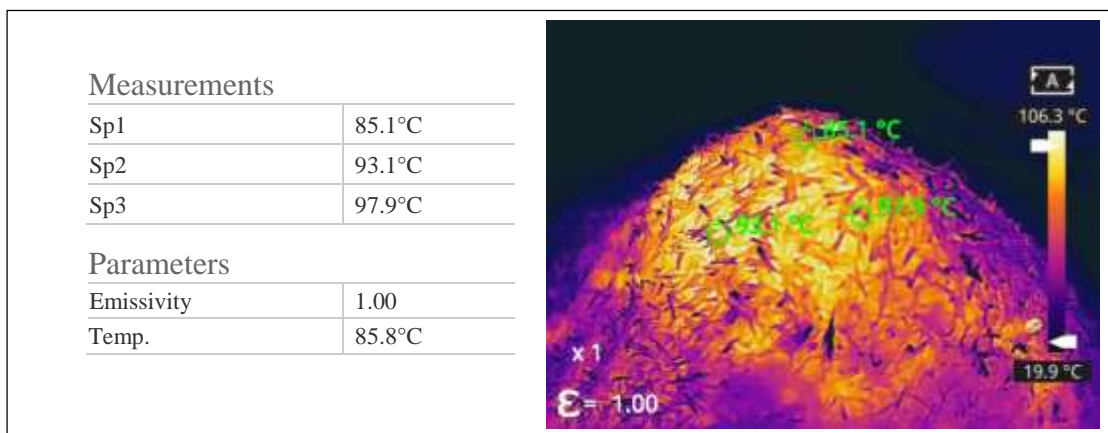
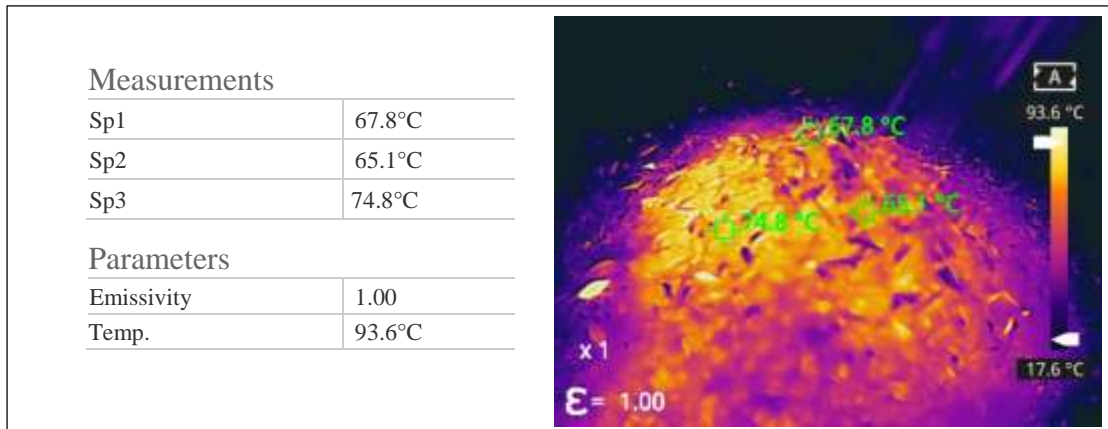
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### Thermal Images:



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### Moisture Analysis Report:

Drying started		Drying started	
Date :	23-02-2023	Date :	23-02-2023
Time :	10:39:24	Time :	11:31:13
Model :	ABS200	Model :	ABS200
Serial number :	138	Serial number :	138
Drying parameters		Drying parameters	
Product :	0	Product :	0
Drying temperature :	105.0 °C	Drying temperature :	105.0 °C
Drying profile :	standard	Drying profile :	standard
Mode :	Short mode	Mode :	Short mode
Calculation :	$[(m0-m)/m0]*100\%$	Calculation :	$[(m0-m)/m0]*100\%$
Finished :	3 samples	Finished :	3 samples
Initial weight :	0.717 g	Initial weight :	0.704 g
Final weight :	0.207 g	Final weight :	0.329 g
Drying time :	00:04:20s	Drying time :	00:09:00s
Sampling interval :	20 sec	Sampling interval :	20 sec
Moisture :	70.7 %	Moisture :	53.3 %
NOTE	Initial moisture	NOTE	Screw pressed sample moisture.
The analysis performed by:		The analysis performed by:	
Signature: 		Signature: 	



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Trial 1	Trial 2	Trial 3
<p>Drying started</p> <p>Date: 23-02-2023 Time: 11:42:00 Mode: AN700 Serial number: 133</p> <p>Drying parameters</p> <p>Product: 10</p> <p>Drying temperature: 105.0 °C</p> <p>Drying profile: standard Mode: Short mode Calculation: <math>\frac{(a0-a)/a0}{100}</math> Finished: 3 samples</p> <p>Initial weight: 0.506 g Final weight: 0.462 g</p> <p>Drying time: 00:02:00s Sampling interval: 20 sec</p> <p>Moisture: 8.7 %</p> <p>NOTE: Final moisture</p> <p>The analysis performed by:</p> <p>Signature: <i>[Signature]</i></p>	<p>Drying started</p> <p>Date: 23-02-2023 Time: 11:43:02 Mode: AN700 Serial number: 133</p> <p>Drying parameters</p> <p>Product: 10</p> <p>Drying temperature: 105.0 °C</p> <p>Drying profile: standard Mode: Short mode Calculation: <math>\frac{(a0-a)/a0}{100}</math> Finished: 3 samples</p> <p>Initial weight: 0.585 g Final weight: 0.543 g</p> <p>Drying time: 00:02:00s Sampling interval: 20 sec</p> <p>Moisture: 7.2 %</p> <p>NOTE: Final moisture</p> <p>The analysis performed by:</p> <p>Signature: <i>[Signature]</i></p>	<p>Drying started</p> <p>Date: 23-02-2023 Time: 11:51:12 Mode: AN700 Serial number: 133</p> <p>Drying parameters</p> <p>Product: 10</p> <p>Drying temperature: 105.0 °C</p> <p>Drying profile: standard Mode: Short mode Calculation: <math>\frac{(a0-a)/a0}{100}</math> Finished: 3 samples</p> <p>Initial weight: 0.596 g Final weight: 0.553 g</p> <p>Drying time: 00:02:00s Sampling interval: 20 sec</p> <p>Moisture: 7.5 %</p> <p>NOTE: Final moisture</p> <p>The analysis performed by:</p> <p>Signature: <i>[Signature]</i></p>



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### Observations:

The heating behavior of Barley Husk was investigated under the Convection heating system. The heating rate was found to be increasing with respect to increasing in time. As per the physical investigation, it was observed that the product was dried as desired without any charring effect and was seal packed after treatment. Also, the desired moisture content was obtained.

**Ms. Sayali Asole**  
( Tested By )