KERONE

A CRISIL-NSIC RATED COMPANY
ISO-9001-2008COMPANY

MemberOf

AIMCAL(USA) A.M.P.E.R.E(EUROPE)

In AssociationWith

EMitech
ELECTRO MAGNETIC Innovative Technologies

Kerone Research & Development Centre (KRDC),
B/47, Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

Drying of High Alumina Cement Nodules in Rotary Drum IR Heating System

ISO 9001-2008 | ISO 9001-2015 | EMS 14001 | OHSAS 18001
In Association with SVCH-Technology, Moscow (Russia)

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

Customer :	**M/s. Poly Refractories, Rourkela**
Process :	**Drying of High Alumina Cement Nodules in Rotary Drum IR Heating System**

TEST REPORT No: 47/KRDC/LAB/44REV.01 Mum 31/10/2021

Date Sample reception : 29/09/2021
ID : 47/LAB/44

SAMPLE DESCRIPTION:

Sampling : As Requested
Sample Condition : Acceptable
Quantity : Approx. 3kgs
Sampling date : 02/10/2021
Product : Nodules
Requirement : Drying
Start test Date : 02/10/2021
End test Date : 04/10/2021

LABORATORY EXPERIMENTAL SETUP:

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

LAB CONTINUOUS IR HEATING SYSTEM SPECIFICATIONS:

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

ENVIRONMENT-LABORATORY AMBIENT CONDITIONS:

Temperature (degree C)	28^{o}C (±5^{o}C)
Humidity (%)	≤67% RH
Pressure (kN/m2 or kPa)	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

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

EQUIPMENTS USED:

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

SAMPLE PREPARATION AND METHOD/PROCEDURE:

The experiment has been performed on given samples of HAC Nodules for drying treatment. For this experimental run, the given sample is passed through continuous rotary IR heating system at various set parameters. Multiple passes/ Single pass are given so as to achieve desired results. The observations are made on the basis of weight loss, moisture in product and temperature on product samples.

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

ANALYTICAL RESULTS:

Trial No. 1 – Small size Nodules with Dia. Range (12.0 to 14.0)mm

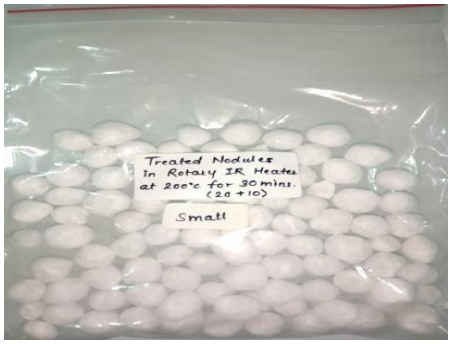
Initial Weight: 236g
Initial Moisture: 24.3%
IR Set Temperature: 200°C

No. of pass	VFD Freq. (Hz)	Cycle Time (minutes)	Product Temp. (°C)	Product Weight (g)	Weight loss (%)	Moisture content (%)	Remarks
1.	5	After 20 min	(50-60)°C	203	13.98%	14.6%	Variant of drying
2.	12	After 10 min	(70-80)°C	144	29.06%	5.2%	Dried as desired

Final Weight: 144g
Final Moisture: 5.2%
Total cycle time: 30 min

BEFORE AND AFTER PICTURES OF TREATED SPECIMEN SAMPLE:

a) UNTREATED



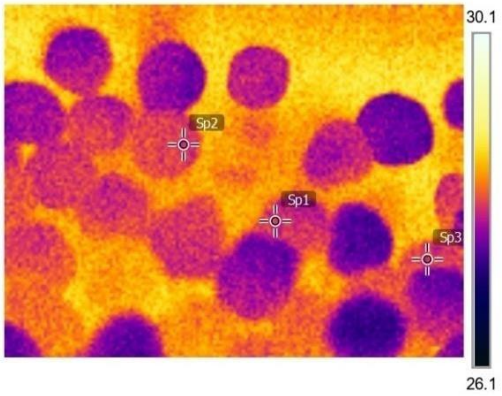
b) TREATED

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

THERMAL IMAGE BEFORE AND AFTER HEAT TREATMENT:

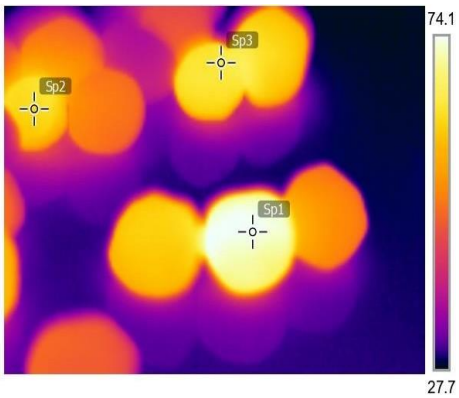
Before Heat Treatment:

Measurements	
Sp1	28.1 °C
Sp2	28.0 °C
Sp3	28.0 °C
Parameters	
Emissivity	0.95
Refl. temp.	20 °C



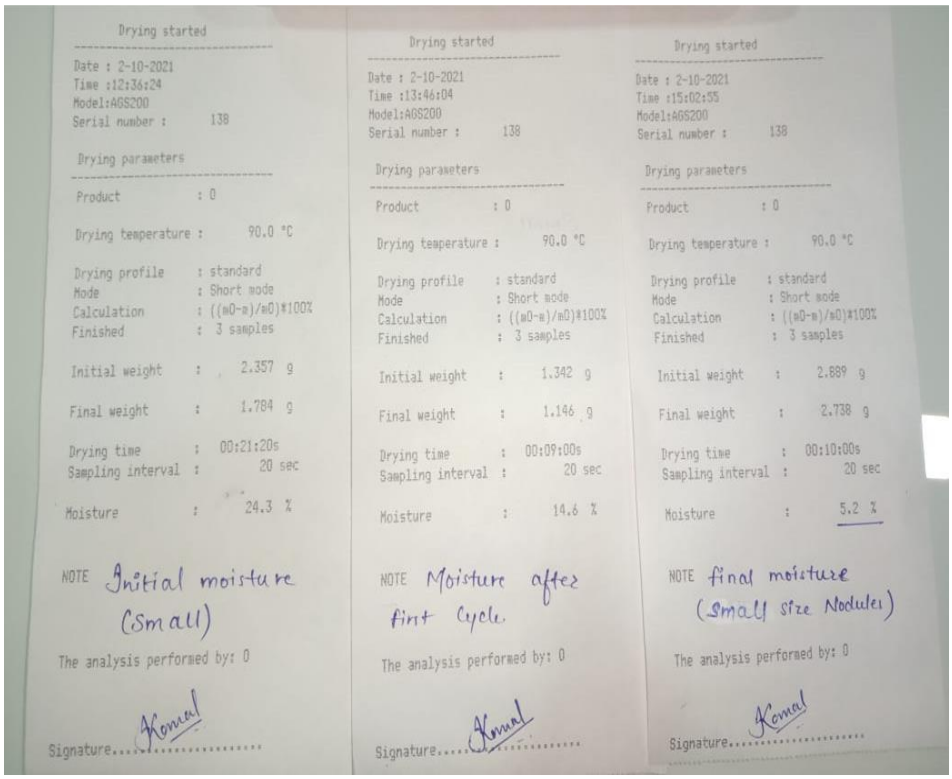
After Heat Treatment:

Measurements	
Sp1	73.5 °C
Sp2	63.8 °C
Sp3	66.2 °C
Parameters	
Emissivity	0.95
Refl. temp.	20 °C



Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

MOISTURE ANALYSIS REPORTS:



Drying started

Date : 2-10-2021
Time :12:36:24
Model:AGS200
Serial number : 138

Drying parameters

Product : 0
Drying temperature : 90.0 °C
Drying profile : standard
Mode : Short mode
Calculation : ((m0-m)/m0)*100%
Finished : 3 samples
Initial weight : 2.357 g
Final weight : 1.784 g
Drying time : 00:21:20s
Sampling interval : 20 sec
Moisture : 24.3 %

NOTE Initial moisture (small)

The analysis performed by: 0

Signature.....Komal

Drying started

Date : 2-10-2021
Time :13:46:04
Model:AGS200
Serial number : 138

Drying parameters

Product : 0
Drying temperature : 90.0 °C
Drying profile : standard
Mode : Short mode
Calculation : ((m0-m)/m0)*100%
Finished : 3 samples
Initial weight : 1.342 g
Final weight : 1.146 g
Drying time : 00:09:00s
Sampling interval : 20 sec
Moisture : 14.6 %

NOTE Moisture after first cycle.

The analysis performed by: 0

Signature.....Komal

Drying started

Date : 2-10-2021
Time :15:02:55
Model:AGS200
Serial number : 138

Drying parameters

Product : 0
Drying temperature : 90.0 °C
Drying profile : standard
Mode : Short mode
Calculation : ((m0-m)/m0)*100%
Finished : 3 samples
Initial weight : 2.889 g
Final weight : 2.738 g
Drying time : 00:10:00s
Sampling interval : 20 sec
Moisture : 5.2 %

NOTE final moisture (small size Nodules)

The analysis performed by: 0

Signature.....Komal

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

Trial No. 2 – Medium size Nodules with Dia. Range (15.00 to 18.00)mm

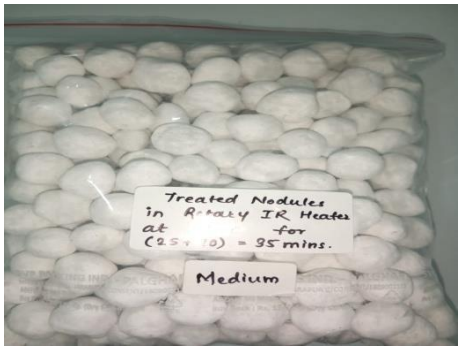
Initial Weight: 800g
Initial Moisture: 24.7%
IR Set Temperature: 200°C

No. of pass	VFD Freq. (Hz)	Cycle Time (minutes)	Product Temp. (°C)	Product Weight (g)	Weight loss (%)	Moisture content (%)	Remarks
1.	4	After 25 min	(50-60)°C	705	11.87%	11.8%	Variant of drying
2.	8	After 10 min	(70-80)°C	680	3.5%	7.8%	Dried as desired

Final Weight: 680g
Final Moisture: 7.8%
Total cycle time: 35 min

BEFORE AND AFTER PICTURES OF TREATED SPECIMEN SAMPLE:

a) UNTREATED

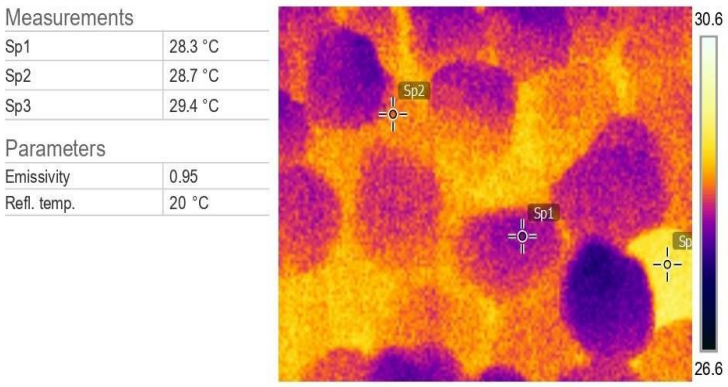


b) TREATED

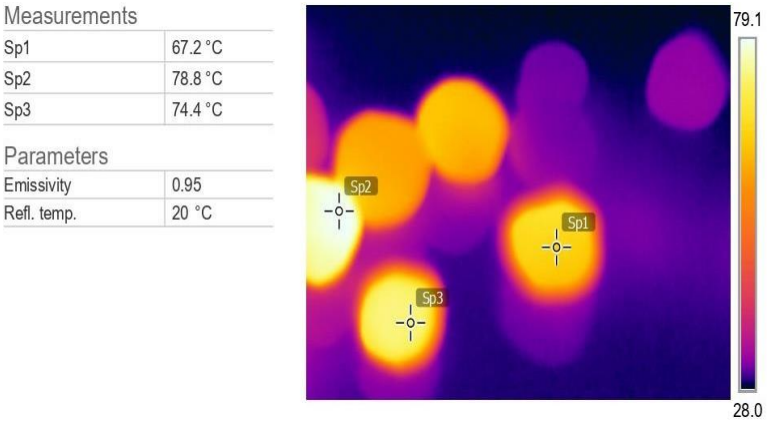
Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

THERMAL IMAGE BEFORE AND AFTER HEAT TREATMENT:

Before Heat Treatment:

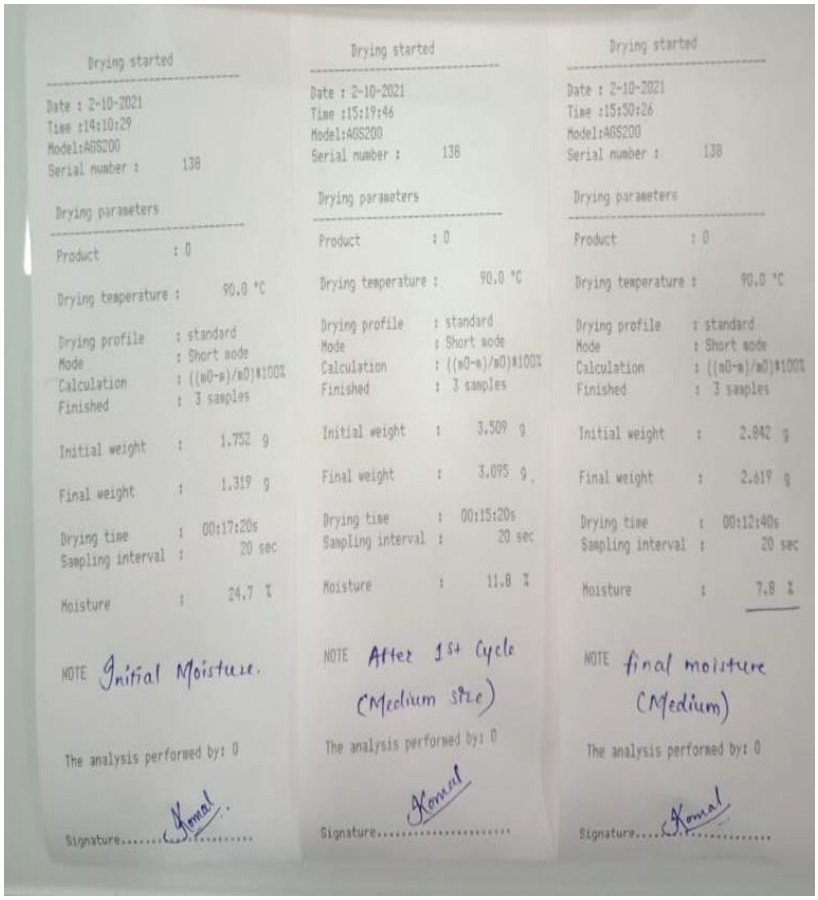


After Heat Treatment:



Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

MOISTURE ANALYSIS REPORTS:



Drying started

Date : 2-10-2021
Time :14:10:29
Model:AGS200
Serial number : 138

Drying parameters

Product : 0
Drying temperature : 90.0 °C
Drying profile : standard
Mode : Short mode
Calculation : ((m0-m)/m0)*100%
Finished : 3 samples
Initial weight : 1.752 g
Final weight : 1.319 g
Drying time : 00:17:20s
Sampling interval : 20 sec
Moisture : 24.7 %

NOTE Initial Moisture.

The analysis performed by: 0

Signature.....Komal.....

Drying started

Date : 2-10-2021
Time :15:19:46
Model:AGS200
Serial number : 138

Drying parameters

Product : 0
Drying temperature : 90.0 °C
Drying profile : standard
Mode : Short mode
Calculation : ((m0-m)/m0)*100%
Finished : 3 samples
Initial weight : 3.509 g
Final weight : 3.095 g
Drying time : 00:15:20s
Sampling interval : 20 sec
Moisture : 11.8 %

NOTE After 1st Cycle (Medium size)

The analysis performed by: 0

Signature.....Komal.....

Drying started

Date : 2-10-2021
Time :15:50:26
Model:AGS200
Serial number : 138

Drying parameters

Product : 0
Drying temperature : 90.0 °C
Drying profile : standard
Mode : Short mode
Calculation : ((m0-m)/m0)*100%
Finished : 3 samples
Initial weight : 2.842 g
Final weight : 2.619 g
Drying time : 00:12:40s
Sampling interval : 20 sec
Moisture : 7.8 %

NOTE final moisture (Medium)

The analysis performed by: 0

Signature.....Komal.....

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

Trial No. 3 – Large size Nodules with Dia. Range (18.0 to 22.0) mm

Initial Weight: 846g
Initial Moisture: 24.7%
IR Set Temperature: 200°C

Sr. No.	VFD	Cycle Time (minutes)	Product Temp. (°C)	Product Weight (g)	Weight loss (%)	Moisture content (%)	Remarks
1.	2.2	After 45 min	(60-72)°C	675g	20.21%	4.4%	Dried as desired

Final Weight: 675 g
Final Moisture: 4.4 %
Total cycle time: 45 min

BEFORE AND AFTER PICTURES OF TREATED SPECIMEN SAMPLE:

a) UNTREATED

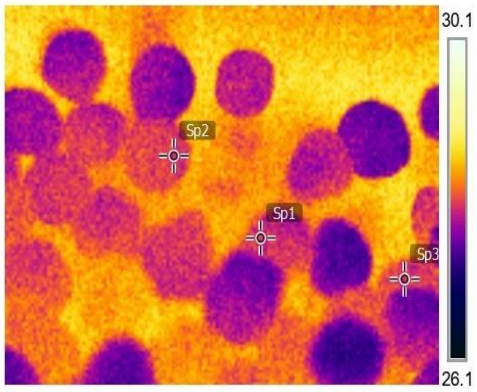
b) TREATED

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

THERMAL IMAGE BEFORE AND AFTER HEAT TREATMENT:

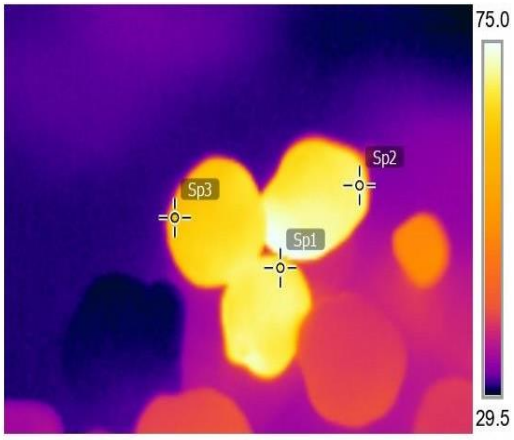
Before Heat Treatment:

Measurements	
Sp1	28.1 °C
Sp2	28.0 °C
Sp3	28.0 °C
Parameters	
Emissivity	0.95
Refl. temp.	20 °C



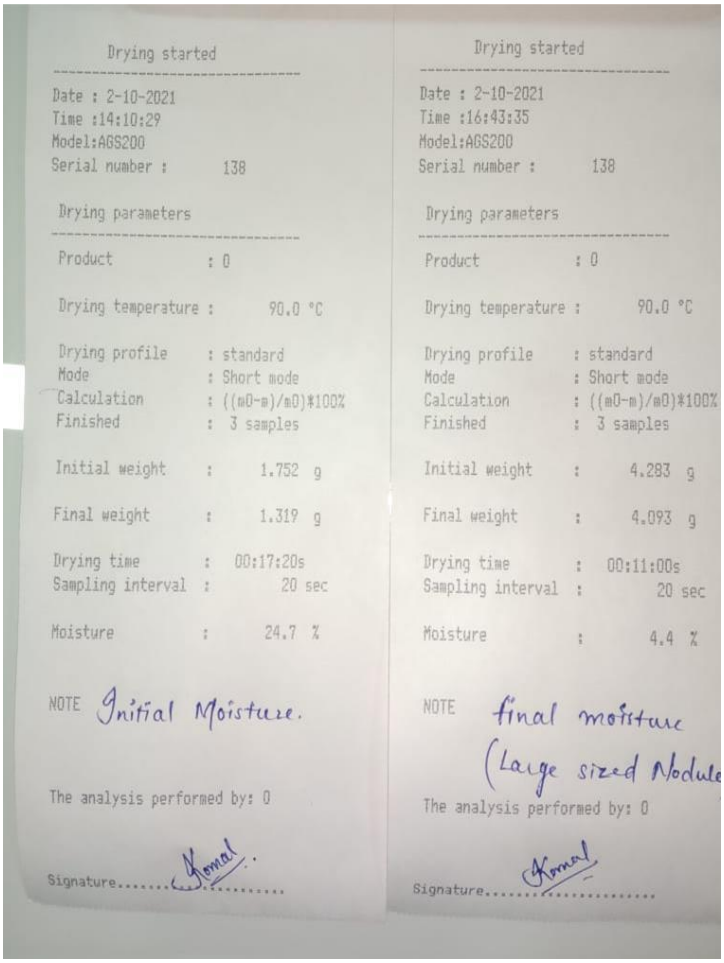
After Heat Treatment:

Measurements	
Sp1	70.0 °C
Sp2	71.1 °C
Sp3	64.5 °C
Parameters	
Emissivity	0.95
Refl. temp.	20 °C



Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

MOISTURE ANALYSIS REPORTS:



Drying started

Date : 2-10-2021
Time :14:10:29
Model:AGS200
Serial number : 138

Drying parameters

Product : 0
Drying temperature : 90.0 °C
Drying profile : standard
Mode : Short mode
Calculation : ((m0-m)/m0)*100%
Finished : 3 samples
Initial weight : 1.752 g
Final weight : 1.319 g
Drying time : 00:17:20s
Sampling interval : 20 sec
Moisture : 24.7 %

NOTE Initial Moisture.

The analysis performed by: 0

Signature.....Komal.....

Drying started

Date : 2-10-2021
Time :16:43:35
Model:AGS200
Serial number : 138

Drying parameters

Product : 0
Drying temperature : 90.0 °C
Drying profile : standard
Mode : Short mode
Calculation : ((m0-m)/m0)*100%
Finished : 3 samples
Initial weight : 4.283 g
Final weight : 4.093 g
Drying time : 00:11:00s
Sampling interval : 20 sec
Moisture : 4.4 %

NOTE final moisture
(Large sized Module

The analysis performed by: 0

Signature.....Komal.....

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

Trial No. 4 – Large & Medium size Nodules with Dia. Range (15.0 to 22.0) mm

Initial Weight: 853g
Initial Moisture: 22.5%
IR Set Temperature: 300°C

Sr. No.	VFD	Cycle Time (minutes)	Product Temp. (°C)	Product Weight (g)	Weightloss (%)	Moisture content (%)	Remarks
1.	4	After 25 min	(80-110)°C	534g	37.4%	0.9%	Dried as desired

Final Weight: 534 g
Final Moisture: 0.9%
Total cycle time: 25 min

BEFORE AND AFTER PICTURES OF TREATED SPECIMEN SAMPLE:

a) UNTREATED

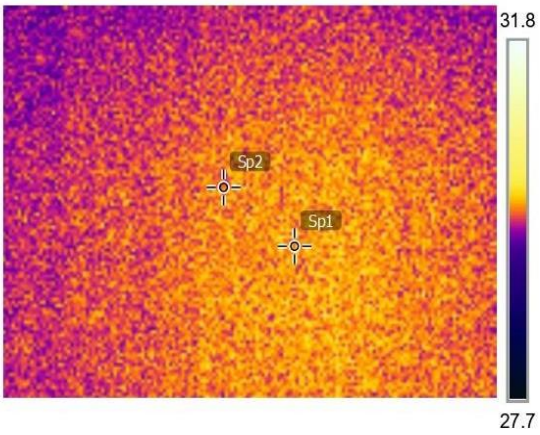
b) TREATED

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

THERMAL IMAGE BEFORE AND AFTER HEAT TREATMENT:

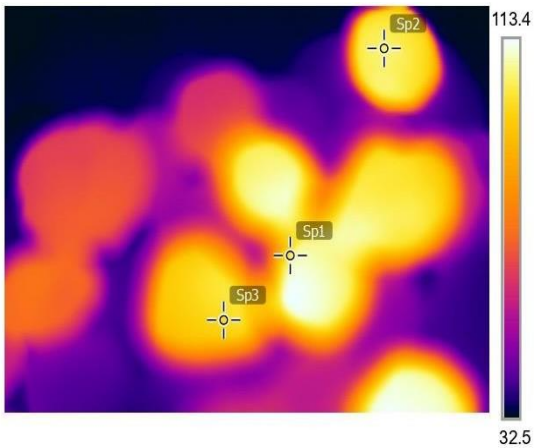
Before Heat Treatment:

Measurements	
Sp1	29.8 °C
Sp2	29.9 °C
Parameters	
Emissivity	0.95
Refl. temp.	20 °C



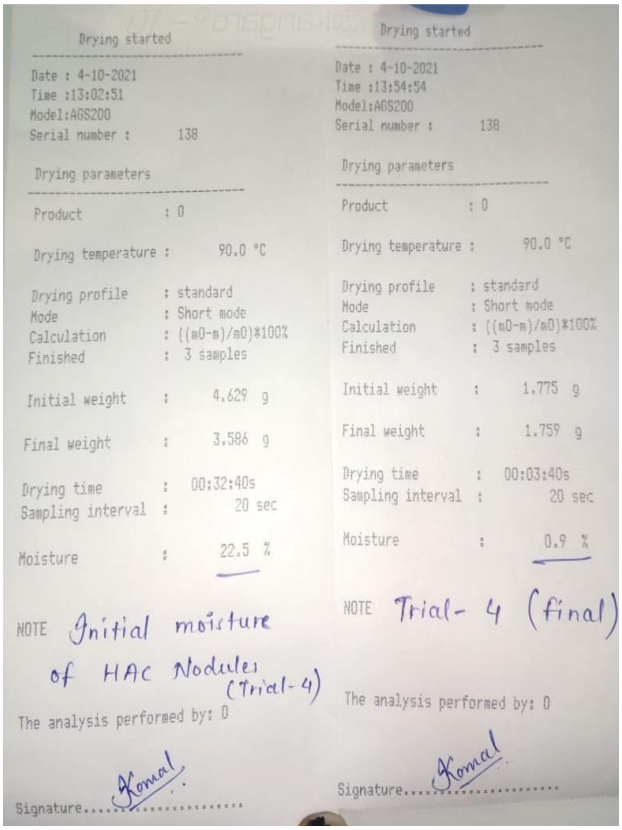
After Heat Treatment

Measurements	
Sp1	104.8 °C
Sp2	106.6 °C
Sp3	101.4 °C
Parameters	
Emissivity	0.95
Refl. temp.	20 °C



Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com

MOISTURE ANALYSIS REPORTS:



Drying started

Date : 4-10-2021
Time :13:02:51
Model:AGS200
Serial number : 138

Drying parameters

Product : 0
Drying temperature : 90.0 °C
Drying profile : standard
Mode : Short mode
Calculation : ((m0-m)/m0)*100%
Finished : 3 samples
Initial weight : 4.629 g
Final weight : 3.586 g
Drying time : 00:32:40s
Sampling interval : 20 sec
Moisture : 22.5 %

NOTE Initial moisture of HAC Nodules (Trial-4)

The analysis performed by: 0

Signature..... Komal

Drying started

Date : 4-10-2021
Time :13:54:54
Model:AGS200
Serial number : 138

Drying parameters

Product : 0
Drying temperature : 90.0 °C
Drying profile : standard
Mode : Short mode
Calculation : ((m0-m)/m0)*100%
Finished : 3 samples
Initial weight : 1.775 g
Final weight : 1.759 g
Drying time : 00:03:40s
Sampling interval : 20 sec
Moisture : 0.9 %

NOTE Trial- 4 (final)

The analysis performed by: 0

Signature..... Komal

OBSERVATIONS:

The heating behavior of High Alumina Cement Nodules has been investigated under the Rotary IR Heating System. The drying rate is found to be increasing with respect to increasing cycle time. It has been found that the moisture content on the dry basis (%) decreases with respect to increase drying time. As per physical investigation, it has been observed that there is no colour change and no cracks on sample. Complete product is dried as desired.

Komal

Ms. Komal Ingle
Tested By