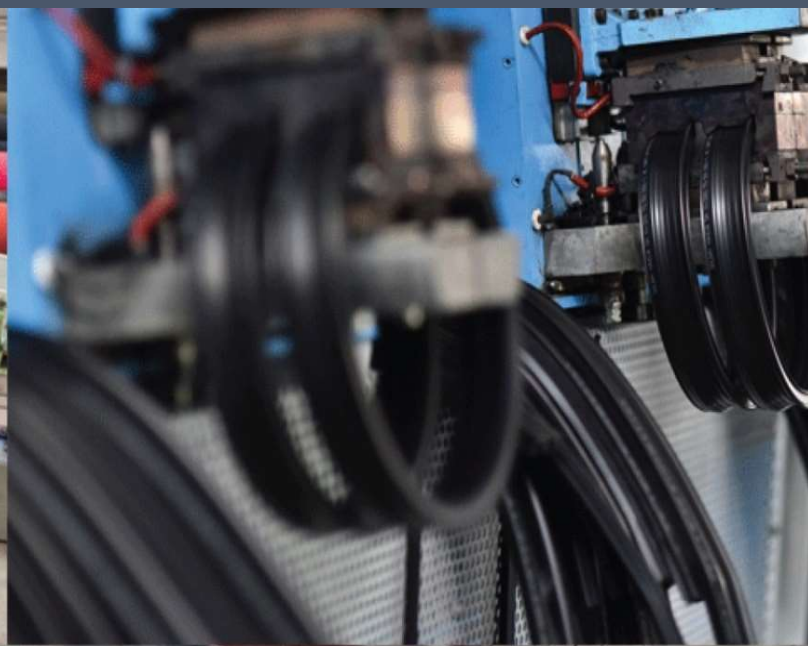


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**Batch Microwave Heat Treatment for Drying
of Nickel Waste Material**



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Customer:	
Process:	Batch Microwave Heat Treatment for Drying of Nickel Waste Material

Test Report No: 245/KRDC/LAB/17 Mum 18/11/2023

Date Sample reception : 10/08/2023
 ID : KRDC/R&D/23-24/18/11

Sample Description:

Sampling : As Requested,
 Sample Condition : Acceptable
 Sampling date : 16/11/2023
 Requirement : Drying of Nickel Waste Material
 Start Date test : 16/11/2023
 End Date test : 18/11/2023

Laboratory Experimental System -**Format: F/R&D/01**

The value obtained is already corrected for possible recover value stated, if applicable. This document may not be reproduced or disclosed wholly or partly in any part thereof without the written consent of the laboratory management or customer. This document relates only to the specimen samples processed. The processed sample will be kept in this laboratory for 7 days from the date of heat treatment.



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System Specifications –

Microwave Power	1.7 KW (CW)
Frequency	2450 MHz \pm 50
Convective Power	3.5 KW (airflow 350 l/min at 20°C)
Microwave Exposure Zone (Cavity)	1 Cubic meter
Mode Stirrer	One
Thermal Monitoring System	Single Channel Fiber Optic: Range - 40 to 250°C
Exhaust Power	1 HP
Tray size (width*height*depth)	450*950*50 mm

Laboratory's Environmental Conditions –

Temperature (degree C)	29.4°C (\pm 5°C)
Humidity (%)	\leq 50% 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






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Equipment 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: $\pm^{\circ}\text{C}$ (1.8°F) Temperature resolution: 0.1°C (0.2°F) Humidity range: 10%~99% RH Humidity accuracy: $\pm 5\%$ 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)

Procedure of the Experiment -

- The experiment was performed on Nickel Waste Material to speed up the heating rate.
- For this experimental run, the given sample was placed in the MW heating system with suitable parameters.
- After the heating treatment, the sample was analyzed.

Format: F/R&D/01



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Analytical Results:**Trial 03****Initial Weight: 3000 gm****Initial Moisture: 50.8%**

Cycle	Sample Wt.	Cycle Time (Mins.)	Specifications of Microwave	Remark
1	3000 gm	After 20 mins	Magnetron Power: 1.7 kW; Set temp: 70°C	Drying up the Material On product temp: (66-91) °C

Final Weight: 2.122gm**Final Moisture: 28.2%****Trial 04****Initial Weight: 3000 gm****Initial Moisture: 51.3%**

Cycle	Sample Wt.	Cycle Time (Mins.)	Specifications of Microwave	Remark
1	3000 gm	After 20 mins	Magnetron Power: 1.7 kW; Set temp: 70°C	Warming up the drum On product temp: (66-91) °C

Final Weight: 2.272 gm**Final Moisture: 30.2%****Trial 05****Initial Weight: 3000 gm****Initial Moisture: 49.3%**

Cycle	Sample Wt.	Cycle Time (Mins.)	Specifications of Microwave	Remark
1	3000 gm	After 20 mins	Magnetron Power: 1.7 kW; Set temp: 70°C	Drying up the Material On product temp: (66-91) °C

Final Weight: 2.140gm**Final Moisture: 26.7%****Trial 06****Initial Weight: 3.745 gm****Initial Moisture: 47.9%**

Cycle	Sample Wt.	Cycle Time (Mins.)	Specifications of Microwave	Remark
1	3.745gm	After 20 mins	Magnetron Power: 1.7 kW; Set temp: 70°C	Drying up the Material On product temp: (66-91) °C

Final Weight: 2.567 gm**Final Moisture: 26.9%****Format: F/R&D/01**



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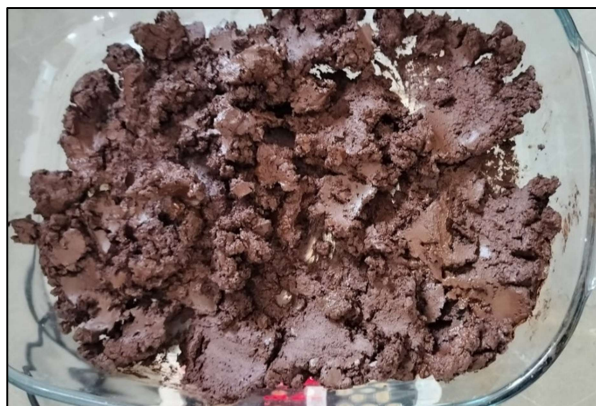
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Trial 07**Initial Weight: 1000 gm****Initial Moisture: 53.3%**

Cycle	Sample Wt.	Cycle Time (Mins.)	Specifications of Microwave	Remark
1	1000 gm	After 20 mins	Magnetron Power: 1.7 kW; Set temp: 70°C	Drying up the Material On product temp: (66-91) °C

Final Weight: 725 gm**Final Moisture: 28.3%*****Before and After Images:*****Trial 03*****Untreated Sample******Treated Sample*****Trial 04*****Untreated Sample******Treated Sample***



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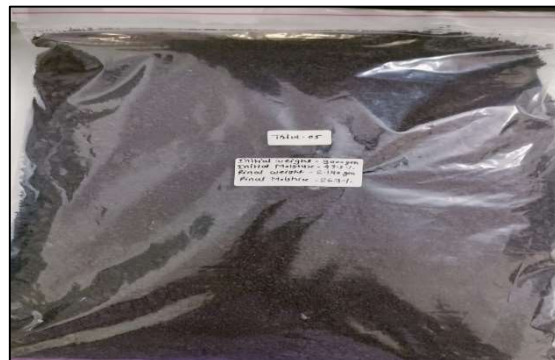
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Trial 05



Untreated Sample

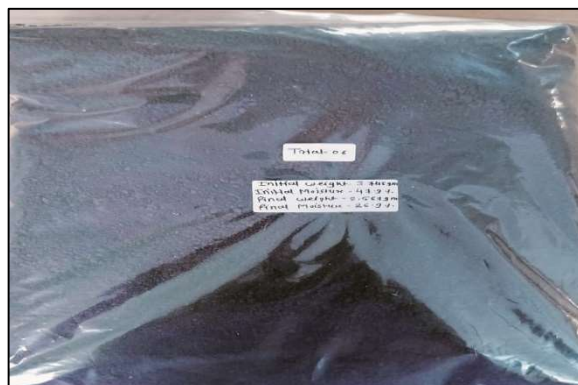


Treated Sample

Trial 06



Untreated Sample

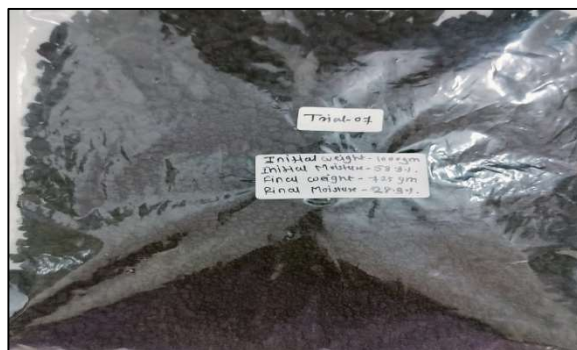


Treated Sample

Trial 07



Untreated Sample



Treated Sample



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Moisture Analysis Report:

Trial 03

Trial-03	
Drying started	
Date :	18-11-2023
Time :	13:02:12
Model :	AGS200
Serial number :	138
Drying parameters	
Product :	0
Drying temperature :	140.0 °C
Drying profile :	standard
Mode :	Short mode
Calculation :	$((m0-m)/m0)*100\%$
Finished :	3 samples
Initial weight :	1.296 g
Final weight :	0.638 g
Drying time :	00:20:00s
Sampling interval :	20 sec
Moisture :	50.8 %
NOTE Initial Moisture	
The analysis performed by:	
Signature.....	
Drying started	
Date :	18-11-2023
Time :	15:44:48
Model :	AGS200
Serial number :	138
Drying parameters	
Product :	0
Drying temperature :	105.0 °C
Drying profile :	standard
Mode :	Short mode
Calculation :	$((m0-m)/m0)*100\%$
Finished :	3 samples
Initial weight :	1.105 g
Final weight :	0.793 g
Drying time :	00:08:40s
Sampling interval :	20 sec
Moisture :	28.2 %
NOTE Final Moisture	
The analysis performed by:	
Signature.....	



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Trial 04

Trial 04

Drying started		Drying started	
Date : 18-11-2023		Date : 18-11-2023	
Time : 12:36:17		Time : 15:57:15	
Model : AGS200		Model : AGS200	
Serial number : 138		Serial number : 138	
Drying parameters		Drying parameters	
Product : 0		Product : 0	
Drying temperature : 140.0 °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 : 1.194 g		Initial weight : 1.179 g	
Final weight : 0.582 g		Final weight : 0.823 g	
Drying time : 00:22:20s		Drying time : 00:11:20s	
Sampling interval : 20 sec		Sampling interval : 20 sec	
Moisture : 51.3 %		Moisture : 30.2 %	
NOTE Initial Moisture		NOTE Final Moisture	
The analysis performed by:		The analysis performed by:	
Signature: <i>Boyle</i>		Signature: <i>Boyle</i>	



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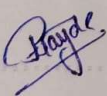
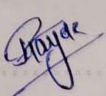
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Trial 05

Trial-05		Trial-05	
Drying started		Drying started	
Date : 18-11-2023		Date : 18-11-2023	
Time : 12:07:39		Time : 16:04:53	
Model: AGS200		Model: AGS200	
Serial number : 138		Serial number : 138	
Drying parameters		Drying parameters	
Product : 0		Product : 0	
Drying temperature : 140.0 °C		Drying temperature : 165.0 °C	
Drying profile : standard		Drying profile : standard	
Mode : Short mode		Mode : Short mode	
Calculation : $((m_0 - m) / m_0) * 100\%$		Calculation : $((m_0 - m) / m_0) * 100\%$	
Finished : 3 samples		Finished : 3 samples	
Initial weight : 1.087 g		Initial weight : 0.678 g	
Final weight : 0.551 g		Final weight : 0.497 g	
Drying time : 00:14:20s		Drying time : 00:06:20s	
Sampling interval : 20 sec		Sampling interval : 20 sec	
Moisture : 49.3 %		Moisture : 26.7 %	
NOTE Initial Moisture		NOTE Final Moisture	
The analysis performed by:		The analysis performed by:	
Signature: 		Signature: 	



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Trial 06

Trial 06		Trial 06	
Drying started		Drying started	
Date : 18-11-2023	Date : 18-11-2023	Date : 18-11-2023	Date : 18-11-2023
Time : 11:31:51	Time : 16:13:34	Time : 16:13:34	Time : 16:13:34
Model : A08200	Model : A08200	Model : A08200	Model : A08200
Serial number : 138	Serial number : 138	Serial number : 138	Serial number : 138
Drying parameters		Drying parameters	
Product : 0	Product : 0	Product : 0	Product : 0
Drying temperature : 140.0 °C	Drying temperature : 105.0 °C	Drying temperature : 105.0 °C	Drying temperature : 105.0 °C
Drying profile : standard	Drying profile : standard	Drying profile : standard	Drying profile : standard
Mode : Short mode	Mode : Short mode	Mode : Short mode	Mode : Short mode
Calculation : $((m0-m)/m0)*100\%$	Calculation : $((m0-m)/m0)*100\%$	Calculation : $((m0-m)/m0)*100\%$	Calculation : $((m0-m)/m0)*100\%$
Finished : 3 samples	Finished : 3 samples	Finished : 3 samples	Finished : 3 samples
Initial weight : 1.037 g	Initial weight : 1.084 g	Initial weight : 1.084 g	Initial weight : 1.084 g
Final weight : 0.540 g	Final weight : 0.792 g	Final weight : 0.792 g	Final weight : 0.792 g
Drying time : 00:12:40s	Drying time : 00:07:40s	Drying time : 00:07:40s	Drying time : 00:07:40s
Sampling interval : 20 sec	Sampling interval : 20 sec	Sampling interval : 20 sec	Sampling interval : 20 sec
Moisture : 47.9 %	Moisture : 26.9 %	Moisture : 26.9 %	Moisture : 26.9 %
NOTE Initial Moisture	NOTE Final Moisture	NOTE Final Moisture	NOTE Final Moisture
The analysis performed by:		The analysis performed by:	
Signature: <i>[Signature]</i>		Signature: <i>[Signature]</i>	



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Trial 07

Trial 07	
Drying started	
Date : 18-11-2023	Date : 18-11-2023
Time : 11:51:54	Time : 14:25:27
Model: AGS200	Model: AGS200
Serial number : 138	Serial number : 138
Drying parameters	
Product : 0	Product : 0
Drying temperature : 140.0 °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 : 0.666 g	Initial weight : 1.063 g
Final weight : 0.311 g	Final weight : 0.762 g
Drying time : 00:17:20s	Drying time : 00:10:20s
Sampling interval : 20 sec	Sampling interval : 20 sec
Moisture : 53.3 %	Moisture : 28.3 %
NOTE Initial Moisture	NOTE Final Moisture
The analysis performed by:	The analysis performed by:
Signature: <i>Hayde</i>	Signature: <i>Hayde</i>



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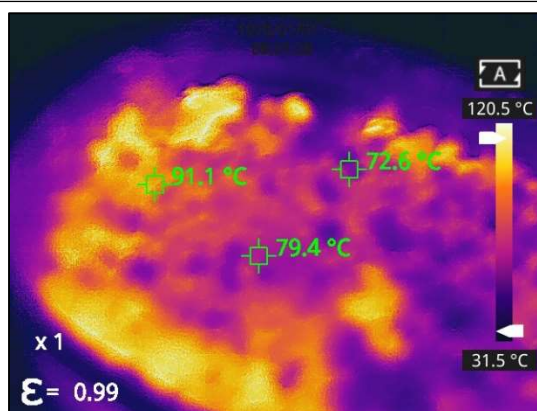
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Thermal image:Measurements

Sp1	91.1°C
Sp2	72.6°C
Sp3	79.4°C

Parameters

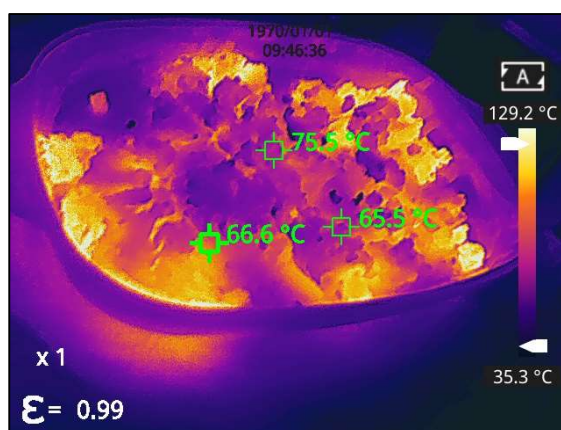
Emissivity	0.99
Temp.	120.5°C

Measurements

Sp1	75.5°C
Sp2	66.6°C
Sp3	65.5°C

Parameters

Emissivity	0.99
Temp.	129.2°C





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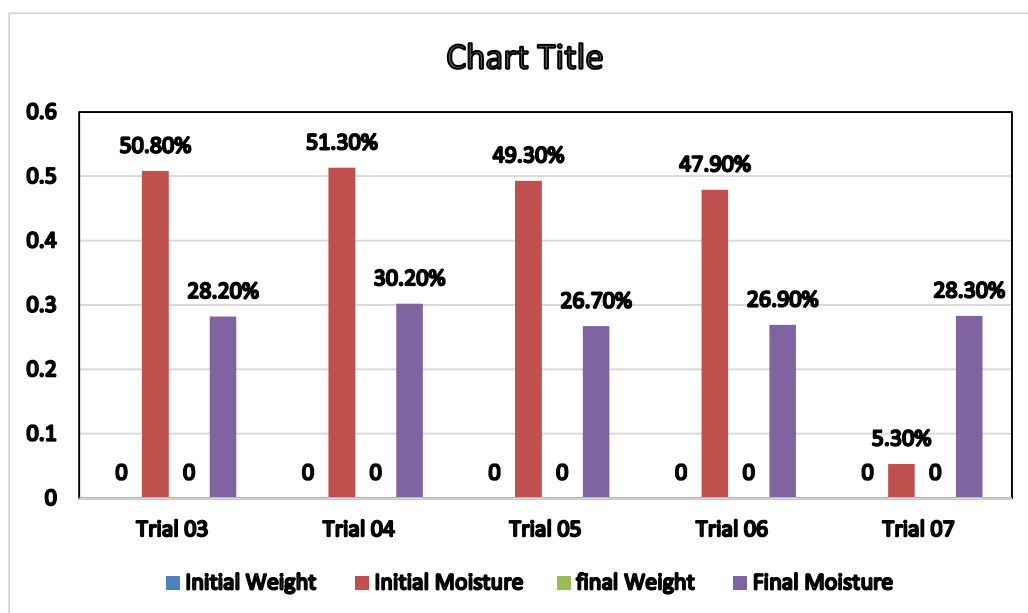
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2-D Column of Moisture Analysis



Observations:

The heating behavior of the Nickel Waste sample was investigated under the Microwave heating system. The heating rate was increasing with respect to increasing in time. As per the physical investigation, it was observed that the drying of the product (66-91 °C (on product temperature)) was achieved without any charring effect.

Mrs. Priya Tayde

(Tested By)